ISSN 2612-5056

Diritto e politica dei trasporti

rivista semestrale *open access*
di dottrina, giurisprudenza
e documentazione

Fascicolo I/2020

Promossa da

demetra
CENTRO STUDI

Anno 3, n. 4 (I-2020)

La Rivista è pubblicata dal Centro Studi Demetra (Development of European Mediterranean Transportation), con sede a Roma, via F. Civinini, 85, 00197, ed è registrata presso il Tribunale di Roma al n. 150/2018 del 19 settembre 2018.

The Journal is published by the Centro Studi Demetra (Development of European Mediterranean Transportation), based in Rome, via F. Civinini, 85, 00197, and was registered at the Court of Rome under No. 150/2018 on 19 September 2018.

Direttore responsabile/Editor-in-Chief: Prof. Francesco Gaspari, Università degli Studi "G. Marconi" di Roma, via Plinio 44, 00193, Roma

http://www.dirittoepoliticadeitrasporti.it/

ISSN 2612-5056

info@demetracentrostudi.it
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Grafica e impaginazione: Centro Studi Demetra
Pubblicato nel mese di ottobre 2020

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The new European Union Regulation on Unmanned Aircraft System and the Air Navigation Services*

Federico Franchina

Avvocato e Dottore di Ricerca in Diritto della Navigazione e dei Trasporti

Abstract
The new European Union Regulation on Unmanned Aircraft System and the Air Navigation Services.

In the recent years, unmanned aircraft systems (commonly known as "drones") have raised attention in the public opinion due to their disruptive use in many fields of life. From agriculture to industrial activities, surveillance, mapping and photographing, drones have shown their great capabilities in order to simplify a series of works that usually were done directly by humans or were not possible. Lawmakers, manufactures and stakeholders have begun to deal with opportunities and issues from modern uses of drones even in consideration of economic forecasts that within next years show a strong growth of the sector.
This has led to a European approach that overcoming different domestics legislation aimed to have a common European Union legal and technical framework. On June 2019 a package of regulations relating to the operations of unmanned aircraft systems has been adopted by the European Union: Commission Delegated Regulation (EU) 2019/945on unmanned aircraft and on third country operators of unmanned aircraft systems and Commission Implementing Regulation (EU) 2019/947on the procedures and rules for the operation of unmanned aircraft. These regulations seem to look at unmanned aircraft in a not usual way – as an aircraft tout court *– but that consider it as something different and providing specific rules on the light of the apportionment of the risks.*
*On the other hand, the "explosion" of drones in the near future has pointed out several challenges related to air navigation services and airspace management in consideration of the integration with manned aviation. In this sense the European Commission has developed a vision for the phased introduction of procedures and services to support safe, efficient and secure access to airspace, called U-Space (as "*a set of services designed to support safe, efficient and secure access to airspace for large numbers of drones*").*
The impact of the European legislation is not yet comparable, nor it allow a wide and scientific consideration due to its very recent issuing. On the other hand, and according to the aim of this paper it could be used in order to analyse its correlation with the specific air navigation services that the European Union in its different shapes has thought for the unmanned aircraft system.

Key words: *Unmanned Aircraft Systems; U-Space; Air Navigation Services; European Regulation on Drones.*

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1. Introduction

In the recent years, unmanned aircraft systems[1] (commonly known as "drones[2]") have raised attention in the public opinion due to their disruptive use in many fields of life. From agriculture to industrial activities, surveillance, mapping and photographing, drones have shown their great capabilities in order to simplify a series of works that usually were done directly by humans or were not possible[3].

To be correct drones are not new[4] as they existed in the shape of "model aircraft" or as a "toy plane[5]" and in this way they did not jump to the attention of aviation industry as well as of lawmakers and above all of consumers on a large scale. Indeed, a part of the military use and a part the provision of the art. 8 of the Chicago Convention 1944[6], for the common sense drones were mainly "toy" or "model" for only playful use[7].

What has changed is the technology applied to drones, from their endurance and their ease of use (through smartphone app, tablet, etc.) to the accessories (normal camera, infra-red camera, sensors, etc.) that make them possible to fly both beyond visual line of sight (BVLOS) and visual line of sight (VLOS)[9]. These evolutions together with new

[1] For an overview over rules and regulation see B. J. Scott (eds.), *The Law of Unmanned Aircraft Systems: An Introduction to the Current and Future Regulation Under National, Regional and International*, Kluwer, 2016 and also ICAO, 'Unmanned Aircraft Systems' Advisory Circular on Drones 328 (2011) (hereafter Advisory Circular 2011), ICAO, Manual on Remotely Piloted Aircraft Systems (2015) (RPAS Manual 2015).

[2] The art. 3 of EU Reg. 2018/1139, provides some useful definitions as follow: (30) 'unmanned aircraft' means any aircraft operating or designed to operate autonomously or to be piloted remotely without a pilot on board; (31) 'remote pilot' means a natural person responsible for safely conducting the flight of an unmanned aircraft by operating its flight controls, either manually or, when the unmanned aircraft flies automatically, by monitoring its course and remaining able to intervene and change the course at any time; (32) 'equipment to control unmanned aircraft remotely' means any instrument, equipment, mechanism, apparatus, appurtenance, software or accessory that is necessary for the safe operation of an unmanned aircraft, which is not a part, and which is not carried on board of that unmanned aircraft. On terminology see M. Huttunen, *Unmanned, Remotely Piloted, or Something Else? Analysing the Terminological Dogfight*, in *Air and Space Law*, 42, No. 3, 2017, p. 349.

[3] E. Machperson, *Is the World Ready for Drones?*, in *Air and Space Law*, 43, No. 2, 2018, p. 149.

[4] L. R. Newcome, *Unmanned Aviation: A Brief History of Unmanned Aerial Vehicles*, in *Amer Inst of Aeronautics & Co*, 22 Nov. 2004.

[5] In this sense the operations of unmanned aircraft that are toys within the meaning of Directive 2009/48/EC on the safety of toys fall outside the scope of this work.

[6] See R. Abeyratne, *Convention on International Civil Aviation. A Commentary*, Springer, 2014, p. 117. Although the Chicago Convention (1944) recognize the unmanned aircraft providing a legal status, it is clear that so far its main use has been for military and intelligence purposes (see S. Hobe, *Drones in International Law: The Applicability of Air and Space Law*, in H.-J. Heintze, P. Thielborger (eds.), *From Cold War to Cyber War*, Springer, 2016, p. 107.

[7] For some consideration see also R. Abeyratne, *Remotely Piloted Aircraft Systems: Some Unexplored Issues*, in *Air and Space Law Review*, 41, No. 3, 2016, p. 289.

[8] Visual line of sight operation ('VLOS') means a type of UAS operation in which, the remote pilot is able to maintain continuous unaided visual contact with the unmanned aircraft, allowing the remote pilot to control the flight path of the unmanned aircraft in relation to other aircraft, people and obstacles for the

and emerging needs in the modern society[9] are leading to a different conception of drones as aircraft able not only to perform complex or dangerous operations but also to perform normal and daily routine operations such as transport of goods.
On these grounds lawmakers, manufactures and stakeholders have begun to deal with opportunities and issues from modern uses of drones even in consideration of economic forecasts that within next years show a strong growth of the sector[10].
This has led to a European approach that overcoming different domestics legislation aimed to have a common European Union legal and technical framework. The outcome of these efforts has materialized in the Warsaw Declaration[11]. This document, among others things i) called for the swift development of a drone ecosystem that is simple to use, affordable, commercially and operationally friendly, yet capable of addressing all societal concerns such as safety, security, privacy and environmental protection; ii) welcomed the progress being made towards a flexible framework of safety regulation at EU level based on the operation centric approach, taking into account subsidiarity; iii) acknowledged the need for urgent action on the airspace dimension, in particular the development of the concept of the "U-Space" on access to low level airspace especially in urban areas; iv) confirmed the need for continuous investment in the integration of drones in the aviation system, in particular through the SESAR Joint Undertaking, and called for the use of the full range of funding mechanisms, including their combination; v) called for the creation of an effective coordination mechanism between the European Commission, the relevant European Agencies, including the European Defence Agency, and all stakeholders reflecting the drone services market, to monitor, advise and assist with: a) the establishment of the regulatory framework, including the timely delivery of industry standards; b) the efficacy and funding of drone integration projects; and c) the development of the U-Space.
According to this "ideological" framework the European Union has dealt with drones from two different perspectives. From one point it has established a legal framework aiming to create and support the "European Market of Drones" while on the other hand it has provided regulation for the operation of unmanned aircraft. The new European regulation on drones should be considered together with technical regulation by EASA[12] and with the fundamental support of EUROCONTROL[13] rules and procedures for the

purpose of avoiding collisions. It usually means an area of about 500 m horizontally and about 120 m vertically (see A. Završnik (eds.), *Drones and Unmanned Aerial Systems. Legal and Social Implications for Security and Surveillance*, Springer, 2015, p. 112). On contrary, beyond visual line of sight operation' ('BVLOS') means a type of UAS operation which is not conducted in VLOS.
[9] For a broad meaning see A. Završnik (eds.), *Drones and Unmanned Aerial Systems. Legal and Social Implications for Security and Surveillance*, Springer, 2015 and also B. Custers (eds.), *The Future of Drone Use Opportunities and Threats from Ethical and Legal Perspectives*, Springer, 2016.
[10] To this end see *SESAR European Drones Outlook Study*, November 2016.
[11] Warsaw Declaration on "Drones as a leverage for jobs and new business opportunities" delivered on 24th November 2016. The document represents the outcome of the Warsaw High Level Conference also attended by the European Commissioner for Mobility and Transport, the Executive Director of European Aviation Safety Agency, the Executive Director of the SESAR Joint Undertaking, a number of Directors General of Civil Aviation from the EU Member States, representatives of ICAO, international associations, European bodies, Agencies, together with leaders of the industry.
[12] F. Manuhutu, *Aviation Safety Regulation in Europe: Towards a European Aviation Safety Authority*, in *Air and Space Law*, XXV, No. 2, 2000, p. 264.
[13] W. Schwenk, R. Schwenk, *Aspects of International Cooperation in Air Traffic Management*, Kluwer, 1998, p. 31.

unmanned air navigation all in the light to consider the unmanned issues and needs as different from the manned aviation.
The impact of the European legislation is not yet comparable, nor it allow a wide and scientific consideration due to its very recent issuing. On the other hand, and according to the aim of this paper it could be used in order to analyse its correlation with the specific air navigation services that the European Union in its different shapes has thought for the unmanned aircraft system.
It is indeed clear that the topic of UAS essentially needs of a broad approach to different questions and issues that it pointed out especially in consideration of its impact on several domains as doctrine has well highlighted[14] and that falls beyond the scope of this work.

2. The new European Union Regulation on Drones

2.1 The "Basic Regulation" 2018/1139

On 2016 the European Drone Outlook Study[15] has explained the potential impact of drones and the forecasts for their development by 2050. Beyond the new capabilities for public safety and security, drones are transforming commercial businesses making economically viable activities that once could result expensive or literally impossible. The Outlook has also highlighted how the developing of drone industry within EU's borders would have been fundamental in order to support its leadership in aerospace and

[14] From different perspectives on UAS see U. La Torre, *La navigazione degli UAV: un'occasione di riflessione sull'art. 965 c. nav., in tema di danni a terzi sulla superficie*, in *Riv. dir. nav.*, 2012, II, p. 553; U. La Torre, *Gli UAV: mezzi aerei senza pilota*, in *Tranquilli Leali-Rosafio (a cura di), Sicurezza, navigazione e trasporto*, Milano, 2008, p. 93; E. G. Rosafio, *Considerazioni sui mezzi aerei a pilotaggio remoto e sul regolamento ENAC*, in*Riv. dir. nav.*, 2014, II, p. 787; R. Lobianco, *Aerei a pilotaggio remoto: brevi osservazioni sul regolamento ENAC*, in *Resp. civ. prev.*, No. 6, 2017, p. 2065; M. Brignardello *Collisioni tra mezzi aerei senza equipaggio e aeromobili tradizionali: misure di prevenzione e responsabilità in caso di drone strike*, in *Riv. dir. nav.*, 2018, II, p. 439; A. Zampone, *Riflessioni in tema di responsabilità nell'esercizio di, remotely-piloted aircraft system (RPAS)*, in *Dir. trasp.*, 2015, I, p. 63; A. Antonini, *Le future sfide del diritto aeronautico: nuovi aeroporti, nuovi aeromobili*, in *Dir. trasp.*, 2015, III, p. 739; A. L. M. Sia, *Profili attuali della disciplina giuridica dei mezzi aerei a pilotaggio remoto e il regolamento dell'ente nazionale dell'aviazione civile italiana (ENAC)*, in *Dir. trasp.*, 2014, III, p. 743; A. Masutti, *Prospettive di regolamentazione dell'uso dei velivoli senza pilota (UAV) nello spazio aereo comune*, in *Dir. trasp*., 2007, p. 783; B. Franchi, *Aeromobili senza pilota (UAV): inquadramento giuridico e profili di responsabilità*, in *Resp. civ. e prev.*, 2010, p. 732 and p. 1213; C. Severoni, *La disciplina normativa attuale degli aeromobili a pilotaggio remoto*, in *Dir. trasp.*, 2016, p. 65; A. L. M. Sia, *Considerazioni sulla nuova strategia della Commissione europea per l'aviazione civile e i sistemi aerei a pilotaggio remoto*, in *Dir. mar.*, 2018, p. 310; J. Straub, J. Vacek, J. Nordlie, *Considering Regulation of Small Unmanned Aerial Systems in the United States*, in *Air & Space Law*, 39, No. 4&5, 2014, p. 275–294; S.A. Kaiser, *UAVs and Their Integration into Non-segregated Airspace*, in *Air and Space Law*,36, No. 2, 2011, p. 161–172; A. Froomkin, M. Colangelo, P. Zak, *Self-defense Against Robots and Drones*, in 48 *Conn. L. Rev.*, 2015, p. 1–69; J. Andresen, *Due Process of War in the Age of Drones*, in 41 *Yale J. Int'l. L.*, 2016, p. 155–188; M. E. Peterson, *The UAV and the Current and Future Regulatory Construct for Integration into the National Airspace System*, in 71 J. *Air L. &Com*., 2006, p. 521; B. Kapnik, *Unmanned but Accelerating: Navigating the Regulatory and Privacy Challenges of Introducing Unmanned Aircraft into the National Airspace System*, in *Journal of Air Law and Commerce*, 84,Issue 4, 2019, p. 439.
[15] See above fn. 10.

defence as well as leveraging the technology innovation[16]. In the same document has been stressed as the development of the civil drone industry is linked to the ability of drones to operate in various areas of the airspace, especially at very low levels in order to perform commercial operations close to inhabited areas[17].
In order to support this economic and industrial outcome and at European Union level, lawmakers have dealt with the necessity to deliver a specific legal framework[18] dealing with the rising of the new aviation technology, catching the opportunity for undertakings and consumers and on the other hand ensuring an adequate level of safety in consideration of the interaction with humans and with manned aviation as well.
On these grounds, the European Commission[19] has taken in consideration the opportunity to develop a specific regulation on unmanned aircraft systems relying on the so-called "risk-based approach"[20] and principles stablished in art. 4 of the EU Reg. 2018/1139[21] (the "basic regulation") aiming to match the ends of aviation strategy[22].
In this last regulation the European Commission has also taken into account that an unmanned aircraft is now able to operate within the airspace alongside manned aircraft and technologies developments make possible a wide range of operations that should be subject to rules that are proportionate to the risk of the particular operation or type of

[16] According to the European Drone Outlook Study 2016, the European drones demand suggestive of a valuation in excess of EUR 10 billion annually by 2035 and over EUR 15 billion annually by 2050. The impact of civil missions by (either for governments or for commercial businesses) is expected to generate the majority of this value as related services are anticipated to represent more than EUR 5 billion of annual value by 2035, highlighting their importance within the marketplace. The other main sectors, defence and leisure, will continue contributing to this marketplace and remain the largest sources of value in the near-term. Both together represent nearly EUR 2 billion in annual product-related turnover in Europe over the long term.
[17] For the European Drone Outlook Study 2016, some 7 million consumer leisure drones are expected to be operating across Europe and a fleet of 400 000 is expected to be used for commercial and government missions in 2050.
[18] The starting point of this strategy was the paramount European Union Regulation in the field of aviation, Reg. 2018/1139 on common rules in the field of civil aviation and establishing a European Union Aviation Safety Agency (so-called "The Basic Regulation") and the necessity to include in this legal instrument also the unmanned aircraft and their new dimension in order to clarify the purpose of the EU aviation strategy (see COM/2015/0598 final - Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions - An Aviation Strategy for Europe).
[19] For an early consideration about the European regulation on UAS see A. Masutti, *Proposals for the Regulation of Unmanned Air Vehicle Use in Common Airspace*, in *Air and Space Law*, 34, No. 1, 2009, p. 3.
[20] Recital n. 27 of the EU Reg. 2018/1139 considers that "*In order to implement a risk-based approach and the principle of proportionality, a degree of flexibility should be provided for the Member States as regards unmanned aircraft operations, taking into account various local characteristics within individual Member States, such as population density, while ensuring an adequate level of safety.*" Risk-based approach could be defined as a combination of both the type of vehicle and the desired mission profiles in order to determine a risk classification and the airworthiness qualifications. See H. Pham, *Safety and Risk Modeling and Its Applications*, Springer, 2011, p. 274 and also H.G. Wolf, *Drones. Safety Risk Management for the Next Evolution of Flight*, Routledge, 2017, p. 52.
[21] Among principles according to which regulation shall be considered we can underline that it shall: a) reflect the state of the art and best practices in the field of aviation, and take into account worldwide aviation experience and scientific and technical progress in the respective fields; d) take into account interdependencies between the different domains of aviation safety, and between aviation safety, cyber security and other technical domains of aviation regulation.
[22] See U. Schulte-Strathaus, *Is the European Commission Fulfilling Its Ambitious Aviation Strategy?*, in *Air and Space Law*, 42, No. 6, 2017, p. 517.

operations[23]. In consideration of the risks that unmanned aircraft can present for safety, privacy, protection of personal data, security or the environment, the "basic regulation" also provides that it is necessary to establish a system of registration for unmanned aircraft and for their operators on the light of digital, harmonised and interoperable national registration systems in which information, including the same basic data, about unmanned aircraft and operators of unmanned aircraft registered should be stored[24].

Again, for the same "basic regulation" rules and procedures for unmanned aircraft should take into account the nature and risk of the type of operation concerned (type, scale, complexity, size and type of traffic, etc.); whether the operation is open to members of the public; the extent to which other air traffic or persons and property on the ground could be endangered by the operation; the purpose of the flight and type of airspace used; and the complexity and performance of the unmanned aircraft involved[25].

In order to reach these targets, the Reg. 2018/1139 left to the Commission (see art. 57 of EU Reg. 2018/1139) the task for the implementation of the legal framework on UAS with detailed provisions concerning:

(a) the specific rules and procedures for the operation of unmanned aircraft as well as for the personnel, including remote pilots, and organisations involved in those operations;

(b) the rules and procedures for issuing, maintaining, amending, limiting, suspending, or revoking the certificates, or for making declarations, for the operation of unmanned aircraft as well as for personnel, including remote pilots, and organisations involved in those activities, and for the situations in which such certificates or declarations are to be required;

(c) the privileges and responsibilities of the holders of certificates and of natural and legal persons making declarations;

(d) the rules and procedures for the registration and marking of unmanned aircraft and for the registration of operators of unmanned aircraft;

(e) the rules and procedures for establishing digital, interoperable, harmonised, national registration systems.

A clarification of these principles is set in the art. 56 of the "basic regulation" which establishes conditions for the compliance of unmanned aircraft (e.g. certification[26]).

According to the provisions of art. 57 of Reg. 2018/1139, it is also relevant – as another "border" of the legal framework that surrounds the UAS – the Annex IX of the same regulation establishing the 'essential requirements for unmanned aircraft' as paramount references for the further implementing regulation[27].

For the purposes of this paper, some essential points emerge from Annex IX such as: i) the safety of operation and safe separation of the unmanned aircraft from people on the ground and from other airspace users[28]; ii) a flight must be performed in accordance

[23] Recital No. 26, Reg. 2018/1139.
[24] Recital No. 31, Reg. 2018/1139.
[25] Recital No. 32, Reg. 2018/1139.
[26] On certification see A. Završnik (eds.), *Drones and Unmanned Aerial Systems. Legal and Social Implications for Security and Surveillance*, Springer, 2015, p. 198.
[27] The Annex IX of the EU Reg. 2018/1139 essentially provides some principles about design, production, maintenance, airworthiness, operations, environment and registration.
[28] According to the Annex IX, Reg. 2018/1139, this point includes good knowledge of the operating instructions provided by the producer, of safe and environmentally-friendly use of unmanned aircraft in the airspace, and of all relevant functionalities of the unmanned aircraft and applicable rules of the air and ATM/ANS procedures.

with the applicable laws, regulations and procedures, pertinent to the performance of their duties, prescribed for the area, airspace, aerodromes or sites planned to be used and, where applicable, related ATM/ANS systems; iii) operations with unmanned aircraft must ensure the safety of third parties on the ground and of other airspace users and minimise the risks resulting from adverse external and internal conditions.
The "basic regulation" identifies (Annex IX, point 4) the "benchmark" of unmanned aircraft which is relevant for the aviation regulation. Indeed, it provides that operators of unmanned aircraft shall be registered, where they operate any of the following: (a) unmanned aircraft which, in the case of impact, can transfer, to a human, kinetic energy above 80 Joules; (b) unmanned aircraft the operation of which presents risks to privacy, protection of personal data, security or the environment; (c) unmanned aircraft the design of which is subject to certification pursuant to Article 56 of Reg. 2018/1139.
The above mentioned elements that make binding the registration according to three different criteria – respectively i) physical potential harmful (material); ii) personal data and security potential harmful (immaterial); iii) risk of operations (environment) – stand for a more broad approach from the lawmaker that probably look at the UAS as an "aeronautical product" located in a particular setting and surrounded by a specific regulation. It maybe represents a positive action that overcame the early approach on UAS that has placed it on the same level of the manned aircraft leading to strict regulatory behaviours as well as complexity and disproportionate compliance requirements that have caused an industry and market slow down[29].

2.2 The EU Regulation on Unmanned Aircraft Systems

Having in consideration the terms fixed in the Reg. 2018/1139, on June 2019 a package of regulations relating to the operations of unmanned aircraft systems has been adopted by the European Union. This regulation package consists of two different but interlinked regulations as follows:
- Commission Delegated Regulation (EU) 2019/945on unmanned aircraft and on third country operators of unmanned aircraft systems[30].
- Commission Implementing Regulation (EU) 2019/947on the procedures and rules for the operation of unmanned aircraft[31].
This kind of regulation should be considered alongside with technical rules issued by EASA and EUROCONTROL in their respective fields as well as the ongoing works that aim to continuous update the current framework.
In this sense we find out several documents that facilitate the implementation and execution of the general regulation according to different practical and technical perspectives[32].

[29] See M. de Miguel Molina and V. Santamarina Campos (eds.), *Ethics and Civil Drones*, Springer, 2018, p. 7.
[30] The Reg. 2019/945 is currently in force and applicable according its art. 42. Also and more recently this regulation has been amended by the Reg. 2020/1058 regarding the introduction of two new unmanned aircraft systems classes.
[31] The Reg. 2019/947 is currently in force, but it shall apply from 1st July 2020. This regulation has also been first amended by Commission Implementing Regulation (EU) 2020/639 of 12 May 2020 as regards standard scenarios for operations executed in or beyond the visual line of sight, and more recently by Commission Implementing Regulation (EU) 2020/746 of 4 June 2020 as regards postponing dates of application of certain measures in the context of the COVID-19 pandemic.
[32] From EASA perspective we find out: i) the ED Decision 2019/021/R about the "Introduction of a regulatory framework for the operation of unmanned aircraft systems in the 'open' and 'specific'

Essentially and according to the framework traced by the Reg. 2018/1139, the regulations follow three basic concepts:
1. Unmanned aircraft operations are considered through the risk that they present. This means an overcoming of the early distinction – mainly at domestic level of regulation – between commercial and non-commercial flights in order to appreciate and evaluate the operation.
2. The risk-based approach brings with it the necessity to consider the kind of operation performed by the UAS rather than who and why it is being done. This means to shift the attention from a subjective perspective to an objective one in order to consider the environment in which the operation has been done.
3. The last aspect to be considered is the performance of the unmanned aircraft. In this sense and as we said before, the regulation looks at drone through the lens of its capability in terms of potential harmful (material and immaterial) regardless the reasons of its use.
The above mentioned characteristics emerging from the regulation represent a new paradigm that seems to look at unmanned aircraft in a not usual way – as an aircraft *tout court* – but that consider it as something different and providing specific rules on the light of the apportionment of the risks.

2.3 The EU Regulation on unmanned aircraft systems and on third-country operators of unmanned aircraft systems: EU Reg. 2019/945

The first recent effort on drones' regulation at European Union level has regarded the building of legal framework that establishes common rules about the EU's market of UAS. As it is wide recognized the low cost offers and the different size (for different purposes) of drone technology, have led these systems to become a tool of common use with clear application at economic and social level.
For these reasons and in order to meet the functionalities necessary to mitigate risks pertaining to the safety, security and data protection, arising from the operation of UAS, the European Union has been aware about the necessity to provide the necessary balance between economic opportunities and consumer protection.
In this sense the Reg. 2019/945 lays down the requirements for the design and manufacture of UAS intended to be operated under the rules and conditions defined in Implementing Regulation (EU) 2019/947. It also establishes rules on making UAS intended for use in the 'open' category[33] and remote identification as well as their free movement in the Union. It also lays down rules for third country UAS operators, when

categories"; ii) Opinion 01/2020 (13 March 2020) on "High-level regulatory framework for the U-space". It is important to note that opinions are issued in order to assist the European Commission in its preparation of proposals for basic principles, applicability and essential requirements to the European Parliament and to the European Council. Most EASA opinions are handled through the comitology procedure. From EUROCONTROL perspective we find out the U-Space Concept of Operations as *a document describing the characteristics of a proposed system from the viewpoint of an individual who will use that system such as a business requirements specification or stakeholder requirements specification. It is used to communicate the quantitative and qualitative system characteristics to all stakeholders.* Together with these documents it is also relevant to point out that the EU Agency as well as Eurocontrol and SESAR Joint Undertaking facilitate a huge amount of technical projects and experimentation towards Members States aiming to continuous testing not only the practical aspects but also the applicable regulation (in this sense see https://www.sesarju.eu/U-space).
[33] See below par. 2.4.

they conduct a UAS operation pursuant to Implementing Regulation (EU) 2019/947 within the Single European Sky.
The EU Reg. 2019/945 provides different kinds of obligation over manufactures[34], importers[35] and distributors[36] as well as a conformity assessment and procedure[37] aiming to make the UAS in compliance with rules and regulation applicable for the movement of goods across the European Union.
It is clear that this regulation aims to fill the gap and to overcome the fragmentation due to single domestic legislation of each member State over the realization of unmanned aircraft providing some essential rules that established a European Market also in this specific sector.
Beyond the economic purposes and market surveillance tasks, it is important to highlight that the operation of UAS both made by EU or non-EU operators must comply with the Single European Sky airspace.

2.4 The EU Regulation on the rules and procedures for the operation of unmanned aircraft: EU Reg. 2019/947

With the Reg. 2019/947, the European Union has set up the organization of UAS operations according to a series of principles that aim to create a safe environment able to not be separate from the manned aviation[38].
In this sense the Reg. 2019/947 firstly provides that unmanned aircraft, irrespective of their mass, can operate within the same Single European Sky (EU Reg. 2004/549-550-551-552) airspace, alongside manned aircraft, whether airplanes or helicopters and that the rules and procedures applicable to UAS operations should be proportionate to the nature and risk of the operation or activity and adapted to the operational characteristics of the unmanned aircraft concerned and the characteristics of the area of operations, such as the population density, surface characteristics, and the presence of buildings[39].
The new EU legal framework for unmanned aircraft does not make any distinction between commercial and non-commercial use of UAS, based the difference only on the evaluation of the risk (that should be "proportionate"), the operational environment and the technical aspects of the UAS[40].
In order to match these general principles, the EU Reg. 2019/947 makes a classification of drone operations according to three categories[41] and not of drone itself[42].
In the *open* category, the UAS is not being subject to any prior operational authorisation, nor to an operational declaration by the UAS operator before the operation takes place. In this category, for example, could be fall consumers, leisure and simple professional.

[34] See art. 6 of EU Reg. 2019/945.
[35] See art. 8 of EU Reg. 2019/945.
[36] See art. 9 of EU Reg. 2019/945.
[37] See art. 12 of EU Reg. 2019/945.
[38] See below par. 3 on U-Space.
[39] See Recital No. 1 and No. 5.
[40] See above par. 2.2.
[41] According to Recital No. 6, "*The risk level criteria as well as other criteria should be used to establish three categories of operations: the 'open', 'specific' and 'certified' categories*". Recital No. 7 also states that "*Proportionate risks mitigation requirements should be applicable to UAS operations according to the level of risk involved, the operational characteristics of the unmanned aircraft concerned and the characteristics of the area of operation*".
[42] See art. 3 of Reg. 2019/947.

In the *specific* category, the UAS requires an operational authorisation issued by the competent authority or, under specific circumstances, an authorisation received, or a declaration made by the operator[43].
In the *certified* category, UAS requires the certification pursuant to Delegated Regulation (EU) 2019/945 and the certification of the operator and, where applicable, the licensing of the remote pilot[44].
As it was already stressed, this legal framework classifies the three categories of operations according to the level of risks involved and also with a different regulatory approach for each category. In other words, low-risk operations (e.g. open category) does not require any authorization, but they are subject to strict operational and practical limitations in term of flight. For medium-risk operations, operators will have to require an authorization from the national aviation authority on the basis of a standardized risk assessment or a specific scenario (e.g. specific category) while in case of high-risk operations, classical aviation rules become fully applicable (e.g. certified category).

The Open category
Open category operations are based on three essential features:
- the maximum take-off mass of the unmanned aircraft must be less than 25kg;
- the unmanned aircraft must be operated within visual line of sight (VLOS);
- the unmanned aircraft must not be flown further than 120 metres from the closest point of the surface of the earth.

The "open category" is then further divided down into three operational "subcategories[45]", in order to allow different types of operation without the need for an authorisation. In this sense we find out:

- UAS-Subcategory A1, where operations can only be conducted[46] with unmanned aircraft that present a very low risk of harm or injury to people. According to this classification UAS that falls in the category A1 must have a specific weight[47] and does not overfly assemblies of people.

- UAS-Subcategory A2,where operations can only be conducted with an unmanned aircraft with a mass of less than 4kg, that can be flown to a minimum safe horizontal distance of 30 metres from uninvolved people, or down to 5 metres

[43] In this case operations are authorized on an individual basis.
[44] This category as we will see is that one close to the manned aviation and it obviously deals with complex operations such as carriage of goods or passengers transport.
[45] See Annex to EU Reg. 2019/947, UAS operations in the 'open' and 'specific' categories part A - UAS operations in the 'open' category.
[46] According to the Annex to Reg. 2019/947, Part A,UAS.OPEN.020(4), the operation should be performed by a remote pilot who: (a) familiarized with the user's manual provided by the manufacturer of the UAS; (b) in the case of an unmanned aircraft class C1, as defined in Part 2 of the Annex to Delegated Regulation (EU) 2019/945, who has completed an online training course followed by completing successfully an online theoretical knowledge examination provided by the competent authority or by an entity recognized by the competent authority of the Member State of registration of the UAS operator. The examination shall comprise 40 multiple-choice questions distributed appropriately across the following subjects: i. air safety; ii. airspace restrictions; iii. aviation regulation; iv. human performance limitations; v. operational procedures; vi. UAS general knowledge; vii. privacy and data protection; viii. insurance; ix. security.
[47] The maximum take-off mass (MTOM), including payload, must be less than 250 g and a maximum operating speed of less than 19 m/s.

horizontally when its 'low speed mode' is selected[48]. In addition, the remote pilot must have successfully completed an additional competency examination[49].
- UAS-Subcategory A3,regards the general types of unmanned aircraft operations where the it can only be flow where the remote pilot reasonably expects that no uninvolved person will be endangered, be conducted at a safe horizontal distance of at least 150 metres from residential, commercial, industrial or recreational areas and be performed by a remote pilot who has completed an online training course and passed an online theoretical knowledge examination. Also, the UAS must have an MTOM, including payload, of less than 25 kg.
The EU regulation has also dealt with the necessity to reach common manufactures standard through a process of conformity[50] close to the "CE" marking scheme[51].
In order to achieve this standardisation, unmanned have been further subdivided[52] into five different "classes" establishing a link to the above operational subcategories as follows:
- UAS – Class C0,regards very small unmanned aircraft that are less than 250g maximum take-off mass, have a maximum speed of 19m/s and that are unable to be flown more than 120m from the controlling device.
- UAS – Class C1,includes unmanned aircraft that are either: less than 900g maximum take-off mass, or are made and perform in a way that if they collide with a human head, the energy transmitted will be less than 80 Joules. They shall be designed and constructed so as to minimise injury to people[53].
- UAS – Class C2**,** should be less than 4kg maximum take-off mass and also have other aspects such as noise limits, geo-awareness. They can make operations as in subcategory A2 or A3.
- UAS – Class C3, should be less than 25kg maximum take-off mass and have other elements as Class C2. They fall only in subcategory A3.
- UAS – Class C4 are characterized for not being any kind of automation and with a less than 25kg maximum take-off mass. Like the Class C3 they can operate only in subcategory A3.

[48] In this case it should be taken into consideration the follow elements: (a) weather conditions, (b) performance of the unmanned aircraft, (c) segregation of the overflown area.
[49] According to the Annex to Reg. 2019/947, Part A, UAS.OPEN.030(2), the operator must hold a certificate of remote pilot competency issued by the competent authority or by an entity recognized by the competent authority of the Member State of registration of the UAS operator. This certificate shall be obtained after complying with all of the following conditions and in the order indicated: (a) completing an online training course and passed the online theoretical knowledge examination; (b) completing a self-practical training in the operating conditions of the subcategory A3; (c) declaring the completion of the self-practical training defined in point (b) and passing an additional theoretical knowledge examination provided by the competent authority or by an entity recognized by the competent authority of the Member State of registration of the UAS operator. The examination shall comprise at least 30 multiple-choice questions aimed at assessing the remote pilot's knowledge of the technical and operational mitigations for ground risk, distributed appropriately across the following subjects: i. meteorology; ii. UAS flight performance; iii. technical and operational mitigations for ground risk.
[50] See art. 12 of Reg. 2019/945.
[51] See Reg. 2008/765 and art. 15 of Reg. 2019/945.
[52] See Annex to Reg. 2019/945.
[53] The standards cover aspects such as noise limits, height limits and requirements for remote identification and geo-awareness systems.

The Specific category

In the "specific category" UAS operation cannot be performed according to the "open category" and, on the same time, it does not have requirements to be considered as "certified category". It represents the most complicated category because the operations have a higher risk rather than the "open" one and, above all, it requires new models and rules that only part can be borrowed from the "certified category".

Operators within the "specific category" shall be required to obtain an operational authorization[54] from the competent authority in the Member State where it is registered[55] before the operation can be commenced.

The application[56] for authorization begins with a declaration by UAS operator that shall contain[57] (a) administrative information about the UAS operator; (b) a statement that the operation satisfies the operational requirement and a standard scenario as defined in Appendix 1 to the Annex of the Reg. 2019/947; (c) the commitment of the UAS operator to comply with the relevant mitigation measures required for the safety of the operation, including the associated instructions for the operation, for the design of the unmanned aircraft and the competency of involved personnel; (d) confirmation by the UAS operator that an appropriate insurance cover will be in place for every flight made under the declaration, if required by Union or national law. Upon receipt of the declaration, the competent authority shall verify that the declaration contains all the elements mentioned[58] and shall provide the UAS operator with a confirmation of receipt and completeness without undue delay. After receiving the confirmation of receipt and completeness, the UAS operator is entitled to start the operation and he shall notify, without any delay, the competent authority of any change to the information contained in the operational declaration that they submitted.

In order to simplify the process of authorization especially for usual operators, the regulation also contains a provision[59] for an optional light UAS operator certificate ("LUC") scheme, which allows to issue privileges to UAS operators, including the possibility of authorising their own operations. Application for an LUC or for an amendment to an existing LUC shall be submitted to the competent authority and shall contain all of the following information: (a) a description of the UAS operator's management system, including its organisational structure and safety management

[54] See art. 5 of Reg. 2019/947.

[55] According to art. 12 of Reg. 2019/947, the "competent authority" (normally the national Civil Aviation Authority and to this end see also art. 18 of Reg. 2019/947) shall grant an operational authorization when the evaluation concludes that: i) the operational safety objectives take account of the risks of the operation; ii) the combination of mitigation measures concerning the operational conditions to perform the operations, the competence of the personnel involved and the technical features of the unmanned aircraft, are adequate and sufficiently robust to keep the operation safe in view of the identified ground and air risks; iii) the UAS operator has provided a statement confirming that the intended operation complies with any applicable Union and national rules relating to it, in particular, with regard to privacy, data protection, liability, insurance, security and environmental protection.

[56] The application for an operational authorization shall be based on the risk assessment referred to in Article 11 and accordingly itshall include in addition the following information: (a) the registration number of the UAS operator; (b) the name of the accountable manager or the name of the UAS operator in the case of a natural person; (c) the operational risk assessment; (d) the list of mitigation measures proposed by the UAS operator, with sufficient information for the competent authority to assess the adequacy of the mitigation means to address the risks; (e) an operations manual when required by the risk and complexity of the operation; (f) a confirmation that an appropriate insurance cover will be in place at the start of the UAS operations, if required by Union or national law.

[57] See Annex to Reg. 2019/947, part B.

[58] See Annex to Reg. 2019/947, part B, UAS.SPEC.040.

[59] See Annex to Reg. 2019/947, part C.

system; (b) the name(s) of the responsible UAS operator's personnel, including the person responsible for authorising operations with UASs; (c) a statement that all the documentation submitted to the competent authority has been verified by the applicant and found to comply with the applicable requirements. The regulation also provides a series of duty that the operator should follow in order to get and maintain the license[60] that makes him as an almost usual aircraft operator.

The Certified Category

As it has been said the "certified category" of UAS operations means the application of traditional and usual rules of aviation rightly leading a part from the EU 2019/947 which only provides that the category is certified when a) the UAS is certified pursuant to points (a), (b) and (c) of paragraph 1 of Article 40 of Delegated Regulation (EU) 2019/945[61]; and b) the operation is conducted in any of the following conditions: i) over assemblies of people; ii) involves the transport of people; iii) involves the carriage of dangerous goods, that may result in high risk for third parties in case of accident.

In addition, the unmanned operation shall be classified where the competent authority, based on the risk assessment provided for in Article 11[62], considers that the risk of the operation cannot be adequately mitigated without the certification of the UAS and of the UAS operator and, where applicable, without the licensing of the remote pilot.

Responsibilities (UAS Operator and Remote Pilot)

The Annex to Reg. 2019/947 also contains some provisions related to responsibilities of the UAS operator and remote pilot for both "open and specific categories" aiming to ensure compliance with safety rules and reducing risk and harmful as well.

In particular for "open category" the UAS operator shall i) develop operational procedures adapted to the type of operation and the risk involved; ii) ensure that all operations effectively use and support the efficient use of radio spectrum in order to avoid harmful interference; iii) designate a remote pilot for each UAS operation; iv) ensure that the remote pilots and all other personnel performing a task in support of the operations are familiar with the user's manual provided by the manufacturer of the UAS,

[60] For example (see Annex to Reg. 2019/947, Part B, UAS.SPEC.030), the UAS operator shall (a) nominate an accountable manager with authority for ensuring that within the organization all activities are performed in accordance with the applicable standards and that the organization is continuously in compliance with the requirements of the management system and the procedures identified in the LUC manual referred to in point UAS.LUC.040; (b) define clear lines of responsibility and accountability throughout the organization; (c) establish and maintain a safety policy and related corresponding safety objectives; (d) appoint key safety personnel to execute the safety policy; (e) establish and maintain a safety risk management process including the identification of safety hazards associated with the activities of the UAS operator, as well as their evaluation and the management of associated risks, including taking action to mitigate those risks and verify the effectiveness of the action; (f) promote safety in the organization through training and education as well as communication; (g) document all safety management system key processes for making personnel aware of their responsibilities and of the procedure for amending this documentation; key processes include: i) safety reporting and internal investigations; ii) operational control; iii) communication on safety; iv) training and safety promotion; v) compliance monitoring; vi) safety risk management; vii) management of change; viii) interface between organizations; ix) use of sub-contractors and partners.

[61] See art. 6 of Reg. 2019/947 and art. 40 (Requirements for UAS operated in the 'certified' and 'specific' categories).

[62] The art. 11 of Reg. 2019/947 regards the rules for conducting an operational risk assessment

v) update the information into the geo-awareness system when applicable according to the intended location of operation.
On the other hand, before starting an UAS operation, the remote pilot shall: a) have the appropriate competency in the subcategory of the intended UAS operations; b) observe the operating environment, check the presence of obstacles and check the presence of any uninvolved person. During the flight he also has to comply with the operator's procedures and rules applicable and he may be assisted by an unmanned aircraft observer, situated alongside them, who, by unaided visual observation of the unmanned aircraft, assists the remote pilot in safely conducting the flight.
For the "specific category" the Annex provides similar duties to open one, adding others related to unlawful interference, noises and emissions, training and certification.

UAS Registration
The EU regulations[63] introduce requirements for registration[64] of UAS based on the assumptions of its potential operational impact[65] or in case its design is subject to certification. Taking in consideration the above classification, we can put on light that "certified category" of the unmanned aircraftmust be registered as well as the manned aircraft does.
UAS operators[66] shall also registered when operating within the "open category" any of the following unmanned aircraft with a MTOM of 250 g or more, or, which in the case of an impact can transfer to a human kinetic energy above 80 Joules and when it is equipped with a sensor able to capture personal data. Registration is also necessary when UAS of any mass is operating within the "specific category".

3. UAS and Air Traffic Navigation Services

The impact (not only from economic perspective) of unmanned aircraft in the years to come has considerable implications for air navigation services and airspace management[67] as well. Forecast[68] consider that by 2050 UAS will represent approximately 20% of the future fleet meaning that air traffic management would need to account for 5-10 million hours of such flights in controlled airspace. This lays several

[63] See Annex IX, point 4, to the Reg. 2018/1139.
[64] According to art. 14.2 and art. 14.3 of the Reg. 2019/947 the registration systems for UAS operators shall provide the fields for introducing and exchanging the following information: (a) the full name and the date of birth for natural persons and the name and their identification number for legal persons; (b) the address of UAS operators; (c) their email address and telephone number; (d) an insurance policy number for UAS if required by Union or national law. The registration systems for unmanned aircraft whose design is subject to certification shall provide the fields for introducing and exchanging the following information: (a) manufacturer's name; (b) manufacturer's designation of the unmanned aircraft; (c) unmanned aircraft's serial number; (d) full name, address, email address and telephone number of the natural or legal person under whose name the unmanned aircraft is registered.
[65] See above par. 2.1.
[66] According to art. 14.6 of Reg. 2019/947, operators as legal persons shall register themselves where have their principal place of business and ensure that their registration information is accurate. A UAS operator cannot be registered in more than one Member State at a time. For natural persons, UAS operators shall register themselves in the Member State where they have their residence. Member States shall issue a unique digital registration number for UAS operators and for the UAS that require registration, allowing their individual identification.
[67] For a wise reflection on the evolution of ATM see R. Van Dam, *The Long and Winding Road: Air Traffic Management Reform in Europe*, in *Air & Space Law* 40, No. 1, 2015, p. 43.
[68] See *SESAR European Drones Outlook Study*, November 2016, p. 37.

challenges related to air navigation services and airspace management in consideration of the integration with manned aviation[69].

The essential classification of airspace[70] starts with the Chicago Convention (1944) that recognizes the sovereignty of each state over the airspace above its territory (national airspace) and continues with the fundamental distinction between controlled and uncontrolled airspace where in controlled airspace air navigation services are provided, while, on the other hand, in uncontrolled airspace we find only minimum services. In any cases and spaces, the general principle is that the flight should follow guidance measures in order to ensure the safety of the entire aviation system.

A similar task arises from the UAS operation and from its future integration in the airspace. So far it seems to be that lawmakers have approached to the unmanned aircraft assuming that the main issue relies on the potential risks and liabilities for third parties. Outlook and forecast on drone escalation has led to a different approach that granted attention to the necessity to better understand this "new" technology and, above all, to create its own environment in which it can growth in a safe manner and accordingly the aviation perspective (that does not mean a completely equivalence with the "normal" aircraft). Indeed, the main issue is represented by the specific environment – in term of airspace – in which the UAS are intended to operate.

Most of drones will indeed operate in the "very low level[71]" airspace as part where manned aviation must be off (for example in a populated area, it must not fly less than 300m/1000ft above the highest fixed object within 600m/2000ft of the aircraft)

To this end the European Commission, EASA, the SESAR Joint Undertaking, and EUROCONTROL are working together, and alongside such organisations as the Joint Authorities on Rulemaking for Unmanned Systems (JARUS), to develop rules and standards to make the safe execution of UAS operations easier and more understandable for both commercial and recreational pilots in Europe.

In this sense the European Commission has developed[72] a vision for the phased introduction of procedures and services to support safe, efficient and secure access to airspace, called U-Space[73].

According the *U-Space Blueprint (2017)* issued by the European Commission, U-Space is defined as *"a set of services designed to support safe, efficient and secure access to airspace for large numbers of drones"* that rely on a high level of digitalisation and automation of functions, whether they are on board the drone itself, or are part of the ground-based environment.

U-space provides an enabling framework to support routine drone operations, as well as a clear and effective interface to manned aviation, ATM/ANS service providers and authorities. U-space is therefore not to be considered as a defined volume of airspace,

[69] To this end see also *SESAR JU European ATM Masterplan 2020*, p. 25.
[70] See R. Abeyratne, *Air Navigation Law*, Springer, 2012, p. 9.
[71] VLL is the airspace below that used by visual flight rules operations (VFR). In ICAO Annex 2 [10] and Standard European Rules of the Air (SERA) [12] there are statements about the minimum height for VFR. For example in SERA section 5005 is written:(f) Except when necessary for take-off or landing, or except by permission from the competent authority, a VFR flight shall not be flown: (1) over the congested areas of cities, towns or settlements or over an open-air assembly of persons at a height less than 300 m (1 000 ft) above the highest obstacle within a radius of 600 m from the aircraft; (2) elsewhere than as specified in (1), at a height less than 150 m (500 ft) above the ground or water, or 150 m (500 ft) above the highest obstacle within a radius of 150 m (500 ft) from the aircraft.
[72] See *U-Space Blueprint* issued by European Commission in 2017.
[73] See M. Huttunen, *The U-space Concept*, in *Air and Space Law*, 44, No. 1, 2019, p. 69.

which is segregated and designated for the sole use of drones and is capable of ensuring the smooth operation of drones in all operating environments, and in all types of airspace, in particular but not limited to very low-level airspace[74]. It addresses the needs to support all types of missions and may concern all drone users and categories of drone[75].

The European Commission Blueprint on U-Space also set some essential principles that will drive the development of this asset. In particular the delivery of U-space will pass through the safety of all airspace users operating in the U-space framework, as well as people on the ground and also through a scalable, flexible and adaptable system that can respond to changes in demand, volume, technology, business models and applications, while managing the interface with manned aviation. In addition, the U-space should enable high-density operations with multiple automated drones under the supervision of feet operators, to guarantee equitable and fair access to airspace for all users and enable competitive and cost-effective service provision at all times, supporting the business models of drone operators. Finally, the U-space has to follow a risk-based and performance-driven approach when setting up appropriate requirements for safety, security (including cyber-security) and resilience (including failure mode management), while minimising environmental impact and respecting the privacy of citizens, including data protection.

In practical terms the U-space services that will be offered to both private and public users consist in a wide range of "tools" that make up a "platform" where UAS operator accesses and interact with different players, from Civil Aviation Authority to Air Navigation Service Provider, etc. As the U-space Blueprint states, these services do not replicate the function of air traffic control but deliver key services to organise the safe and efficient operation of drones and ensure a proper interface with manned aviation and relevant authorities.

The U-space Blueprint identifies three "foundation services": a) electronic registration (e-registration), b) electronic identification[76] (e-identification) and c) geofencing.

[74] See *U-Space Blueprint* issued by European Commission in 2017.

[75] As technical regulation it is important to refer to CORUS Project that exists to write a Concept of Operation (ConOps) for U-space (UTM in Europe). The CORUS project has been initiated by the SESAR Joint Undertaking. The aim of CORUS is to addresses, under technical and operational level, those drones that are expected to operate in the VLL (Very Low-Level) environment, covering many types of aerial activity, including leisure, remote infrastructure inspection, rural operations, flights in densely-populated and urban areas, and flights near protected sites, such as airports or nuclear power stations. In order to make clear the complexity of the work done, we can mention that inputs for CORUS come from a) U-space Blueprint; b) SESAR roadmap for the safe integration of drones into all classes of airspace; c) European Drones Outlook Study; d) Unmanned Aircraft Systems (UAS) ATM Integration Operational Concept from EUROCONTROL and EASA; e) The EASA Concept of Operation for Drones; f) ICAO Annex 2 to the convention on Civil Aviation, Rules of the Air; g) ICAO Annex 11 to the convention on Civil Aviation, Air Traffic Control Service, Flight Information Service, Alerting Service; h) 'SERA', EU regulation 923/2012; i) ICAO Manual on remotely piloted aircraft systems (RPAS) – ICAO doc 10019; l) ICAO Procedures For Air Navigation Services, Air Traffic Management, ICAO doc 4444; m) The FAA / NASA Unmanned Aircraft Systems (UAS) Traffic Management (UTM) Concept of Operations; n) The many reports on the NASA UTM portal; o) Blueprint for the Sky, The roadmap for the safe integration of autonomous aircraft by Airbus/Altiscope; p) Airbus/Altiscope's Technical Report series; q) The Global UTM Association (GUTMA) UAS Traffic Management Architecture; r) The Swiss U-space ConOps; s) JARUS publications in general and SORA in particular.

[76] Electronic identification for example will allow authorities to identify a drone flying and link it to information stored in the registry.

The other ground of the U-space relies on its continuous evolution over time. Indeed, its deployment is linked to the increasing availability of blocks of services and enabling technologies and its progress will be determined by the level of automation and by the forms of interaction with the environment and by digital information and data exchange.
According to the Blueprint there are four steps ahead for the deployment of the U-space:
- U1: U-space foundation services provide e-registration[77], e-identification[78] and geofencing[79].
- U2: U-space initial services support the management of drone operations and may include flight planning[80], flight approval, tracking[81], airspace dynamic information[82], and procedural interfaces with air traffic control[83].
- U3: U-space advanced services support more complex operations in dense areas and may include capacity management[84] and assistance for conflict detection.
- U4: U-space full services, particularly services offering integrated interfaces with manned aviation, support the full operational capability of U-space and will rely on very high level of automation, connectivity and digitalization for both the drone and the U-space system.
More recently, the European Aviation Safety Agency has issued the first opinion[85] as high-level regulatory framework for the U-space aiming to propose an effective and enforceable regulatory framework to support and enable operational, technical and

[77] The service enables the registration of the operator, drone and pilot with the appropriate information according to Regulation (definition from *SESAR ATM Masterplan Drone Roadmap*).
[78] The service allows the identification of a drone operator from a drone in operation (in line with the global scope of registry (ICAO) &eIDAS - Regulation (EU) No 910/2014). The identification provides access to the information stored in the registry based on an identifier emitted electronically by the drone. The identification service includes the localization of the drones (definition from *SESAR ATM Masterplan Drone Roadmap*).
[79] The service provides the operator with geo-information about predefined restricted areas (prisons, etc.) and available aeronautical information (NOTAM, AIRAC cycle) used during the flight preparation. This service requires the identification of accredited sources and the availability of qualified geo- information related to restricted areas (definition from *SESAR ATM Masterplan Drone Roadmap*).
[80] This service covers the receipt of a flight notification or a flight plan and provides the appropriate answer according to the characteristics of the mission and applicable regulations (definition from *SESAR ATM Masterplan Drone Roadmap*).
[81] This refers to the service provider using cooperative and non-cooperative surveillance data to maintain track-identity of individual drones. The capability includes ground and air surveillance systems, as well as surveillance data processing systems (definition from *SESAR ATM Masterplan Drone Roadmap*).
[82] This service provides the operator with relevant aeronautical information for drone operations. It will connect to the Aeronautical information service (AIS) to guarantee coherent information provision for manned and unmanned operators (definition from *SESAR ATM Masterplan Drone Roadmap*).
[83] The service is a set of defined procedures for some mission types where there may be an impact on ATC. The procedures ensure clear and unambiguous drone operation and provide an appropriate flow of information between the drone operators and ATC (definition from *SESAR ATM Masterplan Drone Roadmap*).
[84] Upon the definition of drone density thresholds (that can be dynamically modified), the service monitors demand for airspace, and manages access to that airspace as new flight notifications are received. This service may be coupled with the flight planning management service. There should be appropriate set of rules and priorities for slot allocation when a portion of airspace is expected to reach its capacity limits. Apart from the demand and capacity balancing, the service could manage capacity due to non-nominal occurrences, such as weather hazards or emergency situations (definition from *SESAR ATM Masterplan Drone Roadmap*).
[85] See above fn. 32.

business developments, and provide fair access to all airspace users, so that the market can drive the delivery of the U-space services to cater for airspace users' needs[86].
The EASA Opinion in order to create the conditions for a safety operations of unmanned aircraft has foreseen the creation of a common information service (CIS) that *will enable the exchange of essential information between the U-space service providers (USSPs), the UAS operators, the air navigation service providers (ANSPs) and all other participants in the U-space airspace.*
Accordingly, another key objective of this proposal[87] is to create a competitive U-space services market able to attract business investments both in UAS and U-space services marketthat leads to safe and sustainable operations in the U-space airspace[88].
From the EASA Opinion 01/2020 seems to emerge some interesting points for the future development of UAS operations. According to art. 5 of the draft Commission Implementing Regulation on a High-level Regulatory Framework for the U-space (enclosed to the Opinion 01/2020), Member States shall designate a certified common information service (CIS) provider for each designated U-space airspace. The CIS provider shall ensure the exchange of static and dynamic information between U-space service providers and air navigation service providers, necessary for safe operations. The CIS provider then shall make the following information available: (a) horizontal and vertical limits of the designated U-space airspace; (b) the UAS capabilities and performance requirements set by the competent authorities for a given U-space airspace; (c) a list of different certified U-space service providers effectively offering U- space services in the designated U-space airspace; (d) requirements related to the use of public key infrastructure, identity management, and authentication; (e) the list of all the publicly known authorities that can be contacted with regard to the common information. Also, the draft regulation establishes that the CIS provider shall not be related or connected in any manner or form to any U- space service provider in the airspace for which it has been designated and shall not provide any U-space services itself in that airspace.
The draft regulation enclosed to the EASA Opinion 01/2020 seems to open a window in the usual way to conceive the air navigation services. From a single-provider system to something similar to an independent authority and multiple services providers at the bottom.

[86] The Opinion 01/2020 points out that "*the draft text of this Opinion has been developed by EASA in discussions with the responsible services of the European Commission4 based on the input of a working group composed of representatives of Member States as well as experts from EUROCONTROL and the SESAR Joint Undertaking. The working group held eight meetings, from January 2019 till September 2019. All interested parties were consulted through the Advisory Bodies (ABs) in accordance with Article 16 'Special rulemaking procedure: accelerated procedure' of MB Decision No 18-2015. Before the AB consultation, EASA organized, in July 2019, a focused consultation to receive feedback on its very first draft regulation. More than 1 000 comments were received from the drone and U-space stakeholders as well as from the authorities and the aviation industry. Furthermore, a dedicated workshop was held on 11 October 2019 with the drone community to discuss the draft regulation. More than 2 500 comments were received on the draft Opinion from interested parties, including industry, national aviation authorities (NAAs), local authorities and aviation associations*."
[87] See EASA Opinion n. 01/2020 p. 6.
[88] By Opinion 01/2020 this "*framework should support and enable operational, technical and business developments, and provide fair access to all airspace users, so that the market can drive the delivery of the U-space services to cater for UAS operators' needs*."

4. UAS into Very Low Level (VLL) Airspace and Air Management and Navigation System

According to EUROCONTROL U-space Concept of Operations[89] U-space divides the very low level (VLL) airspace into different volumes as "UAS geographical zones[90]". The grounds of this division rely on the kind services being offered, the types of operation which are possible, and their access and entry requirements[91]. Three airspace volume types are identified and referred to as X, Y and Z[92].

In the X volume (that present low risk) UAS operator has a wide access to airspace due to few requirements but with correspondents few services[93]. The pilot remains responsible for separation at all times.

The access to Y volume where high ground risks are expected, requires an approved operation plan as well as a remote piloting station connected to U-space and a position report tool[94].

The Z volume which is divided into Zu (volume with tactical resolution service) and Za (volume controlled by air traffic services[95]) requires an approved operation plan and a fully operation of all U-space services as explained[96]. In the Z volume there are more risk mitigations provided than in Y or X and it requires pilot to be appropriately trained and it also allows higher density operations.

As an explanation on UAS operations according the legal and technical rules as above mentioned, we may consider three different phases (pre-flight; in-flight; post-flight) as a typical scheme that UAS should follow.

As pre-flight phase it is relevant the registration of UAS, of its operator as well as training and insurance certification. After this the log-in to U-space service provider will be necessary. This first step is then completed by the planning of the operation with the check of the appropriate airspace structure and the choice about the type of

[89] EUROCONTROL, 9thJuly 2019 by which it is also necessary to refer – as unmanned aircraft – to the concept of Unmanned Traffic Management (UTM). In this last sense see *EUROCONTROL UAS ATM Integration. Operational Concept*, 2018, p. 22.

[90] See art. 15 of the Reg. 2019/947.

[91] For strategic and economic aspects see *SESAR European ATM Masterplan. Roadmap for the safe integration of drones into all classes of airspace* (2018).

[92] According the EUROCONTROL Concept of Operations, the most significant difference is in the provision of conflict resolution services: X: No conflict resolution service is offered; Y: Pre-flight ("strategic") conflict resolution is offered only; Z: Pre-flight ("strategic") conflict resolution and in-flight ("tactical") conflict resolution are offered.

[93] According the EUROCONTROL Concept of Operations, in the X Volume the following U-space services are mandatory: i) registration; ii) e-identification; iii) aeronautical information; iv) geo-awareness; v) geo-fencing; vi) incident/accident reporting; vii) weather information. Other services are optional: i) position report; ii) operation plan processing; iii) monitoring; iv) traffic information; v) population density map; vi) tracking. These services are not provided: i) capacity management; ii) strategic conflict resolution; iii) tactical conflict resolution while these ones are suggested ("when available") i) emergency management; ii) legal recording; iii) digital logbook; iv) procedural interface with ATC.

[94] In the Y Volume the following U-space services are mandatory: i) registration; ii) e-identification; iii) aeronautical information; iv) geo-awareness; v) geo-fencing; vi) incident/accident reporting; vii) weather information; viii) emergency management; ix) operation plan processing; x) strategic conflict resolution; xi) legal recording; xii) digital logbook. Geospatial service is optional while no tactical conflict resolution is needed. As suggested services we find: i) tracking; ii) position report; iii) capacity management; iv) monitoring; v) traffic information; vi) procedural interface with ATC.

[95] Za volumes are expected at airports or in other airspaces controlled by ATC.

[96] See above fn. 93 and 94.

operation (open, specific or certified). During the in-flight phase the operator should monitor the UAS and configure an emergency management service as well as follow the procedures related to the communication with ATC (where available). Post-flight usually includes the report of operation and the check of UAS and eventually its preparation for another activity.

5. Conclusions

The positive outlook on UAS development and deployment and the current pandemic disruption due to the Covid-19 has raised the attention of the public opinion, lawmakers and, above all, undertakings, over the unmanned aircraft capabilities able to perform both public and private tasks. Civil operations for public ends and commercial businesses are expected to generate the majority of the economic value on the basis of multi-billion product as well as the majority of risks in terms of both ground and airspace ones with also the support of defence and leisure industries. Also, the outbreak of the SARS-COV-2 has enhanced the opportunities of the use of UAS for the distribution of medical drugs, foods, goods, etc. Indeed, the use of UAS during the pandemic could have produced potential savings in time and distance in performing activities such as the disinfecting of areas and places, detecting, surveillance and real-time monitoring and information, that otherwise require direct human involvement[97] with the associated risk virus spreading.

The European Union legal framework together with the technical rules set up the border of the "environment" in which the "explosion" of UAS will be controlled, assessed and even planned in order to maximise the social benefits in terms of reducing risks and increase of economic and job opportunities.

According to this legal and technical framework, manufactures should asses risks and measures that make viable the investments and safety as well and on the other hand, UAS operators and remote pilots are required to follow rules that, for the first time, are homogenous across EU Members State and fair balanced taking in consideration safety, economic (industry) and consumersneeds.

From air navigation service perspective it is important to point out the latest version of the European ATM Masterplan (2020) by which "*given the dependency of drone deployment on new technologies, new interfaces, new sets of services and new service providers, business models with limited presence in current ATM are likely to emerge to support this ecosystem, particularly for U-space*."

The logical and legal consequence of the reasoning stands in the necessity to develop viable models capable to support investments and realize benefits.

In this sense the new European regulations aiming to create a European market of UAS and UAS Services, seems to introduce a different scheme than the usual one that surrounded the aviation and, especially, the air navigation services. The fact the UAS operations are usually performed in a restricted area – in terms of geographical border that, for example coinciding with a small city or a district of large one – has led to a rethink of air navigation services providing shifting from a national-centric model to an open and eventually a local ones.

In practical and legal terms this means that the air traffic management of unmanned aircraft and its integration in the airspace through the U-space concept could be led by a

[97] In this sense see J. Euchi, *Do drones have a realistic place in a pandemic fight for delivering medical supplies in healthcare systems problems?*, In *Chinese Journal of Aeronautics*, May 2020 (in press).

possible wide and plural services providers supervised by the a central information system that like an independent authority should guarantee the respect of rules and regulation for access to the market of services and their providing with clear benefit in terms of costs and quality for consumers and community.

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