Entwicklung von Flugzeugkabinen

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Content

- Cabin design principles
- Customer / passenger involvement
- Areas of concern

Example: A380 Cabin concept
  - Main dimensions
  - Reference layout
  - Cabin Operation
    - Boarding / deplaning
    - Cabin servicing concept
    - Flexibility concept
Design principles

- All cabin items to be handled by passengers are subject to damage
  - if they are not easy to handle,
  - if it is not evident how to handle them
  - and if they are not properly designed!

- Weight constraints do not allow an aircraft cabin to be built as solid as home furniture. Replacement of damaged parts must be easy and quick, without removing adjacent parts or use of special tools.

- Safety aspects are a primary concern. The cabin must be designed in such a way, that the possibility of passenger and cabin crew injuries are limited to the greatest possible extent during normal operation and during emergency evacuation.

- An aircraft cabin is a workplace for the crew. An un-ergonomic environment may directly translate into low service quality.
Design principles

- Practicality (user-oriented)
- Safety (first)
- (low) Weight (sum of all elements)
- Durability (of parts) and tenacity (of alignment)
- Maintainability, repairability and exchangability
- Flexibility in operation
- Comfort (visual, sensual, aural)
- Operational aspects (boarding time etc.)
- Handling qualities (stowage bins, systems etc.)
- Simple design
Customer / passenger involvement

- The customer is playing and increased role in the cabin design

- The passenger opinion is important also for the manufacturer
  - A380  Airbus Industrie First passenger survey 1998
  - Second passenger survey 1999
Airline involvement

- **20 major airlines** have been shaping the design of the A3XX / A380 for five 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

**Major 747-400 operators** involved in A380 design since 1996
How do I feel about sitting here?

What influences the way I feel?
Scope of the project

- Fieldwork undertaken April - July 1998
- 8 cities in 3 continents
- Some 1 200 people surveyed
- Frequent long-haul travelers
- First, Business and Economy
- 2 000 man-hours of interviews
- 200 hours of recorded material
- Key A380 airlines invited to observe subject to signed NDA
Fieldwork

- San Francisco
- New York
- Paris
- Frankfurt
- London
- Tokyo
- Hong Kong
- Singapore
Upper deck mock-ups

A3XX variable geometry  747-400
# Economy Class clearances

![Diagram](attachment:image.png)

‘Andy’, the 95% North American male (2010)

<table>
<thead>
<tr>
<th></th>
<th>Tight</th>
<th>Middle</th>
<th>TLAR</th>
<th>Loose</th>
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<tr>
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<td>15</td>
<td>60</td>
<td>70</td>
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<td>96</td>
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*all dimensions in millimetres*
佐藤

天ほうがシンプル

席が横にきついに並ばず、だんだん、感じ

広い通路

広い通路

広い通路

広い通路
Continuing cabin development
Comparison

The Yellow Concept
The Orange Concept
The Red Concept
The Blue Concept
**Areas of concern**

- Luggage stowage
- Illumination
- Air Condition
- Seat spacing / comfort
- Entertainment Systems
The boarding experience - more space when most needed

A330/A340

767/777
Overhead stowages sized to stow “roll-aboard” luggage (L=24in)


**Lighting**

Study Items

1. Glass fibre optic RL
Specification under work, release for Vendor Selection planned for 02/00. Verification of eye safety in combination with extreme small light output diameters is outstanding. **NO PUBLISHED CONCLUSION AT 01/01**

2. T5 fluorescent tubes
As no short length tube is available on the market, this item is postponed to A3XX (frame pitch 25” instead of 21”, which makes 600mm tubes possible)

3. Lighting temperature adaption
No space for additional coloured fluorescent tubes available, but as alternative concept coloured piggy-bag LED-strips are under investigation. Performance still TBD. **Long-running “debate” with VIR and AIM**
This feature would be an alternative to LLL only
sidewall lighting

26mm tri-phosphor

current A340

26mm
Something for nothing

“free illumination”
**Something for nothing**

"free illumination"
Is the lighting effective?
Extensive analysis using powerful Computerized Flow Dynamics (CFD) techniques showed that with only two ceiling outlets, a comparable comfort level with the A340-300 was not achievable.
The aircraft cabin...
is strongly influenced by its contents
Drivers for choice of airline
Long-haul by class

1998 Corporate Air Travel Survey

- Schedules
- Seat Comfort
- Service
- Fares
- Other
- Safety
- Punctuality
- FFP

First
Business
Economy
Economy Class

Theoretical seat width per passenger (in)

- **A380 upper deck**
- **A380 main deck**
- **747 main deck**
- **747 upper deck**

Aisle width (in)

A clearly superior product

- **ONE cabin product**
- **2 different cabin products**
Passenger's perspective in-flight
Growing demand for greater number of zones

Customisation
**A380 Cabin cross section**

- **Business**
  - 54” 23” 54” 23” 54”

- **Economy**
  - 42” 20” 42” 20” 42”

- **First**
  - 57” 36” 57” 36” 57”

- **Economy**
  - 62” 20” 42” 42” 20” 42”

- **Freight**

- **Under floor Facilities**

- **70” wider**

- **20” wider**
**A380 zone flexibility**

- **Upper deck**
  - Business
  - Economy
  - First
  - Economy
  - First
  - Business

- **Main deck**
  - First
  - Economy
  - Business
  - Economy
  - Economy

... the potential to develop solutions for all future market mixes
A380-800 Reference layout

TWO wide-body cabins: 555 seats

96 Business

103 Economy

22 First

334 Economy
A380 Passenger boarding concept

Upper deck boarding via door 1 using the fwd stair

- TRT 89 min (555 pax three class)
- TRT 82 min (718 pax all tourist)

Main deck boarding via door 2
## Ref. A3XX-100 Turn-round time (555 pax)

<table>
<thead>
<tr>
<th>Activity</th>
<th>Time in Min</th>
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<tbody>
<tr>
<td>Deboarding / Boarding L1</td>
<td>11 / 15</td>
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<tr>
<td>Deboarding / Boarding L2</td>
<td>14 / 23</td>
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<tr>
<td>Cabin Cleaning</td>
<td>31</td>
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<tr>
<td>Catering Mid MD Galley</td>
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<td>Catering Aft MD Galley</td>
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<tr>
<td>Catering Aft UD Galley</td>
<td>24</td>
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<tr>
<td>Fwd Cargo Exchange</td>
<td>25 / 31</td>
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<tr>
<td>Aft Cargo Exchange</td>
<td>24 / 29</td>
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<tr>
<td>Bulk Cargo Exchange</td>
<td>17 / 21</td>
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<tr>
<td>Left Side Refuelling</td>
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<tr>
<td>Right Side Refuelling</td>
<td>31</td>
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<tr>
<td>Potable Water Service</td>
<td>21</td>
</tr>
<tr>
<td>Lavatory Service</td>
<td>22</td>
</tr>
</tbody>
</table>

**Total Servicing Time = 89 min**

### Passenger Boarding
- Door L1: 205 Pass board at a rate of 14.0 pass/min
- Door L2: 350 Pass board at a rate of 15.0 pass/min

### Passenger Deboarding
- Door L1: 205 Pass deboard at a rate of 18.0 pass/min
- Door L2: 350 Pass deboard at a rate of 25.0 pass/min

### Cabin Cleaning
- Door L5: Cleaning with 12 cleaning agents

### Catering Service
- Mid Main Deck Galley at Door R2: 24 FSTE (at 1.5 min)
- Aft Main Deck Galley at Door L4: 22 FSTE (at 1.5 min)
- Fwd Upper Deck Galley at Door R1: 24 FSTE (at 2.0 min)
- Aft Upper Deck Galley at Door R5: 12 FSTE (at 2.0 min)

### Aircraft Refuelling
- Left Side Pressure Refuel Connector: 122000l at 4000 l/min
- Right Side Pressure Refuel Connector: 122000l at 4000 l/min

### Cargo Unloading
- Fwd Cargo Door: 18 HSC (at 1.4 min)
- Aft Cargo Door: 17 HSC (at 1.4 min)

### Cargo Loading
- Fwd Cargo Door: 18 HSC (at 1.7 min)
- Aft Cargo Door: 17 HSC (at 1.7 min)

### Baggage/Bulk Cargo Unloading
- Bulk Cargo Door: 2000 kg at 115.0 kg/min
- Baggage/Bulk Cargo Loading
- Bulk Cargo Door: 2000 kg at 95.0 kg/min

### Lavatory Service
- Waste Water Service Panel: 3000 l waste water at 143.0 l/min 54 l flush water at 38.0 l/min
- Potable Water Service
- Potable Water Service Panel: 1800 l at 87.5 l/min

© AIRBUS
**A380 Lift position / Service concept**

Optimal Lift positions for minimum turn around times and most efficient usage of space

Simultaneous servicing possible
A380 Ramp set up
Upper Deck servicing

Solutions will exist to serve the A380 Upper Deck
**Flexibility - Trans. Galleys on MD**

**MAIN DECK**

- **CENTER:**

- **LATERAL LH/RH:**

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**RESULTING FLEXIBILITY**

- **MORE THAN 50% OF AIRLINES**

- **BETWEEN 20% & 50% OF AIRLINES**

- **LESS THAN 20% OF AIRLINES**

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**TRANSVERSAL GALLEY FLEXIBILITY**

**STUDY BASED ON GALLEY DEPTH 34”/42”**

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**STUDY BASED ON GALLEY DEPTH 34”/42”**

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**VIR**

**UAE**

**SIA**

**QFA**

**KAL**

**JAL**

**IBE**

**DLH**

**BAW**

**ANZ**

**AFR**

**ACA**

**AIB**

**ANA**
Flexibility - Lavatories on MD