



**EASA**  
European Aviation Safety Agency

# Certification by Analysis - EASA Perspective

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(M&S = Modelling & Simulation)



# Terminology

- Certification by Analysis (CbA)...
- Certification & Qualification by Analysis (CQbA)...
- Certification by Analysis Supported by Test (CAST)...
- Virtual Certification...
- Digital Certification...
- Certification by (Numerical) Simulation...

“No more testing...?”



“But test data needed to validate analysis...!”

## Modelling and Simulation (M&S)

- **M&S** is a complement or substitute for physical experimentation, in which computers are used to compute the results of some physical phenomenon
- **Modelling** is the act of constructing a model
- **Simulation** is the execution of a model



# The Bigger Picture

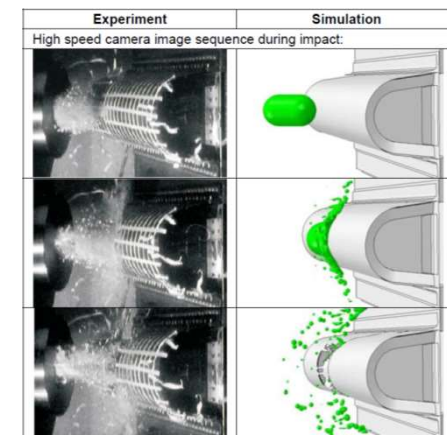
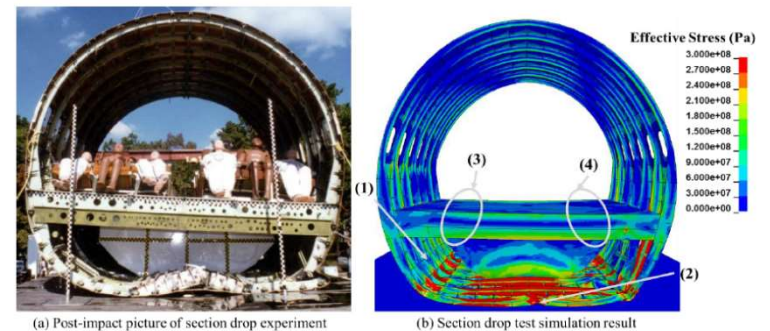
- “The Virtual or Digital Aircraft”
  - Cover the complete lifespan of an aircraft, from conception to retirement from service
  - Design & Development
    - Virtual Prototyping (Computer Aided Design, Computer Aided Engineering)
    - Virtual Manufacturing
    - Systems and Software Development
  - **Certification & Qualification by Analysis**
    - Virtual Ground Testing and Computational Flight Testing
      - Structures: Computational Solid Mechanics, Computational Fluid Dynamics
      - Systems (Avionics, Flight Control Systems, Hydromechanical, Electrical, ECS,...)
      - Flight Test: Computational Flight Mechanics
    - Virtual / Augmented Reality (maintenance, flight simulators,...)
  - In-service operations
    - Digital Twin (maintenance, overhaul, health monitoring,...)





# M&S for Structures

- Main Structures subjects where M&S is applied in the showing of compliance:
  - Static strength
  - Impact conditions
    - Crashworthiness including Ditching
    - Bird strike
    - Dynamic seat certification
    - Fuel system crash resistance
    - Uncontained engine failures
    - Wheel & tyre debris
  - Loads and aeroelasticity / vibration & buffeting
  - Thermal (heat transfer) analysis
  - Engine failure conditions
  - Fatigue & damage tolerance
- For metallic, composite and hybrid structures





# Challenges

- Overall increase in use of M&S techniques to support the showing of compliance with certification requirements, and in some cases even to replace testing
- Safety benefit
  - Allows investigations by analysis where testing would be impractical or impossible
- Safety risks & challenges
  - Lack of standardization and guidance material
  - EASA resources needed to review M&S certification efforts



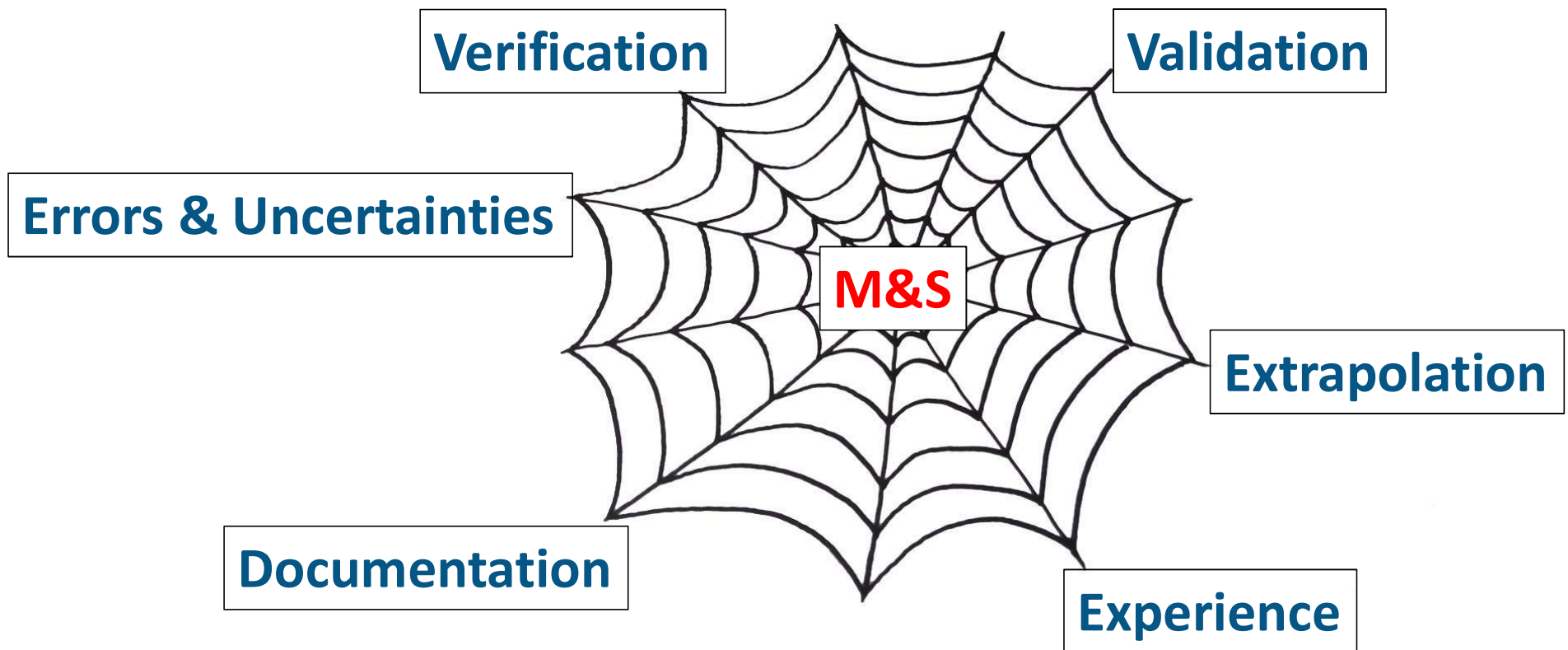


## EASA Vision on M&S

- Better to rely on process rather than detailed review of every M&S case
  - Based on Industry best practices and processes
  - Documented in regulatory guidance material and/or Industry standards
  - Incorporated in design approval holders' manuals and procedures
  - Spot-checked during design approval process



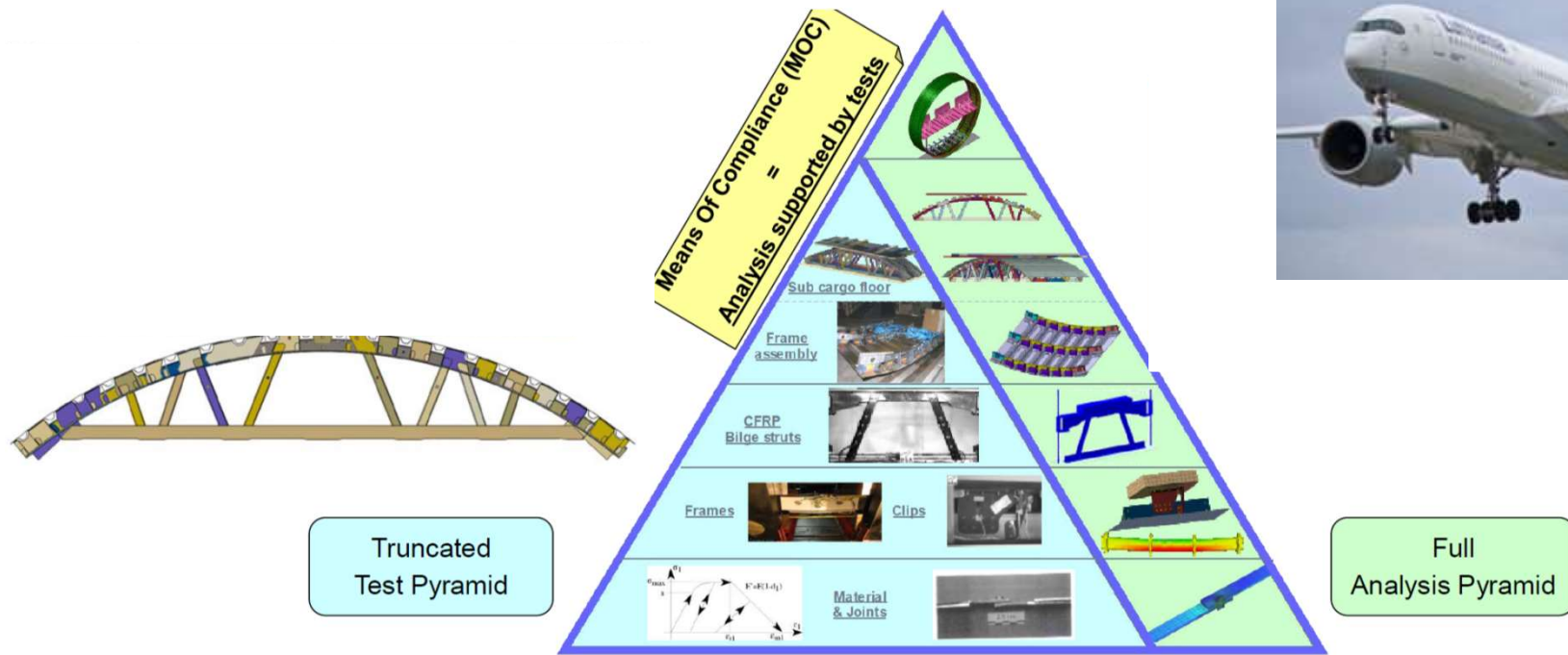
# Main Attention Items for M&S





# Example - Crashworthiness

## ► Building block approach



(ref. "Smarter Testing & Simulation", Airbus, October 2019)



## Summary

- Modelling & Simulation plays an important role in the life cycle of an aircraft, from conceptual design to retirement from service
- Software tools are becoming more advanced, more capable, more widespread....and more difficult to comprehend /assess
- Trend is to perform more analysis and less testing
- Requires more attention to issues such as verification & validation aspects, errors and uncertainties, extrapolation, experience and documentation/record keeping
- Overall lack of guidance material – more standardization is needed, as much as possible (EASA guidance material is being prepared – EASA Workshop in 2020?)
- Need to identify best practices & develop guidance material to facilitate application of M&S (level playing field) and streamline certification process



## Q & A

Thank you for your attention – any questions...?

