ICAS 2016

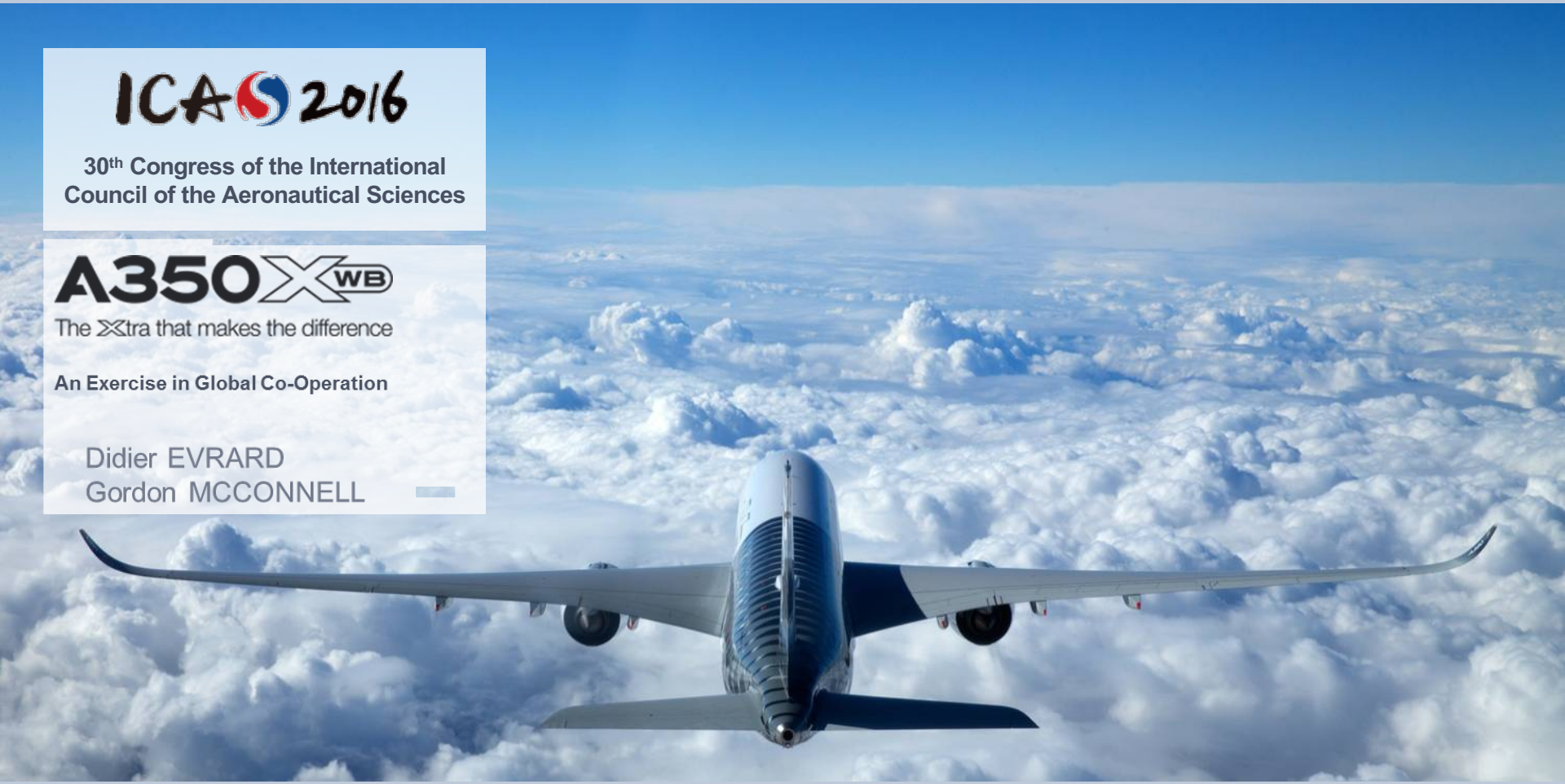
30th Congress of the International Council of the Aeronautical Sciences

A350 XWB

The Xtra that makes the difference

An Exercise in Global Co-Operation

Didier EVRARD
Gordon MCCONNELL



The Airbus reaction:… A350 XWB a clean sheet design!

Fabrice BREGIER and Louis GALLOIS
Dec 1st 2006

Didier EVRARD appointed new head of A350 XWB Programme

… with immediate effect

PRESS RELEASE

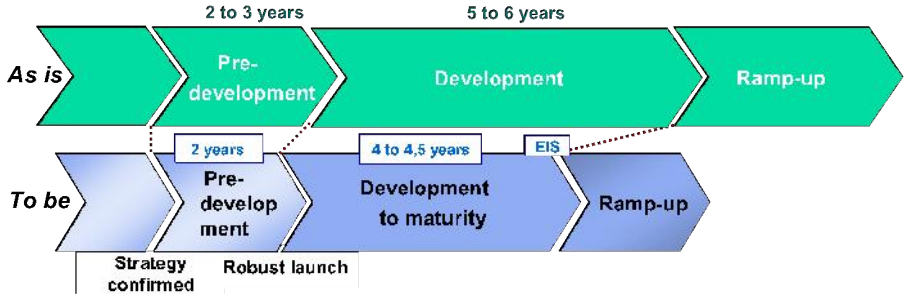
10 January **2007**

Airbus wants the 350 to compete with Boeing's "Dreamliner"

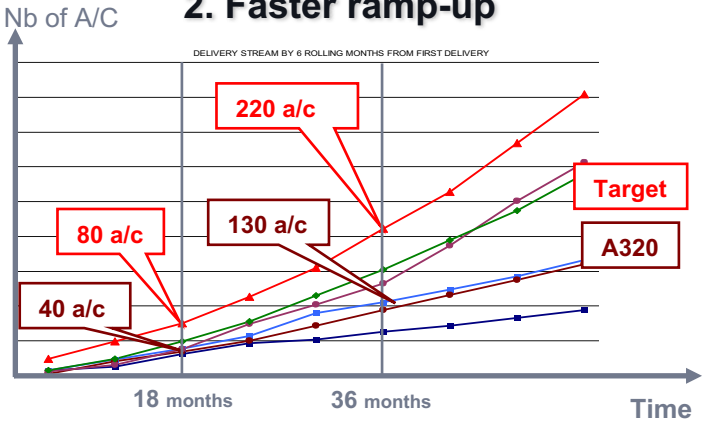
Le Bourget 2007 80 A/C for QATAR

Akbar al Baker	Louis Gallois
CEO Qatar Airways	CEO Airbus

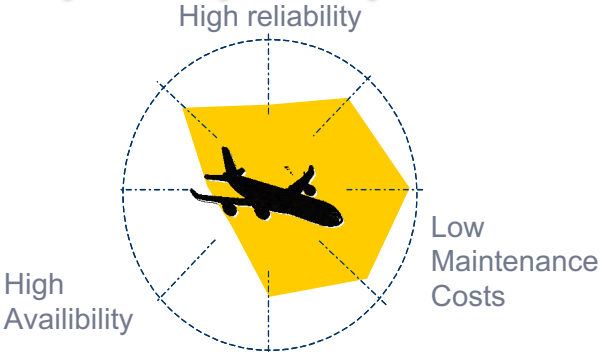
1. Benchmark lead time



2. Faster ramp-up



3. Fully Maturity at Entry into service



3 clear and simple programme targets

- Faster
- More
- Better

A350 XWB

This time, customers like it!

810
Firm orders

43
Customers

End August 2016

Americas
119 orders

SYNERGY GROUP
UNITED
LATAM
DELTA

Europe
154 orders

BRITISH AIRWAYS
FINNAIR
AEROFLOT Russian Airlines
Lufthansa
AIR CARAÏBES
DUBREUIL
KLM Royal Dutch Airlines
SAS
IBERIA
AIRFRANCE
virgin atlantic

Africa & Middle East
194 orders

QATAR AIRWAYS
Yemenia
AFRIQIYAH
ETIHAD AIRWAYS
Ethiopian
AIR MAURITIUS
KUWAIT AIRWAYS

Asia & Pacific
267 orders

SriLankan
AIR CHINA
Vietnam Airlines
JAL JAPAN AIRLINES
THAI
ASIANA AIRLINES
CHINA AIRLINES
SINGAPORE AIRLINES
HONGKONG AIRLINES 香港航空
CATHAY PACIFIC
中國東方航空 CHINA EASTERN
Philippine Airlines

Leasing Companies
75 orders

CIT
AWAS
AIR LEASE CORPORATION
ALAFCO
AERCAP Aviation Solutions

Corporate Jet & undisclosed
4 orders

UNDISCLOSED

Integrated & co-located multi-disciplinary teams in the best location


Plateau team in Toulouse

From TRL2* …

Program

Research

Materials & Processes

Design & Trades

Sizing

Architects

Procurement

Specimens manufacturing

Tests

Quality

Risk Share Partners

… to TRL6*


Cabin Definition Centre in Hamburg

*TRL: Technology Readiness Level

Customer First

Competitive Product
- Technology maturity
- Design maturity

Develop Faster
- Programme risks anticipation
- Tools & processes

Produce Faster
- Ramp-up drivers
- Customisation

An Extended Enterprise Team
- Transparency and trust
- Communication

Shaping efficiency

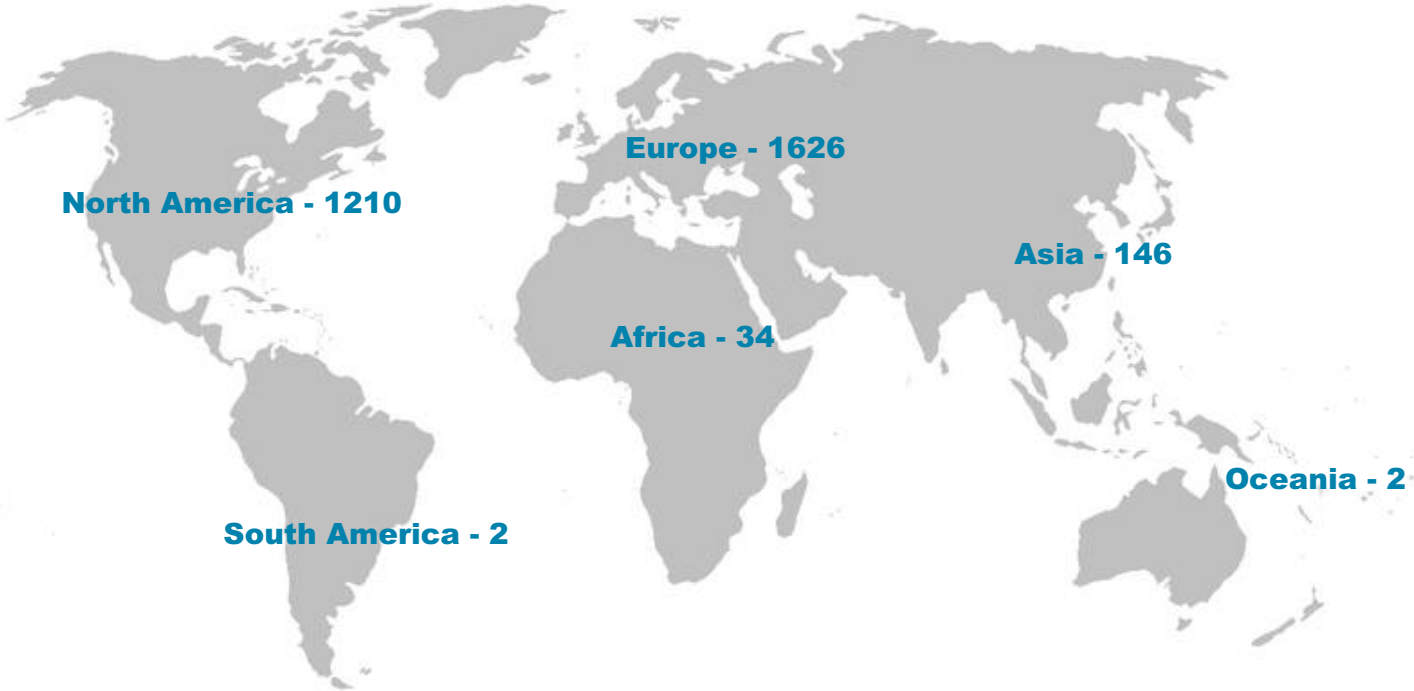
Extended Enterprise

Fewer but larger workpackages

Systems Suppliers as Integrators

And a partnership mindset

Extended Entreprise

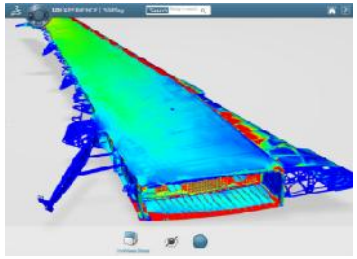


A Global Industrial Footprint

Tier 1 and tier 2 suppliers

Airframe & Systems Installation Design
CATIA v5 3D DMU – Design in Context

Requirements Based Engineering
IBM Doors

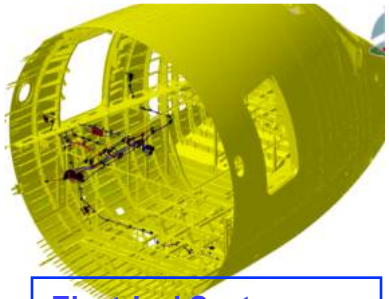


Structural Analysis Tools
Nastran, Isami
Transnational Structure Analysis **Solution**

Tooling and Factories Layout
Catia v5 3D and Delmia

IT Network

Product Data Management
PTC PDM Link SSCI
System, Structure & Cabin Installation



Electrical Systems Design
Full 3D based on 3D Catia definition

Extended Enterprise

A common toolset

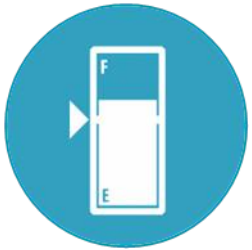
- Full 3D DMU
- Design & Sizing tools
- Route Book & Unified Planning
- TRL & MRL management

The Xtra that makes the difference

A350 XWB Family design

A family based on
a single type
with a common engine

Highest levels:
- Passenger comfort
- Amenities



25% lower fuel burn
than existing aluminium
competitors

25% lower operating
cost per seat
than existing aluminium
competitors

Reliable aircraft with
Shortest development
time and Fastest ramp-up

Most advanced technology:
- Aerodynamics
- Structure
- Systems

Some very challenging technical objectives…

A350 XWB Family

One new generation family

vs

two different generation families

777-9

398 seats **(10 abreast, 17”)**

777-300ER

352 seats **(10 abreast, 17”)**

787-10

324 seats **(9 abreast, 17”)**

787-9

283 seats **(9 abreast, 17”)**

A350-1000

366 seats **(9 abreast, 18”)**

A350-900

325 seats **(9 abreast, 18”)**

A350 XWB Cabin

Comfort

18” Y-class seat width
Wide panoramic windows

Efficiency

Largest overhead bins on the market
Space-efficient monuments

Technology

4th generation IFE
Unique flat floor
Full LED moodlighting

Well being

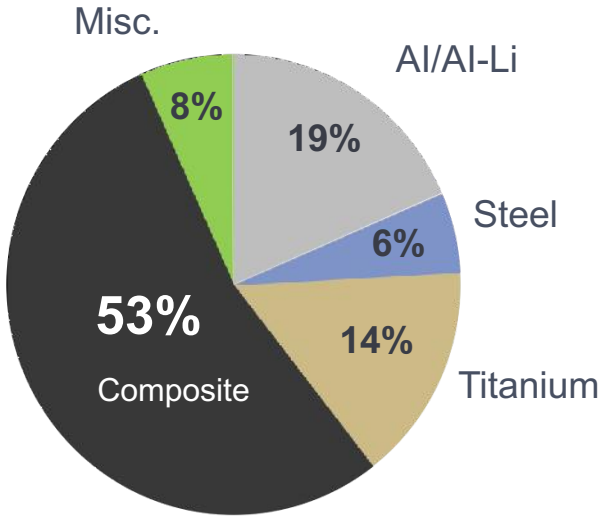
Quietest cabin in its class
Optimal cabin environment

Huge 25% less fuel burn

- Lightweight materials
- Latest generation engines
- State-of-the-art aerodynamics
- Highly integrated systems

A350 XWB
the new technology journey

- Advanced aerodynamics and high lift system
- Natural laminar flow air inlet
- Enhanced load alleviation functions
- CFRP primary structure
- Advanced cockpit and connectivity
- Highly integrated avionics
- 240V electrical system
- Electrical network and systems installation



Titanium

- High load frames
- Door surroundings
- Landing gear
- Pylons

No corrosion tasks

CFRP

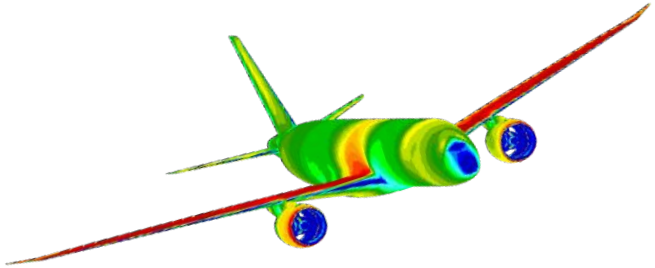
- Wings
- Centre wing box and keel beam
- Tail cone (Section 19)
- Skin panels
- Frames, stringers and doublers
- Doors (Passenger & Cargo)

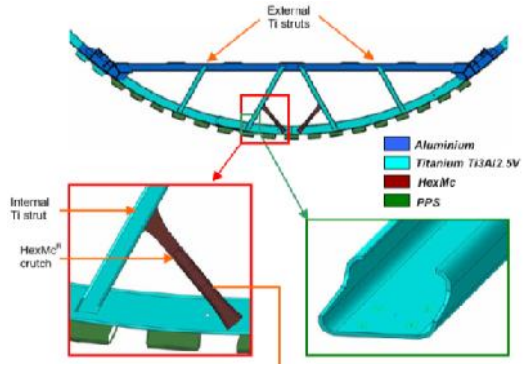
No corrosion or fatigue tasks

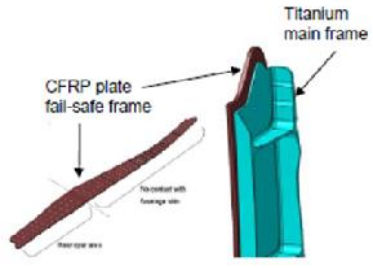
A350 XWB Intelligent airframe

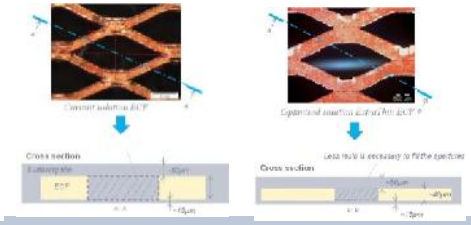
The right material in the right place:

- Reduced weight
- Significantly lower maintenance costs







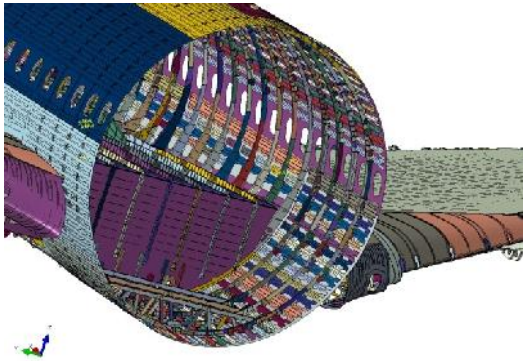


Major contribution from research centers

- •Aerodynamics and load alleviation
- •CFRP and metallic materials development
- •Lighting and EMI protection
- •Simulation and FEM modelling
- •Aircraft systems development (electrical network, avionics, …)

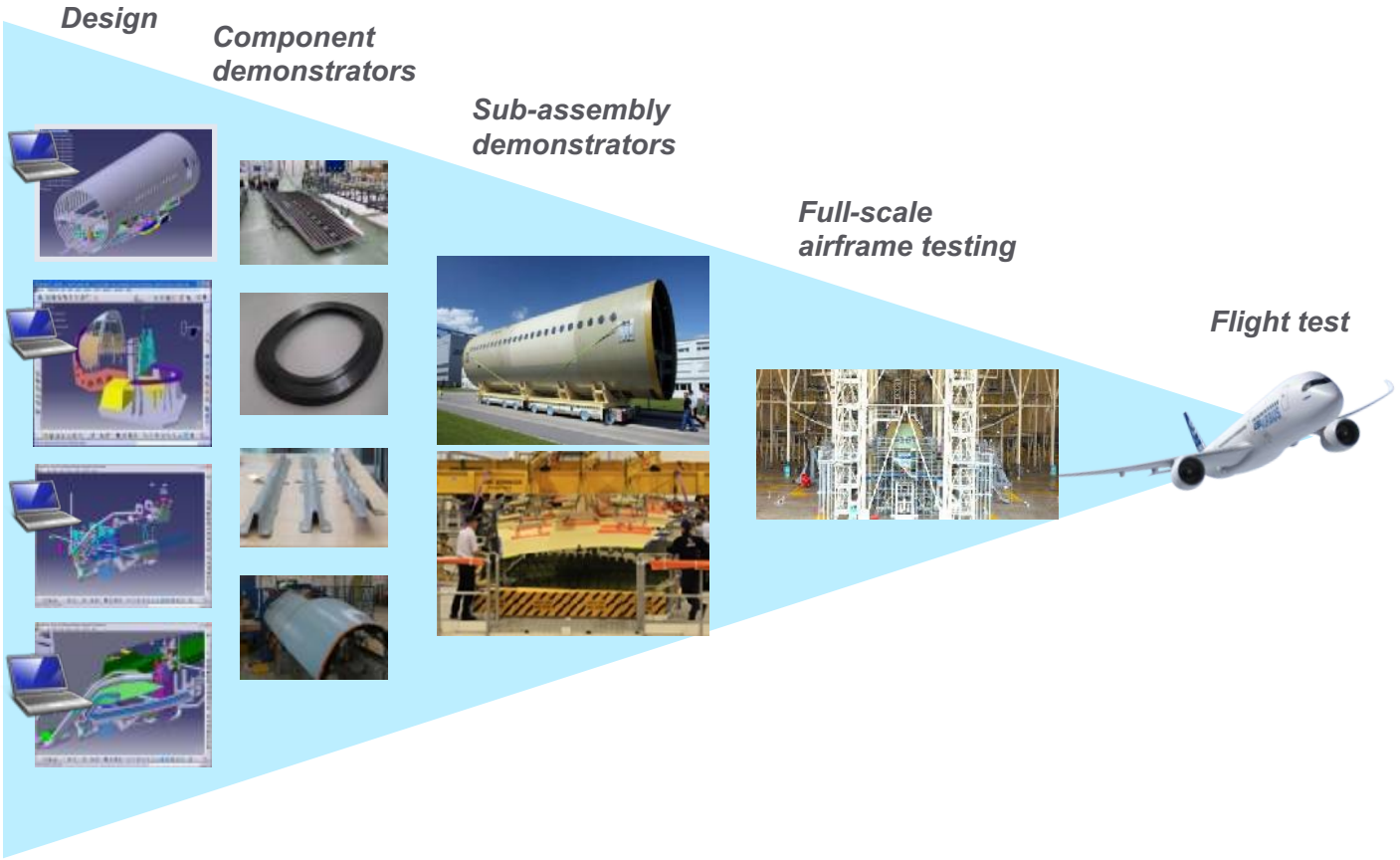
Research & Test Centers:

DGA, LCEO, NLR, ONERA, DLR



CFRP primary structure – New challenges

- Design and engineering tools
- Materials and process development
- Thermal and acoustic performance
- New factories and partnerships
- Tooling and industrialisation
- Repair technologies
- Lightning protection
- Electrical bonding and current return



A350 XWB structure test pyramid

Unprecedented intensive test campaigns to ensure

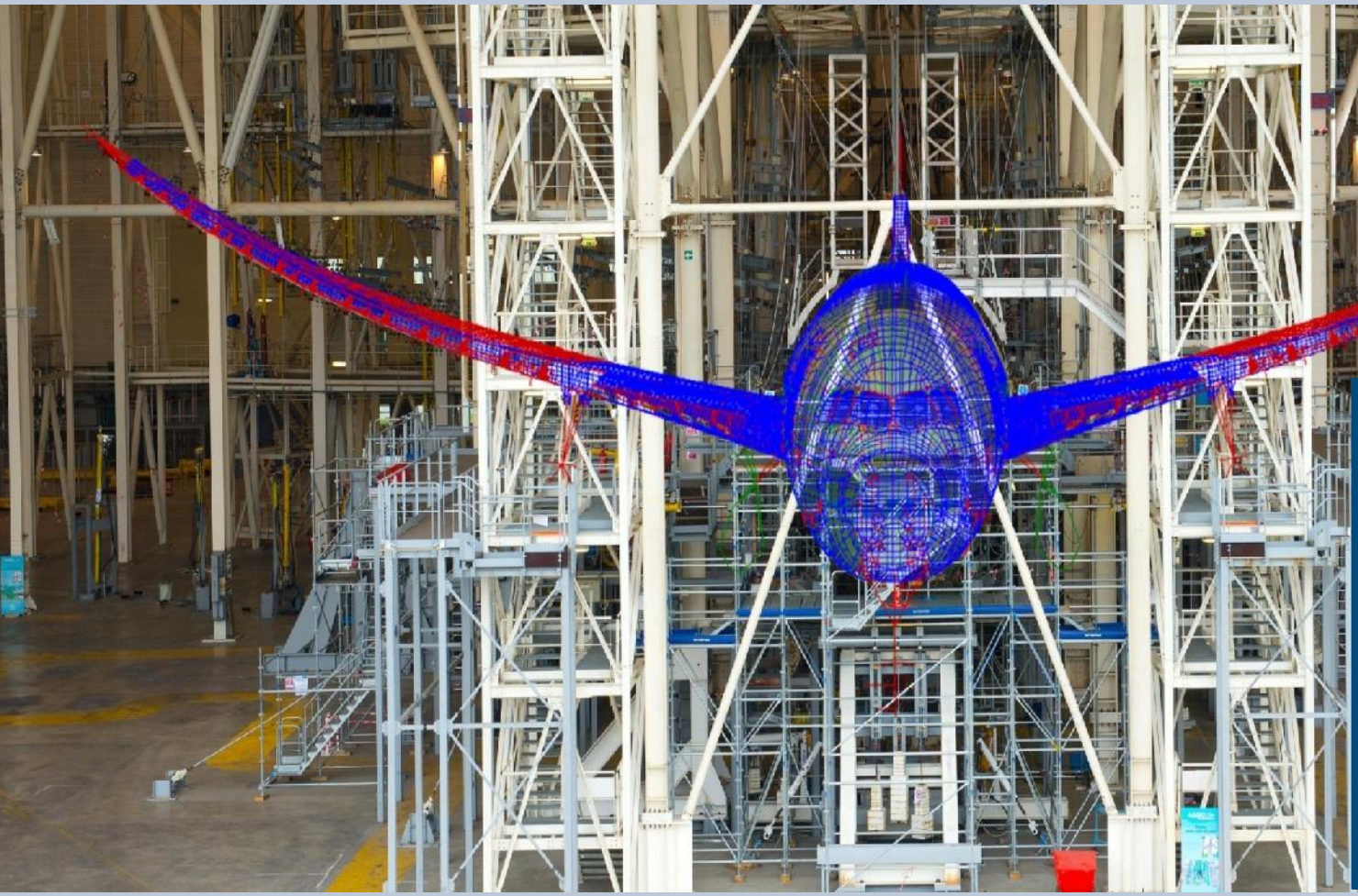
- Development of design allowables
- Validation of methods and tools
- Proof of design features
- Robust manufacturing process

A350 XWB

Virtual full scale test model (VIFST)

Full non-linear FEM - allows real time simulation of the test specimen

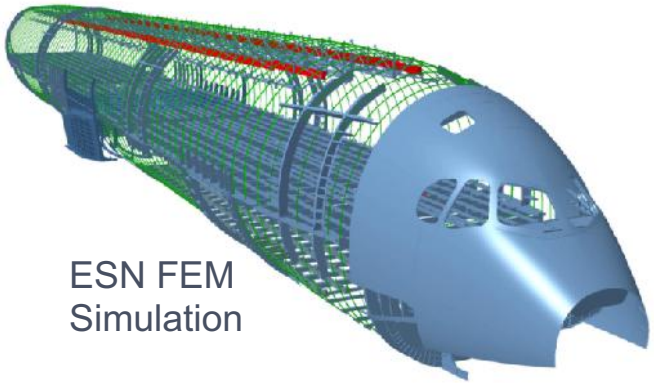
- Reduction of risk during static test
- Excellent correlation between model and test strains
- Test programme on time



A350 XWB
Airframe development

- Finite Element VIFST model compared to actual test deflections

Electro magnetic hazards



ESN FEM Simulation

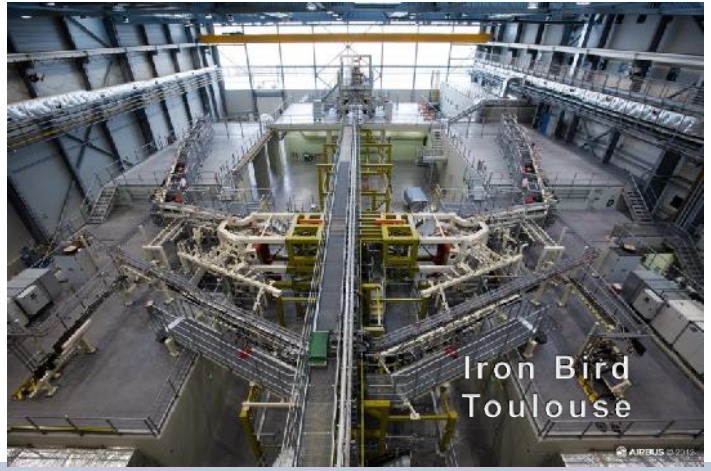
12 full scale fuselage EMH tests for Development and Certification

- **Validate Simulation**
- **Protection means ➔ Verify efficiency**
- **Anticipate manufacturing issues**

Electrical Network Modelling validated by full-scale test

Demonstration by flight testing ILDAS

- 5 Icing exposure tests
  - 75 lightning flashes
  - 500 airframe damage sites
- No system disruptions
- No CFRP delamination only minor surface damage
- Excellent damage corellation



Systems simulation and testing

- Virtual Systems simulation platforms
- Functional Integration benches
- Aircraft simulators, iron bird and full-scale testing

Flight test and certification

- Unprecedented timescale for a successful flight test campaign:
- 15 months
- 5 test aircraft operated in “airline” conditions
- Over 2,500 flight hours
- 370 min. ETOPS granted at certification by EASA

Testing in all environments

In service – 37 aircraft already delivered to all corners of the globe

Qatar Airways
11 A/C in service
first commercial flight
15 January 2015

Vietnam Airlines
4 A/C in service
First commercial flight
3 July 2015

Finnair
6 A/C in service
first commercial flight
9 October 2015

LAN/TAM
4 A/C in service
first commercial flight
25 January 2016

Singapore Airlines
5 A/C in service
first commercial flight
8 March 2016

Cathay Pacific
4 A/C in service
first commercial flight
1 June 2016

Ethiopian Airlines
2 A/C in service
first commercial flight
1 July 2016

Thai Airways
1 A/C in service
first commercial flight
September 2016

Next to come before year end, China Airlines and Lufthansa

A350 XWB – Expanding the Family

A substatial fleet by 2020

Over

500 A350s

In service with

39 customers

Summary

- A350 XWB was a step change in Airbus for Integrated Programme and Technical management
  - New Technologies, New Ways of Working, Innovation in development methods and tools, Transparency

- Collaborative team work across Partners and Nations has always prevailed and enabled to achieve very tough targets :
  - A Human adventure beyond the technical achievements
  - Jointly we can have great pride for what has been achieved in the spirit of Professor Von Karman's vision


Efficiently Yours
A350
A350 AIRBUS