More than an Air Taxi –
Intermediate Results of DLR’s HorizonUAM Project

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Objective: Assessment of chances and risks of air taxis and urban air mobility (UAM) concepts

Main content
• Forecast of UAM market share
• Model-based UAM system simulation
• Air taxi vehicle system development
• Flight guidance concepts for vertidromes
• Public acceptance
• Airport integration of UAM traffic
• Scaled flight demonstrations in model city

Duration: 07/2020 – 06/2023 (36 months)
Scope: 51.4 PJ (FL: 19.6) / 9.0 M€ (FL: 3.2)
Participants: DLR FL (lead), AT, FT, FW, KN, LY, ME, PA, SL, UX

Further reading:
• B.I. Schuchardt et al., Urban Air Mobility Research at the DLR German Aerospace Center – Getting the HorizonUAM Project Started, AIAA Aviation, 08.2021, https://doi.org/10.2514/6.2021-3197
Vehicle
Top Level Aircraft Requirements

System-of-system Simulation

Many Unknown Unknowns:
- TLAR of aircraft or fleet
- Homogeneous or heterogeneous fleet
- Point to point or hub & spoke
- Speed, range, etc.

For multiple scenarios
Multiple concept vehicles

Family of Vehicle Designs, Fleet and Architectures

Design Space Exploration Family of Vehicles Detailed Design

On Board Systems Cabin Propulsion

DICUAM 2022: Tackling the Threat of Wildfires: Design and Assessment of Advanced Aerial Firefighting Fleets, Prajwal Shiva Prakasha, Nabi Naeem, Patrick Ratei, Nazlican Cigal, Björn Nagel, Thu. 13:40-14:00

Further reading:
- O. Bertram, Impact of different powertrain architectures on UAM vehicle concepts, DLRK, 09.2021
Infrastructure
## Vertidrome Airside Level of Service

### Vision

150? arrivals & departures / hour expected by 2028 „The Paw“

### Reality

116 arrivals & departures / hour (2019) Frankfurt Airport

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### How do we decide if a vertidrome satisfies our requirements from an operational perspective?

#### Vertidrome Level of Service (VALoS) Concept

<table>
<thead>
<tr>
<th>Stakeholder Requirements</th>
<th>Reference</th>
<th>Passenger</th>
<th>VTOL Vehicle</th>
<th>Vertidrome</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Acceptable</strong> Flow [Processed Operations/ Time Interval]</td>
<td>$\varnothing d_{PAX}$</td>
<td>$t_{AFT} - t_{NFT}$</td>
<td>$\geq 95%$ Flights $\leq d_{TF}$</td>
<td>Metric</td>
</tr>
<tr>
<td>$\leq 2$ Minutes</td>
<td>$\leq 5$ Minutes</td>
<td>$d_{TF} = 2.5$ Minutes</td>
<td>Objective</td>
<td></td>
</tr>
<tr>
<td><strong>Non-Acceptable</strong></td>
<td>$\varnothing d_{PAX}$</td>
<td>$t_{AFT} - t_{NFT}$</td>
<td>$&lt; 95%$ Flights $\leq d_{TF}$</td>
<td>Metric</td>
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<td></td>
</tr>
</tbody>
</table>

**Nomenclature**
- $d$ = delay
- $t$ = time (duration)
- $AFT$ = actual flight time
- $NFT$ = nominal flight time
- $TF$ = total flight
- $PAX$ = passenger

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- K. Schweiger et al., Urban Air Mobility: Vertidrome Airside Level of Service Concept, AIAA Aviation, 08.2021, virtual, [https://doi.org/10.2514/6.2021-3201](https://doi.org/10.2514/6.2021-3201)
Vertidrome Airside Level of Service

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Insights about...
- Processing Airside Performance
- Resilience Capability
- Behaviour of Flow Rates
- Degree of Stakeholder Satisfaction
Operation
Impact of Air Taxis on Air Traffic in the Vicinity of Airports

Analytical model for air taxi (AT) operations at Hamburg airport based on fast time simulation

3 touchdown and lift-off areas (TLOF)

Energy consumption analysis of air taxis

- Runway-Integration not advisable for medium traffic airports
- Vertiport-Integration allows traffic volume up to 20 AT /h
- Battery capacity shows bottleneck for AT operations

N. Ahrenhold et. al, Impact of Air Taxis on Air Traffic in the Vicinity of Airports, MDPI Journal Infrastructures, 10.2021, [https://doi.org/10.3390/infrastructures6100140](https://doi.org/10.3390/infrastructures6100140)
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https://doi.org/10.3390/infrastructures6100140
Public Acceptance
UAM Cabin Simulator

Work in progress:
- Mixed reality UAM cabin simulator under development
- Real cabin mock-up combined with selected virtual elements, defined near-field elements such as own body remain visible
- Cabin interior design study

DICUAM 2022:
See it, hear it, feel it - Using virtual reality to identify risks and benefits associated with drones in urban environments,
Maria Stolz, Anne Papenfuß, Michaela Rehm, Fabian Utesch, Martin Fischer, Thu. 14:40-15:00

Further reading:
- I. Moerland-Masic et al., Urban Mobility: Airtaxi Cabin from a Passengers Point of View, Comfort Congress, 09.2021

Conceptual ideas and first sketches for different seating arrangements

Simulator set-up with cabin mock-up and head-worn mixed reality display, virtual Hamburg scenery
Conclusion

• Urban Air Mobility is more than vehicle design!
• Research within HorizonUAM addresses urban air mobility as system-of-systems, including aspects of
  • Vehicle design
  • Infrastructure development
  • Operations and airspace integration
  • Public acceptance

HorizonUAM Symposium 2022

• September 2022, DLR Braunschweig, Germany
• Technical presentations, simulator demonstration, facility tour
• 2 days in-person event
• Further details will follow soon: http://www.horizonuam.dlr.de/

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