

Presented by

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A380 Design Maintenance Manager



A380 Maintenance in Design

Advanced Technologies and Maintenance



AIRBUS

The A380 Family: Flagship of the 21st Century

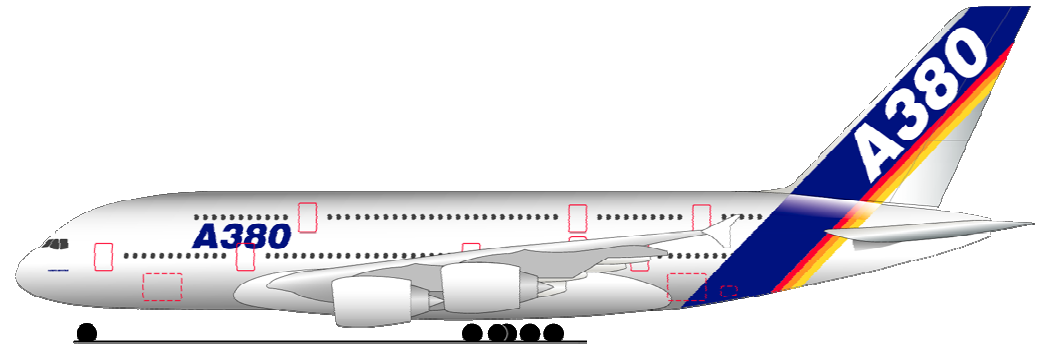
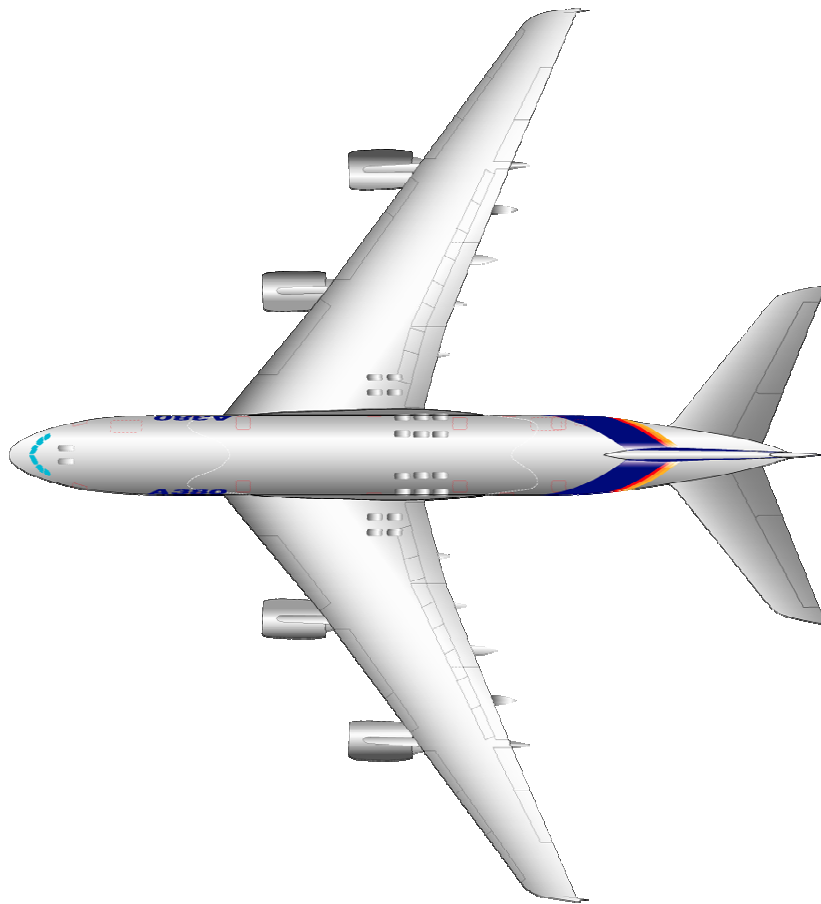


A380-800
555 seats 560t MTOW 8000nm



A380-800F
150t payload 590t MTOW 5600nm

A380 - The Aircraft



	A380-800 / A380-800F
SPAN	261.3 ft / 79.6 m
LENGTH	238.6 ft / 72.7 m
HEIGHT	79.0 ft / 24.1 m



Technology Issues



The Case for Advanced Technology

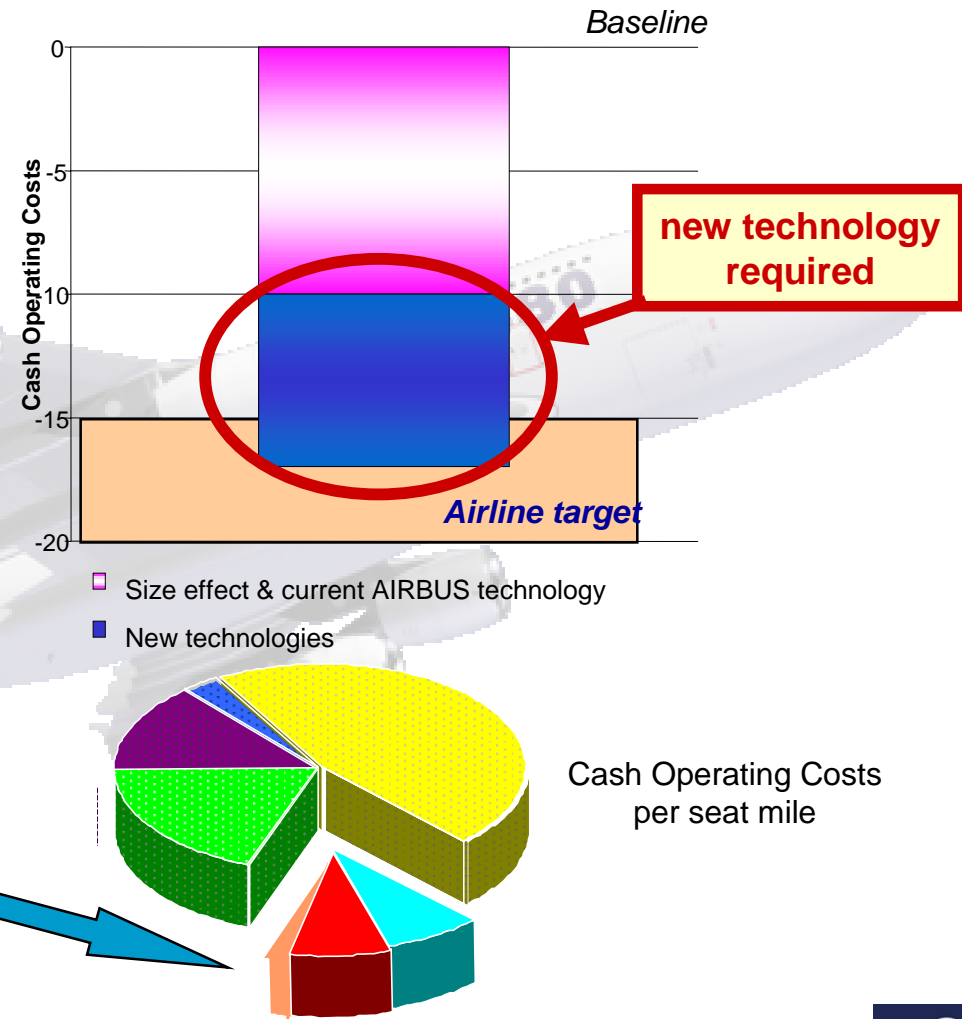
- To achieve Cash Operating Cost target for a 21st Century aircraft

- Performance : fuel burn

- ▶ Drag and sfc
- ▶ Airframe weight
- ▶ Systems

- Maintenance cost

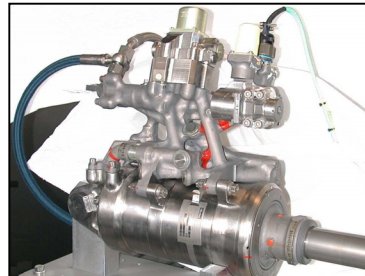
- ▶ Engine
- ▶ Airframe
- ▶ Systems



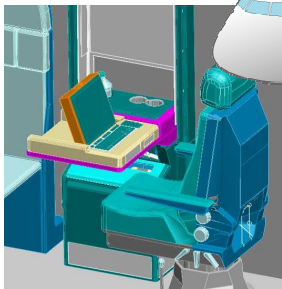
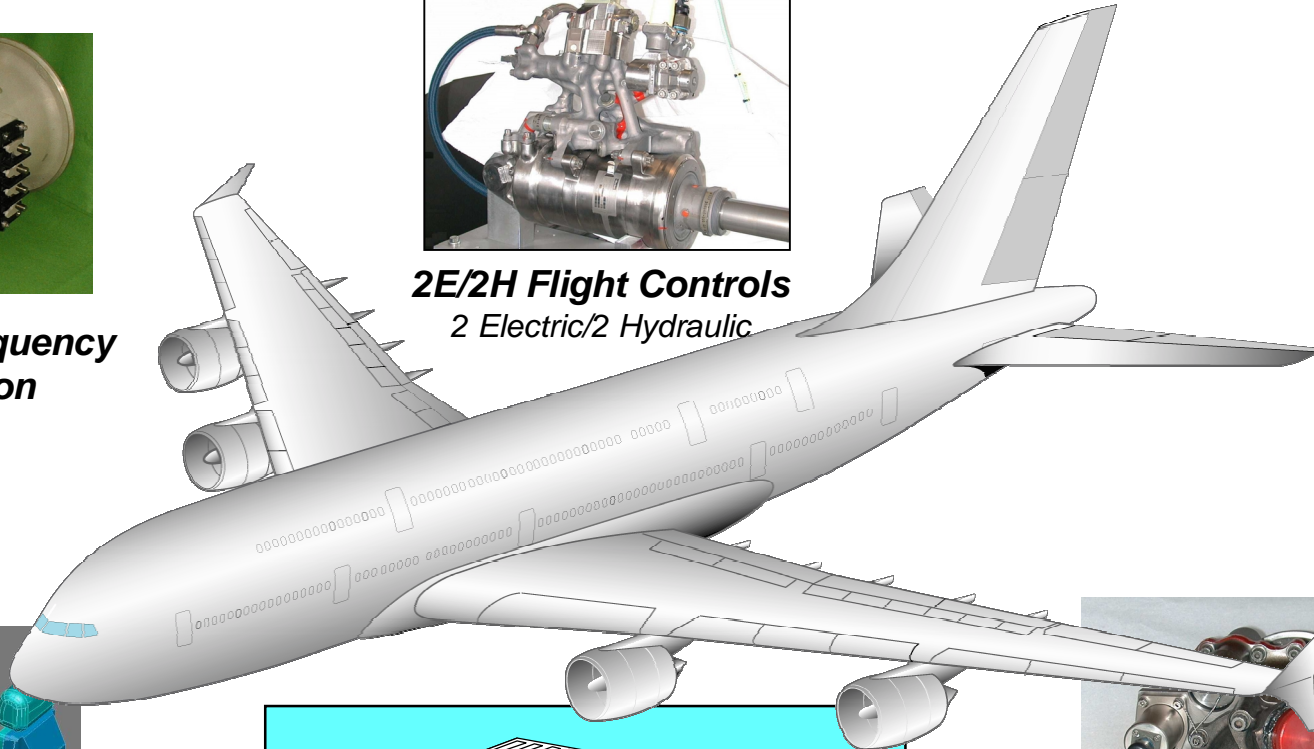
Advanced Technology - Systems



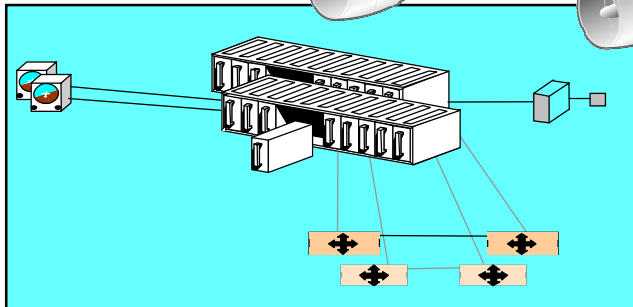
Variable Frequency Generation



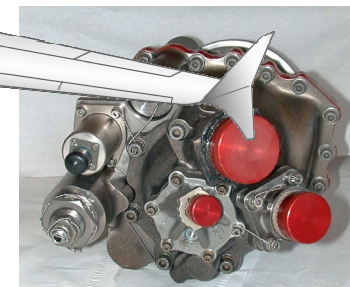
2E/2H Flight Controls
2 Electric/2 Hydraulic



Onboard Maintenance and Information System

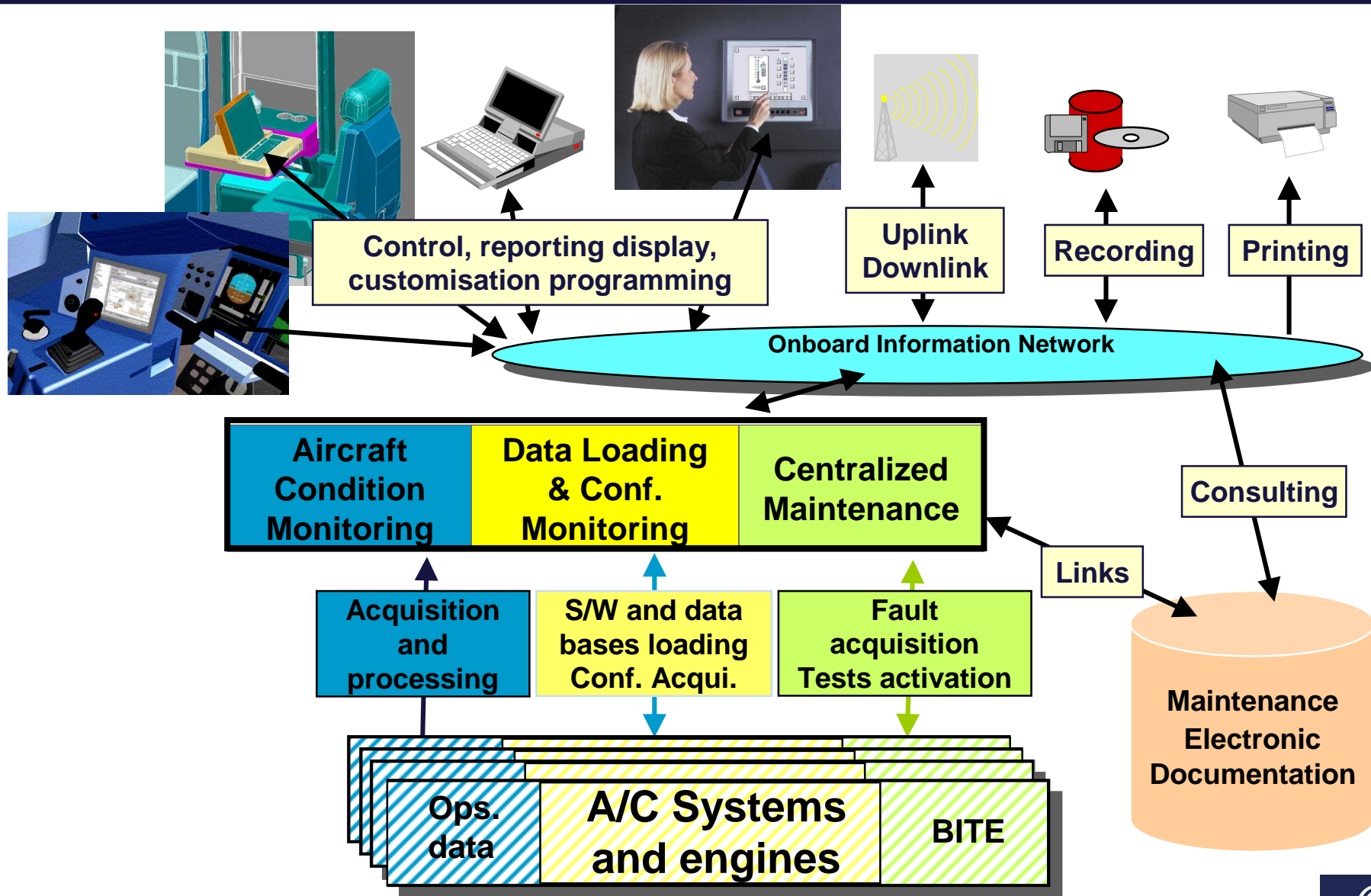


Integrated Modular Avionics

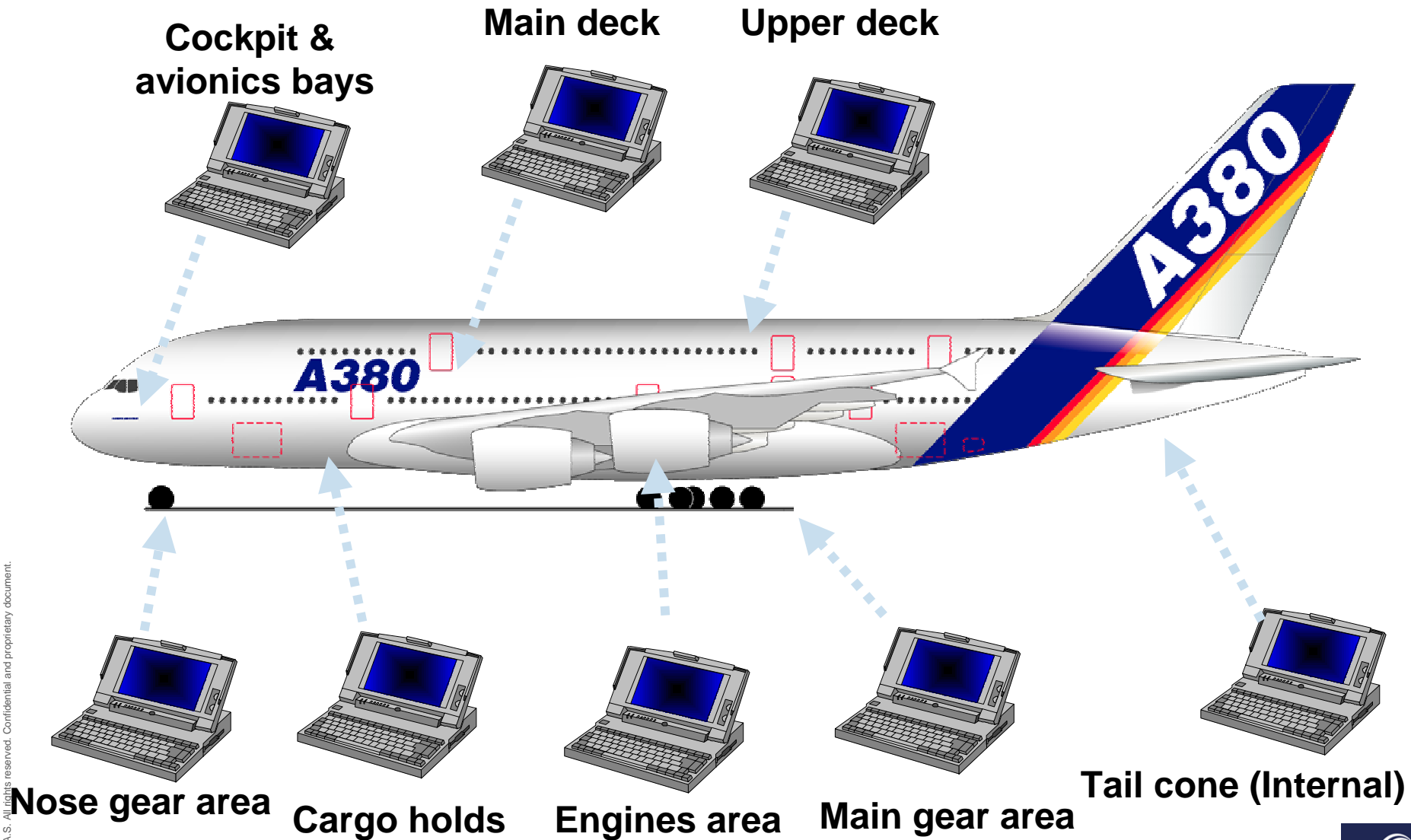


5000 psi Hydraulic Power

Onboard Maintenance System Concept



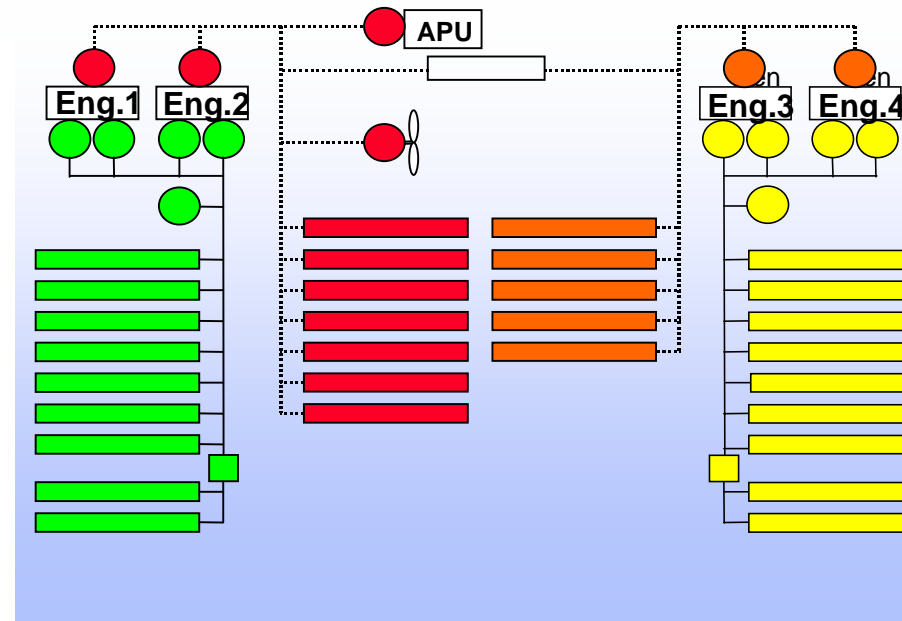
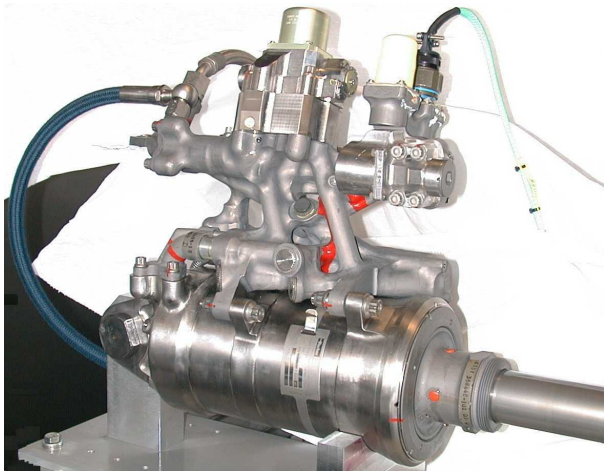
OMS Access from Portable Terminals : Areas to be covered by Aircraft Wireless LAN



Flight Controls / Hydraulics Architecture

Features:

- 4 fully independent systems
- 2 x dissimilar system architectures
- 2 x conventional hydraulic systems
- 2 x electro hydraulic systems
- Hydraulic pressure 5,000 psi, tested with no fluid degradation and no component erosion
- Actuators studied since 1990 and flight tested on A320 and A340

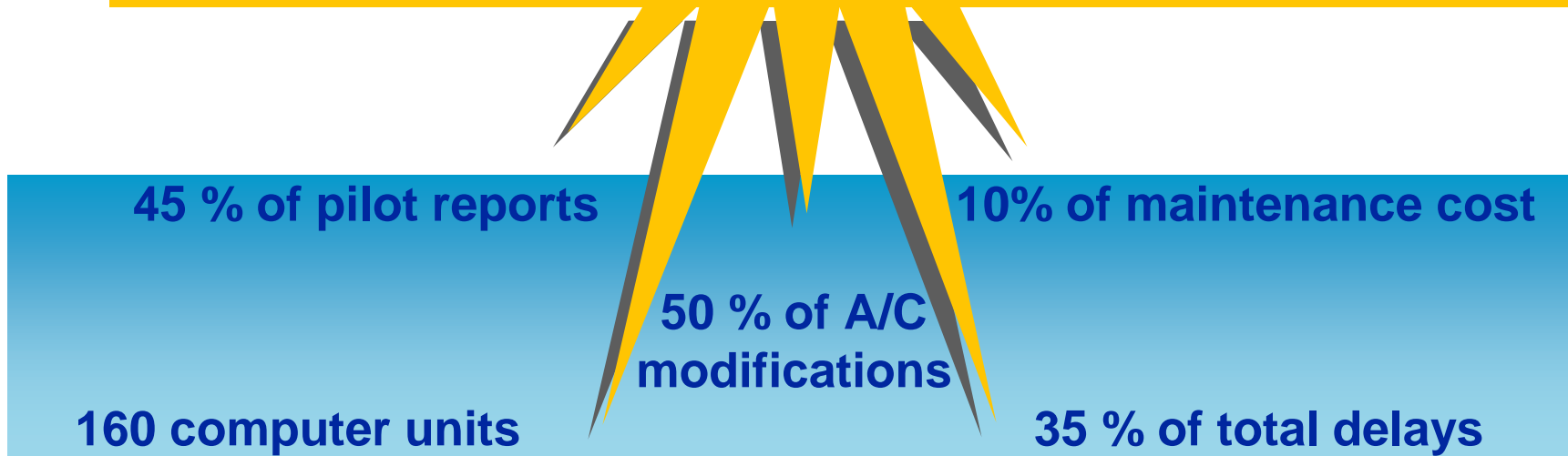


Benefits:

- Weight reduction
- System segregation
- Redundancy and operational reliability
- Maintenance costs
- Maintainability
 - **Smaller pipes easier more reliable connections**
 - **Electro pumps for ground use**

New Avionics

On very long haul aircraft **Avionics / Electronics** count for :



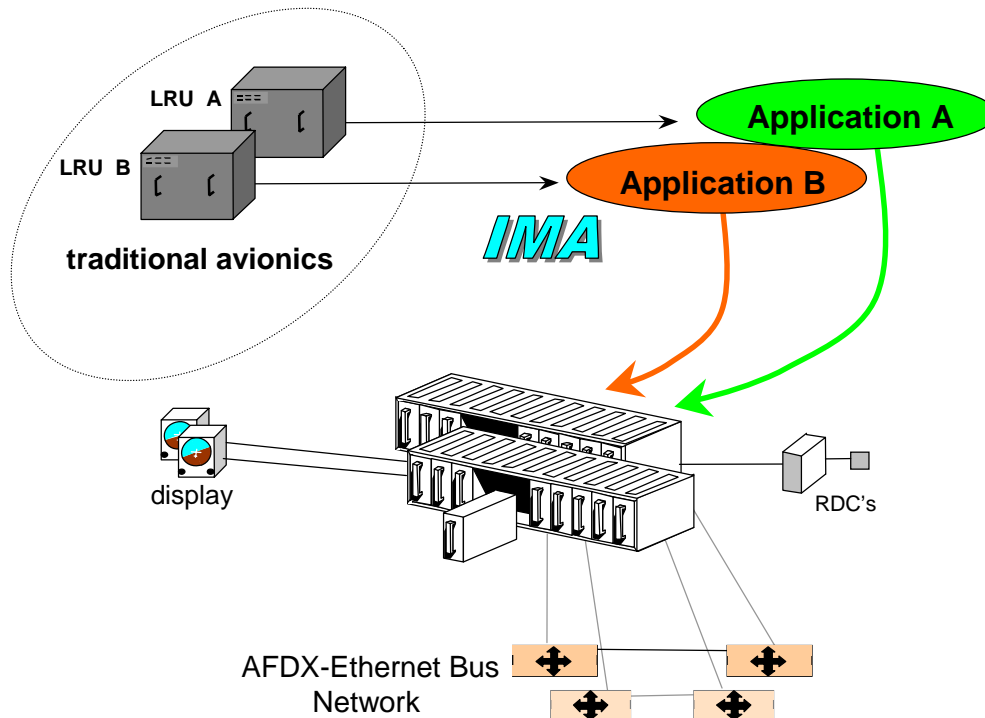
New concepts are needed.
A380 Avionics / Electronics will be

Integrated

Modular

Open

IMA - Principles and Benefits

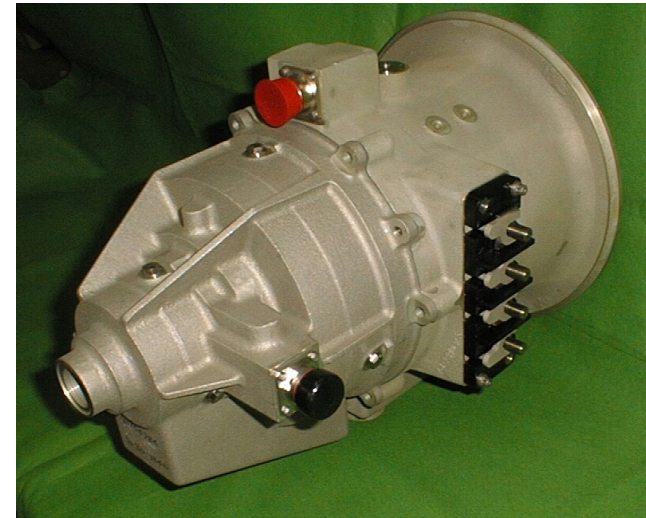
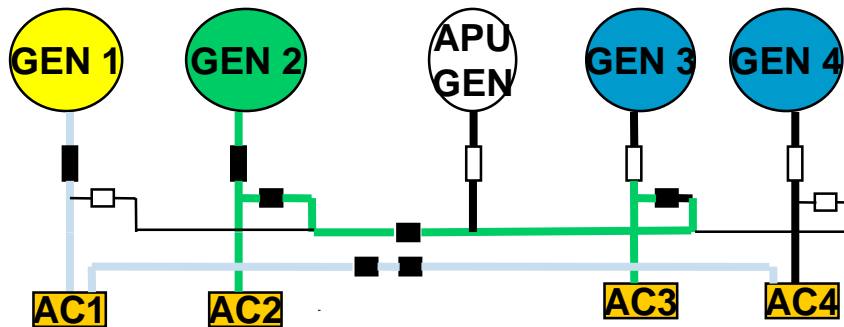


Main features:

- Redundancy of two or three to meet system dispatch and availability objectives
- Connection between the avionics network and open world (not proprietary) through secure communications interface
- Fewer spares through common modules
- Teleloading of data

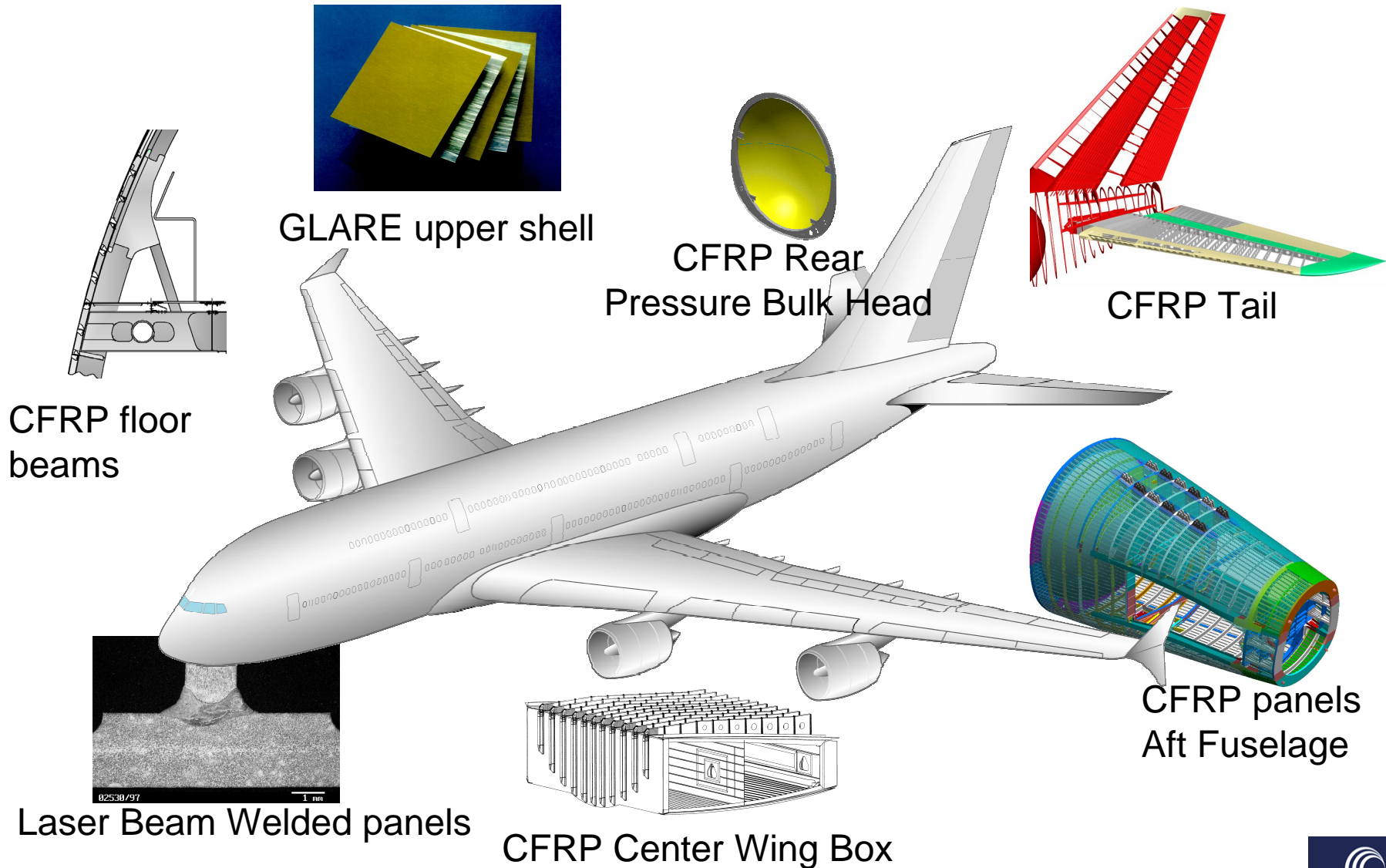
A380 Electrical Power Generation

Variable Frequency AC Generation

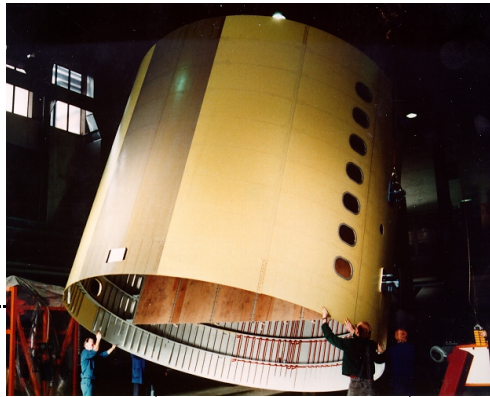
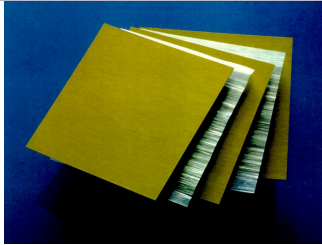


- **Compared with constant frequency generation:**
 - **Weight reduction**
 - **Maintenance cost reduction**
 - **Reliability improvement**

A380 Advanced Technology - Structure

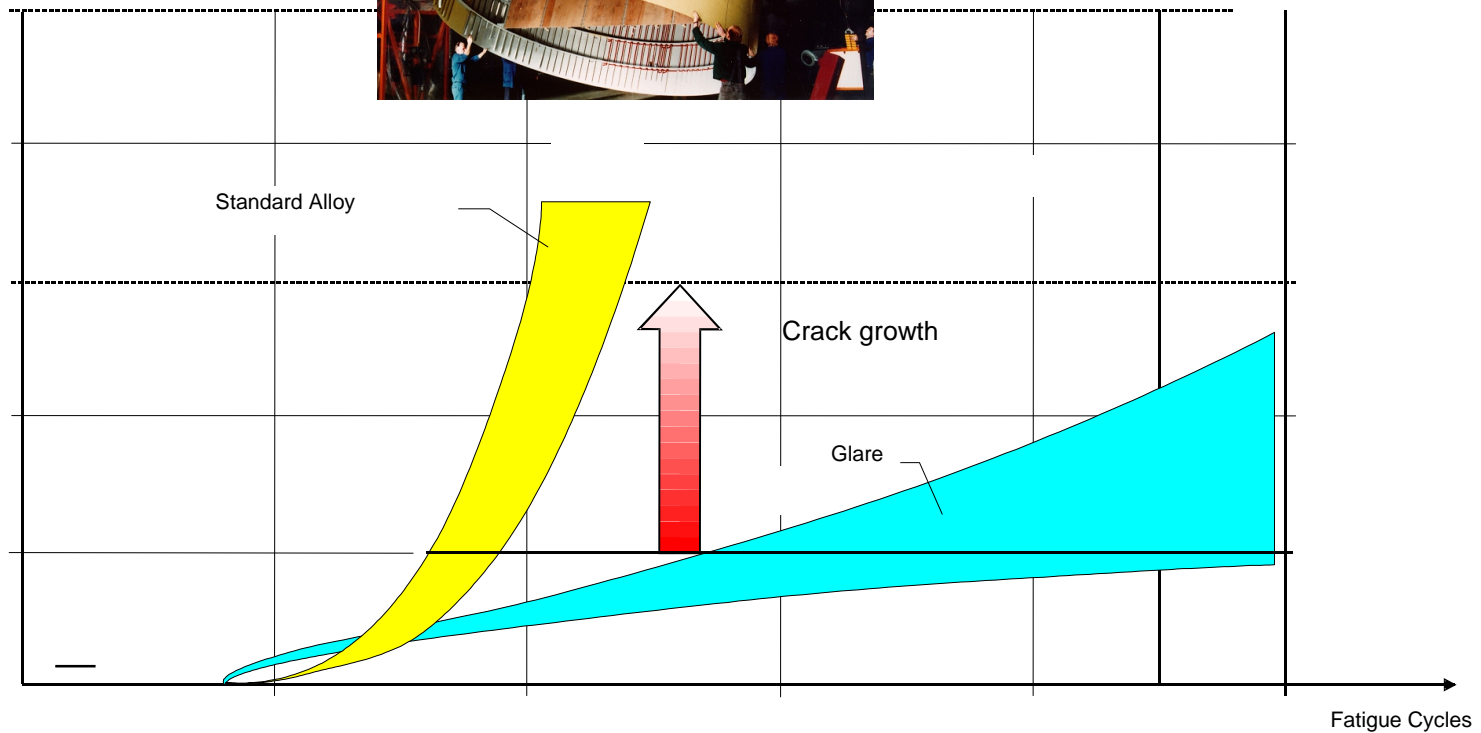


GLARE Fuselage Upper Shells

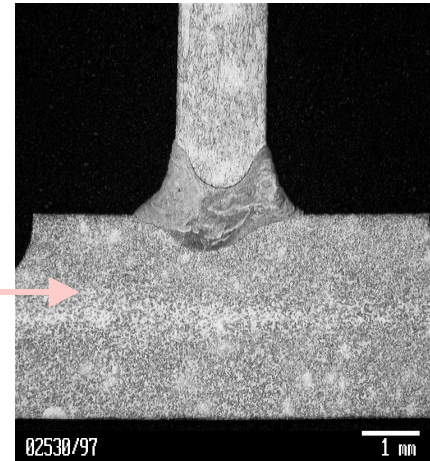
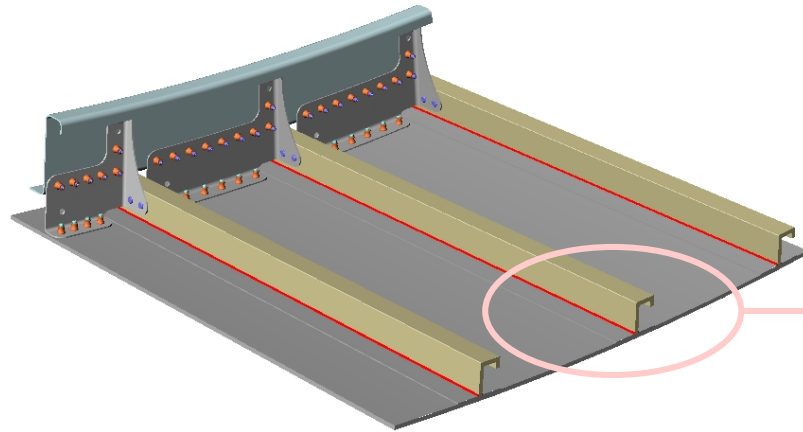


A340 barrel fatigue test

Crack length



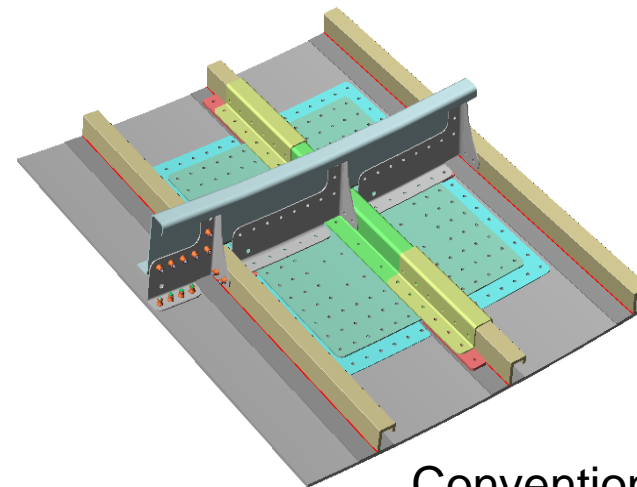
Laser-Beam-Welded Fuselage Panels



Laser welding seam cross section

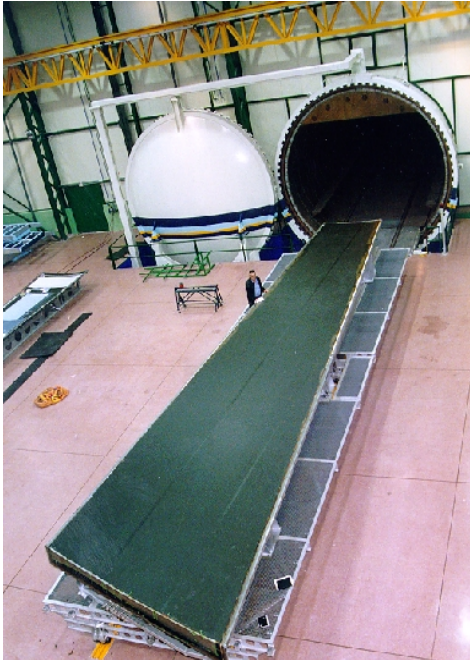


Damage-tolerance test specimen

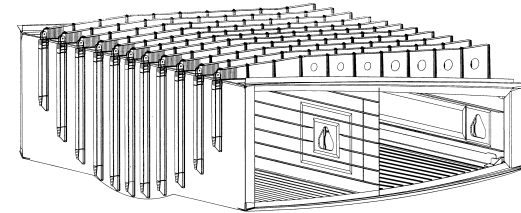


Conventional repairs

A380 CFRP Applications



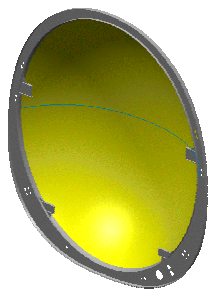
Horizontal stabilizer



CFRP centre wing box



Large CFRP structure demonstrator

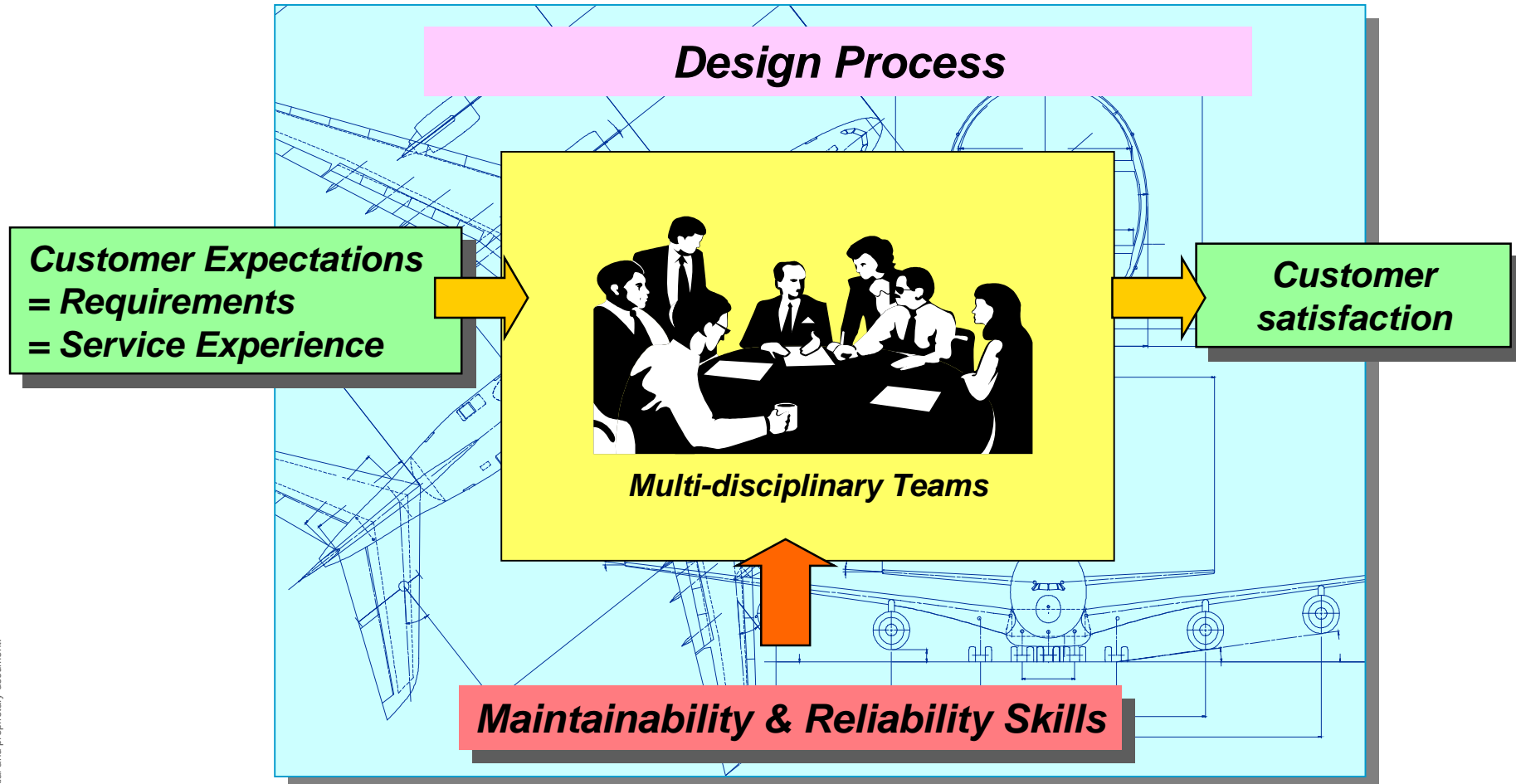


Rear pressure bulkhead

Maintainability & Reliability

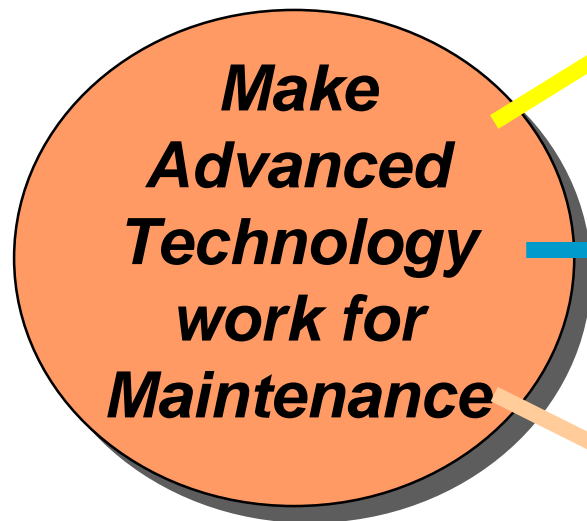


A380 Maintenance in Design



**MAINTENANCE SPECIALISTS INTEGRATED IN
THE DESIGN TEAMS**

Maintenance Philosophy

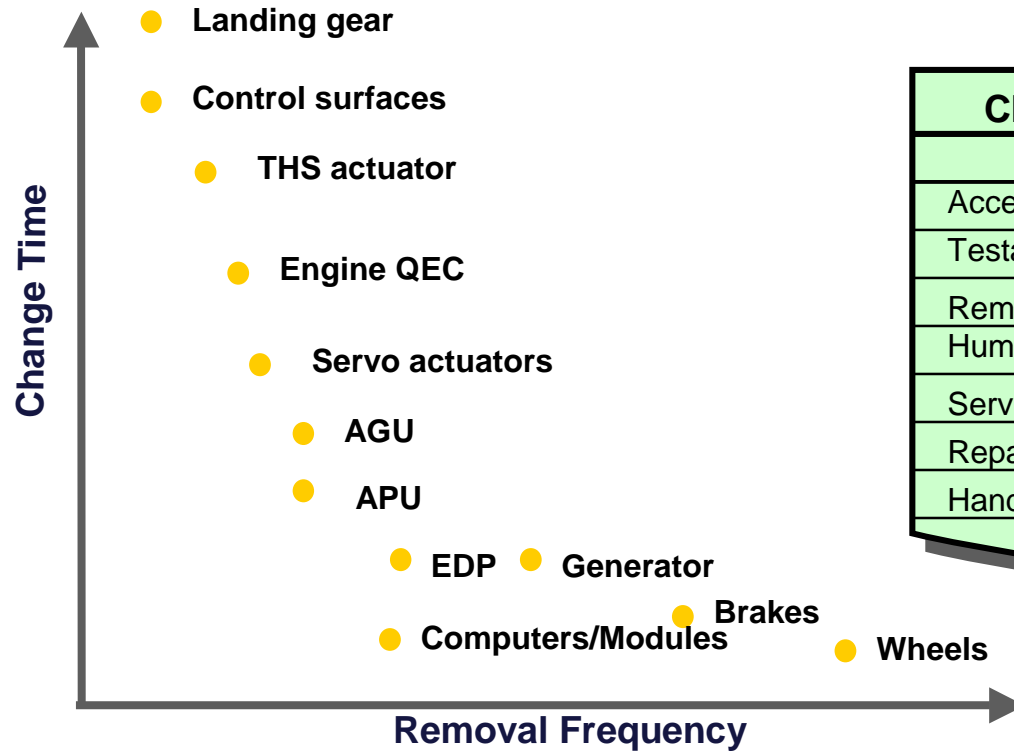


- **Setting new standards for maintenance costs**
- **Efficient maintenance programme**

- **Handling of larger and heavier equipment**
- **Minimise need for new skills and processes for new technology**

- **High operational reliability**
- **High component reliability**
- **Minimise ramp maintenance**
- **Early aircraft maturity**

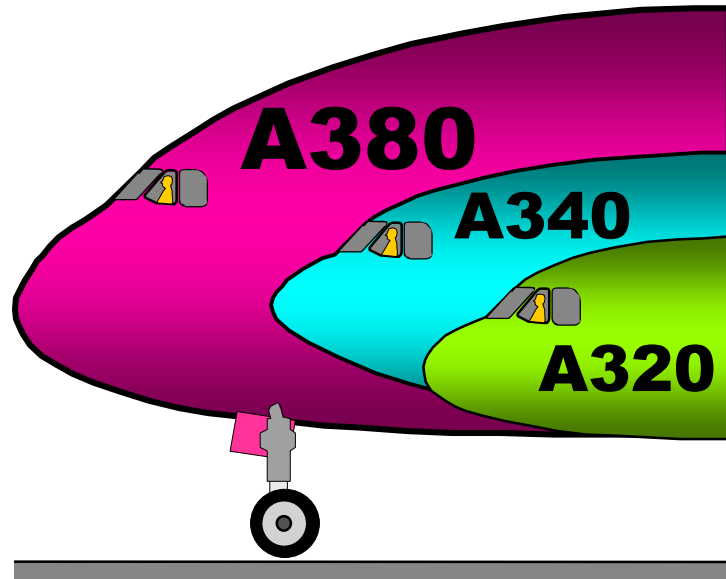
Maintainability Methods



CHECK LIST					
	A	B	C	D	Remarks
Accessibility	X				
Testability		X			
Remove/Replace		X			
Human Factors	X				
Servicing/Lube		X			
Reparability			X		
Handling		X			

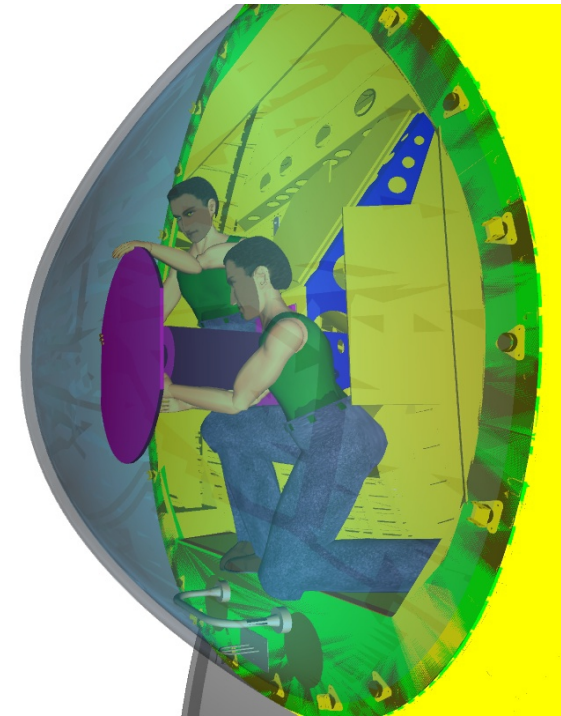
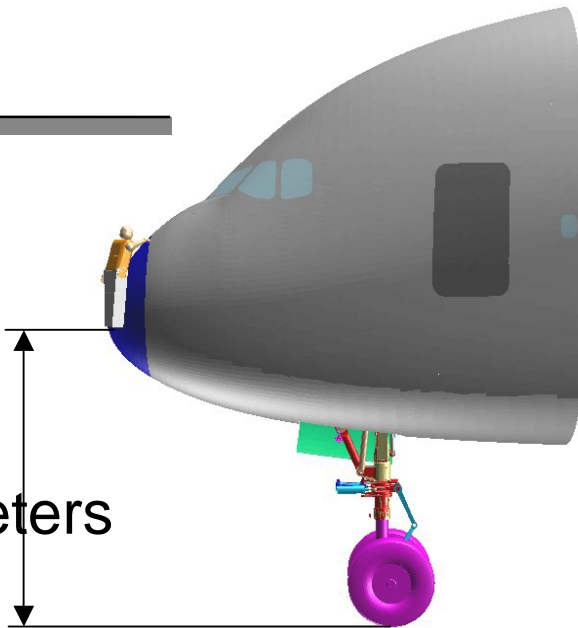
Task	↗	MMEL	Time Remove	Time Replace	Time Test	Total Time
<i>Maintenance Task Analysis</i>						

Radome and Radar Antenna Installation

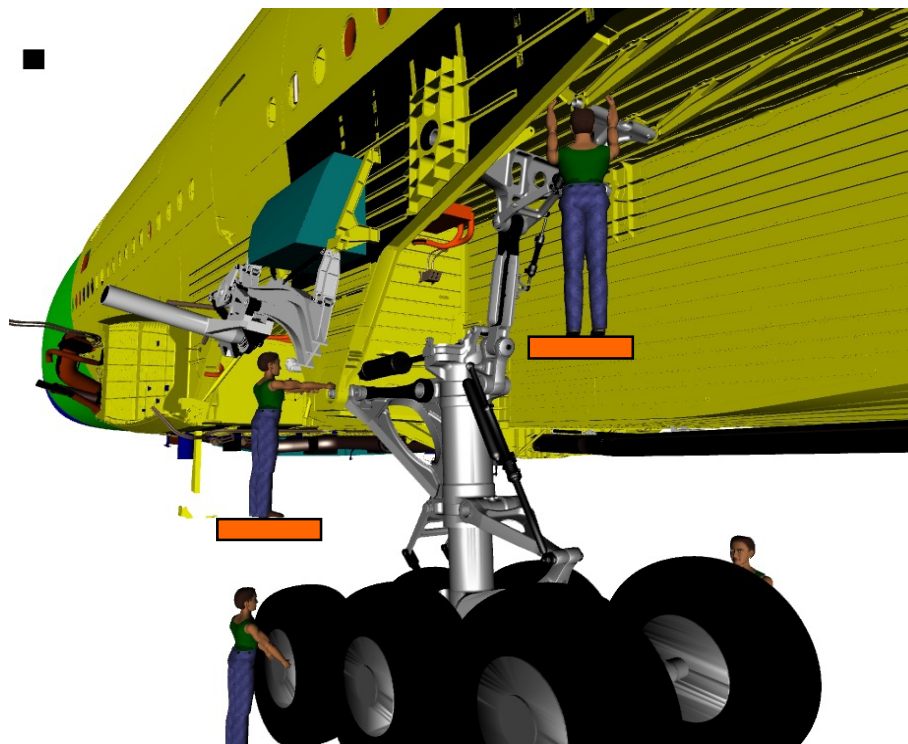
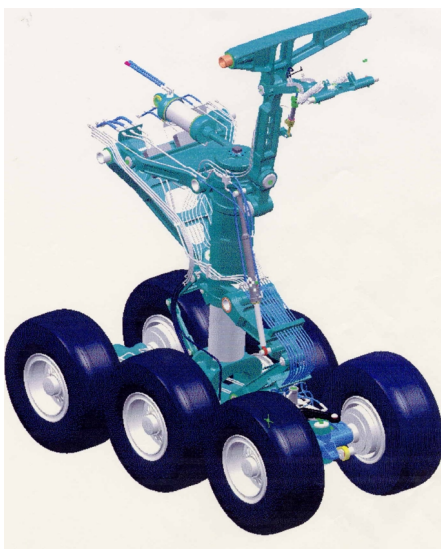


**External
access**

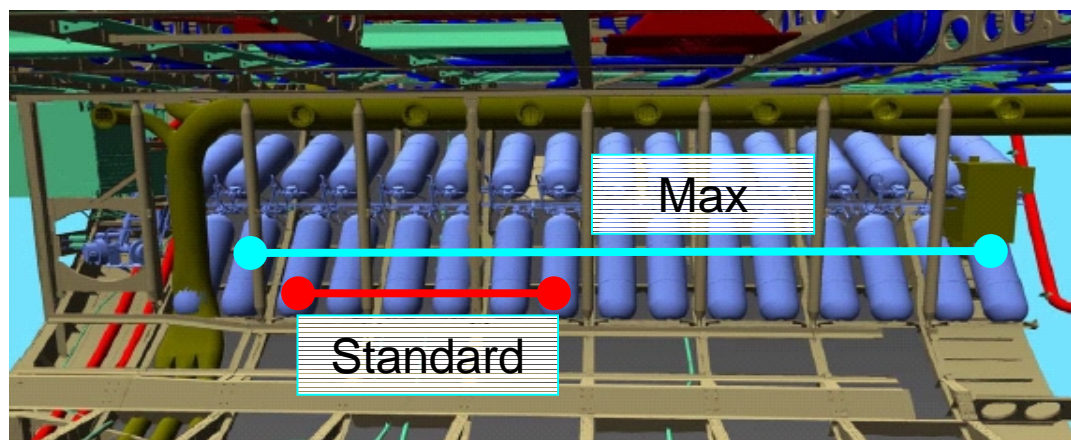
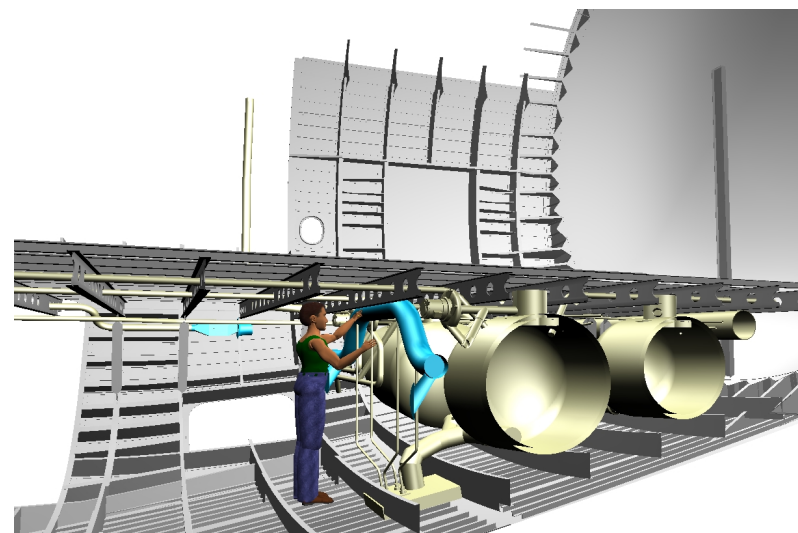
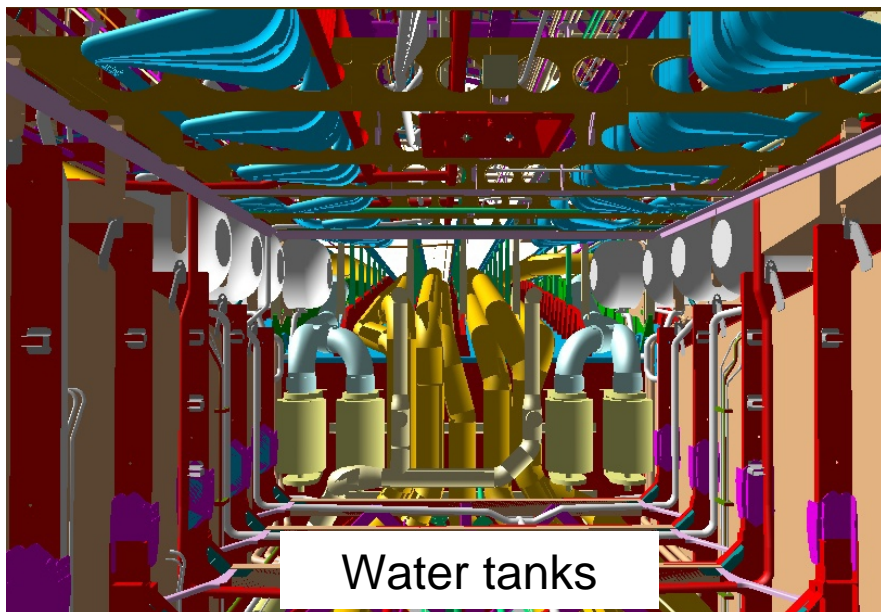
5 meters



Body Landing Gear Installation

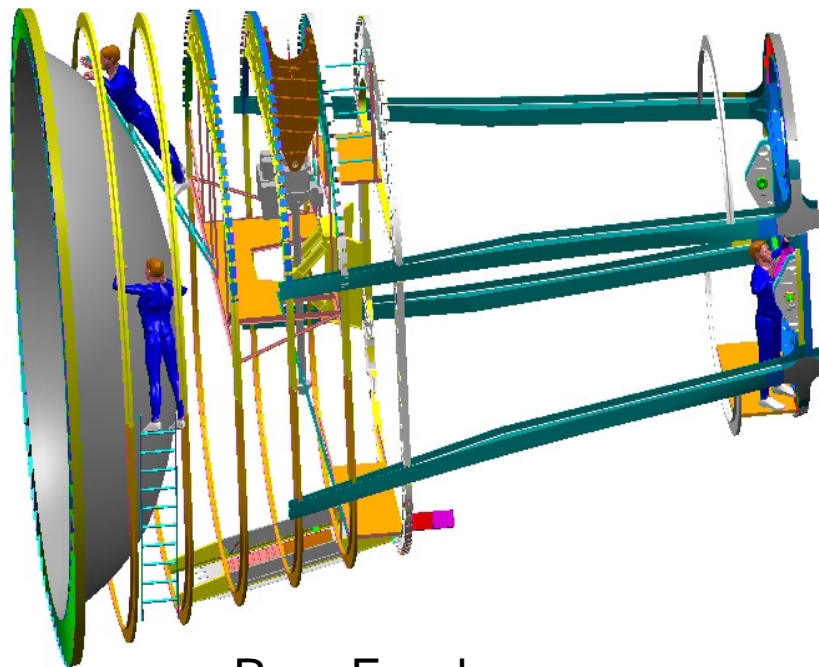


Water & Waste Tanks, Tailplane Trim Actuator and APU Installation

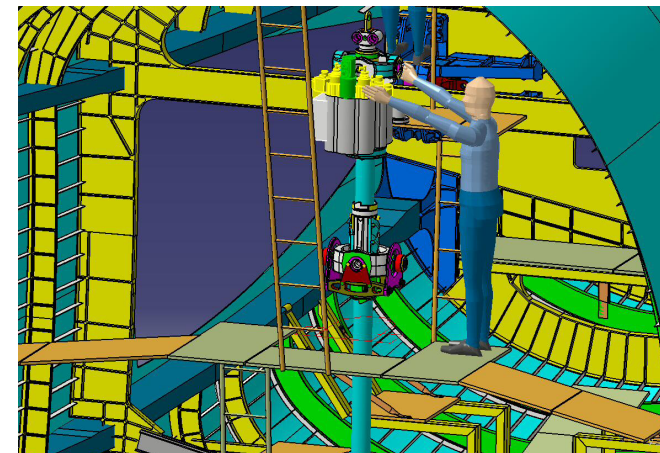


Oxygen bottles

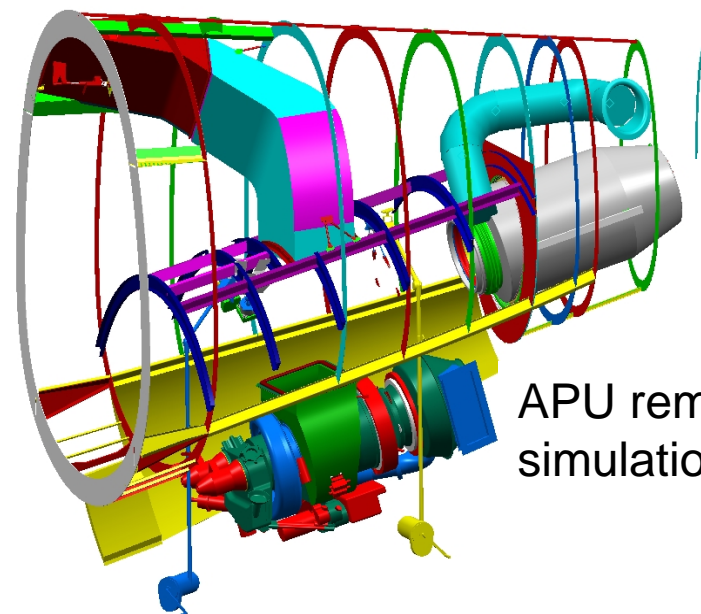
Rear Fuselage, Tailplane Trim Actuator and APU Installation



Rear Fuselage

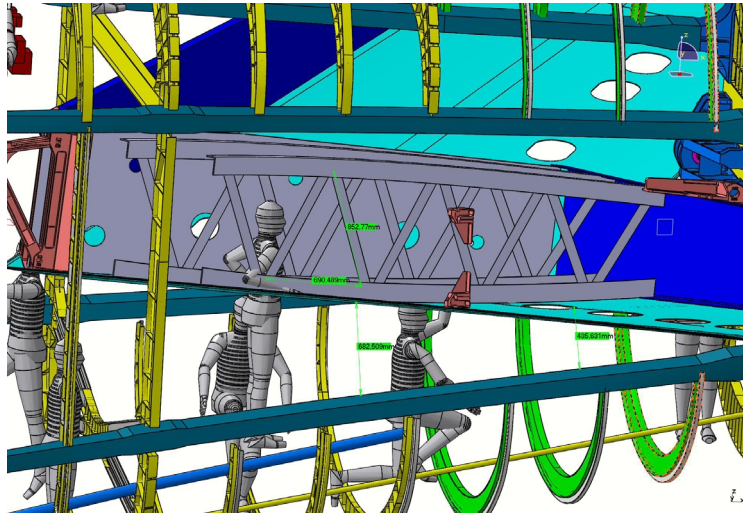


THS actuator installation

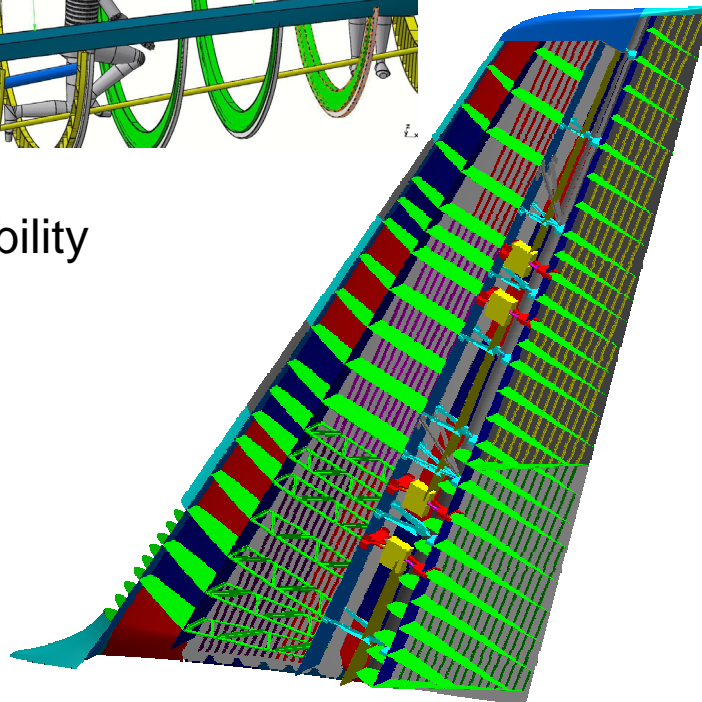


APU removal simulation

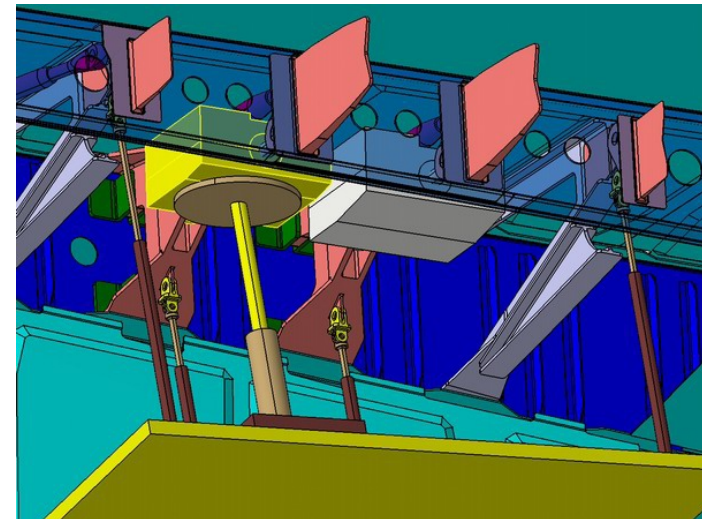
Horizontal and Vertical Tailplanes



HTP accessibility

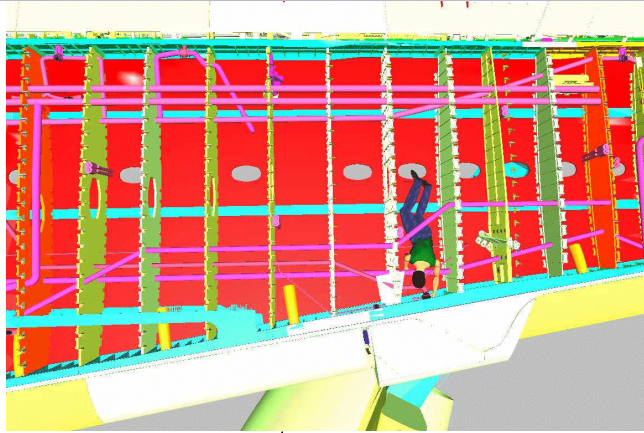


VTP layout

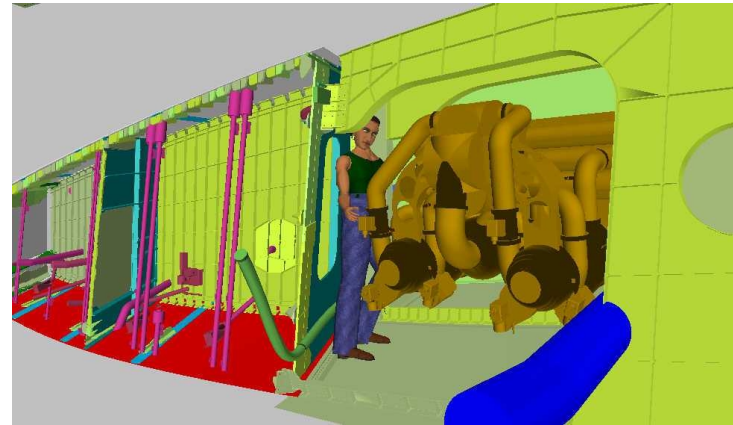


Elevator actuator removal simulation

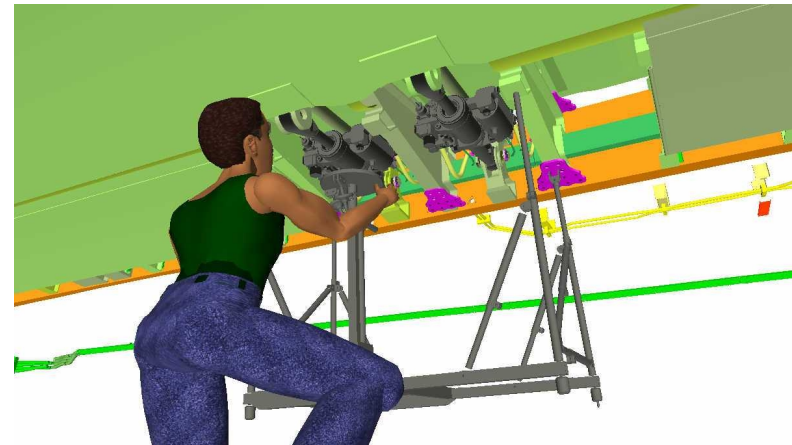
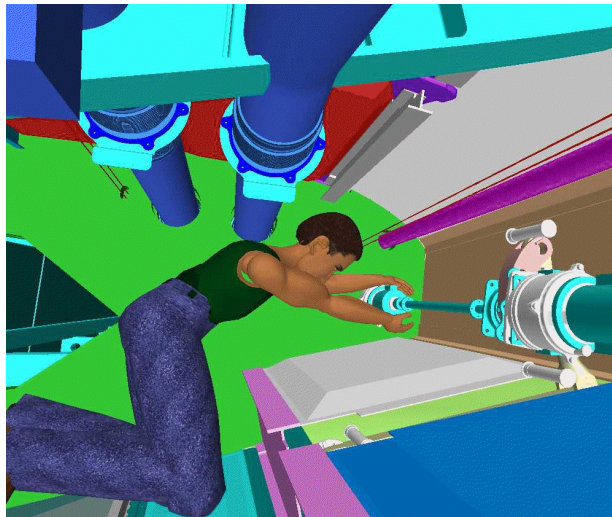
Wing Access and Installations



↑
Wing accessibility

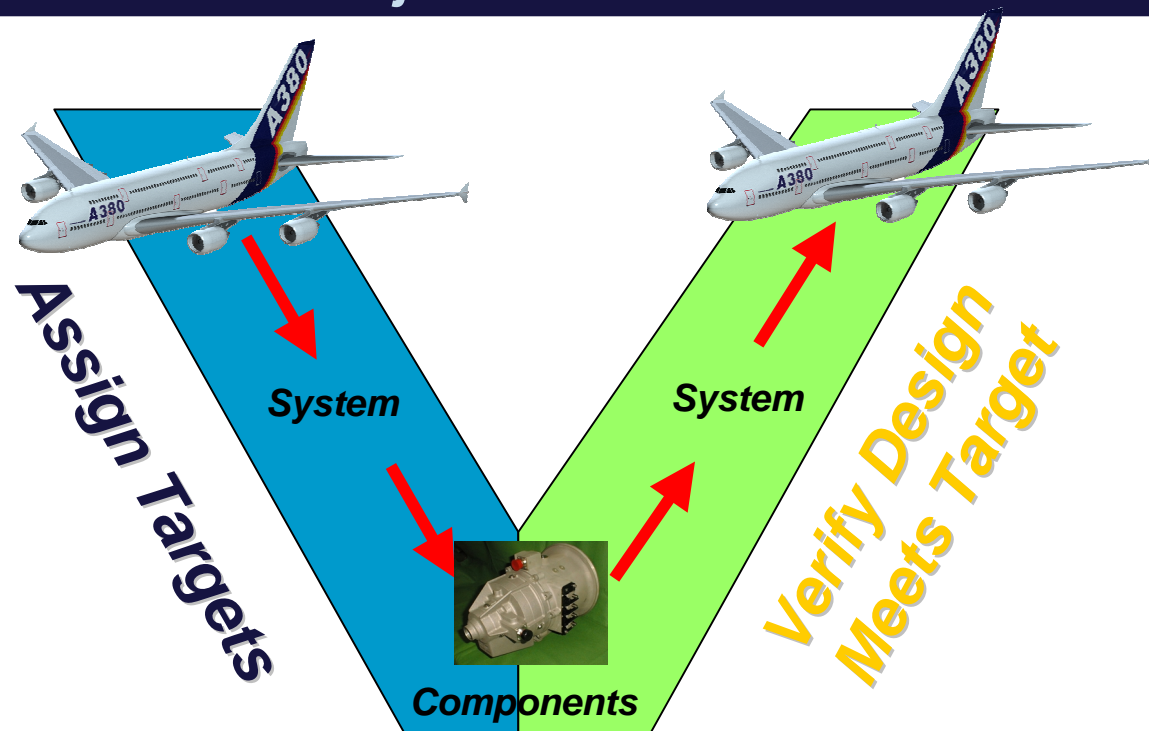


AGU installation



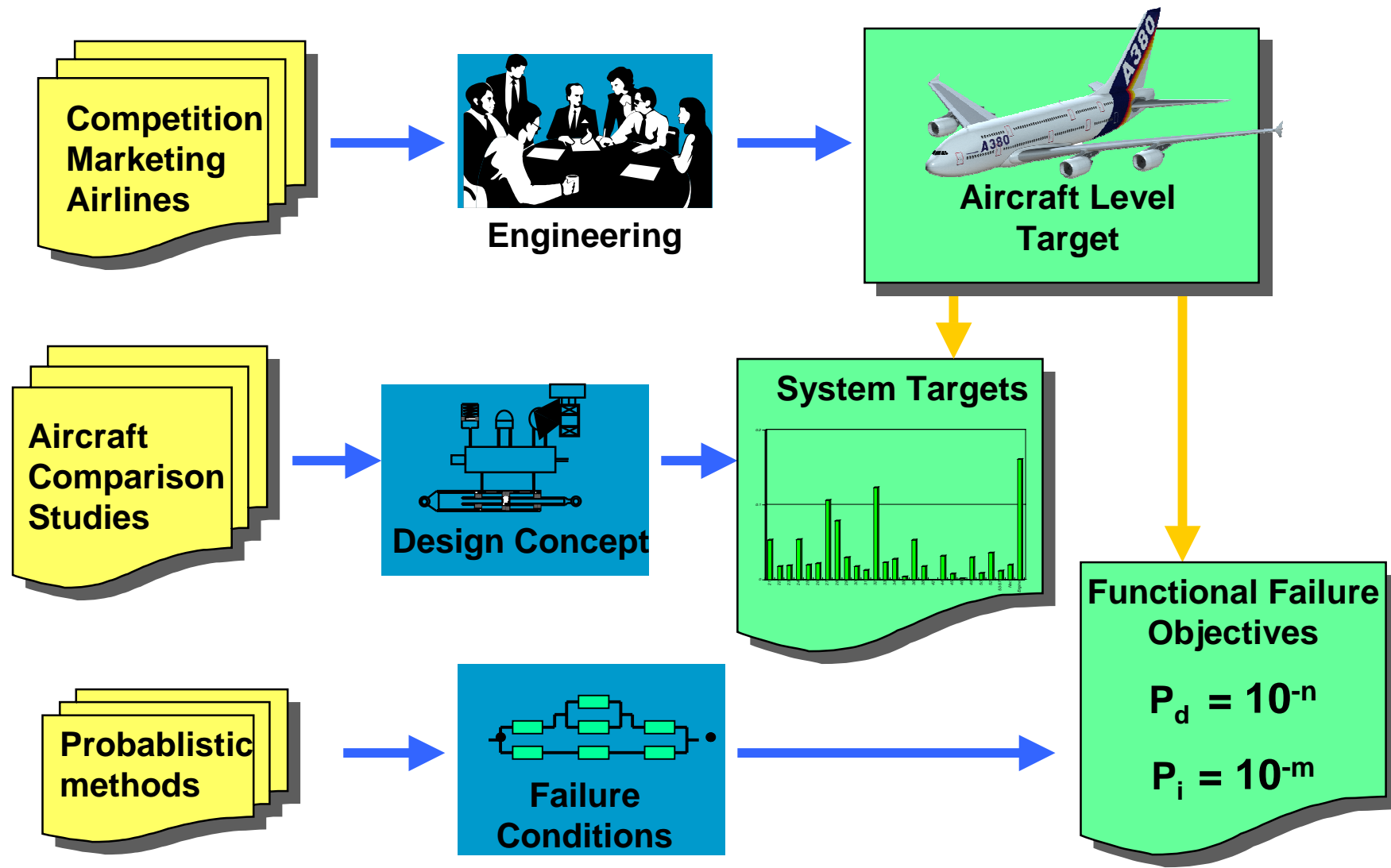
Flight control actuator removal simulation

Achieving Operational Reliability and Maintenance Cost Objectives



- ***Top Down approach to assign aircraft level targets to systems and components***
- ***Bottom Up approach to compare component then system results to arrive back at aircraft level***

Example: Deriving Operational Reliability Targets



Maintenance Programme



A380 Maintenance Programme Interval Framework

- The A380 Maintenance Programme will be designed to allow maximum flexibility by allocating task intervals in usage parameters (flight hours, flight cycles, calendar time) which allows operators to develop:
 - ▶ a “pre-packaged plan” with tasks allocated to letter checks
 - ▶ a “flexible plan” allowing task to be allocated to visits according to limitations, resources and downtime
- Target intervals for design are:

▶ A Check	750 FH
▶ C Check	18/24 months
▶ Heavy Layover	120/144 months
▶ Repeat Layover	60/72 months

Maintenance Programme Development

- The A380 Maintenance Programme will be developed in accordance with the MRB process
- MSG 3 revision 2002 will be used
- The development activities will be inaugurated in early 2003 through the formation of the A380 Industry Steering Committee
- Working Group activities will follow throughout 2003/2004
- Preliminary work is underway to ensure that advanced technology features are fully compatible with maintenance programme objectives

Airports and Facilities



Main Surveyed Airports

ASIA-PACIFIC

Tokyo (NRT, HND)
Hong Kong (HKG)
Singapore (SIN)
Bangkok (BKK,BKK II)
Taipei (TPE)
Seoul (SEL II)
Sapporo (CTS,HKD)
Sydney (SYD)
Brisbane (BNE)
Melbourne (MEL)
Auckland (AKL)
Beijing (PEK)
Shanghai (SHAII)
Guangzhou (CANII)
Osaka (KIX, ITM)
Okinawa (OKA)
Fukuoka (FUK,KMQ)
Nagoya (NGO,NGOII)
Kagoshima (KOJ,KMI)
Jakarta (CGK)
Kuala Lumpur (KULII)
Manila (MNL,MNLII,SFS)

EUROPE

London (LHR,LGW, STN)
Paris (CDG, ORY)
Frankfurt (FRA)
Amsterdam (AMS)
Rome (FCO)
Madrid (MAD)
Munich (MUC)
Luxembourg (LUX)

US

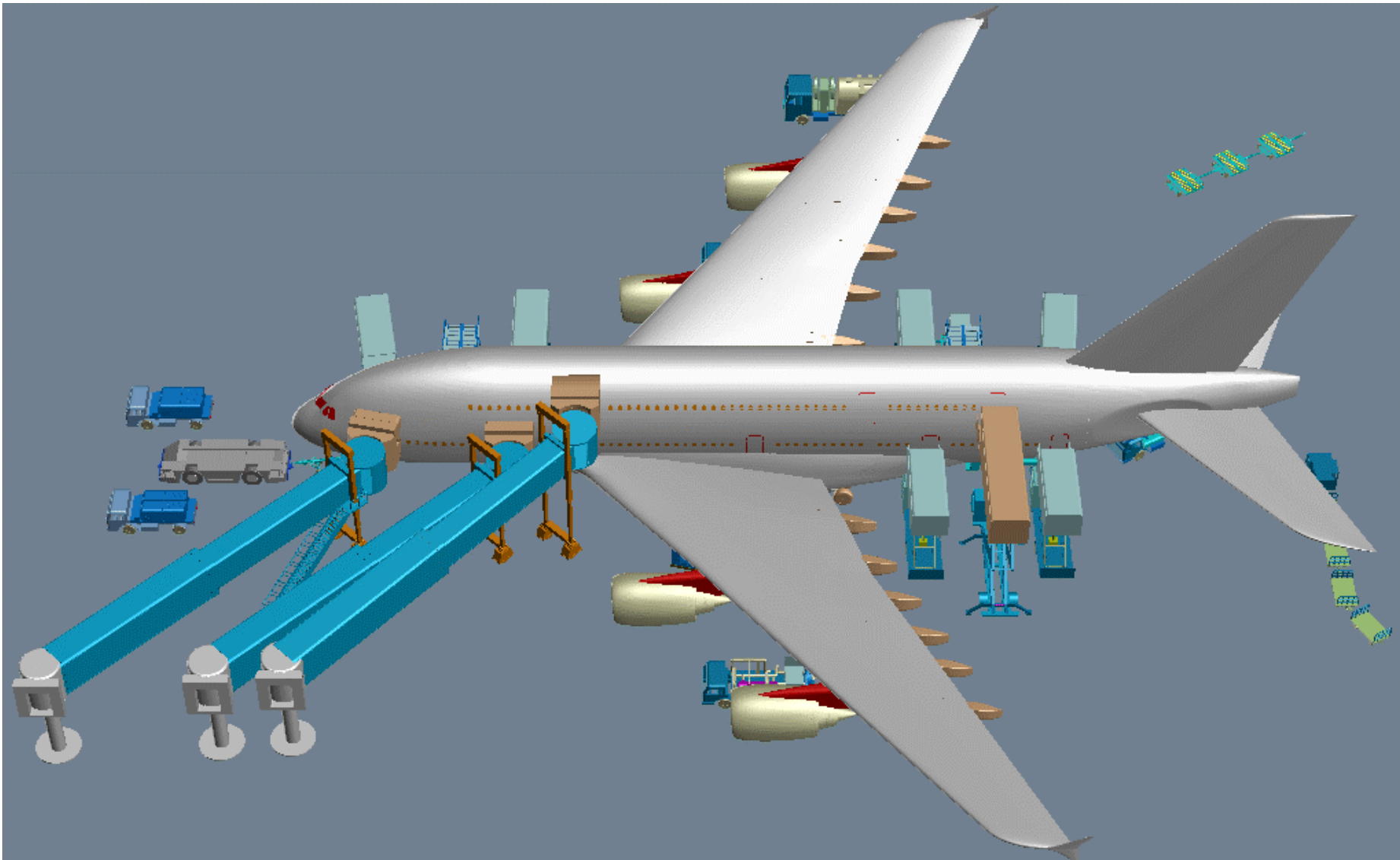
New York (JFK, EWR)
Los Angeles (LAX)
San Francisco (SFO,OAK)
Honolulu (HNL)
Miami (MIA)
Chicago (ORD)
Memphis (MEM)
Anchorage(ANC)
Washington (IAD)
Dallas (DFW,AFW)
Orlando (MCO)
Indianapolis (IND)
Atlanta (ATL)
Denver (DEN)
Detroit (DTW)
Minneapolis (MSP)

Rest of World

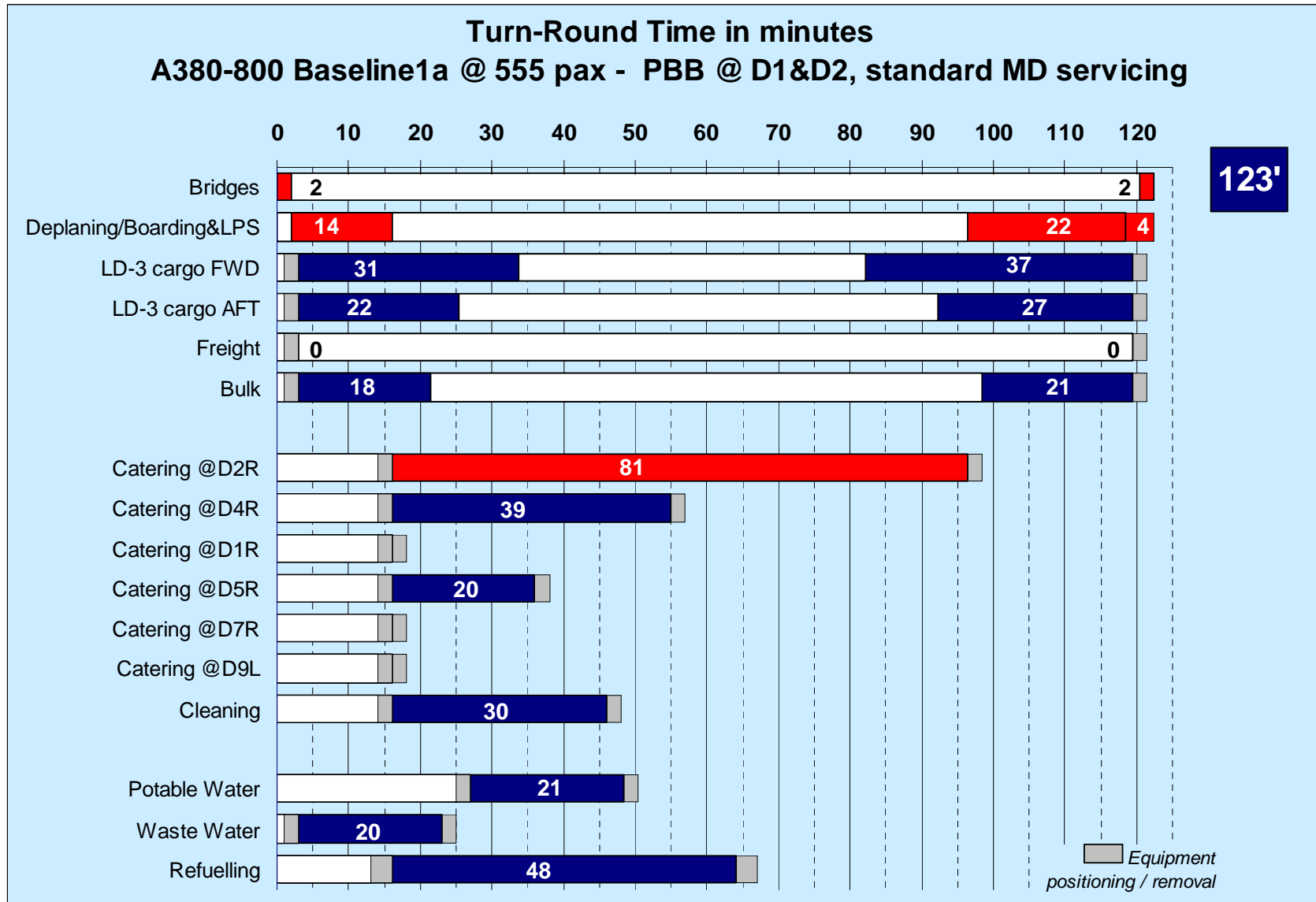
Vancouver (YVR)
Montreal (YUL)
Toronto (YYZ)
Sao Paulo (GRU,VCP)
Rio (GIG)
Delhi (DEL)
Mumbai (BOM)
Fort de France (FDF)
Pointe à Pitre (PTP)
Buenos Aires (EZE)
Johannesburg (JNB)
Dubai (DXB)
Jeddah (JED)
Riyadh (RUH)
Santiago (SCL)
Doha (DOH)
Mexico (MEX)
La Reunion (RUN)
Karachi (KHI)

***Note: Airports with highest number of predicted A380 movements
or requested by airlines and some leading cargo airports***

A380 Ramp Set Up

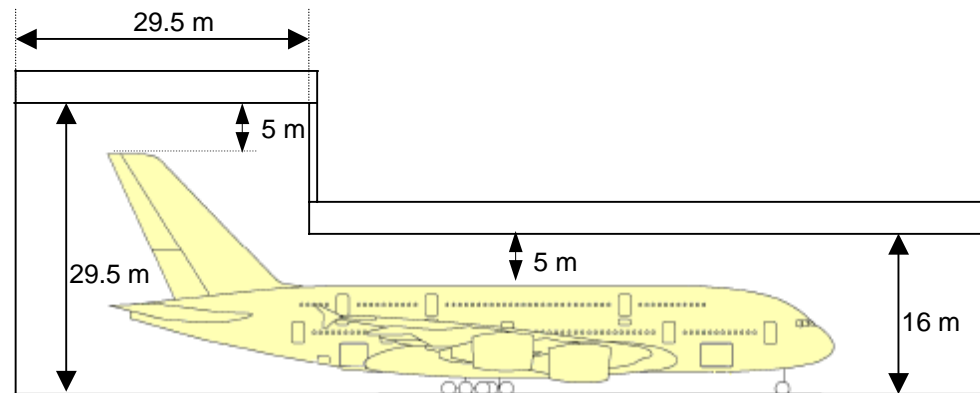


Turn-Round Time: A380 operated as 747



Consistent with Ramp Layout RL01/B1a/800/std

Maintenance Facilities - Hangar



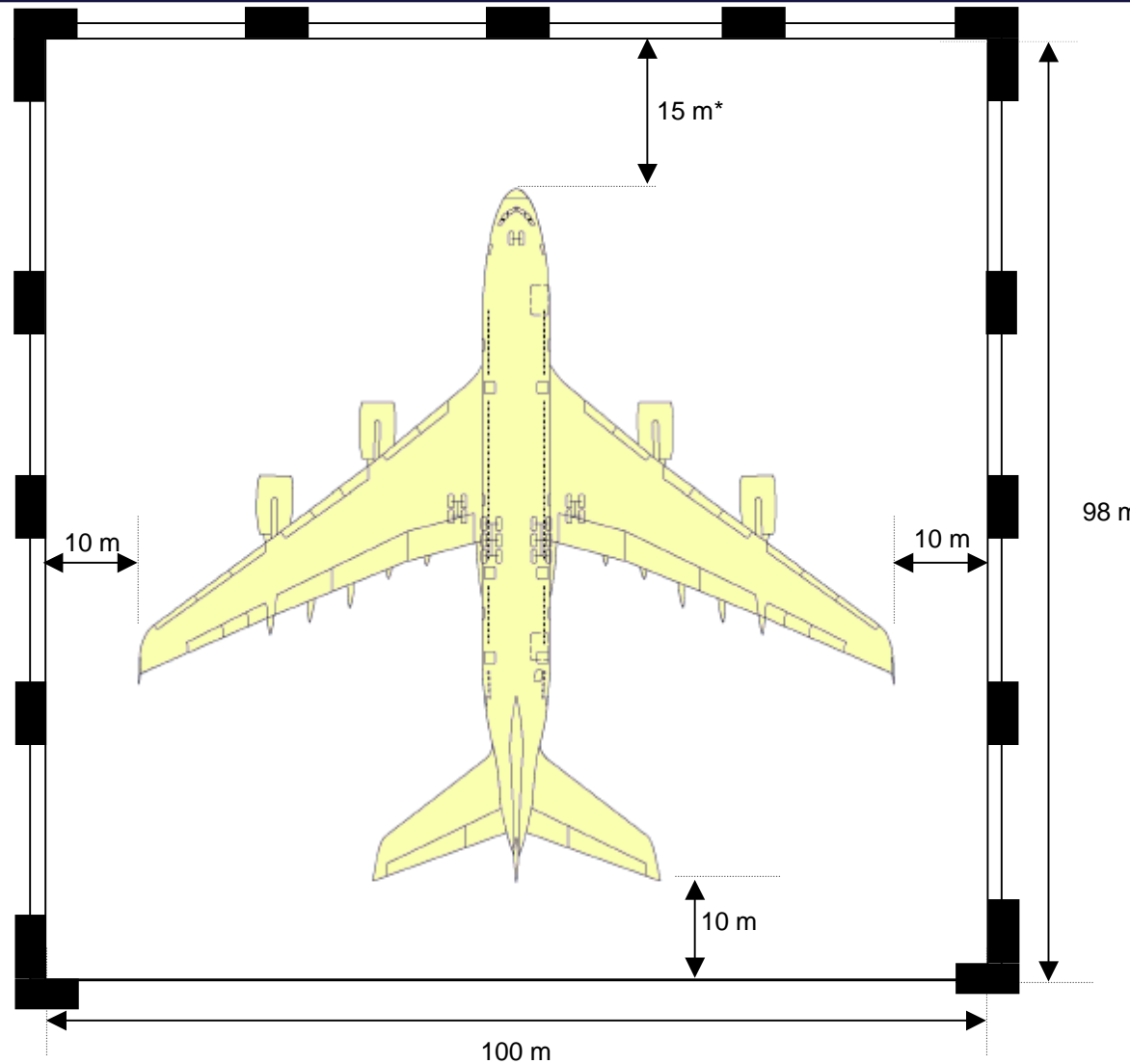
SUGGESTED HANGAR ARRANGEMENT

Nose-in Position

Maintenance Facilities - Hangar

NOTE:

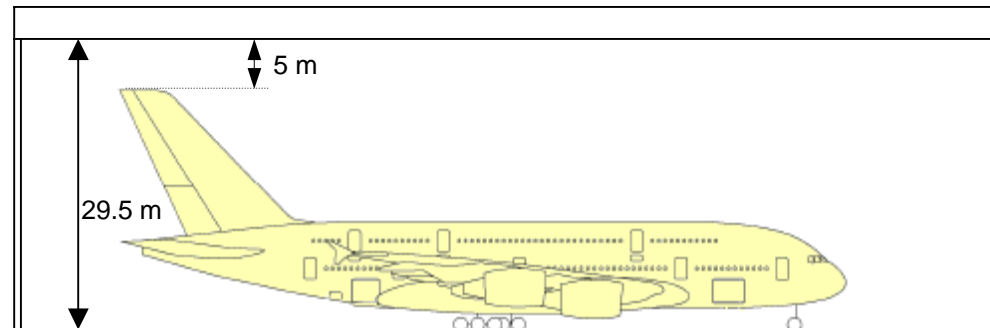
* MINIMUM
NECESSARY
DISTANCE TO
MOVE AWAY A
TRACTOR WITH A
TOW BAR



SUGGESTED HANGAR ARRANGEMENT

Nose-in Position

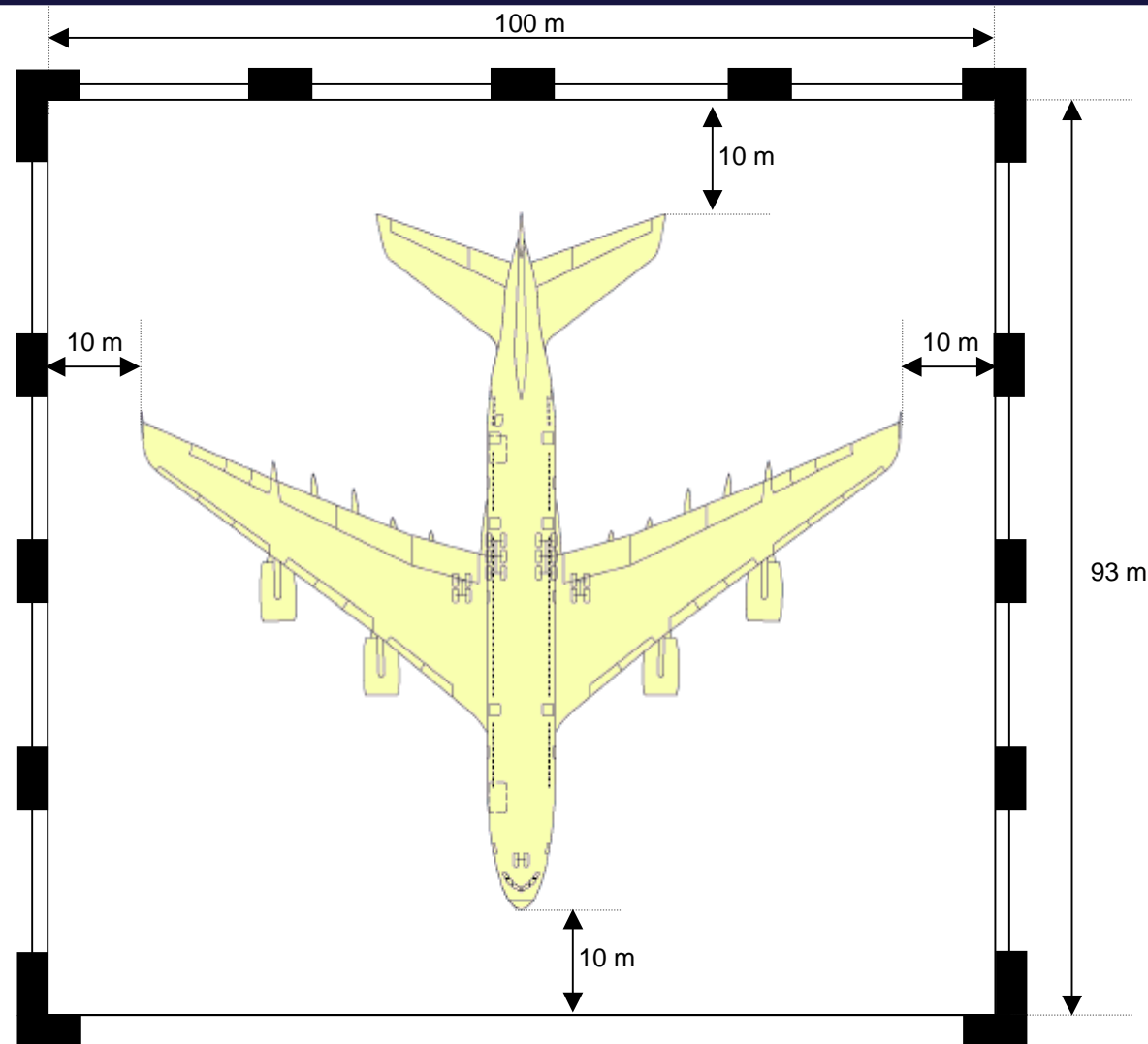
Maintenance Facilities - Hangar



SUGGESTED HANGAR ARRANGEMENT

Tail-in Position

Maintenance Facilities - Hangar



SUGGESTED HANGAR ARRANGEMENT

Tail-in Position

Airline Involvement



A380 Programme - Airline Involvement



- **20 major airlines** have been shaping the design of the A3XX / A380 for seven years
- They represent **two thirds** of seats offered in aircraft with more than 400 seats
- They all operate 747-400s on a **wide range of mission types** : very short to very long haul, high comfort to high density layouts, in all passenger, combi or freighter configurations
- They are the core of the **global airline alliances** taking shape
- **Half of them** are based in the Asia-Pacific area
- Their **expertise** in their business is widely recognized
- By the end of 2002 **over 100 CFG meetings** have been held

**Unprecedented airline involvement
from day one**



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