

May 2007



Deutsche Gesellschaft  
für Luft- und Raumfahrt  
Lilienthal-Oberth e.V.



Hochschule für Angewandte  
Wissenschaften Hamburg  
Hamburg University of Applied Sciences

**VDI**

Verein Deutscher Ingenieure  
Hamburger Bezirksverein  
Arbeitskreis Luft- und Raumfahrt

 Luftfahrtstandort  
Hamburg

Oliver Zeplin  
Manager Virtual Reality and Engineering Mockups  
Cabin Innovations  
Center of Excellence Cabin & Cargo Customization  
Airbus Deutschland GmbH

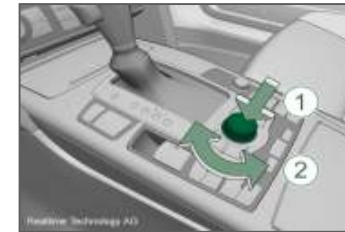


## The Application of Virtual Reality in the Design of Aircraft Cabins



**AIRBUS**

# Virtual Reality in the automotive industry...



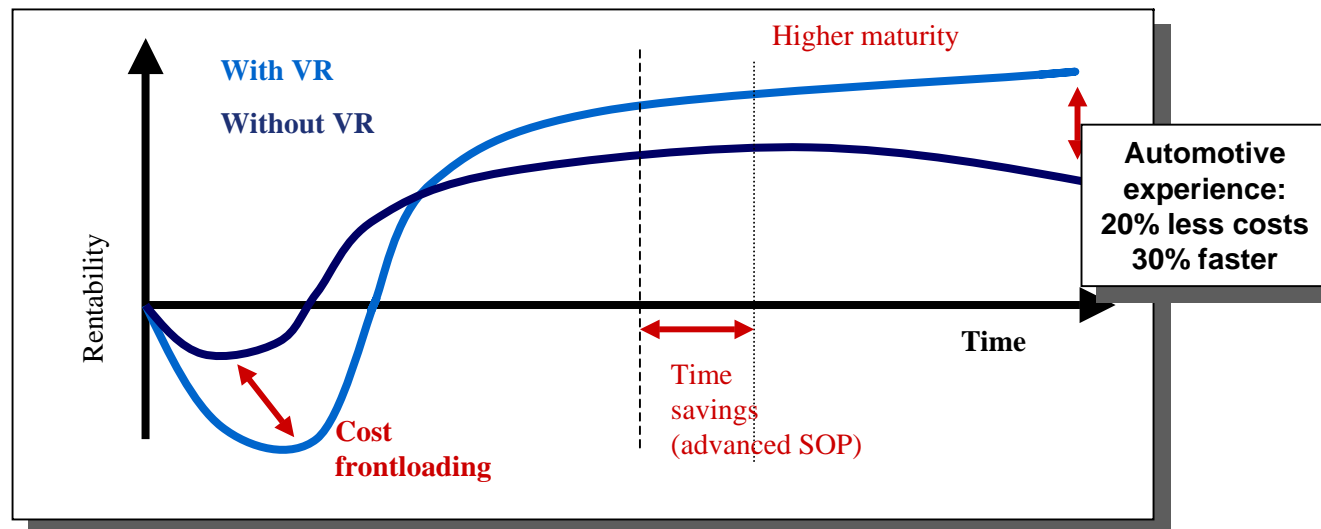
Innovation; Design;  
Marketing

Engineering & Customisation

Manufacturing

Customer  
Service

# Virtual Reality in Automotive Industry...



**Upfront investment and high penetration of VR across the overall process / development lifecycle leads to increased maturity, reduced development time and reduced costs**

**Automotive industry only produces a physical mockup for the baseline, all variants are reviewed virtually with Top-Management**

# What is Virtual Reality?

Virtual Reality is the creation of an artificial world, enabling a significant set of use cases

Virtual Reality is much more than “3D cinema”

- users can actively control the with environment
- and interact with the environment
- in real time (intuitive)

Virtual Reality complements the digital mock-up and covers

- Visualization of 3D data - impression of “reality”
- A set of tools / methodology to support engineering & design work, fostering human-machine interaction

Virtual Reality is characterized by the 3 “i”:

- Immersion
- Interaction
- Integration



# Welcome to the Cabin Virtual World @ Airbus...



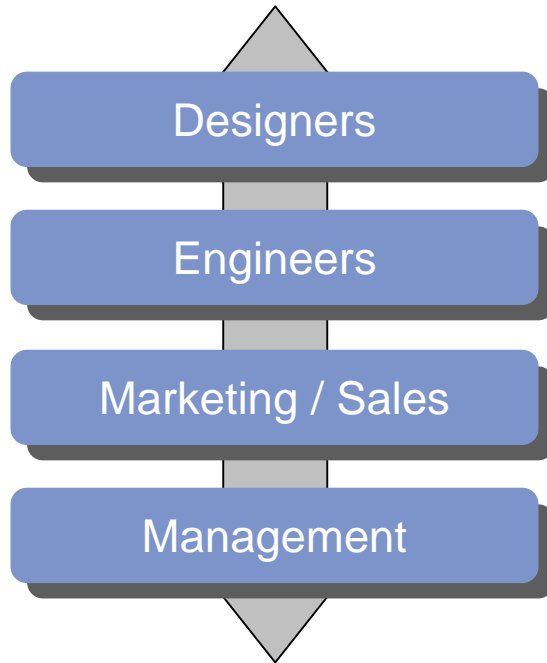
Virtual Reality in General

Infrastructure

Use cases

Summary

# Virtual Reality in product development



visualize ideas & communicate

analyze, understand & optimize

visualize to promote & sell

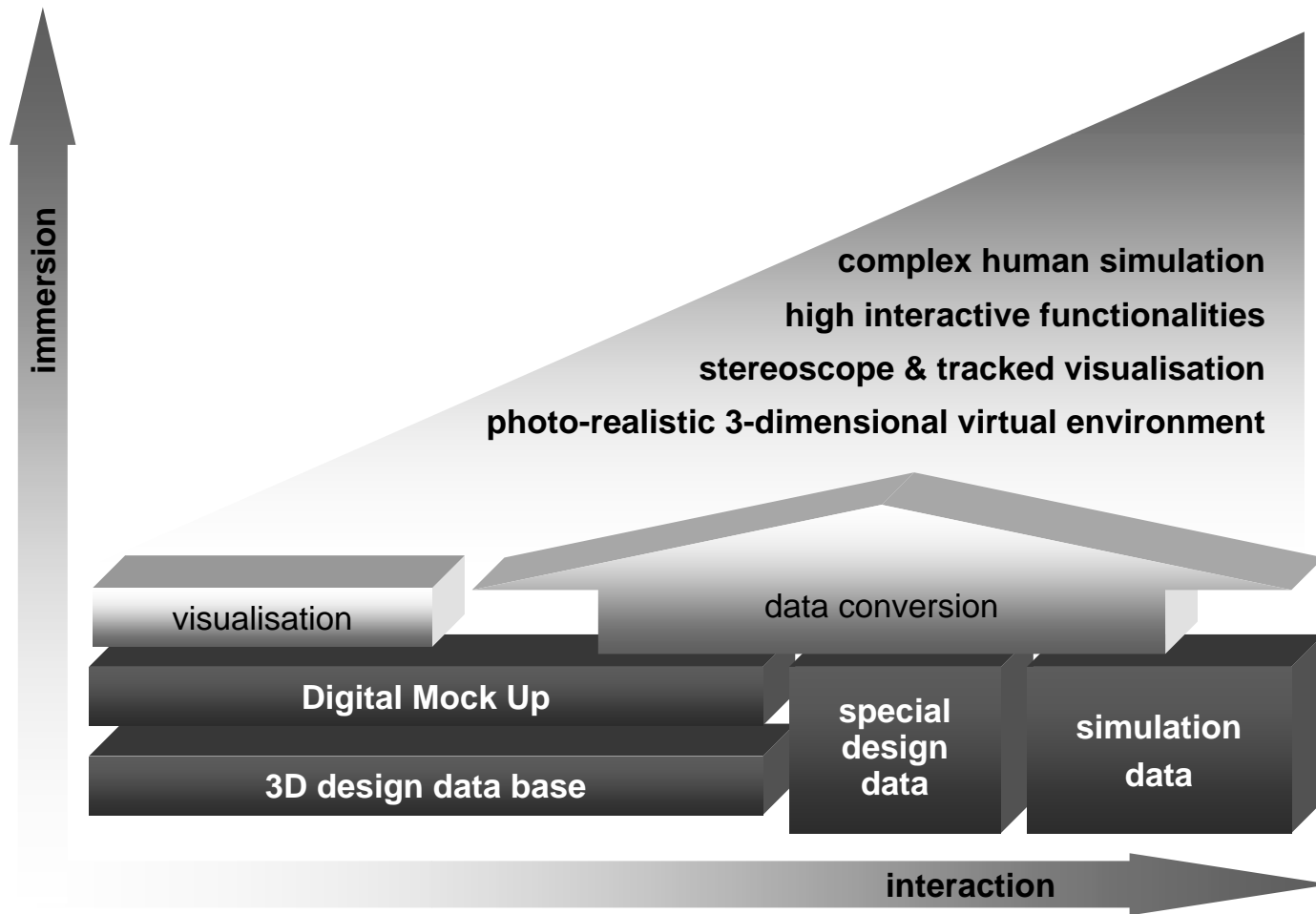
quickly understand & decide to minimize risks & costs

Enhance interdisciplinary communication

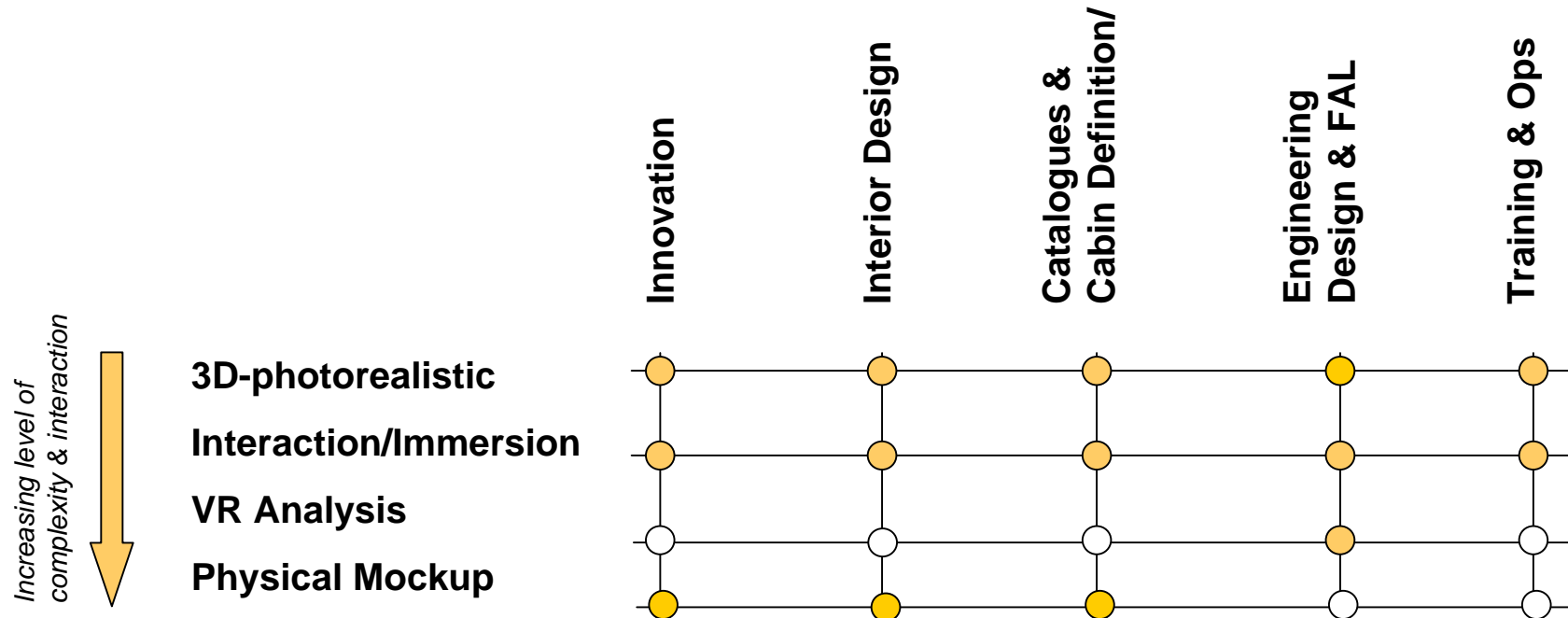
## VR allows stakeholders to

- design products in an early phase
- produce products without using jigs & tools
- test products to validate requirements
- operate products in a virtual environment only

# Scope of Virtual Reality



# VR services offered in cabin, cargo & customization



Virtual reality in CoE CCC processes enables

- decision making and customer presentation through visualization
- a higher level of product maturity
- increased speed of development and design
- reduced development costs as physical mockups can be minimized



# Scope of Virtual Reality @ Airbus: e.g. operations in A380 development

ergonomic analysis

installation simulations

maintainability investigations

cabin - layout presentations

functional tutorials for cabin crew training

engineering and management decision reviews

**more than 200  
investigations per year**

# Welcome to the Cabin Virtual World...



Virtual Reality in General

Infrastructure

Use cases

Summary

# VR - technical opportunities today

## Display and interaction devices



CoE CCC disposes of state-of-the-art technology in europe

# Welcome to the Cabin Virtual World @ Airbus...



Virtual Reality in General

Infrastructure

Use cases – Innovations

Summary

# Innovations / boarding-simulation



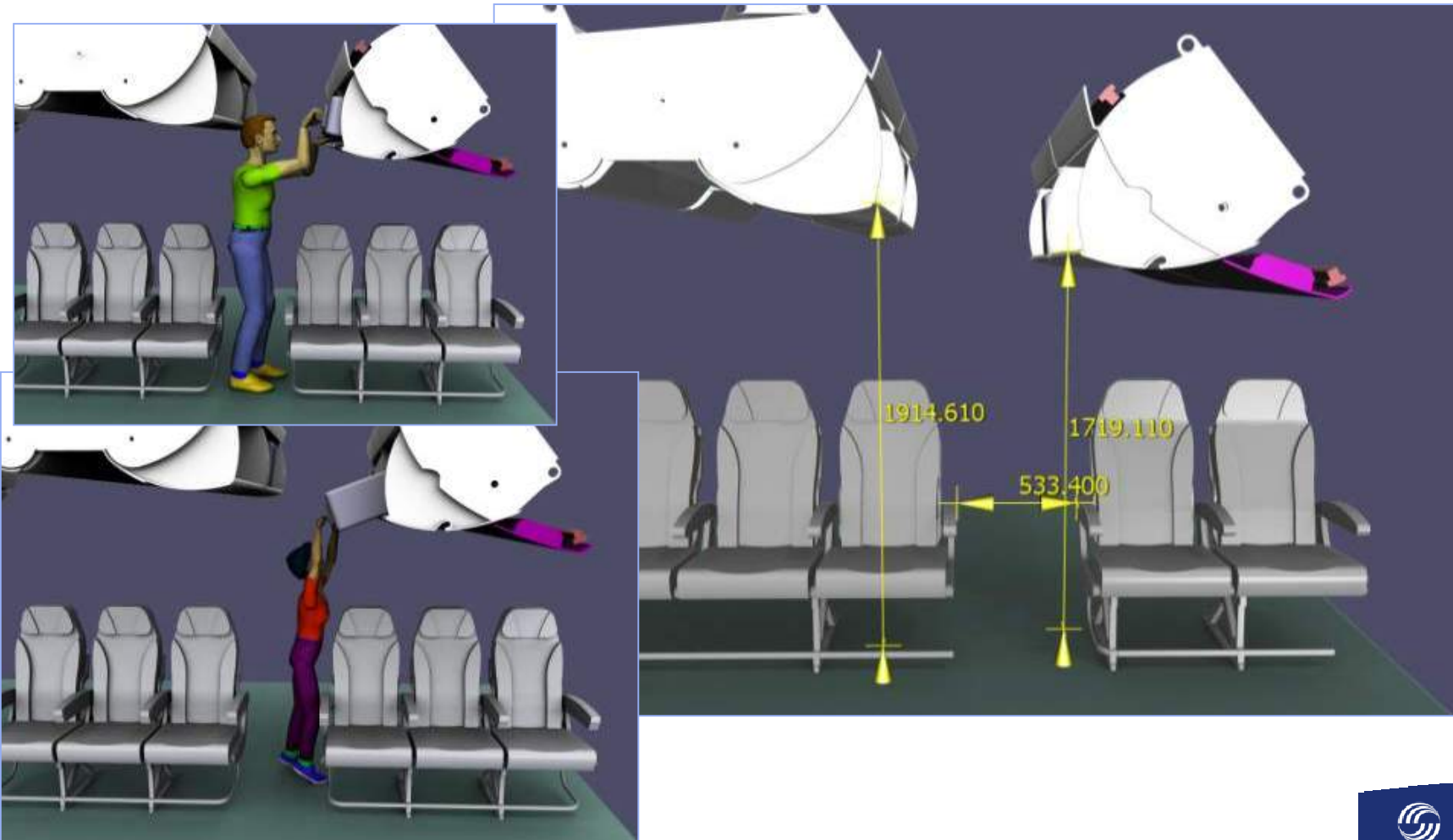
# Innovations / early design



Window Height analysis in CAVE

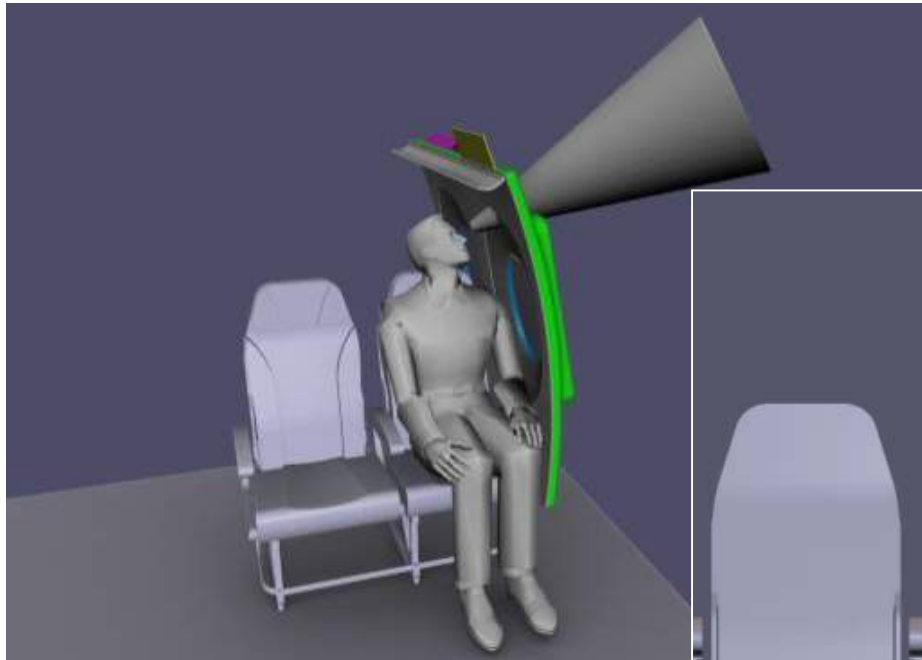
# Innovation / early design

concept verification

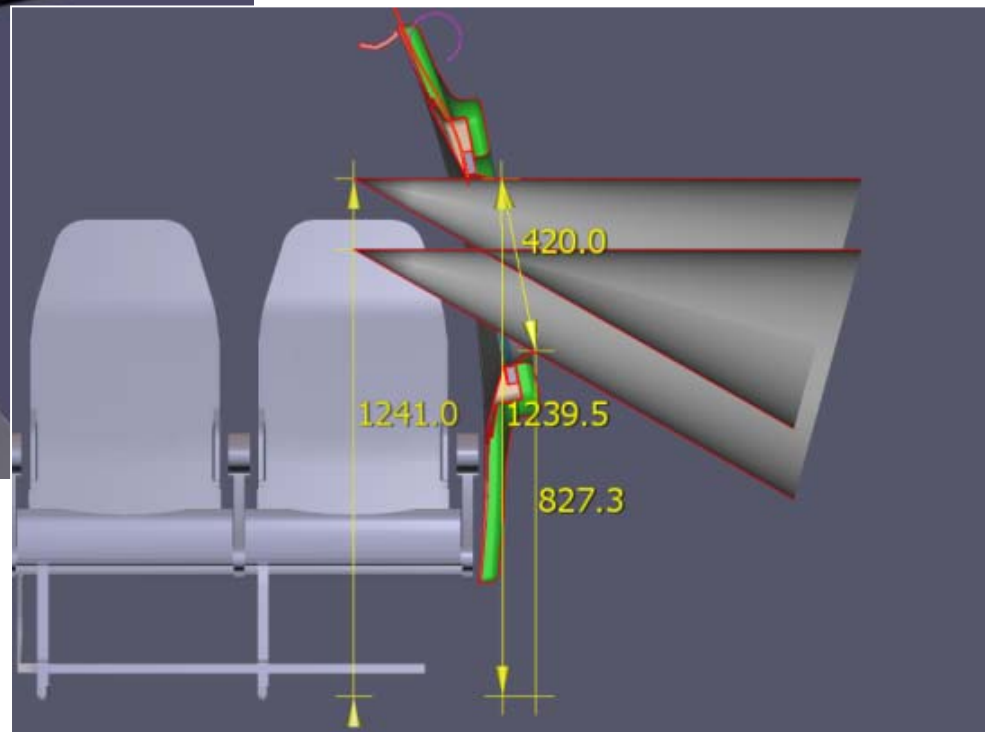


# Innovations / early design

concept analyses



window variations & visual fields





# Innovations – trend/scenario analysis



# Welcome to the Cabin Virtual World @ Airbus...



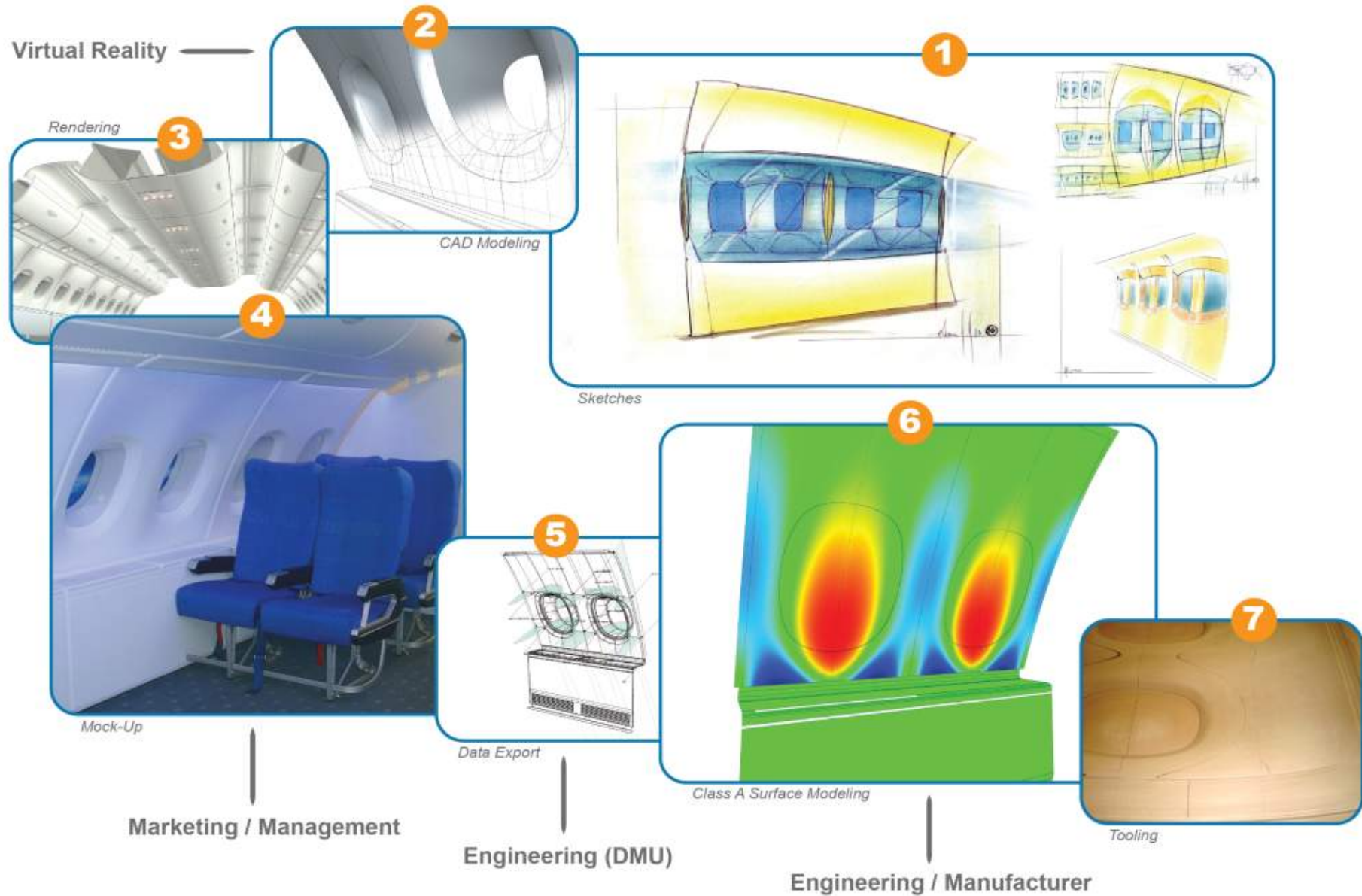
Virtual Reality in General

Infrastructure

Use case - Industrial Design

Summary

# Industrial Design: From Concept to Finished Part



# Industrial Design Prototypes / Studies

Prototype



First drafts



Colour- and materials

Virtual Prototype

# Industrial design customisation: Trim and Finish



- Airline and Cabin Branding
- Colour and Material Concepts
- Interior Colour Specification
- Material Development
- Certification & Approval



# Industrial Design – „Chrysalis“ (design vision)



# Welcome to the Cabin Virtual World @ Airbus...



Virtual Reality in General

Infrastructure

Use cases – customization / layouts

Summary

# Cabin Layout Presentation – A380





# Customer reviews in Powerwall



# Welcome to the Cabin Virtual World @ Airbus...



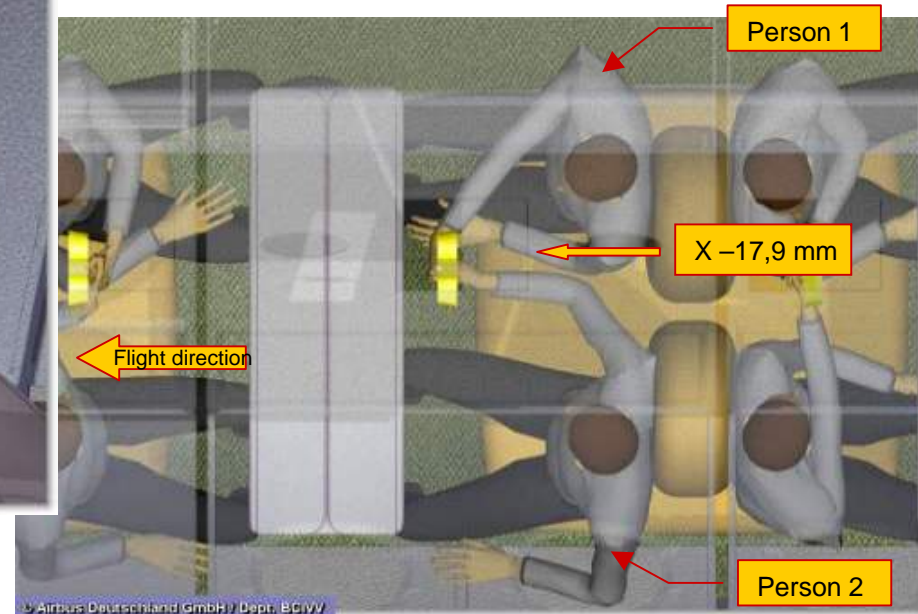
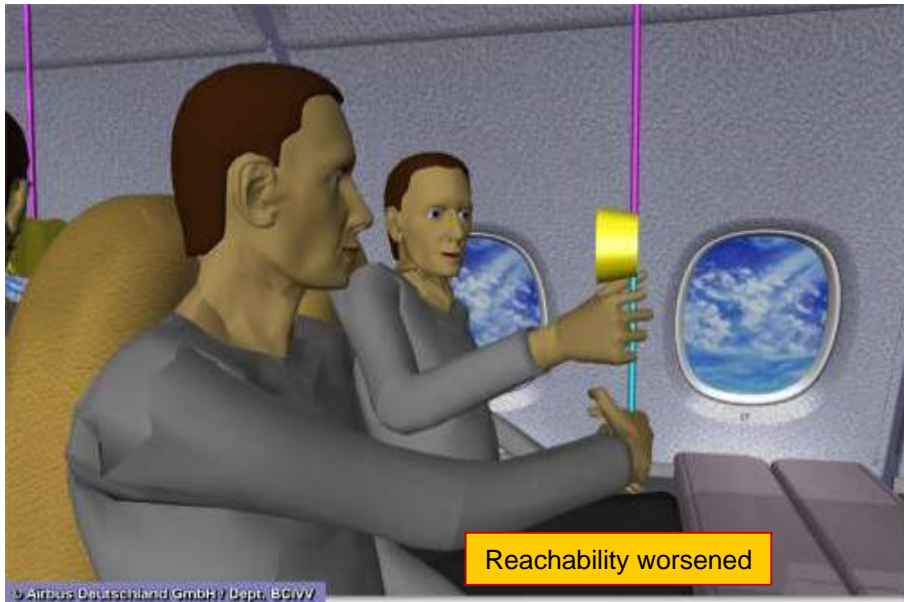
Virtual Reality in General

Infrastructure

Use cases – ergonomoy / comfort

Summary

# Ergonomics – Reachability of Oxygen masks



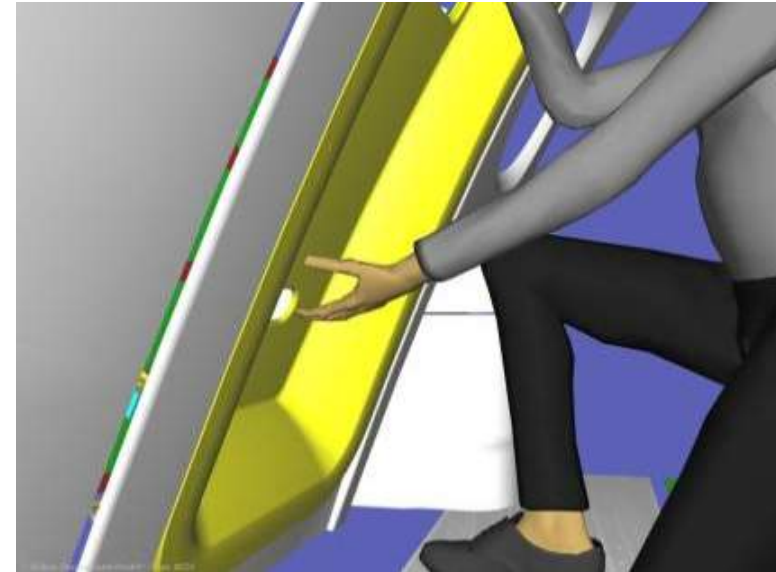
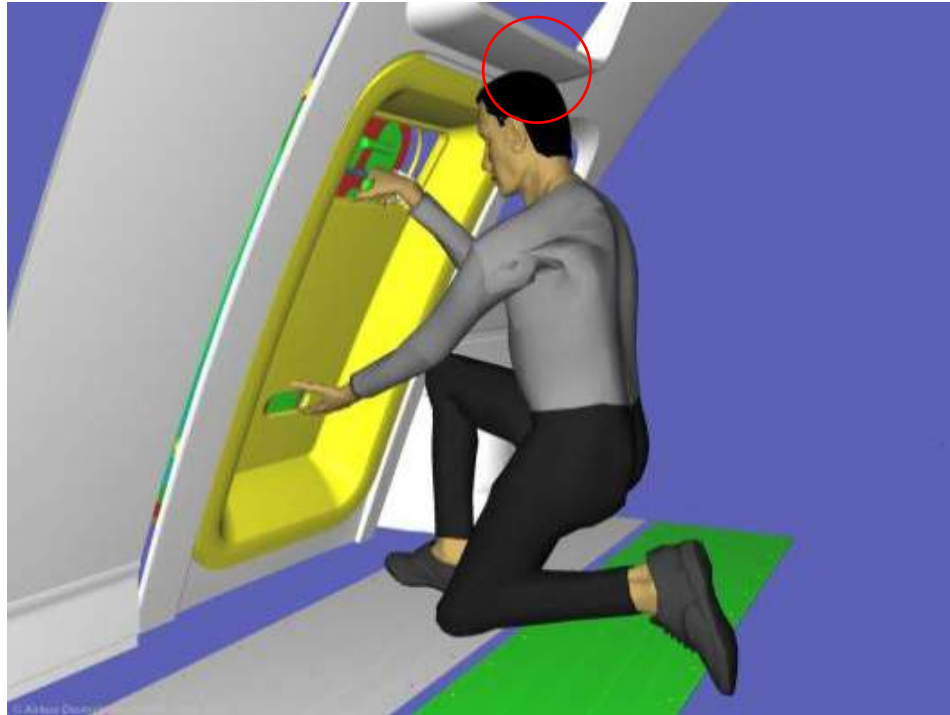
- O<sub>2</sub>-Mask is only reachable wenn the pull flag has a length of 305 mm (measured from mid O<sub>2</sub>-Mask to lower edge of pull flag).
- Body posture and bones stress for persons 1 and 2 are normal

# Ergonomics - Reachability of oxygen masks



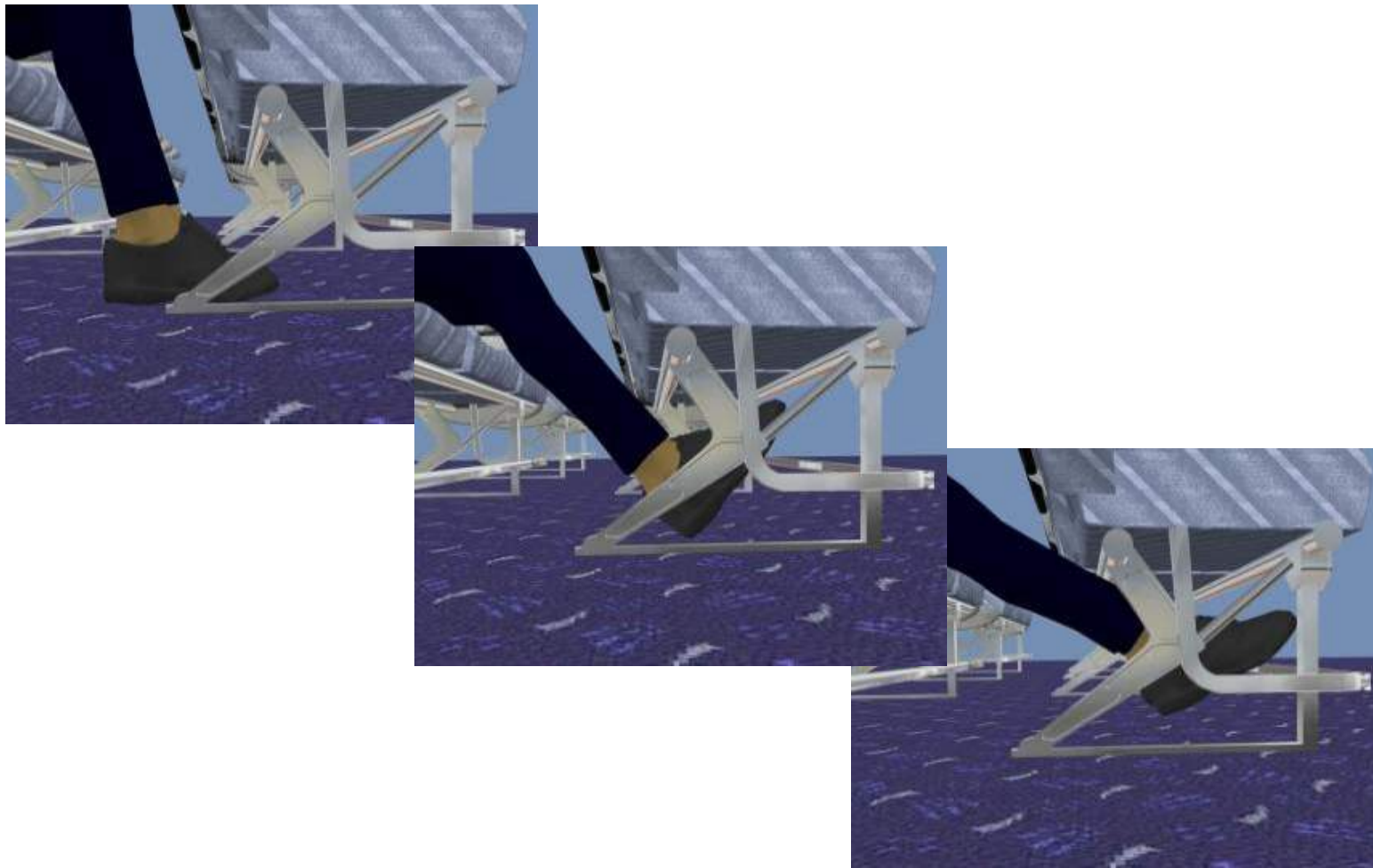
- Although mask is inside reachability curve, it can't be reached as seat neighbour blocks movement area

# Ergonomics - Reachability lower Hatch-Handle



- kneeling down (lowered leg) – reachability of lower handle with one hand. However, head collision with lining when standing up is probable.

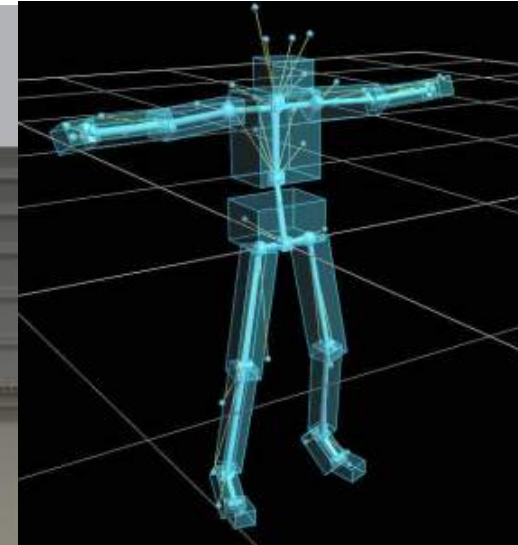
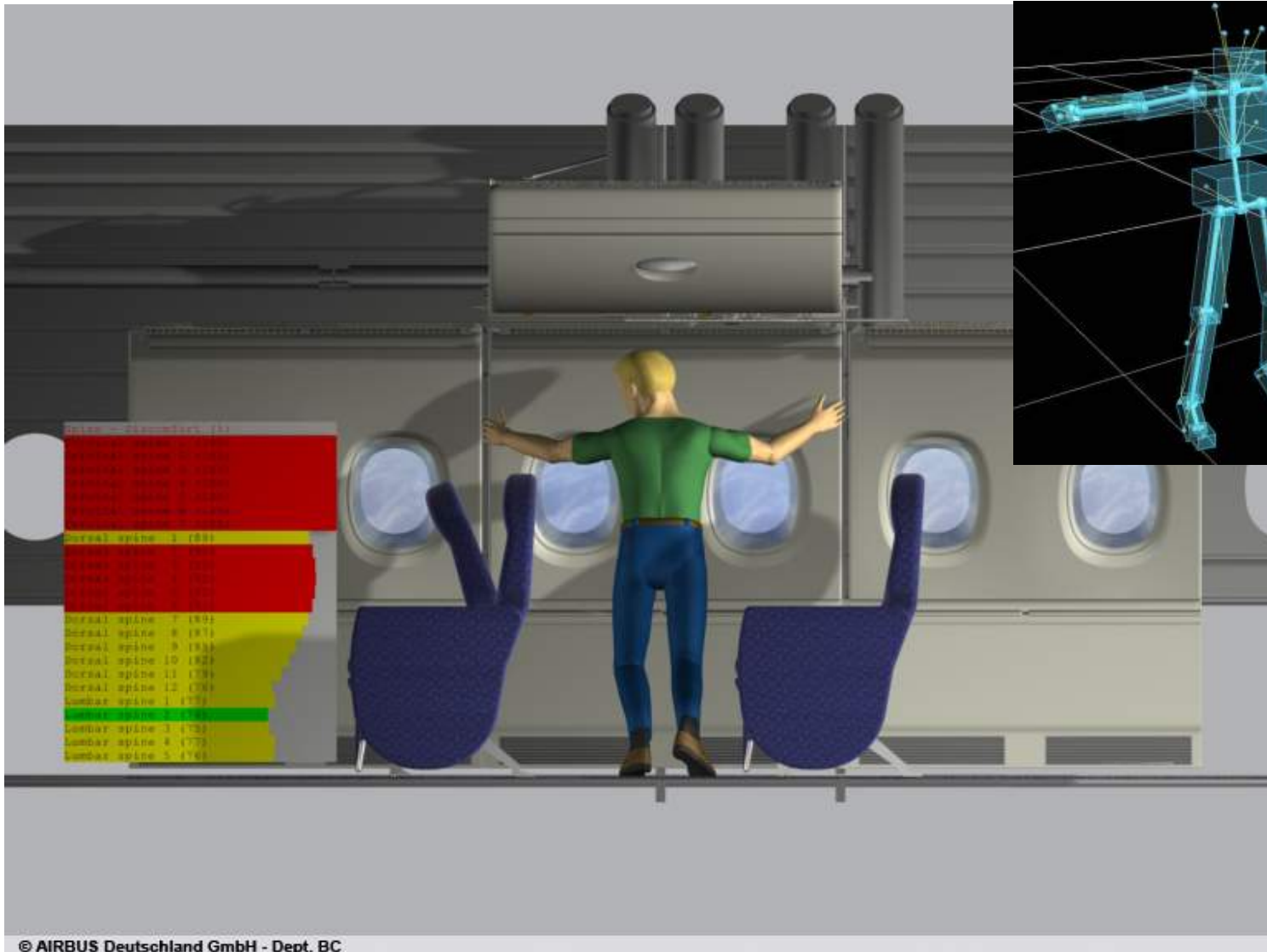
# Ergonomics - Range of Motion / Space Availability



# Cabin Ergonomy in the CAVE



# Discomfort analysis





# Ergonomics – crew rest compartment



# Welcome to the Cabin Virtual World @ Airbus...



Virtual Reality in General

Infrastructure

Use cases –engineering/maintainability

Summary

# Maintainability – Yesterday & today



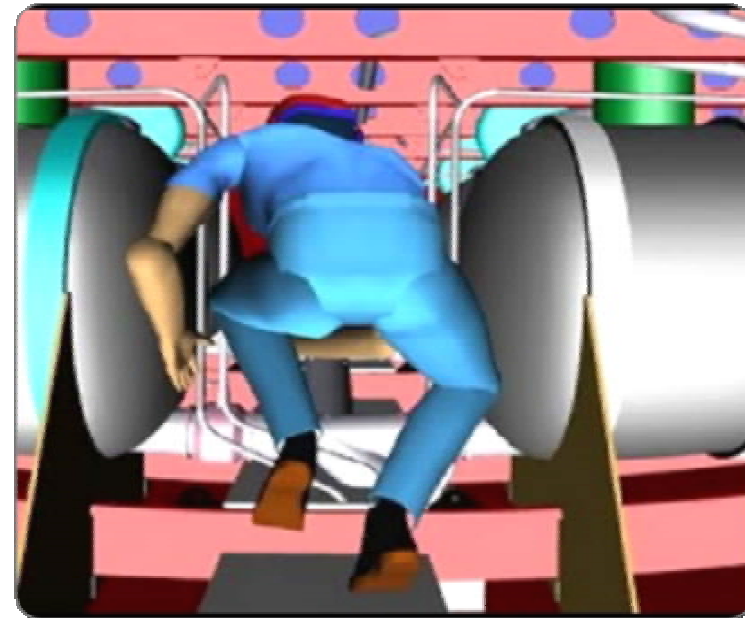
# Maintainability – Yesterday & today

Maintainability  
Analysis in 1999



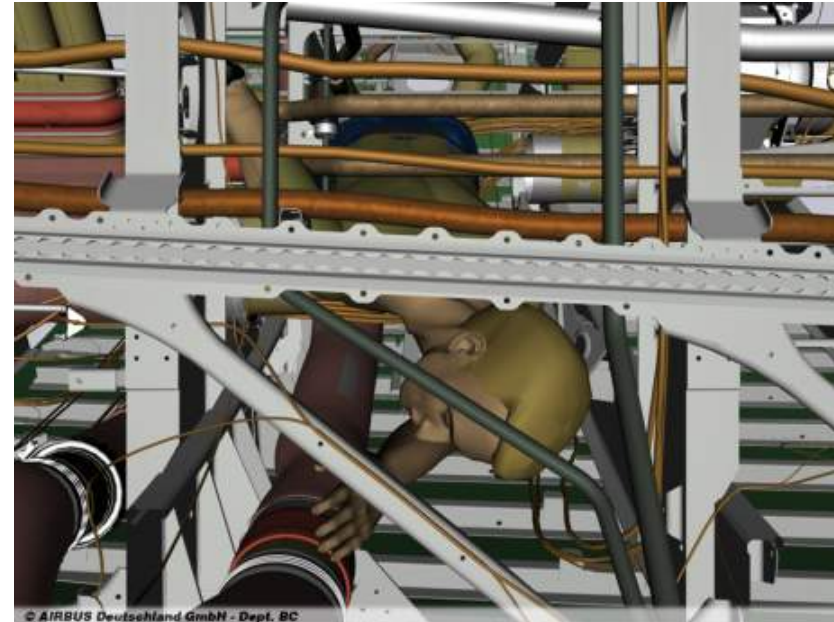
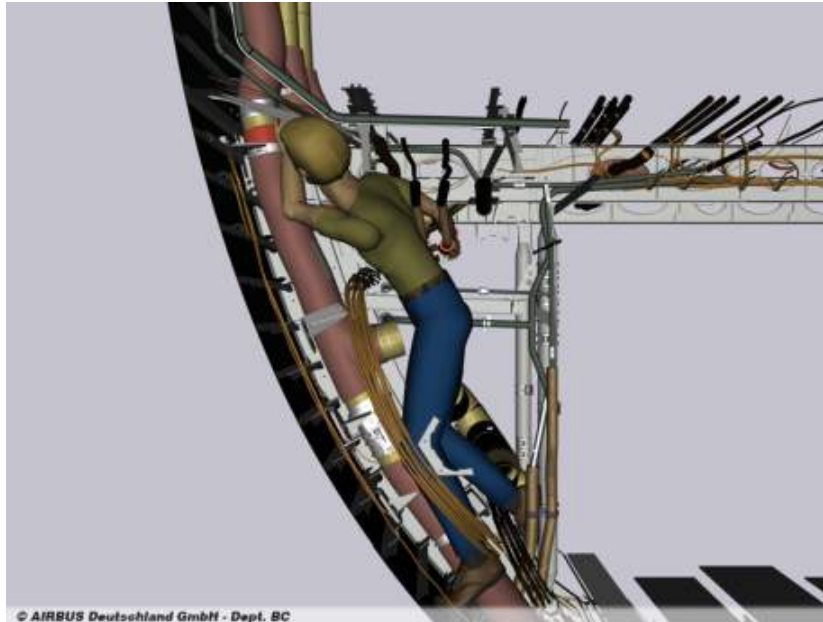
A340-500/600

Maintainability  
Analysis in 2002



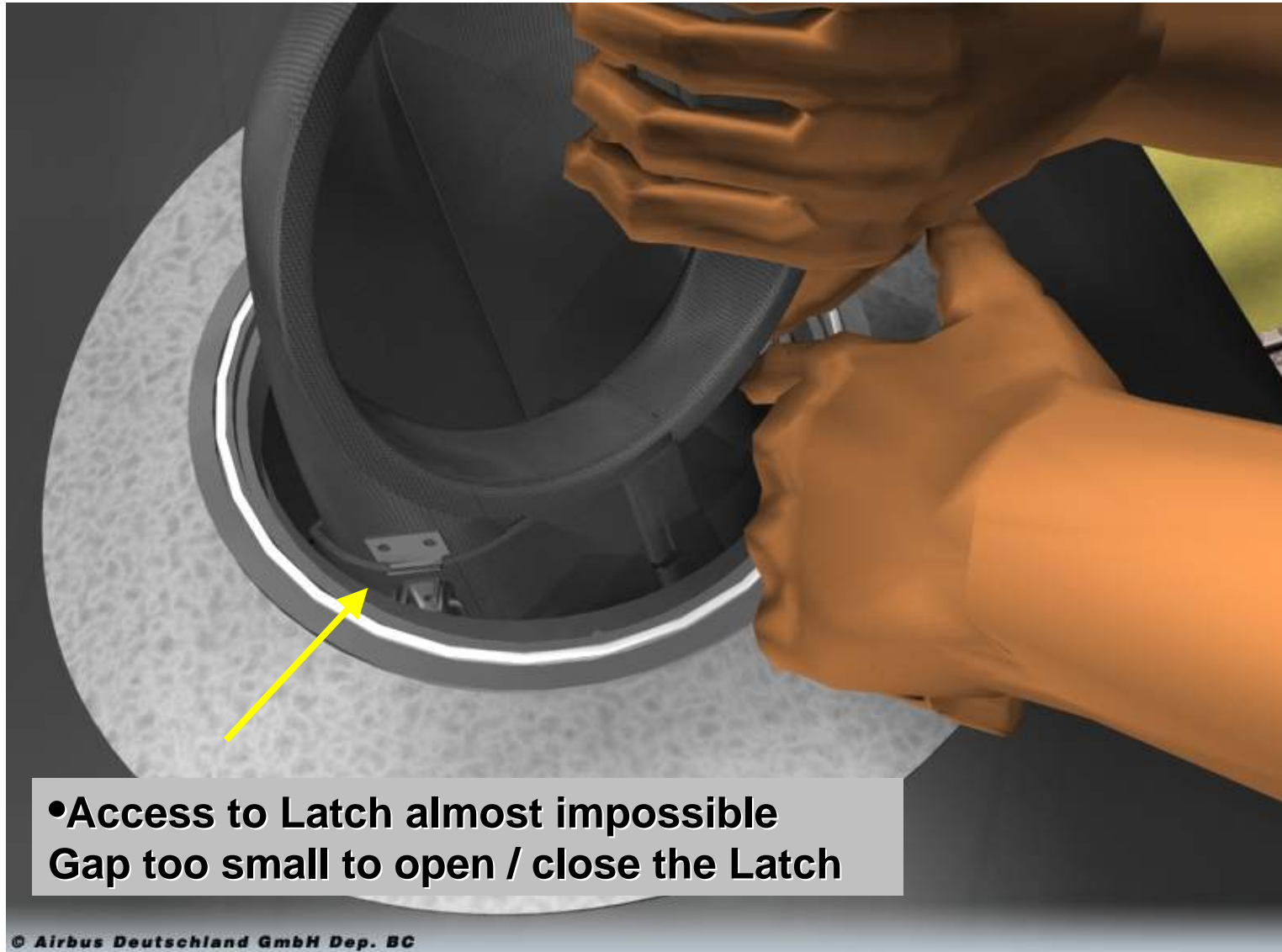
A380-800

# Maintainability & Safety



- Unsafe footing
- Arm „availability“
- Damaging systems / environment through movements
- Field of view

# Maintainability

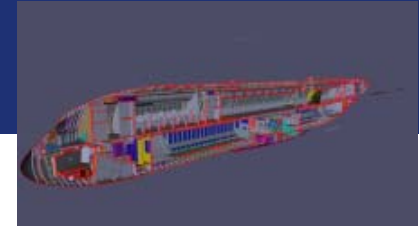


- No field of visibility

- Keep Hands on Diverter Part 2, to get Latches open

- Access to Latch almost impossible  
Gap too small to open / close the Latch

# „Interactive Engineering“ in CAVE



# Welcome to the Cabin Virtual World @ Airbus...



Virtual Reality in General

Infrastructure

Use cases – installation / assembly

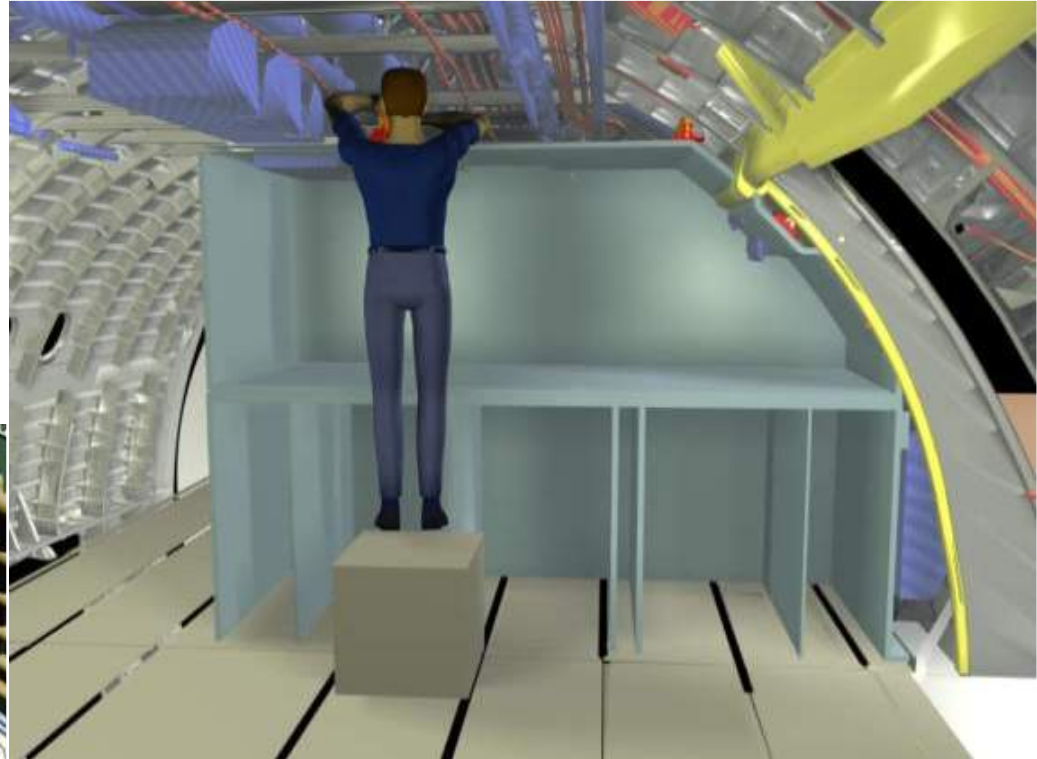
Summary



# Installation / assembly analysis

Analysis with respect to

- Ergonomics
- Reachability
- Visibility
- Path of installation



Installation of galley monuments



Movement and positioning  
of big monuments  
in the fuselage

# Welcome to the Cabin Virtual World @ Airbus...



Virtual Reality in General

Infrastructure

Use cases – customer support

Summary

# Customer support – functional tutorials



A380 electrical door handling

# Welcome to the Cabin Virtual World @ Airbus...



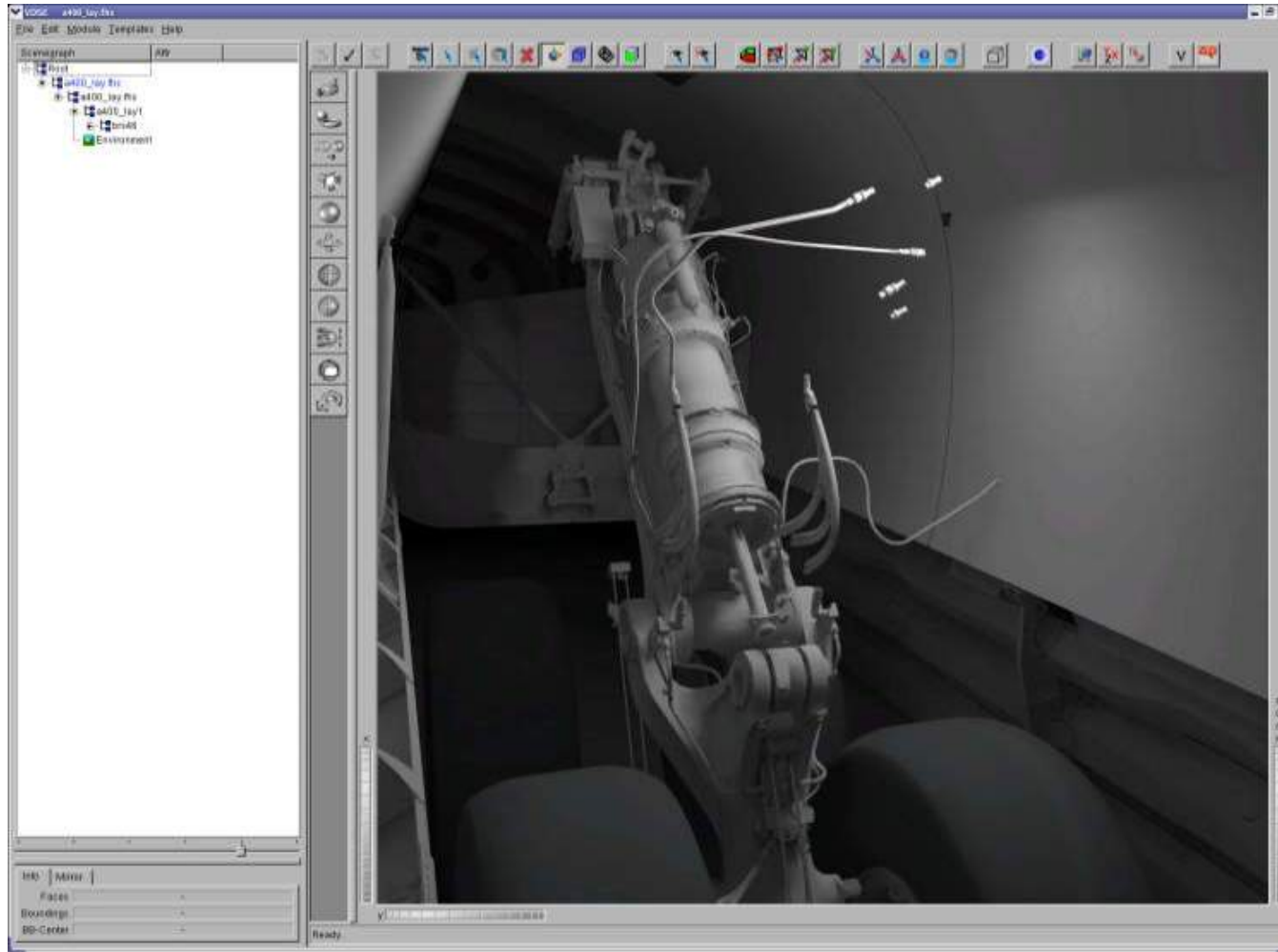
Virtual Reality in General

Infrastructure

Use cases – others

Summary

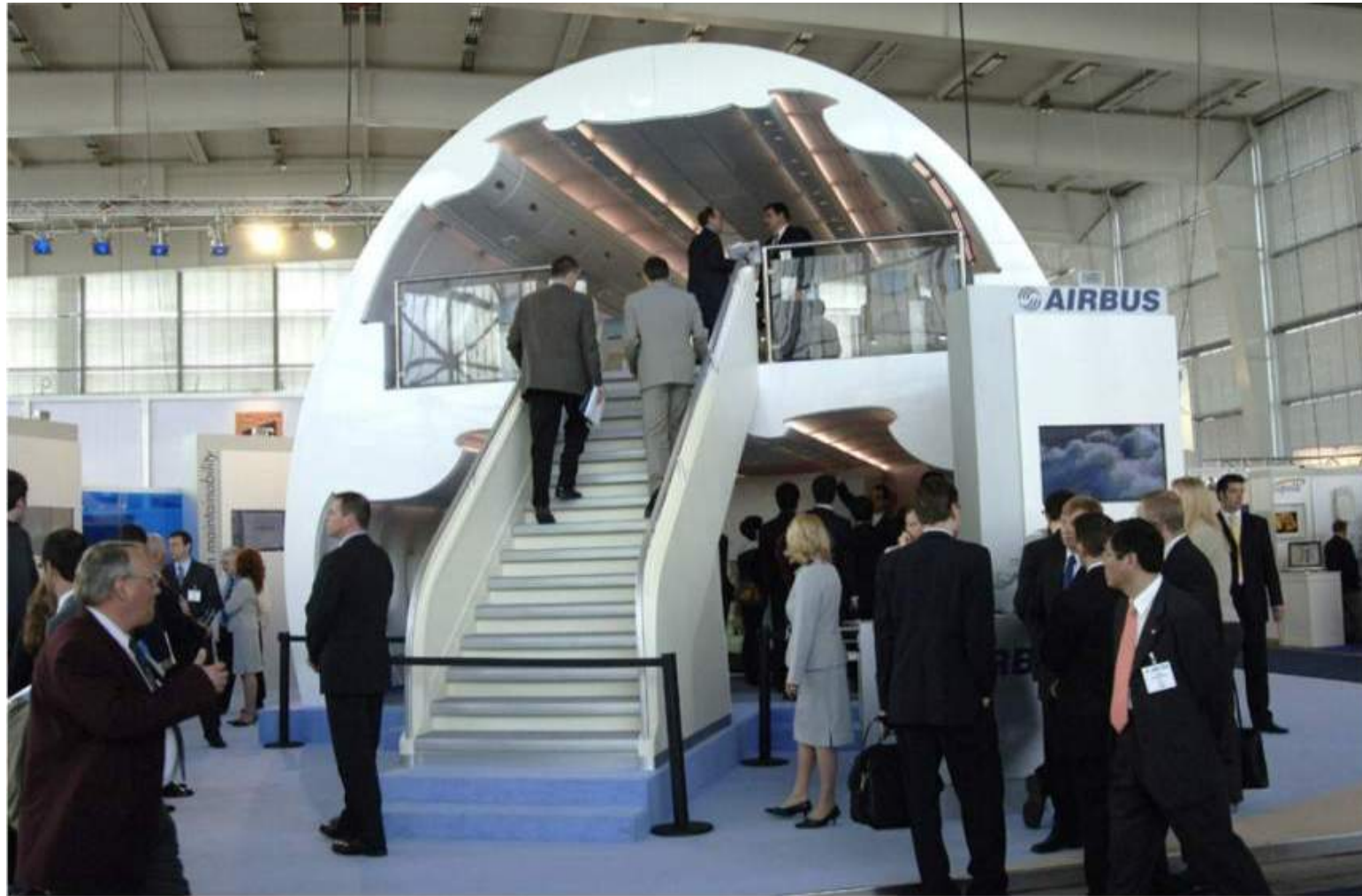
# Realtime Light analysis – “raytracing” technology



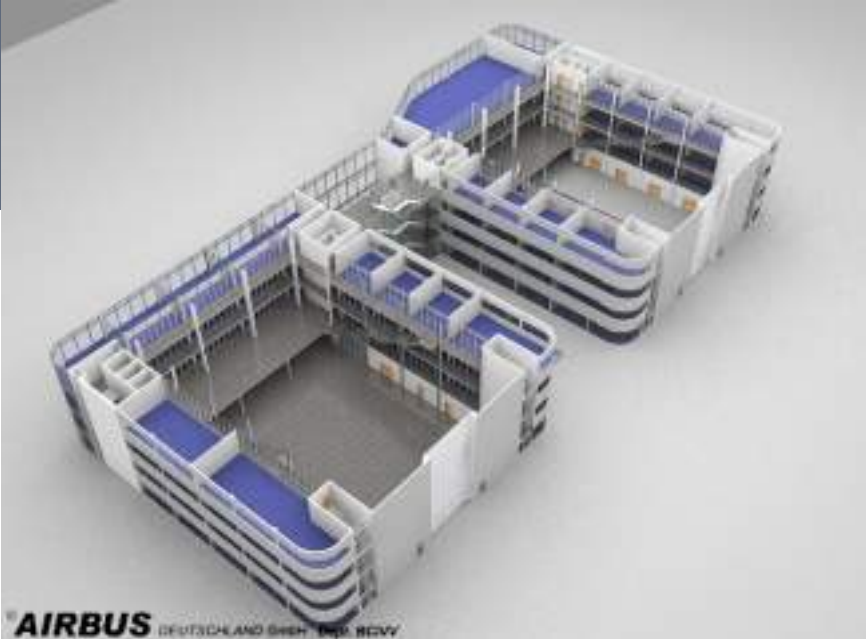
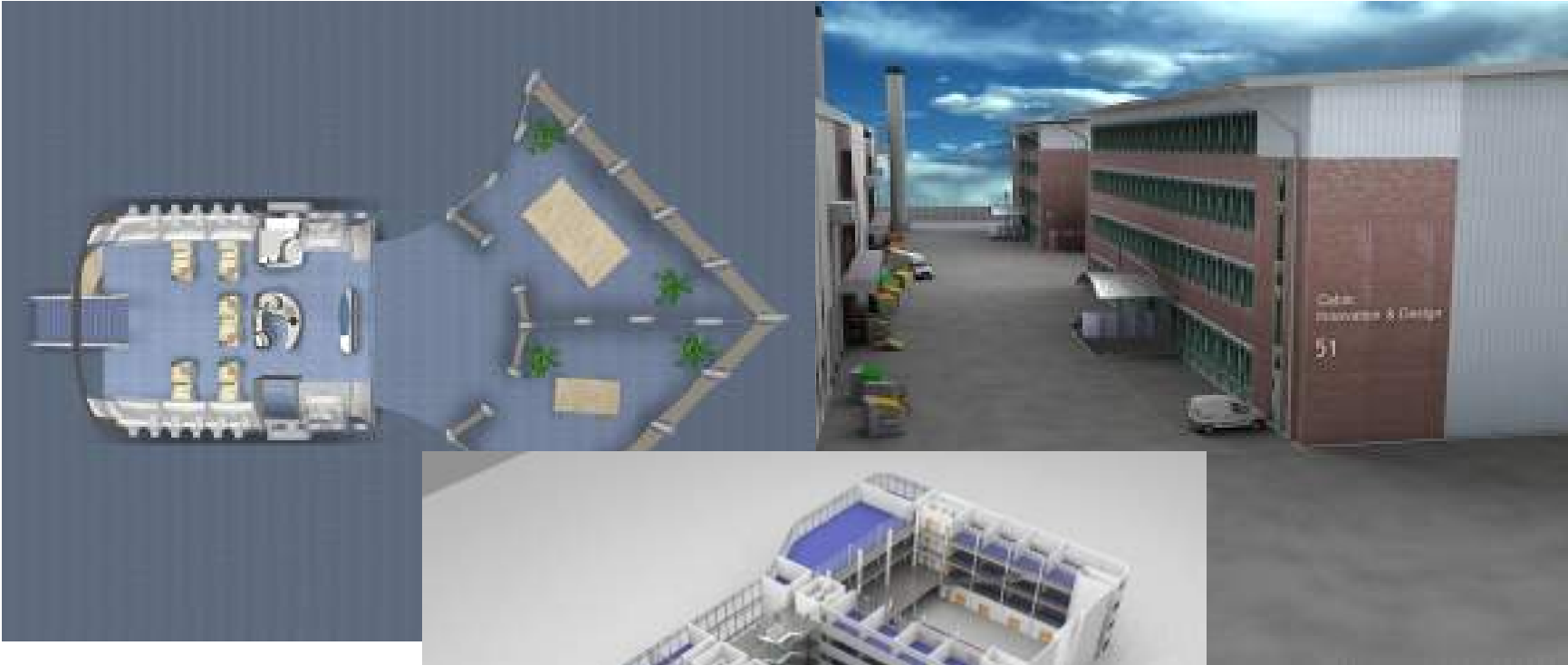
# Interior EXPO 2004 – virtual Mockup



# Interior EXPO 2004



# Expo / Building Visualization



© AIRBUS DEUTSCHLAND GMBH. Alle Rechte vorbehalten. Vertrauliches und geschütztes Dokument.





# Welcome to the Cabin Virtual World @ Airbus...



Virtual Reality in General

Infrastructure

Use cases

Summary

# Virtual Reality offers new opportunities

VR allows new way of working

Foster innovation and design



Earlier presentation of concepts leads to reduced predevelopment time and risks

Increased ergonomomy, comfort, maintainability, reliability in engineering



Increased product quality & product maturity

Improved visualization & definition of cabin layout / special requests



Earlier customer definition freeze, more reliable requirements management

Support management reviews / decisions



Management decision support:  
Better understanding of complex solutions and customer requests

# Virtual Reality offers new opportunities

## VR technology incorporates benefits

Integration with / complementation of  
of 3D DMU and other data sources

➔ **Maturity of design processes  
and of product**

Experience & interaction  
in virtual environment (CAVE)

➔ **Haptic solution finding  
for complex problems**

Adaptability / changeability of VR scenes

➔ **Faster & easier change- &  
configuration management**

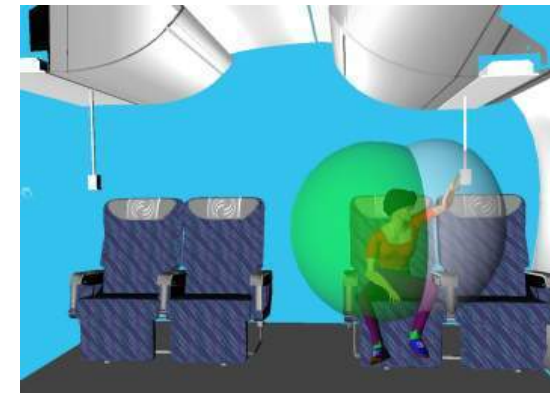
Reducing amount of H/W mock up  
generation by means of Virtual Reality

➔ **Reduced time and costs  
of development process**

# Virtual Reality - Lessons learnt in A380 programme

## VR in an early phase of **A380 development**:

- maintainability investigations with design changes before production
  - installation studies (design changes as result)
  - ergonomic analysis (e.g. oxygen boxes)
  - cabin-layout presentations
  - functional tutorials for cabin crew
  - engineering reviews (CFG and internal)
- 
- over 450 investigations with means of VR:  
80% affected by design changes
- 
- significant savings due to VR



# Extending the horizon ...

- Enhanced realism & „functionality“

- ▶ Ergonomics (anthropometrics)
- ▶ Kinematics, Physics
- ▶ Flexible Parts
- ▶ Light & Illumination
- ▶ Functional Simulations



- Further increase of performance

- ▶ Automated DMU transfer - bidirectional
- ▶ Intelligent Data Management (re-use)
- ▶ Sophisticated interaction tools (e.g., force feedback)



# Virtual Reality...

... will never replace the real world.

But it will support in the daily work -

→ designing better cabins, systems and airplanes

→ Reducing costs and time-to-market

**→ Thank you for your attention!**

*Interested? Write an email to [virtualreality@airbus.com](mailto:virtualreality@airbus.com)*

*or contact me or anyone in the department BCIV.*