Unmanned Aerial Vehicles for Passenger Travel

DETAILS
SECTOR | Transport
STAGE | Operations and Maintenance
TECHNOLOGIES | Unmanned Aerial Vehicles (UAVs), LiDAR, CCTV

SUMMARY
Unmanned Aerial Vehicles (UAV) are drone-like aircrafts without an onboard pilot. UAVs operate with varying degrees of autonomy, such as remote control by a human operator or autonomously by onboard computers. They operate using a combination of technologies, including computer vision from CCTV, artificial intelligence and object avoidance (LiDAR) technology. Several prototypes are in production and they are projected to become revenue earning in 5-10 years from now (2025-30). To operate they require specific station infrastructure to be developed across urban areas and cities.

Drones have been successfully used for military applications and are quickly being adopted by the private sector, as well as in people’s everyday lives, for a variety of applications. Today, various passenger UAV prototypes exist, most taking the form of vertical take-off and landing vehicles: an aircraft that takes off, hovers, lands vertically and does not require a runway. UAVs can accommodate between two and five passengers or an equivalent cargo weight and present an ecofriendly and efficient alternative to traditional helicopter usage and other forms of road and rail transport as they are powered using electricity.

Congestion is a major issue for urban areas around the world. This is expected to worsen as populations rise, with millions more people expected to migrate to urban centres. In the most congested cities, drivers spend 50 to 100 hours per year in traffic which impacts their health and the environment. Traffic also impacts the efficiencies of operations (freight and goods delivery, tradespeople, emergency services) resulting in wasted time and higher prices of goods and services. One opportunity to provide some relief is to look to the sky and utilize the airspace above urban and suburban areas for the movement of people and goods.

There are multiple potential applications for UAVs as new models of mobility. It is foreseen that they could amount to one leg of a multimodal journey as part of a wider Mobility-as-a-Service (MaaS) system (see use case). UAVs can operate as point-to-point passenger transport (air taxis), operating in much the same way as today’s car-based ride hailing services. They could act as short-range shuttle services to/from airports in urban centres and/or medium- to long-range intercity fixed flight operations. In the freight sector, UAVs could act as a point-to-point freight last mile solution (see also the Unmanned Freight and Logistics Use Case) or consumer delivery service, minimising road congestion, delivery costs, fuel emissions and lessening the demand for street parking in the urban centres.

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VALUE CREATED

Improving efficiency and reducing costs:

- Reduce demand for more road space and parking as vehicles move to the skies and utilize rooftops
- Complete existing transport networks with an additional mode and offer a premium alternative for shorter travel times on specific trips (such as airport to business districts)

Enhancing economic, social and environmental value:

- Reduce emissions as UAVs are powered by electricity (shared if connected to the grid) and are more energy efficient than helicopters
- Create additional fare revenues complementing the existing transport chain with an additional solution (i.e. Airport to City/Business centres)
- Provide users with an alternative means of transport which will be less impacted by road congestion

POLICY TOOLS AND LEVERS

Legislation and regulation: UAVs for passenger travel will require a robust air traffic management system to ensure safe, consistent and efficient operations, including the collaboration and co-operation with local Aviation Safety Authorities. In addition, a reliable traffic management framework should be developed with focus on the integration with other modes, especially in urban areas. This will be enabled through the collaboration with commercial stakeholders and local councils.

Effective institutions: Strong collaboration between multiple stakeholders will be required to navigate the complex challenges related to UAV development. Similar challenges have been faced by the aerospace industry before. Authorities will need to develop a comprehensive regulatory framework to guarantee the safety of people, facilities and third-party property.

Transition of workforce capabilities: Key success factors for passenger UAV manufacturers include technology maturity and integration, the ability to get their aircraft designed and built, a scalable supply chain, production capacity, and getting their aircraft certified and safe to operate with passengers. It is unlikely that individuals will own a UAV, like a car, due to their expense. Fleet operators will own or lease the vehicles and be directly responsible for the full set of operational and maintenance requirements, like the model for the on-demand executive jet market today. Training and certification requirements will need to be legislated for remote pilots and controllers. Mobility managers will be responsible for providing seamless trip planning, ticketing, and payments incorporating this mode into their interface. Digital infrastructure would be key to ensuring safe, secure, and reliable communications between fleets of passenger aircraft.
IMPLEMENTATION

Ease of Implementation
UAVs will require strategically placed take-off and landing zones/parking, battery charging stations and maintenance facilities. A wide network of vertiports would either require new infrastructure to be built or existing infrastructure, such as helipads, rooftops of large public buildings, and unused land, to be modified (see also the Vertiports Use Case).

To create a truly unified traffic management system, additional infrastructure may need to be installed along predefined flight corridors to aid high-speed data communications and geolocation.

Cost
The costs of planning, and implementation of the enabling policies and infrastructure for the safe operations of UAVs is high, as it requires important work on interface integration with the energy sector and with other modes of transport.

Country Readiness
Each country’s priority on safety, cost, travel time, reliability, comfort and new technologies, will define the level of readiness required to enable operations of UAVs. In passenger-oriented city with existing infrastructure, UAVs would mainly be deployed as an additional transport solution to complete the transport chain.

Technological Maturity
UAVs will require advanced technologies, such as artificial intelligence and cognitive systems, to enable advanced detection and avoidance capabilities. Machine learning could be essential as operations move to fully autonomous.

They will also require on-board sensors (radar, optics, geolocation sensors) to operate in GPS-denied environments. These technologies are currently being utilized in autonomous cars (see also the Autonomous Cars Use Case), but they need improvement to provide longer-range sensing and recognition capabilities necessary for the multidirectional and convergence speeds associated with autonomous flight.

Energy management is crucial: to increase capacity and extend the ranges of passenger drones, battery technology will need to improve, or alternatives need to be found.

RISKS AND MITIGATIONS

Implementation risk
Risk: Developing the supporting communications and energy interfaces along with the infrastructure is essential. Well integrated hubs will need to be developed from a structural and systems perspective, with the rest of the city’s structure and systems/technology requirements.

Mitigation: Planning solutions, operating permits and regulations will need to be implemented to enable UAVs to be used for passenger transport. Business plans should showcase the value UAVs can add for transport authorities and the community (economically and liveability), and their limited impact on infrastructure.

Social risk
Risk: To achieve long term success and avoid becoming a niche and expensive transport mode reserved for a very few, UAVs will need to quickly demonstrate themselves to be safe, quiet, convenient and affordable and integrate with the wider transport network.

Mitigation: UAV service providers must select the right products and collaborations to offer attractive and affordable services to the public. Users will need to overcome psychological barriers associated with flying in a
pilotless aircraft which can be achieved through regulatory authorities ensuring UAVs are as safe as a traditional aircraft and community education.

Safety and (Cyber)security risk

Risk: Current research looking at UAV cybersecurity threats has focussed largely on GPS jamming and spoofing. However, there is also a potential for attacks on the controls and data communications stream. Threats are like those applicable to airplanes, but they are amplified with UAVs due to the potential for high numbers of vehicles flying in relatively small urban areas.

Mitigation: For scaled adoption, operators of UAVs would have to demonstrate a safety record, covering both mechanical integrity as well as safe operations, and operations should be regulated. The UAV autonomy and its systems reliability should be proven through specific verification and validation processes, that have started to be developed in areas like Dubai with the Velocopter.

Environmental risk

Risk: The use of shared energy sources (e.g. from buildings for the stations that could be developed on them) to operate the UAVs is an asset as well as a risk. The energy requirements need to be clearly defined.

Mitigation: Sharing the power with buildings hosting the vertiports can be a risk but also a great advantage to both charge the UAVs or collect their power when they do not need it.

EXAMPLES

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<tr>
<th>Example</th>
<th>Implementation</th>
<th>Cost</th>
<th>Timeframe</th>
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<td><strong>CityAirbus</strong></td>
<td>Electric four passenger vertical take-off and landing craft initially pilot operated, moving to full autonomous mode when the technology allows.</td>
<td>High implementation costs for the UAV development, for the testing processes and for the required supporting infrastructure.</td>
<td>To be implemented with existing airports and aviation related clients ‘first/last mile’ UAVs.</td>
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<td><strong>Volocopter</strong></td>
<td>Volocopter already has a permit to fly in Germany and hopes to be part of Dubai’s commercial pilot program in the early 2020s.</td>
<td>High implementation costs for the UAV development, and for the required supporting infrastructure. Safety is a challenge to achieve and requires additional safety requirements to be checked.</td>
<td>Operations expected prior to 2025 as part of Dubai’s 15% autonomous transport objectives.</td>
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<td><strong>Ehang 184</strong></td>
<td>Passenger drone built by China-based Ehang using 100% green technology.</td>
<td>High implementation costs for the UAV development, infrastructure not yet developed.</td>
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