



AIRBUS Virtual Hybrid Testing Framework: focus on V&V concerns

Dr. Emmanuelle Garcia, Airbus Toulouse, EZMM, strategy, process, methods and tools, simulation projects
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AGENDA

- **Virtual Hybrid Testing definitions**
- **VHT Projects Typologies**
- **Evaluate as soon as possible**
- **Drive improved exploitation of VHT**
- **Overall Enterprise VHT architecture**
- **Architecture Framework Approach**
- **VHT Multi View-Point framework definition**
- **Verification and Validation of models**
- **V&V plan/method Selection criteria**

Virtual Hybrid Testing definitions

Virtual Testing (VT)

Structured use of Modelling & Simulation based processes to critically evaluate (Verify or Validate) a virtual product behaviour (model of \neq maturity) in a configuration/scenario against specified (or/and specific) requirements (or behaviour) in a M&S environment

Real Testing (RT) or P&B Based Evaluation (PBBE)

Structured use of Prototype & Bench (or Facility) based processes to critically evaluate (V&V) a real product behaviour (prototype of \neq maturity) in a configuration/scenario against specified (or/and specific) requirements (or behaviour) in a P&B test environment

Live Testing (LT)

Structured use of a final product based processes to critically demonstrate its behaviour against high level objectives and requirements in its operational environment

Virtual Hybrid Testing (VHT) Structured mix/coupling of VT and RT to evaluate a product (models/prototypes) against behaviour in a specific (virtual/real) environment

VHT Projects Typologies

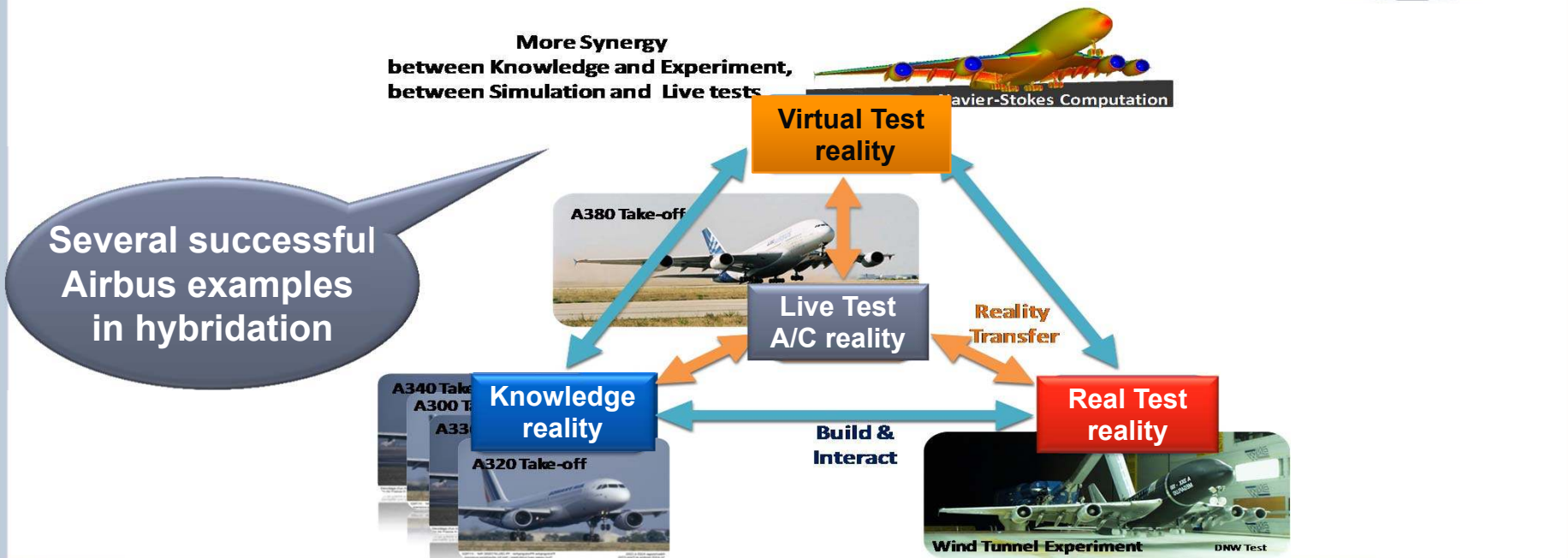
VHT requirements depends on Aircraft and VHT Targeted Maturity
And on evaluation purposes and Impacts

Production of Means of Compliance for certification is one of the VHT targets

A lot of hybridation configurations

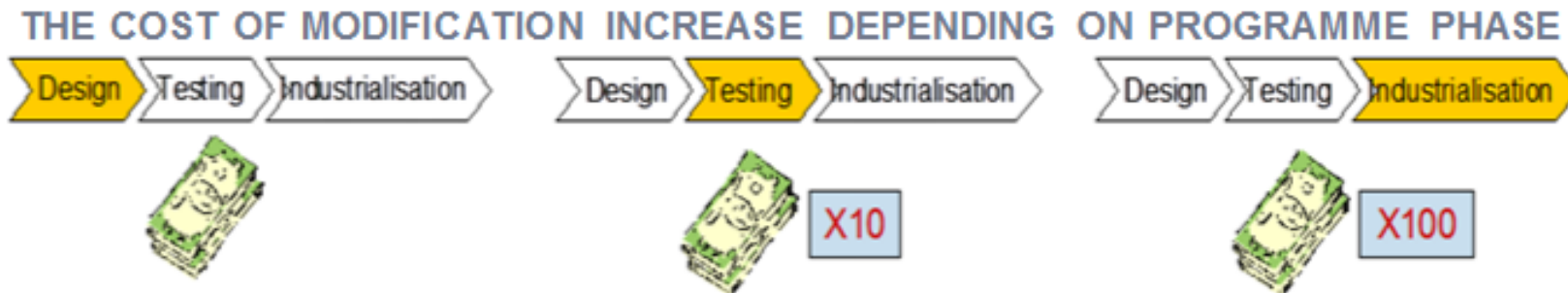
VHT Projects Typologies depending on required hybridation

Several MoC Alternatives



Evaluate as soon as possible

Be representative, **evaluate** as soon as possible the future A/C behaviour in the most representative operational environment
Be **right** at the first flight test



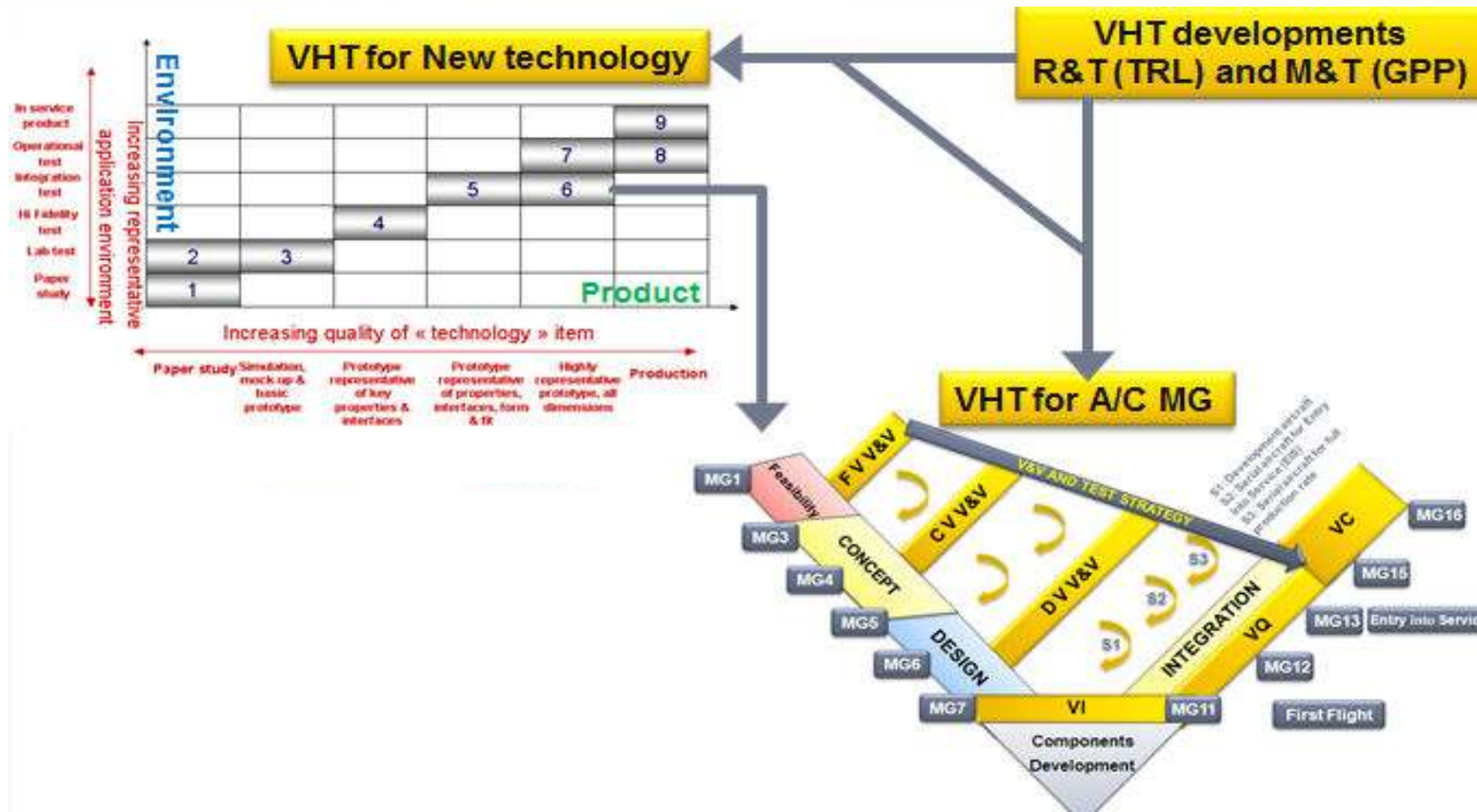
Avoid late changes with negative business impacts

ROBUSTNESS

Allow late changes without negative impacts

FLEXIBILITY

Drive improved exploitation of VHT



**A VHT project is not a one shoot activity
 It is a dynamic process throughout the product development with
 capitalisation of previous programs and lessons learnt**

Overall Enterprise VHT architecture

Continuous improvement / development on M&S, VT and RT capabilities
VHT is **already** used **successfully** in some A/C areas

BUT

VHT Development/Confidence: long & need huge investments
VHT development, Capability, Acceptance, practice: not enough harmonised
Not the same level of VHT capability everywhere
No cross-capitalisation, no re-use (a lot of redo !)

TARGET: OVERALL VHT CAPABILITY ARCHITECTURE FRAMEWORK

From a **patchwork** To a **Federated Approach**
Collaborative Aircraft V&V MoC backbone (R&T, authority, industrial partners)
Enhance & Ease VHT, foster **maturation/confidence**

From document To model centric processes

Architecture Framework Approach

Frameworks' Survey

Manage Complex task, information or Product in a certain environment
Military operations, communications, Enterprise, IT, System Architecture
Examples: DoDAF, MoDAF, TOGAF, NAF...

Ex, US Department of Defense Architecture Framework (DoDAF) V. 2.0; Volume 1: Introduction, Overview, and Concepts; Manager's Guide; 2009

Methodology/definition/content of a framework Depends of what is targeted



Consider & Meet efficiently All VHT stakeholders' concerns & requirements for V&V purposes and All development steps A/C global and local objectives

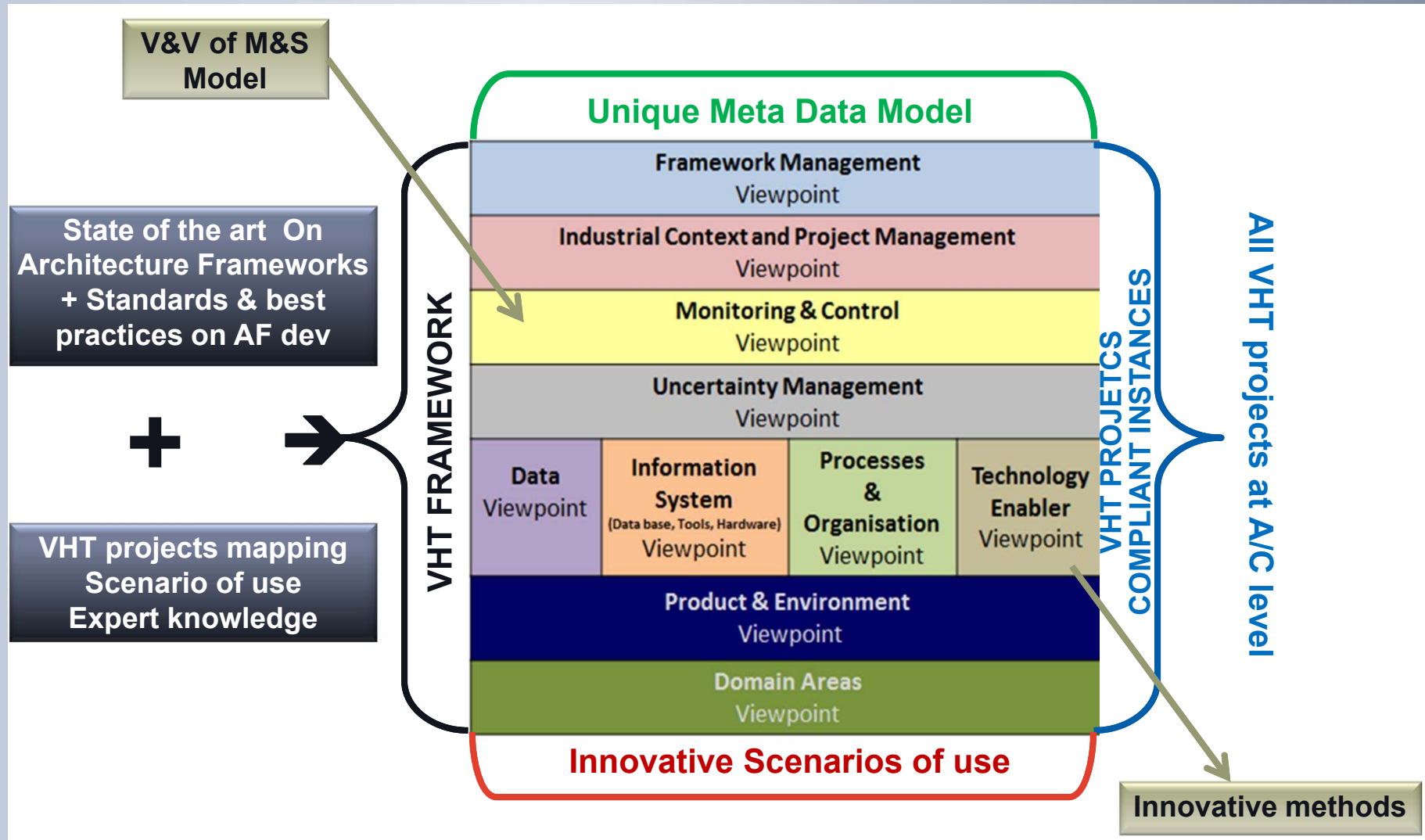
Perform complex/dynamic tasks & Master VHT complexity at an A/C level

Build a structure by VHT Major Thematics

Foundation of Multi View-Point (M-VP) Enterprise Architecture framework

Organise and secure coherency/interfaces of the overall information by VP

VHT Multi View-Point framework definition



Verification and Validation of models

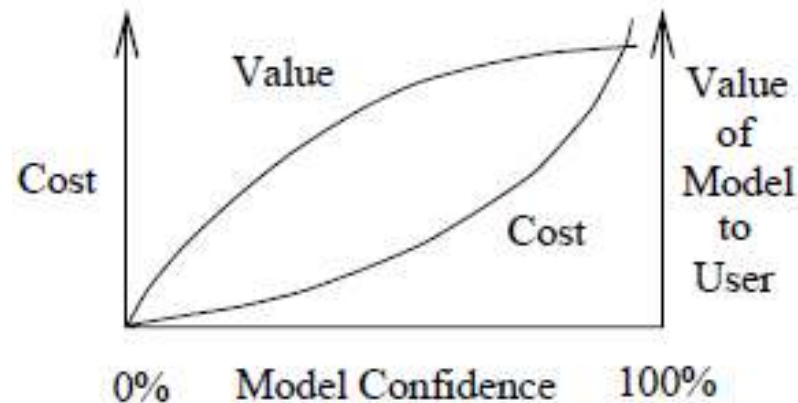
Thousands of references with substantially different V&V definitions

- **Assess/develop evidences of correctness and credibility of modeling & simulation (physics, concept, logic, assumption, artifact, data, process, M&T, results, analysis)**
- **Accredited, improving models, calibration, tuning, confirmation, test the model, construction correctness, confidence/predictive accuracy, performance, sensitivity**
- **Model to reality, review, cross-checking, comparison, Formal Proof, V&V reference**
- **V&V hierarchy, M&S Duplication, regression, aggregation, metrics**
- **Degree of Model abstraction/granularity/complexity/understanding**
- **Objective & subjective / Qualitative & quantitative approaches, quantities of interest**
- **Historical assessment facilitates effective & efficient V&V: previous evidence exists !!**
- **Software, systems & physics, technical domains, product & model: V&V foundation principles could be the same but, the way to perform V&V differs and they are linked!**

Verification and Validation of models

- **Models influence/help decisions → build credible & understandable models by decision makers and reversely Decision makers contribute to model validation**
- **Observe/understand the behavior of the model/reality to secure relevance of the M&S results analysis in decision making regarding a specific purpose, association of several independently wrong/simplified models can lead to a good decisional analysis if limit of relevance of model are understood and, reversely !**
- **Accurate risk assessment for prioritizing V&V, V&V planning, realistic expectations**
- **Compare what is comparable and relevant for confidence/behaviour/credibility**
- **Appropriate V&V documentation/traceability**
- **Each V&V technique has characteristics: Combining multiple V&V techniques**
- **V&V Use Case/ref data base for understanding/executing V&V effectively & efficiently**
- **From V&V to predictive maturity (beyond validated domain of application)**
- **Integrate V&V in the overall development / modelling process**

V&V plan/method Selection criteria



Scheme Extracted from V&V OF SIMULATION MODELS, Robert G. Sargent, 2010

COST/CONFIDENCE IS NOT THE ONLY CONSTRAINTS
Example: TIME / RESSOURCES

Criteria and indicators to select the most relevant hybridization(s) regarding synergies & complementarities taking into account Aircraft V&V, Models V&V needs all along development and all VHT-F View-Points constrains/opportunities for all VHT projects at A/C level...

Thanks for your attention

QUESTION ?

Contact: emmanuelle.garcia@airbus.com



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