



FLYING FORWARD 2020

White Paper

Creating a Living Lab for Drone Services in Tartu, Estonia

DATE:
04.09.2023

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Flying Forward 2020 has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement no.101006828.

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1. Description/Executive Summary

The rapid development of unmanned aerial systems (UAS) or drones has the potential to bring significant benefits to urban and rural areas alike. Different industries can benefit from a wide range of future services carried out by drones, e.g.: inspection, delivery, emergency, civil services, etc.

This white paper presents the concept of **creating a U-space Living Lab** (hereinafter referred to as the living lab) in Tartu, Estonia, to support the development, testing and integration of innovative drone technologies and applications in real-life environment. The living lab will serve as an **international collaborative test environment** where public and private stakeholders, researchers, entrepreneurs, and citizens can work together to identify and address the challenges and opportunities of drone services in Europe (check Fig.1).

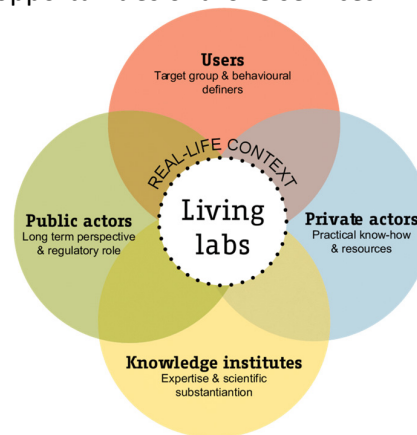


Figure 1 - Living Lab Context

acquired from: <https://icld.se/en/article/call-for-research-proposals-living-labs-grant>

The activities carried out within FF2020 project, especially the use cases carried out by participating living labs¹ have supported the living lab concept development and involvement of relevant actors both locally as well as internationally. Focus for Tartu Science Park in the FF2020 project framework has been to map and provide possible solutions for the main roadblocks described by local stakeholders interested in UAM field, e.g.:

- **U-space infrastructure availability and capacity** (both hardware and software), combined with the high cost of development of drone services, is a major barrier to fully capture the available demand. This includes investment into infrastructure as well as access to state-of-the-art research, use cases testing and demonstrations in operational living lab environment.
- **Start-up support** is needed to provide insights into how to effectively develop the services for market application, incl. access to funding, business incubation and acceleration, testing and certification services.
- Evaluating **public perception** of safety and environmental challenges regarding future UAM services might become a large obstacle, thus involvement of citizens is needed throughout the whole process.
- **To overcome legal and regulatory barriers**, research-based policy recommendations are needed with continuous feedback loop from the field e.g., Unmanned Traffic

¹ FF2020 demonstrators: <https://www.ff2020.eu/demonstrators>

Management (UTM) has been described as a roadblock, especially for non-allowance of BVLOS (Beyond Visual Line of Sight) flights in the city airspace.

These and other related issues will be tackled with the joint effort of all stakeholders involved within the living lab setting.

2. Introduction

Drones have demonstrated the potential to transform various industries, including transportation, agriculture, public safety, and environmental monitoring. However, there are still many challenges to be addressed to ensure the safe and efficient integration of drone services into the daily lives of citizens. This white paper describes the creation of a living lab for drone services in Tartu, a city with a thriving innovation ecosystem and a strong commitment to supporting new technologies.

In January 2023, the EU Commission's **U-Space Regulation**² came into effect, requiring member states to establish U-space for unmanned aircraft operations, both in terms of airspace and digital services. The implementation of the European U-space regulation and legal framework is hindered by numerous technical, legal, organizational, as well as social and environmental challenges. Furthermore, several technical solutions in the aviation context lack requirements and require validation before their deployment.

Based on the **European Drone Strategy 2.0**³, cities play a crucial role in aligning innovative aviation services with their citizens' needs and preferences. Cities should decide to what extent drones can operate within their territory, considering factors such as protecting critical infrastructure, determining daytime or nighttime operations, and implementing measures to reduce noise and visual disturbances. Many European cities are already at the forefront of logistics innovation with drones, aiming to achieve ambitious climate and mobility goals. Member states of the EU should use tools like sustainable urban mobility plans (SUMP) as a mechanism to integrate alternative solutions offered by urban aviation mobility into urban mobility planning and help address mobility issues throughout the functional urban areas, including spatial planning, energy, and climate plans.

Local governments play a central role in regional planning for urban and rural areas, as well as in creating specific infrastructure for vertical take-off and landing platforms or necessary infrastructure for launch and landing sites. Local governments should be involved and could communicate to society a message confirming security and transparency regarding what innovative aviation mobility entails and how, when, and where it will be implemented. Citizen participation in testing environments, living labs, and promotional activities should be encouraged to consider local/regional aspects when making final decisions regarding the implementation of innovative mobility solutions.

In this context, the local ecosystem in Tartu region has set up ZeroEst NGO to be the main body implementing the living lab in Tartu to support its ambitions for a climate-neutral and

² Available at: <https://www.easa.europa.eu/en/regulations/U-space>

³ Available at: https://transport.ec.europa.eu/system/files/2022-11/COM_2022_652_drone_strategy_2.0.pdf

smart city, as well as the development of the entrepreneurial landscape connected with drones and drone services. **The living lab will serve as a certified testing environment for experimentation, demonstration, and evaluation of new drone services, drone-based business models, and regulations in a real urban environment.** The living lab will contribute to the safe and efficient integration of drones into the city's airspace. The development of the Tartu living lab will gradually progress from simpler to more complex stages, evolving over time into an international aviation innovation center.

3. Problem Definition

The drone services industry is a dynamic emerging industry. According to feedback from stakeholders from within the drone services domain, currently, U-space development efforts are fractured, regulatory barriers make testing and evolving technology and concepts expensive and very slow, and standards are being prepared in isolation from a large proportion of the current industry knowledge base and specific needs. Currently, U-space environment does not support effectively beyond visual line of sight operations (BVLOS), which hinders autonomous drone services.

At the same time the technology to support U-space is being developed around the world from the technology push and market pull perspective. This makes it complicated as no-one knows, what will be the standards and certification in the field in the future. In the EU, several projects are tackling the U-space from different perspectives, e.g. DORAI group (Drone Operator Requirements Aero Initiative, check: <https://www.linkedin.com/company/dorai>) develops and promotes standardization requirements for drone manufacturers. SAFIR-Ready initiative (<https://www.linkedin.com/company/safir-ready>) is building mission-ready capability for ad-hoc BVLOS operations, enabling rapid flight authorization and ground automation from the healthcare and emergency response services perspective. We will monitor these processes closely and actively utilize key findings and suggestions throughout the near future.

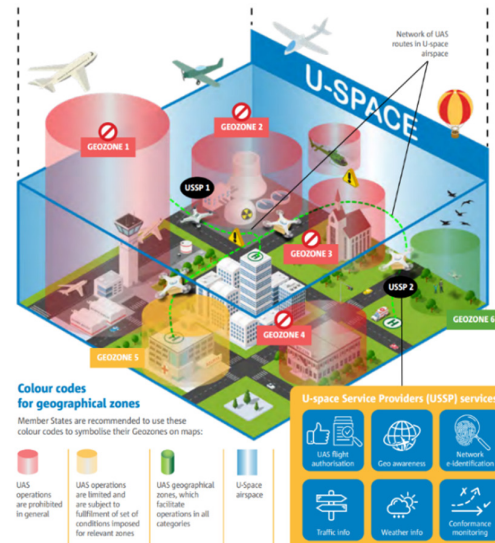


Figure 2 - U-space and USSP services (EASA)

Key issues targeted by the living lab:

- What kind of infrastructure is needed for future drone services? Both hardware and software needs will be considered to allow future BVLOS flights within cities.
- How to decrease safety and security, environmental, privacy and other risks regarding drones and drone services?
- What kind of legal and regulatory barriers exist locally in Tartu/Estonia and across EU and how to overcome these barriers?
- How is the public perception changing, when more and more drones will be flying in future cities?
- How to effectively support drone and drone services start-ups?
- How can traditional industries benefit from these novel services?

4. High-level Solution(s)

On the highest level, the involved partners have analyzed the building blocks for future drone services and will focus on working in-depth with all the related areas. The discussions held within the FF2020 project have resulted in the following challenges need to be addressed to unlock the full potential of drone services:

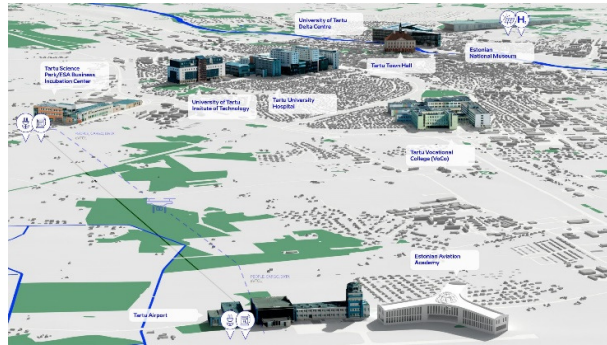


Figure 3 - Key ecosystem locations in Tartu

- **Infrastructure and integration:**
Creating the necessary infrastructure, including physical and digital infrastructure to support drone operations.
 - **Physical infrastructure** includes vertiports and similar drone-specific physical landing sites in several locations as well as the hardware needed to run the digital infrastructure.
 - **Digital infrastructure** includes connectivity and communication networks for 4G, 5G, 6G, RF, etc. as well as digital platforms and traffic management systems for enabling and monitoring the U-space.
- **Regulatory and policy framework:** Developing a clear and flexible regulatory framework that ensures safe and efficient integration of drones into the airspace while fostering innovation.
- **Risk analysis:** Creating a safe environment for drone services within a city needs a thorough analysis of risks and clear regulation/action plan for decreasing these risks. There is a wide range of risks involved in drone services planning, regarding privacy, noise, safety as well as environmental risks - cold weather, strong winds, etc.
- **Technological development and standardization:** Encouraging the development and adoption of interoperable and scalable drone technologies and services.
- **Public acceptance and awareness:** Building trust and acceptance among the public by addressing concerns related to privacy, noise, and safety.
- **GDPR and data safety related issues:** As currently most drones have cameras attached, the key issue is how to avoid conflicts with potential privacy related topics.

The creation of a living lab for drone services in Tartu will involve the following high-level solutions:

- Forming a consortium of public and private stakeholders
- Developing a comprehensive testing and demonstration environment
- Fostering collaboration and knowledge exchange
- Providing support for research and development and startup businesses

4.1 Forming a consortium of public and private stakeholder



The local stakeholders in Tartu have established and are jointly leading **ZeroEst NGO** activities with a clear focus on building a platform including government agencies, industry partners, research institutions, and end-users, to oversee the living lab planning and future activities for a Climate Neutral Air Mobility Ecosystem. The next step will be involving external partners and attract additional international public and private funding into cooperation. In addition to FF2020 activities, several EU and local level projects and initiatives are ongoing in the same field.

Main U-space stakeholders in Estonia:

Policy level, public funding and political support on national and local level

- Estonian Ministry of Economic Affairs and Communications
- Tartu City Government
- Association of Municipalities of Tartu County

Technical partners, U-space facilitators

- Estonian Transport Administration (<https://transpordiamet.ee/en>) – competent authority, that provides certification to both single common information service providers (sCISP) as well as U-space service providers (USSP). It also runs the platform for registering unmanned aircraft operators in Estonia: <https://lois.transpordiamet.ee>
- Estonian Air Navigation Services Ltd. (<https://www.eans.ee/en>) – Estonian ANSP
- Tartu Airport in cooperation with Tallinn Airport – remote tower related services
- Mobile operators, providing connectivity

Research and Development (R&D) partners

- Estonian Aviation Academy – R&D and flight operations support
- University of Tartu – R&D support
- Other universities and research institutions

Living lab services end-users

- Drone developers and drone services startups
- Local and international startups
- Other businesses, potential end-users of services
- Citizens

Business incubation and acceleration services

- Tartu Science Park Foundation

The main goal of the cooperation is planning activities for the future, information exchange and ecosystem development.

4.2 Developing a comprehensive testing and demonstration environment.

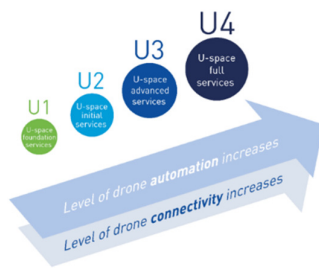


Figure 4 U-space implementation roadmap (Eurocontrol, 2022)

According to Eurocontrol U-space Services Implementation Monitoring Report⁴ published in October 2022, a phased approach has been foreseen to achieve a safe, efficient and secure integration of drones' operations with manned aviation. 4 phases (see Fig.3) describe the needed services and procedures, including 4 foundation services, 22 initial services and 3 advanced services. Drone automation and connectivity increases with more and more services being made available in the next few years across Europe. The constant updates need also testing of the available services in live environment. Thus,

we have foreseen the following set-up for testing and demonstration environment in Tartu, Estonia:

- Designating specific areas within Tartu for drone testing, including urban and rural settings, to allow for the testing of various use cases and scenarios.
- Establishing connections with technology providers for collaboration (hardware and software, vertiports, U-space service providers, eVTOL, etc.)
- Integrating U-space services available to the local offer, incl. testing the Estonian drone app: <https://utm.eans.ee/avm>
- Preparing, validating, and running drone related services/use cases
- Establishing potential locations for vertiports

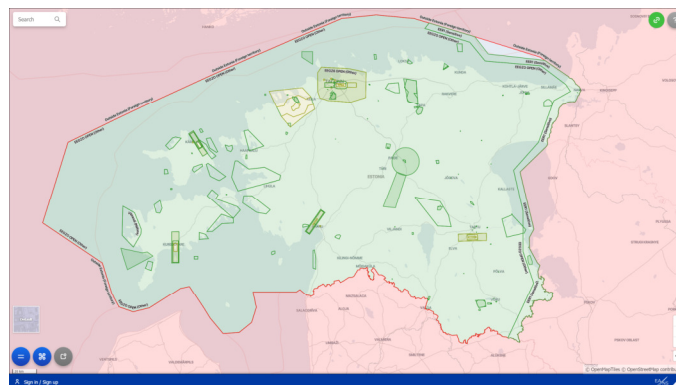


Figure 5 - Estonian Drone App (<https://utm.eans.ee/avm>)

One possible way forward is focusing first on **optimizing and replacing existing public sector services with drone services**. This would provide a platform to build the knowledge and technical base. To achieve this, the Tartu City Government has identified potential use cases where drones could provide various services in the future. The initial set of use cases aims to solve the following urban services using drones:

- **Construction Supervision:** Automatic detection of new construction and extensions using drone photos, measurement of the identified buildings' footprint, identification of objects such as heat pumps, solar panels, and visible equipment, classification of

⁴ Available at: <https://www.eurocontrol.int/sites/default/files/2022-11/eurocontrol-u-space-services-implementation-monitoring-report-2022.pdf>

detected activities and objects, and verification of the legality of activities based on, for example, restricted areas, general plans, and permits in the building register.

- **Road Marking Maintenance:** Assessment of road marking quality based on drone photos taken in spring, prioritization of tasks, and transmission of work assignments to road marking companies. Evaluation of work quality based on drone photos taken in autumn and comparison with the spring situation.
- **Supervision of Temporary Road Works and Closures, Road Quality Assessment:** Mapping urban areas with drones after road closures, followed by analysis using AI tools to verify the proper removal of temporary traffic management signs and the restoration of road surfaces and green areas in compliance with regulations.
- **Real-time Measurement of Hotspots:** Real-time measurement of hotspots, crucial for climate adaptation. Currently, the city government uses satellite data or sensors.

4.3 Fostering collaboration and knowledge exchange.

The key to future success is channeling different ongoing and future initiatives and projects into living lab environment and encouraging cooperation between stakeholders through meetups, workshops, seminars and conferences to share experiences and best practices in the field.

The goal is to utilize public funding for building a self-sustainable service in the future. For the funding of the activities, the local community will actively look for opportunities for government grants, private sector partnerships and research funding. Already, a lot is going on. In addition to FF2020 project, several other projects are currently running including partners from Tartu, tackling different aspects regarding future use of drones, e.g.:

- **CITYAM** (<https://interreg-baltic.eu/project/cityam-interreg-baltic-sea-region-green-mobility>) – The project is focusing on the ingredients and tools for a solid UAM strategy, to adapt city planning practices in relation to landing site and airspace management, and also to scale city-owned drone operations as part of a multimodal transport system. Partners from Estonia: Tartu City government, Estonian Aviation Academy and TalTech. It is funded by Interreg Baltic Sea Region program.
- **SAFIR-Ready** (<https://sesarju.eu/projects/SAFIR-ready>) - The project aims to develop new U-space advanced services together with a central command and control centre (C2C), as well as an automated ground integration (Drone Cargo Port - DCP) to facilitate automated time-critical drone-based services for medical and non-medical use cases. This is the SESAR program funded research project, involving 34 partners, including 3 from Estonia – Estonian Aviation Academy and 2 Estonian drone startups SKYCORP and Hepta.
- **CACTUS project** – a local project focusing on building U-space sandbox in Tartu

4.4 Providing support for research and development and startup businesses.

The core of the self-sustainable service is available infrastructure and expert network for offering technical support for R&D activities related to drone technologies and services, as

well as promoting the involvement of local startups and SMEs, including business incubation and acceleration support and access to funding.

Tartu is a perfect location for this with state-of-the-art R&D infrastructure and specialists available at local universities and public sector support provided by active involvement of Tartu City in different drone related activities.

Business incubation and acceleration services will be provided by Tartu Science Park, already running the S2B Launchpad program focusing on deep-tech startups, European Space Agency Business Incubator focusing on startups with space connection and NATO Diana program for dual use startups. Tartu Science Park has also been working with a growing investor environment interested in investing into future technologies.

5 Conclusion

In conclusion, this whitepaper has delved into the intricate landscape of the emerging drone services industry, shedding light on the dynamic evolution of U-space development and the challenges surrounding future automated operations. Through the insights gathered from stakeholders within the domain, it becomes evident that the path to fully realizing the potential of autonomous drone services is multifaceted and requires collaborative efforts from various fronts.

The current state of fractured U-space development efforts, regulatory barriers, and isolated standards preparation has underscored the necessity for innovative solutions. This whitepaper has proposed the establishment of a living lab in Tartu as a strategic response to these challenges. **Such a living lab would serve as a center for collaboration, innovation, and experimentation, where key stakeholders including technology providers, regulatory bodies, academia, and industry can converge to drive progress.**

By embracing a holistic approach that encompasses technology development, regulatory engagement, standardization alignment, and knowledge sharing, the living lab in Tartu can become a nucleus of transformative change. It would offer a controlled yet dynamic environment for testing and refining U-space components, while also fostering an ecosystem that catalyzes startups, attracts investments, and cultivates research endeavors.

The journey towards an effective U-space ecosystem that supports automated drone operations is complex, with myriad unknowns looming on the horizon. However, by embarking on the journey together, leveraging the collaborative spirit of the industry's pioneers, and harnessing the power of innovation, it is possible to navigate these uncharted waters with purpose and confidence. The living lab proposed herein has the potential to not only overcome the challenges but also to pioneer new horizons in autonomous drone services, making Tartu a beacon of progress in this transformative era. As the technology landscape continues to evolve and the industry matures, the living lab's contributions will undoubtedly play a pivotal role in shaping the future of the drone services industry worldwide.

6 Call to Action

In EU, there is a growing number of R&D-focused test sites and sandboxes. However, in order to realise the EU's 14 billion drone services potential by drone services, we need to move towards higher TRL (technology readiness level) activities and Living Labs are an ideal tool to facilitate this. The creation of a living lab for drone services in Tartu will pave the way for the development and implementation of innovative drone solutions that can address societal needs and create new economic opportunities. By fostering a collaborative environment, the living lab will help overcome the challenges associated with the integration of drone services and support the growth of the drone industry in Estonia and beyond.

Join us in the efforts to support the creation of a living lab for drone services in Tartu. Public and private entities, research institutions, and the local community are encouraged to engage in this initiative, contribute their expertise, and help shape the future of drone services in Europe.

7 Glossary of Terms

ANSP: Regulatory Authority or the Air Navigation Service Provider

BVLOS: beyond visual line of sight operations. In the future, the drones will be flying in an automated environment, out of sight of a pilot.

CAA: Civil Aviation Authority

Drone Traffic Management System: A system for managing the safe and efficient movement of drones in the airspace, ensuring separation from other aircraft and obstacles.

Living Lab: An experimental environment where users, researchers, and stakeholders co-create and test innovative solutions in real-life settings.

U-space: a set of specific services and procedures designed to ensure safe and efficient access to airspace for a large number of drones, and which are based on high levels of digitalization and automation.

Unmanned Aerial System (UAS): An aircraft without a human pilot onboard, controlled remotely or autonomously.

Vertiport: A dedicated facility for the takeoff, landing, and charging of vertical takeoff and landing (VTOL) aircraft, such as drones.

8 References

EU Drone Strategy 2.0: https://transport.ec.europa.eu/system/files/2022-11/COM_2022_652_drone_strategy_2.0.pdf

Eurocontrol U-space Services Implementation Monitoring Report: <https://www.eurocontrol.int/sites/default/files/2022-11/eurocontrol-u-space-services-implementation-monitoring-report-2022.pdf>

Flying Forward 2020 project: <https://www.ff2020.eu>

U-space regulation: <https://www.easa.europa.eu/en/regulations/U-space>



FF2020



Flying Forward 2020 (FF2020) is a collaborative three-year research and innovation project funded by the European Union under the Horizon 2020 programme. Our project is developing an entire state-of-the-art Urban Air Mobility (UAM) infrastructure by incorporating this new form of mobility within the geospatial digital infrastructure of cities. It includes a governance model and framework, a regulatory framework, a geospatial digital infrastructure, a Digital Toolbox, an Identity of Things (IDoT) scheme, and interoperability frameworks. The solutions developed during the project will be tested in five living labs across Europe: Eindhoven, Milan, Zaragoza, Tartu and Oulu – enabling an open dialogue with stakeholders, end-users and citizens to improve processes and results. Ultimately, our goal is to have a positive and lasting impact on the quality of life of European citizens and to create sustainable partnerships and cities.

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Flying Forward 2020 has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement no.101006828.