Functional Verification cubesats: Reference Test Facility

Quirien Wijnands

→ THE EUROPEAN SPACE AGENCY

Outline

- Recap + Status
- ATB
- ATB / RTF Context
- MBSE

Recap

Previous CubeSat Industry days:

- Functional Verification of OBSW and equipment is still underrated,
- Heavy cost of developing these facilities in the traditional way is not affordable nor justified,
- Also from "time-constraint perspective" the traditional approach is not "the way",
- The OBC emulator is traditionally seen as difficult area, however the cheaper / availability of the OBC hardware is seen as a solution.

Conclusion:

There is the need for a Reference Testing Facility that is easily accessible / instantiate-able and that has pre-cooked library of Simulation Models and (proven) HW and SW components and interfaces.

It needs to be closely linked / integrated to the development tools, however ensuring the independability.

Status recent activities
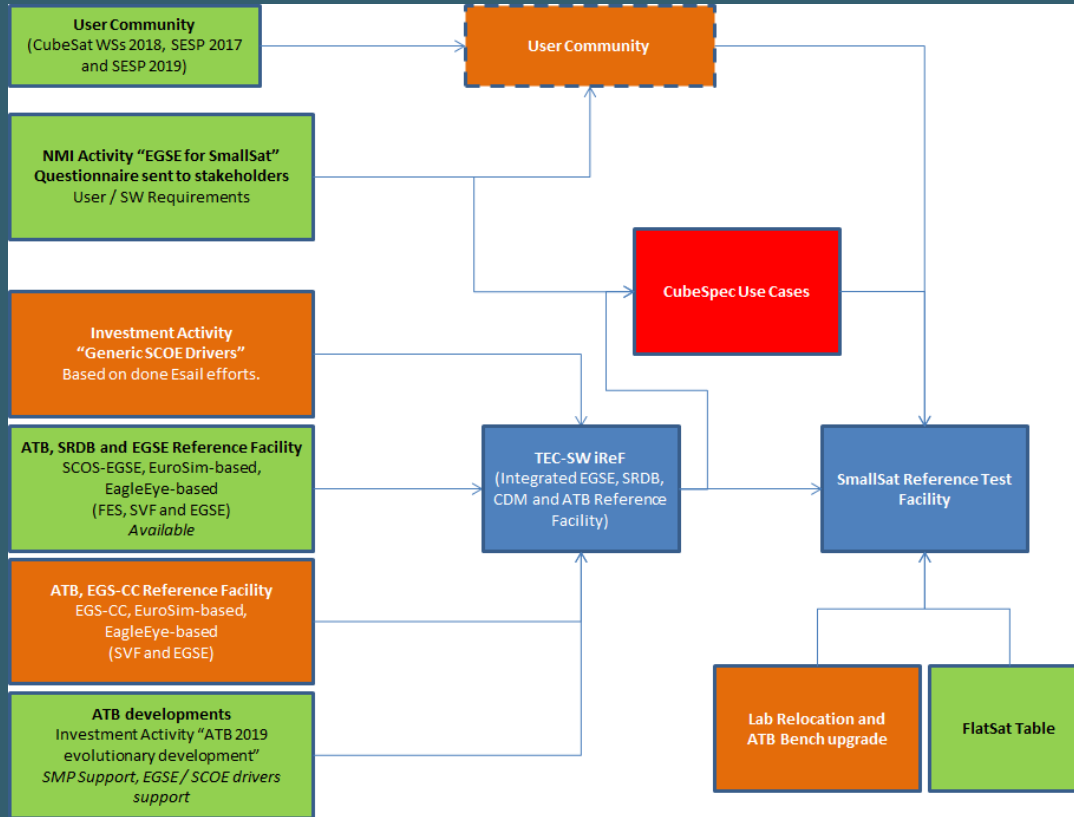
Targeting the Functional Verification and Validation of the Avionics:

- OBSW Verification and Validation at System Level,

- Failure Detection, Isolation and Recovery (FDIR) Verification in context,

- Onboard Data Handling (OBDH) Verification in context,

- Onboard Software (OBSW) Modes transition verification in context,

- Data Management Verification

Configurations used from ATB perspective: **SVF (HIL)** and **AIV/EGSE**

To allow the **CSW** and **DH Engineer** to **verify/validate the system requirement OBSW at system level**

Mission/Spacecraft) in a representative environment with a representative OBC-model in loop and equipment

Relevant System components provided by SmallSat EGSE:

- hardware where needed.
- MCS system (e.g. CCS) in CCS+MCS configuration with data handling/archivation
- To support system verification tests and end-to-end tests with the ground segment.
- Mission Planning and automation environment
- RT Simulator with simulation models
- Item under Test
- TM/TC Front-End adapter software (representation of the Space to Ground link)
- (Distributed) OBSW
- SCOE Front End adapter software (link between CCS+MCS to the RT Simulator e.g. for failure injection)

note: Static Analysis and Code Coverage tests are not considered under this UC

Relevant System components provided by mission/project:

- OBC with OBSW
- PCDU with onboard bus
- Communication unit
- Ground and onboard bus interface unit
- TM/TC Definitions and Flight Operations Procedures
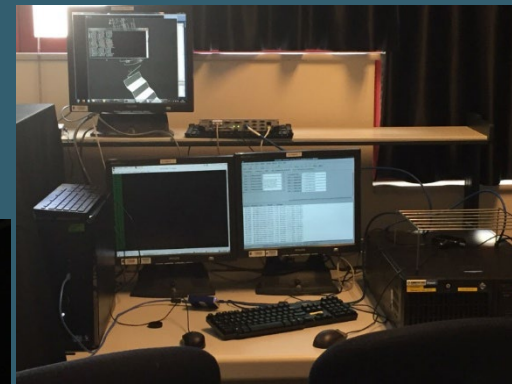
Avionics System Test Bench (ATB) *as input*

EagleEye-based

FES, SVF (SIL, HIL)

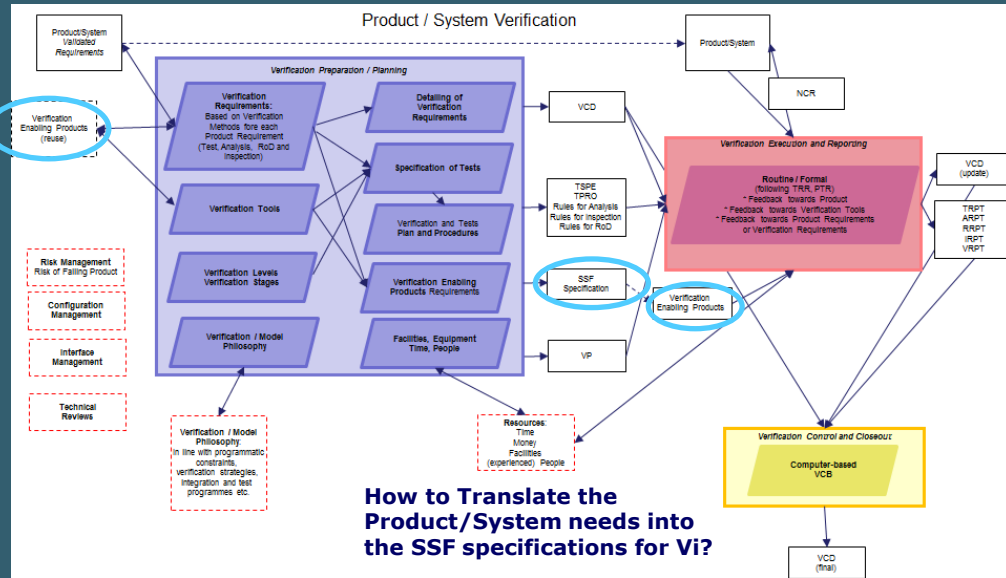
Micro-launcher TVC

FES, SVF and EGSE

Vision-based GNC

FES, SVF and EGSE

Place of the Functional Verification Test Facility (FVTF) within the Product/System Verification process


Functional Verification for *any* product system

Challenge for the RTF for cube-sat: how to simplify and speed up the overall process without sacrificing the quality and independability: reuse, model-based, "agile", …

ATB / RTF Context (2/4)

FVTF: Functional breakdown

A: Simulation Modelling Phase(s)
Z: Software development Phase(s)
B: Configuration Setup phase(s)
C: Configuration Package Setup Phase(s)
D: Simulation Execution Phase(s)
E: Data Processing and Archiving Phase(s)

A1: Reuse & Development
A2: Autocoding
A3: Modelling & Coding rules checking
A4: Model documentation

Steps to take for setting up and using

any System level Simulation Facility
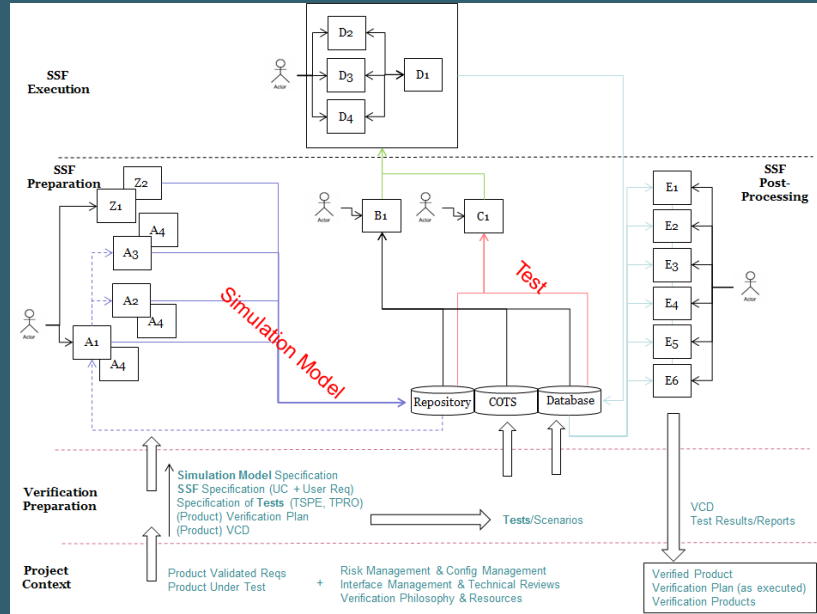
Stakeholders
System Engineer (user)
GNC Engineer (user)
AOCS Engineer (user)
CSW/DH Engineer (user)
EGSE Engineer (user)

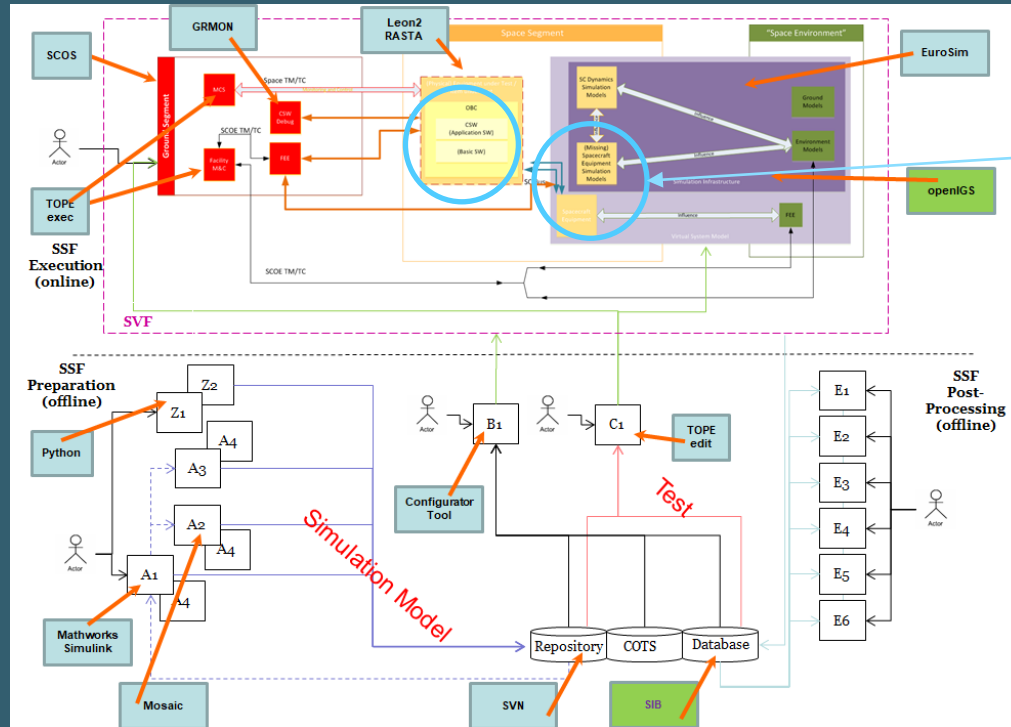Simulation Engineer:
SIM-SPEC, SIM-DI, SIM-TV

Test Engineer:
TEST-SPEC, TEST-EXEC

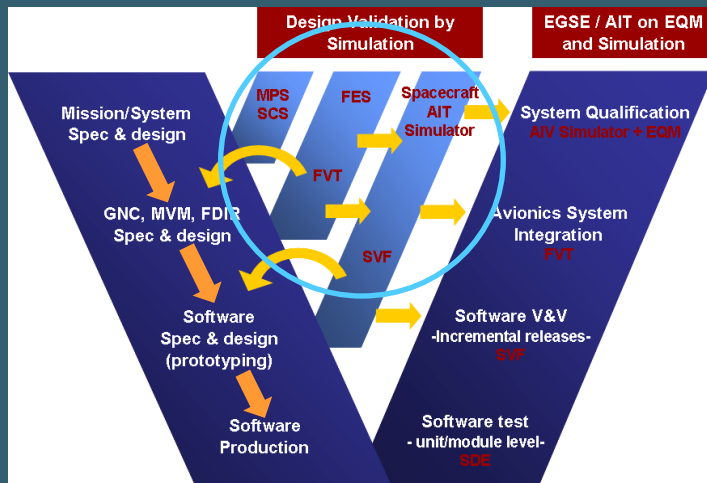Mapping of process to the tools (mission/company specific)

NEED!

Alignment with respect to:
- Product information,
- Functionalities,
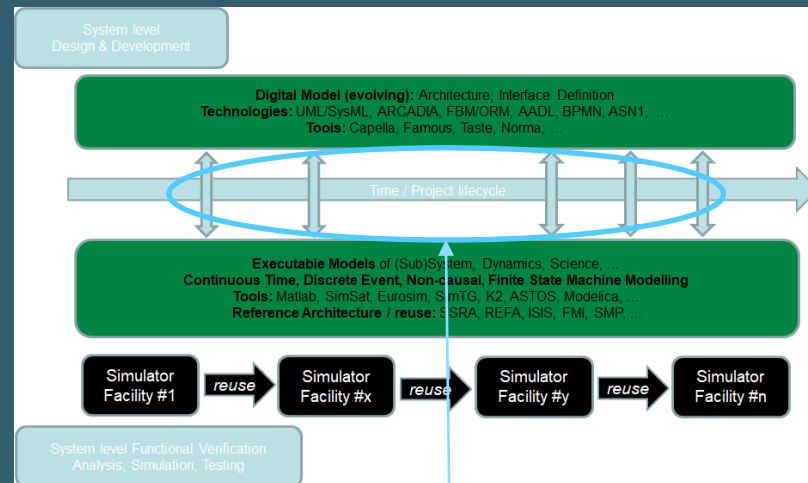- Time-wise,
- Starting set of User stories is possible
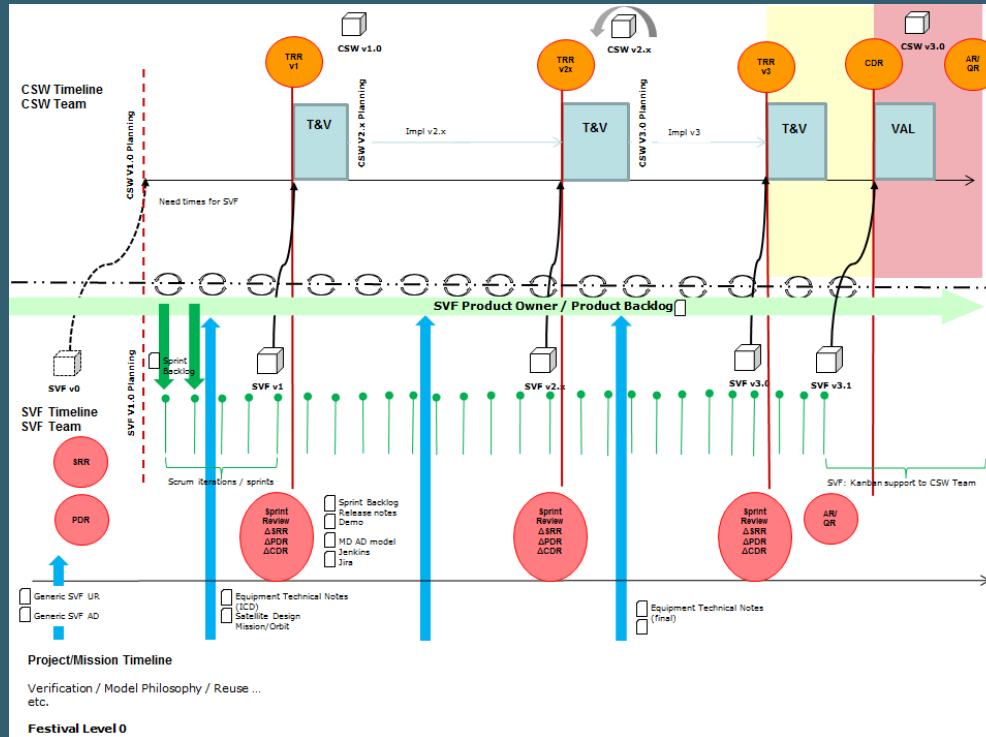
Alignment of processes and needs for the facility (project specific)

Relationship to MBSE

Place of the "model-based" simulator(s)

usage within the traditional V-model and MBSE

MBSE versus simulation-based Functional Verification

Interoperability / ontology

→ **MBSE 2022 (https://indico.esa.int/event/407/overview)**

　　→ **Incl. Space System Ontology Workshop**

Questions and suggestions:

alexia.mallet@esa.int

robert.blommestijn@esa.int

quirien.wijnands@esa.int