



The European U-Space Regulation: Current Challenges Hindering Full Scale Drone Deployment in Europe

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Abstract: The rapid growth of the global drone industry and particularly that of Europe has brought about a revolution in urban air mobility. The current Air Traffic Management rules cannot not directly apply to Unmanned Aerial Vehicles, and therefore their integration into the airspace is associated with several challenges. Drones are operated without a pilot onboard, they fly at low altitudes, they are numerous, and therefore not compatible with the rules designed for manned aviation. This creates challenges ranging from safety, privacy, the management of traffic between the drones and manned aviation. In Europe, the European Union adopted the U-Space regulatory framework (EU Regulations 2019/947 and 945 representing the Commission Implementing Regulation and the Commission Delegated Regulation) in April 2021 which provides a set of technical requirements, services, and operational standards for drones in the Open, Specific and Certified categories of the U-Space Airspace. This U-Space concept aims at facilitating the integration of drones in the European airspace in a safe and efficient manner. This paper examined what challenges currently impede the smooth integration of drones into the European airspace. To effectively answer the problem at stake, a qualitative research method is used. It involved an exploratory process by means of in-depth interviews conducted with industry players including manufactures, service providers, regulators, and drone insurance companies. A total of 12 stakeholders participated in the interview sessions which were virtually conducted and lasted an average of 45 minutes. The results from the interview reveal that there are certain barriers that currently impede the smooth integration of drones in the European airspace including the dynamics of the U-Space regulation itself, segregation of airspace management, bureaucratic and administrative processes, etc. The study recommends a reinforced collaboration between public and private stakeholders to achieve the objectives of U-Space. The study concludes that the drone industry is very important in the growth of the EU member states and the U-Space regulation is the solution to the safe integration of drones in the airspace.

Key words – U-Space, regulation, Unmanned Aircrafts, Drones, Airspace, Europe, Challenges.

1. Introduction

Unmanned Aerial Vehicles (UAVs) popularly known as Drones, have been attracting a drastic increase in attention in recent years. Their ability extends to performing a broad variety of applications in the civil and public sectors whereas they were initially used in military applications. Some of the prominent areas of application include agriculture, research, inspection, logistics, urban air mobility. The increasing demand for these UAVs and their safe integration into segregated and non-segregated airspace has raised several concerns of safety especially in populated urban environments with regards to the people on the ground, other air space users, critical infrastructure, privacy, security, and the environment.

It is presumably the case that most of the UAVs will carry out their operations at very low altitudinal levels in combination with the already existing usage of the airspace by general aviation. Drone usage is anticipated to have significant impact on the quality of life, health, and social and economic wellbeing of the population (Kyrkou et al., 2019). This technological disruption creates issues that require the management and minimization of the adverse impacts as well as maximizing the positive potentials (Kwon et al., 2017).

In recent years, there have been numerous reported incidents of drone operational encounters. A typical example to this effect occurred on the 16th of August 2015 when the pilot of a JetBlue airplane got startled by a white drone with its sudden appearance of the left wing of the airplane a short period before landing at the Los Angeles International Airport (Wendland & Boxnick, 2017)). The number of encounters between UAVs and airplanes have increased over the years as the demand for the former increases. The Federal Aviation Administration of the United States of America reported 700 of such incidents in the year 2015 (FAA, 2018). Drone traffic management has therefore become an important issue that needs to be addressed to prevent the ever-growing problem of low altitude traffic. Fortunately, after serious deliberations amongst stakeholders from the European Union member states for several years, the U-Space regulatory framework (EU Regulations 2019/947 and 945 representing the Commission Implementing Regulation and the Commission Delegated Regulation) was finally adopted in April 2021 (European Union, 2021). The goal of this regulation is to ensure a smooth integration of drones into the European airspace in an efficient and safe manner. In recent years, several studies (Ruwaimana et al., 2018; Bujak & Sliwa, 2017) have focused only on the potential benefits of large-scale deployment of drones such as its usage in monitoring traffic, infrastructure inspections, search and rescue operations, improvement in accessibility to places of opportunities like health care, jobs, education; and contribution to a more efficient, safer, and sustainable transport system, but these studies failed to tackle the issues that might prevent cities from experiencing these benefits of large scale drone deployment in the European airspace. The aim of this paper is to fill this gap of knowledge by answering the following research question; *What factors impede the smooth integration of drones in the European U-space airspace? What strategies could be adopted to curb these barriers?* An interview study was conducted to better understand the perceptions of drone manufacturers, service providers, and regulators in Europe on the current barriers to the full-scale drone deployment in Europe with regards to the U-Space regulation.

This paper is structured as follows; Firstly, the U-Space regulation is reviewed. Then the method used for this research is presented, followed by presentation of the results. The final section discusses the findings from the study and reveals the limitations and opportunities for future research, and the conclusion.

2. Review on the U-Space Regulation

An Unmanned Aerial Vehicle or a drone is defined by the International Civil Aviation Organization (ICAO, 2011) as an aircraft operated without a human pilot onboard. UAV flights operate with varying degrees of autonomy as they can be remotely controlled by a human operator, or they can be intermittently or fully autonomous, and lastly by onboard computers. The initial usage of drones can be traced from military applications around the 1960s and since then, the recent technological developments have led to its spread in civilian applications especially in the agricultural, transportation and medical sectors (Vacca and Onishi, 2017).

The U-Space framework is a representation of the European ecosystem of services and procedures specifically designed to ensure a safe, efficient, and secure access to the airspace for UAV operations (European U-Space Blueprint, 2017). These ecosystems of services are largely a function of high levels of automation and digitization irrespective of whether they are onboard the drones or are a component of the ground based-based environment.

The delivery of U-Space services is reliant on some key principles (European U-Space Blueprint, 2017), and they include:

- To effectively ensure the safety of all airspace users operating in the U-Space framework, including people on the ground.
- The U-Space is also aimed at providing a scalable, adaptable, and flexible system that responds to changes in volume, demand, technology, business models and applications, while ensuring a smooth management of the interface with manned aviation.
- Enabling high density operations with a multitude of automated UAVs under the auspices of fleet operators.
- To guarantee an equitable and fair access to the airspace for all users.
- Enabling an all-time competitive and cost-effective service provision that supports the business models of all drone operators.
- The U-Space is aimed at minimising the deployment and operating costs by capitalising on existing aeronautical services and infrastructure as well as those from other sectors such as mobile communication services.
- Accelerating deployment by the adoption of technologies and standards from other sectors where they meet the needs of U-Space.
- Lastly, the U-Space is bound to follow a risk-based and performance-driven approach in the setting up of appropriate requirements for safety, security, which includes cyber security, and resilience, while ensuring a minimisation of environmental impacts and respecting the privacy of the citizens and ensuring data protection.

To attain a safe and efficient integration of UAVs and manned aviation, the U-Space framework involves a rollout approach with different levels of sophistication. This rollout approach is illustrated in figure 1.

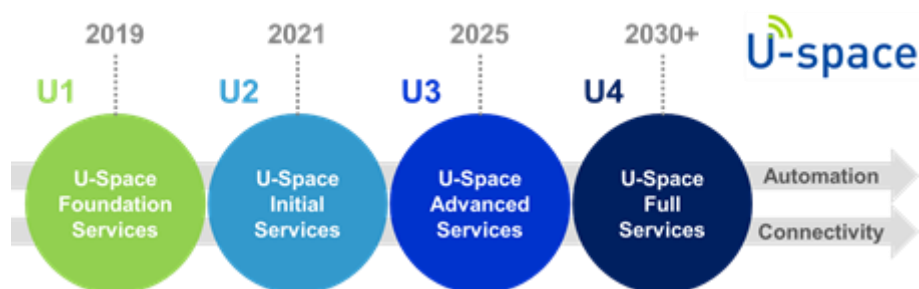


Figure 1: U-Space rollout roadmap (Source: SESAR JU, 2019)

The various step in the rolling out of the U-Space services in an incremental manner will propose a new set of services, while continuously upgrading the service versions already existing in the previous phase

3. Method

The U-Space regulation is a recent and emerging topic in Europe and therefore an exploratory study was conducted. The Sampling method applied is a non-probability sampling method. The participants were selected based on a non-random criterion. This method is suitable in order to select participants that were most useful for this study. This ensured an output of in-depth knowledge on the research questions rather than drawing statistical inference. The list of participants selected fall under manufacturers, service providers, and policy makers. While survey data can be useful to identify and quantify patterns and perceptions, qualitative data can offer more detailed and nuanced understanding of the research (Hargittai et al. 2010).

In order to grasp a better understanding of the European U-Space framework and the barriers to its full implementation, a semi-structured interview with open-ended questions was carried out with 12 stakeholders that were relevant for the study (Appendix A). This system was preferable because it adopted a conversational approach that will create a rapport between the researcher and the interviewee and enable the later to reveal more information that was not limited to the few defined questions from the researcher. This method was also flexible and allowed the researcher to ask follow-up questions based on the new information provided. These interviews were 100% performed virtually through Teams, Google meet, and Webex. The responses were recorded through jotting and recording with prior permission from the interviewee. The interviews were initially scheduled for 30 minutes but all exceeded this time as some lasted up to a maximum of 1h: 30 minutes. The interviews were fully transcribed verbatim using the Otter.ai Pro software, and a manual thematic analysis performed. This involved coding the data after transcription to identify broad themes and patterns that were reviewed. Each identified theme was examined to gain a proper understanding of the perceptions and motivations of the participants regarding the research questions. The codes applied represent keywords that are used to organize text, and which are considered essential aspects of qualitative research (Sarantakos, 1998). The data was then analyzed and interpreted by identifying any reoccurring themes throughout and highlighting any differences or similarities that existed in the data.

4. Results

In this section, the perceptions of the interviewees on the U-Space regulation and the current barriers to the large-scale deployment of drones in Europe were iteratively identified and presented into four categories.

The full integration of drones into the European Airspace is not yet a reality. The U-Space regulation follows a timeline of events and activities but besides this, the stakeholders also provided significant insights on why the full-scale integration of drones in Europe is not yet a reality at this moment. Their responses are categorized as follows.

4.1. The U-Space Regulation as a Barrier

Although the stakeholders acknowledged the importance of the U-Space regulation and the potential benefits associated with it when fully implemented, they are however discontent with the content and framing of the regulation as well as the slow pace of its implementation. Some expressions to this regard include.

The U-Space regulation might be rewritten for it lacks a good concept of operations. There are clear differences in interpretation across member states and there is also no clear definition on state operators like

the police, emergency services on flight request and authorisations. The regulation still needs to be clear enough and to me it will constantly be updated as time goes on.

(Participant 9)

I don't see the possibility of the U-Space coming into full operation in the nearest future, not 2023 and not even in 2024. I say this because the U-Space regulation has been discussed for several years now but no tangible advances and so it will really take time to realise this in Europe.

(Participant 3)

It's imperative that the regulation even though originally designed to aid the smooth and safe integration of drones in the European U-Space Airspace, is equally acting as an impeding factor to the realisation of this objective as a lot of things remain unclear with its constant dynamism.

4.2 Segregation of Airspace Management

Another important key finding is the fact that airspace segregation is a pull factor to the smooth integration of drones into the European U-Space Airspace. The airspace is generally regarded as a collective resource even though we must acknowledge the presence of existing users who have been operating there before. But with the rapid development of technologies, the airspace is required to become a shared airspace for the benefit of all users provided it is effectively managed. The stakeholders believe that the current approach for the regulation of drones which is based on airspace segregation is not the best.

Europe started in a bad way with segregation of airspace and there is need for an effective harmonization even though it will take time to be realized.

(Participant 9)

From the analysis, it is evident that the segregation of airspace management is a huge impediment to the effective integration of drones into the European Airspace. Different countries are adopting different approaches to integrating drones into their national airspaces and this needs a harmonization framework to ensure smooth operations. This is the more reason why ongoing research is interested in developing sense and avoid or collision avoidance technologies to this effect.

4.2. Administrative and Bureaucratic Tendencies

The complex bureaucratic processes associated with the drone business is also one of the main hindrances reported by the stakeholders. These administrative and bureaucratic processes affect almost every stakeholder involved ranging from manufacturers, service providers, pilots etc. The stakeholders generally agree that the difficulty in interpretation of the regulation and the continuous amendments on it as earlier seen, makes the administrative process to become more complicated. This relates to the delays experienced in certification and authorization approvals.

The Civil Aviation Authority in Belgium for example lacks the manpower, vision, and competence to effectively process the volume of authorization requests and on time.

(Participant 9)

I think Authorization approvals are not slower than before rather there are just too much more people and more professionals who want to fly, and these flights are requested in complex environments. The authorities

just want to be sure that there are no incidents with regards to safety of flights because if you want to fly at night, then that's different from flying during the day. Also, Beyond Visual Line of Sight flight is different from Visual line of Sight and as the market and industry is demanding to go forward with drones, the legislation will have to cope with it. Nobody else has done this in the past and so its new to everybody since there is no reference point hence the delays experienced.

(Participant 10)

The analysis shows that the bureaucratic and administrative challenges are impeding factors to not only the growth of the drone industry in Europe, but also a huge blow to the rapid integration of drones in the U-Space airspace.

4.3. The Prevalence of Privacy, Security and Safety Concerns

The rising concerns about privacy, security and safety was another motive reported by the stakeholders as a key setback to the smooth integration of drones in the European Airspace. Privacy and safety are very important and even though a recent study by the European Union Aviation Safety Agency on the perception of drones by 3,690 European citizens across 6 European cities, proved that most of them accept the integration of drones into the Urban Air Mobility system (EASA, 2021). The stakeholders believed that this issue of safety and privacy will be around for a while until people fully have trust in the technology.

Policy makers also have a very important role to make sure that the public is on board. So, they should make sure that things are properly communicated, that people know what Drone Services are, why they're being deployed, what the purpose of them is, and where this may lead to in the long term. So, I think this is the role of the public authority. They have to really be sure to understand the concerns of the public, whether it's about privacy, whether it's about annoyance, like because of the noise or because of what they see in the sky, so all these things have to be hedged against basically. There have to be strategies in place how such concerns can be mitigated or avoided completely.

The concerns regarding privacy and safety are significant variables if there should be an effective introduction of drones in European cities. There need to be safety and privacy requirements that need to be met and this is the role of the regulation but unfortunately the instability associated with it and the difficulty in interpretation slows down the realization of eliminating safety and security concerns.

5. Discussion

The constant changes and the uncertainties surrounding the European U-Space regulation was also a prominent hotspot that was uniform across the stakeholders. It is surprising to see that the regulation that has been put in place to ease the implementation of drones in the European airspace becomes a challenge to the attainment of its own objective. The stakeholders expressed dissatisfaction with the lack of clarity of the regulation and the continuous amendments meted upon it. This is an indication that more work needs to be done by the regulatory authority by bringing all stakeholders on board to collaborate and come out with easy access rules that will be suitable for all. This regulatory challenge proves to have an impact on the manufacturers, the service providers, the pilots etc. But since we are dealing here with technology which

constantly evolves especially as companies keep investing in research and development, the regulation is bound to also follow these technological updates to strike a balanced scenario.

Also, the fact that Europe adopted a segregated or decentralized approach to space management was also a key issue amongst the stakeholders. Some believed that Europe started on a rough foundation and therefore there is need for harmonization or the adoption of a centralized architecture. It should be noted here that the U-Space framework advocates for a uniform and single European sky but with the current situation in its slow implementation, various member states are adopting individual approaches to airspace management. However, despite this debate, the regulation should be credited for providing a comprehensive guideline on operations, risk identification and analysis of complex situations prior to the deployment of the drones which these individual countries now use as a template and means of compliance. Harmonization is feasible and under serious development currently.

Furthermore, even though public acceptance of drones is on a high level in Europe, the issues of privacy and security remain a point of contention amongst stakeholders. Registration of drones for example requires the submission of demographic variables like names, date of birth, address etc. and so if there is to be an interoperability of systems across member states, then there should be an advanced technological system put in place to ensure personal data is protected. This should be further reinforced by stringent laws. Public acceptance of a new technology doesn't come that easy but gradually with the potential benefits to be derived from drone use, more and more people will accept the technology. This also agrees to the research of Anania et al., (2019) which states that different parts of a community are more accepting drone technology than others.

6. Limitations and Further Research

The most prominent limitation stems from the fact that the small number of participants means that one has to be cautious in generalising from the findings even though they represent the state-of-the-art of the industry at the moment. In conducting research of any kind, it is important to conduct it on a large scale in order to get a comprehensive understanding of the study. Future research should ensure a large number of participants across Europe in order to have a better and holistic perspective about the U-Space regulation at the European Level.

Also, this study focused only on the EU 28 member states, and it will be important if future research should encompass the whole of Europe. The rationale behind this is the fact that recently we see Ukraine, Georgia being granted membership status in the European Union, and they were not initially considered in the process of U-Space regulation development, and this will result to a lot of challenges with these new countries meeting up with the status-quo. It will therefore be better to study the Europe as a whole than just the EU member states.

7. Conclusion

This paper has provided a clear answer to the research question about what are the challenges currently being faced in the integration of drones in the EU airspace? To effectively address these questions, a qualitative methodology was adopted an in-depth interview conducted with stakeholders of the industry.

The facilitation of the integration of Unmanned Aerial Vehicles into the national airspace has become one of the most prominent challenges in the aviation industry in contemporary times. In order for Europe to remain the leader of this revolution, there should be a robust collaboration at all levels with all actors and this explains why the U-Space regulation is the solution to this challenge. The U-Space regulation is of course providing a dual solution approach to these challenges based on a technological solutions level and regulatory requirements level. This is particularly important for Europe because the drone regulation is keeping pace with technological developments in the industry and such flexibility is commendable. The future of urban air mobility in Europe is already here, and the anxiety and expectations are high at all levels to see this becoming fully a reality soon.

APPENDIX A. Stakeholders Interviewed

Manufacturers	Service Providers	Policy Agencies	Drone Insurance Providers	Other Industries
ANAVIA	Eurocontrol	Belgian Drone Federation	Getsafe Drone Liability	Port of Antwerp
Sensefly	UniFly	European Aviation Safety Agency (EASA)		International Transport Forum
Wingcopter		Belgian Civil Aviation Authority (BCAA)		
		European Commission (Directorate General Defence Industry and Space)		

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