

Validation Pyramid and the failure of the A-380 wing

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Failure of the accreditation of the airbus A380 wing

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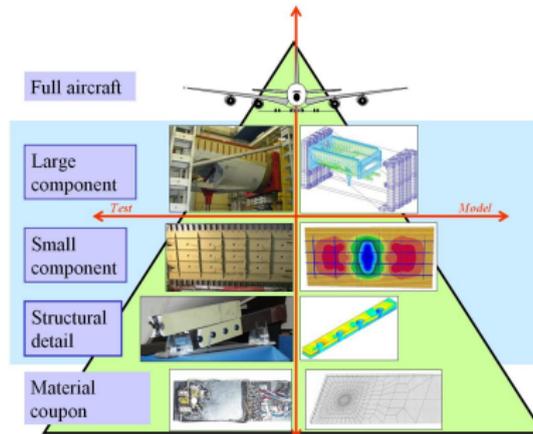
- **THE TEST:** the wing has to endure 150% of limit load for 3 sec.
- **THE FAILURE:** the wing broke at the point between the inboard and outboard engine at 147% of the limit load

How was the model of the wing validated?

By the validation pyramid

Character of the Pyramid

(thanks to Mr. S. Guinard,
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Why the wing failed?

- Because a relevant validation experiment was not in the Pyramid.
The missing validation test would have revealed the problem
- The design of the wing was adjusted after the test.

1) Design of the Pyramid

- 1) What validation experiments will be included?
- 2) Quantification of the uncertainty in experiments
- 3) Quantitative relations between validation metrics and tolerances for validation problems on the different levels of the pyramid
- 4) Quantitative relations of the validation metrics and tolerances to the prediction (quantities of interest)

In the wing test the quantity of interest was the safe load

- 5) Relation to the available experimental data, and their reliability, possibly only from literature or expert opinion.

Adequate approaches: probability, worst scenario, fuzzy sets, etc.

2) Basic considerations for the Pyramid construction

- ① Cost (\$ and Time) for the validation experiments and their quality
- ② Availability of computational analysis (\$ and Time)
- ③ Optimization of the pyramid (\$ and Time): How many repetition samples, etc.

3) What could be the basic approach, influenced by increasing computers power ?

- 1 **Top to Bottom**: preliminary computational analysis (based on preliminary data) on the prediction problem to design the experiments
- 2 **Bottom to Top**: full computational analysis of the validation process using experimental data
- 3 Repeating Top to Bottom analysis if the model has been changed during the validation process.