

Making Berlin ready for Urban Air Mobility

Transdisciplinary approaches for implementing the ‘U-Space Berlin’ real-world laboratory

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The commercial deployment of delivery drones in urban environments remains highly complex and subject to stringent prerequisites. Regulatory barriers to regular beyond-visual-line-of-sight (BVLOS) operations within numerous geographic flight restriction zones present a core challenge in the permitting process [1, 2]. Heightened air and ground risks leave little flexibility in route planning and require comprehensive technical redundancies [3, 4]. Public concerns regarding noise pollution, visual intrusion, and the general utility of a new mode of transportation pose a constant risk of sparking socio-political and legal resistance against such initiatives [5–7]. Finally, standardized, non-proprietary infrastructures must also be cited as a prerequisite for permanently integrating drone logistics into public space [8]. Thus, while the hardware is technologically mature (TRL 8–9), the maturity level of the overall system (TRL/SRL 6–7) lags significantly behind [1, 8].

What, then, motivates a state like Berlin—with tight budgets, a severe backlog of investment, and limited prior experience in UAM—to fund the "U-Space Berlin Real-World Laboratory" with approximately 3 million EUR? Over three years, the project investigates the inner-city deployment of drones in laboratory logistics, implemented by industry partner DiAvEn UG/Labfly, as well as for the delivery of food and commercial goods by marktschwalbe GmbH. Furthermore, by developing a non-proprietary depot, the Technical University of Berlin aims to advance the standardization of ground infrastructure for urban drone logistics.

The primary objective of the funding provided by the Senate Department for Economics, Energy and Public Enterprises is to accelerate the transition of local corporate innovations into market-ready business models. At the same time, the drone real-world lab represents a first-of-its-kind trial of procedural and regulatory permitting steps, which ideally supports capacity building within the participating state and district authorities. A successfully implemented real-world laboratory would also have a significant signalling effect, strengthening the national and international perception of the federal capital as a pioneer in smart city logistics and a breeding ground for Innovative Air Mobility (IAM) [2, 9].

However, examples of hurdles in urban drone logistics abound. Notable examples in Germany include the Medifly project, which has been stalled in the planning phase since 2018 due to regulatory permitting issues [10], or the proposed airborne laboratory logistics

by Morpheus in Iserlohn, which was completely halted shortly after launch due to resident complaints and political pressure, among other factors, and is now being replanned with the inclusion of these stakeholders [11]. Examples from Canberra, Australia, demonstrate how a Big Tech company withdrew its rollout due to political protest [12]. Likewise, in the U.S., where the introduction of end-consumer drone deliveries follows a top-down economic policy approach and is currently being rapidly pushed forward, resistance is mounting [13].

The baseline finding of this paper is, therefore, that resolving technical and regulatory barriers alone is insufficient for deploying delivery drones in urban spaces, as public protests, legal disputes, or bureaucratic roadblocks can lead to the failure of projects like "U-Space Berlin." The thesis is that only a transdisciplinary approach—one that purposefully engages, sensitizes, and connects stakeholders—can create the necessary framework for opening urban airspace to commercial traffic and prepare a metropolis like Berlin for IAM [2].

This paper presents the conceptual understanding of transdisciplinarity within the real-world laboratory context of U-Space Berlin. Key components of its operationalization include:

- Initiating a city-wide debate through the public symposium series "Luftraum Stadt" and the associated building of an informed civil society;
- Identifying the opinions and interests of local residents/abutters in the proposed flight areas through qualitative focus groups as well as proactive, direct outreach in the respective flight zones, i.e., engaging community gardeners and local business owners, among others;
- Conducting a planning workshop using a digital 3D software tool for inter-agency coordination regarding the flight area during initial project planning;
- Sensitizing UAS operators and legal advisors to the concerns arising from public, abutter, and administrative participation early in the project planning stage, well before the formal permitting process begins;
- Hosting information sessions and scenario workshops for the gradual expansion and institutionalization of flight operations in the Teltowkanal industrial zone.

In doing so, the paper provides concrete insights into experiences gained from the process to date. These include scientific-planning paradoxes, such as the fact that, from a regulatory permitting perspective, flying over areas like allotment gardens and recreational green spaces is clearly preferred—even though attitude research demonstrates that higher public resistance is to be expected there [6]—compared to flying along a low-traffic canal or over industrial and commercial areas, where public opinion research shows majority support for drone deployment [14, 15], but which face far greater regulatory hurdles. First-hand insights can also be shared regarding the role of politics

and public administration in managing risks, such as applying the regulatory sandbox clause pursuant to Section 21i of the German Air Traffic Order (LuftVO).

Together with the attending experts, the session aims to discuss whether and to what extent this transdisciplinary approach offers a guarantee for the successful implementation and potential long-term integration of delivery drone operations in Berlin.

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