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EU Drone Sector state of play

Accompanying the document

**Communication from the Commission to the European Parliament, the Council, the
European Economic and Social Committee and the Committee of the Regions**

**‘A Drone Strategy 2.0 for a Smart and Sustainable Unmanned Aircraft Eco-System in
Europe’**

{ COM(2022) 652 final }

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1 INTRODUCTION

This Staff Working Document accompanies the Communication from the Commission on ‘A Drone Strategy 2.0 for a Smart and Sustainable Unmanned Aircraft Eco-System in Europe’, which sets out the actions needed to ensure that a drone eco-system is deployed in the European Union in a way that supports the goals of the European Green Deal¹, the digital transformation of the European Economy and of the Sustainable and Smart Mobility Strategy². The actions set out in the Communication should ensure safe, smart, resilient, inclusive and clean drone operations in the European Union.

The development of drones (unmanned aircraft systems) services supported by a competitive industry can strongly support Europe’s twin transition to a green and digital economy and contribute to the post-COVID 19 recovery as well as the future resilience of the EU economy. From daily commuting, goods delivery to the development of a wide spectrum of new applications and services, drones can become an enabler of our economic and social life and a driving force of the further digitalization of the European economy.

The European Green Deal is a new growth strategy for the EU, which calls for the reduction of greenhouse gas emissions in all sectors of the economy, including transport and the protection of the human health. In this context, the transport system as a whole should be made smart and sustainable. The Communication on the European Green Deal announced therefore a strategy for sustainable and smart mobility, which was adopted by the Commission in December 2020. In the Sustainable and Smart Mobility Strategy, the Commission announced its intention to adopt a Drone Strategy 2.0 in 2022 to reap the full potential offered by drones to contribute to the safeguarding of a well-functioning single market. Drone applications can also strongly contribute to the digital transformation of many businesses and help to meet Europe’s Digital Strategy³ targets.

In order to enhance the competitiveness of the European drone eco-system as well as Europe’s security and defence capabilities, the Commission adopted in February 2020 an ‘Action plan on

¹ <https://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1588580774040&uri=CELEX%3A52019DC0640>

² <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52020DC0789>

³ https://eur-lex.europa.eu/resource.html?uri=cellar:12e835e2-81af-11eb-9ac9-01aa75ed71a1.0001.02/DOC_1&format=PDF

synergies between civil, defence and space industries’⁴, and which includes a ‘EU Drones Technologies Flagship’ project aiming at reaping synergies between the civil, including counter-drones technologies, and military use of drones. This Action Plan also identifies autonomous systems including drones as a critical technology for which Europe needs to achieve technological sovereignty. These objectives were reinforced by the Versailles Declaration adopted by the Member States in March 2022⁵ which marked the EU decision to take more responsibility for its security and take further decisive steps towards building its European sovereignty, reducing our dependencies and designing a new growth and investment model for 2030. In this respect, the Declaration addressed three key dimensions, first, enhance security and defence capabilities, second, reduce energy dependencies; and third build a more robust economic base. Among those measures, the Member States agreed to foster synergies between civilian, defence and space research and innovation, and invest in critical and emerging technologies and innovation for security and defence. They also agreed to take measures to strengthen and develop EU’s defence industry, including SMEs.

To reach its goals, the EU needs to ensure the safe and efficient development of a drone ecosystem, addressing related societal concerns such as safety, security, privacy and environmental protection, while simultaneously nurturing a sustainable economic environment for the European drone industry to grow. Although EU citizens expressed generally positive attitudes to new forms of air mobility, a study⁶ led by the European Union Aviation Safety Agency (EASA) has shown that safety and noise pollution are on top of EU citizens’ concerns, in a list that also includes cybersecurity risks and the potential impact on wildlife. Therefore, there are many other issues beyond safety that must also be addressed in order to ensure the social acceptance of drones, such as environmental and privacy issues.

In 2014 and 2015, the Commission adopted respectively a Communication on a new era for civil aviation⁷ and the Aviation Strategy for Europe⁸ which highlighted that safety is crucial to the successful integration of drones in the airspace as well as the development of this industry and the services and applications enabled by drones.

The Aviation Strategy for Europe set an objective to establish a basic legal framework for the safe development of drone operations in the EU and to prepare more detailed rules that allow drone operations and the development of industry standards. This regulatory framework is now largely in place.

New actions are needed at EU level because the drone sector is developing rapidly with new innovative ways of using drones emerging at a fast pace requiring an assessment of the regulatory and enabling framework to ensure that these new services can thrive in the EU internal market and globally. Related technologies such as radiofrequency communication⁹, Artificial Intelligence¹⁰, advanced sensors and improvements in power sources are opening new prospects.

⁴ Communication for an “Action Plan on synergies between civil, defence and space industries”, adopted in February 2021 including a “Drones Technologies” Flagship.

⁵ <https://www.consilium.europa.eu/media/54773/20220311-versailles-declaration-en.pdf>

⁶ EASA Study on the societal acceptance of Urban Air Mobility in Europe 2021, <https://www.easa.europa.eu/sites/default/files/dfu/uam-full-report.pdf>

⁷ <https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52014DC0207&from=EN>

⁸ <https://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX%3A52015DC0598>

⁹ <https://eur-lex.europa.eu/legal-content/FR/TXT/?uri=celex%3A32014L0053>

¹⁰ <https://digital-strategy.ec.europa.eu/en/library/proposal-regulation-european-approach-artificial-intelligence>

Drones are used as daily tools in ever broadening, data-demanding economic sectors such as agriculture, construction, surveillance, filming, healthcare, energy, environment, public safety and security. Future perspectives include the use of drones, for example, as platforms for communication hubs or weather or pollution monitoring. Drones are also both users and enablers of Global Navigation Satellite System (GNSS) services, they can be used to complement Copernicus imaging, as well as to complement Secure Connectivity services. Conversely, the fact that customised drones can also be used for illegal purposes should be addressed.

In the transport sector, the use of drones for deliveries is already tested in many countries. First pilot trials in passenger transport in Europe are expected to take place within the next few years.

At the same time, it is important that Europe safeguards its open strategic autonomy in this area, as recognised in the “Action plan on synergies between civil, defence and space industries”¹¹.

Against this background, the existing strategy from 2015 has been overtaken by these new developments and a new strategy is needed at EU level to provide a forward-looking vision for the future holistic development of the sector.

This Staff Working Document gives an overview of the Commission services’ assessment of the challenges that the drone sector faces as well as the analysis and data underpinning the new Drone Strategy 2.0. With that, it aims to support the entire drone eco-system, including cities, regions and Member States in the development of drone activities for mobility and services.

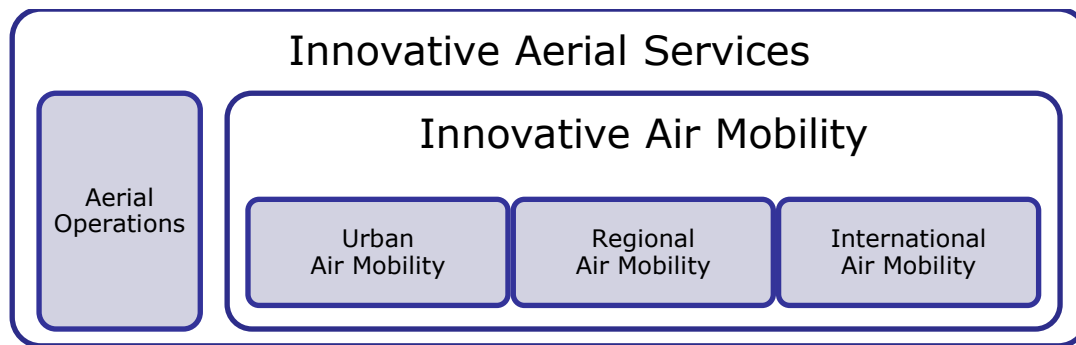
2 SCOPE OF THE STRATEGY

The term “drone” is the layman term for “Unmanned Aircraft Systems” which means an unmanned aircraft and the equipment to control it remotely.

The term “Urban Air Mobility” has been increasingly referred to in the context of new Urban Mobility initiatives. Due to the lack of a definition and in line with the regulatory operation centric approach, EASA has developed the notion of Innovative Aerial Services (IAS). IAS correspond to the set of operations and/or services that are of benefit to citizens and to the aviation market and that are enabled by new airborne technologies – the operations and/or services include both the transportation of passengers and/or cargo and aerial operations (e.g. surveillance, inspections, mapping, telecommunication networking). IAS can be further divided into “aerial operations” (surveillance, inspection, imaging, ...), as well as a whole new emerging market called Innovative Air Mobility (IAM)¹² (including international, regional and urban air mobility).

¹¹ https://ec.europa.eu/info/sites/info/files/action_plan_on_synergies_en_0.pdf

¹² The concept of Innovative Air Mobility (‘IAM’) is to accommodate operations with novel aircraft designs (that do not automatically fall under one of the known categories, but which have VTOL capabilities for take-off and landing, specific (distributed) propulsion features, can be operated in unmanned configuration, etc.), that are conceived to offer a new air mobility of people and cargo, in particular in congested (urban) areas, based on an integrated air and ground-based infrastructure. IAM describes a diverse array of aircraft types (such as manned and unmanned), whose designs are enabled by ongoing innovations particularly in the areas of hybrid and electrification of propulsion systems, energy storage, lightweight materials, digitalisation and automation. These innovations have made possible an array of novel designs spanning multi-rotor, tilt wing, tilt-rotor, powered wing, offering short take-off and landing (STOL) through to vertical take-off and landing (VTOL) capabilities.



Innovative Aerial Services

For further reference in the following text, the term ‘drones’ will be used to cover all vehicles involved in Innovative Aerial Services including manned eVTOL, as well as Unmanned Aircraft Systems used in the defence sector. However, as explained in the Drone Strategy 2.0, the purpose is not to address the conditions of operations of military drones, but rather seeks to identify areas of cross-fertilisation whereby defence projects may benefit from innovative developments of SMEs for civilian drones and that civil aeronautics benefit from developments in the field of defence.

3 CONSULTATION STRATEGY

As part of its consultation strategy, the Commission announced in the roadmap for the preparation of the Drone Strategy 2.0 the launching of an online Open Public Consultation (OPC), desk research as well as targeted stakeholder consultations in the context of a preparatory Fact finding study¹³. Consultation tools used for collecting information for the study included surveys/questionnaires, interviews, stakeholder workshop and meetings of the informal drone expert group. The targeted consultations also included consultations of the defence community by Commission services to explore civil/military synergies in the development of drone technologies.

The stakeholders that have been identified included national competent authorities/administrations, drone operators and producers, U-space and air navigation service providers, local rural and urban communities, airport operators, and relevant European associations.

3.1 Roadmap summary result analysis

The Commission published the intention to develop the Drone Strategy 2.0 on the website “Have your Say”, together with the roadmap for the Drone Strategy 2.0¹⁴. 45 comments were received on the roadmap in the period between 4 June and 2 July, 2021. The analysis of the comments received to the Roadmap is available in Annex A.

¹³ Fact finding study preparing a “Drone Strategy 2.0”, Final report”, 2022, Ecorys

¹⁴ https://ec.europa.eu/info/law/better-regulation/have-your-say/initiatives/13046-A-Drone-strategy-20-for-Europe-to-foster-sustainable-and-smart-mobility_en

3.2 Open Public Consultation

Citizens and organisations were invited to contribute to the online public consultation which was open between 8 October 2021 and 31 December 2021. A total of 258 comments were received. The analysis of the comments can be found in Annex A.

3.3 Informal Drone Experts Group and Drone Leaders' Group report

The Commission also used its existing consultation platforms for the development of the Drone Strategy 2.0, notably the Informal Drone Experts Group¹⁵. In addition, in order to give a high-level steer to the development of the Drone Strategy 2.0, the Commission created on an ad hoc basis a 'Drone Leaders' Group'. In total, the Drone Leaders' Group held four meetings between October 2021 and April 2022, collecting the views of its 26 members representing all core stakeholder groups whether from the national authorities, EU agencies, manned or unmanned aviation. The Group also organised three hearings with the members of the Informal Drone Experts Group addressing the following issues:

- Hearing 1 on Urban Air Mobility (cargo/passengers) and U-space (held on 18 February 2022)
- Hearing 2 on Enhancing drone services including the SME dimension (held on 25 February 22)
- Hearing 3 on Developing Civil-Defence industry synergies and technology building blocks (held on 8 March 2022).

The Drone Leaders' Group delivered a report including its Vision for the Drone Sector in 2030, identified key performance indicators and identified the main obstacles (and solutions) for the development of the EU drone services market. The most cited obstacles were: societal issues (privacy, security, noise and visual nuisances); technology (absence of standards, immature technologies, problems of integration); regulation ('specific' and 'certified' categories, vertiports, rules of the air, ATM-UTM integration); lack of investment and funding; and market issues (access to airspace, fragmentation). The Vision proposed by the Drone Leaders Group and a list of SMART performance indicators are presented in paragraph 7.1 below and the full report of the Drone Leaders' Group is available in the Appendix of the synopsis consultation report.

4 EU DRONE POLICY UP TO NOW ("DRONE STRATEGY 1.0")

4.1 Formulating a policy

4.1.1 Communication for "A new era for aviation Opening the aviation market to the civil use of remotely piloted aircraft systems (RPAS) in a safe and sustainable manner"

The European Summit of 19 December 2013 called for action to enable the progressive integration of drones into civil airspace from 2016 onwards. This Communication focused on drones for civil use and responded to the call of the European manufacturing and service industry to remove barriers to the introduction of RPAS in the European single market. It set out the

¹⁵ Commission Expert group (E03533). <https://ec.europa.eu/transparency/expert-groups-register/screen/expert-groups/consult?lang=en&groupID=3533>.

Commission's views on how to address drone operations in a European level policy framework which would enable the progressive development of the commercial drone market while safeguarding the public interest. The regulatory action and the related research and development efforts were to be built on existing initiatives involving a number of actors: the European Aviation Safety Agency, the national Civil Aviation Authorities, the European Organisation for Civil Aviation Equipment (EUROCAE), EUROCONTROL, the SESAR Joint Undertaking (SJU), the European Defence Agency, the European Space Agency, the drone manufacturing industry and operators.

4.1.2 High Level Drone Conferences in Riga (2015), Warsaw (2016), Helsinki (2017), Amsterdam (2018)

The Riga Drone Declaration of 2015 stated that drones need to be treated as new types of aircraft with proportionate rules based on the risk of each operation and EU rules for the provision of drone services should be developed quickly as well as technologies and standards ensuring the full integration of drones in the European airspace.

The Warsaw Drone Declaration of 2016 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. The Declaration also called for the safety rules to be kept simple, proportionate to the risk of the operation, performance-based, future-proofed, and based on global standards. Calling for urgent action on the airspace dimension, in particular the development of the concept of a U-space, a set of digital services enabling the safe scaling up of routine drone operations, the development of the U-Space was mentioned for the first time in a Declaration.

The Helsinki Drone Declaration of 2017 supported the adoption of the new EASA Basic Regulation as providing the foundation for a European legislative framework for drone services. The growing fragmentation along national boundaries of the EU drone services market was also noted with concerns, indicating the urgent need for close cooperation between European and national authorities. The Declaration called for the opening of the drone services market and in particular, the introduction of competition between U-Space providers to ensure that services are delivered at the best possible cost-benefit ratio while allowing fair and timely access to airspace for drone operators.

The Amsterdam Drone Declarations of 2018 called for a push towards integrated smart mobility and fair access to all dimensions of public space, inviting cities and regions, also within the Smart Cities initiative, to co-create with the citizens the public conditions and the infrastructure for integrated air and ground smart mobility solutions to flourish and for the timely delivery of the U-space regulatory framework.

4.1.3 Communication for “an Aviation Strategy for Europe”

In 2015, the Commission adopted its Communication on “an Aviation Strategy for Europe” highlighting the fact that while safety is crucial it cannot be looked at in isolation. In this Communication, drone technologies were considered as a major opportunity both for the European aeronautical manufacturing industry, especially for small and medium sized enterprises, and for the many aviation and non-aviation businesses that will be able to integrate drones into their activities and increase their efficiency and competitiveness. The Commission stated its intention to propose a basic legal framework for the safe development of drone operations in the EU, as part of the new basic aviation safety Regulation replacing Regulation

216/2008 and tasked the European Union Aviation Safety Agency with preparing more detailed rules allowing the drone operations and the development of industry standards.

4.1.4 Communication for a “Sustainable and Smart Mobility Strategy – putting European transport on track for the future”

In its 2020 Sustainable and Smart Mobility Strategy, the Commission addressed the future challenges and opportunities for European mobility and the transport sector. From daily commuting to the proper functioning of global supply chains, mobility is an enabler of our economic and social life. As the second-largest area of expenditure for European households, the transport sector contributes 5% to European GDP and directly employs around 10 million workers. Whilst mobility brings many benefits for its users, it is not without costs for our society. By far, the most serious challenge facing the transport sector is to significantly reduce its emissions and become more sustainable. At the same time, this transformation offers opportunities for better quality of life, and for European industry across the value chains to modernise, create high-quality jobs, develop new products and services, strengthen competitiveness and pursue global leadership as other markets are moving fast towards zero-emission mobility.

In its Sustainable and Smart Mobility Strategy, the Commission announced its intention to adopt a Drone Strategy 2.0 in 2022 setting out possible ways to guide the further development of this technology and its regulatory and commercial environment. .

4.1.5 Communications on “the EU Security Union Strategy” and “Counter-Terrorism Agenda”

In 2020, the Commission also adopted two Communications which both introduced new policy actions to counter possible threats that drones could pose. The EU *Security Union Strategy*¹⁶ and *Counter-Terrorism Agenda*¹⁷ stated that the threat of non-cooperative drones is a serious concern in Europe that needs to be addressed. In the Counter-Terrorism Agenda in particular, the Commission committed to look into the possibility of releasing an EU handbook for securing cities from non-cooperative drones. This initiative has expanded and will now include “Protection against Unmanned Aircraft Systems – Handbook on Counter-UAS for Critical Infrastructure and Public Spaces” and “Protection against Unmanned Aircraft Systems – Handbook on Principles for Physical Hardening of Buildings and Sites”.

The Commission introduced the Directive on the resilience of critical entities (CER Directive)¹⁸ in December 2020. This directive will reflect the priorities of the EU Security Union Strategy and address a wide range of non-cyber threats against critical entities and their infrastructure. It will cover eleven sectors, including the transport sector. The proposed Directive on the resilience of critical entities will introduce obligations on Member States and critical entities to conduct risk assessments and on critical entities to take technical, security and organisational measures to ensure their resilience against identified risks. Because of their nature, the threat of non-cooperative drones will be an integral part of their risk assessments.

¹⁶ COM(2020) 605 final of 24 July 2020

¹⁷ COM (2020) 795 final of 9 December 2020

¹⁸ COM(2020) 829 final of 16 December 2020. The European Parliament and the Council reached political agreement on the proposed Directive on 28 June 2022 (Security Union (europa.eu))

4.1.6 Communication for an “Action Plan on synergies between civil, defence and space industries”, including a “Drones Technologies” Flagship

The Commission adopted in February 2021 a Communication for an “Action Plan on synergies between civil, defence and space industries”¹⁹, including a flagship project for EU drone Technologies aimed to enhance the competitiveness of EU industry in this critical technology area. This Communication aimed to promote the competitiveness of the European drone ecosystem, as well as, Europe’s defence capabilities, by reaping synergies between the civil and military use of drones. It highlighted that the flagship project forms part of an overall ambition to be further set out in the “Drone Strategy 2.0”. This Action Plan also identifies autonomous systems including drones as a critical technology for which Europe needs to achieve technological sovereignty.

4.1.7 Communication on “the New EU Urban Mobility Framework” and publication of Urban Air Mobility guidelines

To support the transition to cleaner, greener, and smarter mobility, in line with the objectives of the European Green Deal, the Commission adopted in November 2021 four proposals that will modernise the EU’s transport system²⁰. By increasing connectivity and shifting more passengers and freight to rail and inland waterways, by supporting the roll-out of charging points, alternative refuelling infrastructure, and new digital technologies, by placing a stronger focus on sustainable urban mobility, and by making it easier to choose different transport options in an efficient multimodal transport system, the proposals will contribute to putting the transport sector on track to cutting its emissions by 90%.

The new framework announced a more ambitious approach to sustainable urban mobility planning (SUMPs)²¹ and related indicators. Such new and integrated approaches to using and managing urban space includes urban air mobility (e.g. drones).

This complements the proposal for revised guidelines for the Trans-European Transport Network, according to which the largest 424 EU cities on the TEN-T network should adopt a sustainable urban mobility plan by 2025 and collect relevant data.

To provide guidance on Urban Air Mobility (UAM) as specific topic related to Sustainable Urban Mobility Planning, UIC² – the UAM Initiative Cities Community or EU’s Smart Cities Marketplace – released a practitioner briefing in December 2021²².

4.1.8 Communication on a “Roadmap on critical technologies for security and defence” and “Versailles” Declaration

The roadmap on critical technologies for security and defence²³, adopted in February 2022, is part of a number of Commission-led initiatives in areas critical for defence and security within the European Union. It is a concrete step towards a more integrated and competitive European

¹⁹ https://ec.europa.eu/info/sites/info/files/action_plan_on_synergies_en_0.pdf

²⁰ https://ec.europa.eu/commission/presscorner/detail/en/ip_21_6776

²¹ <https://www.eltis.org/resources/tools/sump-self-assessment-tool>

²² https://ec.europa.eu/info/eu-regional-and-urban-development/topics/cities-and-urban-development/city-initiatives/smart-cities_en

²³ COM(2022) 61 final

defence market, particularly by enhancing cooperation within the EU, thereby building scale, mastering costs and enhancing operational effectiveness. The Commission thus provides input in the run-up to the EU Strategic Compass on Security and Defence.

The Roadmap outlines a path to enhance the competitiveness and resilience of the EU security and defence sectors, notably by:

- inviting Member States to contribute actively to the Observatory of critical technologies currently being established;
- encouraging dual-use research and innovation at EU level.

Two preliminary case studies have been carried out so far, including one on the defence technology area of autonomous systems.

The “Versailles Declaration”²⁴, adopted by the heads of EU Member States, emphasised the need to foster synergies between civilian, defence and space research and innovation, and invest in critical and emerging technologies and innovation for security and defence.

4.1.9 Joint Communication on the “the Defence Investment Gaps Analysis and Way Forward”

The analysis of defence investment gaps and the way forward²⁵, adopted in May 2022, is a response by the Commission and the High Representative to a task given by the European Council at the Versailles Summit. It presents an analysis of the defence investment gaps, and propose further measures and actions necessary to strengthen the European defence industrial and technological base, including defence related drone activities. It also responds to the call made in the context of the Conference of the Future of Europe for stronger EU action in defence.

The Joint Communication presents a new level of ambition to build a stronger Europe in defence. It focuses in particular on the joint acquisition of military equipment, on strategic defence programming to set clearer priorities, and on the support to the European industrial base, including the strengthening of the European defence R&D framework, the European Defence Fund (EDF).

The joint communication proposes to work on strategic short-, medium- to long-term capabilities to improve Europe’s defence capabilities. These include development and operationalisation of the medium-altitude “Eurodrone” (MALE RPAS) – which forms part of PESCO and EDF projects. Also, in the short- to medium-term developing and procuring counter drone-capabilities and weaponised medium-sized drones are identified as priorities.

²⁴ <https://www.consilium.europa.eu/en/press/press-releases/2022/03/11/the-versailles-declaration-10-11-03-2022>

²⁵ JOIN(2022) 24 final

4.2 Developing and implementing a regulatory framework

4.2.1 Adoption of Regulation (EU) 2018/1139 on common rules in the field of civil aviation (2018)

The adoption of the new EASA Basic Regulation²⁶ repealing Regulation (EC) 216/2008 was a landmark for the implementation of an EU wide drone policy. The new Regulation extended the scope of EU competence to all drones, irrespective of their weight or size, including the design, production, maintenance and operation of unmanned aircraft, their engines, propellers, parts and non-installed equipment, as well as the equipment to control unmanned aircraft remotely. The operation-centric approach reflects the fact that drones can be used for a large number of missions (recreational, exploration, delivery, etc.) that all display different levels of risks for other airspace users. This complexity could not be reflected by a framework only based on criteria such as weight. The operation-centric approach also ensures that new developments are not hampered by unnecessarily heavy and costly rules and procedures, which is in line with the Commission's Better Regulation approach. The new EASA Basic Regulation gave the Commission the legal power to adopt implementing and delegated acts in order to implement the essential requirements contained in the Regulation and guarantee a high and uniform level of civil aviation safety.

4.2.2 Adoption of detailed implementing rules allowing effective drone operations and the development of industry standards

In line with the operation centric approach embedded in Regulation 2018/1139, the EU drone regulatory framework should therefore be able to address safety and security concerns of different types of drones and operations, keeping in mind the risk level of the operation. Accordingly, the Commission adopted in 2019 two Regulations: Commission Delegated Regulation 2019/945²⁷ on unmanned aircraft systems and on third-country operators of unmanned aircraft systems and Implementing Regulation 2019/947²⁸ on the rules and procedures for the operation of unmanned aircraft.

Limited to outdoor operations, Implementing Regulation 2019/947 applies since 31 December 2020. It lays down detailed provisions and conditions for the operation of drones, including the requirements to qualify as a remote pilot, minimum age of the pilot, requirements regarding the drones' airworthiness requirements, risk assessments, cross border operations, registration of the drone and its operator and competent authority. Regulation 2018/1139 introduces an approach to safety rules proportionate to the risk of the operation conducted by the aircraft. This approach is reflected in Article 3 of the Commission Implementing Regulation (EU) 2019/947. This article defines 3 categories of UAS operations, 'open', 'specific' and 'certified', corresponding to three

²⁶ Regulation (EU) 2018/1139 of the European Parliament and of the Council of 4 July 2018 on common rules in the field of civil aviation and establishing a European Union Aviation Safety Agency, and amending Regulations (EC) No 2111/2005, (EC) No 1008/2008, (EU) No 996/2010, (EU) No 376/2014 and Directives 2014/30/EU and 2014/53/EU of the European Parliament and of the Council, and repealing Regulations (EC) No 552/2004 and (EC) No 216/2008 of the European Parliament and of the Council and Council Regulation (EEC) No 3922/91. OJ L 212, 22.8.2018, p. 1

²⁷ Commission Delegated Regulation (EU) 2019/945 of 12 March 2019 on unmanned aircraft systems and on third-country operators of unmanned aircraft systems, OJ L 152, 11.6.2019, p. 1

²⁸ Commission Implementing Regulation (EU) 2019/947 of 24 May 2019 on the rules and procedures for the operation of unmanned aircraft, OJ L 152, 11.6.2019, p. 45

levels of risks (low, medium, high). They are addressed by three different set of rules, all including a combination of rules on the design of the UAS and on its operations.

The conversion of existing authorisations, certificates and declarations issued under the previous (nationally applicable) regulations could take place until 31 December 2022. A limited number of provisions will apply as from 1 January 2024, e.g. European Standard Scenarios or the use of drones in the Open category (linked to the creation of appropriate European standards).

Commission Implementing Regulation 2019/947 allows Member States to further specify certain elements such as the minimum age for remote pilots and geographical zones for safety, security, privacy, and environmental reasons. Member States may:

- prohibit certain or all drones operations, request particular conditions for certain or all drones operations or
- request a prior operational authorisation for certain or all drones operations;
- subject drone operations to specified environmental standards;
- allow access to certain drone classes only;
- allow access only to drone equipped with certain technical features, in particular remote identification systems or geo awareness systems.

Commission Delegated Regulation 2019/945 entered into force in June 2019 and was immediately applicable. It lays down the technical requirements relating to the unmanned aircraft itself. More specifically, this act lays down the regulation on:

- the product requirements for the design and manufacture of drone;
- the obligations of economic operators, importers, and distributors;
- the definition and requirement of presumption of conformity as well as the type of drone whose design, production and maintenance shall be subject to certification;
- making drones intended for use in the 'open' category and remote identification add-ons;
- third country drone operators when they conduct drone operation pursuant to Implementing Regulation 2019/947 within the single European sky airspace.

Under Commission Implementing Regulation 2019/947, national competent authorities must establish and maintain registration systems for drones, whose design is subject to certification and for drone operators whose operation may present a risk to safety, security, privacy, and protection of personal data or the environment.

On visual and noise pollution, limits reflecting the state of the art in the market have been introduced for small drones with a weight of less than 4 kg and which may be flown close to people by virtue of Regulation (EU) 2019/945. These limits will become even lower over time. In addition, further local noise constraints can be set in respect of 'UAS geographical zones'. Directive 2002/49/EC on noise also imposes to all agglomerations of more than 100.000 people to prepare action plans to manage and limit the noise from air operations including drones.

On emissions, Regulation (EU) 2019/945 imposes that small drones must be powered by electricity. If managed properly, drone operations, particularly in urban area, can contribute to the reduction of air pollutants, rather than causing additional adverse health effects for the citizens.

4.2.2.1 4.2.2.1 'Open' category

The operations in the 'open' category are performed with drones with a Maximum Take Off Mass of 25kg, marked with a Class Identification Label, complying with the technical requirements set out in Regulation 2019/945, always maintaining a Visual Line of Sight between the drone and the remote pilot and at a maximum altitude of 120 meters. They present the lowest

risk of operations and therefore do not require any prior operational authorisation, nor an operational declaration by the drone operator.

4.2.2.2 4.2.2.2 ‘Specific’ category

If one of the conditions of the ‘open’ category cannot be met, the operation is considered as riskier than allowed under the ‘open’ category and must then comply with either the ‘specific’ or the ‘certified’ category conditions, depending on the level of the risk. If the operations falls in the ‘specific’ categories, the drone operators has several possibilities:

First, to carry out a full operational risk assessment (Specific Operation Risk Assessment (SORA)) on which basis the competent authority may grant an operational authorisation.

Secondly, submit an operational declaration of compliance with so-called European ‘standard scenarios’ (as defined in Annexes of Regulation 2019/947) to the competent authority. Such a declaration to the competent authority must contain:

- administrative information about the drone operator;
- a statement that the operation satisfies the operational requirement of a standard scenario;
- the commitment of the drone operator to comply with the relevant mitigation measures;
- confirmation by the drone operator that an appropriate insurance cover will be in place, if required by Union or national law.

Once the competent authority has confirmed receipt of a complete declaration, the operation may take place.

Thirdly, a light UAS (Unmanned Aircraft System) operator certificate (LUC) which gives the privilege to the Drone operator to start operations without requiring a prior authorisation.

In the situation where an operator intends for the operation to take place partially or entirely in the airspace of a Member State other than the one of registration, the drone operator must provide the competent authority of the Member State of the intended operation with an application including: (1) a copy of the operational authorisation granted (in the initial Member State); and (2) the location(s) of the intended operation and eventual mitigation measures.

The competent authority of the sought Member State will assess the intended operation and operational authorisation granted by the initial Member State and can then provide confirmation that the operation may be undertaken.

In the event where a declaration of compliance has been made to another competent authority than the one of the member state where the operation would take place, then the operator provides the competent authority of the member state of the intended operation with a copy thereof, as well as a copy of the confirmation of receipt and completeness.

4.2.2.3 4.2.2.3 ‘Certified’ category

The ‘certified’ category of operations presents the highest risk and therefore are subject to stricter safety requirements and conditions in order to ensure the highest level of safety which require the certification of the drone and the certification of the operator, as well as – where applicable – the licensing of the remote pilot.

These conditions are applicable as soon as the operation is conducted in any of the following conditions:

- over assemblies of people;
- involving the transport of people;

- involving the carriage of dangerous goods, that may result in high risk for third parties in case of accident;
- Or if the drone has a characteristic dimension of 3 metre or more so as to mitigate the risks for third parties in case of accident.

This category should allow a development of a whole new market called Innovative Air Mobility (IAM) (international, regional and Urban Air Mobility (UAM)) to emerge with a use of new types of vehicles, including drones. IAM would represent a major development for the transport of freight and people, particularly within or out of urban environments that can contribute to reduce emissions and increase road safety, while providing new services to all communities.

4.2.3 Adoption of a regulatory framework for the provision of U-space services

Fulfilling one of the policy objectives set in the Sustainable and Smart Mobily Strategy, the Commission adopted on 6 April 2021 an initial regulatory framework for U-Space, consisting of three Implementing Regulations (EU) 2021/664, (EU) 2021/665 and (EU) 2021/666²⁹. The U-space framework, which will be applicable as from 26 January 2023, will ensure the scaling up of routine drone operations in designated geographical zones while ensuring the safety of both people on the ground and traditional users of the airspace.

It introduces new services for drone operators, allowing them to carry out more complex and longer-distance operations, particularly in congested, low-level airspace (below 120m), and when out of sight. The three U-space regulations cover the roles and responsibilities of the various entities involved in the definition of U-space, the provision of U-space services, and the minimum necessary services required for manned and unmanned aircraft to operate within the U-space.

The intent of the U-space regulations is to ensure that any drone operator planning flights in U-space is required to subscribe to one of the U-space service providers (USSPs). Flights may only be performed after a flight authorisation has been requested and issued. The three main (new) actors from a transaction perspective are: the drone operators willing to provide a drone service to a customer; the USSP (enabling the drone operation); and finally, the Common Information Service. Peripheral actors include Air Navigation Service Providers (ANSPs) who will continue to provide air navigation services for manned aircraft, while USSPs provide U-space services for drones. ANSPs must collaborate with USSPs (on a price for service basis) to ensure flight authorisations are coordinated and to exchange information about the airspace designations. Member States have full authority on the designation of U-space and decide how their airspace should be accessed and restricted. In addition to the four baseline services required by the U-space regulation, Member States can require USSPs to provide additional U-space services to support safe and efficient drone operations.

²⁹ Commission Implementing Regulation (EU) 2021/664 of 22 April 2021 on a regulatory framework for the U-space (OJ L 139, 23.4.2021, p. 161)

Commission Implementing Regulation (EU) 2021/665 of 22 April 2021 amending Implementing Regulation (EU) 2017/373 as regards requirements for providers of air traffic management/air navigation services and other air traffic management network functions in the U-space airspace designated in controlled airspace (OJ L 139, 23.4.2021, p. 184).

Commission Implementing Regulation (EU) 2021/666 of 22 April 2021 amending Regulation (EU) No 923/2012 as regards requirements for manned aviation operating in U-space airspace (OJ L 139, 23.4.2021, p. 187)

4.3 Research & Innovation on drones and related systems

A large number of collaborative research and innovation projects addressing drones and Innovative Air Mobility, as disruptive fields of aviation, have been funded at EU level through various Commission research and innovation frameworks:

- **Horizon 2020**, which was the EU's research and innovation funding programme from 2014-2020 with a budget of nearly €80 billion. It included specific topics³⁰ that funded transnational research projects researching, developing and testing drones for specific capabilities, from transport to civil protection to law enforcement and border management.
- **Horizon Europe**³¹, which succeeded Horizon 2020 and is EU's key funding programme for research and innovation for 2021-2027 with a budget of €95.5 billion.
- **Connecting Europe Facility for Transport**, which is supporting investments in building new transport infrastructure in Europe or rehabilitating and upgrading the existing ones. Between 2021 and 2027 the European Climate, Infrastructure and Environment Executive Agency will manage €25.81 billion to support transport infrastructure projects throughout the EU and beyond.
- **The European Defence Industrial Development Programme (EDIDP)**, which, with a financial envelope of €500 million for 2019-2020, was the first ever EU grant programme targeting capability development and co-financing the joint development of (new and upgrading of existing) defence products and technologies. EDIDP was one of precursor programmes of the European Defence Fund.
- **The European Defence Fund (EDF)**, which, with a budget of close to €8 billion for 2021-2027, promotes cooperation among companies and research actors of all sizes and geographic origin in the Union, in research and development of state-of-the-art and interoperable defence technology and equipment.

Those projects addressing drones, including Innovative Air Mobility, are advancing the state of the art in multidisciplinary areas such as autonomous flights for transport monitoring, aerial means for search and rescue, and automated electric mobility. They are developing new know-how and are testing innovative solutions that help to make transport safer, more resilient and more environmentally friendly.

Public concerns about drones and IAM are also addressed. Research and innovation helps drones and IAM not only to become more safe and secure, quiet, and green but also more accessible, affordable, and acceptable by the public.

4.3.1 Single European Sky ATM Research (SESAR)

In 2017, the European Commission mandated the SESAR JU to coordinate all research and development activities related to U-space and drone integration. In 2017, the SESAR JU published the U-space Blueprint, setting out the vision and steps for the progressive deployment of U-space services from foundation services to fully-integrated operations. This was followed by the 2020 edition of the European ATM Master Plan, which incorporated a drone roadmap.

³⁰ See for example research and innovation under the EU civil security innovation and security research programme: https://home-affairs.ec.europa.eu/policies/internal-security/innovation-and-security-research_en#:~:text=EU%20security%20research%20is%20one,anticipating%20tomorrow's%20threats

³¹ https://ec.europa.eu/info/funding-tenders/find-funding/eu-funding-programmes/horizon-europe_en

In 2017 and 2018, the SESAR JU launched 19 exploratory research projects and demonstration projects aimed at researching the range of services and technological capabilities needed to make U-space a reality. The projects brought together some 25 European airports, 25 air navigation service providers, 11 universities, more than 65 start-ups and businesses, as well as 800 experts, working in close cooperation with standardisation and regulatory bodies, including EUROCAE and EASA.

In the Horizon 2020 framework, the EU has invested €44 million into research and development through SESAR JU, namely €9 million for “exploratory research”, €30 million for “industrial R&D” and €5 million for “very large demonstrators”. Overall, by the start of 2018, the EU had provided grants for more than €400 million to drone related projects (covering both civil and military projects), 90% of which correspond to the 7th Framework and Horizon 2020 Programmes³².

In May 2019, SESAR JU launched an open call for exploratory projects within the framework of the SESAR 2020 research and innovation programme. The call covered a wide range of topics and aims at fostering new and innovative ideas to transform air traffic management in Europe.

The SESAR 3 JU was set up in 2021 to build on the work and achievements of earlier SESAR research and innovation programmes (SESAR 1 and SESAR 2020) and accelerate the market uptake of innovative solutions through a portfolio of demonstrators and a fast-track mechanism.

It is co-funded by the European Union through the Horizon Europe research and innovation programme and industry as follows:

- Horizon Europe - EUR 600 million
- Eurocontrol – up to EUR 500 million (in-kind and financial contributions)
- Industry - EUR 500 million minimum (in-kind and financial contributions)

In addition, the Digital European Sky programme will benefit from funding for its demonstrators from the Connecting Europe Facility (in coordination with CINEA) to the value of at least EUR 200 million.

4.3.2 European Climate, Infrastructure and Environment Executive Agency (CINEA)

CINEA also managed a cluster of drone and IAM projects under the EU Research and Innovation programme Horizon 2020, combining several aeronautical disciplines together with cross-cutting areas to test and advance the pre-deployment of drones and new urban air vehicles in very different environments³³. This comprehensive approach includes the efficient integration with urban infrastructures, with energy and communication networks and with other transport modes.

In addition to the Horizon 2020 and Horizon Europe programmes, CINEA also implements other key EU programmes such as the Connecting Europe Facility (CEF) for deployment of infrastructures, including for transport at large and air traffic management (ATM). In close cooperation with the SESAR Joint Undertaking, a call for proposals was launched under CEF in 2021, containing provisions for a series of Digital European Sky Demonstrators. The future demonstrators are a key tool to support the vision of delivering the Digital European Sky. A total

³² https://ec.europa.eu/info/research-and-innovation/funding/funding-opportunities/funding-programmes-and-open-calls/horizon-2020_en

³³ https://cinea.ec.europa.eu/publications/drones-and-sustainable-urban-air-mobility-uam_en

budget of EUR 60 million is earmarked for the future demonstrators, which are expected to be launched in 2022 and to run until 2025.

One of the CEF Digital European Sky topics is “U-space and urban air mobility”. To unlock the potential of the drone economy and enable urban air mobility (UAM) on a wide scale, a new air traffic management framework for low-altitude operations needs to be put in place. Known as U-space, the framework foresees a set of new services relying on a high level of digitalisation and automation of functions and specific procedures designed to support safe, efficient and secure access to airspace for large numbers of drones. As such, U-space is an enabling framework designed to facilitate any kind of routine mission, in all classes of airspace and all types of environments - even the most congested.

4.3.3 European defence research and innovation

Drones have been actively used in the defence sector over the last decades as well. The Commission launched in 2016 the European Medium Altitude Long Endurance Remotely Piloted Aircraft System (MALE RPAS) programme to ensure EU’s sovereignty in the field of Intelligence, Surveillance, Target Acquisition and Reconnaissance (ISTAR) and to foster the European Defence Technological and Industrial Base (EDTIB). As part of the direct award project within the European defence industrial development (EDIDP)³⁴ work programme, this project led by four European entities (Airbus Defence and Space, Leonardo and Dassault industrial partners), received an EU contribution of €100 million for a total cost of €300 million.

The European Defence Fund, for which the EDIDP was a predecessor, is a powerful instrument to boost industrial Defence cooperation throughout Europe and increase EU’s technological edge and develop the capabilities that are key for the strategic autonomy and resilience of the Union.

EDIDP had a budget of €500 million for 2019-2020, to be compared to the €8 billion from the EU budget dedicated to the European Defence Fund for 2021-2027. This means that the EU will become one of the top 3 defence research investors in the world.

4-8% of this budget will be set aside to support innovative disruptive technologies for defence that will boost Europe’s long-term technological leadership and contribute to high-end defence products. One category of actions considered is called “Digital Transformation” and includes calls and topics related to unmanned aircraft.

Coherence with other EU initiatives is key and the Action Plan on synergies between civil, defence and space industries complements the European Defence Fund with the aim to avoid unnecessary duplication, enhance complementarity and ensure cross-fertilisation between civil, security and defence.

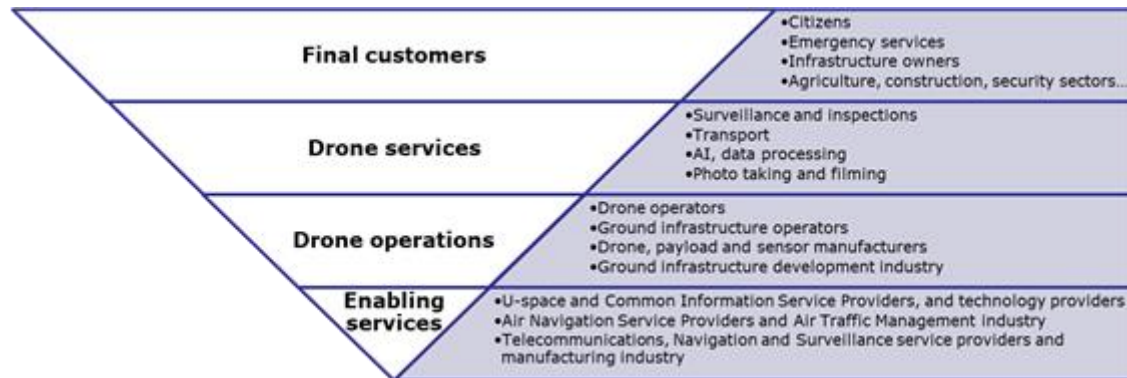
The emergence of new types of platforms, from micro drones to larger drones, as well as the current development of MALE, offer an opportunity to foster synergies with sustainable and smart mobility objectives, improve the competitiveness of European industry and strengthen Europe’s strategic autonomy in this key technical domain. This also represents an excellent opportunity for civil-military cooperation since many of the technological building blocks building up these systems, such as Detect and Avoid, autonomy, datalinks, electro-optical sensors and other payloads are paradigmatic cases of dual-use enabling technologies, which ideally should also have European origins.

³⁴ The European Defence Industrial Development Programme (EDIDP) was a two-year programme (2019- 2020) of the European Commission aiming at supporting the joint development of defence technologies and products.

5 PRESENTATION OF THE EU DRONE ECO-SYSTEM TODAY

5.1 The elements of the eco-system

The Drone Value Chain includes many actors which are coming from the transport sector and beyond. To present the drone value chain, distinctions should be made between the systems/products put in place to enable drones to operate safely and securely; and the services (or groups of services) that drones can deliver to the end-customers, as presented in the figure below:



The drone eco-system

In more details, the B2B drone value chain includes several segments which are all interlinked:

- Drone operators (service provider) performing Innovative Aerial Services;
- IAM operators offering innovative transport services;
- Drone manufacturers which produce the hardware. This activity may also include the assembly of some components produced by third parties;
- Producers of other payloads to be integrated to the drones, e.g., for filming, inspection, cargo, monitoring or measuring purposes;
- Technology providers for the platform who develop equipment and software systems whether for communication, control of the flight, situational awareness, or to enable specific or autonomous operations);
- Distributors selling or renting finished drone to third companies;
- Ground infrastructure operators such as vertiports and airports;
- Air traffic management suppliers (e.g. ANSPs, U-space service providers, Common Information Service Providers);
- Telecommunication infrastructure providers, as well as navigation and surveillance infrastructure providers.

These actors are grouped in the following drone market segments:

- Drone services market: primarily service providers and customers. The drone services market facilitates access to all industries as the final customer and eventually provides most societal value. For example: by safely operating drones for data gathering or inspections, data is delivered into value chains in sectors like agriculture, construction, security, etc., where it can be processed and analysed for specific purposes. The key point is: the drone is a data gathering instrument in a longer value chain that includes other technological applications to make best use of the data collected.
- Drone operations market: primarily drone technology developers and drone users/pilots. The drone operations market is the tool to deliver transport for passengers or cargo as well as to deliver drone services where the drone becomes a link in a full value chain.

- Enabling services and infrastructure market: primarily associated with the implementation of U-space services, and enabling service/infrastructure providers. The enabler for automated longer distance, scalable drone operations and drone services. This enabler should be as cost-effective as possible, while providing fair access to airspace for a diversity of drone operators from across the EU.

Each individual link of the value chain needs in principle to be competitive to allow access by all industries potentially benefitting from drone operations and services, as well as final customers, and ultimately to provide societal value.

5.2 Drone services offered today

As introduced in section 2, drone operations can be classified in two main groups:

- (1) Aerial Operations - in this case, drones are used as daily tools in ever broadening fields such as inspection (pipe line, rail, windmill maintenance), agriculture, mapping, architecture, constructions, real estate, energy, environment and public safety (firefighting, search and rescue, border patrol, local law enforcement);
- (2) Innovative Air Mobility – where drones and electric Vertical Take Off and Landing aircraft (eVTOL) are used for the transport of people and cargo.

5.2.1 Aerial operations

The drone services market related to aerial operations is well established and includes the following mature use cases, with a confirmed or very short term expected commercial viability:

- Data collection, for example: aerial photography and data collection for scientific research;
- Surveillance, providing aerial security and monitoring;
- Surveying, inspection and maintenance, for example: improving urban planning; measuring building energy efficiency, allowing servicing of infrastructure in particular in environments where safety is a concern;
- Entertainment or advertising, for example: using a drone swarm to replace fireworks displays.

This is by no means an exhaustive list and other use cases are developing rapidly and are expected to become commercially viable with 2 to 5 years, for instance:

- Precision agriculture: monitoring of crops, spraying, environmental protection, planting, etc;
- Emergency and other public services, including police, firefighting as well as natural disaster response.

5.2.2 Innovative air mobility

Innovative Air Mobility covers use cases related to the transport of goods and people. Those use cases show considerably less maturity and longer term expected commercial viability compared to most aerial operations.

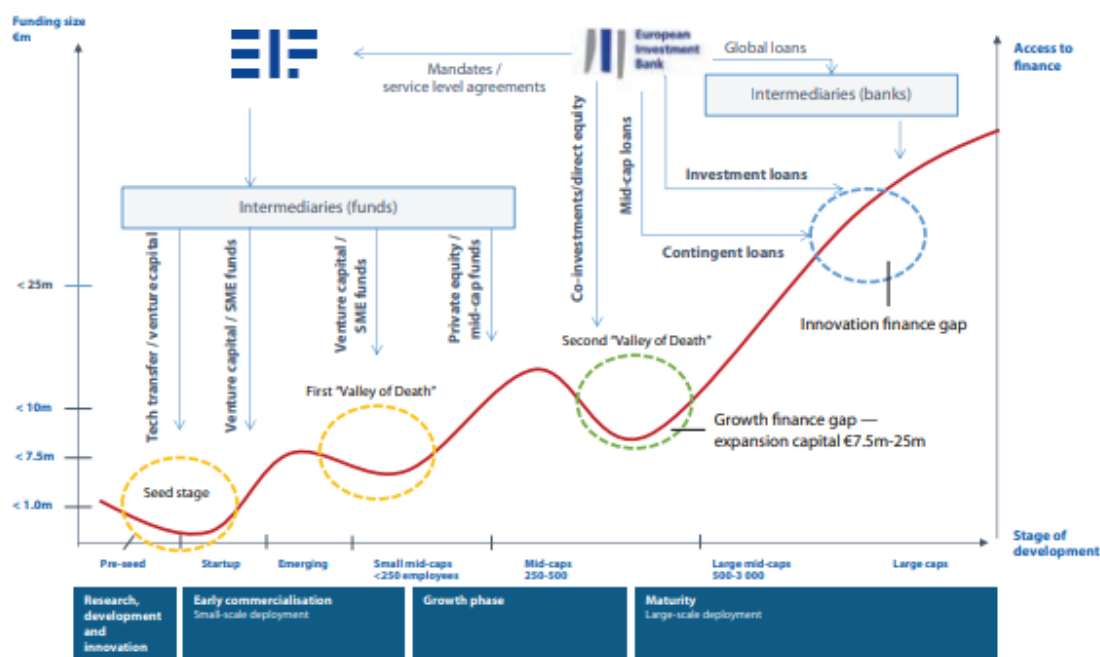
Indeed, we are at the dawn of small parcel delivery services by drone, with pioneer implementations existing in Europe (e.g. “Manna” drone delivery service near Dublin, Ireland, or “Wing” drone delivery service near Helsinki, Finland), and medical transport is also developing fast (transport of medical samples between hospitals and laboratories, delivery of prescriptions to remote areas...). However, operations related to the transport of people – or heavier cargo - have yet to materialise.

High noise levels, lack of helipads availability and high operational costs can explain the lack of success of passenger transport by helicopter so far. Recently though, the interest in Urban Air Mobility has been reinforced by the development of small, electrically powered Vertical Take-Off and Landing (eVTOLs) aircraft. An eVTOL aircraft is a type of manned or unmanned aircraft that uses electric power to hover, take-off and land vertically, without the use or need for a runway. In an initial phase, these vehicles will have a qualified pilot on board. In a later stage, it will then be possible to have the drone remotely piloted (from the ground) or even proceed to fully automated flights (remove the pilot on board or on the ground).

Passenger drones may be used within large and sprawling urban areas as part of a new Urban Air Mobility approach, or to connect cities with regions that are either difficult to access by surface transport or lack the infrastructure or scale necessary to support traditional forms of aviation. Although the capabilities of these aircraft have been improved significantly, there are still performance issues that need to be addressed, linked for example to the batteries and range limitations, as well as social acceptance. Furthermore, their financial viability also depends on several conditions like the targeted level of safety, the fact that the first phase of commercial operations will be carried out with a pilot on board, initial higher costs related to the OEMs production and maintenance, traffic management and operational constraints related to social acceptance and which are examined in Chapter 8 below.

5.3 Drones as an emerging sector of the economy

The EIB monitors the evolution of the drone sector in particular for Urban Air mobility and U-space and provides funding and technical assistance including for infrastructures that will enable drone operations. However, as found by the EIB, most private sector entities in the drone ecosystem are small scale and some are yet without a robust business plan in place to achieve commercial operations. There is a reliance on central funds, grants and venture capital to invest in research and development projects. All of this suggests a need to mature the industry capability rapidly, which requires having funding and financing mechanisms available to suit each part of the cycle and avoid falling into the first ‘valley of death’, as shown in the Figure below:



(Source: European Investment Bank)

Financial cycle of a business

The European Investment Bank Guide to Finance for Drone Projects maps out the advisory and financial products that can potentially be used to support investments in drones, depending on the area of investment and the maturity of the market.³⁵ The EIB itself identified a lack of products covering vehicles, associated technologies and enablers and maintenance during the early commercialisation stage. These areas might be covered by venture capital activities.

Venture capital is more abundant outside of Europe, with the US leading the world in drone venture capital investment. The majority of investments are focused on drone operations (e.g. drone hardware) rather than enabling systems and end services.³⁶ There is an incentive for European start-ups to move to the US to seek venture capital funding for their projects.³⁷ Europe also lags behind both the US and China in total investment in drone services and number of vehicles respectively. A constraint faced worldwide is that investment in this immature industry is a high risk and long-term horizon investment. The projected development of the drone market in the future suggests profitability in various applications by 2040, but timescales remain imprecise and perhaps speculative. The main issue is the lack of established business models for drone services, which means any business who wants to invest in drone services needs to be willing to sustain losses for a relatively long amount of time while the market matures³⁸.

6 THE POTENTIAL BENEFITS OF A VIABLE DRONE ECO-SYSTEM IN EUROPE

6.1 Growth and Jobs

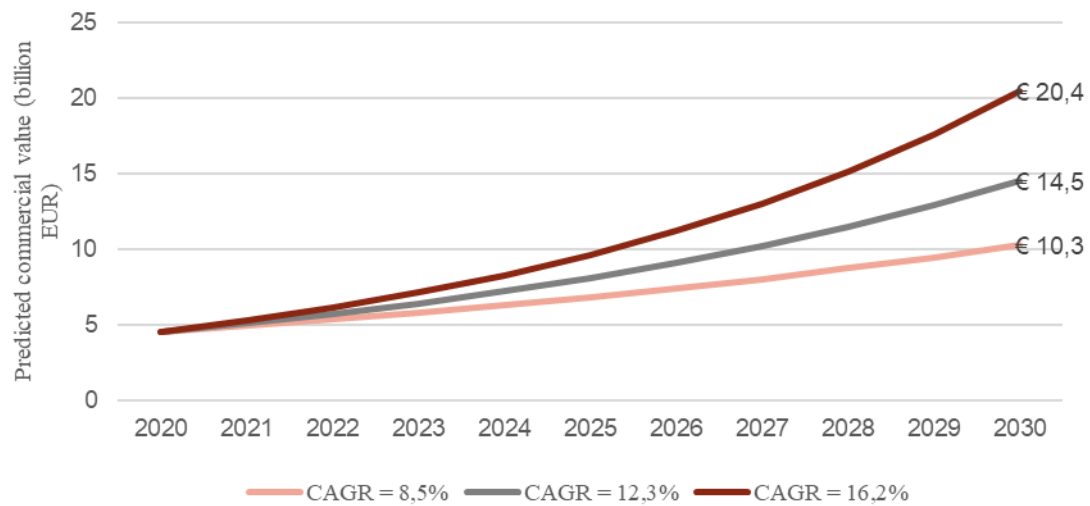
There is a variety of studies on the current and future expected market size of the drone market. Based on an analysis of the available studies and forecast, the estimated amount of the commercial value of drones in 2030 ranges between € 10,3 billion and € 20,4 billion, with the most likely outcome being € 14,5 billion, with an associated CAGR of 12.3%, as presented in the figure below:

³⁵ https://www.eib.org/attachments/publications/eib_guide_to_finance_for_drone_projects_en.pdf.

³⁶ McKinsey estimated in 2017 that start-ups had attracted more than \$3 billion in funding to explore drone applications. About half of the investment was aimed at vehicle development: <https://www.mckinsey.com/industries/travel-logistics-and-infrastructure/our-insights/commercial-drones-are-here-the-future-of-unmanned-aerial-systems>.

³⁷ See for example German start-up Lilium, which is aiming to offer a UAM service in New York by 2025.

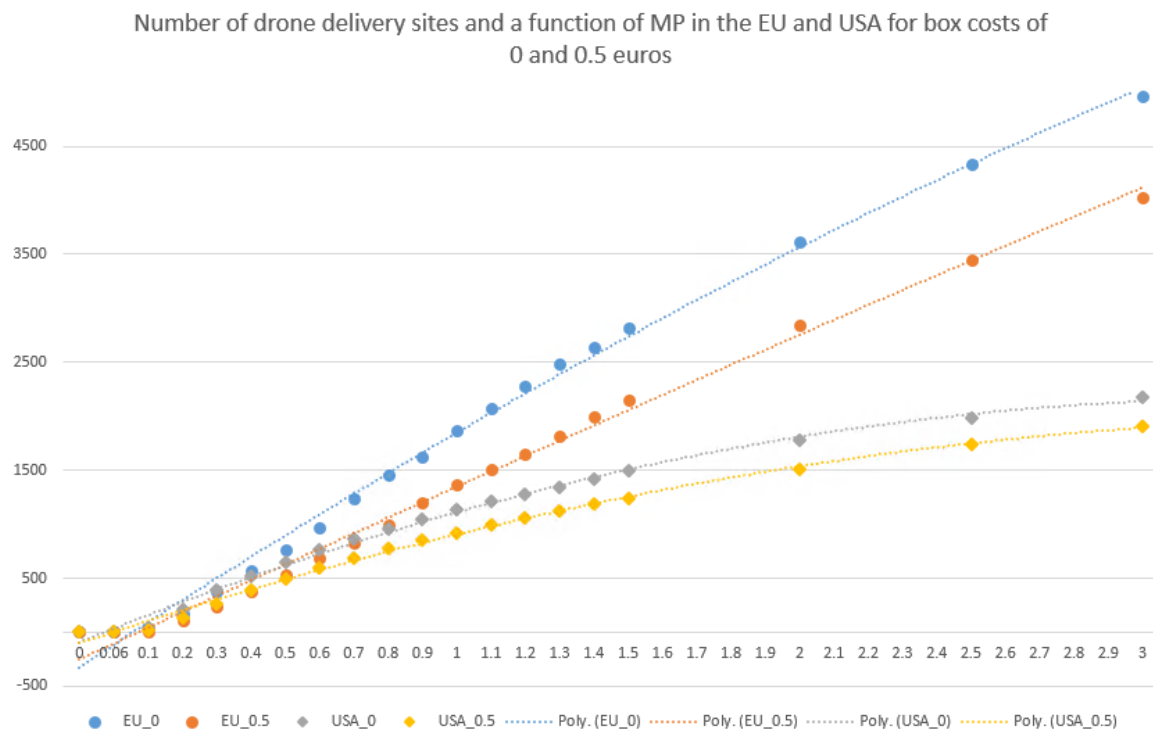
³⁸ See for example Wing, which has successfully implemented drone deliveries in Helsinki, but relies predominantly on finances from the large multinational parent company Alphabet who generally has a high technology risk appetite.



Source: Drone Strategy 2.0 Fact-Finding Study, Ecorys

Estimated commercial value of drones (in EUR billion) in Europe

Furthermore, a recent study by the JRC³⁹, currently being updated to include more scenarios and to compare the EU situation with the US one, has shown that the existing land-use patterns in the EU can ensure financial viability of drone delivery services in most cities. In addition, as shown in the next figure, the research shows that as soon as the demand for freight deliveries by drones increases, the number of financially viable drone “nests” in the EU could be substantially higher than in the US (due to the land-use pattern of EU cities) thus representing a potentially more interesting market:



Number of estimated economically viable drone delivery nests as a function of Market Penetration (MP) for EU and US for a box cost of 0 and 0.5 euro.

³⁹ <https://etr.springeropen.com/articles/10.1186/s12544-019-0368-2>

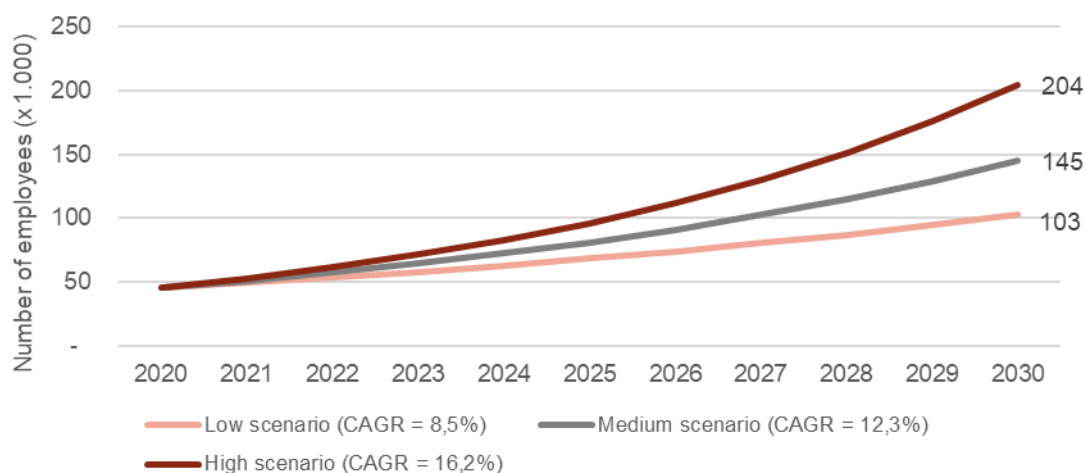
In general drone services are providing automated solutions, which have an impact on employment. These effects could work both ways (negative or positive) and likely in parallel. According to a recent study by the International Transport Forum (ITF), drones will increase productivity in some sectors. Businesses may also replace human centric tasks using other justifications, for example safety benefits associated with inspection of dangerous infrastructure. In practice a combination of both people and drones will likely be used over the short to medium term. As with all technological changes in the workplace, learning or reskilling programs would facilitate transitions in the labour market. Apart from employment effects related to the changing business models, drones could also create new tasks.

Predictions with varying geographic scale and timelines are available for the potential number of operational drones show:

- A current baseline (2020) of between 100,000 – 200,000 commercial drones in use in Europe;
- A commercial drone fleet of between 400,000 – 800,000 in Europe in 2030 (with higher probability that it is closer to the lower bound).

According to SESAR (2016), there is substantial job creation expected (such as localised operations, pilots, insurers and others). One might expect a large opportunity for jobs in the software development/automation and telecommunications /data industries. In total, the sector is conservatively expected to create roughly 100.000 direct jobs. When including wider employment effects (so called indirect effects), the total number of jobs at a European level rises to between 250.000 and 400.000 jobs towards 2035.⁴⁰

To provide an idea of the potential number of jobs in the EU in 2030 the support study took the employee productivity figure used by SESAR JU in their drone outlook study and scaled it based on updated market predictions. The figure applied is 100.000 euro per employee. The study has determined a low, medium and high scenario, which have a similar growth rate as the market value predictions. In the medium scenario, the total number of direct employees is estimated at around 145.000 in Europe in 2030. The results are presented visually in the Figure below:



Source: Drone Strategy 2.0 Fact-Finding Study, Ecorys

Estimated number of (direct) employees in Europe (x 1.000 employees)

⁴⁰ SESAR JU (2016), European Drones Outlook Study.

Indirect effects are retrieved from macroeconomic multipliers produced by the OECD⁴¹. The relevant multipliers from sectors such as computer related activities, electrical machinery, etc. range between 1.9 and 3.0. The multipliers provide a simple method for determining indirect employment impacts based solely on the expected level of direct employment impacts. Using these multipliers the external study suggests that the total employment impact of the drone industry (direct and indirect) should range between 200.000 to 600.000 additional employees in 2030.

6.2 Decarbonisation and circular economy

6.2.1 Decarbonisation

Decarbonising transport remains one of the major challenges ahead in order to mitigate climate change. Globally, roughly 25% of the greenhouse gas (GHG) emissions are emitted by fuel combustion from transport. And as of today, the sector remains dependent on oil for 92% of its energy demand.⁴²

In the EU, transport emissions represent around 25% of the EU's total greenhouse gas emissions. A clear path is needed to achieve a 90% reduction in transport-related greenhouse gas emissions by 2050, in line with the European Green Deal objectives. Although emissions reduction is possible across almost all drone use cases, the emissions reduction potential is mostly associated with logistics and passenger transport.

A number of drone applications are powered through electric propulsion (and other emerging technologies) providing a decarbonised alternative to current modes of transport and therefore supporting the Paris Agreement and the European Green Deal objectives to achieve net zero emissions. Drones have the potential to contribute to the decarbonisation and modernisation of the transport and mobility system, addressing its negative impact on the environment and improving the safety and health of European citizens.

However, while drones are emission free the production of electricity may generate emissions. Most drones are powered by electricity and produce zero tailpipe emissions creating no direct (scope 1) greenhouse gas emissions, as combustion engine drones will likely not be used in the future. This means they can immediately contribute to reduce net greenhouse gas emissions. All drones will consume energy creating indirect (scope 2) emissions. The amount of energy used and subsequently the amount of scope 2 emissions will depend on the design of the drone, its payload, the energy mix used for electricity production, and the method of electricity transmission to the battery. The production and scrapping of drones at the end of their lifespan will also consume energy and produce indirect (scope 3) emissions. The net emissions of drones compared to traditional modes of transport will depend on the specific use case, the local context and the source of energy supply.

Given the forecasted fast drone development in the future, the environmental impact of drones must be given high consideration and requires further research. Expected environmental impacts will especially arise from the manufacturing, the utilization, and the waste streams of drone

⁴¹ OECD STAN Database for Structural Analysis (ISIC Rev. 4): For selected industries factor is determined by division of "Production (gross output)" by "Number of persons engaged (total employment)".

⁴² International Transport Forum (2021), Ready for Take-Off? Integrating Drones into the Transport System.

products and of the related infrastructure as well as by the development of drone operations in metropolitan areas, which will entail the development of suitable network of vertiports.

Drones have the potential to reduce energy use especially if sustainable use of batteries is mandated. Transport-related CO₂ and other emissions could be reduced (e.g. last mile transport for low weight goods when energy comes from sustainable sources) in comparison to traditional modes of transport. On the other hand, there is clearly a debate about negative externalities⁴³ that might be realised with the further scaling of drone activity (such as noise related impacts).⁴⁴ These environmental impacts on noise, air pollution and wildlife are further addressed in chapter 8.1.4 below.

The potential emissions reduction for drone delivery were estimated in the support study by means of a “quick scan” analysis. The following methodological steps were taken to determine the potential emissions reduction for goods delivery:

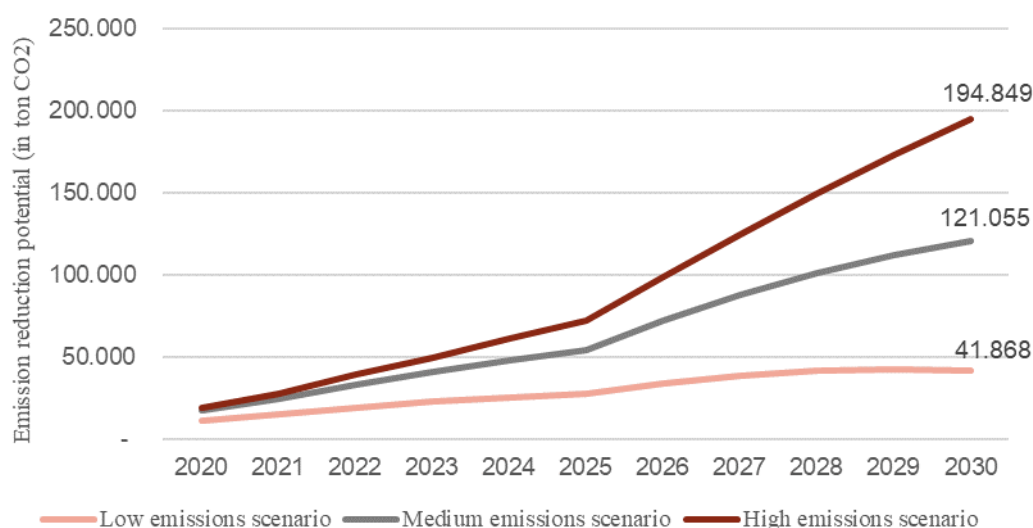
- Step 1: Determining the commercial value of good delivery services and share of goods delivery within the estimated economic value of the European drone industry;
- Step 2: The added value (expressed in euro p. eVTOL unit) of delivery drones is estimated;
- Step 3: Assessing the number of delivery drones towards 2030;
- Step 4: Estimating the number of potential drone deliveries and freight potential by assuming the average productivity of delivery drones;
- Step 5: Retrieving the emissions key figures from existing literature;
- Step 6: Providing an estimated bandwidth of the potential emissions reduction from drone delivery services by determining the expected modal shift (e.g. electric van, diesel van, cargo bike and drone).

By replacing cargo deliveries and last-mile express deliveries from traditional means of transport to drone services, the emissions reduction potential is estimated at around 120,000 ton CO₂ in 2030 in Europe. The results (and bandwidths associated with the analysis) are presented in the figure below.

⁴³ Externalities occur when producing or consuming a good cause an impact on third parties not directly related to the transaction.

⁴⁴ International Transport Forum (2021).

(Source: Ecorys)



Source: Drone Strategy 2.0 Fact-Finding Study, Ecorys

Potential emission reduction for drone deliveries (in ton CO2)

Several scientific studies in the field of the impact on the level of CO2 emissions from drone deliveries have been performed. Besides the impact in the drone delivery domain, there is also impact on decarbonisation expected in other applications and sectors. For example, drones might be used instead of high emissions vehicles in some agricultural practices such as spraying or planting. The findings from several studies (non-limitative) can be briefly described as follows:

- Park, J., Kim, S., & Suh, K. (2018)⁴⁵ studied the environmental impact of drones compared to motorcycle delivery and differentiating between urban and rural areas. The results showed that global warming potential (GWP) per 1 km delivery by drone was one-sixth of a motorcycle delivery. In addition, the particulates produced by drone delivery were half that of motorcycle delivery. The researchers conclude that the actual environmental impact reduction in case of delivery distance was 13 times higher in a rural area than in an urban area. When increasing the use of environmentally friendly electricity systems, for instance solar and wind power, this could further enhance the environmental effects of a drone delivery system.
- Borghetti, et al (2022)⁴⁶ investigated the viability of last-mile delivery drones in Milan, where they used stated preference survey and financial analysis. Findings show a high propensity by end users to use last-mile delivery by drones can be successfully used to deliver small and light packages, reducing environmental and social impacts, and ensuring profits for the transport provider. In light of the financial viability of last-mile delivery drones, they could be a solution to reduce traffic congestion and CO2 emissions.
- WING investigated – by means of ex-ante and ex-post studies – the effects of drone deliveries to society. One of these studies are performed by Gaia Consulting Oy⁴⁷, which studied the potential benefits of drone deliveries in Finland. The benefits are expressed for

⁴⁵ Park, J., Kim, S., & Suh, K. (2018). A comparative analysis of the environmental benefits of drone-based delivery services in urban and rural areas. *Sustainability*, 10(3), 888.

⁴⁶ Borghetti, F., Caballini, C., Carboni, A., Grossato, G., Maja, R., & Barabino, B. (2022). The Use of Drones for Last-Mile Delivery: A Numerical Case Study in Milan, Italy. *Sustainability*, 14(3), 1766.

⁴⁷ Gaia Consulting Oy (2021), Potential Benefits of Drone Deliveries in Helsinki.

local businesses, consumers and society. Societal benefits are expressed via the reduction of vehicle kilometers travelled by road (equal to a reduction of 11 million km); reducing CO₂ emissions (reduction of 2.000 t CO₂); reducing road accidents (38 less road accidents). For local businesses and consumers, the benefits are linked to lower delivery costs (45% lower costs) and the connectivity (expressed via delivery reach and product variety).

6.2.2 Circular economy

The development of a drone value chain should also give careful consideration to circular economy aspects. The risks associated to the lack of raw materials are concrete and the EU cannot accept being dependent on external support for the implementation of this key technology. On the other hand, this issue may represent a significant opportunity for the European industry for developing the drone industry, building competitive advantage on environmental sustainability and Circular Economy. The waste of electronics components must be avoided and the drone's end-of-life opportunities should and could be more effectively and efficiently addressed now at the beginning of the fast-emerging drone sector.

Moreover, when looking at drones we cannot focus only on the airborne segment. To execute their tasks, drones require dedicated ground infrastructures. The same Circular Economy considerations apply to the ground segment as drone operations spread across the territory.

6.3 Digitalisation

The development of Innovative Aerial Services and the digital transformation go hand in hand. Drone technology and its multiple applications are based on a high level of digitalisation and automation, as described below. At the same time, drones can deliver accurate and actionable data to improve operational workflows, streamline processes and contribute to finding digital solutions in a wide variety of use cases, such as agriculture, construction, mining, surveillance, and inspection.

Embracing digital technologies has become essential for many businesses to remain competitive in an ever increasingly interconnected economy. Digital technologies and products have also the potential to lower the environmental footprint of the economy and lead to higher energy and material efficiencies.

The 2030 Digital Compass⁴⁸ identified five key industrial ecosystems for digital transformation:

- Manufacturing;
- Health;
- Construction;
- Agriculture; and
- Mobility.

Out of these, at least four (health, construction, agriculture, and mobility) have the potential to directly benefit from the introduction of aerial operations and innovative air mobility to drive changes in their respective sector, as illustrated by the drone-use cases listed in 5.2. But other ecosystems could also reap benefits from synergies with the technological development brought by drones, in particular in the fields of automation and artificial intelligence.

⁴⁸ 2030 Digital Compass: the European way for the Digital Decade, COM(2021) 118 final, Brussels, 9.3.2021

This digital transformation will not only concern industrial ecosystems but also affect public services, and enable an efficient, holistic, and easy access to public services to all citizens. Here again drone services have the potential to support this transformation by connecting remote communities and ensuring the continuity of public services.

The contribution of drones to the digitalisation of the economy is not limited to drone services provided to industrial and public sectors but extends across the whole drone value chain. Drone operations and enabling services have indeed the potential to be instrumental in the digitalisation of aviation.

First, drone vehicles are catalyst for innovation in aviation. They are not only spurring the electrification of aviation and the development of more sustainable aircraft, but they are also advancing automation and connectivity at an unprecedented speed in air transport.

Autonomous flight technology should enable accurate operations (including detection and avoidance of other vehicles and obstacles) without any involvement of human operations. Also here, the drone operations market is expected to act as a catalyst for the development of aviation, functioning as an enabler of innovation and digitalisation.

The standard SAE J3016 developed for road vehicles⁴⁹ is commonly used as basis when assessing the level of automation within drones. The standard defines six levels from no automation to full automation.

Currently, due to restrictions in permitted level of flight automation, the use of drones still faces limitations. Nevertheless, drones are applied at various levels of autonomy, as illustrated in the figure below. Drones are applied at low automation degree in inspection & maintenance; location & detection; photography and filming, and monitoring. At partial automation degree, drones are used in mapping; spraying & seeding, measuring; and surveying. At degree of conditional automation, drones are used in mapping, delivery and surveying. Initial steps are taken in high automation in the case of photography and filming.

A enabling service such as U-space, the set of digital services and operational procedures designed to support a safe, efficient, and secure access to airspace for large numbers of drones, can be an accelerator of the ATM innovation life cycle, facilitating faster, lower risk adoption of new technologies or approaches (automation, AI, cloud, etc.) in manned aviation.

Such disruptive innovations can reduce innovation cycles from about 30 years that are typical in traditional aviation to about 5-10 years. To achieve this, the development and deployment of the integration of drones into the airspace, and in particular the development and implementation of U-space services, may be used as a ‘laboratory’ that can support faster life cycles in the manned aviation environment, and ultimately the implementation of the digital European sky⁵⁰.

The digital European sky leverages the latest digital technologies to transform Europe’s aviation infrastructure enabling it to handle the future growth and diversity of air traffic safely and efficiently, while minimising environmental impact. In doing so, these technologies enable the system to become more modular and agile, while building resilience to disruptions, traffic growth and diversity of air vehicles⁵¹. Drones, relying on an operations-centric approach and a digitalised system, can be a catalyst towards increased levels of digitalisation of the entire aviation system, currently still relying on a human-centric approach, for example in ATM.

⁴⁹ https://www.sae.org/standards/content/j3016_202104/

⁵⁰ Strategic Research and Innovation Agenda - Digital European Sky, SESAR Joint Undertaking, 2020.

⁵¹ Digital European Sky – Blueprint, SESAR Joint Undertaking, 2020.

7 VISION AND STRATEGIC OBJECTIVES

7.1 Vision

Setting out a vision involves on the civil side to cater for the situation of three different but interlinked markets: Aerial Operations, Innovative Air Mobility and U-Space services as described above. The drone eco-system also includes the defence/military dimension, as both sides stand to benefit from technological synergies.

This vision, developed by the Drone Leaders Group (see A.4) for 2030, can be formulated as follows:

By 2030 drones and their required eco-system will have become an accepted part of the life of EU citizens and Member States.

They will be used to provide numerous services to the benefits of diversified civilian and defence end-users, including EU citizens, organisations, States, and industry. These aerial operations will include emergency services, inspections, and surveillance, using drones as flying Internet of Things (IoT) platforms to gather data, as well as for the delivery of goods.

Innovative Air Mobility (IAM) services will also have started to provide regular people transport services in various European cities and for some regional connections, initially using aircraft with a pilot on board but with the aim to fully automate their operations. Drone services will effectively integrate or complement existing transportation systems and contribute to the decarbonisation of the transport system, while minimising their impact on the environment throughout their life cycle. Urban Air Mobility (UAM) will have started to become a part of the future urban multimodal intelligent mobility ecosystem and the infrastructure enabling these services will be widely deployed and integrated.

A wide spectrum of distinct types of drones and use cases will coexist in the future. The EU legislator, the Commission, the European Union Aviation Safety Agency (EASA) and the Member States all have an institutional responsibility to safeguard the safety, security and efficiency of their operations. They will ensure that all drone services are provided in a manner that ensures safety, security, privacy, and affordability, in line with citizens' expectations and addressing their concerns. Drones used for the transport of people and goods will be particularly oriented to the achievement of publicly accessible services, thus creating benefits for citizens and local communities.

The current U-space regulatory framework will have been completely rolled out in a seamless EU market. Additional advanced U-space services will support large scale highly automated and digitally connected affordable, safe, secure, and environmentally friendly unmanned aircraft operations in several Member States. The integration between manned and unmanned traffic in the same airspace will have been initiated, inside and outside U-space airspace.

The EU drone industry will become viable, and accessible to EU citizens and businesses with an active participation of actors of all sizes, including a variety of diversified SME's, fostering collaboration between all actors, and broadening the spectrum significantly beyond the limited number of global multinational stakeholders.

Civil-defence industry synergies will be systematically identified and exploited. They will benefit both sectors. They will improve the competitiveness of European industry

and strengthen Europe's strategic autonomy, by allowing Member States to rely on competitive UAS technology of European origin.

The drone eco-system thus created will provide jobs, promote, and protect European technological know-how and allow for growth opportunities for the EU economy as a whole, enabling European companies, including new SMEs to grow and flourish as global leaders.

This was the basis for the Commission vision spelled out in the Drone Strategy 2.0 for a Smart and Sustainable Unmanned Aircraft Eco-System in Europe.

7.2 Strategic objectives

As set in the Commission roadmap for the Drone Strategy 2.0⁵², the following elements are part of the strategic objectives of this strategy:

The strategy should foster the uptake of this innovative technology in Europe, while establishing the right balance between safety, security, health protection and other societal concerns, and a sustainable economic environment.

The safety, security, health protection and privacy of people in the air and on the ground remains the priority. In addition, the future policy framework should provide an innovative, cost-efficient and market-led business environment for the development and take-up of new drone services and technologies within the EU's internal market. It should also guarantee their widest possible social acceptance.

The Drone Strategy 2.0 should provide a comprehensive policy package and address obstacles to the development of new drone applications and transport services and to the competitiveness of this industry. As outlined in the Action Plan on synergies between civil, defence and space industries, reaping synergies between the civil, security and defence use of drones and related technologies, including counter-drones' solutions, can be an important success factor.

The ambition of the strategy is therefore to further develop the drone sector, in light of the European Green Deal, Smart and Sustainable Mobility Strategy, Digital Strategy and other Union policies.

7.3 SMART objectives

The Drone Leaders' Group proposed a number of SMART (Specific Measurable Achievable Reasonable Time-bound) objectives to be used to measure progress on achieving the above Vision and the targets to be reached by 2030. In this regard, the Group agreed on the following set of objectives:

- Number of cities/regions that will be served by IAM regular commercial services (Target for 2030: at least 45 in the EU and at least one per Member State)
- Number of Member States where emergency health services (medical samples, defibrillators, air ambulances) will be provided using drones (Target: services used in at least 20 Member States)
- Use of European U-spaces Airspace by commercial drone flight operations (Target: at least 100.000 a day)

⁵² https://ec.europa.eu/info/law/better-regulation/have-your-say/initiatives/13046-A-Drone-strategy-20-for-Europe-to-foster-sustainable-and-smart-mobility_en.

- Number of EU Member States where advanced U-space Services (additional to those defined in the current regulatory framework) are operational in at least one U-space. (Target: at least 6 Member States)
- Number of USSPs designated in each U-space airspace (Target: at least 2)
- Safety level achieved (Target: the ratio between the number of accidents vs the number of drone flights is as low as required for manned aviation)
- Aerodromes falling under the EASA Basic Regulation, cities with over 100.000 inhabitants, and critical infrastructures will have assessed the security risk related to drone incidents and put in place procedures and measures that will protect them from such incidents proactively and reactively (Target: 100%)
- Number of assessments run by the EIB “European Drone Investment - Advisory Platform” and number of loan agreements granted by European Investment Bank (EIB) to drone sector stakeholders (Target: increased percentage respectively of 10%, year on year)
- Carbon emissions of urban and regional IAM operations (Target: 0%)
- The civil and military drone technology used in Europe will be designed and/or produced in Europe (Target: at least 50% of total value of drones used in Europe)
- Number of Universities / Technical Schools that offer drones subjects or specialisations (Target: at least 40 in the EU and one per Member States).
- Turnover in the overall drone eco-system and its contribution to EU GDP (Target: at least € 15 billion)

8 THE ELEMENTS OF A THRIVING EU DRONE ECO-SYSTEM IN 2030

8.1 Building the European drone services market

As mentioned, the drone sector is composed of several different dimensions including State activities (including security, military and rescue-services), non-commercial use (hobby), and commercial activities (including hardware and software developments, maintenance, the provision of infrastructures such as vertiports).

The current EU legal framework already offers many possibilities for the operation of small drones used for recreational or professional purposes. However, the feedback received during the consultation process showed that the current regulatory framework does not sufficiently support the scaling up of commercial drone operations, particularly for some of the most promising use cases. Furthermore, the current framework, for instance, does not allow the transport of people. There is thus a need to define further regulatory requirements, notably in urban areas.

Whilst economic players from across the whole drone industry and beyond are joining forces to develop drone activities, it requires addressing several obstacles to make them become a reality by 2030.

The regulatory dimension is only one aspect of these challenges faced by the Drone sector, which comes across the 10 different areas identified in the Drone Strategy 2.0. The first steps to address them was to define a clear vision. The high-level vision set out above is providing the foundation for the next steps to be taken at EU level to develop a viable drone eco-system in Europe.

8.1.1 Improving airspace capabilities (U-space development and integration with Air Traffic Management)

The provision of air traffic service follows the demand for air transport and other airborne operations. Since the beginning of aviation, this demand has generally seen a pattern of growth. Whenever ATM is not able to deliver capacity where and when it is needed, traffic limitation measures are taken to continue to ensure safety, causing rapid increases in delays and thereby a deterioration in environmental and cost efficiency and the achievement of airspace user needs.

As the drone service market continues to grow and take shape in Europe, the pressure is on to make sure that these air vehicles are safely and securely integrated into our already busy airspace. Transforming infrastructure to support such operations is critical to harnessing the potential of the sector, unlocking market growth, jobs and services to EU citizens. But a simple adaptation of our current air traffic management system is not enough; accommodating these air vehicles in the numbers forecasted required a new approach.

Therefore, to unlock the potential of the drone economy and enable innovative air mobility on a wide scale, a new ATM paradigm was developed to safely cater for a high level of expected low-altitude unmanned operations. This concept, referred to as U-space, includes new digital services and operational procedures and its development had already announced in 2017.

U-space is a set of services and procedures relying on a high level of digitalisation and automation of functions to support safe, efficient and secure access to airspace for large numbers of drones. It provides an enabling framework to support routine drone operations and addresses all types of missions including operations in and around airports.

As mentioned in section 4.2.3 above, the European Commission adopted in 2021 the U-space package - three regulations that together create the conditions necessary for both drones and manned aircraft to operate safely in section of our airspace known as the U-space.

These regulations introduce new services for drone operators, allowing them to carry out more complex and longer-distance operations, particularly in congested airspace, and when out of sight. U-space creates and harmonises the conditions needed for manned and unmanned aircraft to operate safely, to prevent collisions between drones and other aircraft, and to mitigate the risks of drone traffic on the ground.

U-space is expected to provide the means to manage safely and efficiently high-density traffic at low altitudes involving heterogeneous unmanned vehicles, including operations overpopulated areas and within controlled airspace. Ultimately, U-space will have to integrate seamlessly with the ATM system to ensure safe and fair access to airspace for all airspace users, including IAM flights departing from airports.

The current U-space Regulation identifies an initial set of U-space services required to implement an initial U-space environment. In order to enhance U-space deployment to support IAM, it is necessary to continue research and development in accordance with the European ATM Master Plan (MP) vision, and the Roadmaps to achieve this as described in the Strategic Research and Innovation Agenda (SRIA) for the Digital European Sky. The first SESAR 3 JU Digital Sky Demonstrators addressing U-space will focus on direct support for the deployment of initial services, in support of the U-space Regulation. In parallel, research should continue to develop the overall concept of operations for U-space and IAM, both in terms of service definition and in the supporting technologies, in order to deliver more advanced services. This development should be designed to increasingly consider the ATM and U-space environments together so that, by the time the full U-space environment is deployed, the two environments will have become one, fully integrated air environment seamlessly encompassing small drones, IAM, ATM, RPAS and Higher Airspace Operations (HAO).

The introduction of new types of aerial vehicles within the airspace requires ensuring a fully collaborative approach between all actors with the objective of ensuring an efficient interface between U-space and ATM, as well as avoiding airspace fragmentation. An efficient U-space–ATM interface is required to enable an adequate, robust and timely exchange of U-space information services between various U-space stakeholders such as drone and IAM operators, USSPs, ATM service providers, data service providers, aeronautical data providers and authorities. The relevant solutions are expected to have a positive impact on access and equity, enabling seamless ATM / U-space high-density automated and fully digitalised operations managed in close cooperation with UAS/IAM fleet operators.

In a longer term, a fully integrated ATM / U-space CONOPS definition is required to cover seamless operations inside and outside controlled airspace, further defining the interface between ATM and U-space, as well as examining the corresponding information exchange concept and requirements. Information exchange will be critical to enable a safe convergence of U-space and ATM. The possibility of a fully integrated airspace without segregation between U-space and ATM users is the ultimate goal.

A fully integrated ATM / U-space ecosystem without segregation between U-space and ATM operations also requires the setting up of common fundamental enablers. Some of these enablers include the definition of a common altitude reference system (CARS), separation minima, safe operating distances from buildings and fundamental aviation tenets, such as airspace classification.

The need to revise the rules of the air becomes necessary to consider the specificities of unmanned traffic in general, as well as of mixed traffic (unmanned and manned). Such work has been initiated by EASA, as part of the process of establishing a comprehensive set of new regulations to enable operations of UAS in the ‘certified’ category and aircraft with VTOL capability to deploy the potential of the IAM. Systems allowing drones to have a capability to “detect and avoid” (DAA) and/or “sense and avoid” (SAA) other aircraft do not exist yet and EASA objective is to develop them in accordance with a European harmonised set of validated standards adapted to the European airspace and working in all airspace classes. Therefore, there is a need to use strategic and tactical mitigation means offered by the ATM/U-space system in a first phase until these systems are available, provided that the traffic and traffic complexity is such that safe operations can be guaranteed.

Always keeping safety as the primary goal, further work will be required on enablers for automation and autonomy for U-space and IAM. In this framework, a critical aspect of the integration will be the role of humans, particularly regarding the high level of automation that will be delivered by U-space services and the known automation disparity between ATM and U-space. IAM integration in the ATM / U-space ecosystems is also a specific research topic, as well as the challenge of how to support the transition from piloted vehicles to IAM/autonomous operations. Of course, the evolution of the ATM / U-space convergence will need to be synchronised and coordinated with the development of IAM services and the certification of IAM vehicles. Special consideration should be given to the operational limitations of these new vehicles and how U-space and ATM can contribute to their operational safety by protecting their operations in contingency and non-nominal situations.

As research continues in each thread, lessons from one environment should be applied to each of the others such that the final environment is safe, economically viable and environmentally sustainable. This will contribute to making aviation smarter and more sustainable, and delivering the Digital European Sky.

On the topic of Communication, Navigation and Surveillance (CNS), the SRIA of the SESAR3 JU clearly describes the transformation from three separate CNS domains into one integrated CNS (ICNS) environment. This includes all current CNS technologies used for ATM, but also

those needed to support U-space, IAM, RPAS integration and HAO. The research programme, as envisaged in the SRIA, should look to ICNS as the mechanism by which all airspace users can inter-operate safely, while reducing costs and environmental impact through rationalisation and multi-use of existing and developmental technologies. This integration should include technologies from other domains, such as the telecommunications and the space industries, and should address increased connectivity through digital communications as well as the more conventional elements. Research and demonstration under this Action should address both technological issues and the specific performance and certification requirements of all relevant technologies that arise from the evolving U-space and IAM domains.

8.1.2 Facilitating Aerial Operations

As mentioned in Chapter 2 above, the terms “Aerial Operations” refers to the use of new aerial technologies and services provided to customers for other purposes than the transport of people and freight. These small drones equipped with advanced sensors and AI technologies can be deployed in diverse sectors such as construction, railways, ports, agriculture, energy, public safety, security, filming, insurance, real estate, transport of small payload, etc.

Companies’ drone programmes can be either outsourced to third companies offering specialised drone services or partially developed in-house, using leased fully tested material from third company suppliers or finally, they can be fully developed internally. In this case, it may also require buying hardware, software and consulting services at an initial higher cost for their implementation. The aerial operations eco-system is largely composed of Small and Medium Enterprises providing hardware, software and services to commercial drone operators (see description in chapter 5.2.1 above).

Most companies which are developing drone programmes chose to do it internally and to a large extent operations are conducted in visual line of sight. In fact, despite the risk-based operation-centric approach underpinning the development of the regulatory framework for drones, one of the key challenges faced by companies in the commercial drone sector is to be able to build up drone programmes based on fully autonomous drone operations in beyond visual line of sight conditions.

As highlighted in the Communication, one of the missing regulatory elements at a European level is to perform operations at both end of the drone operations’ risk spectrum in the ‘specific’ category. On the one hand, for simple low risks operations in Beyond Line of Sight Operations or Extended Visual Line of Sight, which are not falling under the ‘open’ category and are not yet subject to a European standard scenario, there is a need to develop further European Standard Scenarios. On the other hand, for more risky operations there is a need to develop methodologies and procedural mechanisms which can facilitate the granting of an operational authorisation from the competent authority.

Whenever operations do not fall under the ‘open’ category, drone operators must carry out a risk assessment to determine under which category the operation will fall, ‘specific’ or ‘certified’. Many stakeholders highlighted the complexity of conducting this risk assessment and the fact that the operation approval granting process might be a lengthy one and its outcome uncertain.

This is in particular the case if the level of robustness of any of the operational safety objectives linked with the drone design is considered “medium”, as the national competent authority could in this case require a full design verification of the drone by EASA.

One of the possibilities to facilitate the launching of a low-risk operation in the ‘specific’ category is that the operation falls under a European Standard Scenario as it would suffice for UAS operators to submit an operational declaration of compliance to the competent authority.

The widespread consultations with industry stakeholders highlighted the need to improve some regulatory aspects related to the ‘specific’ category, as pending the development of new European standard scenarios, drone operators have to undertake the SORA in order to receive an authorisation from the competent authority which is perceived to be more cumbersome and may generate some business uncertainty. One of the risks for the drone operator is that the competent authority may reach the conclusion that the operation should be performed under the conditions of the ‘certified’ category instead of the ‘specific’ category, which requires the certification of the aircraft, the operators and the remote pilot as applicable.

As a large part of commercial operations performed by drones are presenting a low to a medium risk, more efforts could be made to facilitate use-cases in the ‘specific’ category of drone operations. Indeed, in some cases, requirements to permit operational authorisations are considered as disproportionate to the level of risks from both an operational and financial point of view. The same also applies to the testing and demonstration of new types of aerial operations for which the requirements are considered as too restrictive. The SORA mitigation requirements to reach Specific Assurance and Integrity Levels (SAIL) category III, even using proven and reliable systems, are difficult to reach without a drone redesign and could be reviewed.

The administrative burden related to the operational authorisation process could be alleviated by developing further European standard Scenarios and pre-defined risk assessments. However, at this stage, only two European Standard Scenarios have been developed. Further developing this regulatory approach will also support the inclusion of Small and Medium Enterprises in the drone operations market. In addition, new European Standard Scenarios could also address specific needs related to State or military operations and maritime surveillance activities.

Consequently, the development of standard scenarios can enable rather complex operations to be safely incorporated in the airspace with a minimum of formalities. At this stage, already two standard scenarios have been adopted⁵³: (1) STS-01 – VLOS over a controlled ground area in a populated environment, and (2) STS-02 – BVLOS with Airspace Observers over a controlled ground area in a sparsely populated environment. Considering that a large part of Aerial Operations are presenting a low to a medium risk, the conditions for the ‘specific’ category of drone operations could be alleviated by developing further European Standard Scenarios and pre-defined risk assessments⁵⁴.

Further, to support the development of urban and higher risk operations in the ‘specific’ category, EASA should review its AMC/GM for the specific category of operations to ensure that design verification requirements, and their application by national competent authorities, are proportionate with the risk of the operations in the ‘specific’ category. Particular attention should be paid to the required scope of the design verification (full drone design, mitigation means and/or enhanced containment functions).

⁵³ Commission Implementing Regulation (EU) 2020/639 of 12 May 2020 amending Implementing Regulation (EU) 2019/947 as regards standard scenarios for operations executed in or beyond the visual line of sight, OJ L 150, 13.5.2020, p. 1.

⁵⁴ European standard scenario (STS) and the pre-defined risk assessment (PDRA) aims to facilitate respectively the declarative and the permit application process by drone operators by ensuring that the risk assessment has already been performed in accordance with the SORA methodology for some low to medium risk operations performed in the ‘Specific category’.

8.1.3 Developing Innovative Air Mobility

Drones are no longer limited to small, electric rotor aircraft commonly used by recreational users or commercially, and have the potential to replace conventional piloted aircraft. eVTOL aircraft in particular have opened a whole new range of possible mobility services to urban and sub-urban local communities. As drone technology has advanced, the identified potential use cases involving manned eVTOLs have rapidly expanded, particularly for public services such as emergency medical transport and evacuation, air taxi or deliveries. In addition to intra-urban or sub urban eVTOL aircraft using vertiports on top of buildings and other dedicated landing pads, there are also fixed wings type of drones which offer longer range connectivity. These operations are falling under the 'certified' category and should be subject to the same safety levels as manned aviation. Therefore, drone operators, remote pilots and drones (including manned VTOL aircraft) should be subject to uniform rules and procedures. The remaining significant technical and safety regulatory gaps which are preventing such 'certified' operations to be performed should be addressed by new regulatory rules addressing the certification of aircraft, as well as the approval of the drone operator and the remote pilot licence by the competent authority.

New aircraft types are coming onto the market with alternative propulsion and new vehicle designs, all increasingly automated and remotely piloted. These have the potential to meet the demand for alternative modes of transportation in large cities or rural area, and the challenge of reducing noise and CO₂ emissions (green propulsion and optimized designs). Urban Aerial Mobility thus offers to local decision-makers the opportunity to rethink their mobility and land development planning by giving their territorial development projects a new orientation, reconvert the existing means of transport and improve the quality of life of their populations.

Several studies estimate that impact of Innovative Air Mobility on overall travelling time, particularly over congested road traffic to be positive. These services can be seen from multiple angles:

- Air taxi services based on a wide network of point-to-point travel often associated with eVTOLs and similar to current road taxis.
- Scheduled air passenger transport following pre-determined routes, regular schedules, and a network of stops throughout the city, complementing existing ground public transport.
- Drones could potentially deliver small payloads faster to the customer (B2C) for example by reducing the number of pickups and thereby save time;

According to studies, in a city like Helsinki, drones for consumers could deliver orders 35 - 75 percent faster, depending on the scenario. The impact on time savings as a result of reduced pickups in this area is estimated at approximately 1.5 million hours. In addition, delivery costs (incurred by service providers) will likely reduce by up to 45 per cent in case of instant deliveries compared to conventional methods of delivery.⁵⁵ This would clearly lead to a reduction in consumer costs for delivered goods.

The addition of aerial mobility in the city's landscape gives urban planning authorities an additional dimension to play with. This opportunity will require new tools, new skills and will open up a new field of decisions to be made, supporting a gradual transformation over a period of at least five to ten years. In the short term, the most useful developments will emerge through gradual homogenic integration as cities continue to modernise themselves, and only in agreement with the local authorities and communities.

⁵⁵ Gaia Consulting Oy (2021), Potential Benefits of Drone Deliveries in Helsinki.

IAM eVTOL operations require some physical infrastructure assets such as vertiports and other landing paths, including embarking and disembarking facilities, such as lockers or other storage facilities, for package deliveries as well as charging stations. Vertiports are a key enabler for the IAM concept and city authorities⁵⁶ are increasingly starting to include drone transport into their urban development plans. Vertiports should be open large multi-landing locations that have support facilities (including charging infrastructure, support personnel, etc.) for multiple eVTOL companies. A regulatory framework for vertiports and other ground infrastructure should be developed, and a particular attention should be given to ensure appropriate interface with aerodromes, interoperability, and open access of equipment to ground infrastructures by drone operators and environmental impacts. In this regard, the regulatory framework should ensure that those ground infrastructures do not become proprietary and follow the same open model as airports and heliports.

Over time, drones for transport can be expected to affect land use and property values, both positively and negatively. Where drones are perceived to provide benefits, property values are likely to increase, but where they are perceived to be an annoyance (e.g. due to noise, visual disturbance or privacy concerns), property values are likely to decrease.

Drones may also affect land use patterns, as improved accessibility may create an incentive for people or businesses to move away from dense urban areas.

Although drones have the potential to improve many aspects of our society and economy, the realisation of these benefits will depend on putting into place a good foundation. The question of market access of drone operators has to be addressed at EU level. Currently, the economic and financial conditions to obtain a Community Air Carrier operating licence are set out in Regulation (EC) 1008/2008²⁴. This Regulation covers the transport of passengers, cargo and mail and is therefore also potentially applicable to drone operators. However, these rules, which were originally designed to cover large Commercial Air Transport undertakings, might be disproportionate for drone operators. A review of this Regulation should ensure fair market access and establish common requirements which are more suited to the economic and financial situation of drone undertakings. The use of existing tools such as the Union framework for screening of foreign direct investment (FDI)⁵⁷ could avoid hindering the development of IAM by removing barriers to access to venture capital.

With careful management, drones could improve access to places of opportunities (such as jobs, health care, education) and contribute to a safer, more efficient and more sustainable transport system. However, they have also the potential to increase noise, vibration and other environmental impacts while exacerbating inequality in the transport system if they are not managed carefully.

8.1.4 Ensuring societal acceptance

Drone in general and IAM services in particular may only emerge if local communities and their representatives subscribe to them. A study led by EASA showed that “EU citizens initially and spontaneously express a positive attitude towards and interest in UAM; it is seen as a new and attractive means of mobility and a majority is ready to try it out”⁵⁸. The social benefits of drone

⁵⁶ <https://civitas.eu/urban-air-mobility>

⁵⁷ Regulation (EU) 2019/452 of the European Parliament and of the Council of 19 March 2019 establishing a framework for the screening of foreign direct investments into the Union, OJ L 79I, 21.3.2019, p.1.

⁵⁸ EASA, “Study on the societal acceptance of Urban Air Mobility in Europe”, May 19, 2021

operations should be highlighted as they would justify support from national and local public authorities to further their development. The main benefits which can secure public acceptance would first and foremost be emergency medical transport, transport of medical products and other first aid and rescue applications. The point-to-point transport of people for example, in the context of city centre-airport or port links, are another useful application which could support the acceptability of for example the siting of drone vertiports and other specific infrastructures located close to residential areas, as IAM would provide improved connectivity.

It is clear that the fact that the drones operated at a low and medium altitude over populated areas also raise safety concerns. EU citizens want to limit their own exposure to all possible risks, whether related to safety, noise, security and environmental impact (including the protection of the wildlife), as well as other concerns related for instance to cyber-security. Furthermore, on the economic side, the issue of affordability is of key importance. IAM should not be seen as a service for a small part of the population only. Public acceptance will also be based on the price of the service offered by IAM operators.⁵⁹

As highlighted in the EASA study, the environmental impacts of drones are both positive and negative. Besides the noise aspect, drones may also have negative impacts on wildlife and generate visual disturbance. All these impacts will need to be clearly identified and carefully managed.

According to the EASA study, the acceptability of intra-urban and inter-city drone operations involving goods delivery and air taxi would require addressing in priority:

- high safety level;
- noise;
- environmental impact (including greenhouse gas emissions) and the impact on wildlife;
- security and, in particular, protection from cyber-attacks from such autonomous devices;

In terms of safety, EASA and national aviation authorities have a duty to ensure the safety of flights, operations and passengers for both drones and manned aircraft. The overall objective which has been set for drones is to achieve the same level of safety as in manned aviation. EU aviation safety rules provide a framework to ensure that this goal can be achieved. It also implies regular audits and inspection, oversight by the competent authorities in order to guarantee the initial and ongoing airworthiness of aircraft and the entities operating them.

As mentioned in chapter 1.5.2.3 above, similar to manned aviation, drone manufacturers will have to obtain a certificate of airworthiness ensuring the safety of passenger and cargo transport operations, initially with a pilot and later for autonomous operations. The drone operators will have to obtain an Air Operator Certificate or its equivalent for eVTOL aircraft operators and remote pilot will have to hold a licence similar to airline pilots. These regulatory developments will have to be addressed in the coming years as explained in the Communication.

Noise is a key factor which has been highlighted as a major obstacle to drone integration. This is due not only to the actual noise drones produce (often a high-pitched tone), but also to the ways in which noise is perceived – such as disruption of people’s tranquillity and people’s familiarity with and acceptance levels of drones, or surrounding noise levels). In cities, the ambient noise levels of conventional vehicles may make drone noise less apparent if flown along main roads at very low altitude. However, their proximity to residential areas, and the increasing uptake of

⁵⁹ “Seat prices as presented today range from less than €100 (RATP ADP) to €300 or €400 (ADP target for the 2024 Olympics). The profitability horizon of an air mobility service when announced is quite distant (after 2050).” Air and Space Academy, AAE Dossier 53 2022, “The viability of electric urban transport aircraft”.

quieter electric ground vehicles, may make drones more noticeable and create strong, localised pushback as the market expands. To help avoiding this, the Commission will fund the development by EASA of an online platform as a “pilot project Sustainable IAM Hub” that will provide support to authorities, cities, industry and other stakeholders for IAM implementation. This European cross-sectorial governance platform for IAM should enable engagement, alignment, and coordination between the different stakeholders. Furthermore, when developing the IAM regulatory framework, EASA could examine possible alleviations for specific use cases or operations that would be in the direct interest of the public. EASA should also continue the development of suitable drone and eVTOL noise modelling methodologies, which should be taken into account by the Commission for the next amendment of Annex II of the Environment Noise Directive for the purposes of adapting common noise assessment methods to scientific and technical progress.

Unsurprisingly drone noise primarily depends on the drone model and payload, as well as on the operating state or the flight manoeuvre. Drone noise annoyance strongly depends on the sound pressure level, which is the same as for other transportation noise sources. Comparisons of drones to other transportation noise sources are still scarce, which seems to be a large gap in understanding the potential impact. The Environmental Noise Directive should take account of IAM developments to counter misapprehensions about drone potential noise impact. Rather than attempting to drive acceptance from the public for unacceptable noise and visual disruption, focus should instead be on how to make civil drones more acceptable, through technological improvement. This would be in conjunction with the creation of exchange platforms between industry and neighbourhood associations and give industry operational experience and opportunity to develop technologies and testing methodology to evaluate noise in an urban operating environment, as well as give regulators valuable feedback on the adequacy of rules.

Regarding environmental aspect, the EASA study highlighted in particular the perception that drones can negatively impact wildlife and protected nature areas. Like for noise, scientific papers specifically evaluating the effects of drones on wildlife are also scarce but increasing. The impact on wildlife (even in urban areas) is an increasingly important consideration as drone activity scales up. Among different animal types, birds, especially in larger groups, are the most sensitive to drones. Flightless birds and large birds are more likely to be disturbed than smaller ones. Terrestrial mammals are overall less reactive to drones than birds. Given the low altitude at which small drones operate, drones may also interact with local fauna, generating a new type of anthropogenic disturbance that has not yet been systematically evaluated.

On cybersecurity too, it is increasingly apparent that low and medium altitude overflights of populated areas are perceived as a threat, hence the strong focus on the vulnerability to cyber-attack of these aircraft systems and controls. This aspect is covered under chapter 8.2.4 below.

8.1.5 Promoting the human dimension (knowledge, training, competences)

Changes in skills requirements are most visible in sectors that are strongly influenced by the digitalisation of their operations, notably in air transport. To realise the full potential of drones, the private sector is not only developing the drones themselves, but also the technologies needed to support their integration into the transport system. Drones need to integrate not only the aviation system, but also the transport system and society more broadly. This requires input from experts in new technology fields and other transport sectors beyond aviation; and experts from both aviation and from outside the sector need to understand the regulatory environment and culture of both aviation and other transport policy fields, such as urban transport planning.

This will require new competency profiles. Digitalisation and automation are at the core of the drone operations development and is already affecting employment in this sector. The development of skills and competence will be a key factor to maintain European leadership by ensuring that the different drone segments can cope with complex regulatory requirements, i.e. certification of drone operators, SORA, certification of Common Information Services and U-space service providers. Without a highly educated, qualified and experienced workforce on the ground and in the air, operational safety cannot be achieved. The qualification level of a sufficient number of pilots for the initial phase of eVTOLs and remote pilots for the control unit could pose a recruitment and training problem if the number of e-VTOLs increases. The autonomy or remote control of e-VTOLs envisaged in the future could provide part of a solution to this problem but there is a need for the sector to keep pace with the needs as drone operations will increase.

To ensure that remote pilots have the requisite level of knowledge and skills in line with continuous advancing technological development, Commission initiatives could be used like the “European Skills Agenda for sustainable competitiveness, social fairness and resilience” and its flagship action: the “Pact for Skills” aims to gather industry, private and public entities, which could support the Drone ecosystem and the digitalisation priorities identified in the Sustainable and Smart Mobility Strategy (see 4.1.4). These partnerships can build on the “Blueprint for sectoral cooperation on skills”⁶⁰ for gathering sectoral skills intelligence, mapping key occupation needs, defining occupational profiles and developing training programmes.

The sector should develop and enhance competency-based training such as those of drone specialists. Initially, the ‘certified’ category will involve two different types of pilot licences. One for flying a ‘VTOL aircraft’ with an on-board pilot and one for flying an ‘unmanned aircraft’ as a remote pilot who may control one drone at a time, or control simultaneously several drones, also of different types and from different operators. Training should also be given as a priority to IAM operators’ personnel in view of future autonomous operations.

The EU sectoral social dialogue as well as partnerships between research, universities and industry on education could provide a framework to develop a joint approach to the social challenges related to digitalisation, training requirements and professional qualifications. Education and training programmes specific to drone technologies, the regulatory framework and the integration of SUMP’s activities should be set up in all Member States. Such academic and vocational programmes across Europe would foster the competences and technological progress but also increase the public awareness and acceptance of drone utility.

To support the implementation by Member States of the newly created regulatory framework and to be in the position to smoothly manage SORA approvals, EASA has developed a number of tools to assist competent authorities implementing EU regulations correctly and on time, which include guidance documents, implementation plans, expert groups, explanatory documents, training, organising workshops and holding online meetings. Competent authorities should have the necessary competences that reflect the highly digital and automated nature of the technologies underpinning drone operations and U-space services provision as well as the necessary number of regulatory experts in drones and drone operations at both local and national authorities’ level to address industry needs.

⁶⁰ <https://ec.europa.eu/social/main.jsp?catId=1415&langId=en>

8.2 Strengthening European civil, security and defence industry capabilities and synergies

The EU industrial policy⁶¹ stresses the importance of reinforcing Europe's industrial and strategic autonomy and supporting the development of key enabling technologies that are strategically important for Europe's industrial future. By seeking synergies between civil, space and defence industries in EU programmes, the EU will make more effective use of resources and technologies and create economies of scale. The Action Plan on synergies between civil, defence and space industries identifies the drone technologies as critical technologies for the EU and calls for the need to 'identify areas of cross-fertilisation, so that defence projects benefit from innovative developments emerging from SMEs active in the field of civilian drones and that civil aeronautics benefit from developments in the field of defence'.

8.2.1 Providing funding and financing

The European Commission has funded various drones-related research projects through its successive R&D Framework Programmes. The support for research in the drone sector has been substantial in the past and critical for an early deployment. 320 projects relating to the drone sector were conducted under Horizon 2020, with a total budget of almost 980 million euros invested in the development or use of drones for innovative applications. This effort will be further latest framework being the current Horizon Europe programme. In May 2019, SESAR Joint Undertaking launched an open call for exploratory projects with the framework of the SESAR 2020 Research and innovation programme covering drone technologies such as U-space and more recently, one of the specific objectives of SESAR 3 Joint Undertaking will be to develop a research and innovation ecosystem covering the entire ATM and U-space airspace value chains allowing to build the Digital European Sky defined in the European ATM Master Plan, enabling the collaboration and coordination needed between air navigation services providers and airspace users to ensure a single harmonised Union ATM system for both manned and unmanned operations.

In addition, there is a need to secure support and buy-in from the military community (in their roles as air navigation service providers (ANSPs), airport operators, airspace users and regulators) in relation to SESAR 3 JU activities and the ATM Master Plan. In particular, areas of common interest include the ATM Master Plan, regulations, space-based systems, the integration of unmanned aerial systems, cybersecurity threats and vulnerabilities of ATM, and the development of aviation/ATM standards.

Public financing and R&D funding should support projects that are geared towards further automation and sustainability. Infrastructure associated with U-space and IAM implementation, including the landing site and charging infrastructure, should be considered for eligibility within traditional EU infrastructure funding pathways. Funding should also focus on multi-mode infrastructures where aviation could benefit from energy (i.e. hydrogen to power drones) and telecom cross-fertilisation. Eligibility requirements for public funding should be adapted to the new competitive market framework and should include a robust business plan.

In 2020, the EIB Group adopted the Climate Bank Roadmap 2021-2025, withdrawing support from conventionally fueled aircraft. The European Investment Bank (EIB) can finance drone projects aligned with the Climate Bank Roadmap (i.e. deployment of zero emission drones) in areas such as civil protection, deliveries, medical supplies, surveillance, using a wide range of adapted financial products such as loans or venture debt.

⁶¹ COM(2020) 102 final, COM(2021) 350 final

The EIB and other international financing institutions also provide a broad range of technical assistance services to IAM projects at different stages of the market-based project life cycle. The handout “European Drone Investment - Advisory Platform” was jointly launched by the European Commission and the EIB to support innovation and investment in drones. The handout maps out the advisory and financial products that can potentially be used to support investments in drones depending on the area of investment and the maturity of the market. The EIB monitors the evolution of the drone sector in particular for Urban Air mobility and U-space providing funding and technical assistance including for infrastructures that will enable drone operations. The EIB also produced a guide to finance for drone projects, which helps promoters, among other things, to develop a structured approach to assess air mobility projects, identify missing components and outline sources of funding, and prepare clearly defined requests for technical assistance and/or financing. The InvestEU Advisory Hub which complements the InvestEU Fund is supporting the identification, preparation and development of investment projects across the European Union.

Due to the immaturity of the wider IAM market in the European Union, it is difficult to assess whether there is a lack of available financing or a lack of financeable projects. According to the EIB, engagement with some key European cities appears to indicate the latter, as many projects are lacking a robust business case including an appraisal of required funding or how such funding may be sourced.

Most IAM projects are still at the R&D phase, funding needs for UAM projects are ranging from the development of living-lab for drone operators to test their technology and business model (e.g. medical deliveries, transfer of patient via eVTOL, ground infrastructure, etc.) to the development of the U-space system. Beyond venture capital, the most relevant financial instruments are still research funding (specifically through research grants).

In addition to these funding programmes by European and national bodies and agencies, there is also access to funding to venture capital investors that can accelerate the deployment of drones and U-space. However, according to the EIB, due to the immaturity of IAM applications, most of the investments are focused on the vehicles rather than infrastructure and services.

The European Defence Fund (EDF)⁶² incentivises and supports collaborative, cross-border research and development in the area of defence. The Fund will increase the EU’s technological edge and develop the capabilities that are key for the strategic autonomy and resilience of the Union and its Member States and the protection of its citizens. Complementing and amplifying Member States’ efforts, the Fund promotes cooperation among companies and research actors of all sizes and geographic origin in the EU. In doing so, it will integrate further the European defence technological and industrial base, develop industrial skills and competencies as well as the innovation potential of Europe’s industry.

Through the EDF and its precursor programmes, the Preparatory Action on Defence Research (PADR) and the European Defence Industrial Development Programme (EDIDP), the European Commission has funded and aims to further fund various drone-related projects in the framework of defence research and development projects. The PADR (2017-2019) programme funded two research topics on technological enablers for drone operations (EU grant together € 3 million). In the EDIDP (2019-2022) programme seven development projects up to a grant value of € 189 million, including Counter-UAS, are funded. In EDF 2021, a total of five projects are selected for funding that contain drone relevant research and development (EU grant together € 87,3 million). EDF 2022 calls for proposal include three drone-related topics.

⁶² https://defence-industry-space.ec.europa.eu/eu-defence-industry/european-defence-fund-edf_en

As presented in Chapter 4.3, the Commission is funding and financing drone R&I through number of different programmes. These programmes continue providing support under the current 2021-2027 MFF as well as defence-related R&D with new EFD instrument.

The increased size of funding which is delivered through a variety of EU programmes and instruments presents opportunities for synergies that could reduce risk of duplication and provide more user-friendly opportunities for financing (e.g. grants, public procurement, guarantees) while safeguarding at the same time that promising projects funded at an early phase are not starved of funding before they are deployed. It is necessary to seek coherence and enhance the complementarity between the relevant EU programmes to increase efficiency of investments and effectiveness of results, thus bringing better value for EU money by maximising the exploitation of EU funded R&D projects in civil, security and defence sectors.

Further coordination could also be pursued on national research activities with the help of EASA on UAS/UAM to ensure that there are no gaps and to ensure cross sharing of results from research activities.

8.2.2 Identifying strategic technology building blocks

Remaining at the cutting edge of technological development is critical for ensuring Europe's prosperity, security and way of life. The new technologies are transforming the security and defence sectors at a faster pace than ever before and blurring the dividing line between the civilian and military domain.

In her 2019 political guidelines⁶³, President von der Leyen underlined that *'it is not too late for Europe to achieve technological sovereignty in some critical technology areas'*. The 2020 EU industrial strategy⁶⁴ stated that Europe's strategic autonomy is about reducing dependence on others on critical technologies. They also provide Europe's industry with an opportunity to develop its own markets, products and services which boost competitiveness.' The EU will therefore support the development of critical technologies that are strategically important for Europe.

As stated in the Roadmap for Critical Technologies for security and defence⁶⁵, *'lack of foresight on the future importance of technologies is in part to blame for some of the EU's existing strategic dependencies on third countries, e.g. on remotely piloted systems'*.

Based on the Report of the Drone Leaders Group, *'the availability of the required components, vehicles and systems in Europe is a core condition for developing a competitive and autonomous European drone services sector. It is necessary to ensure that the drone manufacturing industry will have a reliable supply of essential parts and financial and technical resources to develop and manufacture state-of-the-art products'*.

Although Europe has a developed drone industry, significant part of production of drones and critical components take place outside Europe. For example, such key components such as batteries, propellers, electric engines and sensors, are commonly produced in Asia, i.e., China, Singapore and Taiwan. Nowadays, the shortage of raw material, such as microchips, electronic components and IT hardware has highlighted the fact that Europe is dependent on Asian suppliers on components and know-how. To minimise this dependency, the EU industry should strongly consider manufacturing drone components in Europe and organise itself accordingly.

⁶³ https://ec.europa.eu/info/sites/default/files/political-guidelines-next-commission_en_0.pdf

⁶⁴ COM(2021) 350 final

⁶⁵ COM(2022) 61 final

Identifying which critical technologies make a decisive contribution to key capabilities can help to decide: (i) which technologies are important for technological sovereignty (i.e. where there is a need to reduce the risk of dependence); and (ii) where combined/coordinated support from different EU programmes and instruments can address such challenges. To strengthen its technological sovereignty, the EU and its Member States must maintain a strong industrial competence and, where possible, seek leadership in these critical technologies.

Alongside the critical technologies, the following aspects should be taken into account:

- the drone value chains, including the security of supply of critical components and materials that are important building blocks for competitive and autonomous industry;
- related research and testing infrastructure, which is key for standardisation and certification.

Therefore, a Strategic Drone Technology Roadmap identifying critical drone technologies such as AI, robotics, semi-conductors, hybrid and electric propulsion systems, safe, secure and resilient C2 link and energy storage, batteries and cloud technologies should be defined at EU level, in collaboration with the Observatory of Critical Technologies set up by the Commission under the Action Plan on synergies between defence, space and civil industries.

In particular, the roadmap should further set out as priorities for Research and innovation in the area of:

- detect and Avoid (DAA) technological development to allow a greater degree of automation, inside and outside U-space airspace, working alongside standardisation bodies, such as EUROCAE, and the global framework governed by ICAO.
- European strategic technologies, such as CNS supporting UAS operations in the specific category and safe, secure and resilient C2 link (satellite based C2L solutions for IFR RPAS) for drone operations in the certified category. Equivalent performance requirements should be demonstrated during the respective civil and military certification paths.

Critical technologies are bound to change as new technologies emerge. Therefore, the Roadmap should be monitored by the Observatory and reviewed periodically in order to identify the latest needs as well for reviewing the previously established priorities.

8.2.3 Enabling testing and demonstrations

Live testing and demonstrations are key to harnessing, developing, and accelerating the take-up of the most cutting-edge technological solutions to manage drones and innovative air mobility.

The SESAR Joint Undertaking (SJU) is managing a portfolio of very large-scale demonstrations aimed at making aviation smarter and more sustainable, and paving the way for innovative air mobility (IAM) in Europe. A sizeable portion of the demonstrations specifically address the safe and secure integration of drones, building on the outcomes of previous SESAR U-space research, with the first related call dating back to 2016. The demonstrators are a key tool to support the SESAR JU's vision of delivering the Digital European Sky, matching the ambitions of the European Commission's European Green Deal, Digital Europe and the recently launched strategy on smart and sustainable mobility.

The Digital Sky Demonstrators take place in live operational environments and put to the test (on a very large scale) the technological solutions necessary to deliver the Digital European Sky. Demonstrations can also lead directly to implementation, which has been the case in the island city of Tromsø, Norway. Following real-life trials by partners in SESAR's GOF2.0 project⁶⁶,

⁶⁶ <https://gof2.eu/>

VLOS unmanned inspection flights are now permitted within the town, despite being within the 5km exclusion zone of Tromsø Airport.

Still, in many SESAR U-space demonstrations, it has become apparent that testing and demonstrations become more complicated, as more new technologies are tested. Current aviation regulations do not yet cover live flights by autonomous vehicles or air taxis, for example, which makes it very difficult for advanced research to progress. Very large demonstration projects are for instance also confronted to the problems already mentioned in 8.1.2 above, which may delay the operational approval operations and make the regulatory authorisation process longer and more expensive than it is reasonable in the context of demonstration projects with individual flights and no immediate commercial pay-back.

EASA should, in addition to reviewing the scope of, and requirements for drone design verifications, develop specific guidelines to support the application of the SORA methodology to operations conducted for the purpose of test, experimentation or demonstration, and consequently facilitate live testing and demonstrations in the context of the current regulatory framework.

Alongside development of the regulatory environment, it would also be useful for the Commission to set up a network on drone civil-defence testing centres. It would also be useful to create a network of such test and demonstration sites across Europe that allow stakeholders to try new concepts and technologies in a safe airspace and ground volume. Such a network should allow for more generic sites all the way to very specialised sites, depending on the technical need, and contribute to the establishment of European digital innovation hubs, as envisaged by the EU industrial strategy, which can act as one-stop-shops for companies to access technology testing and showcase innovative solutions for the civil, defence and space markets.

Moreover, since airspace and airfield facilities are at a premium, maximum use should be made of military facilities to enable dual-use of defined airspace volumes as well as to promote harmonised testing between civil, military and space operators.

8.2.4 Driving for common standards

Standards play a major role in defragmenting markets and helping industry in achieving economies of scale. The development and implementation of research and innovation agendas including through standardisation is essential for EU competitiveness. The Commission gives strong support to the market uptake of innovation, in particular to supporting standardisation through research and putting science into standards. Standardisation activities are an essential channel for the market adoption of research results and for the diffusion of innovations. Creating EU-wide standards and promoting them on a worldwide level is also a vital component of the global competitiveness of the EU economy in general.

The contribution of standardisation to Framework Programmes (FP) for Research and Innovation of the European Union dates back to the early nineties under FP4 (the Standards, Measurement and Testing Subprogram (SMT)) and FP5. In later Framework Programmes, including Horizon 2020, standardisation became a horizontal support tool relevant across all research areas. Horizon Europe, the new Framework Programme for Research and Innovation for the period of 2021-2027, will support valorising R&I results through standardisation to the highest possible extent.

The impact of the digitalisation cannot be underestimated when it comes to standardisation. Aviation moves from a human-centric system - where safety ultimately depends on pilots and air traffic controllers – towards an information-centric system, where highly automated aircraft can fly safely based on information flowing on mobile telecommunication networks. As the aviation and mobile telecommunication worlds converge, the need for Information and Communication Technology (ICT) standards will increase in aviation. This is particularly observable in the field

of drones and unmanned aircraft traffic management solution, which are a laboratory for digital aviation solutions.

U-space service providers should be able to use a range of connectivity tools, including the existing telecom equipment. When using telecom infrastructure for command-and-control purposes, drone stakeholders should be able to use standards developed by the appropriate standardisation organisation, including ICT or joint standards. The importance of such collaboration between ICT and aviation industrial organisations is illustrated by the Aerial Connectivity Joint Activity, an initiative between the Global UTM Association and the GSM Association.

As we progress towards the Digital European Sky, and in accordance with the Action Plan on synergies between civil, defence and space industries, it is vital that standardisation cover all airspace users, including the military, drones and HAO. The concept of dual-use standards was introduced in the 2012 Action Plan for an innovative and competitive Security Industry⁶⁷, which recommended that the development of 'hybrid standards', i.e. standards that apply both to civil and defence technologies, should be actively pursued in areas where technologies are the same and application areas are very similar. This was further reinforced in the 2021 Action Plan on synergies between civil, defence and space industries⁶⁸, calling for the development of hybrid technological standards and best practices applicable across the civil and defence sectors.

Such 'best practices' could include the development of standard scenarios of dual use nature for the specific category such as scenarios Beyond Visual Line of Sight (BVLOS) and above 500 feet (or without altitude limitation) which could facilitate civil and military operations such as cargo and emergency delivery of goods, surveillance over land and sea, reconnaissance for disasters scenario and ferry flights. Deeper collaboration between the key stakeholders such as EASA, EDA and competent national civil and military authorities in the development of such scenarios could lead to savings in time and better use of limited pools of experts.

Much current military standardisation activity for drones is already aiming to be undertaken by civil standardisation organisations such as EUROCAE, so that civil and military platforms can safely inter-operate in the same airspace. Research and demonstration projects should not only seek to ensure that all drone standardisation, when appropriate, meets the needs of both civil and military airspace users, but also mechanisms should be investigated to improve standardisation practices by learning from and re-using, where possible, military standardisation processes and agencies. The scope of such standardisation should include all relevant technologies, including Integrated CNS, DAA and automation.

To coordinate such standardisation activities, the European Commission established the European UAS Standardisation Coordination Group (EUSCG)⁶⁹, a joint coordination and advisory group coordinating the drone-related, including U-space, standardisation activities across Europe, and essentially stemming from the EU regulations and EASA rulemaking initiatives. The membership of EUSCG is composed of:

- AeroSpace and Defence Industries Association of Europe (ASD)
- ASD-STAN
- ASTM (Europe)
- Drone Manufacturers Alliance Europe
- Drone Alliance Europe

⁶⁷ COM(2012) 417

⁶⁸ COM(2021) 70

⁶⁹ <https://www.euscg.eu/>

- EASA
- EUROCAE
- EUROCONTROL
- European Commission
- European Defence Agency (EDA)
- European Standardisation Organisations (ESOs): CEN, CENELEC, ETSI
- Global UTM Association (GUTMA)
- ISO
- JARUS
- SAE
- SESAR JU

The EUSCG is supported by the work of the AW-Drones Horizon 2020 project⁷⁰, which is developing an open repository of unmanned aircraft standards and validating the suitability of technical standards to comply with existing regulation for drone operations.

Finally, relevant actors such as EASA, EDA, EUROCAE and national military authorities should be encouraged to further harmonize certification requirements for civil and military applications towards those set by EASA while considering military specificities and existing military certification standards.

8.2.5 Increasing counter-UAS capabilities and system resilience

Counter-drone

New technologies can offer valuable opportunities but may also pose emerging threats that need to be addressed. The growing use of drones is no exception to this rule, as they can be misused to target public spaces, individuals and critical infrastructure⁷¹. While the EU has regulated the legitimate use of drones, there are no specific EU rules and guidelines on countering their unauthorised, as well as the use for criminal or terrorist purposes. The rapid pace of innovation and easy access to these devices as well as the components to make them, means that the threat is likely to grow – as also shown by the substantial use of civil drones in armed conflicts around the world.

Preventing the unauthorised use of drones in our societies is also necessary to allow the legitimate use of drones to reach its full potential. Protecting our societies against malicious and non-cooperative drones also requires access to affordable and reliable counter-measure technologies that enable flexible solutions adapted to the threat level and the operating situation. It is not possible to have a standardised “one-fit-all” approach to counter drone (C-UAS) measures, as some technological solutions may not fit in an urban or crowded environment while they may be adequate to protect e.g. critical infrastructures. Moreover, it is important to have appropriate legal frameworks in place to implement procedures, provide clear authority to intervene and facilitate collaboration between stakeholders which are not always used to work together (esp. law enforcement, aviation, operators and, manufacturers).

Commercial drones can be used for legal and illegal activities, by citizens and businesses but also by criminals, terrorists or hostile state actors. The majority of drone users, however, are likely to

⁷⁰ <https://www.aw-drones.eu/>

⁷¹ The threat of UAS using explosives was investigated by the JRC (Larcher M, Karlos V, Valsamos G, Solomos G: Scenario study: drones carrying explosives, JRC107683, 2018).

be compliant with the rules and regulations, and notably licensed professional remote pilots are typically aware of the applicable legislation and technical limitations. Nevertheless, clueless, careless, and criminal drone users are responsible for the numerous, if not daily, incidents involving drones across the EU.

Both the 2020 EU *Security Union Strategy*⁷² and *Counter-Terrorism Agenda*⁷³ clearly state that the threat of non-cooperative drones is a serious concern in Europe that needs to be addressed. In relation to the Counter-Terrorism Agenda in particular, the Commission intends to release in 2023 handbooks on “Protection against Unmanned Aircraft Systems – Handbook on Counter-UAS for Critical Infrastructure and Public Spaces” and “Protection against Unmanned Aircraft Systems – Handbook on Principles for Physical Hardening of Buildings and Sites”.

The Directive on the resilience of critical entities (CER Directive)⁷⁴ will introduce obligations on Member States and critical entities to conduct risk assessments and for critical entities to take technical, security and organisational measures to ensure their resilience against identified risks. These assessments may include the risk posed by non-cooperative drones.

Many Member States are still addressing the challenge of making available the necessary budgets, adapting or creating the necessary regulatory framework and identifying the right (technical) solutions to be able to cope with the different threat situations of non-cooperating drones.

To support Member States the JRC and its drone project will review processes and interactions between stakeholders and the use technologies and how these technologies can be combined into solutions, which can be used to ensure the security of citizens and critical infrastructure.

One part of the drone project is the creation of a living lab with a C-UAS solution implemented that will be open to stakeholders to investigate counter UAS solution aspects and how these can be applied in real. The living lab implementation will be designed so that it can be used as a guide to comply with the legally required Geel site protection (Class 1 Nuclear installation).

More specifically in the area of aviation, drone incidents may endanger aircraft and their occupants. Most occurrences have been reported during approach/landing and take-off/climb, which are the most critical phases of a flight. To better understand the vulnerability of manned aircraft to drone strikes, EASA is managing a project supported by Horizon 2020 that is expected to run until June 2023. Besides these physical risks, drones can also cause economic and operational damages. The most severe drone-related disruptions took place at London Gatwick Airport between 19 and 21 December 2018. Following reports of drone sightings, the airport’s runway was closed which led to the cancellation of approximately 1,000 flights and impacting 140,000 passengers. This incident is estimated to have cost the industry up to EUR 64 million. A 2020 study⁷⁵ suggests that if Frankfurt airport had to be closed for a continuous 48-hour period due to drone sightings, it would cost EUR 3 million to the airport and another EUR 34 million to the airlines. Incidents of a smaller scale can also cause significant cost, particularly if they lead to

⁷² COM(2020) 605 final of 24 July 2020

⁷³ COM (2020) 795 final of 9 December 2020

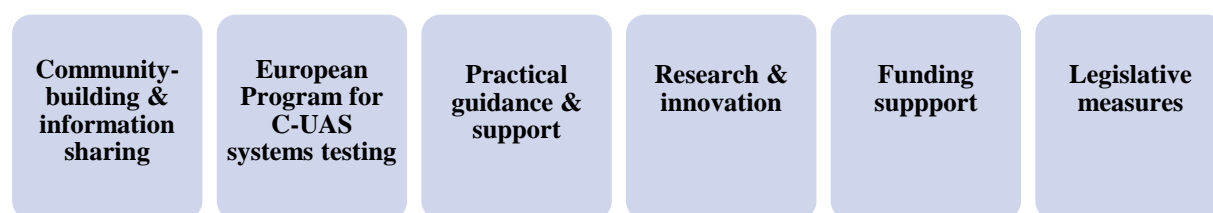
⁷⁴ COM(2020) 829 final of 16 December 2020. The European Parliament and the Council reached political agreement on the proposed Directive on 28 June 2022 (Security Union (europa.eu))

⁷⁵ Wendt, P., Voltes-Dorta, A., & Suau-Sanchez, P. (2020). Estimating the costs for the airport operator and airlines of a drone-related shutdown: an application to Frankfurt international airport. *Journal of Transportation Security*, 1–24.

the closure of the runway. For the ten largest European airports, the delay cost of a 30-minute runway closure is estimated to range from EUR 325,000 to EUR 514,000⁷⁶.

For the time being, EU legislation contains no explicit provision specifically addressing the threats posed by drones at and around airports. Article 38 of the EASA Basic Regulation⁷⁷ contains a general obligation for aerodrome operators to “*monitor activities and developments which may cause unacceptable safety risks to aviation in the surroundings of the aerodrome*” and to “*take the necessary measures to mitigate those risks in as far as this lies within their control*”. Regulation (EC) No 300/2008⁷⁸ dealing with aviation security contains no specific provision on drones.

The Commission has been supporting Member States in addressing the threats from non-cooperative drones since 2016. The scope of the Commission’s counter-UAS work covers a wide range of activities aimed at enhancing Member States’ capabilities in this area, based on the following six pillars:



1. Community building and information sharing

On a regular basis (every 6 months), workshops are organised by the Commission with representatives from Member States, EU Institutions, EU Agencies, EU-funded projects, International Organizations and partner third countries. This has led to a continuous engagement of all stakeholders, facilitating also significantly their operational and practical cooperation.

To this end, the Commission has also set up a dedicated *Counter-UAS Interest Group* (shared drive with limited access to registered stakeholders) which currently has almost 300 members. This platform is regularly updated and hosts all kind of open-source and non-sensitive information on the topic. Twice a year a newsletter is produced and shared with the members of the interest group.

There is an ongoing cooperation with NATO through cross-briefings and mutual staff participation in dedicated counter-UAS workshops and exercises.

2. European Programme for counter-UAS systems testing

This programme has been launched to develop a common methodology for evaluating systems that can be used by law enforcement and security authorities to detect, track and identify potentially malicious drones. The programme is supported by the *Courageous*⁷⁹ project, which started in April 2021 and is funded by the EU Internal Security Fund–Police. There are regular stocktaking meetings where outcomes are shared with Member States as well as selected partner countries and international organisations.

⁷⁶ European Union Aviation Safety Agency, Drone Incident Management at Aerodromes, 8 March 2021

⁷⁷ Regulation (EU) 2018/1139 of the European Parliament and of the Council of 4 July 2018 on common rules in the field of civil aviation and establishing a European Union Aviation Safety Agency

⁷⁸ Regulation (EC) No 300/2008 of the European Parliament and of the Council of 11 March 2008 on common rules in the field of civil aviation security; and secondary legislation

⁷⁹ <https://courageous-isf.eu/>

3. Practical guidance and support

The Commission is also compiling EU best practices with a view to develop practical guidance material, in particular, "Protection against Unmanned Aircraft Systems – Handbook on Counter-UAS for Critical Infrastructure and Public Spaces" and "Protection against Unmanned Aircraft Systems – Handbook on Principles for Physical Hardening of Buildings and Sites".

4. Research and innovation

Based on projects from the EU security research programme, such as ALFA⁸⁰ and ALADDIN⁸¹ (funded under Horizon 2020), as well as ISF-funded projects such as Skyfall, Courageous and DroneWise⁸², the Commission is identifying and sharing regularly relevant deliverables amongst EU stakeholders. Moreover, through its JRC laboratories and Living Labs, the Commission is offering the possibility for testing and supporting pilot projects. Stakeholders can use these facilities to demonstrate policy impact and needs, as well as to develop processes, procedures and solutions⁸³.

5. Financial support

Through the security research programme, as well as the Internal Security Fund (Police) for the period 2014-2020, the EU co-funded the development of Counter-drone tools, knowledge and technologies. This effort will continue in the current Horizon Europe programme, the Internal Security Fund (ISF) and the Border Management and Visa Instrument (BMVI) component of the Integrated Border Management Fund (IBMF). These programmes are complementary as Horizon Europe strengthens research and innovation, while the ISF and BMVI focuses on a wide range of practical applications for law enforcement and border management, such as the acquisition of equipment, promoting and developing training schemes and ensuring administrative and operational coordination and cooperation.

This financial support is made available through national programmes (shared management) or through Union actions supporting transnational initiatives (direct management). With regard to research and innovation related measures, funding is also available under the Horizon Europe programme.

6. Legislative measures

In the EU, there are currently no specific counter-drone rules, which set a common harmonised framework for Member States authorities, operators and manufacturers. As the need for an effective prevention of the unauthorised use of drones and drone technologies is constantly growing, the Commission is working towards EU counter-drone guidelines and examine the need for legislative measures..

In aviation, following the Gatwick incident, an EASA-led Task Force developed a manual entitled "Drone Incident Management at Aerodromes". Completed in March 2021, this manual contains non-binding guidance and recommendations helping airports and authorities to prepare, respond and recover from drone incidents. While these guidelines were favourably received by the sector, their non-binding nature makes them insufficient to mitigate a threat that is likely to grow as drones become more ubiquitous and capable.

⁸⁰ Advanced Low Flying Aircrafts Detection And Tracking <https://cordis.europa.eu/project/id/700002>

⁸¹ Advanced hoListic Adverse Drone Detection, Identification Neutralization <https://cordis.europa.eu/project/id/740859>

⁸² <https://www.projectskyfall.org>, <https://courageous-isf.eu> and <https://dronewise-project.eu>

⁸³ https://joint-research-centre.ec.europa.eu/pilot-living-labs-jrc_en

Furthermore, to address the gap on legislation related to the threats posed by drones at and around airports, the aviation security legislation needs to be amended to ensure that aviation authorities and airports manage the risks posed by drones. It would not need to prescribe specific measures but set a general obligation to manage risks, with the exact measures being determined at the national or local level based on a risk-assessment. This approach would best account for the specificities of each airport and the various risk-levels that may exist across the EU. Moreover, certain mitigating measures, particularly those that involve the use of detection technologies, have a significant cost which makes them more suitable for large or higher-risk airport. As an illustration, it is estimated that it could cost around EUR 500 million to equip Germany's 16 busiest airport with drone detection systems.

The Commission will continue providing operational, technical and financial support to Member States, as outlined above. In addition, the Commission will specifically outline, through a Communication to be presented in the first half of 2023, the EU's future policy on countering drones. This includes taking stock of existing projects, best practices and available reliable technologies for tracking, identifying and neutralising drones adapted to the concrete threat level and operating environment, as well as presenting the Commission's strategic vision in this field, which is characterised by the lack of a clear EU legal framework.

Resilience

Drones and related control units are highly advanced and complex platforms running various different digital processes that control -automated or remotely - the drone or its payload, store and transmit data, broadcasting identification, and so on. Like any similar system, a drone and its control unit is vulnerable to hacking and misuse. In 2020, security research firms revealed that, without a knowledge of drone operators, a major drone manufacturer located outside of the EU could collect information through the control application installed to the operators' phone, and even silently update the application, thus leaving it open for further vulnerabilities. While this feature might not have been introduced with malicious intentions by the manufacturer, it still demonstrates the difficulties of ensuring that a drone is fully controlled by its owner or operator and that the collected data remain safely in their hands. Security vulnerabilities could also lead to hijacking of a drone with aim to use it for criminal purposes.

The Commission should work towards defining criteria which can be used to identify, or label, trusted drones. The voluntary label could be issued by a relevant Authority after a manufacturer has provided evidence that a specific drone fulfils the criteria. Such criteria could be, for example, provision of a secured communication link, secure identification, use of open-source code, transparent software upgrades or protection against GNSS spoofing. It should build on and be compatible with the ongoing work to develop horizontal cybersecurity legislation. The label would make it possible for any end-user to purchase such trusted drones in confidence. Furthermore, it would benefit not only drone operators but also all entities responsible for the monitoring the use of airspace. For example, a relevant authority could require such trusted drone label from all drones operating in a restricted airspace, subsequently helping to separate legally operated drones from illegal ones.

Voluntary labelling would not only improve the security of drones, but it could serve as useful marketing tool for the European drone industry which is generally targeting more high-end professional drone market.

In a longer term, the European Union should assess the need to set a condition that drones acquired by the EU through public procurements meet the security requirements set in the trusted drone label.

9 ACTION PLAN

The following action plan is based on the vision and strategic objectives, as described in Chapter 7. It covers some of the recommendations and suggestions of actions to be taken by the European Commission which were collected during the consultation phase of the preparation of the Drone Strategy 2.0.

In addition to action by the Commission, other stakeholders, as described in this document, are also required to play their part, ranging from European entities, such as EASA and the European Investment Bank, to national authorities, including ministries and regulatory bodies, regional and local governments, military and law enforcement bodies, as well as private entities such as U-space service providers and manned and unmanned aviation industry alike.

List of Actions and means to be implemented by the European Commission to further build the European drone services market	
Action	Means
- adopt amendments to the Standardised European Rules of the Air and the Air Traffic Management/Air Navigation Services Regulation to safely integrate drone and piloted eVTOL operations.	Putting forward proposal to amend the Standardised European Rules of the Air (Regulation (EU)923/2012) ⁸⁴ , and common requirements for providers of ATM/ANS (Regulation (EU)2017/373) ⁸⁵ , to allow safe, orderly, and efficient drone operations in the ‘specific’ and ‘certified’ category, and piloted eVTOL operations.
- promote coordinated research on integrated Communication, Navigation and Surveillance technologies.	The research undertaken at EU level in the following fields should be coordinated: CNS (ICNS) technologies, including all current CNS technologies used for ATM, but also those needed to support U-space, IAM, drone integration and Higher Airspace Operations, including technologies from other domains, such as the telecommunications and the space industries.
- adopt new European standard scenarios for low to medium risk aerial operations.	There are currently 2 European standard scenarios annexed to Regulation (EU) 2019/947, further standard scenario should be developed in order to allow commercial drone operators to declare their operations instead of seeking a prior authorisation.
- adopt rules for the ‘certified’ category of drone operations and the operational requirements applicable to manned VTOL-capable aircraft.	New common rules for the ‘certified category’ and VTOLs should be rolled out covering the certification of aircraft, of operators and remote pilots.
- adopt rules for the design and operations of vertiports under the scope of EASA Basic Regulation.	A new regulatory framework applicable to the design and operations of vertiports under the scope of EASA Basic Regulation will facilitate the development of intermodal transport.
- develop balanced economic and financial requirements for drone operators	Regulation (EC) 1008/2008 should ensure fair market access for new drone operators with more suited

⁸⁴ Commission Implementing Regulation (EU) No 923/2012 of 26 September 2012 laying down the common rules of the air and operational provisions regarding services and procedures in air navigation (OJ L 281 13.10.2012, p. 1)

⁸⁵ Commission Implementing Regulation (EU) 2017/373 of 1 March 2017 laying down common requirements for providers of air traffic management/air navigation services and other air traffic management network functions and their oversight (OJ L 62, 8.3.2017, pp. 1-126)

in the context of its legislative proposal to revise Regulation (EC) 1008/2008.	economic and financial conditions and consider using other instruments to adequately protect the strategic autonomy of the EU when necessary.
- fund the creation of an online platform support a sustainable IAM implementation by authorities, cities, industry and stakeholders.	As a pilot project proposed by the European Parliament, the Commission will fund the creation of a sustainable IAM Hub by EASA as an online platform that supports authorities, cities, industry and stakeholders with the implementation of UAM;
- adopt training and competences requirements for remote pilots and pilots of VTOL aircraft.	New skills and competences such as those of drone specialists should be developed to ensure that remote pilots have the requisite level of knowledge and skills in line with continuous advancing technological development.

List of Actions and means to be implemented by the European Commission in order to strengthen European civil, security and defence industry capabilities and synergies

Action	Means
- continue to provide funding for R&I on drones and their integration into the airspace under the Horizon Europe programme and the European Defence Fund.	The drone sector is still at its early stages requiring further financial support for R&I in order to reach economically sustainable maturity.
- set up a coordinated series of calls of existing EU instruments and EIB loans to support a new flagship project on 'drone technologies.'	In implementation of relevant proposals in the Synergies Action Plan and the Analysis of defence investments gaps meant to support critical technologies and industrial capacities by developing strategic projects, - set up a coordinated series of calls of existing EU instruments and EIB loans to support a new flagship project on 'drone technologies' that can prove the concept of synergies along the pathway from R&D to deployment through public procurement.
- consider possible amendments to the existing financing/funding framework to ensure a consistent approach in support of dual-use research and innovation to improve synergies between civil and defence instruments.	In order to facilitate exchanges between civilian and defence communities, especially in the area of critical technologies, - prepare an approach for encouraging dual-use RTD&I at EU level to be fully implemented in the medium to long term across EU programmes and instruments. This work will also feed into the mid-term evaluation of relevant sectoral programmes.
- develop a Strategic Drone Technology Roadmap in order to identify priority areas to boost research and innovation, reduce existing strategic dependencies and avoid the emergence of new ones.	A Strategic Drone Technology Roadmap should further set out priorities for R&I, identifying critical strategic drone technologies such as AI, detect and Avoid (DAA) robotics, semi-conductors, hybrid and electric propulsion systems, safe, secure and resilient Command and Control link and energy storage, batteries and cloud technologies should be defined at EU level, in collaboration with the Observatory of Critical Technologies.
- coordinate a common approach with the aim of providing sufficient radio frequencies spectrum for drone operations.	Coordinating a European approach to ensure that radio frequencies and protected spectrum are available for drone operations, in cooperation with EUROCONTROL at ICAO and ITU level.
- set up an EU network on civil-defence	Developing a network of joint civil-defence

drone testing centres to facilitate exchanges between civilian and defence sectors.	collaborative field-testing of drone demonstrators and in this context seeking deeper cooperation between civil and military with the aim to optimise the use of restricted airspaces for civil and military trials. This would create a flying-safe space to “test & share” and allow gaining flight hour experience to prove safety under a “fly-before-certify” approach.
- encourage all relevant actors to further harmonise certification requirements for civil and military applications towards those set by EASA while considering military specificities and standards.	EASA, EDA, EUROCAE and national military authorities should further harmonise certification requirements for civil and military applications towards those set by EASA while considering military specificities and existing military certification standards. To the extent possible, this should be done within existing structures such as EUSCG.
- adopt new standard scenarios for civil operations that could facilitate corresponding military use cases.	Further European standard scenarios for the specific category for operations could have both military and civil applications such as surveillance drones.
- adopt a counter-UAS package.	The package could include, but not limited to, actions to continue the ongoing dedicated support to MS; a Commission Communication announcing work towards EU counter-drone guidelines; increased efforts in the protection of critical infrastructure and public spaces by publishing a handbook on the matter; technical guidance on the physical protection principles of infrastructure against drones; an enlarged technical expert group on voluntary standards to cover counter-drone solutions
- adopt an amendment to the aviation security rules aiming to ensure that aviation authorities and airports increase their resilience when faced with the risks posed by drones.	This legislative amendment should not prescribe specific measures but rather contain a general obligation to manage the risks in order to take into account of the different risk levels that exists at different airports.
- define criteria for a voluntary “European Trusted Drone” label.	The label would be granted for cybersecurity approved drones in the ‘open’ and ‘specific’ categories. It should build on and be compatible with the ongoing work to develop horizontal cybersecurity legislation.

A Synopsis consultation report

A.1 Introduction

The stakeholder consultation matrix below provides an overview of how 12 defined stakeholder groups have been consulted, i.e., through interviews (scoping, targeted), survey, stakeholder meetings and Open Public Consultation (OPC) by the external contractor. Stakeholders for interviews and survey were selected in close consultation with the Commission. The OPC enabled the participation of citizens.

Stakeholder group	Scoping interviews	Targeted interviews	Targeted Survey	Stakeholder meetings	OPC
National and regional authorities	1	6	✓	✓	✓
European institutions and relevant agencies	2			✓	✓
Military and Law enforcement		2	✓	✓	✓
Commercial and non - commercial aircraft operators		1	✓	✓	✓
Drone operators, service providers and users		4	✓	✓	✓
Airport operators and ANSPs		2	✓	✓	✓
U-space providers		3	✓	✓	✓
Manufacturing industry	1	3	✓	✓	✓
Inter-governmental organisations and networks		1			✓
NGOs		1			✓
Research and academia	1	2			✓
Citizens					✓
Total number of respondents	5	25	198	3*	258

Source: Ecorys

Five stakeholders were selected for scoping interviews, one national authority; two from EU institutions; one drone manufacturer and one stakeholder representing research and academia. The result provided insights on main issues, which together with desk research established the basis for drafting the questionnaire survey, and the OPC.

The members of the Informal Drone Experts Group were, invited to submit their views on the following topics on the occasion of three hearings on:

- Urban Air Mobility (cargo/passengers) and U-space
- Enhancing UAS services including the SME dimension
- Developing Military/Civil synergies and technology building blocks

A.2 Feedback to the Roadmap

Feedback on the DS2.0 roadmap public consultation includes 45 written contributions provided by 14 companies/business organisations; 10 Business associations; 8 citizens (of which 7 from EU); 6 NGOs; 4 Public authorities and 3 research institutions.

A.2.1 Context & Problem the initiative aims to tackle

- All contributors agreed that - if regulated properly - drones have the potential to generate societal, economic, and environmental benefits. They noted that this will depend on the development of a new strategy that reflect changes and promote safe and responsible drone operations and addresses related societal concerns such as safety, security, privacy and environmental protection.
- All of them acknowledged that the growth of UAV activity must be addressed urgently in order to preserve the safety of manned aircraft and to foster the promotion of the drone industry.
- They welcomed the roadmap and shared the EC's view that the development of a thriving and competitive drone industry can accelerate Europe's transition to green and digital economy, observing that Europe requires a strategy aligned with the latest developments and the needs and concerns of their citizens.

A.2.2 Objectives

Contributions welcomed the objectives identified by the EC. Notably,

Safety, security, and privacy of people in the air and on the ground

- The EC consideration on the importance of the safety objective was acknowledged by the majority of stakeholders and the ambitions to develop a safe and efficient drone ecosystem under the forthcoming Drone Strategy 2.0., to ensure the right balance between safety, security, and other societal concerns, was praised.
- EHA noted that safety was a priority especially for helicopter operations dealing with emergencies, as they must be able to identify potential incoming and colliding drones and engage in safe avoidance manoeuvres. To this end, it called for a number of amendments to the existing regulations.
- Wing expressly welcomed the adoption of the risk-based SORA process for evaluating complex operations, helping to ensure that different operations meet a common target level of safety. It noted that supporting diverse operations will depend on performance-based approaches to regulation, recognizing new and innovative ways to achieve a high level of safety.
- Complementing the welcomed EC's considerations on the safety objective, IAOPA suggested that the EC should address the liability aspect of drone integration. It complained that currently a serious lack of liability persisted when a UAV caused damage and maintained that strict liability for drones' operators needed to apply in case of collision. The

Association also suggested that education aspect was for UAV operators further addressed, implementing consistent training programs with the aim of maximising the safety of people in the air and increase awareness of the relevant legal framework. Regarding privacy, it argued that the strategy should put forward specific measures to enforce the respect of European citizens' privacy outlined in the already adopted legislation.

- CANSO voiced concern for the lack of explicit reference to the need for a comprehensive policy package that includes the scalable integration of UAS/UAM with manned aviation operations as an important success factor.
- The Czech Association of modellers contended that a less strict regime for aircraft models should be part of the Drone 2.0 Strategy plan, due to inter alia, their reduced impact on safety and security and on privacy.
- Omega stressed that the most crucial aspect that required a deep and radical change is the U-space, which should be based on the rethinking of privileges already established in the air space.
- The Swiss Federal Office of Civil Aviation noted that whereas the roadmap pointed to a broad selection of potential societal concerns, positive societal and political externalities such as drone applications contributing to the digital transformation of businesses should also put forward to ensure a fair presentation of the issue.
- One citizen and UECNA complained that noise control was not mentioned in the Roadmap and feared that the development of drones, especially in the mobility and transport sector, may have a negative impact on citizens health.

Guarantee their widest possible social acceptance

- All contributions mentioning social acceptance endorsed this EC objective, as the low social acceptance of drones is seen as a major challenge.
- GAMA stressed the need for supporting the societal but also the local administration acceptance of UAS operations in urban and non-urban areas and for Regional/Urban Air Mobility.
- All called for effectively engaging and consulting incubators local communities from the outset, to increase public acceptability, accelerate the ecosystem's implementation in cities, and inform on drone regulatory developments. They insisted on the need for a better communication (e.g. investing in proactive campaigns) to and engagement with citizens, explaining the drones benefits for the society, while addressing the related concern that affect social acceptance (from privacy to affordability to environmental and noise concerns).
- ACI EUROPE complained that a number of projects with significant potential to foster development of UAS services struggled to get off the ground due to lack of support from local, regional and/or national authorities, partly due to the slow evolution of regulations and/or tried and tested (as well as certified) technology and its use cases. It hence called for an official European endorsement for companies or consortia working on demonstrators / test flights aiming to demonstrate the feasibility of UAS, operational procedures and use cases to secure the necessary support from competent local/national authorities.
- The Drone Office company and UAV DACH e.V. suggested that the Strategy expressly stressed the positive impact on end-users' industries and citizens, thus tackling the social acceptance hurdle.

Address obstacles to the development of new drone applications and transport services and to the competitiveness of this industry

- Concerns were raised for the lack of support of regional and/or national authorities to projects with significant potential to foster development of UAS services.
- EREA found the link missing with multimodality and link with city infrastructure observing that the infrastructure in the city (including vertiports) will need to change to support drone

operations. To reach EC's goal of developing new types of services and capabilities along the value chain, multimodality was deemed key, linking drones to other transport modes and their infrastructure.

- SKYPORTS particularly emphasised the necessity to further develop the framework to enable permanent, commercial drone delivery operations at scale as well as addressing all aspects of advanced air mobility.
- DRONEA welcomed the adoption of the Sustainable and Smart Mobility Strategy and its Action Plan, which introduced the Concept of Green and Digital transformation in a European perspective, considering them as valuable complements that will enable drones contribute to a new Level of sustainable services and transport.
- HHLA Sky listed a number of precise obstacles to be addressed, as remaining regulatory and organizational challenges to realize our drone economy's full potential, starting from the need to contribute to the implementation of the European Green Deal.

Synergies between civil, defence and space industries

- Contributions welcomed that the roadmap addressed civil/defence and space synergies, C-UAS & military use of drone as part of the Strategy. Also the fact that counter-drone systems are explicitly named in the document was positively perceived.
- Mixing military and commercial use of drones was identified as a main risk in this regard, as it could be counterproductive for social acceptance. To avoid that, it was stressed the need to carefully distinguish the civil and military use of drones in the strategy, but also to foster close cooperation between military and civilians and include the space sector for the targeted consultation (WING).

Ensure legal and technical certainty based on a harmonised EU approach / Support technical harmonisation

- Harmonisation was welcomed as it ensured that a drone operator from one Member State could operate in another as easily as in the country in which it is based. DMAE argued that harmonisation is not yet achieved.
- EBF stressed the need of preventing different *modus operandi* in different EU countries and was concerned that U-space, if left to the MS, would end up creating competition between operators because of the different national legislations. It hence called for more central guidance.
- Boeing believed that an international perspective was key, so as to ensure the greatest levels of harmonisation possible – ensuring that any framework facilitates the free flow of products and services.
- GAMA pointed out that the Strategy should support the development of the required infrastructure, including vertiports and U-space-enabling ATM capabilities, in a consistent way across the EU.
- Stichting Space53 and KNVvL stressed that national differences in (interpretation of) rules and legislation withhold cross-border business. The latter complained that differences between countries would not be solved with the new rules and pointed out that differences between the countries still existed, especially in the zoning and prices of the various applications, level of cooperation between military and civilians. It therefore called for clarification.

Increase cooperation between stakeholders

- RATP Group welcomed the objective of increased cooperation, emphasising that new governance models are needed to set to launch the UAM industry and address its complex and interdisciplinary needs. Collaboration between manufacturers and industrial partners, urban public transport operators, infrastructure providers and regulatory authorities and urban

policies makers is a must. These open pluri-disciplinary collaborations are key in ensuring the ecosystem launch based on the safest and most secure operational levels.

Support research and infrastructure initiatives

- Research institutions particularly welcomed the objective of supporting research, highlighting the need to provide access to test sites in multiple locations, hence providing the possibility for gathering field experience in the controlled environment and enhance safety level and public acceptance.
- The use of simulations and flight test centres as well as pilot scenarios was deemed essential to ensure a sustainable and safe air mobility. It was highlighted the need to foster the use of existing test centres and the creation of new test sites, support pilot projects to accelerate the phase of market introduction of technologies, provide a mechanism for technology transfer from Research Establishment to Research Industry, in particular to SMEs, as well as to adjust research infrastructure to UAS test-need according to new regulations.
- RATP Group purported that in order to transition between testing vehicles prototypes and flight demonstration into operating a network of vehicles at scale by 2030, real life areas or incubators were needed.
- Stichting Space53 observed that the Strategy 2.0 should create the conditions for research, development and application of drone technology without unnecessary limitations.

Proposing new legislation

- Some contributors identified areas for legislative actions: EuroUSC Italia ltd suggested that the Strategy should complete some aspects not yet fully covered to implement the existing regulations and other Union's policies. To this end, it proposed a number of amendments to the existing framework.
- Skyports, DJI, and DMAE recommended that the Strategy should focus, inter alia, on further developing the conditions and framework for the operation of UAS in the Specific and Certified categories, exploring how manned and unmanned aviation could coexist in the same airspace in the short term, particularly at low levels, and ensuring the regulatory framework remained risk-based and simple in approach.
- DMAE and AME also listed some regulatory gaps/major issues to be addressed.
- According to ITG, the forecasts for civil drones' traffic should be updated frequently in order to provide a reliable and accurate view at short, medium and long term and the elaboration of AMCs and guidance material must be speeded up in order to deploy U-space as well as to develop vehicles compliant with the high-standard performance levels required for safe operations.
- GAMA mentioned the need to focus new rules on increase automation and AI.
- EREA contended that rules for emergency/landing spots requirements were necessary, as well as minimization of risk for people & infrastructures on the ground in case of accidents by adopting a clear complete framework of norms (prescriptions) and derived procedures. It also called for assessments on the environmental impact and sustainability of drone operations to ensure that drone industry was circular.
- UAV DACH e.V., ITG, Lukasiewicz, and one EU citizen called for a simplification of UAS certification and of the procedures to request permission to carry out validations, as the current requirements made it difficult to conduct proper tests in controlled urban environments.

A.2.3 Better regulation: Consultation of citizens and stakeholders & Evidence base and data collection

- The engagement of stakeholders for the Roadmap is widely welcomed. All contributors appreciated the opportunity to provide their feedback on the proposed Roadmap and wished to assist with future stages of its development, often demanding to be included in the consultation process announced in the document.
- CER noted that it was of utmost importance to involve the drone users in the regulatory process in order to ensure the return of experience of the particular domain being appropriately and comprehensively taken into account and fully understand the market, its needs and problems.
- EUROCONTROL expressed concern that the study as described in the Roadmap was too narrowly focused and called for actions to ensure that a drone operator from one Member State could operate in another as easily as in the country in which it is based.

A.3 Open Public Consultation (OPC)

The aim of the Open Public Consultation was to collect views of stakeholders on drone operations and drone services and to identify possible policy options for the Drone Strategy 2.0.

The public consultation was launched on 8 October and stayed opened until 31 December 2021.

Overall, 258 contributions were submitted, 126 by individuals and 132 by organisations. Most of the answers were submitted by respondents from Estonia (43: 17%), Germany (41: 16%), Italy (33: 13%) and Belgium (26:10%).

Respondents were asked to indicate in which category they are engaged. “EU citizen” was the largest participating group with 48%. “Company/business organization” (25%) was the second largest participating category, while “Business association” and “Public authority” jointly came as third largest participating category with 5,86% of the replies. The category of “Academic/research Institution” followed closely with 5,08%.

Respondents were asked to indicate in which sector(s) they are engaged. Choosing multiple sectors was permitted.

‘Individuals’ was the largest participating group with 19% of the respondents. ‘Drones Operator’ was the second largest group with 17%, closely followed by ‘Drone Pilot’ with 13,5%. The following categories: ‘Aircraft design, manufacturing, or maintenance’, ‘Non-Governmental Organisations’, ‘Research organisation/university/consultancy’, ‘Recreational aviation’, ‘Stakeholder/industry association’, and ‘Aviation professional (working in the aviation industry as a pilot, crew member, controller, etc.)’ – collected similar shares ranging between 6 and 5 % of respondents.

Sectors	Replies
Individuals	109
Drone Operator	99
Drone Pilot	78
Aircraft design, manufacturing, or maintenance	37
Non Gov Organisations/Research organisation/university /consultancy	34
Recreational aviation	33
Stakeholder/industry association	32

Aviation professionals (pilot, crew member, controller, etc.)	31
Aerial work	23
Commercial Air Transport	18
Training organisation for aviation professionals	16
Local or Regional authorities	15
U-space service providers	11
Air navigation service providers	9
Qualified entity, or other organisation officially recognized by the NAA	9
Aerodrome operators	8
Business Aviation	7
Common Information Service providers	7
National regulators	5
Telecom operator	2

The questionnaire had 60 questions of which 53 were compulsory and 7 were optional. Generally, the structure was a series of closed questions followed by optional open-ended questions to specify the answers provided in the closed questions.

The questionnaire was divided into three subtopics:

- (1) Conditions to allow new forms of smart and sustainable mobility and aerial services, including their social acceptance.
- (2) Assessment of the current drone regulatory framework. This subtopic was divided between the assessment for the ‘open’ category, for ‘specific’ category and finally for both the ‘open’ and ‘specific’ categories.
- (3) Additional issues to be addressed in the Strategy.

Each subtopic was presented to the respondents with a preceding section explaining the present situation and introducing the rationale behind the questions. At the end of each subtopic, the respondents were given the opportunity to provide further feedback through a free-form text box if the so wished.

The comments collected in this consultation have been summarised and structured in order of appearance in the questionnaire. Opinions outlined in the present report do not necessarily reflect the view of the Commission.

A.3.1 Presentation of responses

A.3.1.1 Conditions to allow new forms of smart and sustainable mobility and aerial services, including their social acceptance

There was a consensus that safety (98%) and privacy (89%) should be priority.

However, a majority (59%) of respondents believed that the general public did not have sufficient access to safety and security information related to the use of drones.

In addition, there was widespread support (79%) that the general public should be more informed on the environmental aspects related to the use of drones (noise pollution, visual disturbances, etc.).

A majority of the responders (65%) disagreed that drone operations should initially involve only non-commercial operations (e.g. air ambulances, disaster relief, firefighting, crowd control, etc.).

A majority of the respondents (54%) disagreed that companies were sufficiently informed of efficiency gains provided by drone services.

A majority of the respondents (71%) agreed that urban air mobility could provide good alternatives to ground transportation for goods, persons and should always be integrated in the overall mobility offer proposed to the public.

A large majority of the respondents (83%) stressed that pilot projects should be run in parallel in different cities across the EU to enhance public trust.

There was widespread support (67%) that disturbance by noise perception, perceived vibrations and visual disturbances would negatively impact social acceptance.

There was a general opinion (88%) that drone companies should closely work with regulators, local governments and communities to ensure community engagement.

A large majority of the participants (78%) agreed that regulatory measures should ensure that noise related issues are addressed (corridors for drone, hours limits, size of drones, etc.).

A large majority of the participants (84%) also stressed that regulatory measures should ensure that drones are compatible with EU privacy law.

A majority of the participants (58%) disagreed on the statement that every city could currently easily accommodate vertical take-off and landing operations.

A majority of the respondents (74%) supported the idea that urban design development should start taking into account drone operations in order to facilitate their operations.

There was widespread support (74%) that there was a need to develop new types of intermodal infrastructures, including vertiports, to support Urban Air Mobility operations.

Respondents highly agreed (87%) with the statement that cooperation mechanisms between various level of authorities should be established for authorisation of operation of drones in urban area.

A large majority of the participants (84%) considered that U-space airspace services (e.g. network identification service, a geo-awareness service, an Unmanned Aircraft System (UAS) flight authorisation service and a traffic information service) should allow the safe integration of manned and unmanned aircraft operations.

A majority of the participants (72%) supported the statement that U-space airspace services should be available in every urban area.

There was a general (89%) agreement that drone services would have an impact on skills, and new training offers adapted to the smart mobility and drone services should be made available.

90 respondents provided additional input in the open-ended question. Many respondents (10) pointed to the need to create an adequate testing environment and flight approval mechanisms. On U-space, some respondents expressed the views that measures were needed to ensure safety and solve externalities while other expressed the concern that such measures would be overly restrictive. A few respondents also raised the question of the costs of the integration of drones in the airspace and the interaction with existing airspace users.

A.3.1.2 Assessment of the current regulatory framework

A.3.1.2.1 The Drone Regulations (R945/R947) from the perspective of operations in ‘Open’ category

A majority of the participants (65%) considered that the new drone Regulations had contributed to clarify the conditions of operations for small drones of less than 25 kg.

A majority of the responders (60%) agreed that the national registration system was easy to use.

46% of the participants disagreed or strongly disagreed that the provision of drone safety information by the competent authorities and guidance was sufficient while 42% of participants agree or strongly agreed on this.

A majority of the respondents (61%) shared a view that transition measures allowing the use of non C-class label drones were useful.

Most respondents (62%) agreed that drones meeting the requirements of the Open Category would be available.

A small majority of the participants (51%) considered that definition of drone geographical zones was appropriate

A majority of the respondents (65%) shared the view that the EU drone legislation provided adequate protection to citizens from risks and concerns related to safety and security.

A majority of the participants (60%) considered that the EU drone legislation provide adequate protection to citizens from risks and concerns related to privacy.

Most of the participants (55%) considered the EU drone legislation provide adequate protection to citizens from risks and concerns related to noise.

Most of the respondents (55%) agreed that Provisions regarding remote pilot competency for recreational operations were easy to apply

70 respondents provided additional input in the open-ended question. A majority of respondents pointed to a lack of Guidance Material and harmonized implementation of the Regulations across Member States. In addition, respondents indicated that geographical zones were not ready in many Member States. Respondents pointed to the issues with standardisation and CE marking. Respondents indicated the lack of knowledge of the Regulation among drone users, resulting in the need to reinforce pilot competency, through communication and improved training. In addition, guidelines on safety should be accompanied with physical protection mechanisms.

A.3.1.2.2 The Drone Regulations (R945/R947) from the perspective of operations in ‘specific’ category

46% of the respondents agreed that the new drone regulations were fit for conducting professional activities while 34% disagreed with this.

42% of the participants considered that all types of drone services could be fitted under the drone regulations while 36% disagreed with this.

A majority of the participants (60%) considered that the procedure for receiving an authorisation for a drone operation was not easy.

36% of the respondents disagreed that drone operators from one Member State could easily operate in another Member State while 34% agreed with this statement. 30% had no opinion.

40% of the responders disagreed that the availability of drones/equipment meeting the requirements of the ‘Specific Category’ was adequate while 33% agreed with this statement. 26% had no opinion.

44% of the responders considered that the provisions regarding remote pilot competency for professional operations were adequate. 33% disagreed while 23% had no opinion.

A majority of respondents agreed that the drones rules provided adequate protection to citizens from risks and concerns related to safety

There was a general agreement that drone rules provided adequate protection to citizens from risks and concerns related to security.

A majority of stakeholders also agreed that drones rules provided adequate protection to citizens from risks and concerns related to privacy.

A majority of respondents disagreed on the statement that the system of declarations under the light UAS Operator Certificate could be used easily.

59 respondents provided additional input in the open-ended question. Respondents pointed to the lack of drone equipment meeting the requirements of the ‘specific’ category, notably SAIL III and IV. Respondents expressed concerns regarding the implementation of the Regulation and varying interpretations among Member States. In addition, respondents pointed to the issue faced by operators to obtain authorization for flight-tests outside the Member State of registration. Finally, respondents notified issues in obtaining a light UAS operator certificate and suggested that the Drone Strategy 2.0 should envisage faster authorisation procedures with Standard Scenarios.

A.3.1.2.3 Other issues in relation to the ‘Open’ and ‘Specific’ categories in the drones regulation

66 respondents provided additional input. Some respondents indicated that the Regulations should to be reviewed once they will have been fully implemented. Other participants stressed that UAS operations for research and testing ought to be better considered in the Regulations. Respondents recalled the need to focus on local and regional authorities’ role in facilitating operations. Respondents also recalled the need to accelerate the creation of industry standards, facilitate the obtention of a Light UAS Operator Certificate. Respondents also pointed to security risks stemming from airspace segregation and the necessity of creating convergence between Unmanned Aircraft System Traffic Management (UTM), U-space and classic Air Traffic Management (ATM).

A.3.1.2.4 Additional issues to be addressed by the forthcoming Drone Strategy 2.0

A majority of the responders (59%) supported the statement that the use of renewable and clean energy should be obligatory.

A majority of respondents (54%) stated that the environmental impact of drone operations (noise, emissions, visual nuisances) was not adequately assessed nor addressed.

There was a strong support (85%) on that the drone industry should be subject to circular economy principles (reuse of batteries and recycling of equipment).

A majority of the respondents (61%) agreed that drones may posed issues on ethical values in certain cases (e.g. use of Artificial Intelligence).

A large majority of the participants (82%) agreed that rules for emergency/landing spots requirements should be established.

A majority of the respondents (73%) agreed that there was a need to generate synergies and technology transfer between Small and Medium Enterprises.

A large majority of the participants (90%) agreed that use of new Information Technologies should be assessed in terms of cyber security.

In addition to the closed questions, 57 respondents provided additional input. There was a contrast between respondents who supported the inclusion of sustainability requirements and respondents who considered that introducing such requirements would generate burden of costs that would hinder the development of the sector. As a third way, respondents suggested to “encourage” rather than making such sustainable requirements mandatory. Respondents recalled the importance of developing harmonised standards, notably for emergency landing sites and for vertiports. Respondents noted the importance of addressing cybersecurity threats, AI technology and 5G interference. Respondents pointed to the need to identify UAS in a drone digital network to enable remote identification and the exchange of navigational data.

A.4 Drone Leaders’ Group (DLG)

In the wake of the preparation of a ‘A Drone Strategy 2.0 for a smart and sustainable unmanned aircraft eco-system in Europe’ and in addition to the regular channels of communication, such as the Drone Informal Experts Group, the Commission called on a group of representatives from 26 organisations and trade associations including Drone manufacturers, U-space Airspace Service Providers, drone operators, manned aviation, European Parliament, NAA’s, UIC², EASA, SESAR JU, EUROCONTROL, EDA to give a high-level steer to the development of the Drone Strategy 2.0 and provide recommendations for its drafting.

The DLG developed a High-Level Vision and an ambitious pathway, with concrete objectives articulated over 8 thematic areas in order make Europe a global leader in this area. It concluded its activities on 26 April 2022 delivering a report containing a number of findings and recommendations which is available here:

[Drone Leaders’ Group supports preparation of Drone Strategy 2.0 \(europa.eu\)](https://europea.eu).

A.5 Targeted surveys and Interviews

The targeted survey conducted by the external contractor was open for two months, with the launching date on 29 October 2021 and the survey closing on 31 December 2021. A longlist of respondents was selected and invited to participate in the survey. In addition, the survey was distributed by some associations (for example: ACI Europe and CANSO) to their members. This resulted in a total of 198 registered responses of which 103 respondents completed the full survey.

The survey provided a broad geographical coverage, with respondents from all over Europe. The following countries were well represented (> 5 respondents): Belgium, Switzerland, Italy, Lithuania, and Germany. The survey also obtained several responses beyond Europe, from organisations located in the United Kingdom, United States and Turkey.

The responses provided a good coverage of the stakeholder groups. Responses came from national authorities (41); manufacturing industry (40); drone operators (22); NGOs (18); airport operators (17); military (15); research and academia (13); air navigation service providers (12); aircraft operators (11); U-space providers (9); staff associations (7); EU institutions (5); law enforcement (4) and inter-governmental institutions and networks (2).

A total of 25 targeted interviews were carried out by the external contractor, as presented in the Table below, reflecting the distribution over the stakeholder groups. The results of the interviews were used to complement the survey results, as input for the analysis.

Stakeholder group	Interviews
National and regional authorities	Italian Civil Aviation Authority

Stakeholder group	Interviews
	BMVI (Germany)
	Ministry of Infrastructure and Water Management (The Netherlands)
	Portuguese Civil Aviation Authority
	Norwegian Civil Aviation Authority
	PSE S.A. (Polish Government)
Military and Law enforcement	Defence Forces Ireland
	Drones4sec
Commercial and non-commercial aircraft operators	European Air Sports
Drone operators, service providers and users	European Aerospace Cluster Partnership
	Platform Unmanned Cargo Aircraft (PUCA)
	Drone Alliance Europe
	Wing
	Alliance for New Mobility Europe
Airport operators and Air Navigation Service Providers (ANSPs)	CANSO
	ACI Europe
U-space providers	GUTMA
	Unifly
	Droniq
Manufacturing industry	DMAE
	Lilium
	Thales
Non-Governmental Organisations (NGOs)	Accirclate SPRL
Research and academia	Joint Research Centre (JRC)
	Drones Observatory at Politecnico di Milano

A.6 Targeted consultations – presentation of responses

A.6.1 European drone ecosystem, value chains and business models

The drone industry and related services are developing rapidly across the entire drone ecosystem. These developments in the drone ecosystem might open new prospects for using drones and thereby result in different value chains and business models. These developments are taking place

in a policy environment that is focused on drones contributing to the digitalisation of the EU economy and providing a safe and sustainable mode of transport, for both persons and goods.

A.6.1.1 Trends and developments

A.3.1 presents the results of the question “what trends and developments are accelerating the evolution of the drone market in Europe?”⁸⁶ These trends and developments are sorted on a high to low impact. Participants expected slightly to highly positive impact from all developments that the sector is facing. Respondents expected the highest impact from technological developments (83% of the respondents, 123 out of 148) and the development of a regulatory framework (73%, 108 out of 148) of the drone market in Europe.

A.6.1.2 Opportunities in the European drone ecosystem

The drone industry stakeholders were asked to shed their light on the growth opportunities of different use cases (see A.3.1).⁸⁷ The growth opportunities per use case are sorted from high to no growth. The results revealed on the one hand that respondents expect the highest growth in the following three use cases: inspection (83%, 119 out of 143), public mission (80%, 115 out of 143) and surveillance (79%, 113 out of 143). On the other hand, the majority of respondents (62%, 88 out of 142) expected either limited (51%, 72 out of 142) or no growth (11%, 16 out of 142) in the field of person mobility.

Participants were also given the option to fill in the category ‘other’ and provide their growth expectation. Several respondents (n = 5) indicated that high growth is also expected in the entertainment industry (e.g. filming, photography, etc) and environmental monitoring (n = 3).

A.6.1.3 Barriers in the European drone ecosystem

The stakeholder consultation process indicated several barriers that the European drone ecosystem is facing nowadays. The targeted survey has identified the comparative strengths of the EU drone industry and scored the factors listed below on EU competitive (dis)advantage.⁸⁸ Highest in this respect was the presence of an enabling regulatory framework (47%) and lowest was the effective civil-military collaboration (18%). A large number of respondents perceived these factors as neither an advantage nor disadvantage, ranging from respectively 22% (24 out of 108)⁸⁹ to 45% (50 out of 108)⁹⁰. When asked whether existing or foreseen value chains create dependencies to third States⁹¹, a substantial number of respondents (44%, 39 out of 88) were neutral on dependencies to third States. Stakeholders explained that business development is rather irrespective of geography, but directly linked to the service and product capabilities. Also,

⁸⁶ DS 2.0 Targeted Survey (2022), Questions 8: In your view, what trends and developments are accelerating the evolution of the drone market in Europe?

⁸⁷ DS 2.0 Targeted Survey (2022), Questions 9: “In your view, what is the growth potential for drone applications in the sectors and fields that are listed below?”

⁸⁸ DS 2.0 Targeted Survey (2022), Questions 17: “What are the comparative strengths of EU industry in drones compared to global competition?”

⁸⁹ Related to an enabling regulatory framework.

⁹⁰ Related to technology readiness.

⁹¹ DS 2.0 Targeted Survey. Question 25: “Are the existing or foreseen value chains creating dependencies to third states?”

the economic system has (to a large extent) outsourced the production of parts and materials outside Europe. The supply chain of drones is thereby similar to other technology sectors.

A.6.2 Regulatory framework

A.6.2.1 General setting

Stakeholders generally agreed that further development and implementation of the EU regulatory framework is needed to contribute to delivering the objectives of the DS 2.0. The strategy should be focused on equalising and minimising drone related rules and legislation across the EU, without leaving too much space for Member States to divert from the EU principles⁹².

A.6.2.2 Implementation of Regulation 1139/2018, Regulation 945/2019, and Regulation 947/2019

According to a wide majority (71%, 141 out of 198) of the respondents of the targeted survey, the Regulations facilitated the development of the drone industry and market. However, there are still issues to be complied with and requirements are considered complex; some remarks made by respondents were reported as such:

- It takes a lot of time for national authorities to implement the regulations; the framework is incomplete until Acceptable Means of Compliance (AMC) and Guidance Material (GM) are available.
- Airworthiness assessment need to be pushed down to Member State level again⁹³.
- Enhancement of capacities of national authorization bodies and strengthening of the governance framework are needed⁹⁴

It is widely agreed among respondents of the survey that the new basic aviation safety regulatory framework and the detailed rules for unmanned aircraft design and operation guarantee the safe operation of drones (65% ,128 out of 198). Only 8% (15 out of 198) of stakeholders consulted disagree. Drone operators active in the Open Category consulted through the OPC, widely recognised positive impacts of the Regulations on the drone industry and market being: having clarified the conditions of operations for small drones of less than 25 kg (66%, 170 out of 258, agree); providing useful transition measures allowing the use of non-C-class label drones (61%, 157 out of 258, agree); defining appropriate drone geographical zones (52%, 134 out of 258, agree); providing adequate protection to citizens from risks and concerns related to safety (66%, 170 out of 258, agree), security (65%, 167 out of 258, agree), privacy (60% , 154 out of 258, agree), noise (55%, 142 out of 258, agree).

A.6.2.3 Regulations on U-space (664/2021, 665/2021, 666/2021)

Around two thirds of stakeholders (63%, 124 out of 198) consulted with the targeted survey considered that Regulations on U-space will facilitate the development of the drone industry and market. Existing obstacles in the implementation of the new framework were underlined as follows: the Regulations have not provided sufficient clarity on the future evolution of the

⁹² As indicated by a Manufacturer and two Drone Service Providers.

⁹³ Drone Service provider.

⁹⁴ Drone Association and Drone Service Operator.

Unmanned Aircraft System Traffic Management (UTM) service provision framework with specific reference to U-space in controlled airspace, since safety risk is being managed through the segregation of manned and unmanned operations with different respective airspace managers. There is no clear legal basis for designation of a single provider of common information services on which safe operations – manned and unmanned – can be based⁹⁵. Air Traffic Control should be given the mandate to provide separation for drone flights; the U-space Regulations in their current versions are not designed to enable scalable traffic. The focus on strategic pre-planning, which ensures that only one drone operation at a time can take place, is not a viable solution for drone operations in greater numbers^{96[99]}. According to a National Authority interviewed and ‘Other’ stakeholders, the intervention of EASA is necessary, at a framework level, while leaving some flexibility and room for manoeuvre to Member States. For instance, common criteria, at the level of AMC should be defined by EASA, to implement Art. 15 of Regulation 2019/947 and request the setting of geo-zones in a harmonised way, but then the specific decisions on geo-zones should be left to Member States.

A.6.2.4 Technological challenges

Drone Service providers consulted (interviews, written contributions) generally consider the European regulations too strict and complicated to enable easy implementation of experimental activities. The application processes and the technical requirements are too high in certain areas, procedures are too lengthy and cost burdensome. The lagging of the development in the regulation of use cases that are more interesting from the business case point of view is remarked. More specifically, further development of the rules framework to enable permanent, commercial drone delivery operations at scale as well as addressing all aspects of advanced air mobility, is needed. Regulations should be used to create a climate for innovation. National differences in (interpretation of) rules and legislation withhold cross-border business⁹⁷. It was also remarked that EASA should become responsible for certification and operation. A clear and complete framework of norms (prescriptions) and derived procedures are deemed necessary to be adopted to regulate emergency/landing spots requirements, so as to minimize risks for people and infrastructures on the ground in case of accidents. A military aviation authority consulted through the targeted survey, pointed out that AMC and GM for Type 1 ops / 'SORA for certified category are still missing.

A.6.2.5 Military/Civil coordination and cooperation on drones

Stakeholders consulted through the targeted survey were generally unaware (61%, 120 out of 198) and did not know 15%, 29 out of 198 disagreed) whether Member States and third countries with a considerable drone industry have a regulatory framework enabling civil-defence synergies. Stakeholders interviewed stressed out that drone regulations (2019/945 and 2019/947) are not contributing to the alignment and use of synergies between civil and defence industry; UTM services and design of airspace are not conceived to fit both military and civil applications⁹⁸. Some of the stakeholders interviewed⁹⁹ mentioned that the military interests on drone are expected to remain very high in the future and military investments will most likely continue to

⁹⁵ A Service Provider.

⁹⁶ Drone Association.

⁹⁷ Airport operator, Drone Service Provider, Research Institute.

⁹⁸ A representative from the manufacturing sector.

⁹⁹ NGOs and other Strategic Business consultants.

grow. They stated that the military have also expressed a keen interest on Environmental Sustainability and Circular Economy and this could represent an opportunity for including the drone sector (EDA is very active in this). With regard to the use of drones for EU border surveillance needs, Regulation (EU) 2019/1896 enhances the mandate of the European Border and Coast Guard Agency ('Frontex') with respect to external border control. The EU should explore the possibility of bringing flights carried out in the public interest by EU agencies (such as Frontex) within the scope of Regulation (EU) 2018/1139.

A.6.2.6 Other regulatory challenges

Enquired as to whether the existing regulatory framework restricts the drone industry and market, 37% (73 out of 198) of the respondents to the survey, indicated this as an obstacle which hinders lawful drone use, 29% (57 out of 198) mentioned unclear allocation of liability and insurance rules, insufficient level of protection on privacy and data (15%, 29 out of 198), insufficient level of protection of the environment (12%, 23 out of 198), and not being able to maintain a high level of safety and security (12% 23 out of 198). OPC respondents confirmed that further actions are needed at the regulatory level in the following areas: to improve the cooperation of drone companies with regulators, local governments and communities to ensure community engagement (88%, 227 out of 258); address noise related issues (corridors for drone, hours limits, size of drones, etc.(78%, 201 out of 258); ensure compatibility with EU privacy law (84%, 216 out of 258); allow urban design development to take into account drone operations (74% 190 out of 258); establish cooperation mechanisms between various level of authorities for authorisation of operation of drones in urban area (87%, 224 out of 258), .

OPC respondents recommended the following regulatory actions:

- Ensure a regulatory framework which fosters innovation, enable confidence in business and public-support decisions, and ensures safety and security.
- Consider the Circular Economy, in particular on Critical Raw Materials (CRMs) and Rare Earth Elements REEs (REEs) and Waste (e.g. End-Of-Life Vehicle, Waste Electronics).
- Work on GDPR regulations and anti-drone systems.
- Provide regulatory and funding certainty to the emerging mobility industry.
- Reach a first step of regulation to enable first levels of business services; regulate share airspace use.

Stakeholders¹⁰⁰ stated that rules in place on environment protection do not seem to cope with environmental concerns linked to the use of drones. An interview with a stakeholder revealed that the expected major direct and long-term environmental impacts of the drone industry are not yet sufficiently and properly addressed by the European legislation and the industry standards. In particular concerning the need of alignment of the drone sector to the Circular economy principles.

In relation to obstacles identified in the EU wider regulatory framework having an impact on the deployment of drones, market operators interviewed and consulted through the survey expressed concerns about the existing privacy frameworks (GDPR), which does not consider drones and non-consented data collection¹⁰¹; the Product Liability Directive which is considered a

¹⁰⁰ Interviews with Service providers and other stakeholders (business and strategic consultants), and respondents to the Survey and OPC,

¹⁰¹ A drone service operator.

cumbersome instrument that does little in relation to new technologies and increasing relevance of software¹⁰².

Respondents stated that the Regulations should permit the use application of drones to the phytopharmaceuticals sector, which would, in their opinion, be a major step forward for smart farming, thus towards compliance with the European Green Deal¹⁰³.

A.6.3 Technology building blocks

A.6.3.1 Technological development and components

The targeted survey shows that supporting technological development is ranked third (65%, 79 out of 122) in terms of priority action areas for the development of the DS 2.0. Over half (54%, 36 out of 67) of the survey respondent considered that technological requirements are required today to improve drone operators. The top 5 technological drone components mentioned by the survey respondents were: detect and avoid (80%, 49 out of 61); flight control systems (70%, 43 out of 61); command and control link (67%, 41 out of 61); embedded AI platforms (62%, 38 out of 61); and GNSS (59%, 36 out of 61).

A.6.3.2 Barriers towards technological development

Barriers to technological development were identified as a mix of technological aspects (maturity level too low, reliability), production aspects and legal aspects related to the use of the technologies, operational problems and new needs. Some barriers mentioned were as follows:

- Difficulties to develop, implement and deploy technologies that need regulations to be used; BVLOS and counter drones are two technologies that are often mentioned by stakeholders¹⁰⁴.
- Technical requirements are not harmonized between countries, both in civil and military domains. This is seen as a competitive disadvantage for European companies.
- Having different standards, including in the civil and military markets, results in market limitations.
- Technical requirements are too complex, there is a need to simplify requirements¹⁰⁵.
- Having different standards in the civil and military market results in market limitations.
- Raw material shortage, electronic parts mostly, is considered by stakeholders as a barrier¹⁰⁶.

A.6.3.3 Civil-military collaboration

28 % (16 out of 58) of the respondents to the targeted survey both agreed and disagreed (equal score)¹⁰⁷ that there are barriers to the development of dual-use drone technology. Respondents often mention the lack of common standards between the civil and military world as a current barrier. Besides barriers, recommendations were made by survey respondents. In general,

¹⁰² Other (Business Strategic consultants, Research Academy.

¹⁰³ Other: Farmers Association.

¹⁰⁴ See OPC, DS 2.0 Targeted Survey (2022),

¹⁰⁵ Ministry of Transport from European Member State.

¹⁰⁶ OPC.

¹⁰⁷ The balance (44%, 26 out of 58 did not know).

stakeholders stated that drone technology has often been pioneered in military settings; providing valuable input for civil-military collaboration. The vast majority (68%, 40 out of 59) of respondents consider that military technology development would benefit civil technological development. The following military to civil technology transfers were mentioned: counter-drones, communications, sensors, DAA, swarming and UTM. On the other hand, 62% (36 out of 59) of the respondents mentioned that the military sector could benefit from civil technological developments.

Multiple stakeholders in the targeted survey mentioned that although the background and culture (between the civil and military sectors) may be different, civil-military collaboration could bring benefits to both sides. The following recommendations were made by stakeholders: (i) mandate an organisation to take the lead in the standardisation process of technical requirements, with the objective to bring interoperability; (ii) exchanges of hardware parts from military systems and dual use civil-military hardware could reduce the costs on both sides by increasing the production capabilities; and (iii) grant innovation military budgets only if the targeted technologies are for dual use.

A.6.3.4 Future considerations for technological developments

- Stakeholders indicated a range of considerations for future technological developments¹⁰⁸¹⁰⁹:
- Many comments from the survey respondents focused on the need to developing technologies and the associated regulatory framework in parallel, as these aspects are interrelated
- Stakeholders indicated that the development of the EU drone industry and market is dependent on external components and know-how. As such, the EU is lacking strategic autonomy (45% agreed or strongly agreed, 44 out of 98, while 21% disagreed or strongly disagreed, 21 out of 98).
- The current lack of standards needs to be addressed in order to support economic activities and promote interoperability.
- In order to further develop drones as means of passenger transport, the following technological developments should be pursued: propulsion, situation awareness systems, advanced detection and collision avoidance with existing flying objects.
- Stakeholders indicated the need to focus on innovative projects where on-board fused data is developed. This will help several fields, such as surveillance (detection, cross-cueing) and reduce datalink weakness (mix between GNSS, cellular, radar).
- BVLOS is an important aspect that needs to be further developed to facilitate use cases, such as inspections, surveillance and transport of goods. These use cases are currently restricted because of risks related to low altitude and high-speed flights.

A.6.4 System resilience and non-cooperative drones

Drones are a new, fast-growing, and affordable technology, which pose various risks and are of major public concern due to potential unsafe operation, damage to people and property.¹¹⁰ Almost

¹⁰⁸ Many considerations were mentioned in the targeted survey, with a dedicated section on technology building blocks.

¹⁰⁹ This constitutes a selection of future considerations mentioned by stakeholders in the targeted survey.

¹¹⁰ OPC.

all stakeholders¹¹¹ were aware of the risks and threats that non-cooperative drones pose. Unauthorized drone flights remain a problem, especially around commercial airports, and critical infrastructures. They endanger passengers and aircraft crews and can lead to short-term disruptions of air traffic, closures of entire airspaces or airports, and even to the total loss of an aircraft. Unauthorized drone flights in the approach and departure areas of an airport pose the greatest potential hazards and risks. There are cyber and physical security issues that are being addressed effectively enough in traditional aviation but pose many challenges for drones. Drones can easily bypass existing security measures applicable to aviation security. Protecting drones from cybersecurity risks is another important challenge since they can be targets for a cyber-attack themselves just as they risk being used as potential attack vector.¹¹²

A.6.5 Main threats of drones

The main threats and/or risks posed by non-cooperative drones were perceived to be those of ‘illegal and criminal intent’ with 72% (71 out of 89 responses) of respondents indicating the risks arising from these uses. The risks from reckless use and terrorist attacks were lower with 63% (62 out of 89) and 62% (61 out of 89) respectively. On the other hand, 56% (55 out of 89) of the respondents suggested that amateur use was also a risk posed by non-cooperative drones. However, there was no clear distinction amongst the respondents between reckless use and amateur use.

A.6.6 Types of risks

As regards types of risks and levels of threats, it was suggested that these are the ‘inability of operators to decode, comprehend and comply to the overly complex EASA regulations; system failures, untrained pilots or even an unsafe condition for flights; espionage, state sponsored as well as Inability to comply to overly complex EASA regulations.’¹¹³ The main consequence of the threats around airports and other critical infrastructures is the disruption of activities/air traffic, with 92% (90 out of 98) of respondents indicating such consequence, while the second highest consequence 54% (53 out of 98) was interference.¹¹⁴

As regards the threat trends and patterns, the survey respondents 46% (37 out of 81) stated that the threat levels have increased over the past three years with 32% (26 out of 81) suggesting that the threat level stayed the same and 15% (12 out of 81) stating that the threat has significantly increased. Only 7% (6 out of 81) mentioned that the threat level has decreased. The trends in the increase of the threat level were mainly due to drones being much for accessible amongst the population hence more incidents of reckless and amateur use are administered as well as professionals not abiding by the rules set. Stakeholders also mentioned that the ‘number of incidents with drones interfering in air traffic at airports rose tremendously’ and an increase of near misses between helicopters and drones are seen.¹¹⁵¹¹⁶¹¹⁷

¹¹¹ OPC, Interviews and DS 2.0 Targeted Survey (2022),

¹¹² Views from OPC, interviews and DS 2.0 Targeted Survey (2022),

¹¹³ DS 2.0 Targeted Survey (2022),

¹¹⁴ DS 2.0 Targeted Survey (2022),

¹¹⁵ European Aerospace Cluster Partnership (EACP).

¹¹⁶ Research Institutes.

¹¹⁷ DS 2.0 Targeted Survey (2022).

A.6.6.1 Barriers

Almost half of the respondents 48% (26 out of 54) suggested that there are either technical or legal, or technical and legal barriers to using certain types of technological solutions to detect, track, identify, neutralise, and mitigate threats from non-cooperative drones. These are mostly said to be regulations that prevent the use of technologies.¹¹⁸ Stakeholders stated that current regulations that allow very light and small drones, make it harder to provide them with more reliable technical systems (such as the lack of efficient and mature detect and avoid systems). Furthermore, technical regulations, requirements and means of compliance are not fully existing in the detect and avoid solutions areas, especially for AI based systems. It was also envisaged that it is quite challenging to control air space where large aircraft are operating. Therefore, all activities in this domain should be well coordinated.

A.6.6.2 Impacts

The consultation results showed that there are indeed potential impacts of the limitations in mitigating the threat and risks of non-cooperative drones. For example, the limitation might result in a ‘slower adoption of drone services’¹¹⁹, as well as drone jamming, spoofing and guns.¹²⁰ Furthermore, there were concerns that due to the strict regulatory framework, new drone-related protective technology onboard of helicopters can’t yet be installed.¹²¹

A.6.6.3 Capacity of current EU regulation

Only 18% of the respondents (9 out of 51) mentioned that the current policies and regulations are either sufficient or very sufficient to mitigate the threat from non-cooperative drones, with 22% (11 out of 51) suggesting that the current policies/regulations are insufficient and 12% (6 out of 51) saying they are extremely insufficient. The respondents mentioned the need for neutralisation of non-cooperative drones as the detection is not sufficient to secure facilities.¹²² Furthermore, stakeholders said that regulations need to mature on various aspects (for example, communication, environmental, security etc.)¹²³ Accordingly, 52% of the respondents (37 out of 71) mentioned that an EU regulatory intervention is needed to help mitigate the threats posed by non-cooperative drones around critical infrastructure, while only 10% (7 out of 71) stated that such an intervention is not needed.¹²⁴ As regards soft measures used, almost all stakeholders stressed the importance of the implementation of soft measures such as awareness campaigns 71% (12 out of 17 respondents), better coordination and information sharing platforms 53% (9 out of 17), the use of various apps 41% (7 out of 17), and other measures such as patrolling, equipment for signal blocking.

A.6.6.4 Opportunities and good practices

¹¹⁸ DS 2.0 Targeted Survey (2022) and Interviews.

¹¹⁹ Aerospace, defence and security company.

¹²⁰ Views from airports.

¹²¹ An air rescue representative

¹²² An Industry representative.

¹²³ ADR; Air navigation services; CAA; Aviation Security Department

¹²⁴ DS 2.0 Targeted Survey (2022).

The consultation phase revealed that over half of the respondents 56% (10 out of 18 respondents) were not able to identify some good practices that are used at the EU level which can help mitigate the threat posed by non-cooperative. Only 17% (3 out of 18) mentioned that there were some good practices used in some Member States.¹²⁵ As regards specific training offered for law enforcement or relevant authorities in drone detection/tracking/identification and neutralisation 17% (9 out of 54) of the respondents mentioned that their Member State offers such training, which is in line with the rapid technological development of the drones market, while half of the respondents 50 % (27 out of 54) said there was not such a training.

A.6.7 Developing airspace capabilities: U-space development and integration with ATM

A.6.7.1 Importance, opportunities and challenges

Around two thirds (68%, 102 out of 150) of the respondents in the targeted survey identified air traffic management (ATM) systems, supporting drones as potentially having a high impact (the most severe category) on the evolution of the drone market in Europe.¹²⁶ U-space is viewed generally as a critical enabler for realisation of drone market projections in Europe by all stakeholder groups.¹²⁷

A.6.7.2 Governance arrangements

Stakeholders contended that the regulatory framework as well as the upcoming DS 2.0 should put a stronger emphasis on the multi-level governance dimension of drone and U-space regulation. In general industry and national government stakeholders are content with the Commission (as a multinational political body) steering EASA to deliver technically sound proposals.¹²⁸ One of the points raised here is that the Commission plays an important role in making sure that even during implementation of critical systems, drone policy remains integrated with all relevant EU policies, in particular associated with the digitalisation/ automation and decarbonisation agendas.¹²⁹ Metropolitan governments and local authorities indicated that they should be involved directly in setting up U-space systems, geographical drone zones and operational requirements.¹³⁰ Industry stakeholders seem particularly focused on the role of the EU regulatory framework avoiding fragmentation in implementation.¹³¹ Stakeholders also talk about the important role of the

¹²⁵ For example, the EASA repository data base as well as annual training sessions with the law enforcement authorities (police, gendarmeries) are being provided by some Member States.

¹²⁶ DS 2.0 Targeted Survey (2022) and Interviews.

¹²⁷ October 2021 Drone Leaders Group meeting; November 2021 Drone Expert Group meeting; DS 2.0 Targeted Survey (2022); interviews with a global UTM representative body.

¹²⁸ National and regional authority respondent to the DS 2.0 Targeted Survey (2022)

¹²⁹ An NGO, national and regional authority, manufacturing industry and multiple drone operators, service providers and users respondents to the to the DS 2.0 Targeted Survey (2022); supported by participants at the October 2021 Drone Leaders Group meeting

¹³⁰ Position papers and interviews with a global UTM representative body

¹³¹ In written responses and during the meeting of the October 2021 Drone Leaders Group

Commission in encouraging and facilitating cooperation during implementation between Member States.¹³²

The role of competition in U-space is a key discussion.¹³³ At least one U-space provider and one national regulator questioned the potential for service provider competition in the short term (i.e. close to 2023) given the current high barriers to entry.¹³⁴ There is a desire (particularly from the private sector actors) for simple and efficient rules.¹³⁵ They recognise competition as a key driver of: technological innovation; the effective introduction of technologies from outside of the traditional aviation sector; and price setting.¹³⁶

A.6.7.3 Funding and financing

Following on from governance and regulatory discussions are views on future funding and financing. Stakeholders (especially those directly involved in U-space implementation efforts) stated that more central sources of funding are needed to facilitate roll out of U-space in the timeframes identified by regulator.¹³⁷ Moreover, they indicated the need for funding and financing streams to target technological development and innovation practices outside the traditional aviation sector.¹³⁸ There is a group of policymakers at the national level and researchers who are particularly interested in defining payment U-space service payment systems, optimal prices/fees, revenue models and the costs to regulators.¹³⁹ These discussions are generally immature and focus on the relationship between service price, market development (towards potential) and levels of innovation in drone services.

A.6.7.4 Identified benefits

The opportunity at the centre of ongoing U-space conversations is the shift from air traffic control centric approaches to operations centric (automated) approaches, although the details of integration with existing ATM remains a key issue.¹⁴⁰ Most groups of stakeholders see the openness of the system as fundamentally important and very different to the natural monopolies

¹³² In written responses from U-space service providers and during the meeting of the October 2021 Drone Leaders Group

¹³³ October 2021 Drone Leaders Group meeting; November 2021 Drone Expert Group meeting; DS 2.0 Targeted Survey (2022) and Interviews; interviews with a global UTM representative body and U-space service providers involved in implementation activity.

¹³⁴ November 2021 Drone Expert Group meeting and interviews with U-space service providers

¹³⁵ Interviews with U-space service providers, infrastructure managers and a global UTM representative body

¹³⁶ October 2021 Drone Leaders Group meeting; November 2021 Drone Expert Group meeting; DS 2.0 Targeted Survey (2022); interviews with U-space service providers, infrastructure managers and a global UTM representative body

¹³⁷ DS 2.0 Targeted Survey (2022); interviews with U-space service providers involved in early implementation activities around cities and ports in particular

¹³⁸ Interviews with a global UTM representative body and with U-space service providers involved in early implementation activities around cities and ports in particular

¹³⁹ See for example: independent policy research discussed in the European Parliament in 2021

¹⁴⁰ October 2021 Drone Leaders Group meeting; November 2021 Drone Expert Group meeting; DS 2.0 Targeted Survey (2022); interviews with a global UTM representative body and with U-space service providers

that have dominated ATM.¹⁴¹ Traditional aviation sector stakeholders (e.g. ANSPs) tend to see the implementation of U-space differently to new service providers (in particular software based) entering the market. There is an ongoing discussion amongst stakeholders about whether UTM should deliver services to an ATM level, or whether that is an overly narrow and restrictive collective ambition in particular in urban environments.¹⁴²

Discussions about the benefits of U-space generally take two forms. The first is the safety and security benefits associated with having defined procedural and spatial practices.¹⁴³ The second is the role of U-space in facilitating the realisation of value at the drone service level.¹⁴⁴ These discussions make the identification and explanation of ‘value’ associated with U-space implementation complicated. An underlying issue is the desire for appropriate designation by Member States in order to prevent U-space being allocated where it does not bring any significant added value in safety, security, privacy or environment terms.¹⁴⁵ Effective implementation of U-space is seen as a critical activity in determining the actual economic value added, including the transition from viewing drones as transport to viewing drones as an integrated service in the value chains of companies.¹⁴⁶ Stakeholders (in particular USSPs and drone operators in fledgling U-space activities) imply the transition can only occur if automated BVLOS is effectively regulated and priced.¹⁴⁷

The long-term opportunities associated by stakeholders with U-space implementation are aligned with those identified in current policy and regulatory frameworks. Stakeholders specifically identify the need for U-space to facilitate:

- U-space as infrastructure: enabling and prioritising a diversity of operations¹⁴⁸
- Airspace taxonomy and classification based on environmental footprint and market potential¹⁴⁹
- The iterative roll out of connected corridors with a principle of achieving an environment where operations can start from anywhere (appropriate) and can end anywhere (appropriate)¹⁵⁰

¹⁴¹ Written submissions; free text comments in the DS 2.0 Targeted Survey (2022); interviews with a global UTM representative body and with U-space service providers.

¹⁴² Written submissions; free text comments in the DS 2.0 Targeted Survey (2022); interviews with a global UTM representative body and with U-space service providers (in particular those who come at the business opportunity from a non-conventional aviation/ software development perspective)

¹⁴³ See the majority of SESAR JU and EASA communications in particular.

¹⁴⁴ Written responses and interviews with a global UTM representative body and with U-space service providers.

¹⁴⁵ DS 2.0 Targeted Survey (2022), in particular responses from national and regional authorities.

¹⁴⁶ See for example: position papers from U-space service providers and independent policy research discussed in the European Parliament in 2021.

¹⁴⁷ Interviews with U-space service providers and survey responses from drone service providers.

¹⁴⁸ Written responses and interviews with a global UTM representative body and with U-space service providers.

¹⁴⁹ Written responses and interviews with a global UTM representative body and with U-space service providers.

¹⁵⁰ Written responses and interviews with a global UTM representative body and with U-space service providers.

- An environment where a U-space provider safely manages an operation from beginning to end, using all details on the operator, the aircraft and the operation that a digital system can generate¹⁵¹
- A requirement for all aircraft and operators to remain connected with the system and visible¹⁵²
- Collection and management of valuable data related to drone operations and services¹⁵³
- Sharing of information where relevant for safety reasons and exchanging information to de-conflict exclusively with relevant U-space service providers¹⁵⁴
- Full automation where services are digitalised so operations are de-conflicted strategically.¹⁵⁵

A.6.7.5 The necessary transition to mature U-space

The dominant stakeholder view is that early U-space applications will develop as relatively isolated ‘bubbles’, but over time these bubbles will need to be connected into more significant corridors and areas making use of existing infrastructure and sympathetic natural forms (e.g. waterways).¹⁵⁶ Stakeholders identify the need for a clear plan on the iterative roll out of U-space from this perspective. Stakeholders busy with understanding the content and regulations while implementing them identified that some early applications of U-space are being pursued in very complicated (often urban) areas and they questioned whether these complicated applications were indeed a good starting point.¹⁵⁷

Some of the short-term opportunities and challenges identified were:

- Developing a whole of sector understanding of how U-space best rolls out and scales, including where it is possible now and where it should not be applied (e.g. remote agriculture)¹⁵⁸
- Defining the relationship (procedures) between ATM and UTM and establishing dynamic airspace management – in some rare cases UTM was perceived as a direct competitor to ATM¹⁵⁹
- Clarity on USSP certification processes and how multinational businesses might be encouraged¹⁶⁰

¹⁵¹ Written responses and interviews with a global UTM representative body and with U-space service providers.

¹⁵² DS 2.0 Targeted Survey (2022); content from European Institutions and relevant agencies.

¹⁵³ Interviews with U-space service providers; October 2021 Drone Leaders Group meeting.

¹⁵⁴ DS 2.0 Targeted Survey (2022); content from European Institutions and relevant agencies; written responses and interviews with a global UTM representative body.

¹⁵⁵ Written responses and interviews with a global UTM representative body and with U-space service providers.

¹⁵⁶ European agency during the November 2021 meeting of the Informal Drone Expert Group; written responses and interviews with a global UTM representative body and with U-space service providers; DS 2.0 Targeted Survey (2022) free text response from an NGO.

¹⁵⁷ Written responses and interviews with a global UTM representative body and with U-space service providers.

¹⁵⁸ DS 2.0 Targeted Survey (2022) free text response from an NGO and a national and regional authority.

¹⁵⁹ DS 2.0 Targeted Survey (2022) free text response and a national and regional authority during the October 2021 meeting of the Drone Leader Group.

¹⁶⁰ Interviews with U-space service providers.

- The data exchange between ANSPs and USSPs needs to become more open and standardised¹⁶¹
- Systematically building competencies in key institutions (e.g. CAAs) to facilitate the shift, in particular as it relates to introduction and coordination of new technologies; coordinating with local authorities; accepting SORAs; certifying USSPs; automating validation and monitoring¹⁶²
- Better cooperation between stakeholder groups (including military) and more fora to identify and share best practices on U-space implementation, including to develop new competencies¹⁶³
- Providing more support for city governments and local actors to understand U-space opportunities, their role in realising them and what other cities or regions are doing¹⁶⁴
- Working closely with U-space service providers to make sure they are future proofing by considering the needs of all potential drone services (in particular urban air mobility)¹⁶⁵
- More effort to accept and integrate non-aviation standards/ processes in particular from IT sector¹⁶⁶
- Better encouraging, exploiting and reusing the current IT know how from cloud and cybersecurity¹⁶⁷
- Being clear about how to apply risk management processes in a much wider range of operations¹⁶⁸
- Better defining the role of U-space in ‘fairness’, including what fairness means to regulators (rules and mechanism for airspace allocation, who will be prioritised, to which conditions, and when)¹⁶⁹

A.6.8 Developing Urban Air Mobility and Regional Air Mobility; including ground infrastructure

A.6.8.1 Specific benefits and challenges

Urban air mobility (UAM) is considered to be a good alternative for both ground transport of goods and persons; 71% (183 out of 257) of the respondents of the OPC indicated that UAM

¹⁶¹ Written responses and interviews with a global UTM representative body and with U-space service providers.

¹⁶² Written content from European institutions and relevant agencies confirmed in interviews with U-space service providers.

¹⁶³ October 2021 Drone Leaders Group meeting; November 2021 Drone Expert Group meeting confirmed in written work from a European agency.

¹⁶⁴ Written responses and interviews with a global UTM representative body and with U-space service provider.

¹⁶⁵ Written responses and interviews with a global UTM representative body and with U-space service provider.

¹⁶⁶ Written responses and interviews with a global UTM representative body and with U-space service provider.

¹⁶⁷ Written responses and interviews with a global UTM representative body and with U-space service provider.

¹⁶⁸ Written content from a European agency.

¹⁶⁹ DS 2.0 Targeted Survey (2022) free text response from an NGO.

being a good alternative for transport of goods. This percentage is lower (56%, 143 out of 257) for transport of persons.¹⁷⁰ This pattern is confirmed by responses from the targeted survey, indicating combined positive perception for transportation of goods 73% (75 out of 103) and for passengers 59% (61 out of 103).¹⁷¹

Main benefits related to the transportation of goods and persons, according to the targeted survey, included: the ability of drones to service remote areas (93%, 95 out of 102); increased productivity (69%, 70 out of 101); reducing local emissions (67%, 68 out of 102); and access to goods (56%, 57 out of 101). For transportation of persons, the following main benefits were mentioned: faster reaction on emergencies scores highest (87%, 90 out of 104), followed by access to less accessible areas (71%, 72 out of 102), reducing traffic congestion (55%, 57 out of 103), reducing local emission (53%, 55 out of 103) and changing land-use patterns (48%, 49 out of 103).¹⁷²

The top three challenges for transportation of goods, according to the targeted survey, were identified as: increased noise pollution (64%, 65 out of 101); increased visual pollution (55%, 56 out of 101) and increased privacy concerns (46%, 46 out of 101). For transportation of persons, the top three concerns or risks were: noise pollution (63%, 63 out of 101); increased visual pollution (55%, 56 out of 101) and safety and security concerns of the persons transported (39%, 39 out of 101).¹⁷³

Perceptions on noise, vibration and visual disturbances negatively impact the societal acceptance of UAM. The OPC indicated that 60% (154 out of 257) of respondents agreed to this (negative impact on societal acceptance), while 27% (69 out of 257) disagree.¹⁷⁴ Societal acceptance was frequently mentioned by stakeholders as a potential barrier. Based on this, means are proposed to improve societal acceptance, for example through testing and pilots and developing platforms and collaboration mechanisms. On societal acceptance, a social contract in which citizens are consulted was proposed¹⁷⁵, involving also local governments and citizens to deal with issues, such as noise, privacy and safety.

Specific challenges were mentioned to further develop and scale up UAM. For instance, the lack of support from local, regional and national authorities, and their reluctance often linked to slow evolution of regulations and tried and tested technologies.¹⁷⁶ This also applies to U-space, which has advanced in terms of having a regulatory basis and technology developed, but at the moment is still in a testing stage and not yet applied in full in an urban setting. It is expected that in time, the perceived benefits of UAM or drone services in general, as perceived by society, will increase and the perceived risks will be reduced, for example by making less noisy and safer drones, paving the way for a large-scale application of drones.¹⁷⁷

¹⁷⁰ DS 2.0 OPC (2022), Matrix 7 and 8 (combined agree and strongly agree).

¹⁷¹ DS 2.0 Targeted Survey (2022), Question 54 and 55.

¹⁷² DS 2.0 Targeted Survey (2022), Question 56 and 57.

¹⁷³ DS 2.0 Targeted Survey (2022), Question 58 and 59.

¹⁷⁴ DS 2.0 OPC (2022), Matrix 2 (combined score on agree and strongly agree and combined score on disagree and strongly disagree)

¹⁷⁵ By a representative organisation of the advanced air mobility (AAM) sector.

¹⁷⁶ According to a representative from the airport sector.

¹⁷⁷ According to a representative from the U-space sector.

A.6.8.2 Ground infrastructure and U-space

There is general consensus that there is a need to develop new types of infrastructures, including vertiports, to develop UAM. The OPC indicated that 76% (195 out of 257) of respondents either agreed or strongly agreed to this need and 14% (35 out of 257) disagree.¹⁷⁸ The OPC also revealed that it takes effort to develop such infrastructure. On the question that “every city can easily accommodate vertical take-off and landing operations”, 59% (150 out of 256) disagreed or strongly disagreed, while only 7% (17 out of 256) agreed.¹⁷⁹

74% (190 out of 256) of OPC respondents agreed or strongly agreed - against 7% (18 out of 258) disagreeing - that urban design development should consider drone operations.¹⁸⁰ A stakeholder¹⁸¹ pointed out that infrastructure is needed in cities (vertiports, vertistops) to support drone operations, which is not an easy topic, given the fact that it involves noise and public acceptance. Moreover, decisions need to be taken on the location and type of infrastructure and number of vertiports needed. The vast majority of stakeholders of the OPC, 73% (187 out of 257) of respondents agreed or strongly agreed, against 15% (39 out of 257) disagreed or strongly disagreed - consider that U-space services should be available in every urban area.¹⁸²

A.6.8.3 Platforms, collaboration and communication mechanisms

A strong majority of respondents to the OPC - 89% (228 out of 255) agreed or strongly agreed that cooperation mechanisms should be established for authorisation of operation of drones in urban areas.¹⁸³ Involvement of authorities and collaboration mechanisms were mentioned by many stakeholders as a prerequisite for development of UAM. For example, it is proposed to incentivise local authorities to take part in developing a vision (on drone operations). This could result in government procurement to fund innovative solutions. Another stakeholder suggested to involve European cross sectoral players to support UAM adaptive roadmaps that are supported by the industry, Member States, local authorities, and the Commission.¹⁸⁴

A.6.8.4 Testing sites and pilots

A strong majority of stakeholders in the OPC, 84% (214 out of 255) agreed or strongly agreed, that pilot projects should be run in parallel in different European cities to enhance public trust.¹⁸⁵ The link between testing sites and/or pilots and public trust or societal acceptance is made by a number of stakeholders. For example, a stakeholder representing aviation organisations indicated that there is a need to provide access to test sites in multiple locations. Test sites are the enabling factor for unmanned technology development, both digital infrastructure and vehicle technology. Providing the possibility for gathering field experience in the controlled environment could

¹⁷⁸ DS 2.0 OPC (2022), Matrix 17.

¹⁷⁹ DS 2.0 OPC (2022), Matrix 15.

¹⁸⁰ DS 2.0 OPC (2022), Matrix 16.

¹⁸¹ A representative from the research sector in aviation.

¹⁸² DS 2.0 OPC (2022), Matrix 20.

¹⁸³ DS 2.0 OPC (2022), Matrix 12.

¹⁸⁴ A representative active in UTM.

¹⁸⁵ DS 2.0 OPC (2022), Matrix 10.

enhance safety level and public acceptance. A stakeholder representing airports suggested to create a European endorsement for organisations working on testing sites to demonstrate the feasibility of drones and their use cases and by doing so, help secure the necessary support from local and national authorities. This stakeholder indicated that the Urban Air Mobility Initiative & Network of demonstrators is an effective tool to promote awareness, as well as to develop technology and know-how for safe drone operations in suburban and urban spaces. A European transport operator stated that prior to scaling up urban air vehicles deployment and assuming their integral part within a multi-modal transportation ecosystem, the social acceptability of this new ecosystem is crucial. By effectively engaging and consulting incubators local communities from the outset and integrating their feedback into the development of this transportation solution, UAM stakeholders would bring the ecosystem a step closer to achieving public acceptance and accelerating the ecosystem's implementation in cities.

A.6.9 Societal acceptance and dealing with externalities

The perception of a general public interest is a determining factor for acceptance: stakeholders indicate that use cases where a benefit for the community can be perceived, such as the delivery of medical or emergency transport or the contact with remote areas, are seen as the most promising use of UAM.

Civil drones are generally thought of having an impact that stretches into three main areas: surveillance, pollution (noise and visual), and safety. Regarding surveillance, civil drones represent a presence in the sky that captures data from people and places. In the OPC, 89% (229 out of 257) of the respondents said privacy should be a priority, and 85% (218 out of 255) agreed that regulatory measures should ensure that drones are compatible with EU privacy law.¹⁸⁶ The data collected by drones can have many forms: video, picture, sound, thermal record, geolocation, etc. Any understanding of the surveillance that drones pose needs to consider not only the platform itself, but also the other payloads that can be used: cameras, thermal cameras, sound sensors, radars, internet beaming applications, etc. Additionally, drones are big data collection platforms that contribute to the global data economy.

Regarding pollution, civil drones pose two main problems. Firstly, they contribute to visual pollution. Secondly, they produce disturbing sounds that are a source of sound pollution. 78% (201 out of 257) OPC respondents agreed that regulatory measures should ensure that noise-related issues are addressed (corridors for drone, hours limits, size of drones, etc).¹⁸⁷ Both forms of pollution refer mainly to the drones themselves, but also to the infrastructure that enables them to fly¹⁸⁸. This pollution has some implications also in terms of wildlife, given that they interfere with bird flocks and other forms of livelihood.

Finally, as drone technology has proliferated, concerns have grown regarding the potential safety and security threat that it poses. In the OPC, 98% (252 out of 257) of the respondents said that safety should be a priority.¹⁸⁹ Drones can cause all sorts of accidents and they can be used for criminal purposes of all types, from smuggling of goods to industrial espionage, from harassment to surveillance, from politically motivated action to terrorism. All these risks are exponentiated by the problems associated with the technology that is meant to address non-cooperative drones,

¹⁸⁶ DS 2.0 OPC (2022), Matrix 2 and 14.

¹⁸⁷ DS 2.0 OPC (2022), Matrix 13.

¹⁸⁸ Written contribution.

¹⁸⁹ DS 2.0 OPC (2022), Matrix 1.

i.e. counter-drone technology – a technology that is often not fully effective and that faces hurdles with respect to legality, coordination, planning, and safety.

In the 2021 EASA study, safety and noise pollution are on top of EU citizens' concerns, in a list that also includes cybersecurity risks and the potential impact on wildlife.¹⁹⁰

Respondents and interviewees highlighted potential positive societal impacts such as commercial, industrial, and environmental opportunities that can be leveraged and can be both direct and indirect. Direct opportunities emerge from potential for speeding up commerce and deliveries and open up new business cases, including air mobility. Regarding industrial, there is the expectation that a developed drone industry requires qualified jobs and triggers technological development and R&D. As for environmental, the idea is that future forms of urban air mobility can reduce traffic congestion and the use of fossil fuels in certain use cases, therefore reducing the general carbon footprint of metropolitan areas.

It is crucial that public and private institutions collaborate in the development of risk mitigation and response strategies to minimize the risks. Importantly, and considering the technology's evolution, this collaboration should be unfolded on a permanent, regular basis. Current EU efforts in carrying out this societal engagement are praise-worthy and should be reinforced.¹⁹¹ As happens in other areas, there is a potential for the EU to become a standard setter in the area of technology regulation.

The issue of technology acceptance is not a binary one. Indeed, the citizens make nuanced and deliberate decisions depending upon the context. The boundary between acceptable and unacceptable civil drone development are defined by how serious the benefits are, and who the user is.

The integration of drones in society into the existing air and ground infrastructure must respect residents' quality of life and the cultural heritage of old European cities. To reiterate what was mentioned above, considering the big impact that new forms of air mobility will have on society, it is fundamental that the whole civil society, and not only end-users, participate in the regulatory process. Finally, regulators and legislators should consider the full spectrum of the surveillance issues raised by the integration of civil drones in the airspace, beyond the mere visual and sound data collection. Rather, civil drones need to be considered big data collection systems that are integrated with other technologies and participate in the global marketization of data.

The DS 2.0 should do more than highlight risks and obstacles, but equally – if not more – important for societal acceptance, the strategy should illustrate the benefits of drones in society; citizens are not fully aware of the positive benefits of drones¹⁹².

A.6.10 Developing knowledge, training staff and building competence

A.6.10.1 Changing skills needs and building competence

A strong majority of stakeholders of the OPC - 89% (230 out of 257) agreed or strongly agreed that drone services will have an impact on skills and new training offers adapted to the smart

¹⁹⁰ European Union Aviation Safety Agency (2021) Study on the societal acceptance of Urban Air Mobility in Europe. Available at: <https://www.easa.europa.eu/sites/default/files/dfu/uam-full-report.pdf>.

¹⁹¹ Interview with European civil aviation authority.

¹⁹² Written contribution, industry representative.

mobility and drone services should be made available.¹⁹³ Individual stakeholders confirmed the need for training while a European drones association pointed out the differences in training between manned and unmanned aviation. A stakeholder representing workers in aviation stressed the need for an EU pilot training by developing a syllabus for drone pilots, as well as an adequate training programme. Apart from drone operations, stakeholders mentioned a range of domains in which capacity needs to be developed such as, legal capacity to deal with implementation of new legislation. A drone operator indicated the need to invest in skilled workforce at National Authorities and ANSPs and provide funding for key enabling technologies and Technology Readiness Level (TRL) research. A European Civil Aviation Authority indicated the development of a roadmap (2021-2030) including competences development and training activities in line with technological and regulatory evolution.

A.6.10.2 A dedicated Research and Innovation action

Around two thirds (69%, 82 out of 119) of the respondents to the targeted survey were supportive of a dedicated Research and Innovation (R&I) action in support of the development of drones.¹⁹⁴ These included, improvement of drone and remote-control technology; protection of geographic zones and airports; enhancing the potential use of drones; training and education; protection of the environment; the regulatory framework to make use cases easier. Apart from what should be covered, stakeholders indicated that the results of research projects are not always optimally used.¹⁹⁵ Moreover, the focus of such a dedicated R&I action would need to be carefully coordinated with other initiatives, such as SESAR 3, in order to avoid overlaps or parallel research programs not converging.¹⁹⁶

¹⁹³ DS 2.0 OPC (2022), Matrix 21.

¹⁹⁴ Whereas 12% (14 out of 119) of the respondents do not agree to such an action and 19% (23 out of 119) does not know.

¹⁹⁵ Drone operator

¹⁹⁶ According to a representative from the U-Space sector.