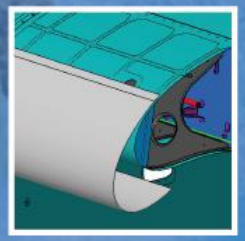













Innovation Takes Off

www.cleansky.eu

Clean Sky 2

Overview of *Clean Sky 2* Programme

Michel Goulain, *Clean Sky 2 JU*

Amsterdam 25 May 2016

Innovation Takes Off

www.cleansky.eu

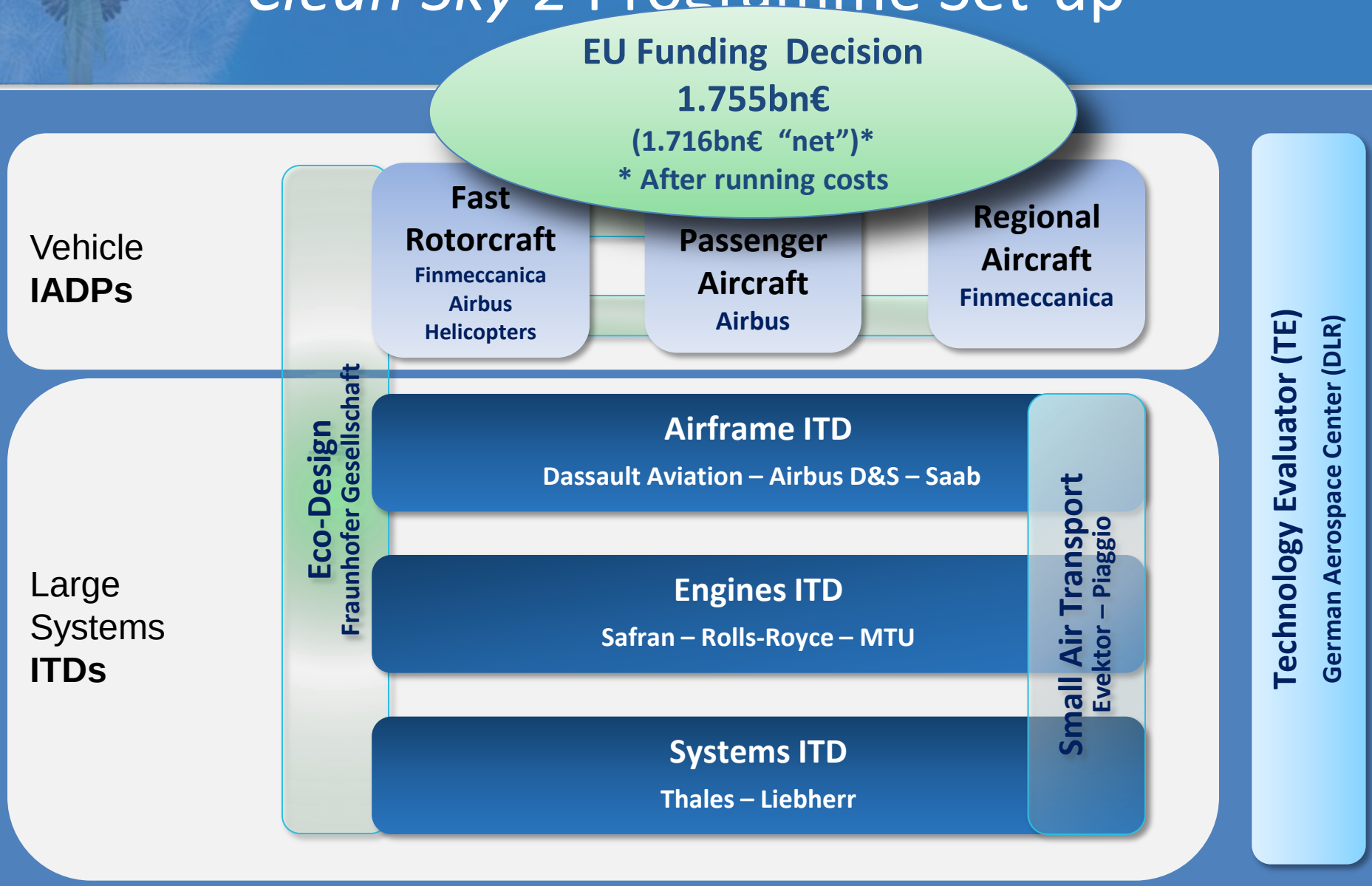
Addressing the H2020 Challenges

- **"Smart Green and Integrated Transport"**
  - **Resource efficient transport that respects the environment**
  - **Ensuring safe and seamless mobility**
  - **Building industrial leadership in Europe**

Enhancing and leveraging innovation capability across Europe, with a strong emphasis on SME participation

Leveraging private sector initiatives, and (important!) building on MS national and regional efforts

Clean Sky 2 Programme Set-up

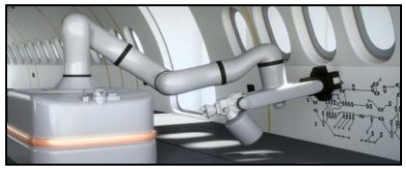


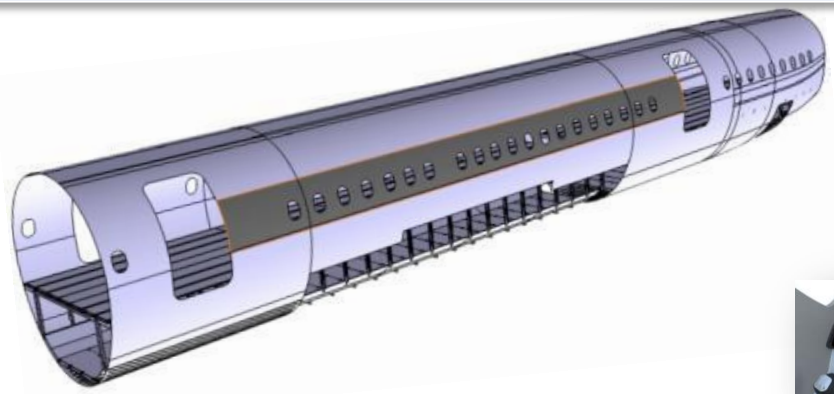
Addressing H2020 Transport Challenge Areas

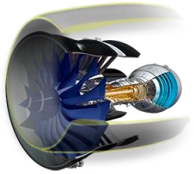
Energy Efficiency & Environment

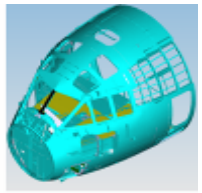
Enabling Safe & Seamless Mobility

Building industrial leadership in Europe









Clean Sky
JOINT UNDERTAKING

CS2 Participation

- **Up to 40% of EU funding available for CS2 Leaders**
- **At least 60% of EU funding open to competition:**

  Up to 30% for Core Partners (becoming Members once selected)

  At least 30% for CfP (i.e. *Partners* as in CS) plus CfTs
- **Meaning >1bn€ of EU funding in play, via open Calls**

Industry, SMEs, Academia, and Research Organizations eligible both for participation as Core Partners or Partners.
Participation may also take place via suitable Clusters / Consortia.

800 - 1000 Participants expected across all tiers of the industrial supply chain and "R&I Chain", with large investment leverage effect

Towards virtual certification in Clean Sky

Amsterdam 25 May 2016

Innovation Takes Off

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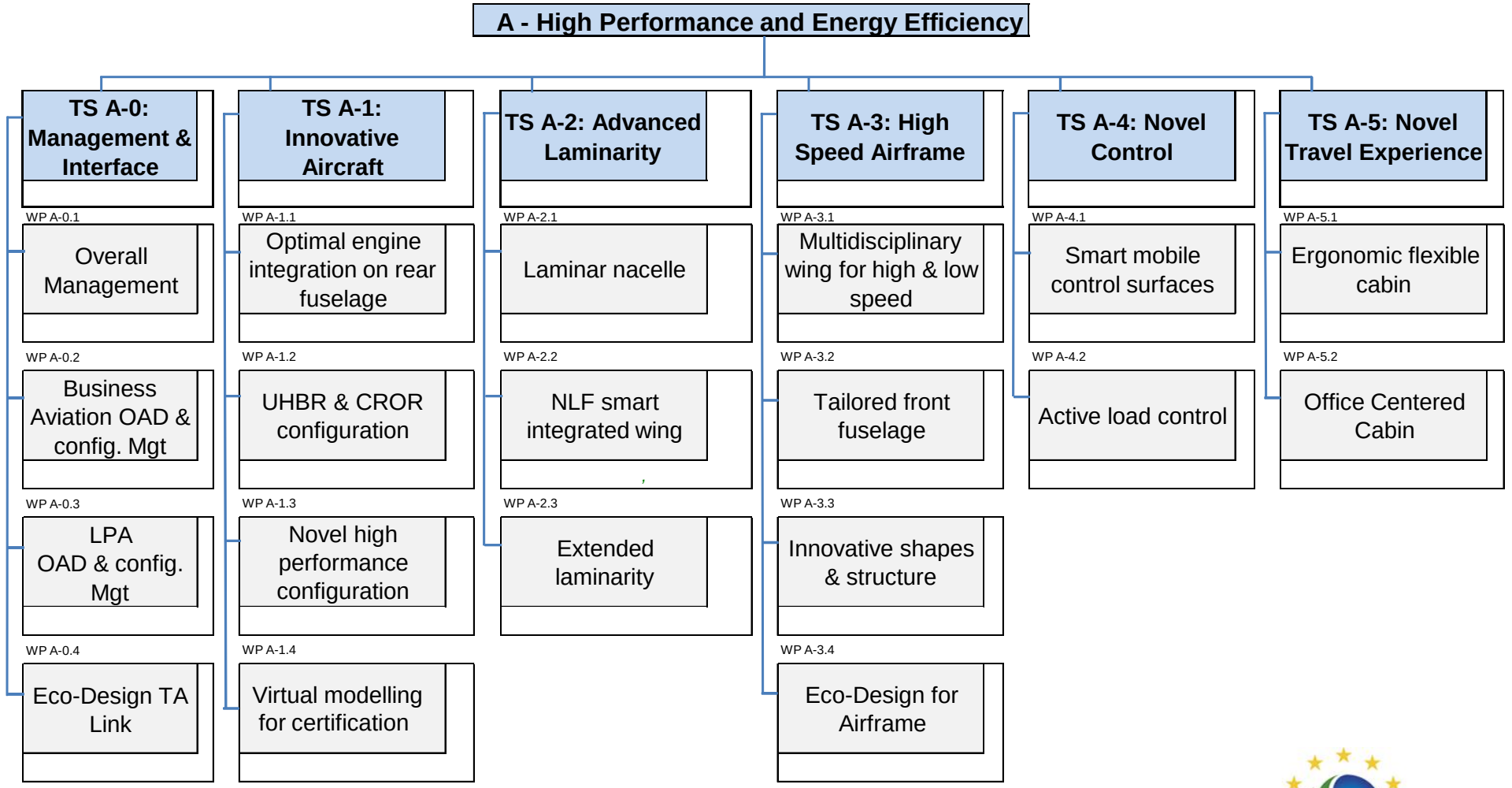
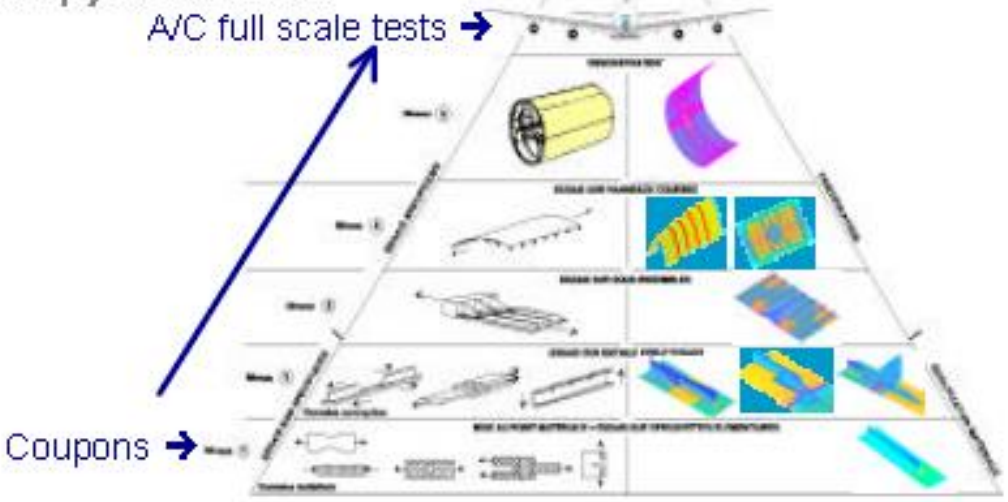
ITD Airframe HPE WBS



Perform a major step forward Virtual Testing

Provide an alternative to tests for

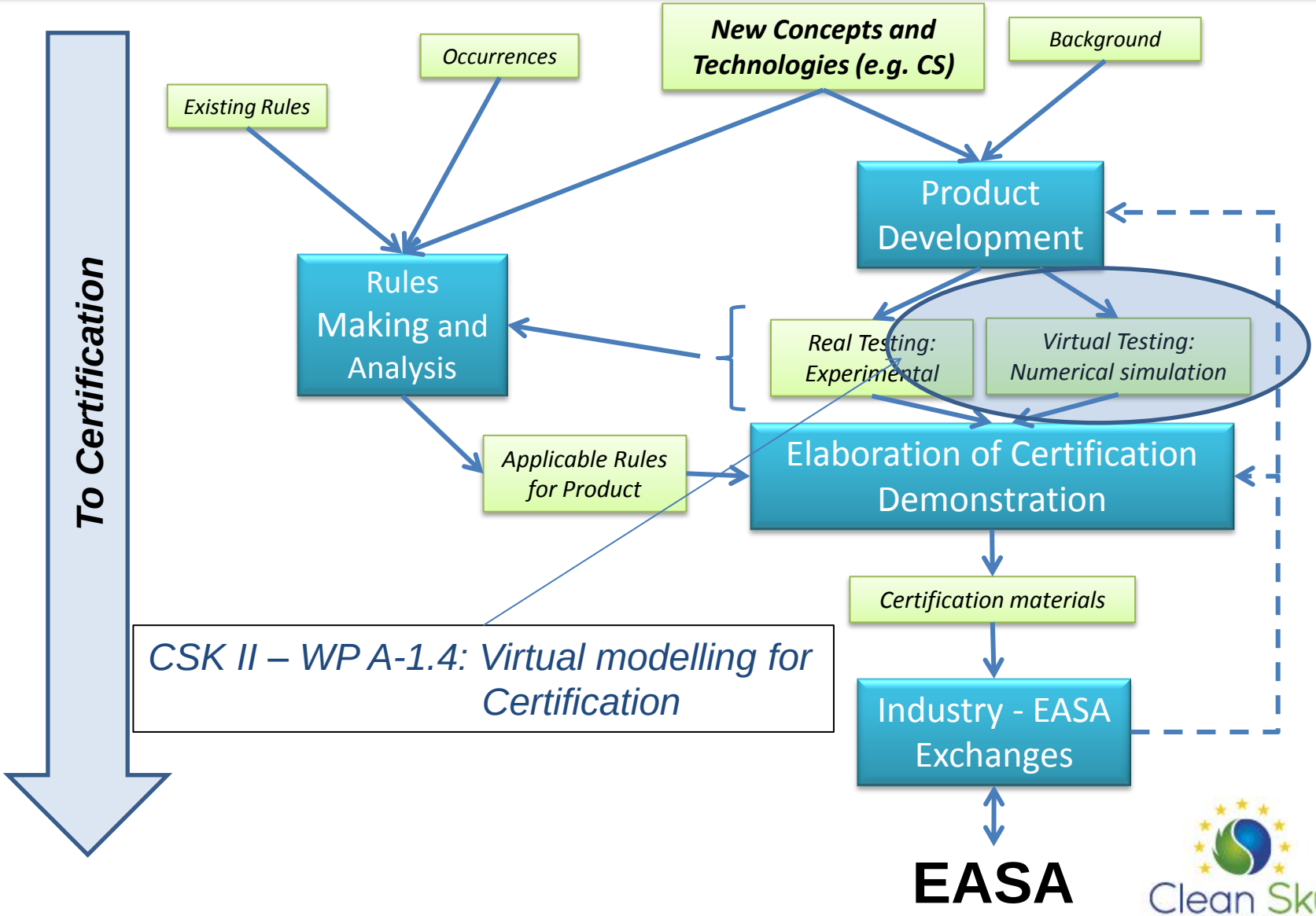
- All validation pyramid levels



- Reduce Validation & Verification (V&V) costs
- Improve A/C performance
- Improve A/C maturity
- Reduce time to market
- Get the full benefit of new technologies

Clean Sky 2

A step forward: Virtual modelling for certification



Virtual Modelling for Certification

- In ITD Airframe, WP 1.4 focuses on the enhancement of virtual modelization in the design processes for certification purpose. The necessary software developments will be specified, carried on and driven by the following applications:

  - **Improvement of aircraft noise modelling using certification data**
  - **Cabin thermal modelling - Human model**
  - **Advanced criteria for rapid dynamic / Crash modelling for safety**
  - **Model based integrated systems analyses**
  - **Safety of composite fuel tank – Lightning**
  - **Prediction of aerodynamic loads at high Reynolds number**

Virtual Modelling for Certification

- **Improvement of aircraft external noise modelling using certification data**

  - **Expected benefits w. r. t. Virtual Certification**
    - Accounting for variable aircraft trajectories and atmospheric conditions in Dassault Aviation aircraft noise prediction tools
    - This should allow to assess certified noise levels of current and future Falcon aircrafts with greater accuracy
  - **Global technical objectives**
    - Improve the current aircraft noise prediction platform by accounting for more realistic trajectories, performance data and noise propagation phenomena in order to predict more accurately the noise of future aircraft in realistic certification and operational conditions

Virtual Modelling for Certification

- **<u>Cabin thermal modeling – Human model</u>**

- **Expected benefits w. r. t. Virtual Certification**
  - Developing the capability of modelisation of human behaviourin extreme temperature conditions met in case of Aircraft ECS failure

- **Global objectives:**
  - Providing tools to get a better knowledge of the aircraft occupants body thermal behaviour during the different phases of the flight
  - Allowing to better model the extreme cold or hot conditions induced by failures of the Aircraft ECS, and so provide a mean of compliance for cabin thermal environment
  - Carrying out thermal Tests on F2000 fuselage mock-up with thermal human manikin in FHG facility to validate human thermal behaviour model in extreme temperature conditions.

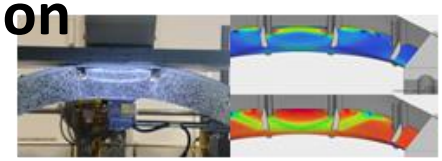
Virtual Modelling for Certification

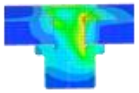
- **Advanced criteria for rapid dynamic / Crash modelling for Safety**

- **Expected benefits for Virtual Certification**

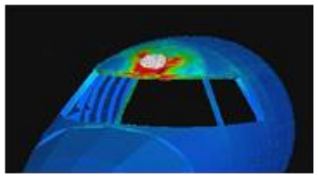
  Increasing the PRL (Process Readiness Level) of rapid dynamic analyses by developing adapted calculation methodologies and sizing criteria.
  This will contribute to support future certification processes for discrete damage and emergency situations
  (crash, bird strike, UERF protections etc.)
  providing validated methods and tools against elementary tests

Examples of rapid dynamic analyses for certification



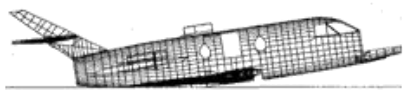


Dynamic sizing criteria



Birdstrike

Passenger safety



Crash

- **Global objectives**

  Develop dynamic crash models for safety analyses at passenger level

WP A-1.4 – Virtual Modelling for Certification

Model based integrated systems analysis

Expected benefits w. r. t. Virtual Certification

Improve the safety analysis techniques for certification purpose, using enhanced and validated numerical simulation tools

Global objectives:

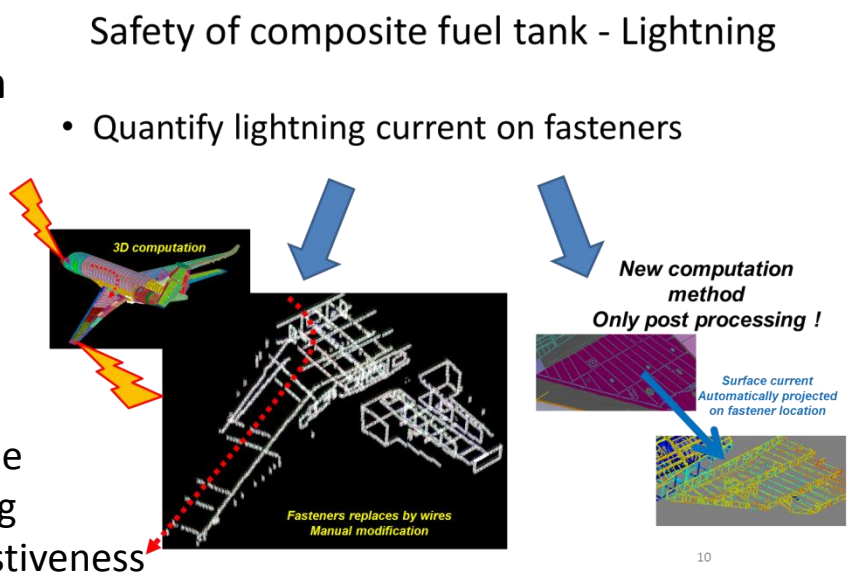
To do so, the work is organized to address the two following questions:

1. how to model efficiently multi-system architectures (eg. The flight control system, hydraulic system, electrical system) ?
2. how to ensure that the model used for the safety analysis is representative of the real system ?

Virtual Modelling for Certification

- **Improvement of lightning current in fuel tank for certification assessment due to the new regulation AC 25-981 (1/2)**

  - **Expected benefits w. r. t. Virtual Certification**
    - For future program, the new regulation AC 25-981 has got and important impact on the process of justification to **demonstrate no sparking inside fuel tank due to lightning**. The justification is performed through tests on complex samples and 3D Electromagnetic (EM) computations. This 3D EM solver must be enhanced to address the following challenging points : accuracy of the computations, exhaustiveness of fasteners, and reduction of the computation margin.
      Solutions allowing to perform this significant step are identified and available, but must be implemented, improved and validated.



The methodology proposed to demonstrate the conformity of the design without any sparking of all fasteners in contact with fuel or fuel vapors, requires important exchanges with the Authority of Certification

Virtual Modelling for Certification

Improvement of lightning current in fuel tank for certification assessment due to the new regulation AC 25-981 (2/2)

Global objectives

Quantify the lightning current on the composite fuel tank assemblies to guaranty no sparking during lightning strike conditions. The innovative software improving : the simplification of Cad data, the exhaustiveness of fasteners computed and the accuracy of 3D computations. The solutions allowing to perform this significant step are identified but must be implemented, improved and validated in a realistic Certification process

WP A-1.4 – Virtual Modelling for Certification

- **Prediction of aerodynamic loads at high Reynolds number**

Expected benefits w. r. t. Virtual Certification

- Defining, implementing and validating a better process to estimate the loads in transonic conditions before flight tests with a compatible precision for certification

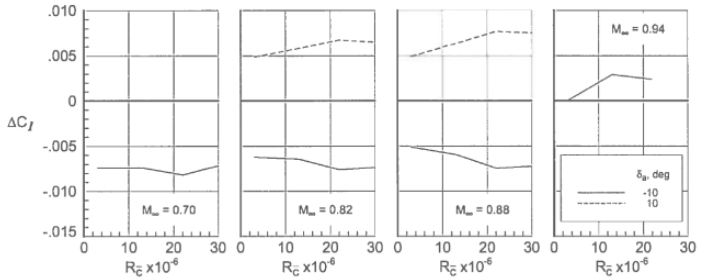
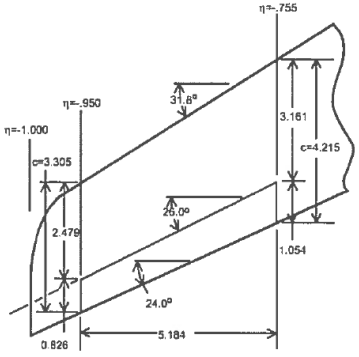


Fig. 9. Variation of rolling moment coefficient with Reynolds number with deflected ailerons. $\alpha = 0°$.



(c) Aileron details.

Global objectives:

- Improve the loads and efficiency prediction of control surfaces at High Mach and Reynolds numbers

Thank You

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