Vertiports - Infrastructure and community aspects

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Air systems categories  
(Source: Roland Berger 2022)

- **Range**: 0 km, >300 km, >500 km
- **Seat capacity**: ≤ 19, >19
- **Segments**:
  - **UAVs**
  - **UAM**
  - **RAM short-distance**
  - **RAM long-distance**
  - **RAT**
- **Aircraft capability**:
  - **VTOL**
  - **STOL**
  - **CTOL**
- **Propulsion type**:
  - **Battery**
  - **H2-FC**
  - **Turboprop, turbofan, GTF, H2-FC**
- **Infrastructure requirements**:
  - **New infrastructure**
  - **Mostly existing airfields**
  - **Existing airfields and airports**
- **Certification limits**:
  - **SC-VTOL (<3,175 kg)**
  - **CS-23 (<8,618 kg)**
  - **CS-25**

Source: Bauhaus Luftfahrt, Roland Berger
Definitions

'vertiport' means 'an area of land, water, or structure used or intended to be used for the landing and take-off of VTOL-capable aircraft (EASA SC-VTOL-01)

- **Vertihub** – simultaneous multi-air system operations, recharging capability, ground handling capability, air system maintenance, storage etc

- **Vertiport** – multi-air system operations, smaller scale facilities/footprint than Hubs

- **Vertistop** – limited facilities, drop off/pick up only.

- All raise issues of density of operations.
- Distance from nearest access point reduces likelihood of use. Issue of noise in residential areas.
- Passenger or cargo (hub-to-hub or last mile)?
- Not CTOL/STOL (currently limiting scope to urban/metro ranges, not RAM)
<table>
<thead>
<tr>
<th>Large cities</th>
<th>Medium cities</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Outposts, areas of interest or private use</strong></td>
<td>Medium, less dense, medium income, urban/suburban city, Sevilla, Lisbon, Dusseldorf, Riga, Athens</td>
</tr>
<tr>
<td>3-5</td>
<td>Major suburban commuting stations, private use for high net worth individuals, or in wealthy suburbs</td>
</tr>
<tr>
<td><strong>Near concentrations of high origin and destination points</strong></td>
<td>3-7</td>
</tr>
<tr>
<td>5-10</td>
<td>Major corporate headquarters, major retail districts, and major commuting stations</td>
</tr>
<tr>
<td><strong>Major airports, city centres, and major commute corridors</strong></td>
<td>2-3</td>
</tr>
<tr>
<td>2-3</td>
<td>Main airport, downtown, and major work district</td>
</tr>
<tr>
<td>40-60</td>
<td>Total landing pads</td>
</tr>
</tbody>
</table>

Source: EASA - A study on the societal acceptance of Urban Air Mobility in Europe
Urban Air Mobility Operations and Key Actors

Source: Boeing and Wisk Concept of Operations for Uncrewed Urban Air Mobility (2022)
Example Vertiport/Vertistop Layouts

Vertistop: open surface

Vertiport: open surface

Vertistop: on elevated structure

Vertistop: floating (marina)

Waiting lounge, Commercial & Hospitality
Corridors to Stands
FATO+SA
1.2 D
Corridors to Stands
Cargo Storage & Processing

Vehicle access for passengers
Access Control, Check-in, Plant & Management
Pedestrian access
Vehicle access for cargo

Processing Area for Passengers and Small Cargo (possibly under FATO) (under FATO or docks)
Access trough exclusive use high-speed elevator/escalators

FATO+SA
Docks
Vehicle access for passengers and/or cargo
Pedestrian access

Source: Bluenest UAM
### Assessment of unit-development costs for types of UAM infrastructure (National Academy of Sciences)

<table>
<thead>
<tr>
<th>Cost component</th>
<th>Vertipad</th>
<th>Vertiport</th>
<th>Vertihub</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Pad material costs</strong></td>
<td>$66,000</td>
<td>$500,000</td>
<td>$1.25M</td>
</tr>
<tr>
<td><strong>Time for pad construction</strong></td>
<td>1,100</td>
<td>9,075</td>
<td>20,900</td>
</tr>
<tr>
<td><strong>Flight deck labor cost</strong></td>
<td>$28,000</td>
<td>$228,000</td>
<td>$625,000</td>
</tr>
<tr>
<td><strong>Charging station cost</strong></td>
<td>$52,000</td>
<td>$416,000</td>
<td>$1M</td>
</tr>
<tr>
<td><strong>Terminal cost</strong></td>
<td>$591,000</td>
<td>$6.9M</td>
<td>$15.8M</td>
</tr>
<tr>
<td><strong>Site and operational capex</strong></td>
<td>$500,000</td>
<td>$4.1M</td>
<td>$9.5M</td>
</tr>
<tr>
<td><strong>Total cost</strong></td>
<td>$1.2M</td>
<td>$12.1M</td>
<td>$28.1M</td>
</tr>
</tbody>
</table>

1. Reinforced concrete priced at $3.30 per sq. ft. (ConcreteNetwork.com)
2. FATO area = 1.5 x rotor diameter \(^2\) uses assumed ‘rotor diameter’ of 45 ft.
3. Facility development cost reflects average rate for total construction cost, including labor.
4. Terminal space has been scaled based on occupancy and capacity assumptions.

**Sources:** Federal Aviation Administration, Heliport advisory circular; Compass International, Airport costs; and US DOE electric vehicle equipment cost.
Public concerns relating to Vertiports

<table>
<thead>
<tr>
<th>Concern</th>
<th>48%</th>
<th>41%</th>
<th>32%</th>
<th>31%</th>
<th>31%</th>
<th>29%</th>
<th>28%</th>
<th>15%</th>
<th>14%</th>
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</thead>
<tbody>
<tr>
<td>Noise from take-off and landing</td>
<td>21</td>
<td>15</td>
<td>12</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Safety¹</td>
<td>17</td>
<td>14</td>
<td>10</td>
<td></td>
<td></td>
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<tr>
<td>Visual pollution</td>
<td>8</td>
<td>13</td>
<td>12</td>
<td></td>
<td></td>
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<tr>
<td>Privacy</td>
<td>15</td>
<td>8</td>
<td>8</td>
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<tr>
<td>Security²</td>
<td>12</td>
<td>10</td>
<td>9</td>
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<tr>
<td>More road traffic in neighbourhood</td>
<td>6</td>
<td>11</td>
<td>11</td>
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<tr>
<td>Space occupation needed for living or recreation</td>
<td>9</td>
<td>8</td>
<td>11</td>
<td></td>
<td></td>
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<tr>
<td>More people walking by</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td></td>
<td></td>
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<tr>
<td>Space occupation needed for retail</td>
<td>4</td>
<td>5</td>
<td>5</td>
<td></td>
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<tr>
<td>None</td>
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</tbody>
</table>

1. Incident due to technical or human failure
2. Incident due to deliberate harmful action, e.g. by criminal organization or terrorists

Source: EASA UAM societal acceptance survey questions C11. Assuming that a take-off and landing-station is close by (under 50 metres), what are you most concerned about? Please select up to 6 answers. C12. Please sort your main concerns from 'most concerning' to 'least concerning'.

Source: EASA - A study on the societal acceptance of Urban Air Mobility in Europe
Current status

- No commercially operating vertiports
- Regulators taking a performance based approach = depends upon the air system being supported/ops model.
- Transport planners largely ignoring AAM as it is not mass transit – few plans for integration with existing mass transit infrastructure.
- City planners leaving it to the market unless there’s a ‘prestige’ event
- Social licence/public perception – focus slipping as introduction date recedes. Not enough on the vertiport ops aspects (noise/traffic/location etc).
- Urban environment complex (building hazards, funnelled wind etc), very large volume of possible traffic (ATM)
- High demand locations have high land costs
Current problem for vertiports

“Forget the hype, concept plans and fancy designs, the reality is that there is no existing industry in vertiport infrastructure anywhere in the world as there aren’t any aircraft commercially certified to use them...Until we have the aircraft approved, there is no point in building anything as we don’t know what the requirements will be”

(Clem Newton-Brown, CEO of Skyportz, 2021)
Future issues

**Autonomous operations/automation**

Uncrewed vertiports (like AAM systems) increase likelihood of operations profitability (security of air systems/ground operations/‘border’ issues?)

Development of remote ops systems.

**Battery life/power output/recharge speed**

Impacts range of air system = spread of network/number of flights per charge

Landing/take off biggest drain on battery, better battery life = more landings = better network coverage

Modular batteries allow for swapping, issues of storage/recharge location/power usage in locality = safety issues (urban/populated location)

Recharge/swapping time impacts on Turnaround Time (yield/utilisation)
Future issues (cont)

- Building regulations (populated/urban environment)
  - Safe power management
  - Battery storage
  - Fire safety/emergency response
  - Retrofitting
- City planning
  - Zoning (commercial mixed with residential)
  - Integration with mass transit systems
- Scalability of vertiport/network
  - Hard in urban environment (individual land costs, proximity to buildings etc)