September 2006

**Presented by**
**Charles Champion**

**Airbus COO and**
**Head of A380 Programme**

# ICAS
(International Council of the Aeronautical Sciences)

7th September 2006

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# 1996 - 2000

## The creation of the A3XX organisation

•The creation of the Large Aircraft Division (LAD) in April 1996 to start the design concept studies on the A3XX

• The LAD objective was to work on the requirements with Airlines, Airports and Airworthiness Authorities for the A3XX

• All the different disciplines where assembled under one organisation e.g. engineering, financial, industrial, marketing and transport

• The objective to get commitments from the Airlines to enable a launch base



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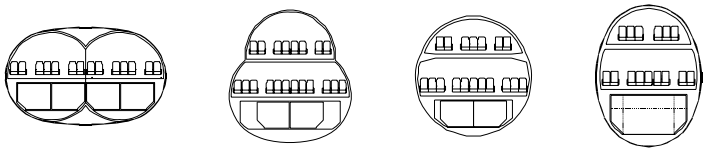
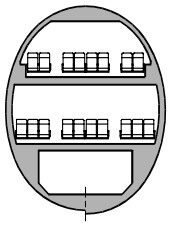
## Fuselage design evolution

- **allow for creative spirit**
- **create competing concepts**
- **evaluate concepts relative to design targets (weight, drag, size...)**



- **select best solution**
- **refine configuration**



*A3XX fuselage section is new from scratch*



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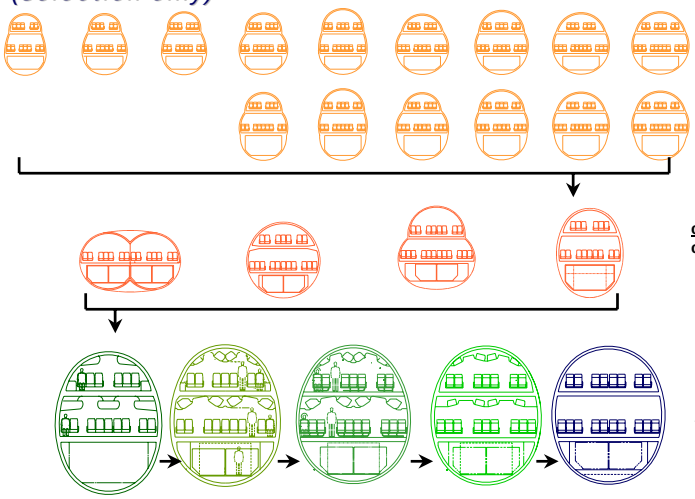
# Fuselage sections studied…

*(selection only)*



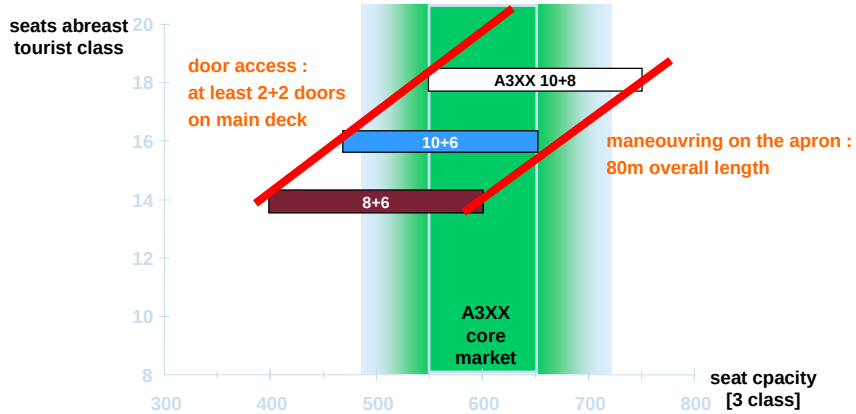
**concept selection**
criteria :surface
check :length
cargo volume

**competitive benchmarking**
criteria :surface
weight
length
cost

**refinement**
surface
tail arm
door access
airline attractivity

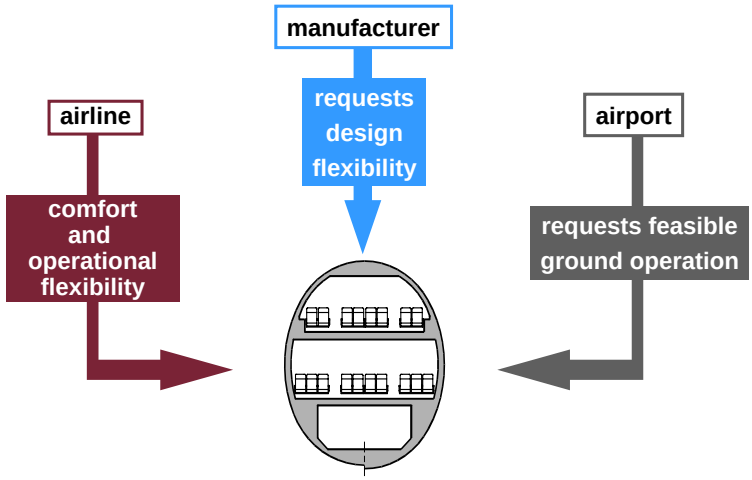


# Aircraft compatibility as sortout criteria




*Limited freedom of choice if all targets are to be fulfilled*

## Seats Abreast Decision




*One fuselage section that fulfills all requirements*

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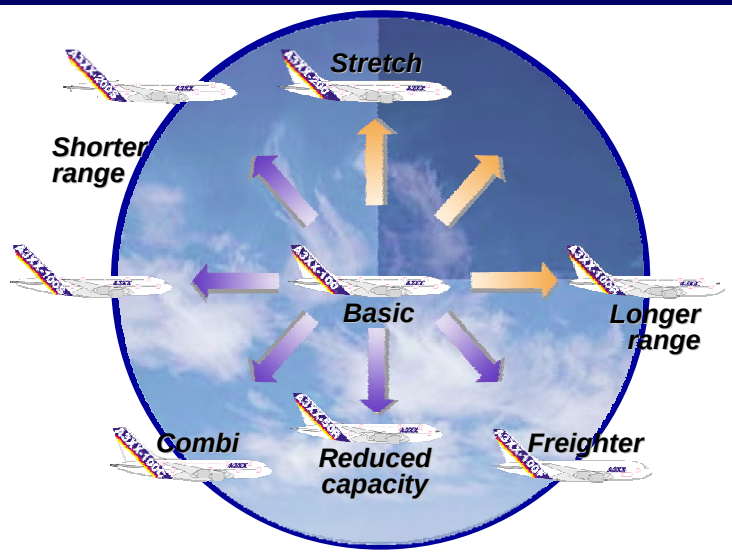
## Limitations on seat capacity

**example: 650 seats with 8+6 seats abreast cross section :**
*long, thin, weak stiffness and heavy*
***too long for airport manoeuvring and 9-door concept***

**example: 480 seat with 10+8 seats abreast cross section :**
*short, stubby, relative low portion of constant sections*
***few doors / non optimal ground service***

*Airport compatibility is a limiting factor on seat capacity*

# A3XX family

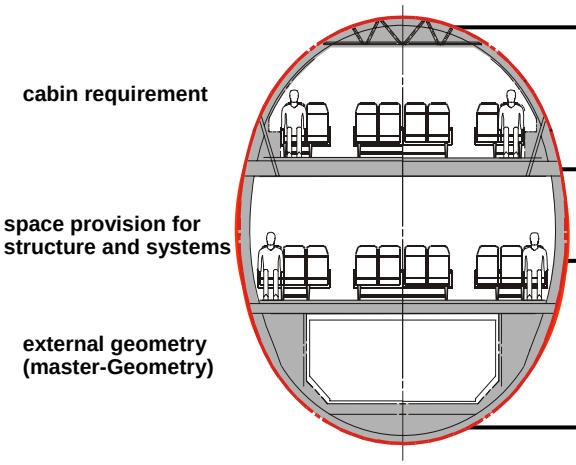



*High development potential*





# From cabin requirements to the outer dimension



**cabin requirement**

**space provision for structure and systems**

**external geometry (master-Geometry)**

**„crown"-height for system ductings**

**floor height for structural concept**

**wall thickness for shell height + insulation + trim**

**belly-depth for ditching capabilty** (emergency landing on water) **and wing integration**

*Early reservation of the space that is later occupied by structure*

## Prepared with a group of highly qualified airlines


*20 leading airlines are shaping the design of the A3XX*





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## A3XX Forums, Carcassonne

June 1996 and December 1996


***Air Canada, Air France, All Nippon Airways, British Airways, Cathay Pacific, Cargolux, EVA Air, Federal Express, Iberia, Japan Airlines, KLM, Korean Air, Lufthansa, Northwest, Singapore Airlines, United, Virgin Atlantic Airways***

**Mapping the future: concept discussions for an aircraft larger, better than the legendary, but venerable, 747. The A380 family was the result.**

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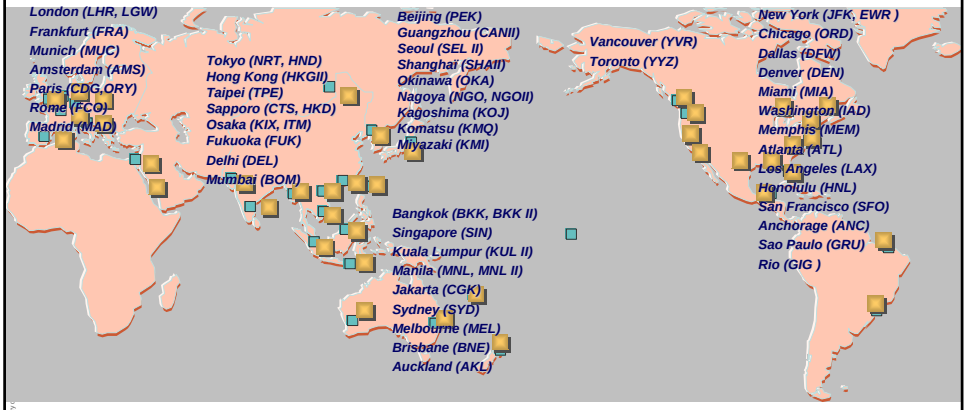
# Airports: planning for the A3XX




- Regular contacts with over 50 major airports worldwide
- Major airports are - or are getting - ready for the A3XX
- Working and planning for a smooth, trouble-free EIS

*For airports, the A3XX is part of the solution*



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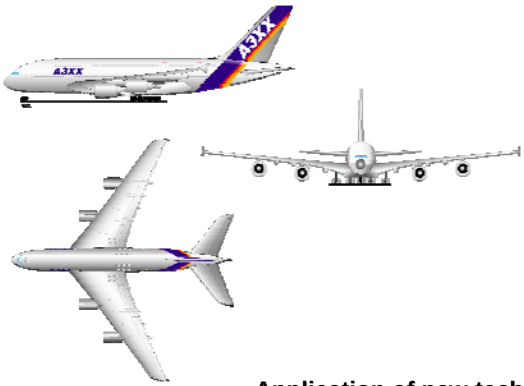
# Technical progress during 1999

**More than 50 aerodynamic / geometrical changes have been incorporated in 1999**




**Examples**

- Wing plan form
- Section shape / twist
- Tank arrangement
- Engine position
- Fuselage cross-section
- Door position
- Fin and HTP size
- System housing for space and c.g reasons

**Application of new technologies and design principles contribute to achieving performance and operation targets**



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# 2000





## Summary of CFGs from 1996 to 2000

| | | |
|---|---|---|
| 1996 | 4 CFG's |  |
| 1997 | 12 CFG's |  |
| 1998 | 11 CFG's |  |
| 1999 | 7 CFG's |  |
| 2000 | 14 CFG's |  |

***By the end of 200 48 Customer Focus Groups performed***

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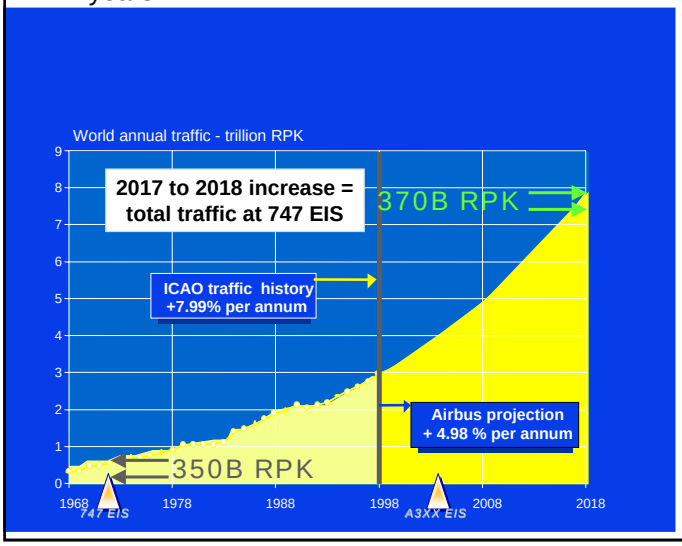
# A growing market

- Analysts world-wide share the Airbus view on an air traffic growth of 5% per annum over the next 20 years i.e. twice as many passengers in 15 years .




- Traffic levels in 20 years time will therefore increase by 4.9 trillion RPKs.
- When Boeing launched the B747 total world traffic levels were one tenth of today's.

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# The Air Transport Industry : cost-conscious

- We believe we cannot rely on a scenario that would provide for the quick and unrestricted availability of :
  - New airports
  - New runways
  - New gates
  - New ATC systems
- We believe that although some developments will happen, there will continue to be :
  - Physical limitations ( land availability)
  - Financial bottle-necks (Budget allocation)
  - Social and political hurdles (cost of opportunity & environment)
- Everybody talks about privatisation, bottom line, shareholder value, return on investment ...

We look towards an efficient, cost-effective, productive aircraft that could minimise the infrastructure investments

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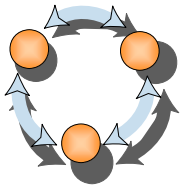
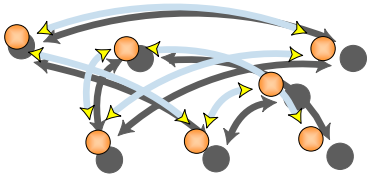
## Market trends





***CONSOLIDATION***

- More cost-effective
- Hub dominance
- Global network
- Linking major hubs
- The logic behind alliances

***FRAGMENTATION***

- Hub by-passing
- Market development
- Frequency on thin routes
- The business flyer's dream

*A3XX* *A330/A340*

*The real world: consolidation and fragmentation*



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## Air Traffic : where we will see it

- Air Traffic is dependant on the globalisation of the economy, the income of the population, and the need for leisure …
- In all of this, speed, reliability and economics determine the efficiency of the Air Transport contribution to serve the people needs

- Active megalopolis will continue to concentrate active, wealthy population and business leadership



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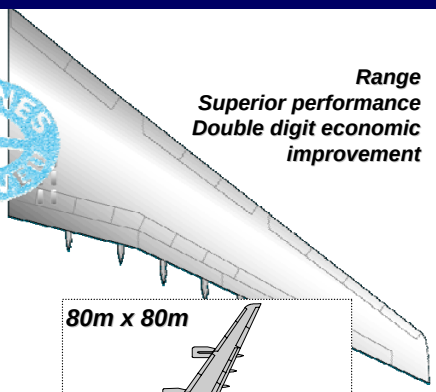
## Top Level Aircraft Requirements

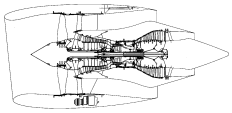
Comfort

Capacity

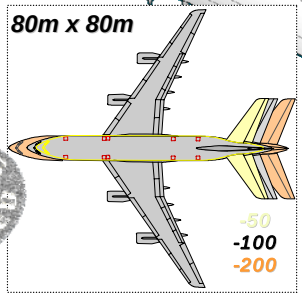

Range
Superior performance
Double digit economic improvement



Efficiency
Silence
Environment friendliness




80m x 80m



-50
-100
-200

Quick TRT





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## A380 Major systems innovations

•New and Open Avionics applied to all system controls
•Ethernet base data communication (AFDX)

On Board Maintenance and electronic documentation/ & log book

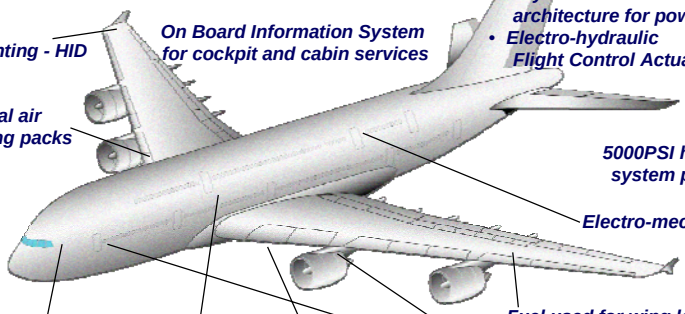
Electrical Flight control back-up
Reduction of stability margins
Split elevators and rudder

2 hydraulic + 2 electrical circuit architecture for power system
• Electro-hydraulic Flight Control Actuators

Bulbless lighting - HID

On Board Information System for cockpit and cabin services

Dual/dual air conditioning packs



5000PSI hydraulic system pressure

Electro-mechanical doors

Fuel used for wing load relief

8 times 6"x8" LCD display units
+ 2 specific display for information services
Interactive control & displays for main HMI functions

On-board Oxygen generating system

20 wheel Landing Gear
Rear wheel steering
Single cavity brakes

Variable frequency electrical power
Solid state components
for electrical distribution





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## Authorisation to Offer

- June: A3XX A.T.O. given
- September: Engine architecture defined for both Rolls Royce and Engine Alliance
- Key driver - Noise
  - 116 inch fan to enable QC2 departure / QC 1 arrival





## The A380 is launched…

- On 19th December 2000, the A3XX was launched and named the

# A380 & A380F

- The launch airlines were:

Singapore Airlines
Emirates
Qantas
Air France, ILFC, Virgin and Fedex

**For a total of 60 firm aircraft**

## A380 launch base established

| | |
|---|---|
| Emirates | 5 A380<br>2 A380-F |
| AIR FRANCE | 10 A380 |
| ILFC | 5 A380 |
| SINGAPORE AIRLINES | 10 A380 |
| QANTAS | 12 A380 |
| virgin atlantic | 6 A380 |
| FedEx Express | 10 A380-F |

***A successful launch - 60 firm orders plus option***

*As of March 31st, 2001





## A380 family - Potential for development

*Increased Capacity*
*A380-900**

***A380-800***
***Launch variants***
***A380-800F***

*Increased Range*

*A380-800R**

**Potential product development*

*Reduced Capacity*
*A380-700**

***The virtues of a whole new programme***

# 2001

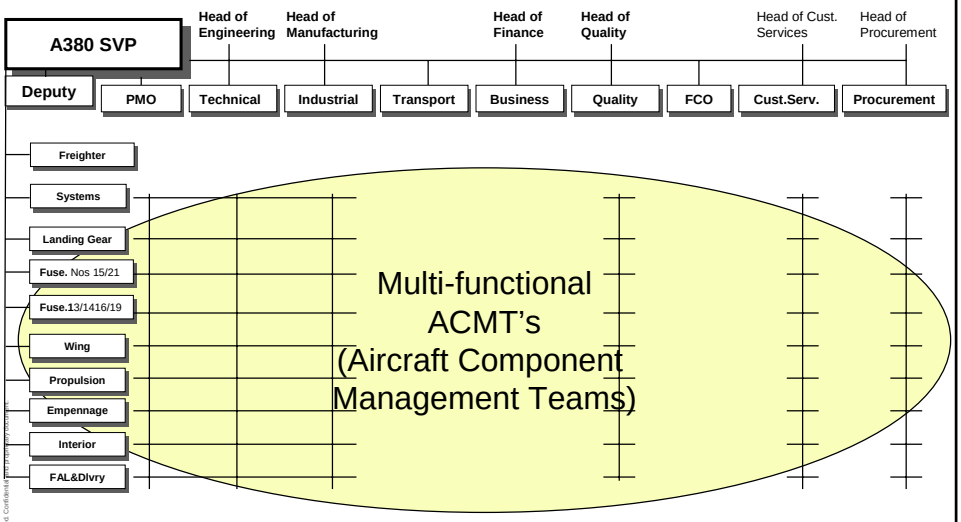




## 2001 Key events and challenges

- Transition from A3XX Project to A380 Development
- Launch of the planning for the new A380 facilities across Europe
  - Broughton
  - Hamburg
  - Toulouse…
- A380 Work package allocation and start firming up Supplier selections
- Establish the A380 Programme organisation
  - Aircraft Component Management Teams (ACMT's) created to design and manufacture the aircraft sections and systems
  - A380 Central Programme for Programme management
- Secure Engineering resources (up to over 5,000 Full Time Equivalent )
- Detailed review of aircraft definition, focus on the weight
- Flying Test Bed vehicle selected for Trent 900 :A340-300 MSN 1
- Firm up the A380 Customers
- Start to firm up commitments from Airports with Airlines
- Put in place specific A380 Transport organisation…Beluga too small !

# The A380 organization

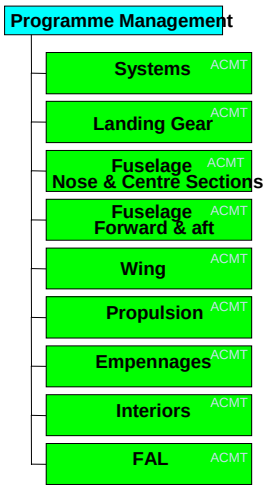



***... for the first time the structure of a Programme is build with integrated and product related teams from Programmes, Operations and Procurement***





# ACMTs form the organizational backbone for the development of the A380 Programme




**Mission of ACMT**
To deliver in time/cost/quality and performance aircraft components and systems

**4 main locations ("Plateaux")**:
Toulouse – Hamburg/Bremen - Filton - Madrid

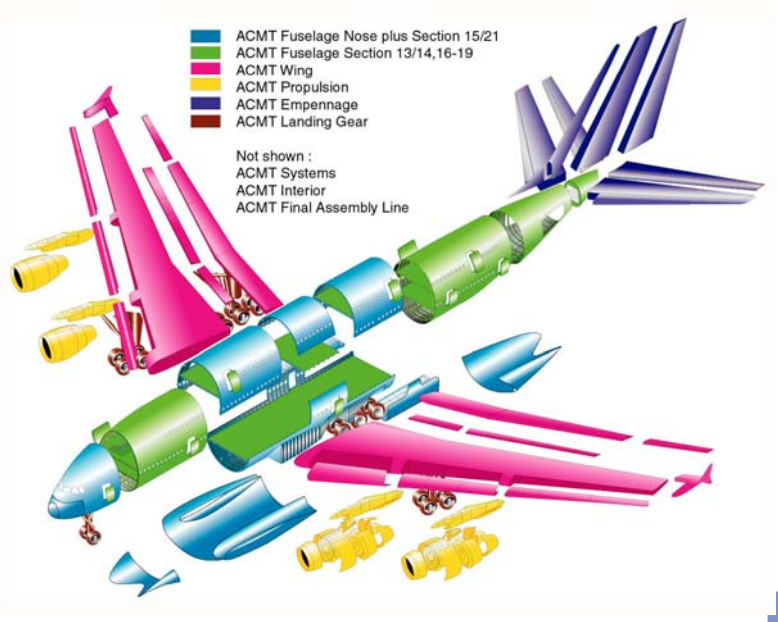
**5 "Plateaux"** including Programme Directorate in Toulouse

The 4 development locations ‚plateaux' will house:
**ACMT + CMIT + CDBT**

Organization of "Plateaux" is defined to ease communication between teams not in direct relationship through organizational breakdown, e.g.:

CMIT: Slats & Flaps (Bremen) <=> Secondary flight control team in BRE

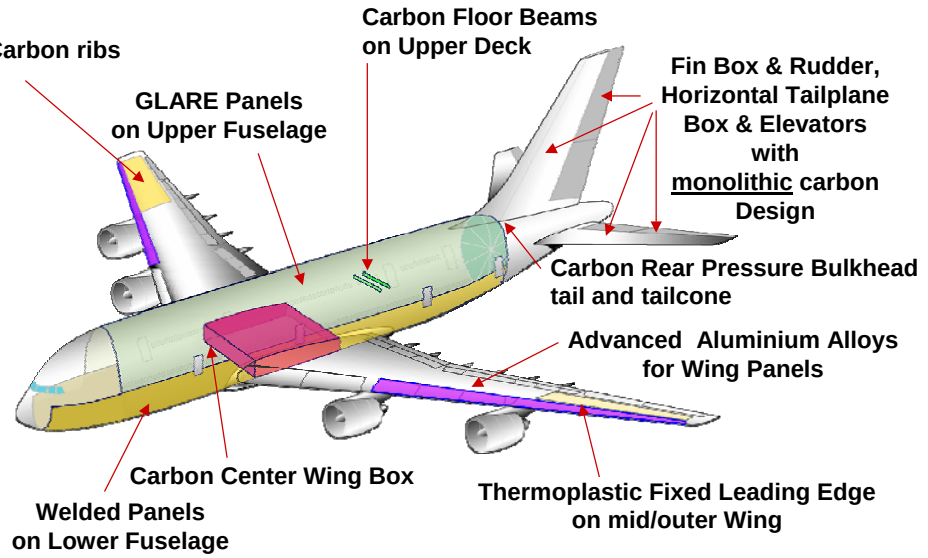
## The A380 Aircraft Component Management Teams (ACMTs)

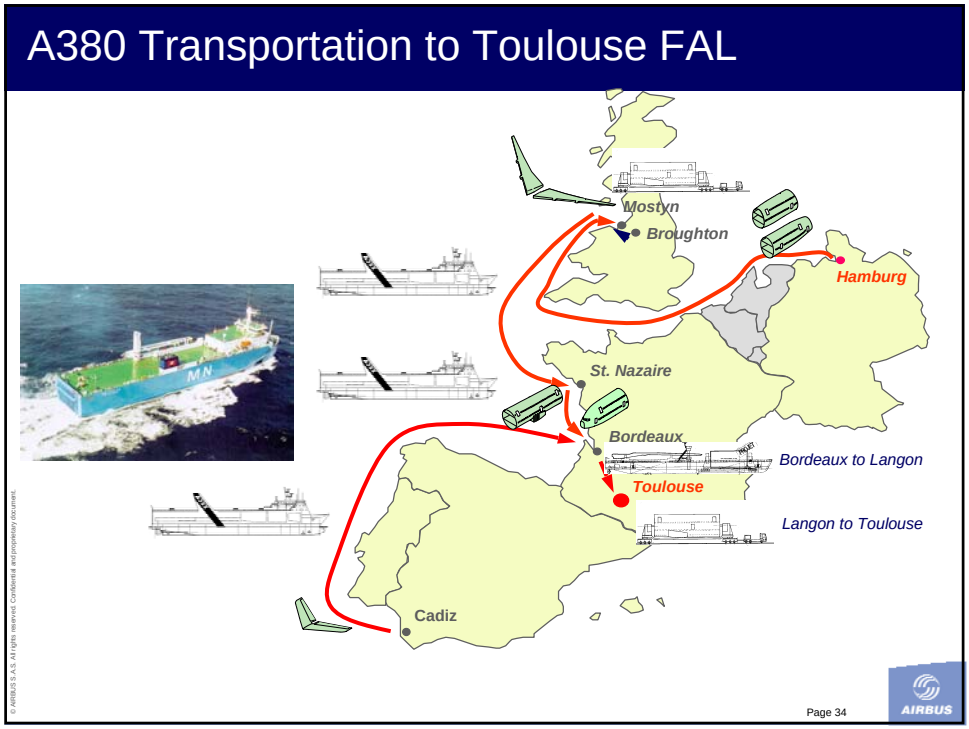







## A380 Technologies for Value…add new chart winglets



## The A380 programme Headquarters

## A380 Engineering building - Toulouse

# 2002



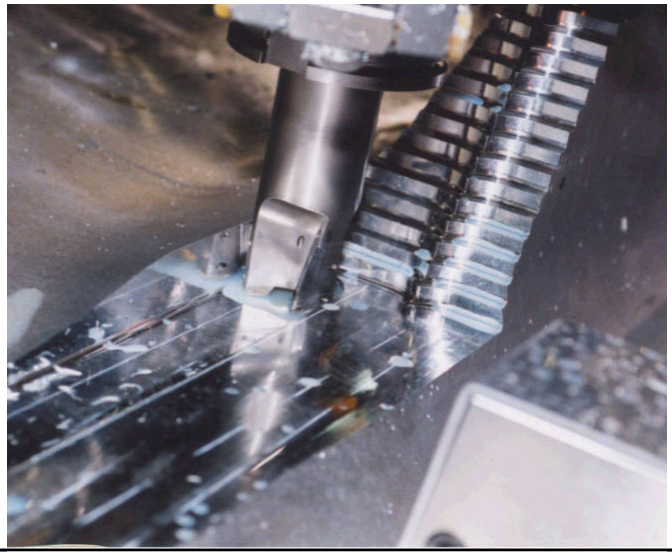


## 2002 Key events and challenges

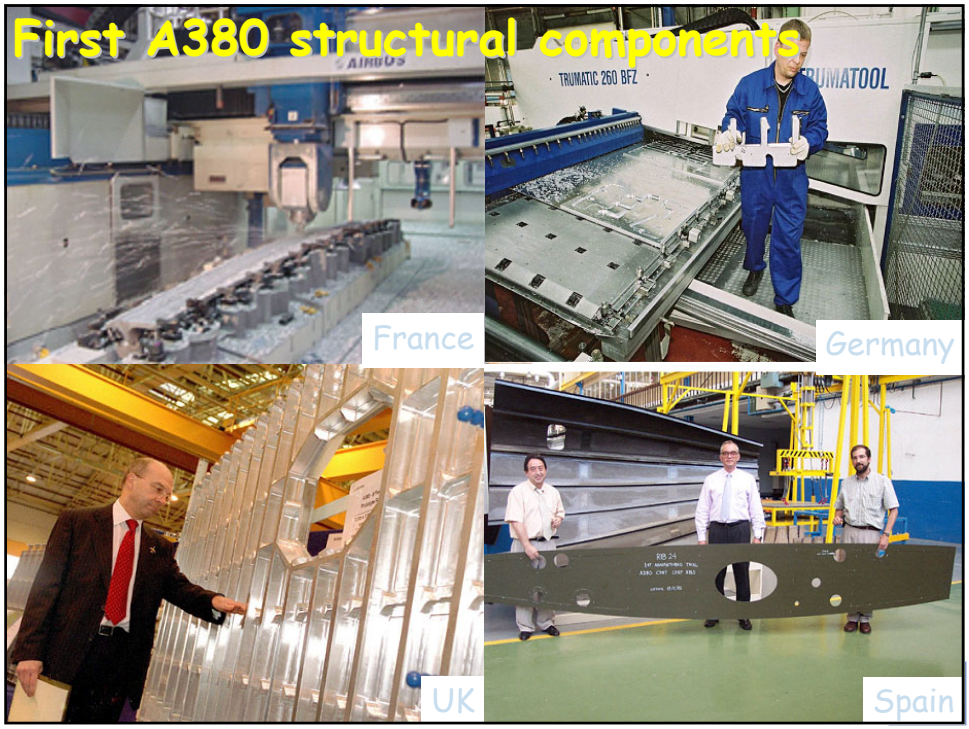
- Keep the Customers on board…
- First Metal cuts – the cruciform for the centre wing box
- Complete the plans for the new facilities across Europe
- Finalise the remaining supplier selections and work packages
- Start of Customisation process with launch airlines
- Establishment of System Test benches
- Major engine / nacelle / aircraft interfaces agreed
- Ensure completion of the Iron Bird Facility and start installation of equipment
- Maintain the ramp up plan across all the Engineering sites
- Maintain the momentum on the Airports
- Get the first drawing sets to Manufacturing

## 2002

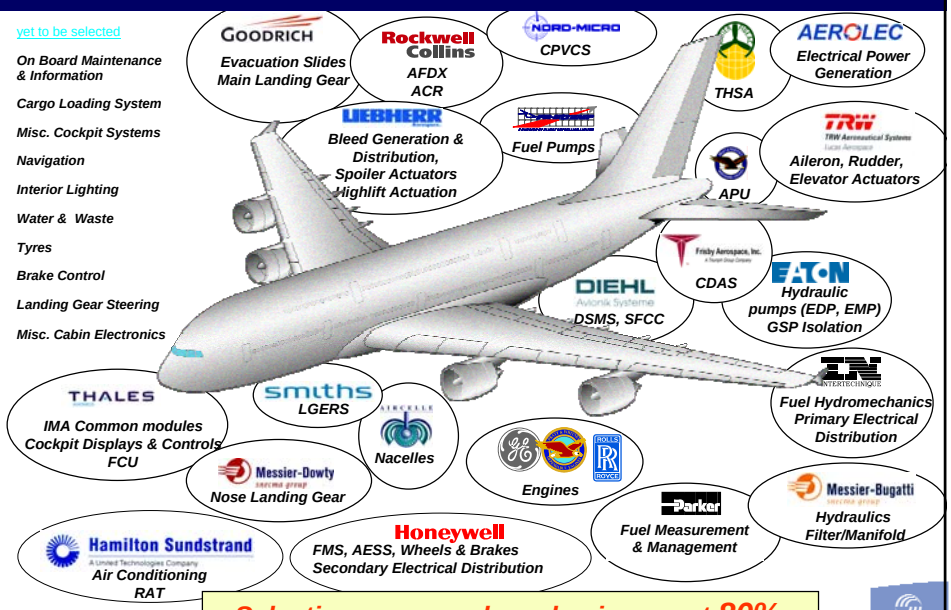
23 JAN 2002: FIRST METAL CUT (FRANCE)







## A380 Global equipment sourcing




## THE JEAN-LUC LAGARDERE SITE
## The key figures

- THE ARCH
  - Dimensions 490 m x 250 m x 46 m
  - Ground limits about 100 000 m²
  - The offices 36 000 m²
  - The big doors 100 m x 27 m
  - Maximum bearing of the beam 117,50 m
- THE OVERALL PROJECT
  - Total weigh of the frame 32 000 tonnes
  - Technical galleries 5 km
  - Total Volume of the Concrete 125 000 m3
- THE WORKS
  - Maximum staff 2000 people (Sept. 2003)
  - Number of contracts more than 150

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## Creation of dedicated Iron Bird Facility November 2002





# 2003

## 2003 Key events and challenges

- Keep the Customers on board…
- First section start to take shape
- Road transport trials planned for 2003
- Trent 900 First Engine to Test (FETT) in March
- FAL Toulouse readied for the delivery of the first sections
- Produce cabin mockups for the new “special cabin projects” in Hamburg
- Establishment of System Test benches
- Get the Iron Bird *“flying”*
- First wing box transport from Nantes to Saint Nazaire
- First wing out of jig in Brought (UK)
- Keep the weight, drag and engine intergration under control



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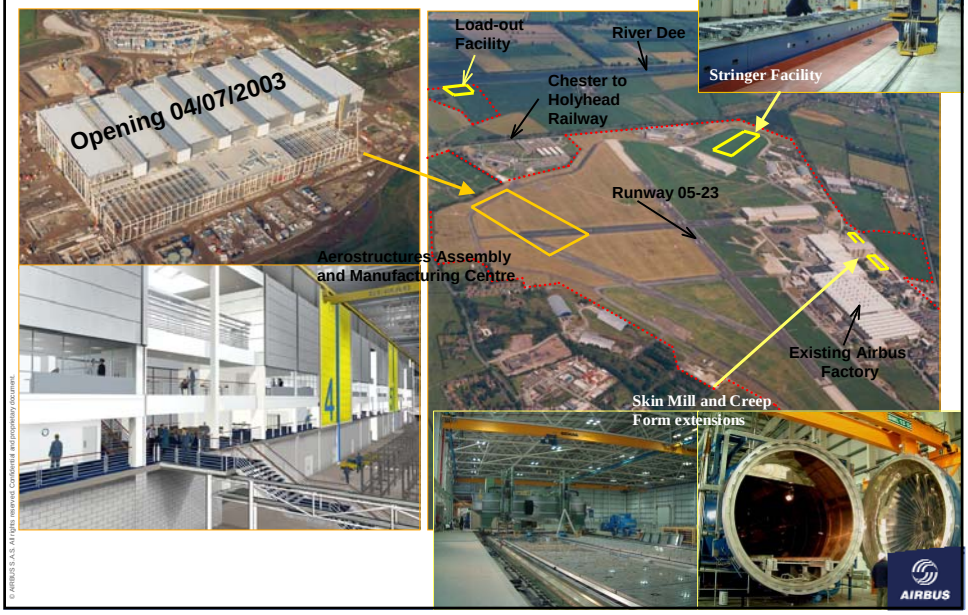
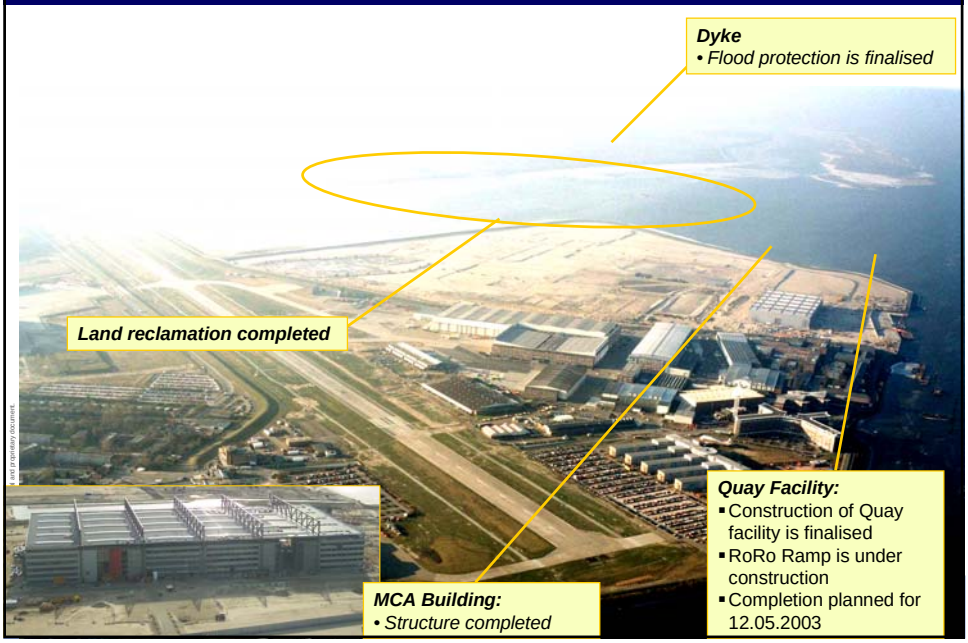
## Airbus UK – Broughton facilities



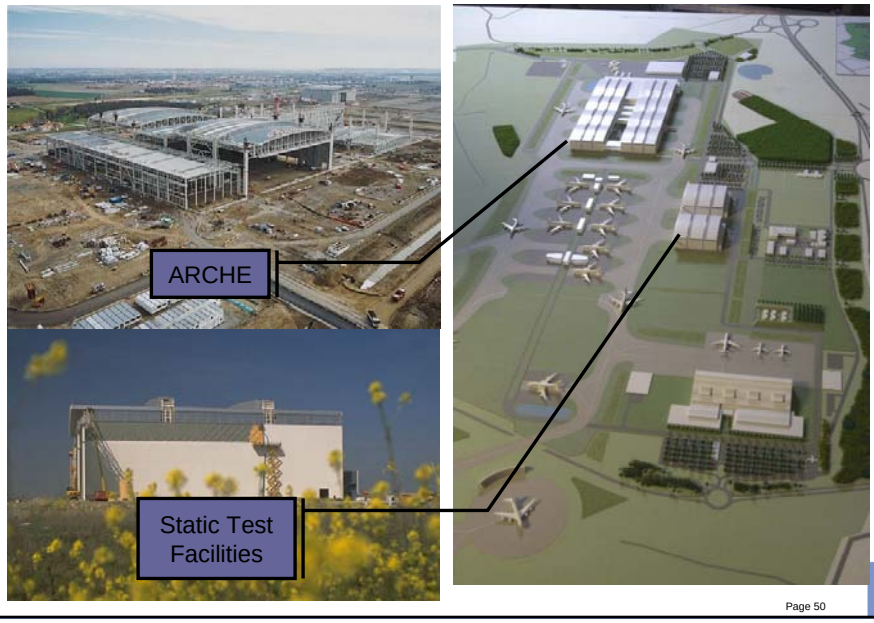
## A380 FAL – First roof section lifted, February 17th 2003

## Airbus Spain – HTP Skin laying in Illescas

## Airbus Germany - Hamburg site




## A380 Final Assembly Line - Construction underway in Toulouse

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## Toulouse - Ironbird


## First wingbox transport – Nantes to Saint Nazaire

## Main key events – A380 Achievements – Nov. 03
## First Wing out of jig in Broughton


**04/11/03** First wing out of jigs in Broughton





## Main key events – A380 Achievements – Nov. 03

**27/11/03** Centre section assembly
from upper shells integration station to belly fairing installation station.


# 2004



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## 2004 Key events and challenges

- First A380 cabin layout freeze and cabin vendor selections to be finalised
- First fuselage sections ready ship
- GP7200 First Engine to Test
- Trent 900 1st Flight and Flying Test bed campaign and Trent 900 certification by EASA
- First shipment of the first A380 to Toulouse (static specimen)
- Opening of the FAL by French Prime Minister
- Delivery of First Rolls Royce engine to Toulouse and First Flight on A340
- MSN 1 Rolls out of Station 40, 1st A380 to fly!
- Start of flight testing of the GP7200 in USA
- By year end MSN's 1, 2, 4 & 7 in FAL Toulouse
- Start of detailed design phase for the Freighter



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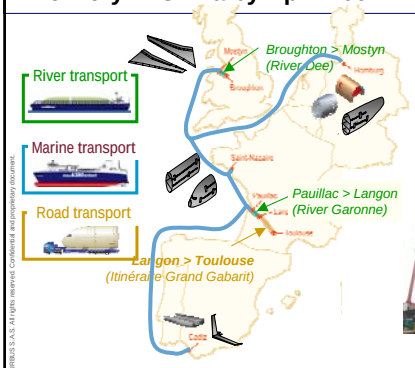
## A380 Transport - Marine Transport


*Ship owner and operator : FRET/CETAM*

- **Vessel built in Nanjing Jingling (China)**
- **Launched on 30th July 2003**
- **Delivery in China by April 2004**


Stern view

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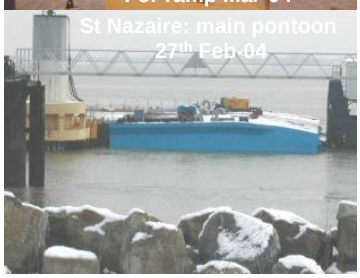
## The “Ville de Bordeaux”


## A380 Transport - Harbors

- **Specific port terminals under construction or in place, located near to the Airbus plants: - Hamburg** completed Sep-03
  **- Mostyn, St Nazaire, Cadiz on progress**






- **Port terminal at Bordeaux/Pauillac, entry point to in-land France: full acceptance on 5th Mar-04**

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# A380 Transport - River Garonne

Bordeaux
Barge crossing Pont de Pierre

River Garonne operator: Socatra
Barge naming: Breuil

1st barge delivered 25th Feb-04
2nd barge by Sep-04


Langon lock
Delivery Mar-04

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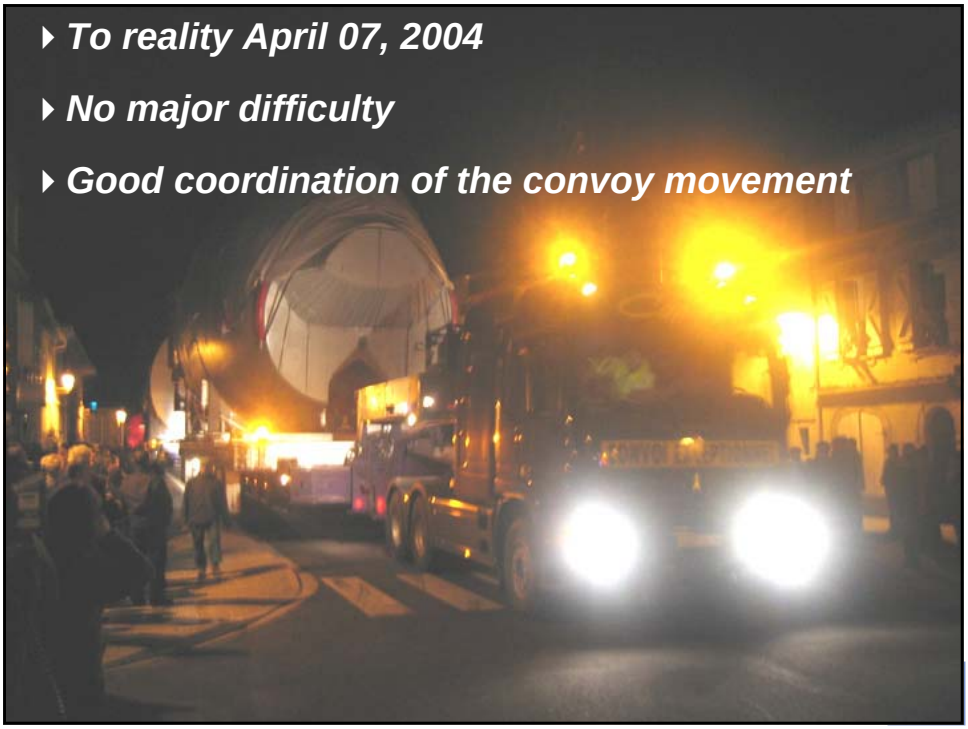
- *To reality April 07, 2004*
- *No major difficulty*
- *Good coordination of the convoy movement*



## Static fuselage sections delivered on time to FAL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## A380 FAL Inauguration - 14th May 2004

## First flight of the Trent 900 - 17th May 2004


## First Flight of the Engine Alliance GP7200 – Dec 04

## From the STAR Project to the A380 FAL Site



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## 2004…a busy year

# 2005





## 2005 Key events and challenges

- The A380 is presented to the customers, the press and the world !
- First Flight 27th April 2005 – the baby is born and doing well…
- Opening of the flight envelope
- Secure 1st flight of MSN 2 & 4 in 2005
- Maturity focus on A380 – creation of dedicated team to ensure operational reliability at EIS
- Bottlenecks in engineering impact the programme leading to re-planning of certification and EIS. Resources redirected and additional support to the teams increased
- The A380 visits the world – over 20 airports visited
- Static and Fatigue testing well underway and ahead of the planning
- GP7200 Engine certification by FAA
- First pieces in manufacturing for the Freighter

## The A380 is Revealed…25 January 2005


## A380 First Flight / Take-off 27th April 2005

## A380 First Flight … 27th April 2005


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## Flight envelope fully opened in 2005

*First flight – 27th April 2005*

*Le Bourget June 2005*

*VMU tests – Istres, July 2005*

*Water trough tests – Istres, October 2005*

***Full flight envelope demonstrated***

***excellent handling***

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## MSN 004 take off - 18th October 2005


## MSN 2 first flight 3rd November 2005

## *Successfully tested at airports worldwide*


## Tested at Frankfurt, Terminal 2, Gate E9

29 October 2005

## From small airports to large airports…

Tarbes, Southern France

Medellin, Colombia

Pointe-à-Pitre, Guadeloupe

Iqaluit, Canada


Sydney

Singapore

Frankfurt

Dubai

*Proven at more than 20 airports visited to date…*



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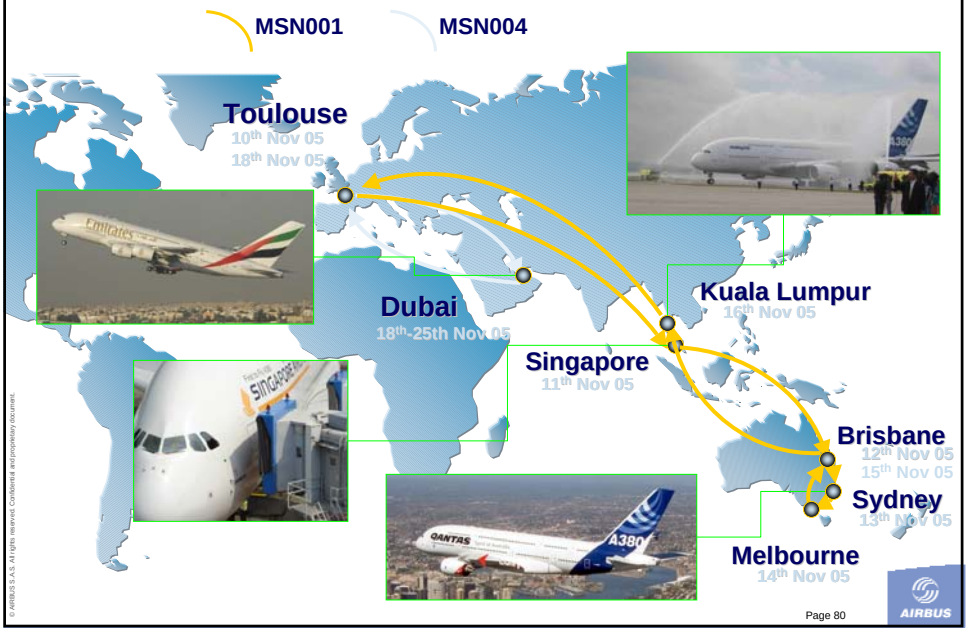
## A380 meets the world



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# 2006





## 2006 Key events and challenges

- Keep the momentum with Flight test – more aircraft added
- Secure the Early Long Range Flights, key for Maturity
- Secure the route to certification before end of the year
- Consolidation of performance and noise measuring flights
- Preparations launched with the airlines for the Route proving, the last part of the certification exercise
- First Flight 27th April 2005 – the baby is born and doing well…
- Preparations underway with first airlines for the entry into service i.e. maintenance training, flight simulators and spares stock
- First flight of the GP7200 on MSN 9
- Prepare for for the Main Component Assembly (MCA) of the Freighter in January 2007
- Secure the ramp up

## First A380 now painted in Hamburg


**MSN 2 in Hamburg 13th January 2006**

## And more recently…



***Hot and High***
***Medellin***
***January 2006***



***Hot and Humid***
***Pointe-à-Pitre &***
***Fort de France***
***January 2006***




***Cold weather***
***Iqaluit***
***February 2006***



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## Asian Aerospace 2006, Singapore


## First Customer Aircraft to fly to Hamburg…

- First production Aircraft – MSN 003
- First flight on 7th May 2006
- Ferry to Hamburg on the same day

## …in the coming months

MSN1
- Systems Development and Certification:
  - Landing gear, hydraulics, radio navigation and communication, electrics, fuel
- High energy RTO

MSN 4
- Mainly systems development & certification in conjunction with MSN 1
- Hot weather campaign started in Abu Dhabi (Al Aïn airport)

MSN 2
- Cabin systems development & certification
- EMI Campaign on-going
- Early Long Flights starting first week of September

MSN 9 (Engine Alliance)
- First flight scheduled in August





## Last 12 months achievements

- ✓ Static tests completed, fatigue test specimen now at 15,052 flight cycles**.** All test benches in operation
- ✓ Both Rolls Royce and Engine Alliance engines certified
- ✓ Development Aircraft first flights:
  - MSN 001 on April 27th 2005
  - MSN 004 on October 18th 2005
  - MSN 002 on November 3rd 2005
  - MSN 007 on February 19th 2006
- ✓ Successful Emergency Cabin Evacuation Trial on MSN 007 in Hamburg on March 26: 853 passengers and 20 crew members in 78 seconds!
- ✓ First Customer Aircraft flew to Hamburg on 7th May 2006
- ✓ MSN 002 Cabin installation completed, Virtual Flight completed on 9th May 2006 now back to Toulouse for Flight Test campaign
- ✓ 15 Aircraft already assembled, including static and fatigue.
- ✓ First Freighter structural elements in production

## A380 Flight testing

From 27th April 2005 to 21st July 2006

- MSN 001
  - 279 flights
  - 950 flight hours
- MSN 004
  - 203 flights
  - 605 flight hours
- MSN 007
  - 2 flights
  - 6 flight hours
- MSN 002
  - 29 flights
  - 107 flight hours

**513 flights and 1669 flight hours to-date**



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## A380 Major Structural Testing

- **Fatigue Test Specimen (EF)**
  - Test purpose : over 2.5 times Aircraft life and at least 1 year life before Aircraft operation
  - 5.000 flight cycles reached on 24 Dec '05
  - As of 19th July 2006, 15,052 FC have been accumulated
  - Average of 950 flights reached per week
  - A- inspection (A29) carried out 03 July '06, no major findings detected

**Current Forecast:**
**Summer '06 1 DSG**
**TC app. 24600 FC**
**EIS app. 30000 FC**

ES Ultimate Wing Bending test February 2006

Rear End Test/max VTP bending test Jan 05

EF Wing after test start September 2005

- **Major Static Test (ES)**
  - All Ultimate Load cases completed
  - Max Wing Bending case achieved up to 1.45 Limit Load, demonstrating the reliability of the analysis
  - Rupture occurred during loading to 1.5 Limit Load
  - To meet delivery date of first Aircraft, conservative measure taken to add some strips to the top cover stringers.

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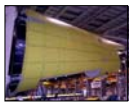
# A380 Industrial Programme Update (22/05/2006)

Section 15, St. Nazaire

022 024 033



Tailcone (Sect.19.1), Getafe

015 016 024

Section 18/19, Hamburg

023 025 036

Cockpit section, Meaulte

025 027 036

**Aircraft in manufacture :**

**Today → MID '06 → END '06**

Rear pressure bulkhead, Stade

029 030 042

Section 13, Hamburg

028 029 039

Fort Wing, Broughton

024 026 036





# Successful Evacuation Test - 26 March 2006

- Evacuation Test using MSN 007 on March 26 in Hamburg witnessed by Airworthiness Authorities (EASA with FAA participation)
- 873 occupants:
  - 853 passengers: 538 MD + 315 UD
  - 18 cabin crews and 2 flight crew members
- Evacuated the Aircraft in semi-darkness with half the doors inoperative…in 78 seconds!

**EASA and FAA approved 853 as the maximum passenger seating capacity for the A380-800.**

## Cabin Virtual First Flight (CVFF) 09th May 2006

During **5 hours of testing 474 passengers** and 20 crew members **simulated a 15 hour flight.**

**Testing of the In-flight Entertainment system, the water waste system and air conditioning**

**All cabin operations** from boarding to safety instructions, galley and trolley lift operations together with **a full meal service were completed successfully**



## ILA Conference – Berlin – May 2006

## BAA – Heathrow – 18/05/2006


## The Freighter is in production…





## Freighter - Engineering

**Definition phase completed……**

- All Structural Design Principles including material choice agreed
- Barrier Wall concept and CFRP material confirmed
- Freighter-specific system architectures (e.g. Door Slide Management System, Cabin Intercommunication Data System, Air conditioning, …) frozen
- 100% design solutions integrated in the Digital Mock Up
- Mechanical and electrical Systems installation well advanced
- Interface agreements:
  - primary structure done
  - mechanical and electrical system installation nearing completion
- 30 % of specific Freighter Drawings already released for manufacturing
- Qualification of Aluminum-Lithium skin material achieved

**….. Now in full Detailed Design process**



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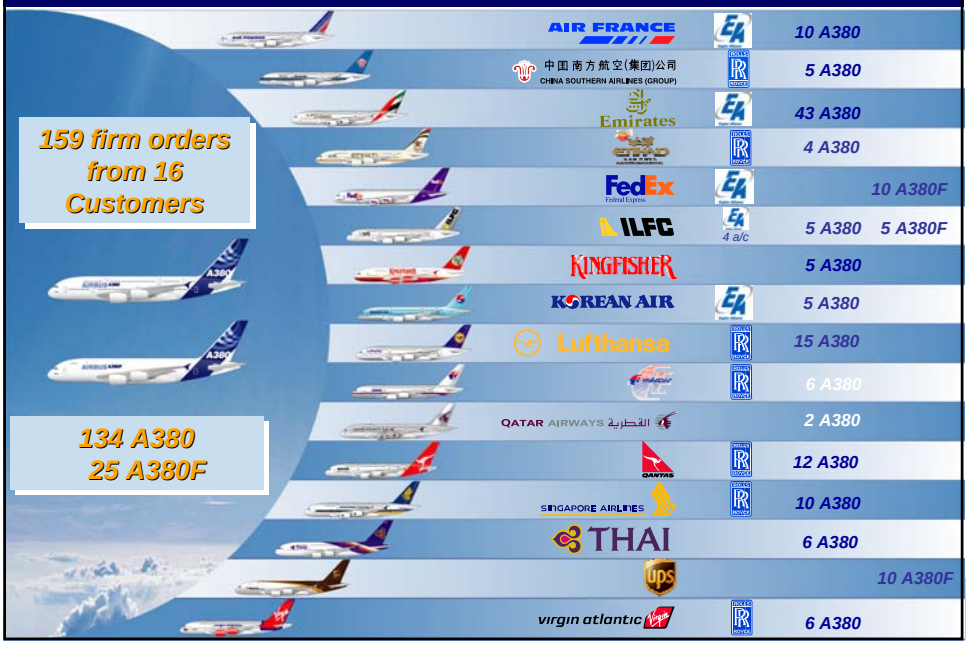
## Strong Market Confidence




## Deciding Together: the market-driven A380 family


***By mid 2006, 242 Airline meetings have been held***

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## And to conclude on A380…

- 159 firm orders …including 25 orders for the freighter
- 1st Flight on 27th April 2005
- 15 Aircraft now completed including static & fatigue test models
- Four development Aircraft have now flown with MSN 7 now in Hamburg and the next three in flight test phase
- Two first Customer Aircraft now in Hamburg for Cabin Furnishing
- First Freighter elements for MSN 037 in production

***Coming soon to an airport near you!***