The Application of Virtual Reality in the Design of Aircraft Cabins

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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 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
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Virtual Reality in General

Infrastructure

Use cases

Summary
**Virtual Reality in product development**

- **Designers**: visualize ideas & communicate
- **Engineers**: analyze, understand & optimize
- **Marketing / Sales**: visualize to promote & sell
- **Management**: 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

- 3D design database
- Digital Mock Up
- Special design data
- Simulation data
- Visualisation
- Data conversion
- Immersion
- Interaction

complex human simulation
high interactive functionalities
stereoscope & tracked visualisation
photo-realistic 3-dimensional virtual environment
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
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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
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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
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Virtual Reality in General

Infrastructure

Use case - Industrial Design

Summary
Industrial Design: From Concept to Finished Part

1. Class A Surface Modeling
2. Rendering
3. CAD Modeling
4. Mock-Up
5. Data Export
6. Engineering (DMU)
7. Tooling

Virtual Reality

Marketing / Management

Engineering / Manufacturer
Industrial Design Prototypes / Studies

Prototype

First drafts

Virtual Prototype

Colour- and materials
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)
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Virtual Reality in General

Infrastructure

Use cases – customization / layouts

Summary
Cabin Layout Presentation – A380
Customer reviews in Powerwall
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Virtual Reality in General

Infrastructure

Use cases – ergonomy / comfort

Summary
Ergonomics – Reachability of Oxygen masks

- $O_2$-Mask is only reachable when the pull flag has a length of 305 mm (measured from mid $O_2$-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 reachibility curve, it can’t be reached as seat neighbour blocks movement area
• kneeing down (lowered leg) – reachibility 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
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- 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

- Access to Latch almost impossible
- Gap too small to open / close the Latch
- No field of visibility
- Keep Hands on Diverter Part 2, to get Latches open
„Interactive Engineering“ in CAVE
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- 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
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Virtual Reality in General

Infrastructure

Use cases – customer support

Summary
Customer support – functional tutorials

A380 electrical door handling
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- 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
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Virtual Reality in General

Infrastructure

Use cases

Summary
Virtual Reality offers new opportunities

VR allows new way of working

- Foster innovation and design
- Increased ergonomy, comfort, maintainability, reliability in engineering
- Improved visualization & definition of cabin layout / special requests
- Support management reviews / decisions

Earlier presentation of concepts leads to reduced predevelopment time and risks

Increased product quality & product maturity

Earlier customer definition freeze, more reliable requirements management

Management decision support: Better understanding of complex solutions and customer requests
Virtual Reality offers new opportunities

VR technology incorporates benefits

Integration with / complementation 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
or contact me or anyone in the department BCIV.