Jesus Morales

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)

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About the A380

AIRBUS

Setting the Standards for the 21st Century

…a 1960s legacy aircraft

A380-800	*555 seats*	*8000nm*
A380-800F	*150t payload*	*5600nm*

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A380 – an all new, state-of-the-art design

Industrial launch	Detail design complete	First Metal Cut	Final assembly start	First Flight	Entry Into Service	First Flight A380F	Entry Into Service A380F
19th Dec 2000	End 2001	Jan 2002	2nd Qtr 2004	April 2005	2nd Half 2006	Mid 2007	Mid 2008

560t
555 seats
8000 nm
EIS 2006

590t
150 t
5620 nm
EIS 2008

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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…

…a new interior concept…

…exceptional flexibitlity to tailor layout…

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

AIRBUS

Strong market confidence

A380… WWOW

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

AIR FRANCE · 中国南方航空(集团)公司 CHINA SOUTHERN AIRLINES (GROUP) · Emirates · ETIHAD · FedEx Express · KOREAN AIR · Lufthansa

malaysia airlines · QANTAS · QATAR AIRWAYS · SINGAPORE AIRLINES · Thai · ups · virgin atlantic

A380 Routes

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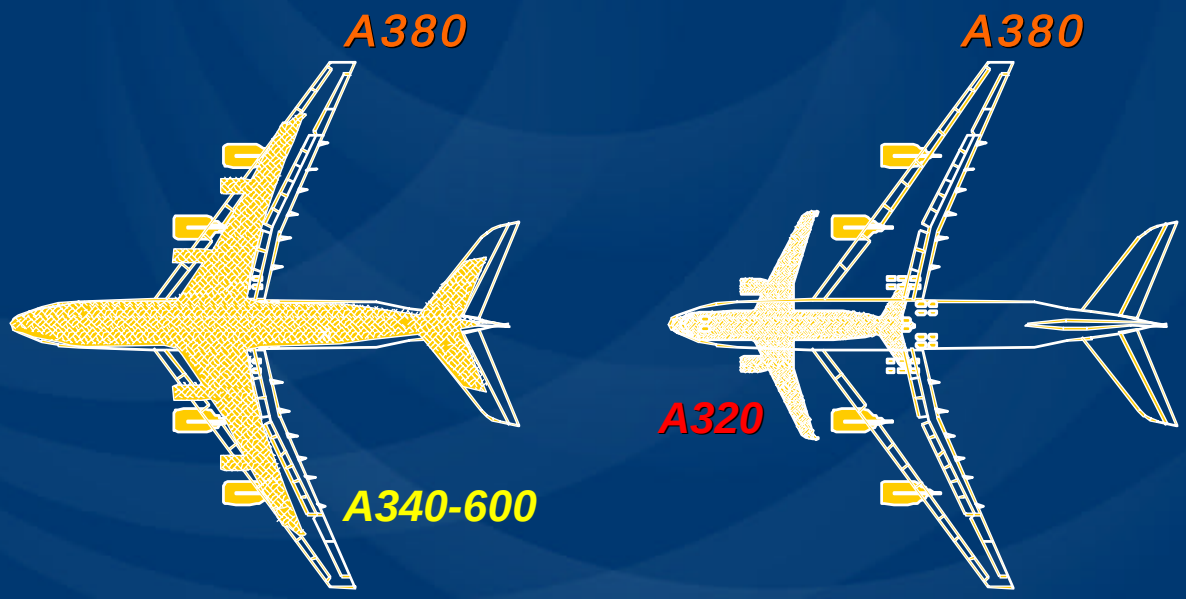
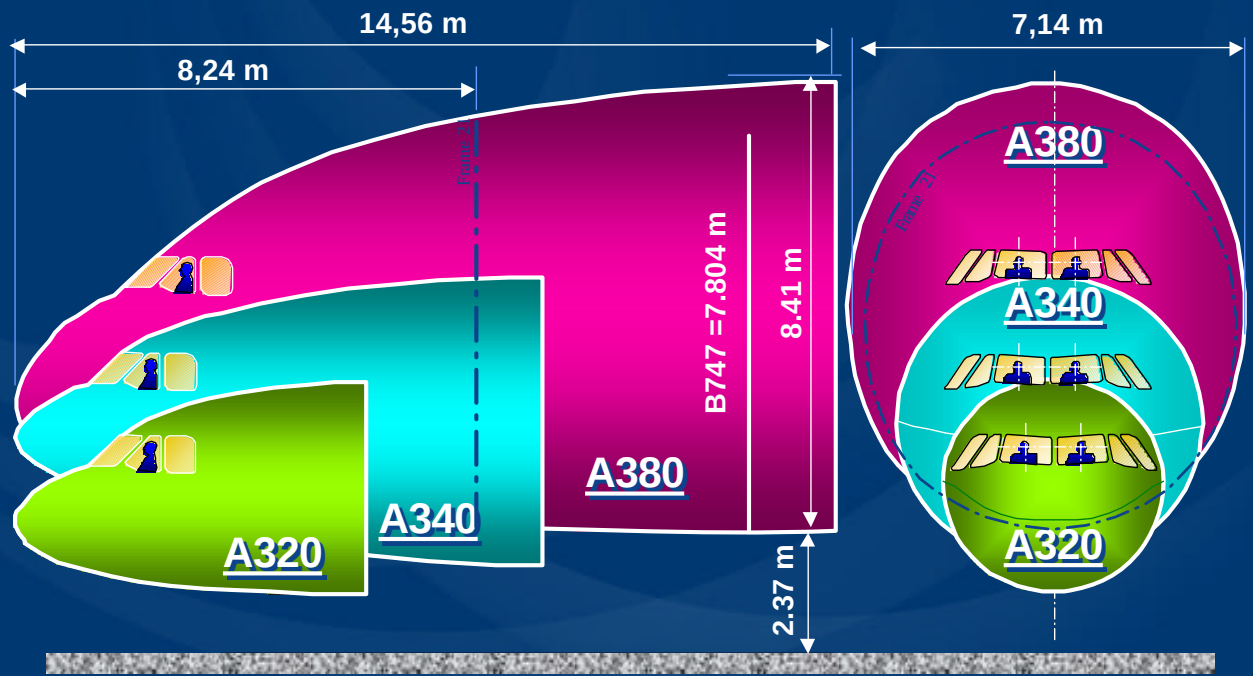
The A380 - New dimensions in the sky

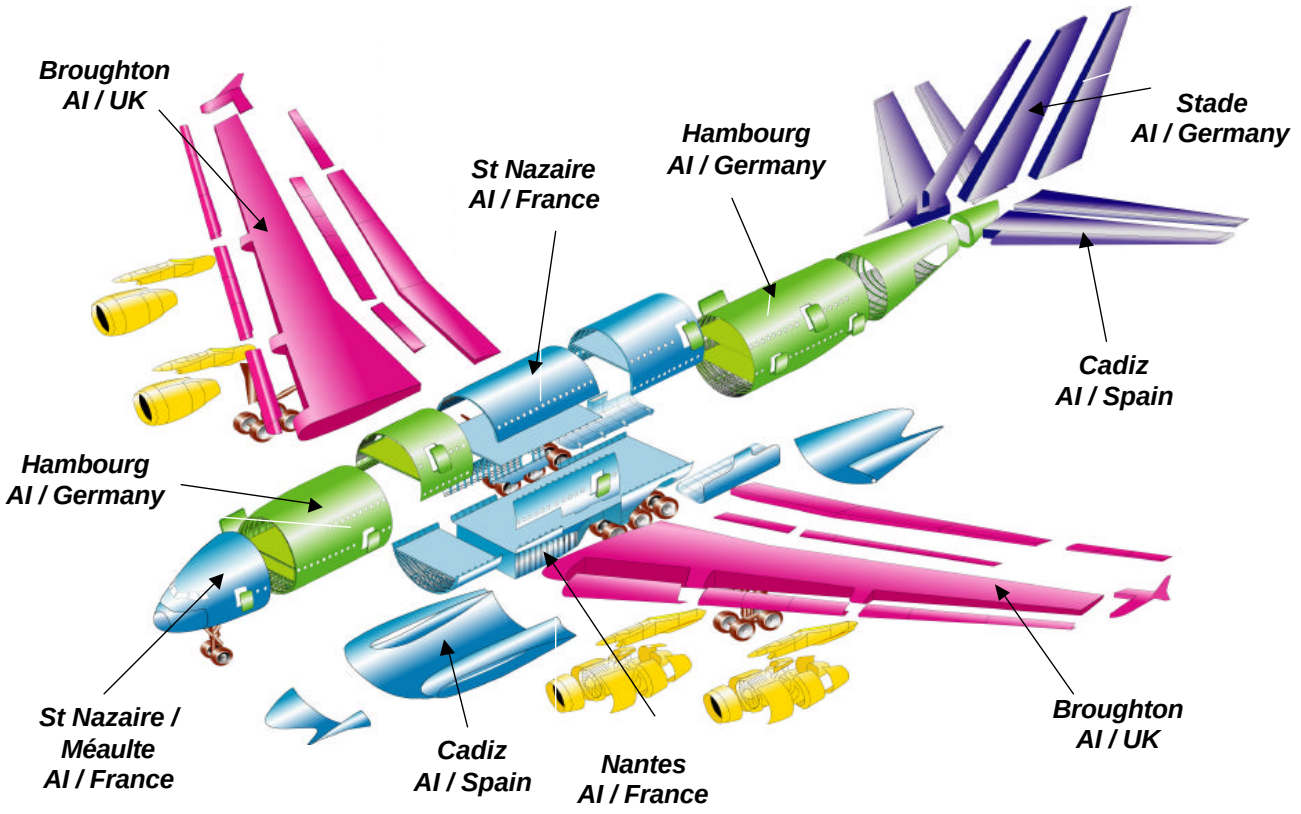


The largest fuselage section ever built…

A380: A relevant scale factor



AIRBUS A380 – Industrial Work share



The A380 in the making


Section 15, St. Nazaire


Tailcone, Getafe


Section 18/19, Hamburg


Cockpit section
Méaulte


Rear pressure bulkhead, Stade


Sub-assembly of
Section 11/12, Méaulte


Section 13, Hamburg

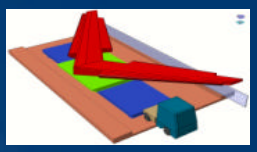

Port Wing, Broughton

Introducing the A380 Transport

AIRBUS

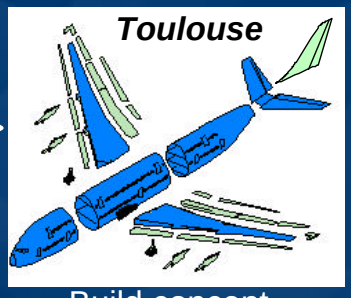
A380 Transport - A Challenge

Broughton :
- *2 components*
- *45 m x 12 m*
- *35 tons*

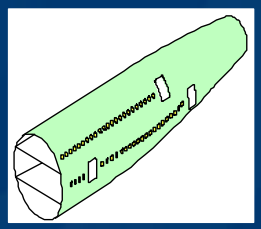


Cadiz :
- *28 m x 12 m*
- *7 tons*

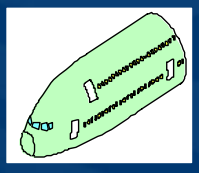
St Nazaire :
- *23 m x 8.5 m x 8 m*
- *44 tons*



Build concept



Hamburg :
- *27 m x 8,5 m x 7 m*
- *23 tons*



St Nazaire :
- *22 m x 8,5 m x 7 m*
- *22 tons*

(between St. Nazaire & Toulouse)

Hamburg :
- *13 m x 8,5 m x 7 m*
- *13 tons*

(between Hamburg & St. Nazaire)

The dimensions of the components to transport exceeded the capacity of "Beluga" and other already existing air transport means.

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A380 Transport – Assessment of alternatives

Alternative	Constraints	Risk
- *by Air*		
. Antonov fleet	Size limitations	Showstopper
. Super Beluga fleet	Technical constraints, resources difficulties	High
. A/C Piggy Back (Wing)	Runway issues, resources difficulties (unfeasible for fuselage)	High
. Airship	Technology unproven, company viability	Very high
. Helicopter	Unfeasible by weight limit	Showstopper
- *by Hovercraft*		
. On the river Garonne	Environmental constraints (infrastructure, noise)	Showstopper
- *by Road*		
. Direct to Toulouse	Wholly unfeasible	Showstopper
- ***by Sea***		
. Ship to Bordeaux	**Followed by inland transport to Toulouse - feasible and reliable**	**Low**

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**

Forward Fuselage

Dimensions in m			weight in T		
L	W	H	Comp.	Jig	Total
22.7	8	9.97	24.5	30.12	54.6

Rear Fuselage

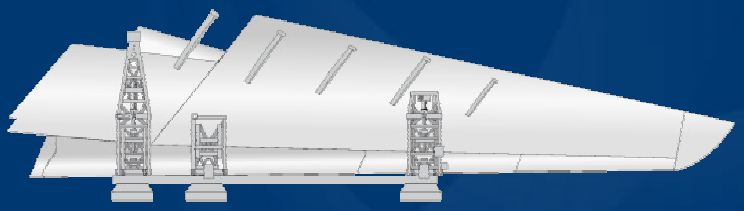
Dimensions in m			Weight in T		
L	W	H	Comp.	Jig	Total
28.26	8	10.07	24	31.5	55.5

Central Fuselage

Dimensions in m			Weight in T		
L	W	H	Comp.	Jig	Total
23.17	8	10.3	44	16	60

Cargo Requirements (con't)

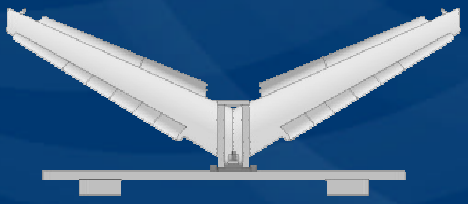
- **2 Wings + 1 Horizontal Tail Plane**



Position for road convoy

Left & Right Wing

Dimensions in m			Weight in T		
L	W	H	Comp.	Jig	Total
45.38	7.2	11.9	45	90	135

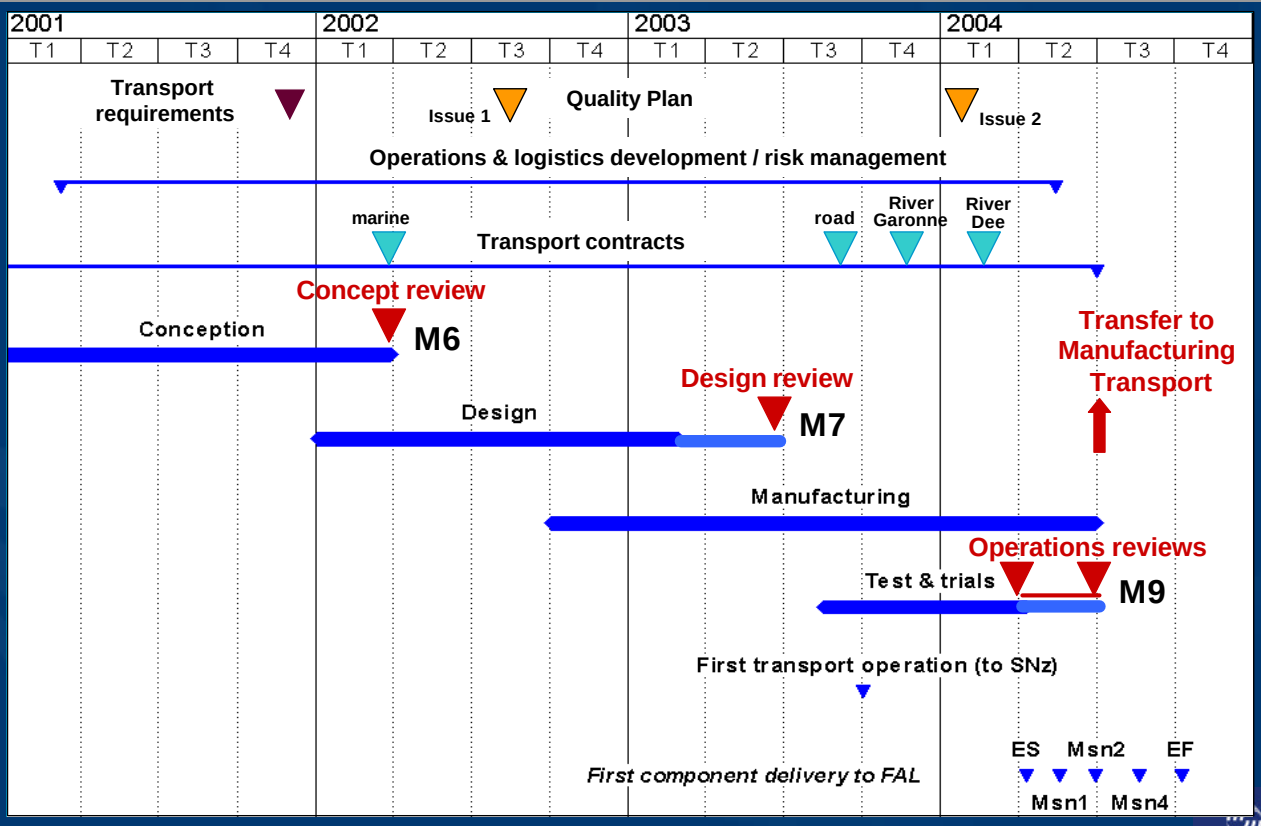


Position for road convoy

Horizontal Tail Plane

Dimensions in m			Weight in T		
L	W	H	Comp.	Jig	Total
27.35	7.68	11.68	7.5	42	49.5

A380 Transport – Project Plan



A380 Marine Transport

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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

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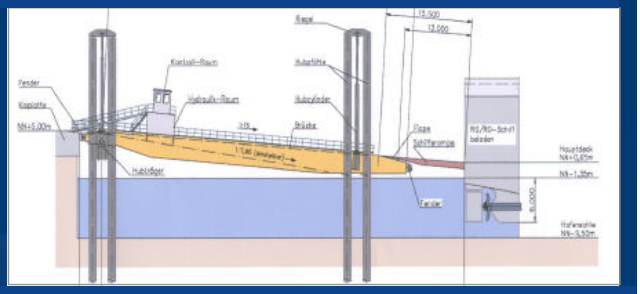
Hamburg Terminal

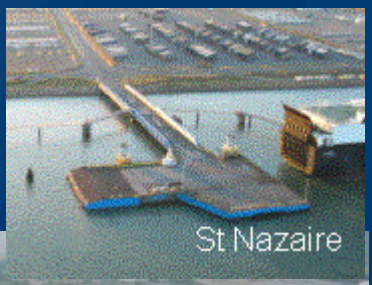
- **New quay and lifting platform in Mühlenberger lock** :
  - Dimensions 65m x 23m
  - Cargo capacity 220 tonnes
  - Automatic level adjustment from +7m to –1.25m



Combined Ro/Ro-Ramp and lifting platform

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

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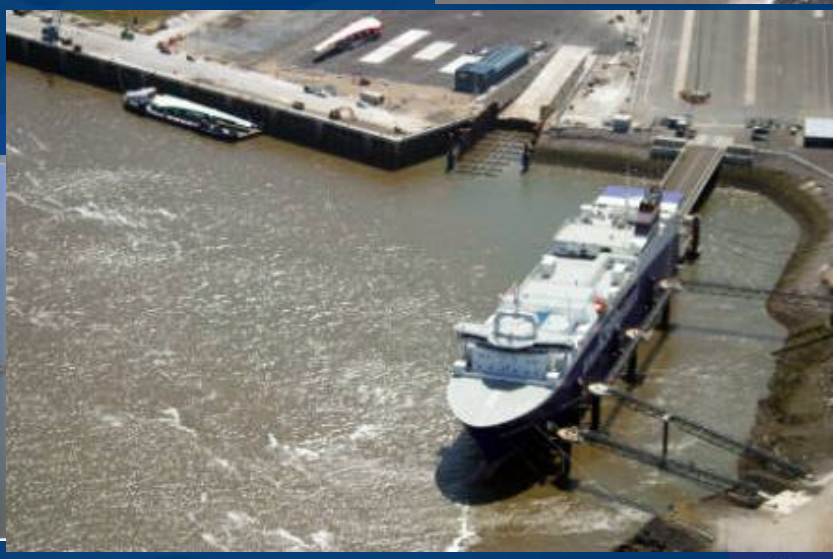
Mostyn Terminal (UK)

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



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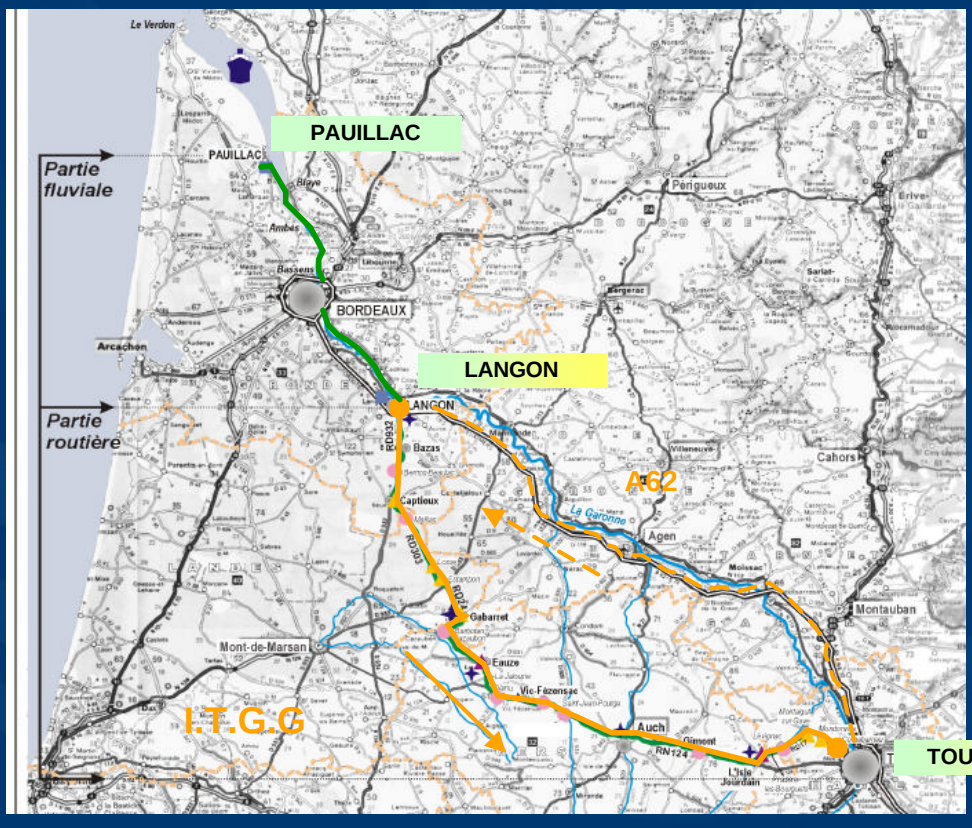
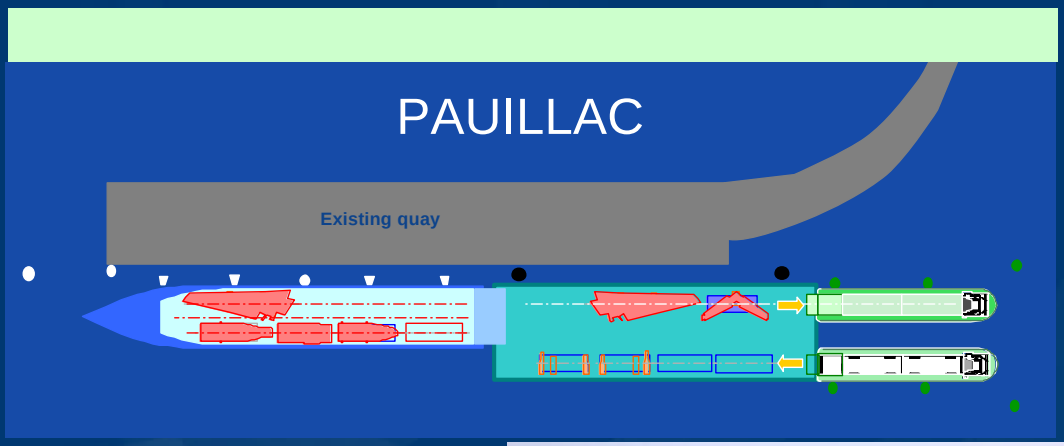
Pauillac Terminal

- **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 costant level
  - Build by REMONTOWA shipyard (Poland)

Pauillac at Bordeaux is the entry point for inland France transport



Paulliac Terminal logistics



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Unloading Wing From Broughton

Central Section Unloading

A380 Transport
Special tooling and equipment

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Multi-purpose vehicule (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

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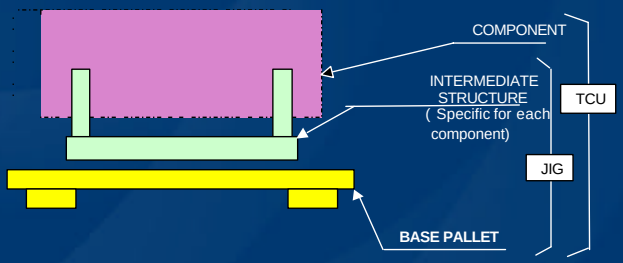
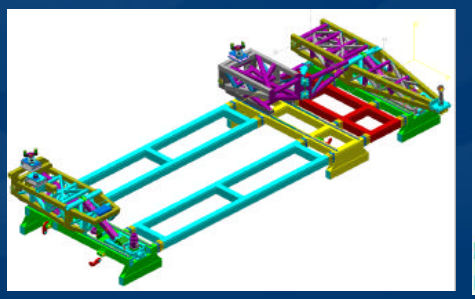
Transport Jigs

- **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





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A380 River Transport
River Dee - UK

AIRBUS

A380 Wing Transport – UK leg

A380 Wing Transport River Dee

NEW INFRASTRUCTURE:

- Road conection 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

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River Dee Operations (UK)

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A380 Wing Transport – Mostyn site logistics

A380 River Transport
River Garonne - France

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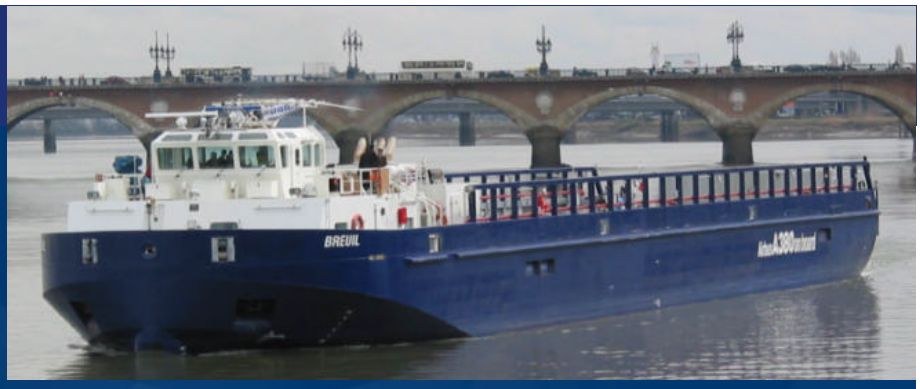
A380 Transport River Garonne

- **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

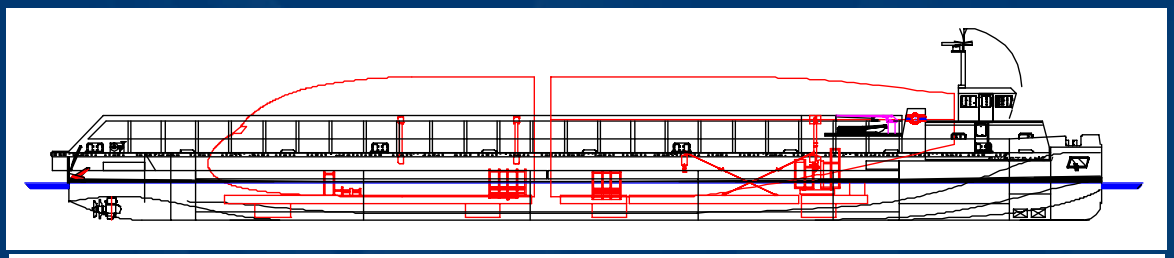
Garonne Rivercraft

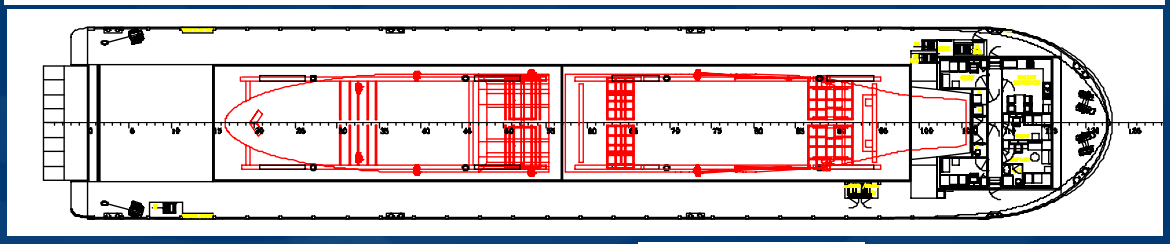


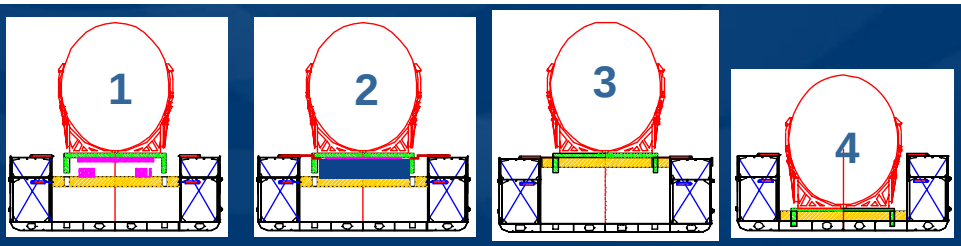
- Marine classification (Bureau Veritas)
- Length 75 m, breadth 13.8 m, deadweight 1300 mt
- Draught 1,3 à 2,6 m, ballast water (1600 m3)
- Speed: 12 knots
- 2 azimuth thrusters aft 2x800 kW
- 1 bow thruster 400kw
- 3 diesel/electric power units 1000 KVA each
- Shipyard De HOOP, Netherland
- 2 ship in opération

Garonne rivercraft

Loading Configuration Fuselage







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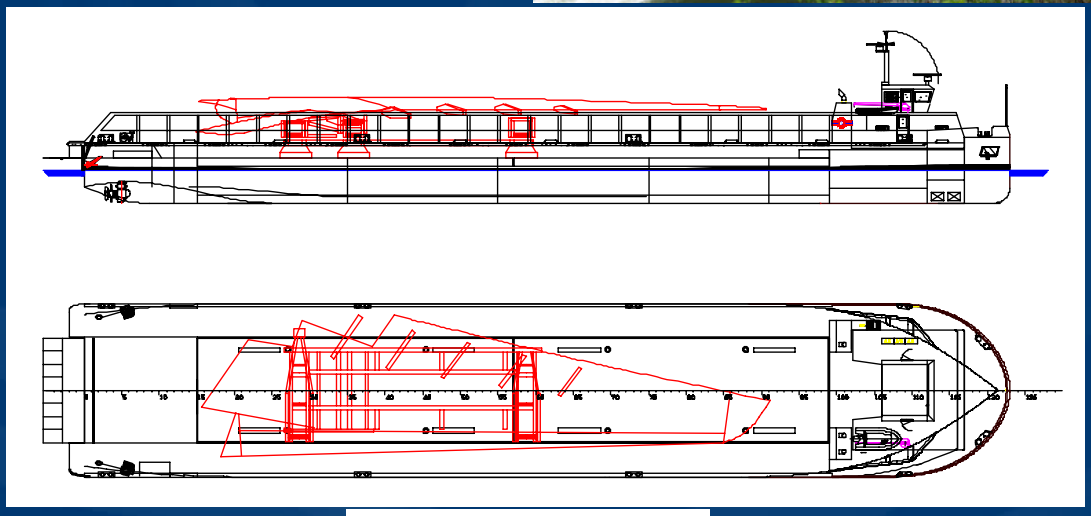
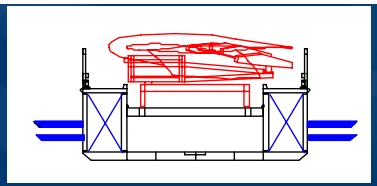
Garonne rivercraft

Loading Configuration Wing





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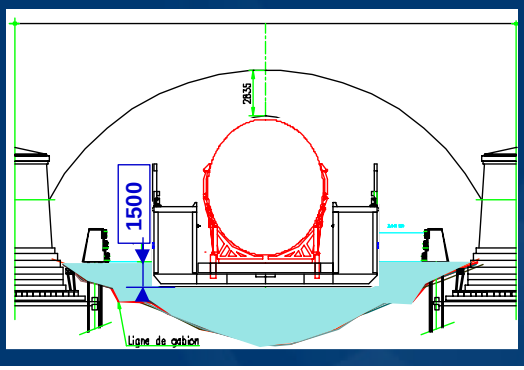
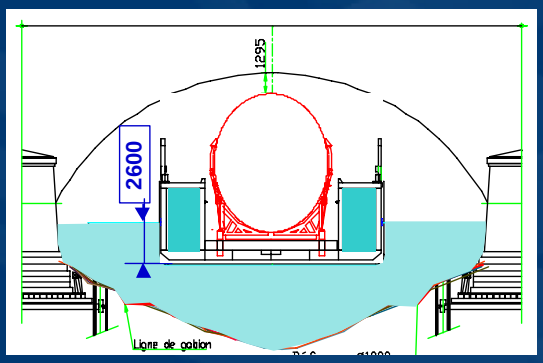
Crossing Pont de Pierre





Conditions for crossing

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

New Infrastructure in Garonne - LANGON LOCK

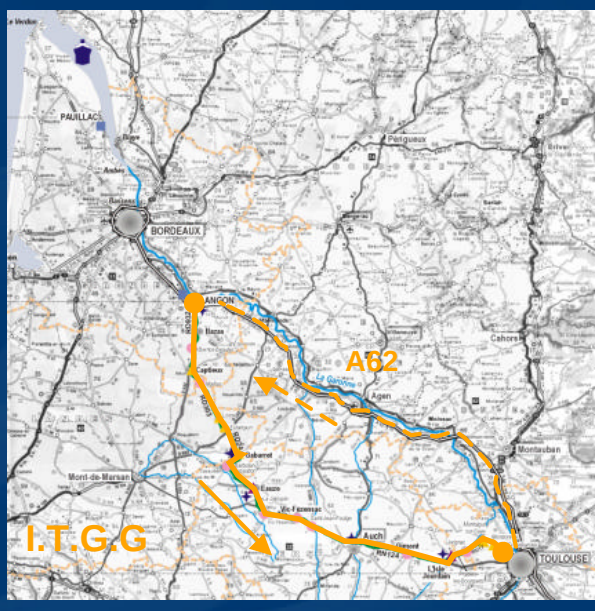
- **Lock capacity: lenght 75 m, width 15 m**
- **Water level variation inside the lock: 7.5 m**
- **Max Operation Duration: 2 hours**
- **One waiting position**

A380 Road Transport

Road Transport LANGON - TOULOUSE

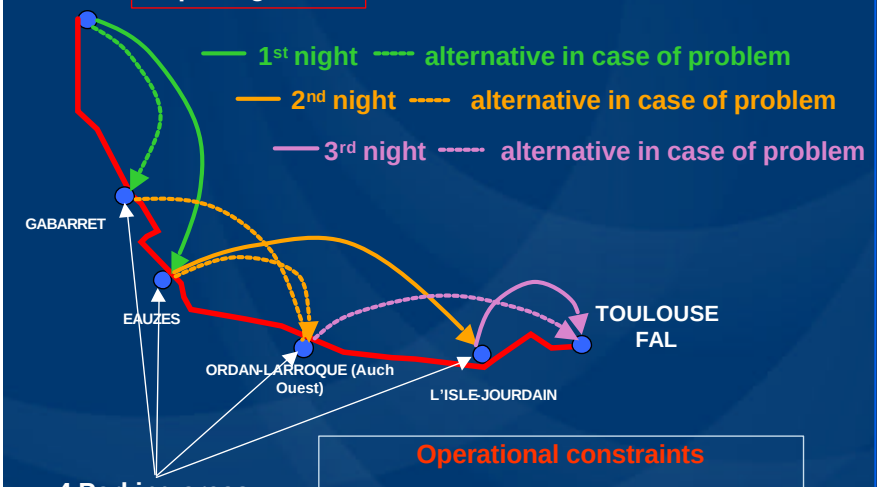
Dedicated itinerary of 240 km

- 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



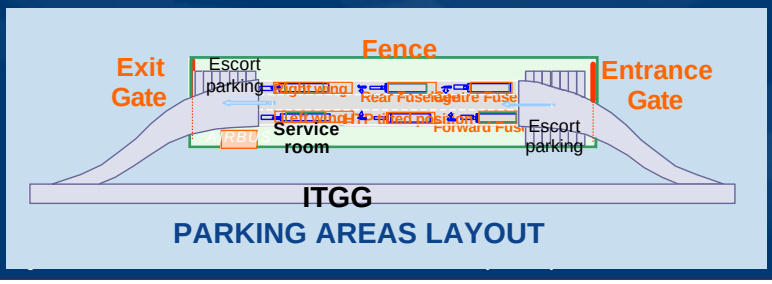
Our Partner: Transports CAPELLE

Road Transport Operations



Operational constraints

Weather limits: Wind, fog, snow, ice



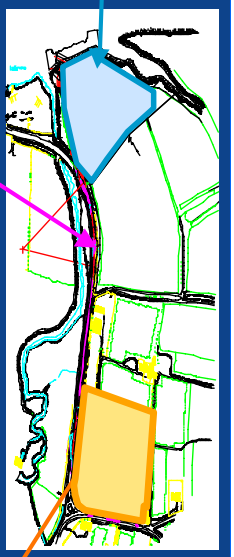
PARKING AREAS LAYOUT

WET LOCK

- TCU Transfer from Barge to Ground

PUBLIC ROAD (300m)

- Transport of TCUs using MPV



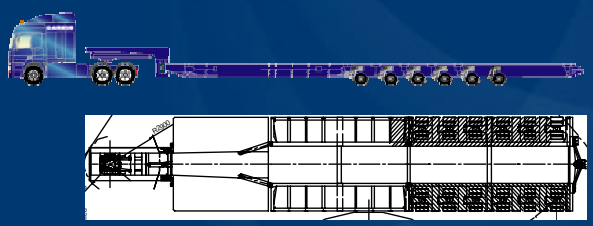
LANGON AREA

DEPARTING BASE

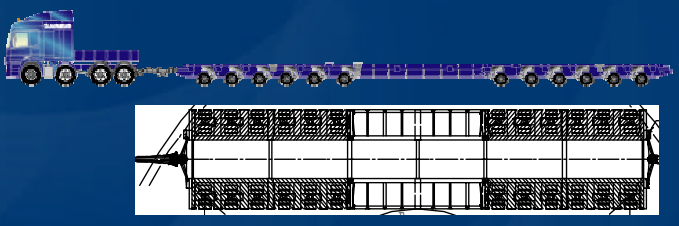
- Secured area for TCU storage
- Road convoy preparation
- Building for jigs re-assy and maintenance

ROAD TRAILERS

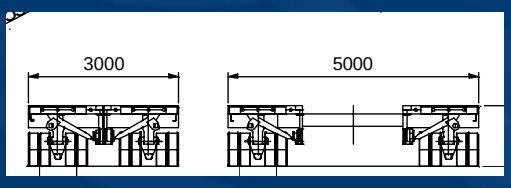
Trailers **TII NICOLAS** , 2 Types



«goose-neck trailer » quantity: 4



«tow-bar trailer » quantity: 2 + 1



Convertible width 5m – 3m

directional axles

self levelling platform

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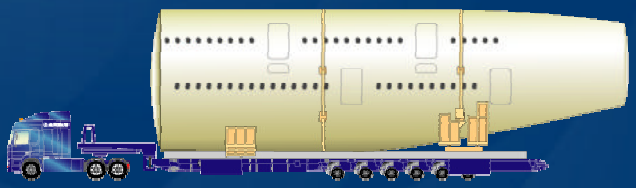
ROAD TRACTORS

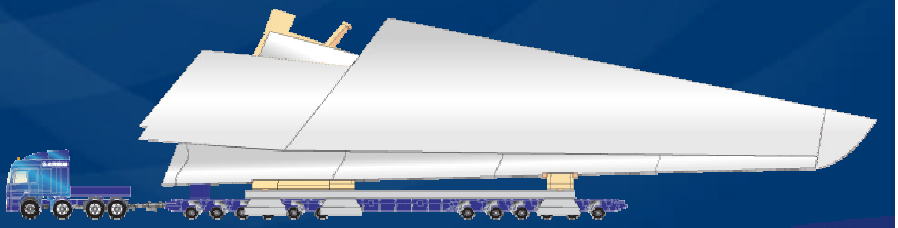
2 types of Tractors MERCEDES Power = 600 HP

- Guidance system by DGPS
- Noise atenuation devices

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



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



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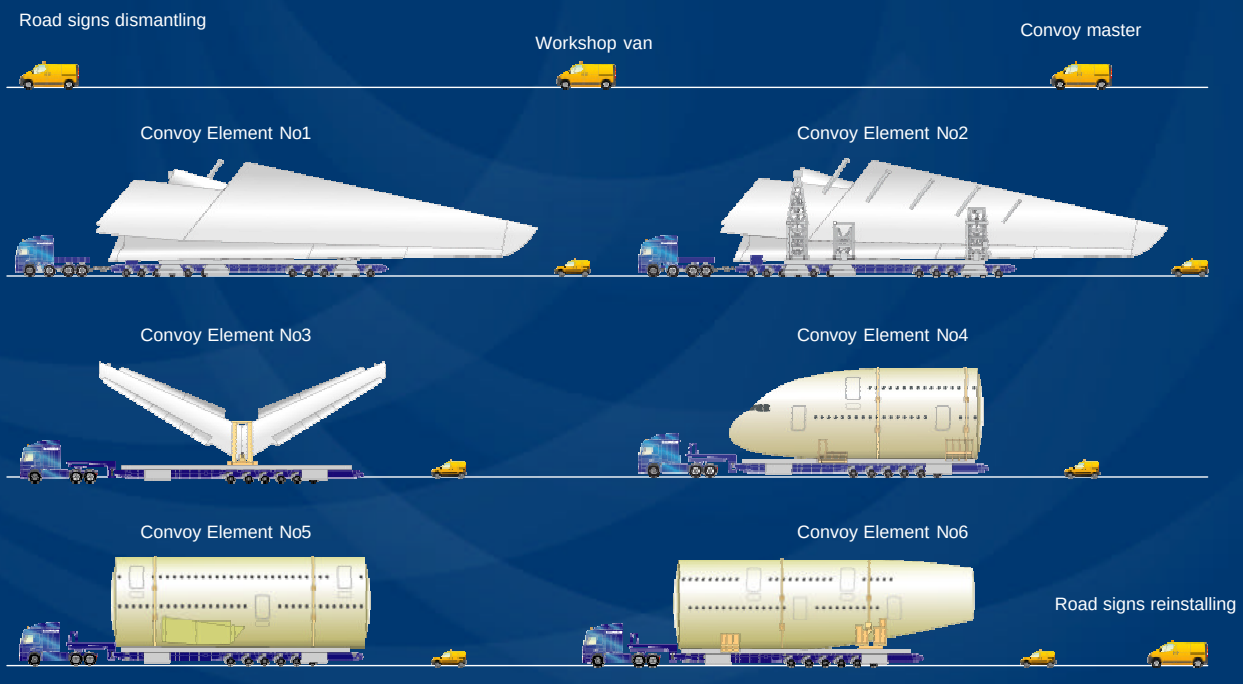
ROAD CONVOY ORGANISATION



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ROAD CONVOY

Horizontal Tail Plane (HTP) from Cadiz

Fuselage Components on the road

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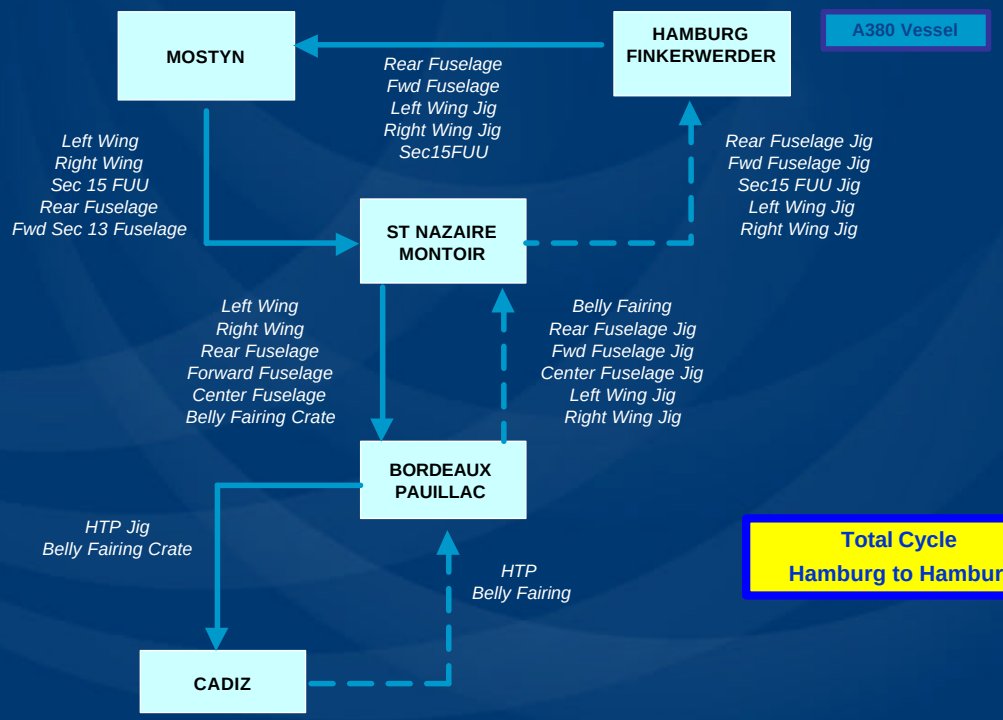
Final Assembly Line

A380 Logistics analysis

A380 LOGISTICS – Sea Routing Patterns

LOGISTICS - MARINE LEG (A380 VESSEL)

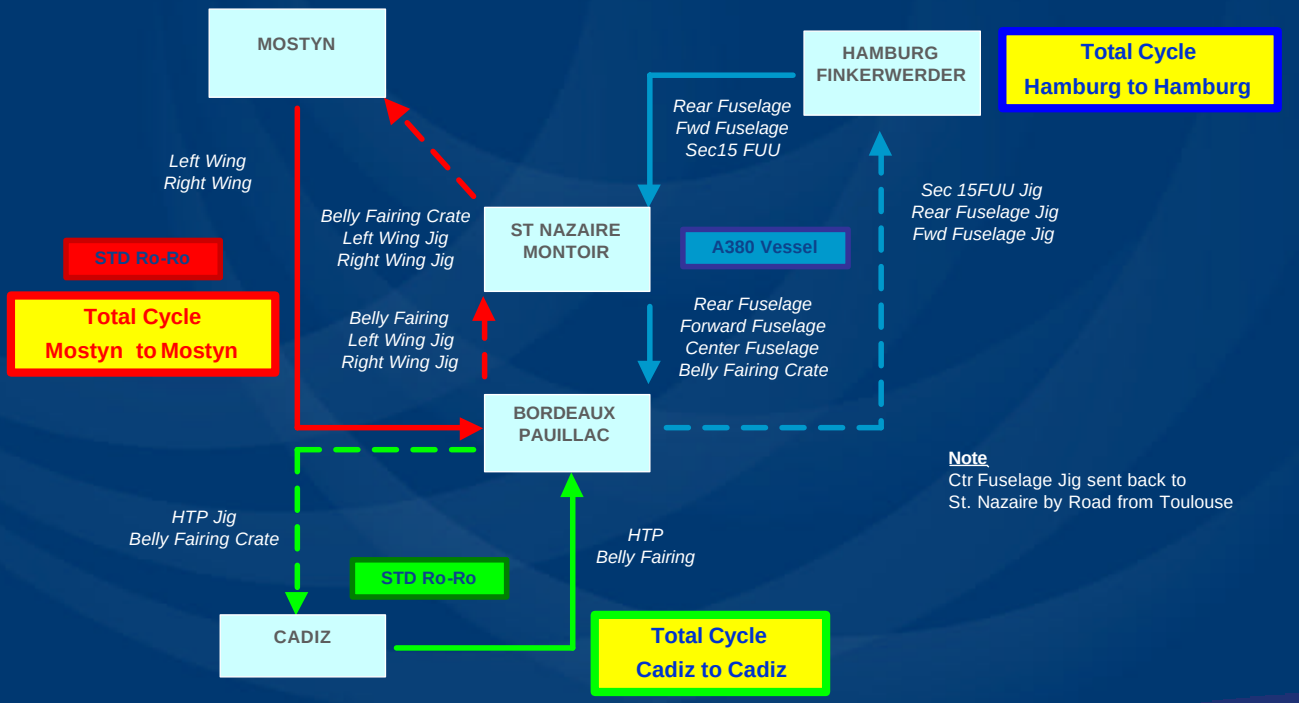
Routing Pattern 1



A380 LOGISTICS – Sea Routing Patterns

LOGISTICS - MARINE LEG (A380 VESSEL + 2 STD Ro-Ro)

Routing Pattern 5

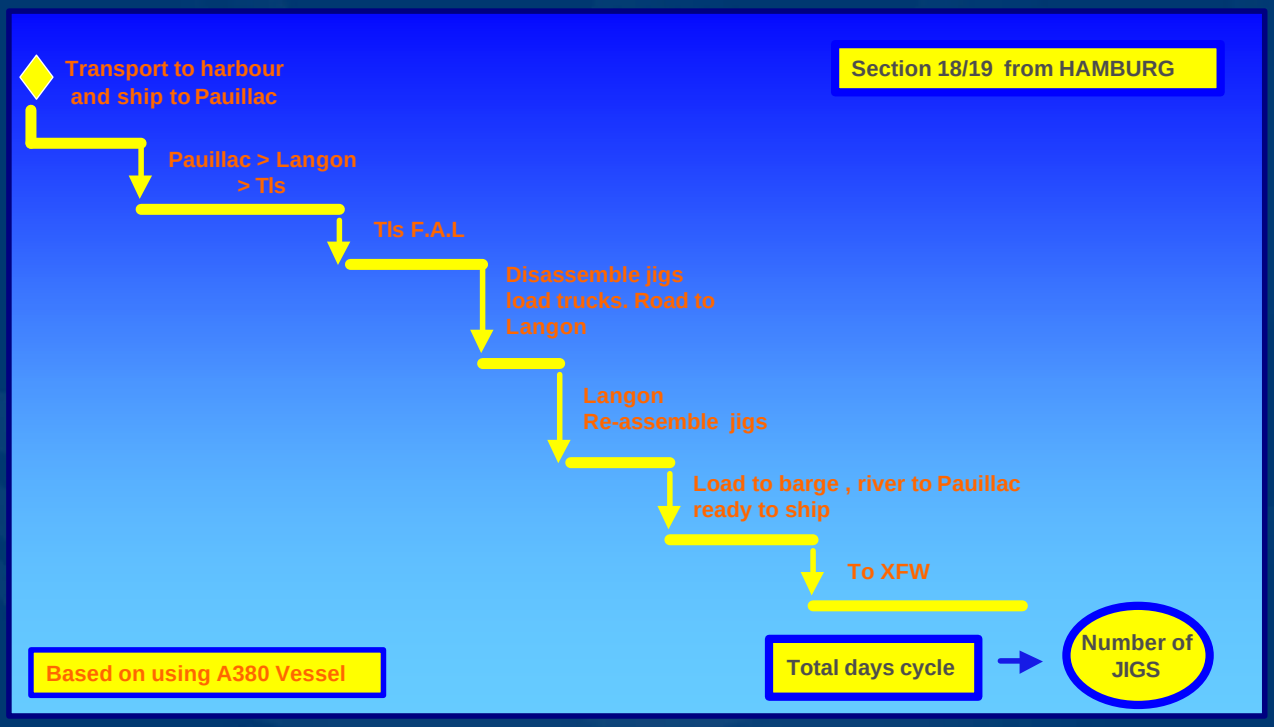


A380 LOGISTICS - Cycle Analysis

LOGISTICS – CYCLE TIMES: MARINE, RIVER, ROAD LEGS

A380 LOGISTIC – Return of Jigs Cycle

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



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A380 Air Transport

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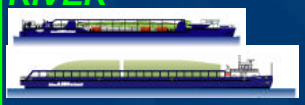
A380 TRANSPORT - The CONCEPT

SEA

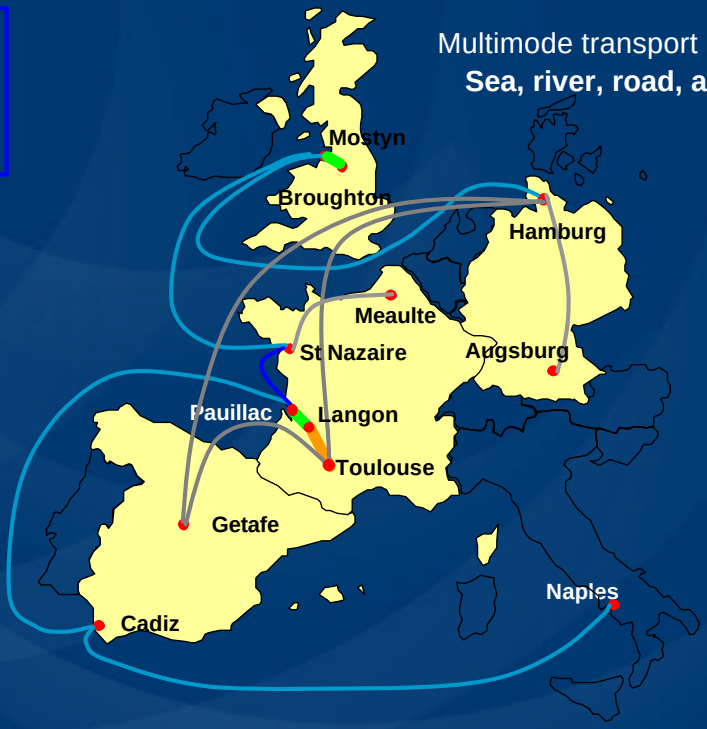
RIVER



ROAD

AIR

Multimode transport system
Sea, river, road, air



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

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Air Transport : Beluga Network

Section Manufacturing

Final Assembly Line

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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

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Vertical Tailplane From Hamburg to Toulouse

Special Transports

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

LoLo Transport as back-up solution

Fatigue Test Specimen To DRESDEN

Fatigue Test Specimen To DRESDEN

Project management Some key drivers…

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The Project Establishment - A380

- 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)

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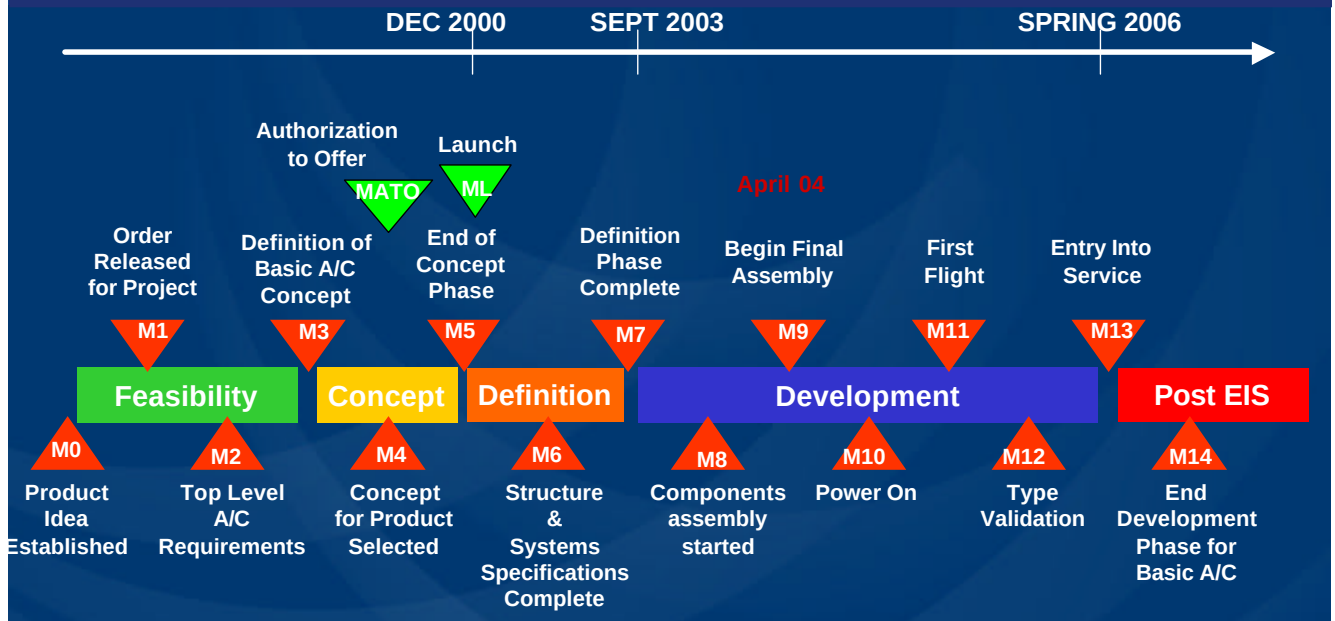
The Project Establishment – A380



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

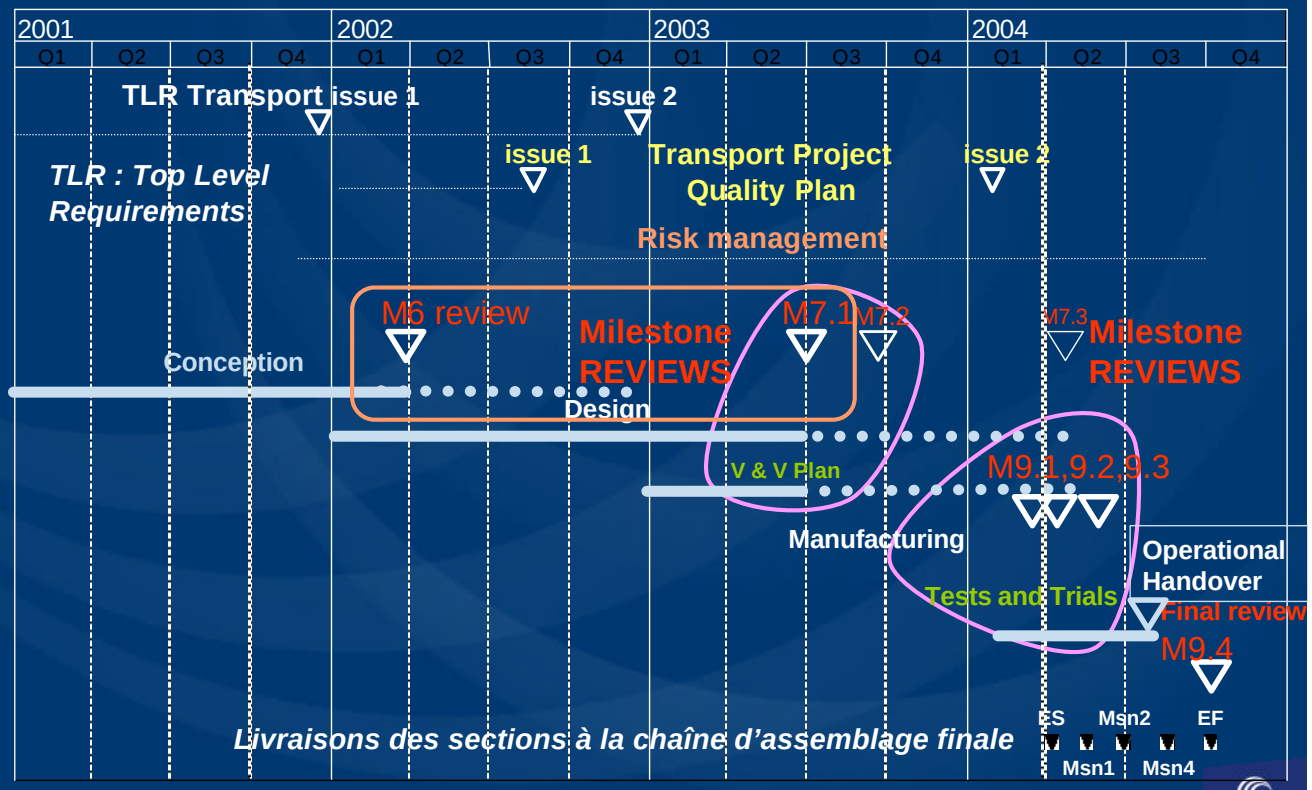
M9
Transport EIS

V & V
Tests & Trials / Operations

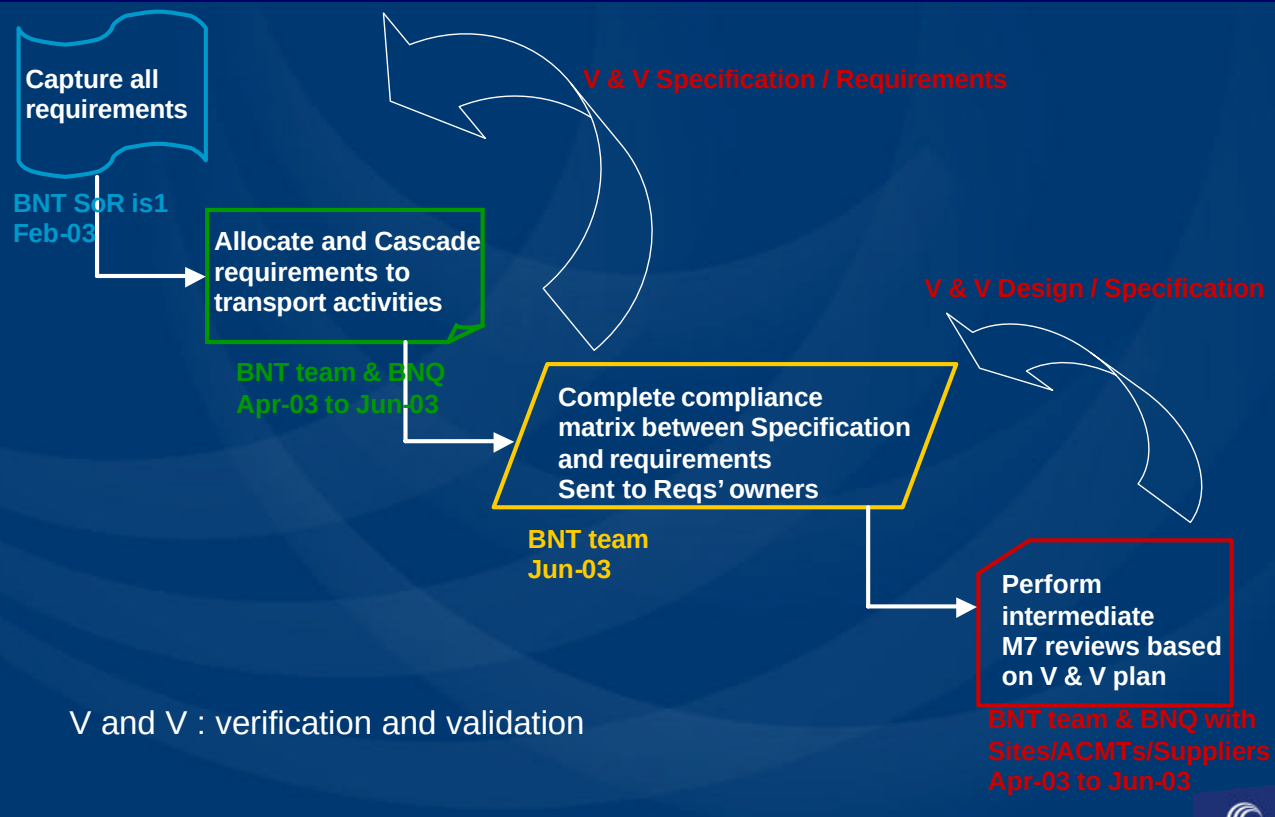
Specific real testing on the spot of Transport means / Operations ready to start

V and V : verification and validation

Transportation Milestones Reviews



Verification and Validation process at M9 Reviews



V and V : verification and validation

Tests & Trials process (V & V)

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

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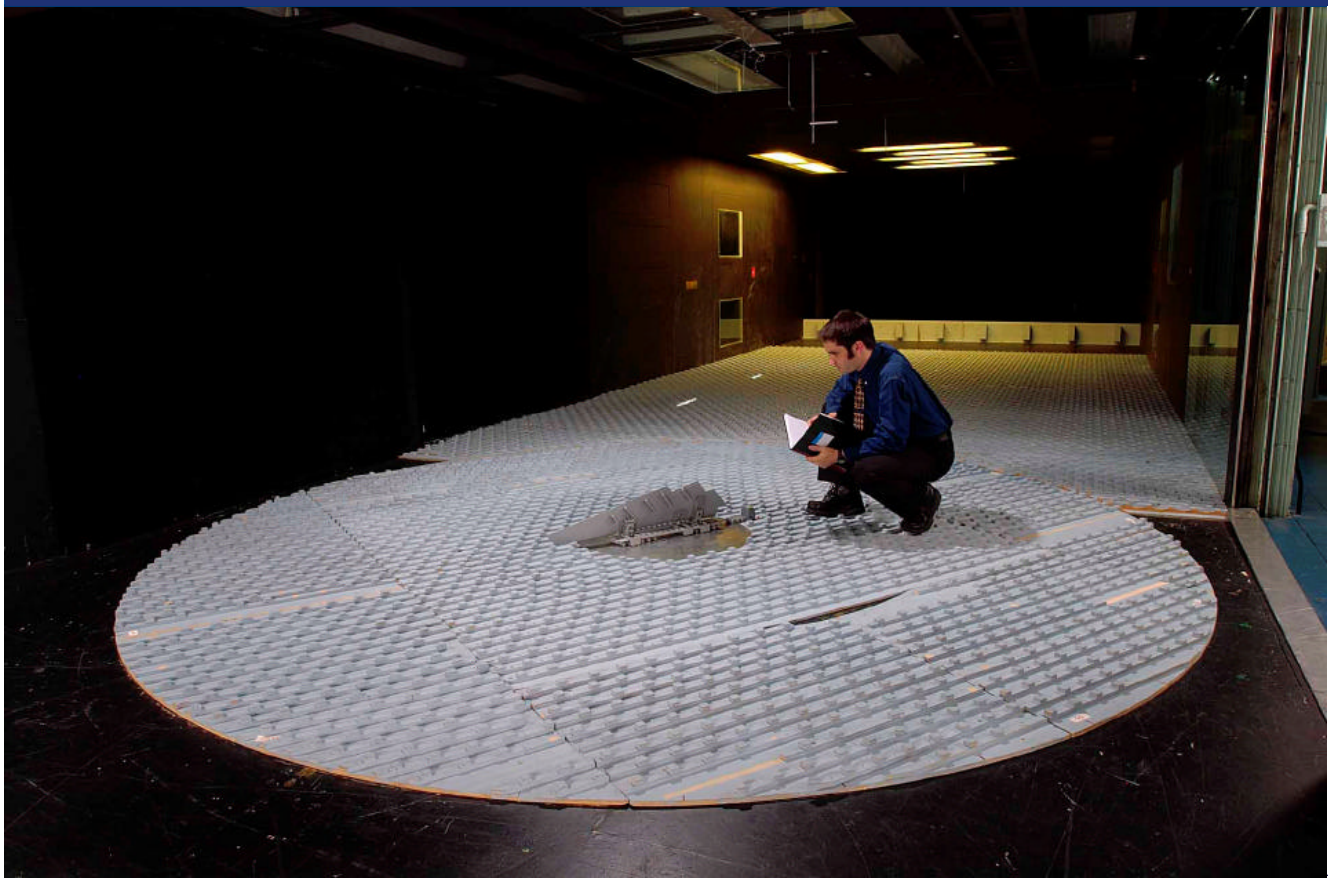
Wind Tunnel Tests



River Trials (Pont de Pierre)

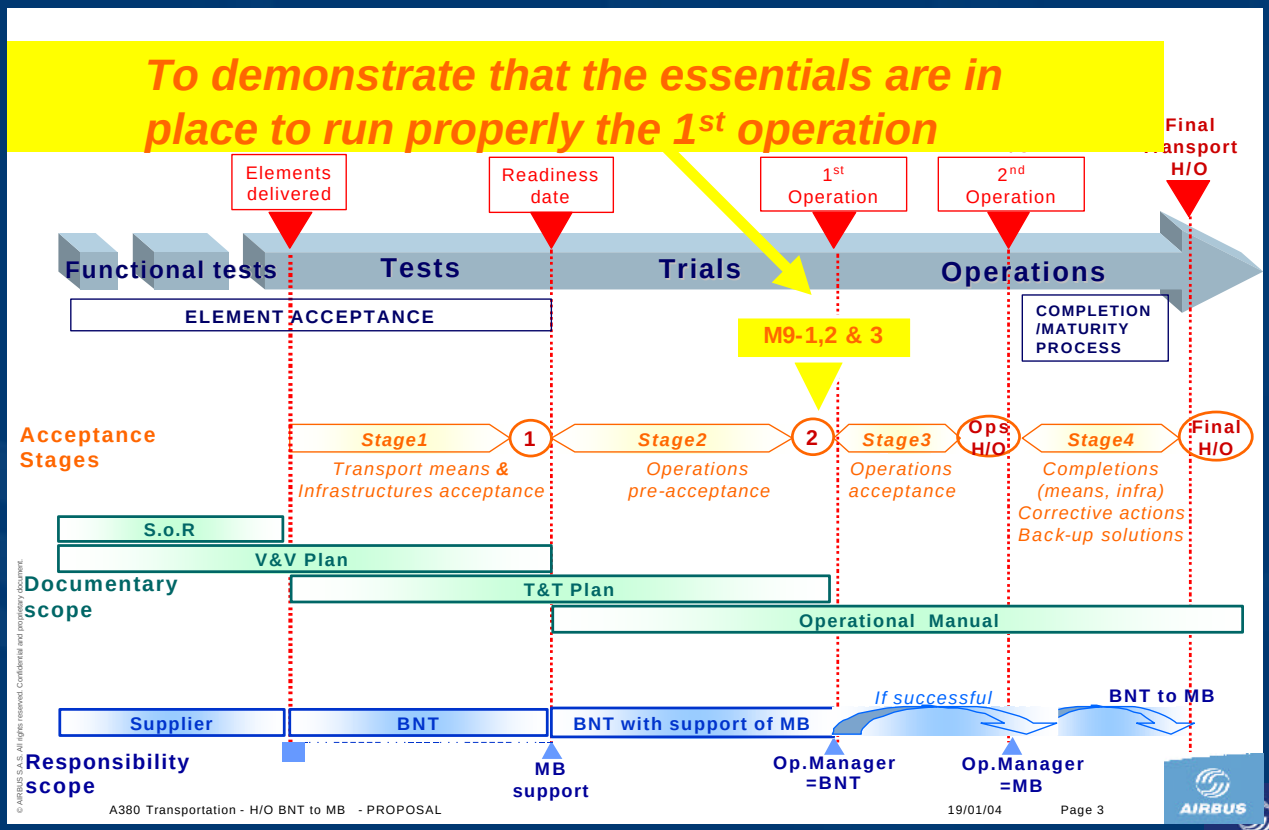
Tests & Trials completes the V & V plan

Test : relative to technical aspects

Trial : relative to operational dimensions

Tests & Trials process - Road trials

Transport M9 Operational Reviews



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 Conclusion

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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**