The A380 Transport Project and Logistics

Jesus Morales
V.P. A350 Industrial Corporation & Partnership (former V.P. A380 Transportation)
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by Jesus Morales, V.P. A350 Industrial Cooperation & Partnership
(former V.P. A380 Transportation)

A380
Flagship of the 21st century
About the A380

Setting the Standards for the 21st Century

...a 1960s legacy aircraft

A380-800  555 seats  8000nm
A380-800F  150t payload  5600nm
A380 – an all new, state-of-the-art design

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560t
555 seats
8000 nm
EIS 2006

590t
150 t
5620 nm
EIS 2008

More volume, more seats, more comfort

Relative net usable* floor area

+49%

More comfort per seat

35% more seats

Datum
747-400
A380

* gross area less cut-outs for stairs/lifts and minimum regulatory aisles / assist space
A380 - more capacity, more comfort

True widebody cabin (A340+)
2-2-2 business class, common product with Airbus long range family

The widest cabin ever
(257” / 6.53m)

wider seats in economy class
large innovation potential for First and Business

Welcome on board...

A quiet & comfortable atmosphere...

...exceptional flexibility to tailor layout...

...a new interior concept...
A380 Family advantages

- **A new standard of comfort**
  - First true widebody double-decker

- **Greater capacity**
  - A380: 35% more passengers
  - A380F: 29% more payload, 50% more volume

- **Massive gains in economics**
  - A380 15% less DOC/seat
  - A380F 20% less DOC/tonne

- **Longer range**
  - More payload on critical routes
  - New non-stop markets, simplified networks

- **The green giant**
  - less than 3l of fuel / pax / 100km
  - Half the noise energy of a 747

*The A380...the solution to 30 years of overwhelming growth in the Air Transport Industry*
A380… WWOOW

First flight on 27 April 2005
3 aircraft in flight
Over 220 flights and 800 hours to Jan 06

Over 60 airports will see the A380 by 2010
The A380 - New dimensions in the sky

A380

A340-600

A320

The largest fuselage section ever built...

A380: A relevant scale factor

A747 = 7.804 m

B747 ~ 7.804 m

8.41 m

7.14 m

14.56 m

8.24 m

2.37 m
AIRBUS A380 – Industrial Work Share

The A380 in the making

Section 15, St. Nazaire
Tailcone, Getafe

Section 18/19, Hamburg
Rear pressure bulkhead, Stade

Sub-assembly of Section 11/12, Méaulte
Cockpit section Méaulte

Port Wing, Broughton
Section 13, Hamburg
The dimensions of the components to transport exceeded the capacity of “Beluga” and other already existing air transport means.
### A380 Transport – Assessment of alternatives

<table>
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<tr>
<th>Alternative</th>
<th>Constraints</th>
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<tr>
<td><strong>by Air</strong></td>
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<tr>
<td>. Antonov fleet</td>
<td>Size limitations</td>
<td>Showstopper</td>
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<tr>
<td>. Super Beluga fleet</td>
<td>Technical constraints, resources difficulties</td>
<td>High</td>
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<tr>
<td>. A/C Piggy Back (Wing)</td>
<td>Runway issues, resources difficulties (unfeasible for fuselage)</td>
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<td>. Airship</td>
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<td><strong>by Hovercraft</strong></td>
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<td>. On the river Garonne</td>
<td>Environmental constraints (infrastructure, noise)</td>
<td>Showstopper</td>
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<td><strong>by Road</strong></td>
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<tr>
<td>. Direct to Toulouse</td>
<td>Wholly unfeasible</td>
<td>Showstopper</td>
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<tr>
<td><strong>by Sea</strong></td>
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<td>. Ship to Bordeaux</td>
<td>Followed by inland transport to Toulouse - feasible and reliable</td>
<td>Low</td>
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### A380 Transport – The Concept

- **Multimode transport system**
  - Sea, river, road

- **Unique logistics system tailored to A380 Industrial Network**
A380 TRANSPORT : Concept Summary

- Multimodal system (Sea, River, Road)
- Roll-on / Roll-off handling principle
- Top level requirements
  - Reliability and safety as per existing Airbus Transport System
  - Transport operations as part of the A/C certification process
- Strict transport conditions
  - No direct handling of A380 components
  - Minimum effort transmitted to the A380 components
  - Cargo protection during transit (splash, accelerations, shocks….)
  - Control of accelerations
- Specific transport means (RoRo vessel, River Barges, Tractors, Trailers, Cargo-loaders)
- Tailored infrastructures (Port terminals, Road adaptations, City-bypasses, Parking areas)
- Special tools / pallets
- Specialized operators
- Back-up solutions

Cargo Requirements

- Fuselage Sections

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<th>Dimensions in m</th>
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<th>H</th>
<th>Comp.</th>
<th>Jig</th>
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- Fuselage Sections

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## Cargo Requirements (con’t)

- **2 Wings + 1 Horizontal Tail Plane**

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## A380 Transport – Project Plan

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A380 Special Purpose RoRo ship

Operated by
FRET CETAM

Ro-Ro Ship « Ville de Bordeaux »
- Double hull, trailer-carrier type
- Length 154m, breadth 24 m, deadweight 2270mt
- 2 set of Diesel engines: 8400 kw each
- Max Speed 22 knots, cruise 16 knots
- Manoeuvrability: bow thrusters
- Door 21m x 11.5m, ramp 220T
- Unique cargo bay dimensions: 120m x 21m x 11m (capacity for all A380 comp.)
- Controlled atmosphère (salt, humidity)
- Stabilizing systems: flume tank, fins. Acceleration recording
Hamburg Terminal

- New quay and lifting platform in Mühlenberger lock:
  - Dimensions 65m x 23m
  - Cargo capacity 220 tonnes
  - Automatic level adjustment from +7m to –1.25m

St Nazaire Terminal

- Adaptation of existing RoRo Terminal 2 at Montoir harbour
- Additional pontoon and bridge modification
- New Airbus buffer area
**Cadiz Terminal**

- New quay and articulated hydraulic ramp
- New logistics building

**Mostyn Terminal (UK)**

- Adaptation of existing link span
- New Airbus wing buffer area
Pauillac Terminal

Our partner: SOCATRA

- **Floating Transfer Station**:  
  - Dimensions 150m x 35 m x 7.5m  
  - Transfer of 6 A380 components and empty jigs  
  - Ballasting capacity for adaptation to Ro-Ro ship and to barges  
  - Capacity to transfer the cargo to quay at constant level  
  - Build by REMONTOWA shipyard (Poland)

Pauillac at Bordeaux is the entry point for inland France transport
Paulliac Terminal logistics

PAUILLAC

Existing quay

Unloading Wing From Broughton
Central Section Unloading

A380 Transport
Special tooling and equipment
Multi-purpose vehicle (MPV)

- Used to transfer cargo at all operational interfaces
- Multi-steering and self levelling platform adjustment
- 8 and 12 axles, self powered, remote control, guidance system
- One MPV in each plant and/or harbour, one in Toulouse, one spare
- By TII Nicolas

Transport Jigs

- Conceived to protect & handle the A/C component
- Permanent & unique interface with transport means & infrastructure
- Design principles:
  - Base pallet
  - Retractable legs
  - Commonality
- Rotating devices in Wing and HTP jigs

Transport Cargo Unit

- COMPONENT
- INTERMEDIATE STRUCTURE
- BASE PALLET
- TCU
- JIG
A380 Wing Transport – UK leg

30 km between Broughton and Mostyn by the river Dee
NEW INFRASTRUCTURE:
- Road connection factory – river port
- Load out facility (LoF) in the river
- NAABSA berth in Mostyn

SPECIFIC BARGE designed for shallow waters, to manage 3 bridges with clearances limits
- Vessel length 57 m, breadth 14.8 m, dw 235 mt
- Mini draught 1.3 m, max 2 m
- 4 azimuth/pump jets, aft 2x480kw, front 2x200kw

OPERATIONS
- One wing at a time
- 2 voyages for one wing set
- Navigation based on tidal cycles!
- Transport time equivalent to 3 to 4 tidal cycles

Operated by HOLYHEAD TOWING Ltd

River Dee Operations (UK)
A380 Wing Transport – Mostyn site logistics

A380 River Transport
River Garonne - France
A380 Transport
River Garonne

- 95 km between PAUILLAC & LANGON

New infrastructure
Fluvial harbour at Langon (wet lock)

Operations
- 2 Barges capable to carry 2 components or 1 wing (4 voyages to carry 1 complete airplane)
- Voyage schedule depending upon Pont de Pierre crossing time
- Transport time for one voyage: 1 tide cycle
- Transport of empty jigs during barge return trip

Operated by SOCATRA

Garonne Rivercraft

- Marine classification (Bureau Veritas)
- Length 75 m, breadth 13.8 m, deadweight 1300 mt
- Draught 1.3 à 2.6 m, ballast water (1600 m3)
- Speed: 12 knots
- 2 azimuth thrusters aft 2x800 kW
- 1 bow thruster 400kw
- 3 diesel/electric power units 1000 KVA each
- Shipyard De HOOP, Netherland
- 2 ship in opération
Crossing Pont de Pierre

Conditions for crossing
- Slack water at low tide
- Procedures defined with harbour Authorities
- Operational Limits:
  - Cross wind
  - Water flow at bridge arch level
  - Barge speed

New Infrastructure in Garonne - LANGON LOCK

- Lock capacity: length 75 m, width 15 m
- Water level variation inside the lock: 7.5 m
- Max Operation Duration: 2 hours
- One waiting position
Road Transport LANGON - TOULOUSE

Dedicated itinerary of 240 km
- Responsible: French State
- 1 departure area at Langon, 4 parking areas alongside the itinerary
- Night time only, week-end and bank holidays excluded
- Voyage over 3 nights, max 1 per week
- Max allowable dimensions:
  - weight 250 T
  - Height 13 m / Length 50m
  - Width 5m at ground level, 8 m at 1m height
- Trailers, tractors, jigs return via A62 motorway

Our Partner: Transports CAPELLE
Road Transport Operations

LANGON

Departing base

1st night ----- alternative in case of problem
2nd night ----- alternative in case of problem
3rd night ----- alternative in case of problem

4 Parking areas

Operational constraints
Weather limits: Wind, fog, snow, ice

Exit Gate
Fence
Entrance Gate

Langon Area

Road Trailers

Trailers TII NICOLAS, 2 Types

«goose-neck trailer » quantity: 4
«tow-bar trailer » quantity: 2 + 1

Convertible width 5m – 3m
directional axles
self levelling platform
ROAD TRACTORS

2 types of Tractors MERCEDES  
- Guidance system by DGPS  
- Noise attenuation devices

- Type 1: 6 x 4 (for articulated trailers) - Quantity: 4

- Type 2: 8 x 6 (for trailers) - Quantity: 2 + 1

ROAD CONVOY ORGANISATION

Road signs dismantling  
Workshop van  
Convoy master

Convoy Element No1  
Convoy Element No2  
Convoy Element No3  
Convoy Element No4  
Convoy Element No5  
Convoy Element No6  
Road signs reinstalling

Véhicules Police Officers
Horizontal Tail Plane (HTP) from Cadiz
Fuselage Components on the road

Final Assembly Line
A380 Logistics analysis

A380 LOGISTICS – Sea Routing Patterns

LOGISTICS - MARINE LEG (A380 VESSEL)
Routing Pattern 1

- MOSTYN
  - Left Wing
  - Right Wing
  - Sec 15 FUU
  - Rear Fuselage
  - Fwd Sec 13 Fuselage

- ST NAZAIRE MONTOIR
  - Left Wing
  - Right Wing
  - Rear Fuselage
  - Forward Fuselage
  - Center Fuselage
  - Belly Fairing Crate

- BORDEAUX PAUILLAC
  - HTP Jig
  - Belly Fairing Crate

- CADIZ
  - HTP
  - Belly Fairing

- HAMBURG FINKERWERDER
  - Rear Fuselage Jig
  - Fwd Fuselage Jig
  - Sec 15 FUU Jig
  - Left Wing Jig
  - Right Wing Jig

Total Cycle: Hamburg to Hamburg

A380 Vessel
LOGISTICS - MARINE LEG (A380 VESSEL + 2 STD Ro-Ro)
Routing Pattern 5

Note
Ctr Fuselage Jig sent back to St. Nazaire by Road from Toulouse

LOGISTICS – CYCLE TIMES: MARINE, RIVER, ROAD LEGS

- DAYS TOTAL FOR SEC 18/19.
- DAYS TOTAL FOR WINGS.
- DAYS TOTAL FOR SEC 11/13, 15/21.
- DAYS TOTAL FOR SEC HTP.
A380 LOGISTIC – Return of Jigs Cycle

LOGISTICS – JIG RETURN CYCLE TIMES: SEA, RIVER, ROAD LEGS

Section 18/19 from HAMBURG

- Transport to harbour and ship to Pauillac
- Pauillac > Langon > Tls
- Tls F.A.L.
- Disassemble jigs, load trucks, road to Langon
- Langon Re-assemble jigs
- Load to barge, river to Pauillac, ready to ship
- To XFW

Based on using A380 Vessel

Number of JIGS
Total days cycle

A380 Air Transport
A380 TRANSPORT - The CONCEPT

Multimode transport system
Sea, river, road, air

Air Transport is the 4th mode completing the A380 logistics system

Air Transport : Beluga Network

- Section Manufacturing
- Final Assembly Line
Air Transport : Key information

- **Beluga Operator:** Airbus Transport Intl (created 1996)
  French Airline, subsidiary of Airbus
- **Fleet:** 5 Beluga (A300-600ST)
- **Airbus Network:** 10 Stations across Europe
  (13 by 2006)
- **Flight Crew:** 39 Crews Members
- **Activity since 1996**
  15 000 Flights
  30 000 Flights Hours
- **2004 Activity:**
  2 200 Flights
  3 400 Flight Hours
  2 560 Aircraft Sections delivered

Vertical Tailplane From Hamburg to Toulouse
Special Transports

A380 S.18/19 & S13 MSN001 - MV "Sabrata Star"

LoLo Transport as back-up solution
Fatigue Test Specimen To DRESDEN
Some key drivers...

Requirements are formalised to Teams by Statement of Requirements documents:
- cascaded within the organisation
- formal contractualisation

In return all the various Teams write their Project Plan. This document should contain at least:
- context, purpose, organisation aspects
- product, tasks & associated schedule, means and resources aspects
- steering, monitoring, management, reporting aspects
- risk management
- validation and verification aspects

WE PROCEED WITH CASCADE OF REQUIREMENTS AND NOT WITH DESCRIPTION OF TASKS (Statement of work)
The Project Establishment – A380

A programme phasing based on high level milestones, reference for all the disciplines

Transportation Milestones Reviews

- **M6**
  - SoR
  - V & V Contract / Specification
  - Requirements Specification
  - Design concept contractualised

- **M7**
  - Definition Complete
  - V & V Detailed Design
  - Detailed Design frozen and Model tests performed

- **M9**
  - Transport EIS
  - V & V Tests & Trials / Operations
  - Specific real testing on the spot of Transport means / Operations ready to start

V and V : verification and validation
Transportation Milestones Reviews

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<tr>
<th>Year</th>
<th>TLR Transport Issue 1</th>
<th>Issue 2</th>
<th>Transport Project Quality Plan</th>
<th>Milestone Reviews</th>
<th>M7.1 Issue</th>
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Livraisons des sections à la chaîne d’assemblage finale

Verification and Validation process at M9 Reviews

Capture all requirements

BNT SoR is1 Feb-03

Allocate and Cascade requirements to transport activities

BNT team & BNT Apr-03 to Jun-03

Complete compliance matrix between Specification and requirements Sent to Reqs’ owners

BNT team Jun-03

Perform intermediate M7 reviews based on V & V plan

BNT team & BNQ Sites/AMT’s/Suppliers Apr-03 to Jun-03

V and V : verification and validation
Why to perform a test or trial?
- Verification & Validation of the DEFINITION, cannot or is not sufficient to ensure that the corresponding requirement will be effective

**Tests:** Relative to the technical aspect
(of transport mean/loading equipment/infrastructure/tooling equipment)

**Trials:** Relative to the operational dimension

All required tests must be performed as early as possible in order to mitigate risks and to increase corresponding safety margin

Trials must consider only final operational tests, which could not have been done before

---

**Wind Tunnel Tests**
River Trials (Pont de Pierre)

Tests & Trials completes the V & V plan

Test: relative to technical aspects
Trial: relative to operational dimensions

Tests & Trials process - Road trials
Transport M9 Review Objectives

To demonstrate that:

- Means and infrastructures are ready and compliant with Airbus needs and requirements
- Subcontractors are ready to operate
- Airbus is ready to operate
- A380 New transport system operational reliability forecast is comparable with the Beluga

Programme goes-ahead with the EIS
A380 Transport Project - Summary

1) An AIRBUS transnational and transfunctional project
A380 Transport Project – Summary (cont’d)

2) A Project delivered mature, on time, on quality

3) An innovative transportation system groundbreaking
technology to overcome obstacles

Some examples:
- How to control accelerations during the sea voyage: Accelerometers together with active & passive stabilizing devices on board
- How to cross beneath the Pont de Pierre: Sensors placed in the riverbed indicate to the pilot when the outgoing current is counterbalancing the incoming tide and when the max clearance is available
- How to pass the narrow street of Levignac village: Drivers are guided by a cabin computer which uses advanced Digital Global Positioning Satellite technology to pinpoint to within centimeters
- Wind tunnel tests performed to predict wind load during road transport
- Using specific computer software for synchronizing operations with tidal movements, for safe navigation and transfer of A380 components between ship / shore

Achievements to Jan 2006…

• 13 Complete Aircraft transported
• 20 Road Convoys....

• All Operations within schedule
• Good adaptability of the Transport System to the Industrial Constraints
• Further developments (back up, fleet devpt....) on good track
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