

Presented by

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Component Integration Manager Forward Fuselage
Chief Engineer Team ACMT F&E

Systems Engineering in der Entwicklung des Airbus A400M

DGLR/GfSE Vortrag am 15.04.2004 in Hamburg

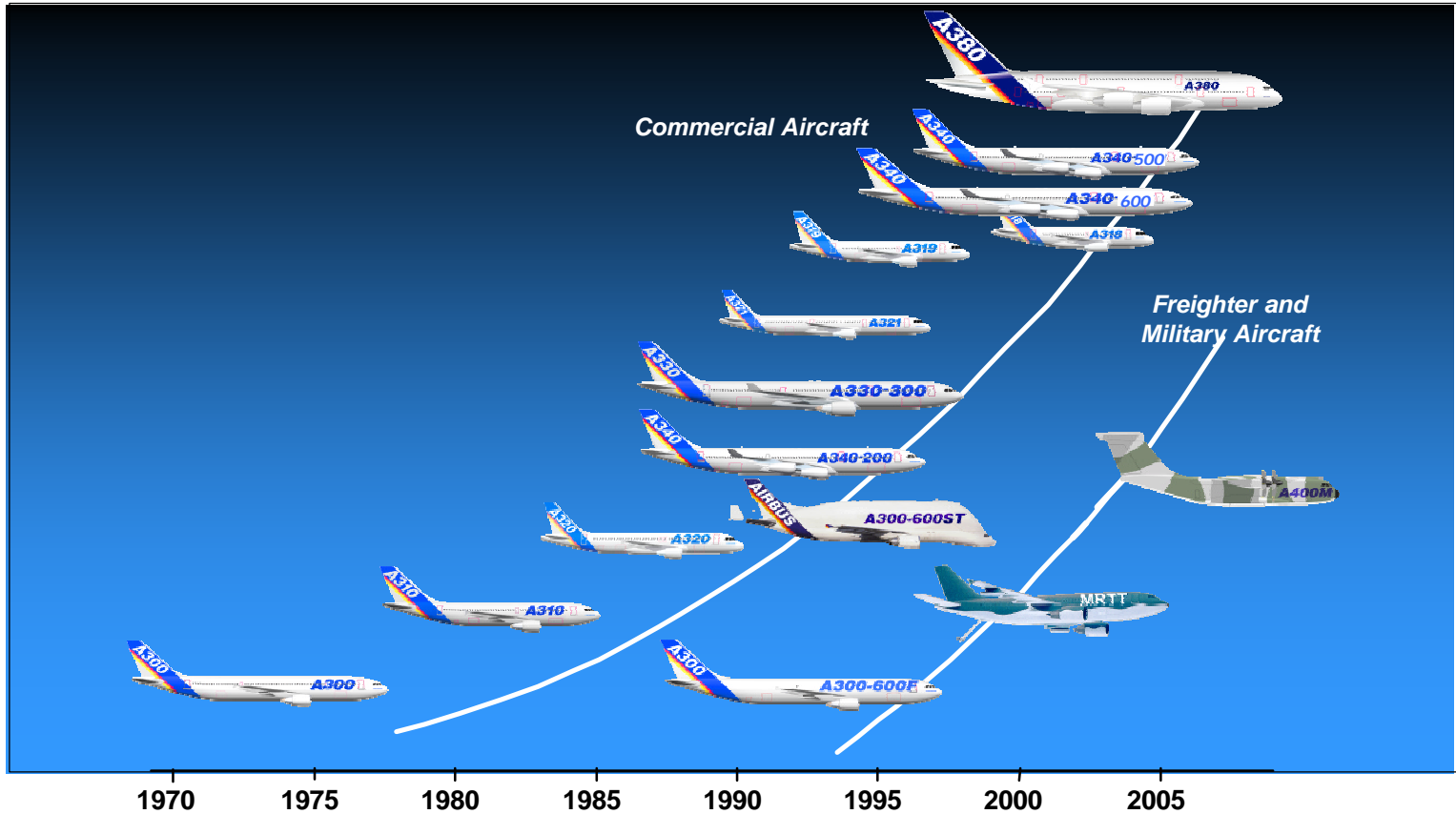
Scope

- Airbus
- A400M
 - ▶ Market
 - ▶ Performance
 - ▶ Contract / Workshare
- Systems Engineering
- A400M practice
 - ▶ A400M Teams
 - ▶ Tools
 - ▶ Requirements Management
 - ▶ Trades (Nose Landing Gear)
 - ▶ Change Management (Mezzanine)
 - ▶ Cultural aspects

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Airbus Product Family



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Combining Tactical and Strategic Capability

Payload



- Large Load & volume capacity
- Long range
- High cruise speed

Medium Tactical Transports
C-130, C-160,
An-12, IL-76/78, C-1

A400M

Strategic Airlifters
C-17, C-5, C-141
An-124

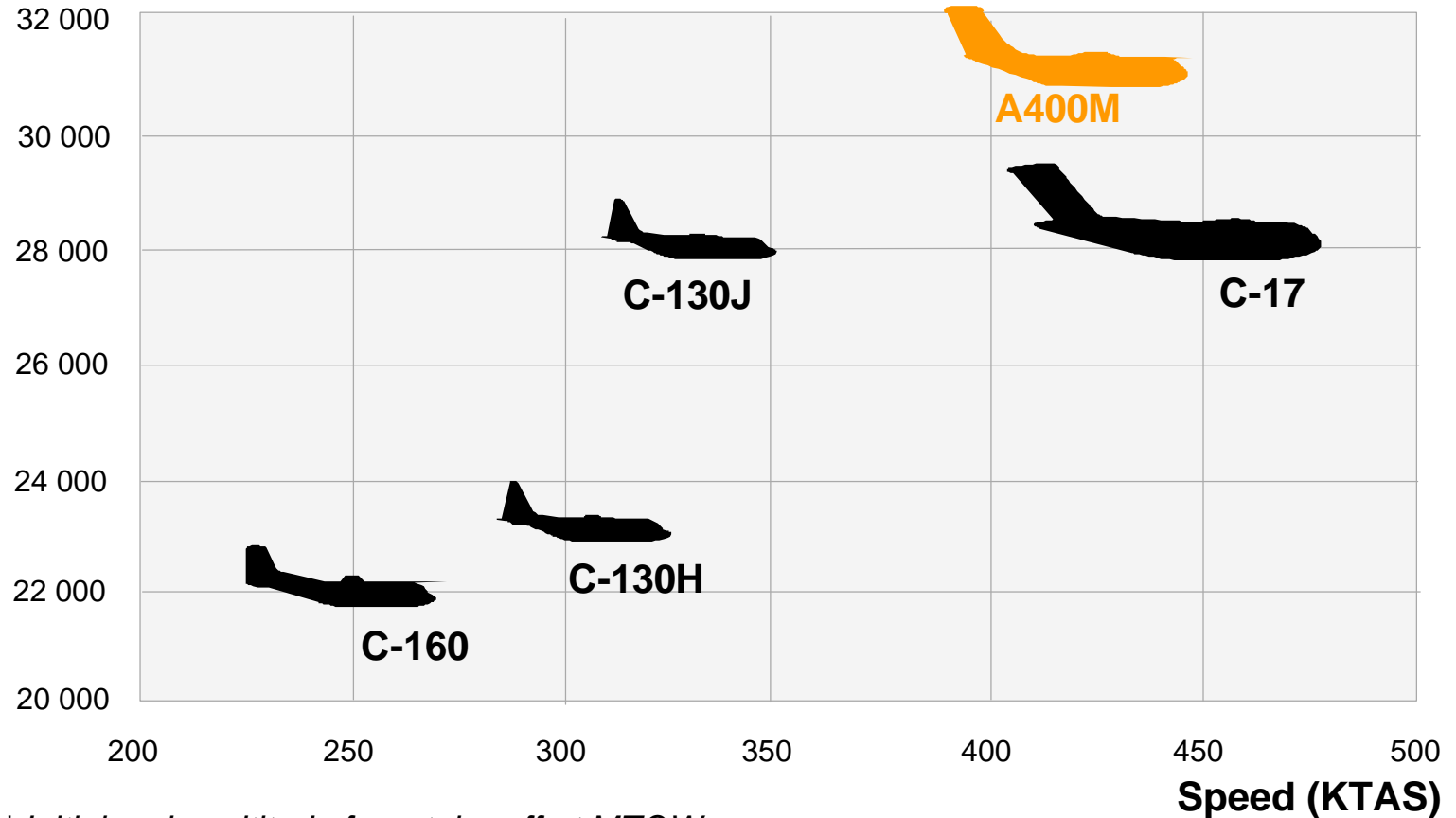
- Short, austere airfield capability
- Autonomous ground operation
- Low level tactical flight

Range



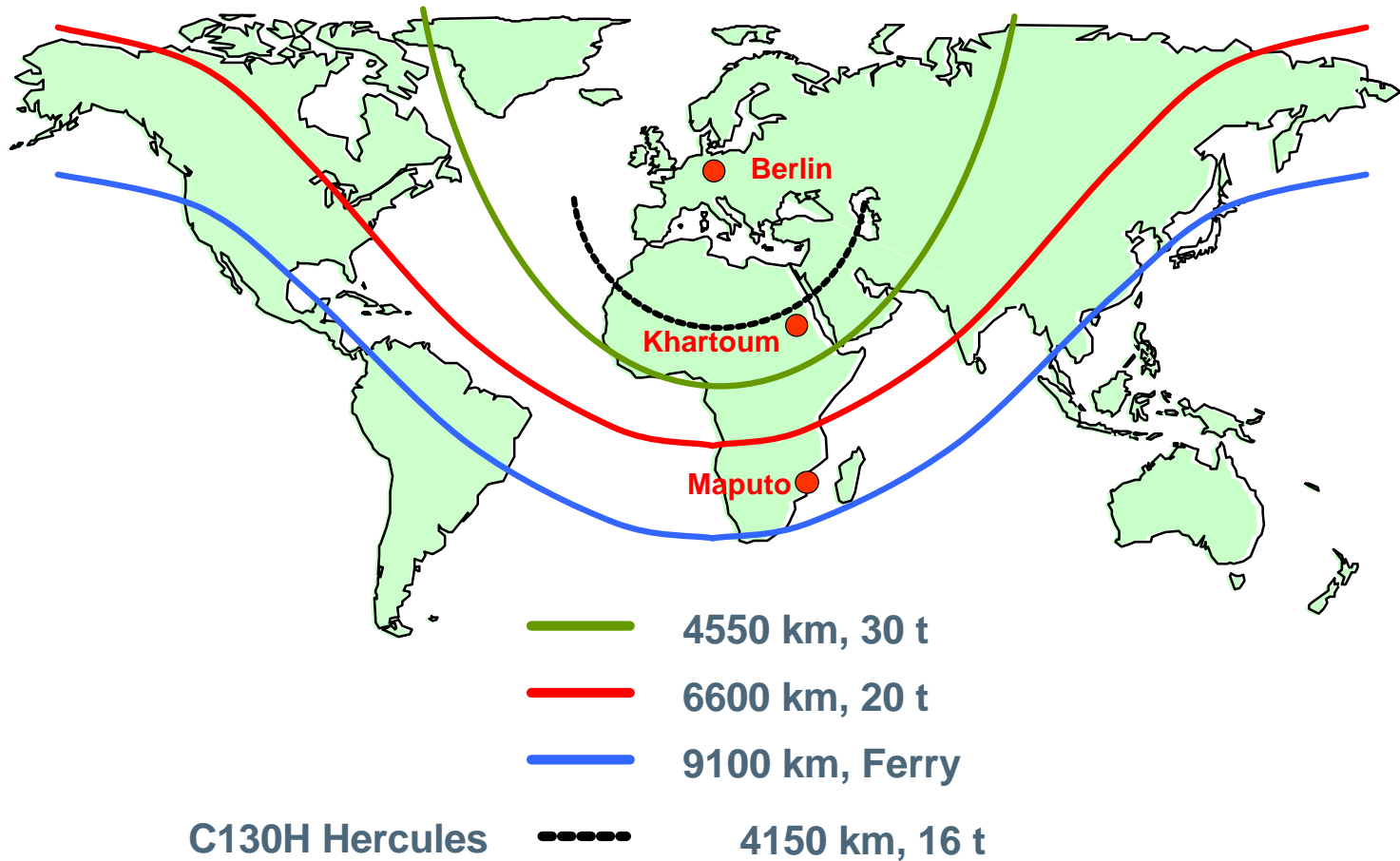
A400M Programme – vs. Competition

Altitude* (ft)

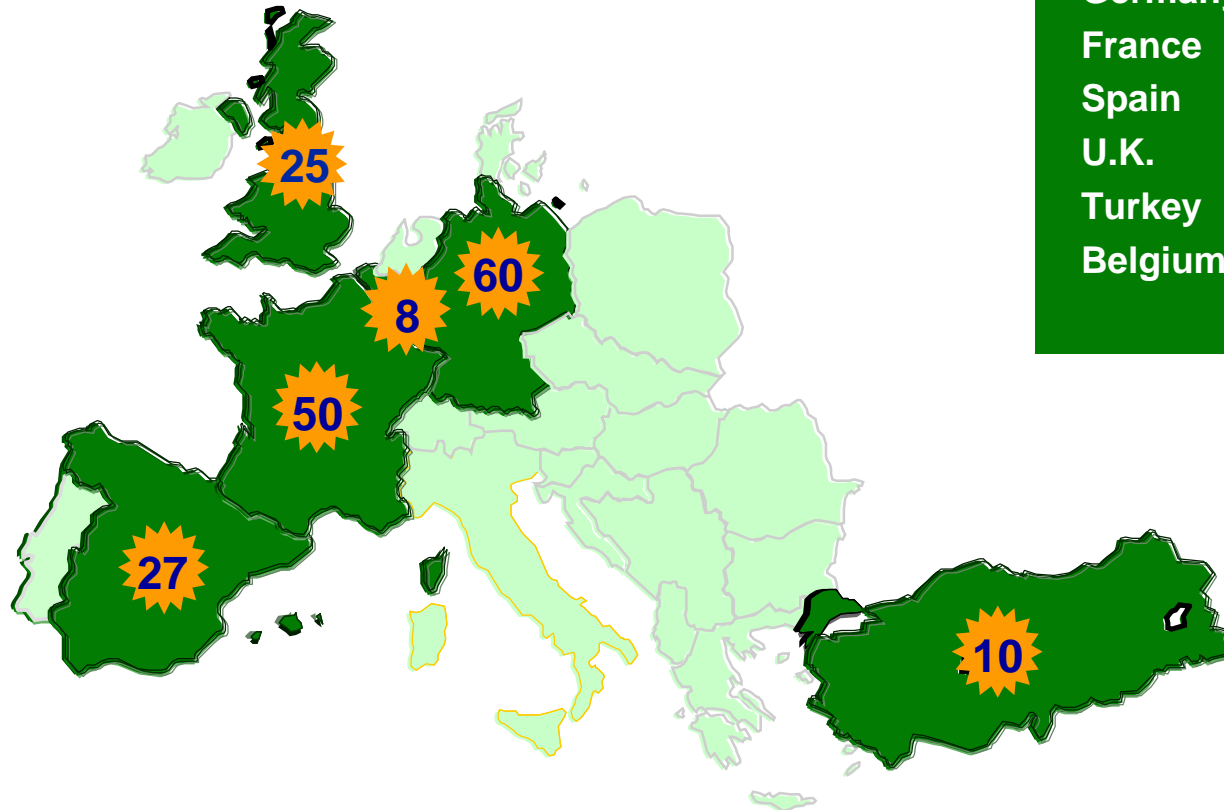


* Initial cruise altitude from take-off at MTOW

A400M Programme – Performance



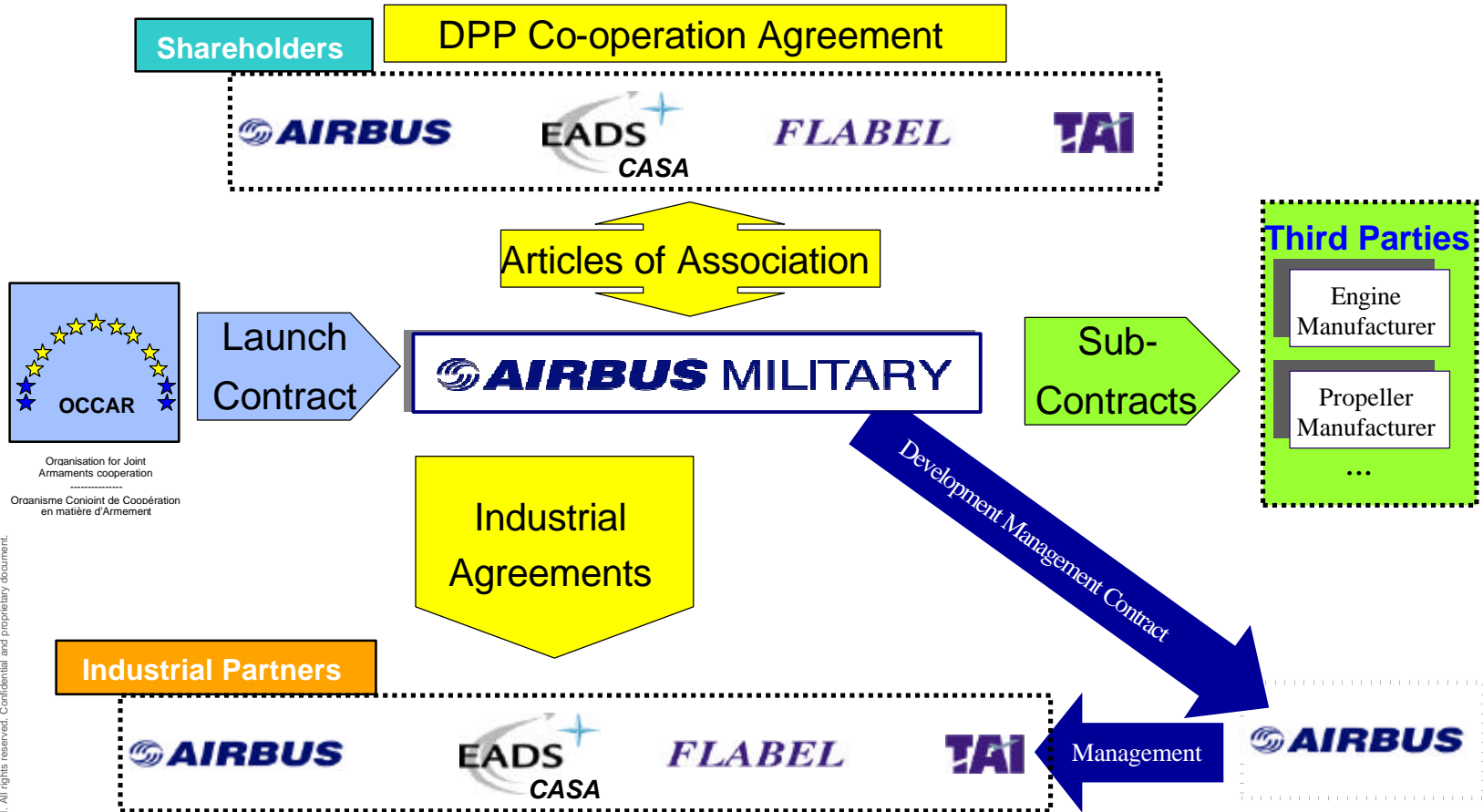
A400M Programme – Launch Base



Germany	60
France	50
Spain	27
U.K.	25
Turkey	10
Belgium + Lux.	8

A launch base of 180 aircraft for seven Nations

Industrial Contracts



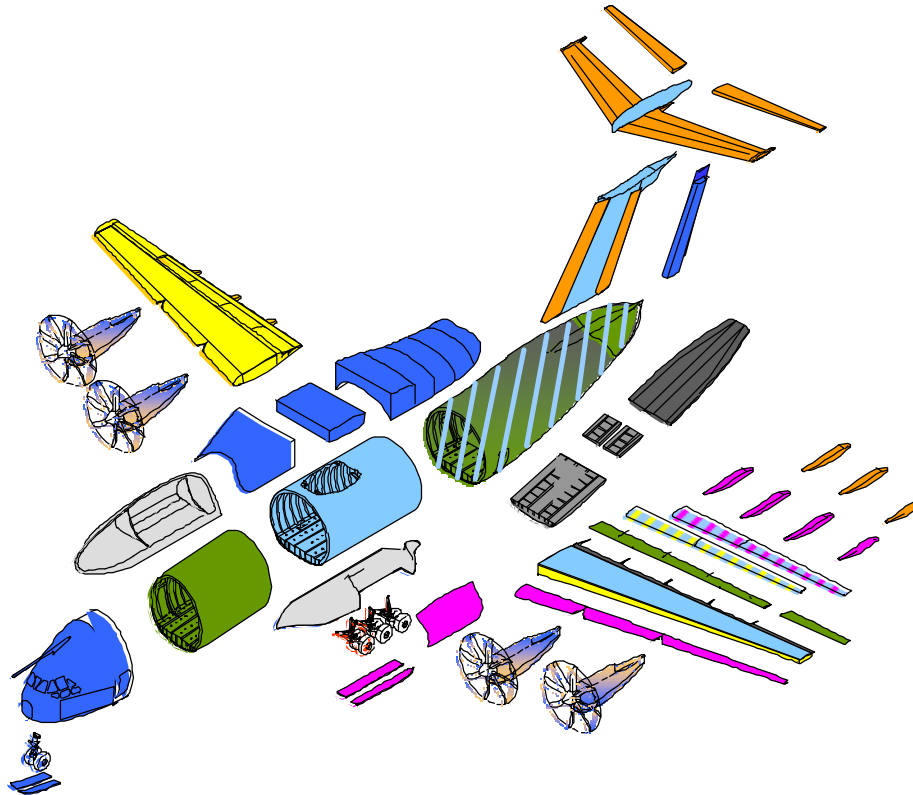
Organisation for Joint Armaments cooperation
 Oronisme Conjoint de Coopération en matière d'Armement











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Airbus manages on behalf of Airbus Military (AMSL) the A400M development.



Industrial Workshare

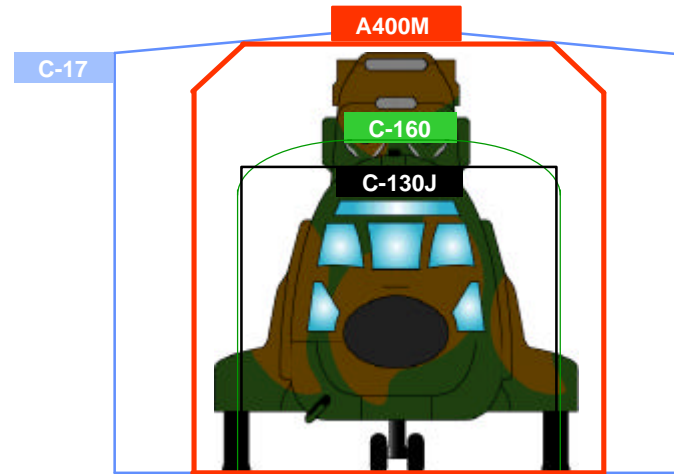


-  Airbus Germany
-  Airbus France
-  Airbus UK
-  EADS MTAD
-  EADS Military Aircraft
-  EADS Sogerma
-  EADS Socata
-  TAI
-  Flabel
-  EADS Defence & Security Systems

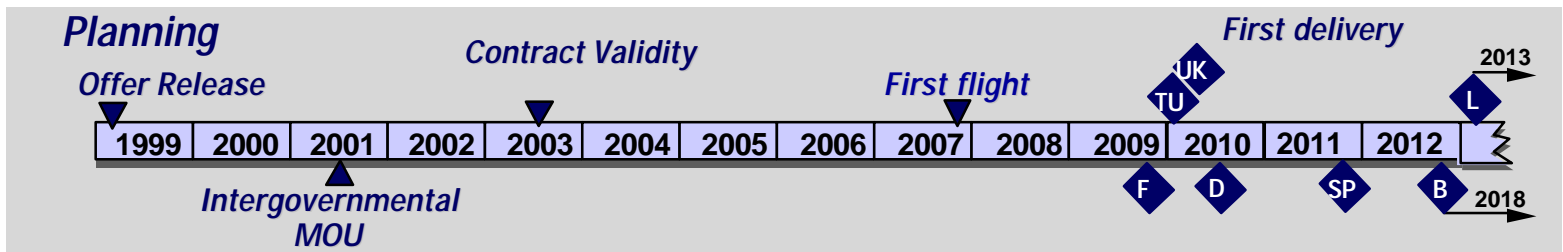
- Final assembly line (FAL) at EADS MTAD
- Integrated Fuselage Assembly (IFA) at Airbus Deutschland
- High lift assembly at Airbus Deutschland

A400M main data

- Ca. 50% payload of C-17 at 33% Life Cycle Cost
- Replaces C130 (Hercules) and C160 (Transall)
- Ca. twice the the carrying capability of C130 at comparable Life Cycle Cost
- Market potential of 380 A/C



Cargo Hold cross section



Seven Nations will purchase the A400M as a replacement for their current transport fleet with a payload of 15-20 t.

Scope

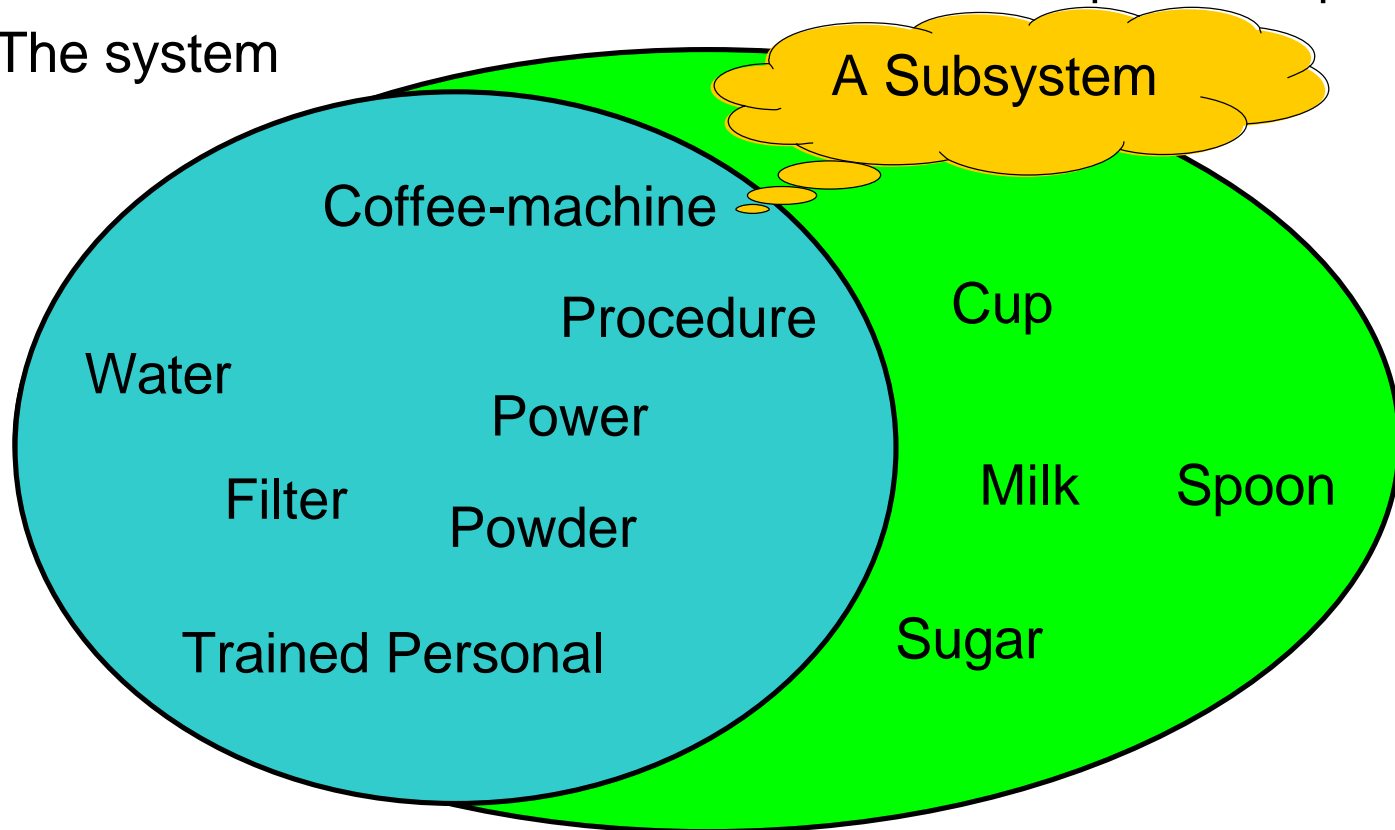
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- A400M
 - ▶ Market
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 - ▶ Contract / Workshare
- **Systems Engineering**
- A400M practice
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Systems-Engineering

- Covers the hole Life-Cycle
- Constraints for a Systems-Engineer
 - ▶ Time
 - ▶ Cost
 - ▶ Budget
 - ▶ Quality
 - ▶ Safety
 - ▶ Contacts
- Costumer requirements as the centre of development
- Use of processes, methods and tools to cope with increase of complexity
- Effective use of interdisciplinary teamwork

What is a system (An example)

- Task description
 - The customer wants to make coffee with a repeatable quality
- The system



Systems Thinking?



Innovation Associates/Taken from James Martin Seminar "How to implement SE

Disciplines and their solutions



The best possible solution
for the customer

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Aircraft Component Management Team - ACMT

- ACMT
 - ▶ Multidiscipline Teams, integrated by AIRBUS and non-AIRBUS personnel, collocated in one site.
 - ▶ Responsible of the full development of an aircraft component.
 - ▶ Cross-National authority.

Fuselage ACMT

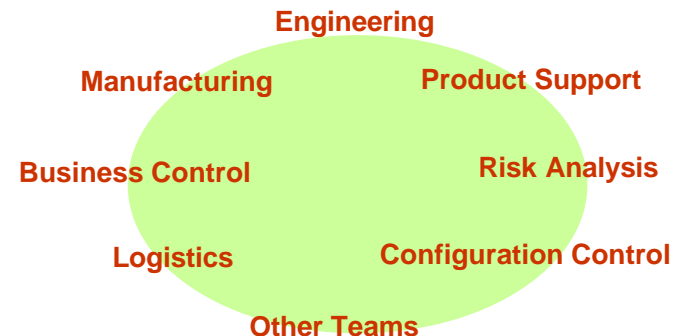
Wing ACMT

Systems ACMT

Military Systems ACMT

Power plant ACMT

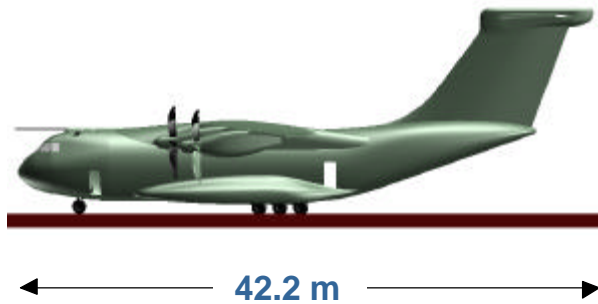
Final Assembly Line ACMT



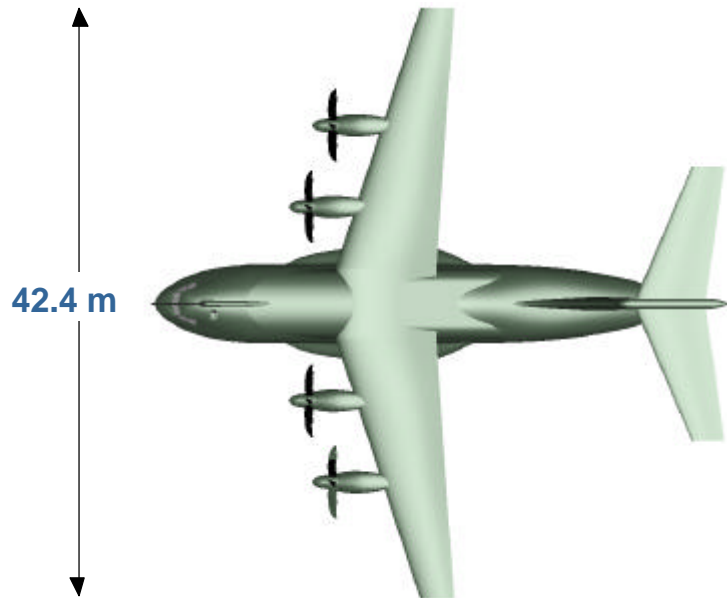
Development Tools and DMU

- **All partners are using the interconnected development tools to support a fast and easy data transfer**
 - ▶ Computer Aided Design Tool : **CATIA V.5**
 - ▶ Product Definition Management Tool: **WINCHILL**
 - ▶ Digital Mock-up: **DVISE**
- **Advantages of 3D digital mock-up**
 - ▶ Real engineering data for the whole aircraft
 - ▶ Allowing concurrent product development
 - ▶ Providing rapid solutions to engineering, operational and maintenance activities
 - ▶ Allows space allocation and system interfaces to be studied without the need for costly physical mock-ups

A400M Programme requirements

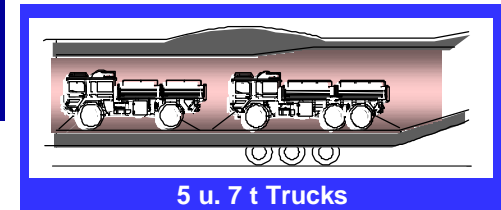
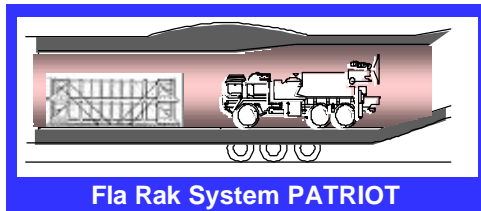
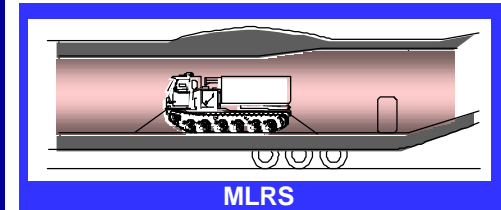
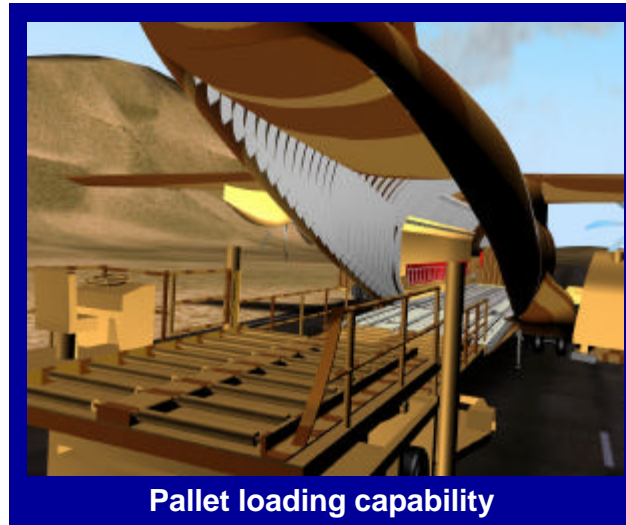
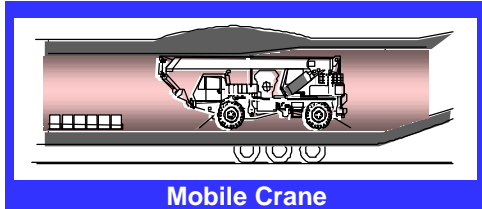
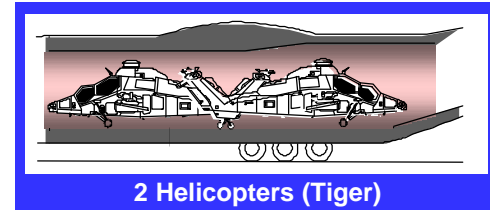
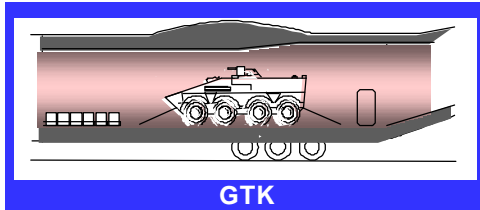


14.7 m



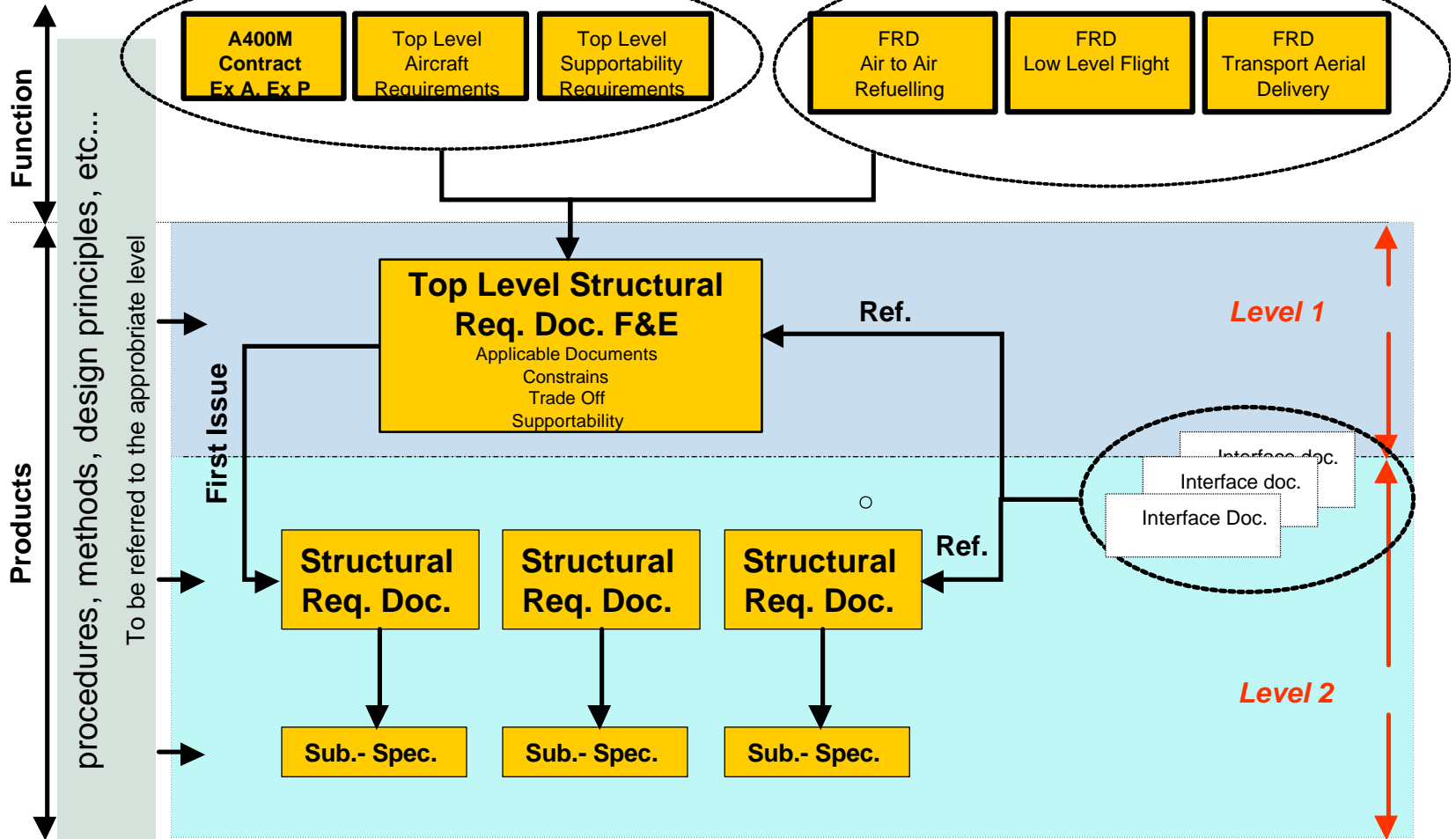
- Four 10 000 shp class Turboprop Engines
- High Speed Cruise Mach 0.68 to M 0.72
- Initial Cruise Height @ MTOW 31,000 feet
- Cruise Ceiling 39,000 feet
- Ferry Range 4900 nm
- Maximum payload 37 tonnes
- MTOW 130 tonnes

A400M Programme – Cargo Hold Capability req.



- Paratroop transport
- Troop transport

F&E Requirements Cascade



Requirement Management

Structural Req. Doc.	Partner
<i>Nose Fuselage</i>	<i>Airbus France</i>
<i>Fwd Center Fuselage</i>	<i>TAI</i>
<i>Center Fuselage</i>	<i>Airbus Deutschland</i>
Sponson	Socata
MLG Doors	Sonaca
Ice Shield	Airbus Deutschland
Wing Fairing	Airbus France
<i>Rear Fuselage</i>	<i>Airbus Deutschland</i>
Ramp	Sogerma
Cargo Door	Airbus Deutschland
Tailcone	TAI
Doors & Hatches	TAI /Airbus France
Vertical Tailplane	Airbus Deutschland
Horizontal Tailplane	MTAD Spain
Cargo Hold	Airbus Deutschland
Landing Gear	MTAD Spain

- Requirements

- ▶ ACMT F&E compl.: 1700
 - Ex. A requirements: 900
 - National Options
 - Supportability req.
 - Certification req.
 - Constraints

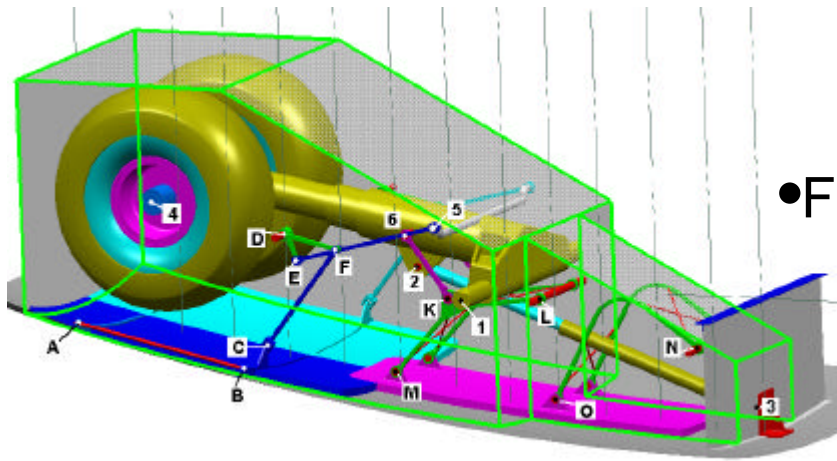
- Tool

- ▶ Commercial
- ▶ Harmonized

- Airbus Process is used

Trade: Nose Landing Gear

Nose Landing Gear work share



- Germany

- ▶ Overall F&E structural design
- ▶ Aerodynamics

- France

- ▶ NLG Bay
- ▶ NLG Doors
- ▶ Cockpit Control

- Spain

- ▶ LG Systems
- ▶ LG Structure
- ▶ FAL

NLG Requirements & Constraints

Maintenance

- On field
- Special tools
- Time

Contract

- Workshare
- Schedule
- CSA

Top level A/C Requirements

- Performance reg.
- Operational reg.
- Functional reg. weight

Systems

- Electric
- Hydraulic
- Electronic

Production

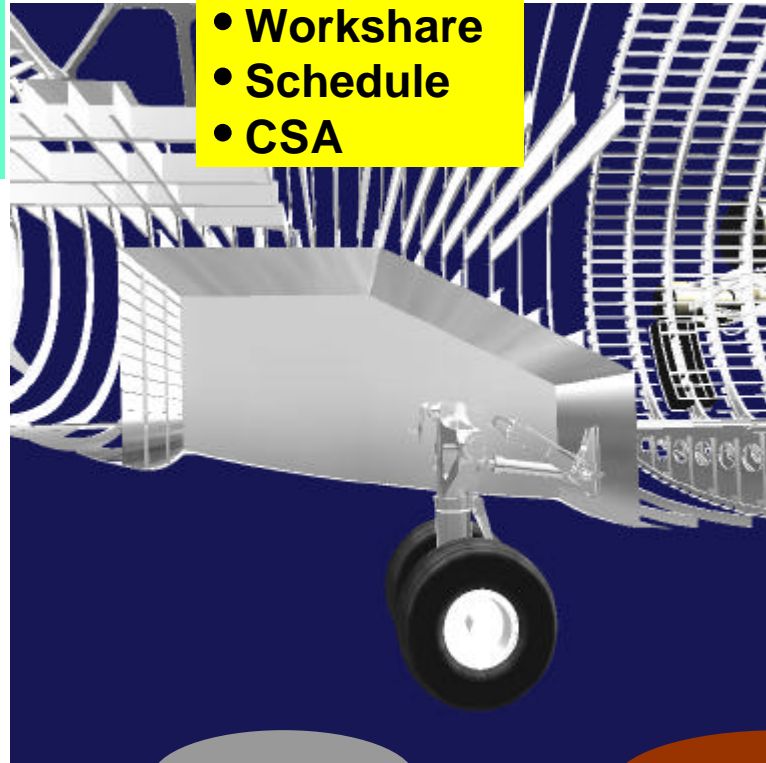
- Facility
- Interfaces
- Concept

Support

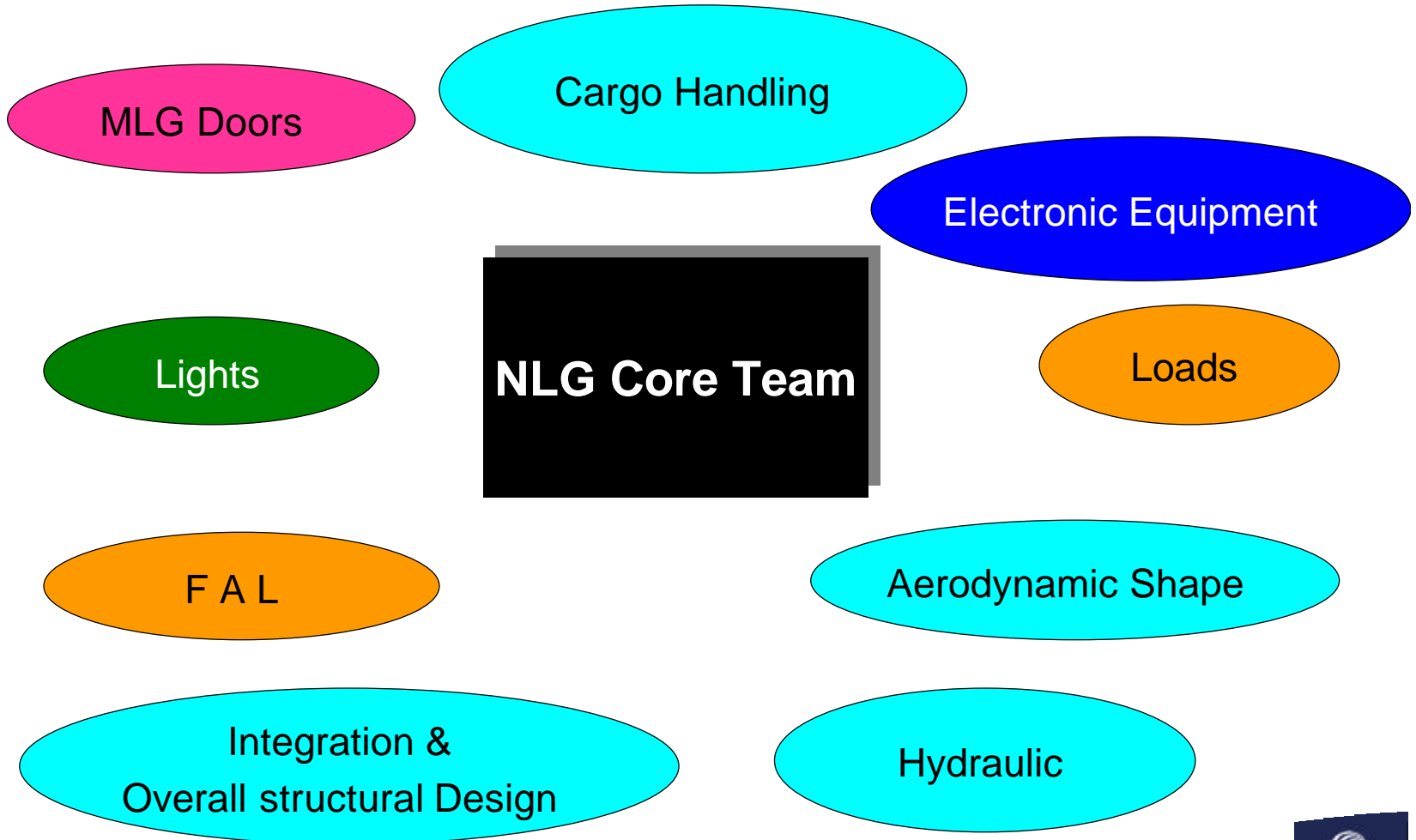
Safety

- Survivability to a shot

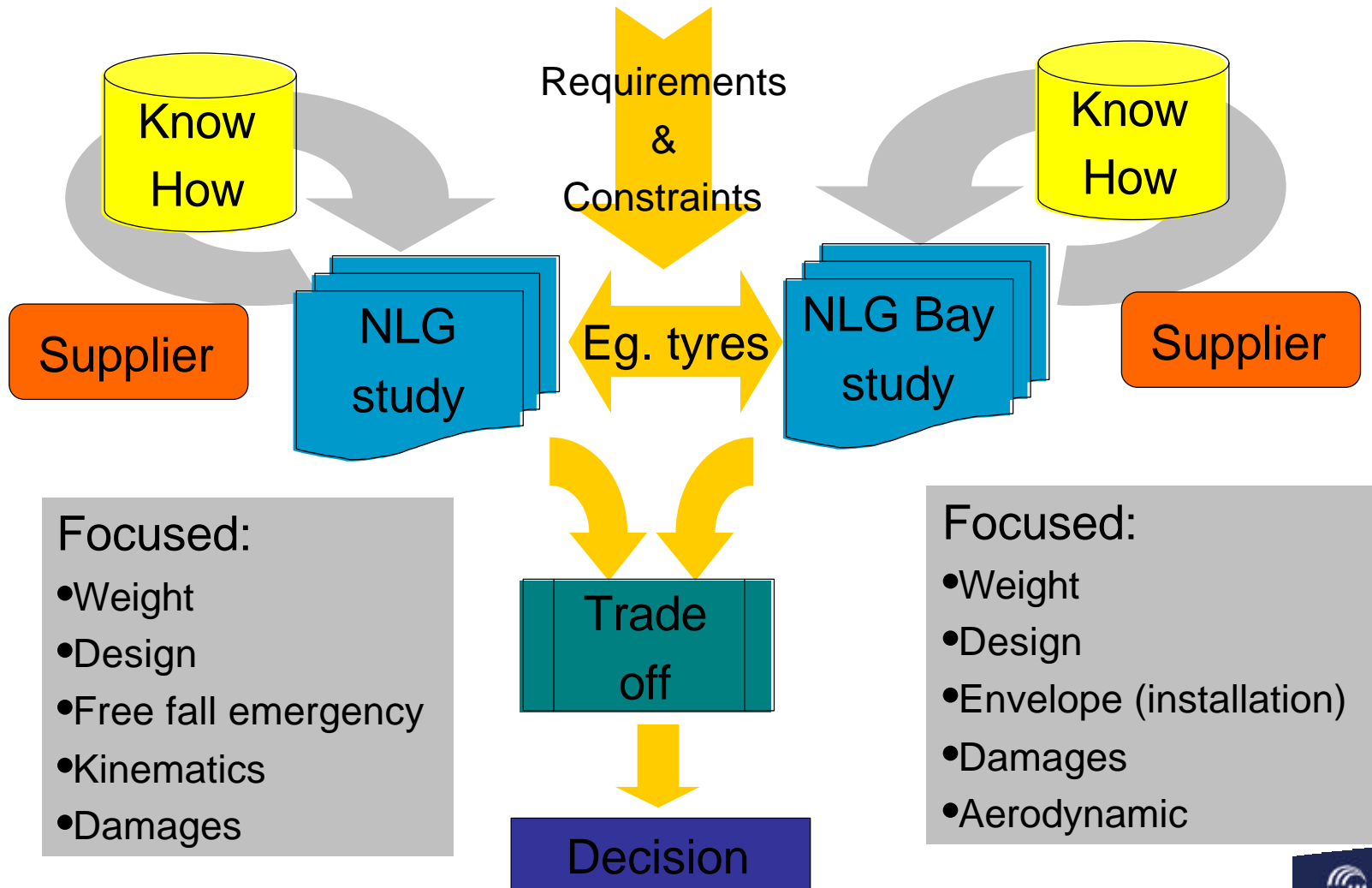
Quality



Multidisciplinary Interfaces

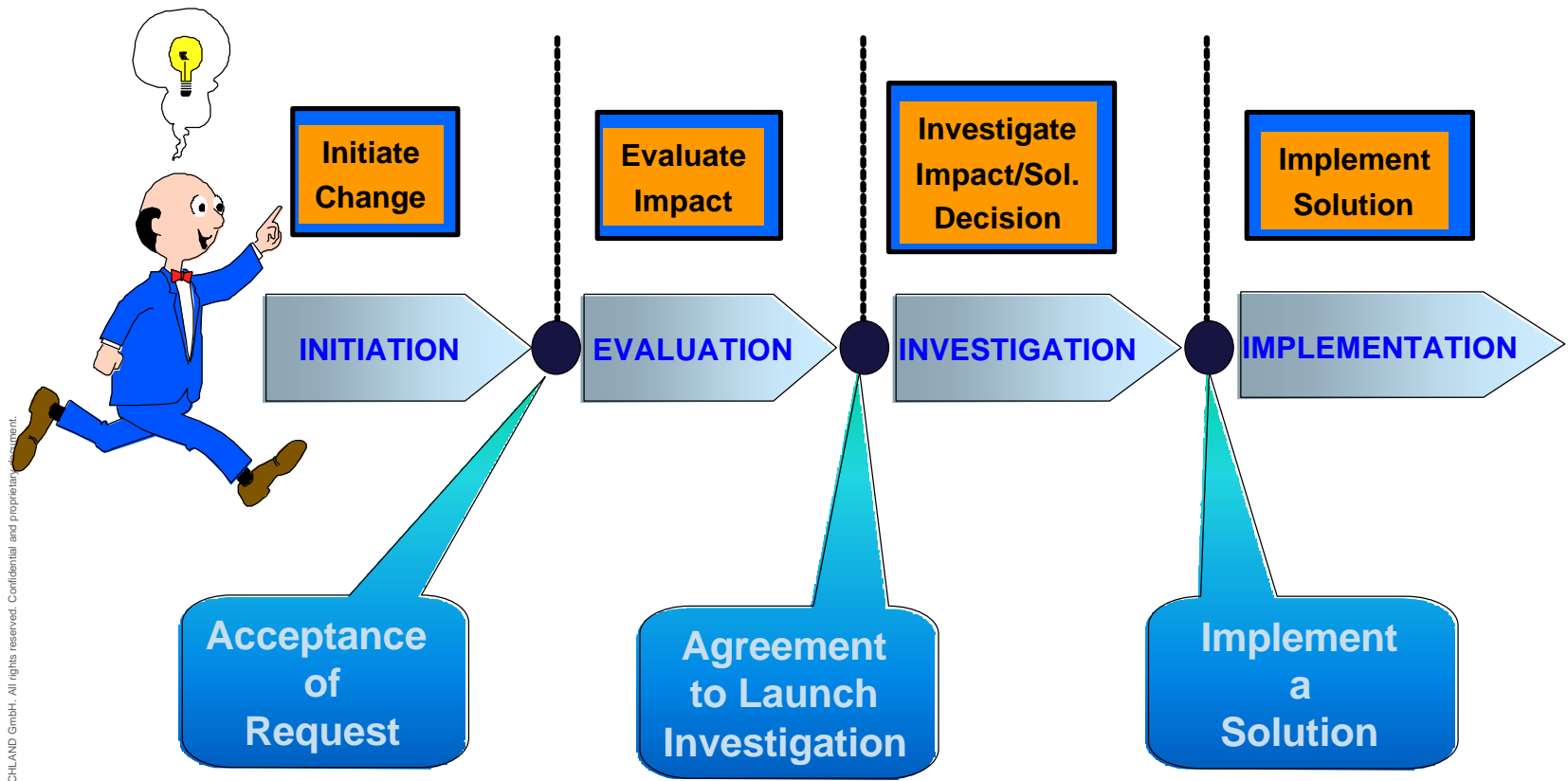


Trade off process & dependency



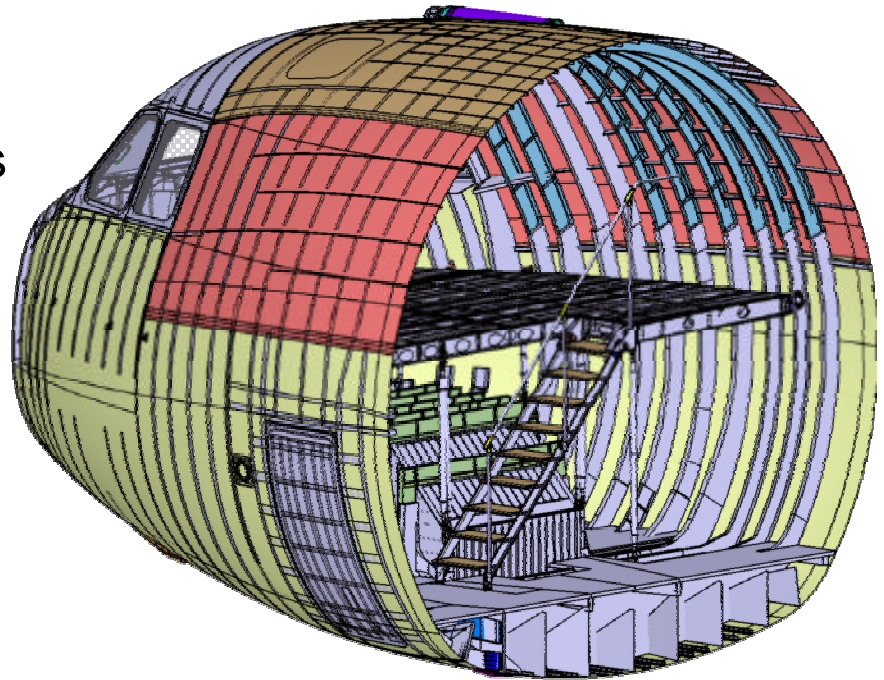
Change Management Prozess

The Change Process consists of 4 Phases:

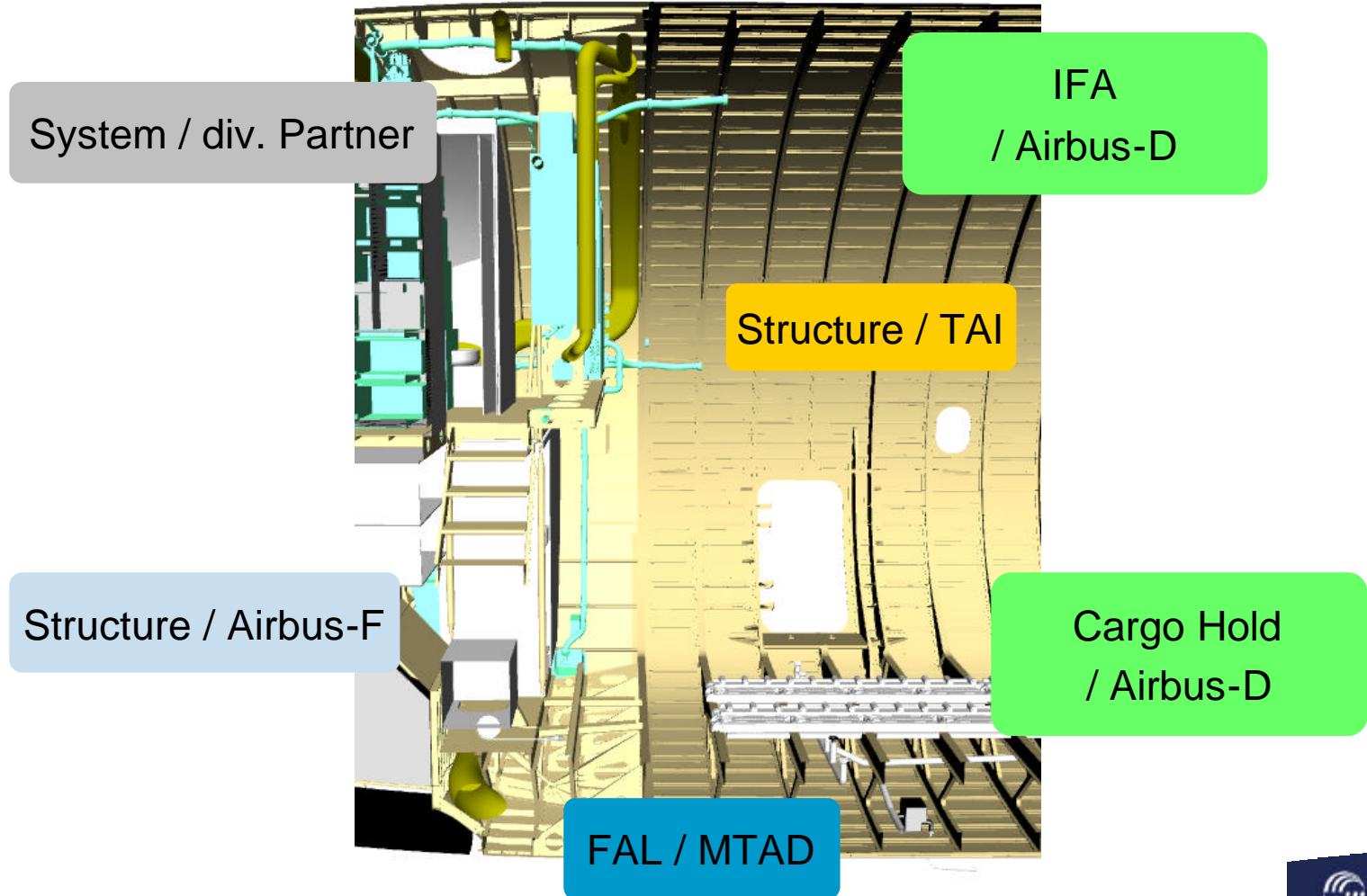


Initiation Phase

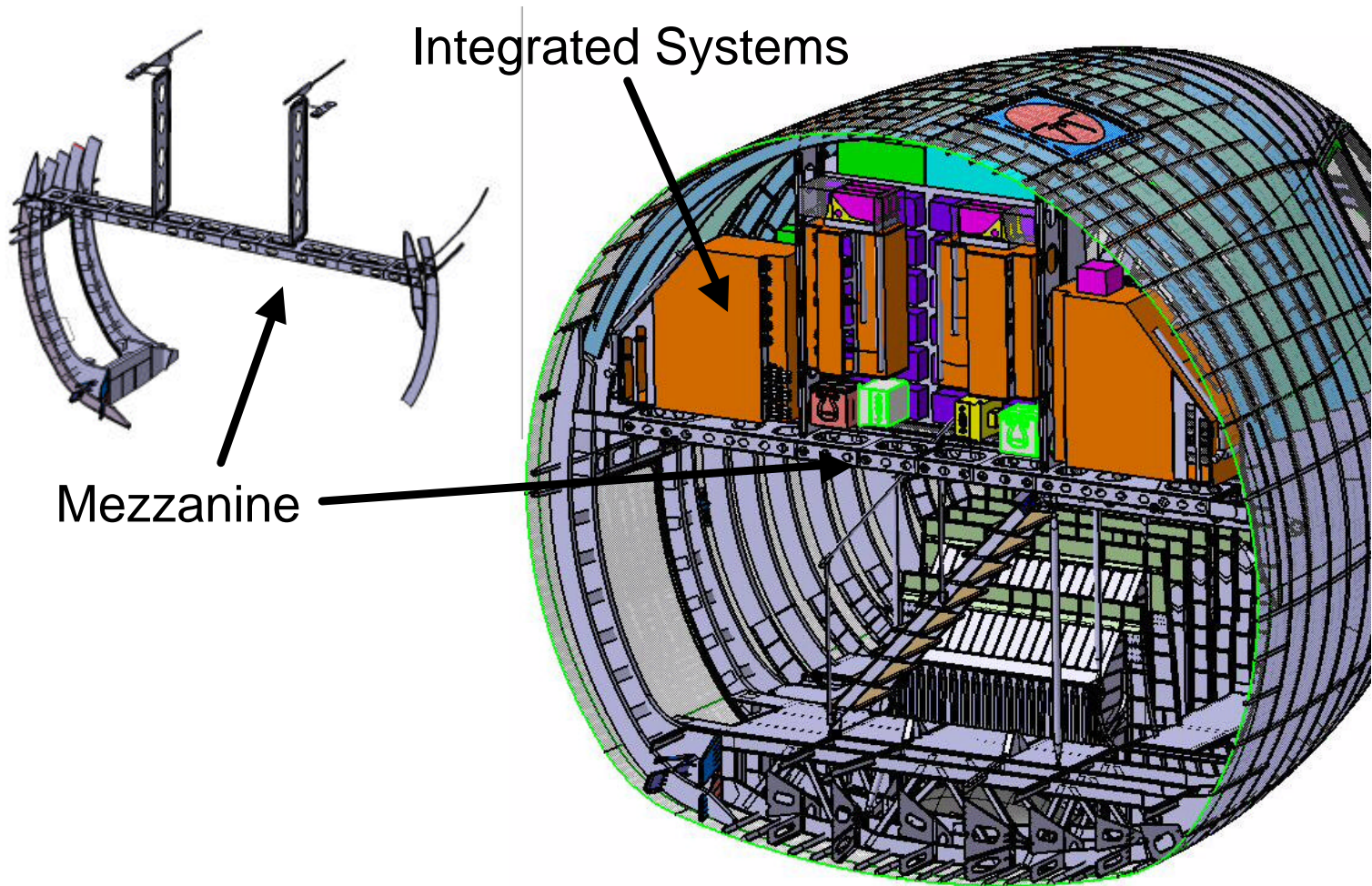
- Basis
 - ▶ Clear Concept available
- Identification
 - ▶ Mechanical interference between air cooling ducts and the main electric power centres
 - ▶ Unacceptable access to wirings
 - ▶ A request for about 30% more volume for Electric Power Centres



Impacted partners and their disciplines

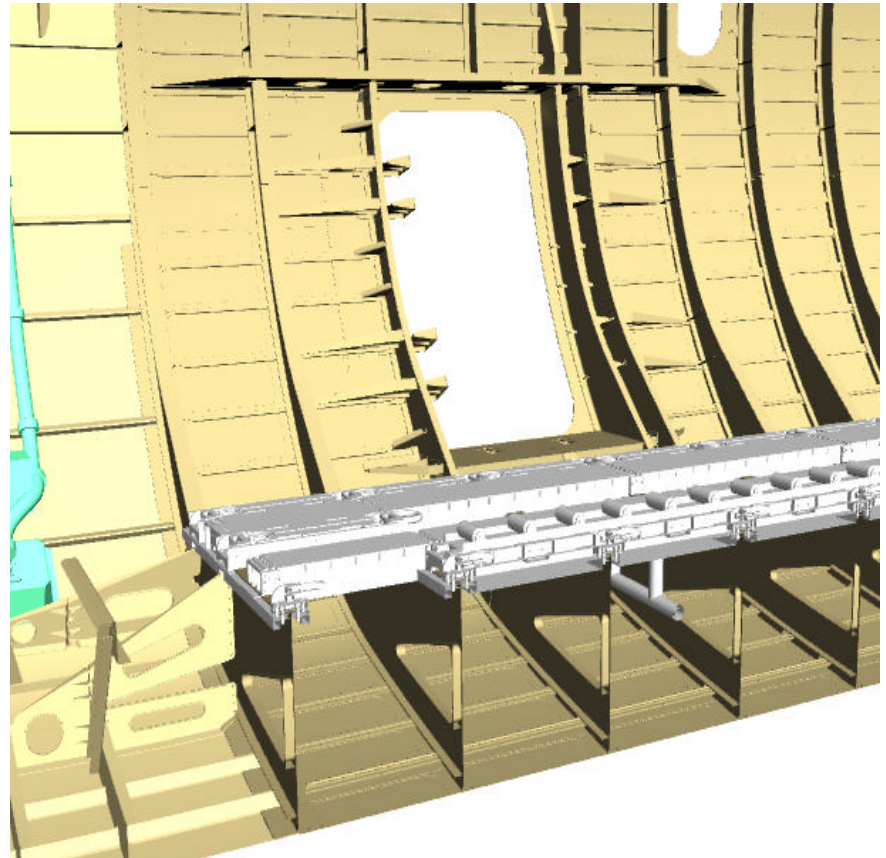


The developed solution



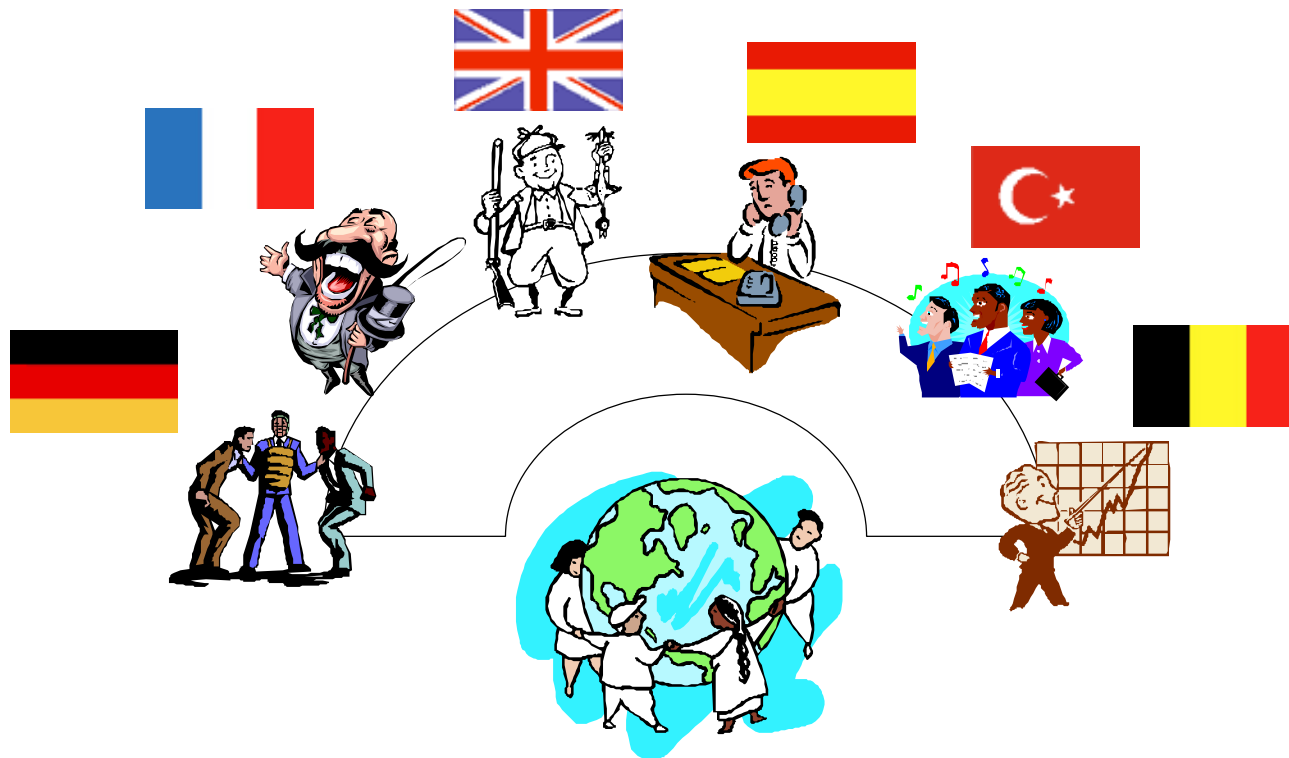
Topic to be looked at

- Structure
 - ▶ Interfaces
 - ▶ Tolerances
 - ▶ Floor attachment
 - ▶ Assembly concept
- Certification
 - ▶ Evacuation
- System installation
 - ▶ EMI
 - ▶ Airconditioning
- Aerial delivery of paratrooper



Cultural aspects

- ▶ Responsibilities
- ▶ Confidence



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AIRBUS

**AN EADS JOINT COMPANY
WITH BAE SYSTEMS**

Darstellung der GfSE e.V.

Vortrag vom 15.04.2004 in Hamburg mit der
DGLR



Überblick

• Unsere Ziele

- Förderung von Wissenschaft und Bildung auf dem Gebiet des Systems Engineering
- Wissens- und Erfahrungstransfer zwischen Industrie, Forschung und Lehre
- gezielte Anstöße zur Verbesserung des Entscheidungsprozesses
- Stellung der deutschen Wirtschaft im internationalen Wettbewerb stärken

• Mitgliedschaft

- Persönlich
- Firmen und Kooperative

• Wer wir sind

- Mittelständische und Großunternehmen
 - Automobilbau
 - Elektrotechnik
 - Luft- und Raumfahrt
 - Stahl- und Schiffbau
 - Telekommunikation
 - Softwareentwicklung
- Hochschulen

• Was wir tun

- Fachvorträge
- Seminare
- Foren
- und mehr

Vorankündigung

Donnerstag, 27.05.2004 in Hamburg

***“Vom Concept of Operations
zur Requirement Baseline“***

Herr Hoppe

Blohm & Voss Hamburg

Informationen und Formulare unter: www.GfSE.de

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Systems Engineering, managing complexity and change

14th Annual International Symposium

4th European Systems Engineering Conference

International Council of Systems Engineering



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