EGHD Expert Group on the Human Dimension of the Single European Sky

July 2018
FINAL

EGHD Position Paper

Impact of RPAS on the human dimension

1 Introduction

This position paper reviews the human dimension impacts associated with the introduction of Remotely Piloted Aircraft Systems (RPAS) ('drones') into the aviation community, and identifies principles and recommendations for the European Commission (EC) to ensure that the human dimension is appropriately considered in future industry developments.

The number of RPAS within European skies is expected to grow dramatically over the coming years. To illustrate this, some seven million consumer leisure drones could operate across Europe and a fleet of 400,000 may be used for commercial and government missions by 2050.

This growth represents a significant extension to the current aviation community. Their introduction therefore needs to be managed carefully to ensure that any adverse impacts on the human dimension are identified and mitigated accordingly. RPAS are being used in different environments, including controlled airspace, non-segregated from other manned commercial air transport, and in uncontrolled airspace, often in locations adjacent to controlled airspace such as airports.

2 Scope

The introduction of RPAS into the traditional aviation system presents unprecedented and unique human challenges, impacting different stakeholders in different operational environments. The EGHD has therefore considered the potential human dimension challenges on the following stakeholders:

1. Commercial and recreational RPAS pilots;
2. Commercial (IFR and VFR), general aviation (GA) and helicopter pilots;
3. Air Traffic Management (ATM) personnel, including Air Traffic Controllers (ATCOs), Air Traffic Safety Electronics Personnel (ATSEP), and other frontline operators such as Flight Information Service Officers (FISOs); and,
4. General public.

The EGHD understands that both the U-space concept and RPAS technologies are rapidly evolving, and therefore it should be noted that the principles and recommendations proposed by the EGHD only reflect the views of the group at the time of publication. Furthermore, due to the early stage of development of U-space, the future roles associated with U-space were not considered. The EGHD also recognises that the terms 'U-space' and 'Unmanned Aircraft System Traffic Management (UTM)' are fundamentally different and should not be used interchangeably; definitions of these two terms and other key definitions are detailed in a glossary in the Appendix.

3 Principles for RPAS deployment

The EGHD believes that the human element plays an important role in the safe and successful integration of drones into the aviation system. The following principles have been identified as fundamental to RPAS deployment to examine the effects on the human dimension.

Note that specific recommendations are identified in the next section in addition to the principles outlined below. The specific recommendations are defined where specific issues have been identified that require further analysis to ensure that the impact on the human is appropriately managed.

The EGHD has identified the following five principles for RPAS deployment:

1. **A pan-European RPAS roadmap should be in place**

It is difficult to regulate and guide development when there is no clear vision in place. A vision, as recommended by the Industry Consultation Body (ICB), could involve a combination of the U-space concept, the planned European ATM Master Plan revision, EASA safety rules, and a clearly defined Concept of Operations (CONOPs).

The EGHD supports the definition of a clear pan-European RPAS roadmap, including regulations and standards. The opportunities for new jobs, human competencies and responsibilities of ATM/UTM personnel, RPAS, commercial, GA and helicopter pilots should be identified by this roadmap.

2. **Regulations and rules should be regularly updated**

A CONOPs has yet to be defined, and implementation of a CONOPs has only been targeted for after 2023[1]. The EGHD therefore recognises that RPAS regulations should be adaptable to change, considering the rate of progression within the industry, and that a pan-European Implementing Rule, as suggested in EASA's Opinion No 01/2018, will help to ensure the safe operation of drones and that the human dimension is adequately reflected.

3. **A collaborative and phased approach for the roll-out of RPAS**

The EGHD recognises the need for sustained relationships with all stakeholders, including dedicated Working Groups and stakeholder consultations, to coordinate the roll-out of RPAS and to ensure that the RPAS vision reflects the needs and constraints of all operational staff who operate within the aviation environment on a day-to-day basis.

Education and training of all drone stakeholders, including the general public, is also fundamental. Please refer to Section 4.5 for the EGHD's recommendations on education, training and licensing.

4. **Standardisation of RPAS operations and technical requirements**

EASA and EUROCAE have made progress towards standardisation. For example, EUROCAE Working Group Groups 73 and 93 were established to focus on RPAS operations across airspace classes and Visual Line of Sight (VLOS) operations respectively. Recently merged, the new Working Group 105 is now developing a series of standards. Other standardisation bodies such as the International Organization for Standardization (ISO) and the European Telecommunications Standards Institute (ETSI) are also making progress towards the standardisation of small RPAS operations and technical requirements.

The EGHD supports the ongoing refinement of existing standards to meet the increasing market demand for RPAS and the increasing variety of public and private uses. This includes standardised definitions, licensing and training to ensure a minimum level of competency for RPAS pilots, design and performance requirements, emergency protocols and contingency procedures.

5. **U-space could be an enabler for the safe and successful deployment of RPAS**

The EGHD supports further research and development efforts to ensure that U-space is able to demonstrate an equivalent level of safety to existing ATM, as per ICAO Annex 19 for safety

[1] https://www.eurocontrol.int/sites/default/files/publication/files/rpas-atm-cocept-of-operations-2017.pdf

management. This will help to address the safety risks associated with RPAS deployment, and thereby potential impacts on the human.

4 Specific recommendations

This section outlines human dimension issues that require specific attention to ensure that the human dimension is considered appropriately during the deployment of RPAS to ensure a successful and seamless integration into the aviation system.

The following human dimension concerns are considered in the context of the following:

1. RPAS operations in uncontrolled airspace
2. RPAS operations in controlled airspace
3. Ergonomics
4. Workload management
5. Education, training and licensing

4.1 RPAS operations in uncontrolled airspace

4.1.1 Improving the detection of RPAS

Given the numerous shapes, sizes and types of RPAS, there is a risk that smaller RPAS may not be detectable by systems onboard manned aircraft. Similarly, due to weight restrictions of unmanned aircraft, only very limited number of RPAS can have 'detect and avoid' systems installed onboard.

This presents several human factor concerns, notably an increase in collision risk due to a reduction in automated detection systems onboard manned aircraft. Furthermore, the size of small RPAS ultimately means that small RPAS are simply undetectable by pilots of manned aircraft, which further exacerbates the risk of airborne collisions between manned and unmanned aircraft within uncontrolled airspace. Drones therefore should not become an additional burden for pilots of manned aircraft within uncontrolled airspace.

Given this, the EGHD believes that there should be minimum standards for detection systems onboard manned aircraft to help improve detection of RPAS in uncontrolled airspace. This includes minimum performance standards for technical systems, standards proportionate to the type of RPAS operation and environment, and override features to allow onboard systems to alert the RPAS pilot when responding to unusual operational scenarios (e.g. airspace infringements).

Recommendation 1

The EC should ensure that minimum European standards for detection systems onboard manned aircraft are in place to help improve detection of RPAS in uncontrolled airspace. The standards should also be proportionate to the type of uncontrolled airspace involved (e.g. above or below the boundary for Very Low Level (VLL) operations of 500ft).

4.2 RPAS operations in controlled airspace

4.2.1 Reducing the number of RPAS airspace infringements into controlled airspace

The EGHD recognises that there are human factor concerns relating to the infringement of RPAS into controlled airspace. For the RPAS pilot, this includes acute stress and pressure arising from real-time demands of recognising and recovering from infringement, and a lack of knowledge of the controlled airspace environment. Infringement could lead to the ATCO having to close the entire airspace sector, and thereby increasing the ATCO and pilot's workload (e.g. having to divert, re-planning the arrival sequence, managing fuel consumption etc.).

More fundamentally, infringement is likely to increase the collision risk with other aircraft. The EGHD recognises that work is already been done to introduce procedures to reduce the likelihood of possible collisions between manned and unmanned aircrafts (e.g. BALPA and GATCO).

The EGHD therefore recommends that there should be an urgency from stakeholders to continue to develop and implement technology and harmonised EU-wide procedures to prevent airspace infringements by unmanned aircraft. This includes the possibility of technically limiting the vertical and horizontal parameters of recreational RPAS (geo-caging), and e-identification (under the U-space concept) to allow authorities to identify an RPAS flying.

Furthermore, the EGHD are in support of strong, dynamic and stringent geofencing systems installed onboard RPAS. These systems are necessary to maintain proper aviation safety standards and mitigate the adverse effects of human deficiencies relating to the perception of heights and distances. The EGHD subsequently believes that geofencing services should provide to any person or entity, especially the RPAS and RPAS pilot, the information on the restricted zones and airspace height restrictions to ensure the safe operation of RPAS.

Finally, a geofencing system without an override function may impair the RPAS pilot's ability to safely respond to an emergency situation. The EGHD recommends that sufficient levels of system resilience (e.g. automatic flight limitations) and appropriate oversight procedures are considered to ensure the proper functioning of such systems.

Recommendation 2

The EC, in liaison with the relevant authorities, should promote the timely development and implementation of U-space services (e.g. geofencing and e-identification).[2] Research and development efforts should be established to ensure that systems are in place to aid operational staff in the recognition and recovery from RPAS operations in the vicinity of manned aviation.

4.2.2 Improving the efficiency of communication and RPAS response execution

- **Between remote pilot and RPAS**

Delays in communication between pilot input and RPAS response execution (known as latency) can significantly impede direct manual control of the RPAS. This can present marked safety implications, particularly during emergency manoeuvres. For example, during lost-link scenarios, the remote pilot may not be able to retain separation which poses a hazard to other manned or unmanned aircraft in the controlled airspace vicinity. Furthermore, latency of communications induces an additional need for anticipation of control inputs by the RPAS pilot. This anticipation increases the complexity of operational tasks for the pilot. Therefore, the EGHD believes that standard recovery procedures should be defined and must be predictable for ATCOs (e.g. during lost-link scenarios).

- **Between remote pilot and ATCO**

Latencies in voice communications between remote pilots and ATCOs may impact the flow of information between ATC and aircraft in their airspace. This introduces the potential for anticipated timing of making radio calls and possible interruption of other communications, which increases the complexity of operational tasks as described above, and poses additional hazards for other airspace users in the vicinity. Procedures should be identified and implemented to mitigate these risks.

Combined with this, the lack of standardised communications rules/phraseology for certified category operations (as defined by EASA Opinion No 1/2018) increases the risk of misunderstanding between

[22] This includes the type and level of restrictions, the designation of the competent authorities responsible for the definition of geofenced areas, parameters of the geofencing system, and an analysis assessment of the impacts of the non-availability and non-integrity of UTM output data.

the remote pilot and ATCO. This may have consequences on operators' workload, result in delays in communication response, and even the misinterpretation of clearances. The EGHD thus strongly recognises the need for the use of universal phraseology between RPAS, commercial, GA and helicopter pilots supported by smart automation that will help to ensure the efficiency and reliability of communications.

Recommendation 3

The EC should ensure that standards are developed to capture the adequate requirements for performance in terms of communication, and performance in terms of the RPAS' reaction time (e.g. acceleration/deceleration, climb/descent, rate of turn).

Recommendation 4

The EC, in liaison with the relevant authorities, should ensure that further research is conducted to determine the effects of latency on remote pilot input and RPAS response, and between the remote pilot and ATCO. The impact of latency when updating best practices, required procedures, and future pilot training materials should also be investigated, and adequate solutions proposed.

Recommendation 5

The EC, in liaison with the relevant authorities, should ensure that standardised universal phraseology is defined for remote pilots for all communications with ATM.

4.2.3 Improving the situational awareness for RPAS pilots

The EGHD recognises that absence of natural sensory cues for RPAS pilots make it difficult for the pilot to maintain situational awareness of the state of the aircraft, its operation, and environment. The absent cues include visual (e.g. no 'see and avoid'), auditory (e.g. environment, engine noise), proprioceptive (e.g. vibration) and olfactory (e.g. smell) information.

The extent to which conventional pilots rely on their sensory cues, in addition to cockpit instruments, is difficult to quantify. That said, such cues play a vital part in maintaining pilot situational awareness which is fundamental for ensuring minimal impact on the human dimension. The EGHD therefore recognises that further research will be needed to quantify the impacts of reduced sensory cues on the situational awareness of RPAS pilots.

Furthermore, the EGHD believes that common situational awareness among all UTM stakeholders is a central component of the overall UTM system. Situational awareness is based on the availability and understanding of all potential constraints and advisory information within the network. This knowledge should be factored into the RPAS operator's flight planning and execution to ensure safe RPAS operations.

Recommendation 6

The EC, in liaison with the relevant authorities, should ensure that further research is conducted to quantify the impacts of reduced sensory cues, and the loss of each type of sensory information, on the situational awareness of RPAS pilots. Further research is also required to improve information sharing of all available UTM information to RPAS operators to enhance the overall situational awareness of RPAS pilots.

4.2.4 Ensuring integrity of UTM information for ATM

The EGHD believes that the UTM information provided to ATM needs to be appropriately defined. Furthermore, the integrity of data exchange between drone systems, pilots, ATM/ANS service providers and ATSEPs must be ensured. ATM operational staff require the provision of reliable data to have confidence in the information they are presented and their ability to detect errors or deviations. Automated systems, as part of U-space, must therefore be introduced to support staff in the monitoring and control of information integrity.

As such, when defining a tool to begin to harmonise U-space and ATM, the EGHD believes that a set of minimum quality requirements for the defined dataset is required to ensure RPAS operators' awareness of data integrity and availability for safe RPAS operations. This includes standards for technology development when fusing new sources of data from new actors with traditional ATM data, or simply to install, operate and/or maintain new Communication, Navigation and Surveillance (CNS) and ATM systems.

Recommendation 7

The EC should ensure a minimum data requirement and minimum quality standard of data reliability, integrity and availability is developed as part of U-space. This will ensure that ATM operational staff have sufficient access to high-quality and accurate data that can be used confidently, reliably and in a continuous manner, in everyday operational scenarios.

4.3 Ergonomics

4.3.1 Improving the design of the Remote Pilot Station

The EGHD promotes the application of user-centred design methods for the design of the remote pilot station (RPS) to ensure the same level of rigour as that applied to manned aircraft cockpit design and ATM workstation design. This will help to manage concerns relating to:

- RPS that do not comply with industry design standards for aircraft cockpits, including standards for ergonomics and human/system integration.
    - Ergonomic issues include: unreachable controls, difficult-to-read fonts and colours and critical controls placed next to non-critical controls. This may result in human performance and occupational health implications for the RPAS pilot.
- Use of 'off-the-shelf' hardware and software which would not satisfy the standards mandated for manned cockpit design.
    - This leads to reliability, compatibility and contingency issues (e.g. frozen screens and unresponsive controls).

Furthermore, the EGHD recognises that there are currently limited industry standards specifically for the design of displays and controls in the RPS. Standards for display and controls are well established for pilot working positions in manned aircraft, however they may not be appropriate for RPS controls.

The EGHD therefore recommends that uniform design standards for RPS are established and are in line with general industry standards for ergonomics and human/system integration. This will help RPAS pilots to accomplish their tasks in an efficient and safe manner. Other issues such as occupational health concerns should also be addressed.

Recommendation 8

The EC, in liaison with the relevant authorities, should ensure that uniform design standards for remote pilot stations are in place and are in line with general industry standards for ergonomics and human/system integration.

4.4 Workload management

The EGHD believes that potential changes to the workload on staff (e.g. ATCOs and ATSEPs) from the introduction of RPAS should be adequately considered and, at the same time, should not result in any unnecessary increase in workload on staff. The EGHD has therefore acknowledged the following concerns regarding workload of operational staff:

- If an RPAS infringes into controlled airspace (e.g. beyond the geofence), an ATCO may need to close the entire airspace sector. This could increase the workload of ATCOs and pilots.
- Too many transponding drones may lead to frequency bandwidth issues and unintended consequences for ATCOs through the display of too many targets on surveillance displays (i.e. clutter). This could lead to the loss of the surveillance picture for certain portions of airspace which may impact negatively on an ATCO's workload.
- There may be extensive periods of low workload for RPAS pilots, particularly when the pilot's role is to perform supervisory control of automated systems (e.g. Medium or High Altitude Long-Endurance (MALE and HALE) operations). However, the pilot must be prepared for the possibility for a sudden increase in workload. This sudden change in workload and its impacts on task engagement must be further investigated.
- The link between UTM and ATM is only just beginning to be defined. With this, there may be new requirements for ATSEPs to fuse new sources of data from new actors with traditional ATM data, or simply to install, operate and/or maintain new CNS and ATM/UTM systems.

The EGHD therefore believes that the impact of RPAS deployment on workload and human performance will require additional research and development efforts to ensure that their expected roles and tasks are safely handled and executed.

Recommendation 9

The EC, in liaison with the relevant authorities, should ensure that the potential effects of workload variations from the changing roles and tasks of operational staff from RPAS roll-out are adequately investigated, managed and mitigated. Additional research and development efforts should be in place to reduce these potential adverse effects.

4.5 Education, training and licensing

The EGHD understands that there are currently no uniform rules surrounding the training and licensing of RPAS pilots. The EGHD understands that ICAO Annex 1 on personnel licensing is subject to amendment that will subsequently set out requirements for the licensing of RPAS pilots.

The EGHD believes that the training and licensing requirements for RPAS pilots should be proportionate to the intended use and operation of the RPAS. Pilots operating RPAS in airspace subject to ATM should have a higher level of training than those operating leisure drones in uncontrolled airspace and performing VLOS operations.

Ultimately, the EGHD believes that all pilots (manned and unmanned) and ATCOs should be trained and licensed in a way that knowledge and skills, but also awareness and airmanship, contribute to high levels of cooperation and safety with other airspace users.

4.5.1 Commercial RPAS pilots

The EGHD endorses ICAO's standard licensing requirement for RPAS pilots, which was mandated in June 2018. The EGHD believes that there should also be a standardised European licensing system for commercial RPAS pilots, in line with EASA requirements. Commercial pilots of unmanned aircraft should be required to satisfy ICAO Standards and Recommended Practices (SARPs), including ICAO Annex 1, and EASA Standardised European Rules of the Air (SERA).

4.5.2 Recreational RPAS pilots

For recreational pilots flying in the 'open' (low risk) category[3] and performing VLOS operations, simplified procedures should be in place to ensure minimum levels of awareness. A licence could be replaced by a sign-up procedure on an EASA or ICAO-dedicated platform. Recreational pilots should be required to be aware of the risks, local airspace classifications and restrictions, and EASA SERA. The national Civil Aviation Authorities (CAAs) should issue licences and conduct oversight according to European standards.

4.5.3 ATCOs/FISOs

A standardised European training programme for ATCOs and FISOs dealing with RPAS should be in place. This will ensure that ATCOs and FISOs are adapted to new processes, procedures and interfaces that accommodate the increasing number of drones that interact with manned aviation and traditional Air Traffic Control (ATC) services. Contingency procedures for ATCOs need to be provided to manage any potential infringements by RPAS into controlled airspace.

4.5.4 General public

National awareness campaigns for RPAS pilots should be promoted at EU-level. The EGHD understands that anyone can purchase drones freely off the market, and thus there are inevitable concerns should the general public not be aware of the risks associated with RPAS operations. Education of the general public is therefore important to raise awareness of the potential risks and hazards of RPAS (e.g. charts of no-fly zones, television commercials, and placard/information leaflets included within drone packaging).

Recommendation 10

The EC should consider the following recommendations regarding the training and licensing of operational staff who interact with RPAS operations on a day-to-day basis:

- *There should be a standardised European licensing system for commercial RPAS pilots, in line with ICAO's standard licensing requirement for RPAS pilots.*
- *Training and licensing procedures should be in place to ensure minimum levels of awareness of recreational RPAS pilots.*
- *A standardised European training programme for ATCOs and FISOs dealing with RPAS should be in place.*
- *National awareness campaigns for RPAS pilots should be promoted at EU-level.*
- *Education of the general public is important to raise awareness of the potential risks associated with RPAS operations.*

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[3] EASA rulemaking task RMT.0230 (June 2018) defines the open, specific and certified UAS operation categories.

5 Conclusion

The introduction of a 'new' airspace user into the traditional aviation system poses unprecedented human challenges. It is imperative that policy makers provide due attention to these challenges and understand the costs and benefits of any future policy initiatives.

The EGHD requests that the Commission considers the five human dimension principles identified as fundamental to the deployment of RPAS, and the following ten recommendations on topics that require specific attention to ensure that the potential impacts on the human dimension are adequately managed.

5.1 Principles

Principle 1

A pan-European RPAS roadmap should be in place

Principle 2

Regulations and rules should be regularly updated

Principle 3

A collaborative and phased approach for the roll-out of RPAS

Principle 4

Standardisation of RPAS operations and technical requirements

Principle 5

U-space could be an enabler for the safe and successful deployment of RPAS

5.2 Recommendations

Recommendation 1

The EC should ensure that minimum European standards for detection systems onboard manned aircraft are in place to help improve detection of RPAS in uncontrolled airspace. The standards should also be proportionate to the type of uncontrolled airspace involved (e.g. above or below the boundary for Very Low Level (VLL) operations of 500ft).

Recommendation 2

The EC, in liaison with the relevant authorities, should promote the timely development and implementation of U-space services (e.g. geofencing and e-identification). Research and development efforts should be established to ensure that systems are in place to aid operational staff in the recognition and recovery from RPAS operations in the vicinity of manned aviation.

Recommendation 3

The EC should ensure that standards are developed to capture the adequate requirements for performance in terms of communication, and performance in terms of the RPAS' reaction time (e.g. acceleration/deceleration, climb/descent, rate of turn).

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Recommendation 5

The EC, in liaison with the relevant authorities, should ensure that standardised universal phraseology is defined for remote pilots for all communications with ATM.

Recommendation 6

The EC, in liaison with the relevant authorities, should ensure that further research is conducted to quantify the impacts of reduced sensory cues, and the loss of each type of sensory information, on the situational awareness of RPAS pilots. Further research is also required to improve information sharing of all available UTM information to RPAS operators to enhance the overall situational awareness of RPAS pilots.

Recommendation 7

The EC should ensure a minimum data requirement and minimum quality standard of data reliability, integrity and availability is developed as part of U-space. This will ensure that ATM operational staff have sufficient access to high-quality and accurate data that can be used confidently, reliably and in a continuous manner, in everyday operational scenarios.

Recommendation 8

The EC, in liaison with the relevant authorities, should ensure that uniform design standards for remote pilot stations are in place and are in line with general industry standards for ergonomics and human/system integration.

Recommendation 9

The EC, in liaison with the relevant authorities, should ensure that the potential effects of workload variations from the changing roles and tasks of operational staff from RPAS roll-out are adequately investigated, managed and mitigated. Additional research and development efforts should be in place to reduce these potential adverse effects.

Recommendation 10

The EC should consider the following recommendations regarding the training and licensing of operational staff who interact with RPAS operations on a day-to-day basis:

- There should be a standardised European licensing system for commercial RPAS pilots, in line with ICAO's standard licensing requirement for RPAS pilots.
- Training and licensing procedures should be in place to ensure minimum levels of awareness of recreational RPAS pilots.
- A standardised European training programme for ATCOs and FISOs dealing with RPAS will be required.
- National awareness campaigns for RPAS pilots should be promoted at EU-level.
- Education of the general public is important to raise awareness of the potential risks associated with RPAS operations.

Appendix

Glossary of definitions

Term	Definition
Certified category	Defined by ToR RMT.0230 by EASA, a high-risk UAS operation category that, considering the risks involved, requires the certification of the UAS, a licensed remote pilot and an operator approved by the competent authority, in order to ensure an appropriate level of safety.
Detect and avoid	The capability to see, sense, or detect conflicting traffic or other hazards and take appropriate action.
E-identification	This U-space service allows the identification of a drone operator from a drone in operation (in line with the global scope of registry (ICAO) & eIDAS - Regulation (EU) No 910/2014). The identification provides access to the information stored in the registry based on an identifier emitted electronically by the drone. The identification service includes the localisation of the drones (position and time stamp).
E-registration	This U-space service enables the registration of the operator, drone and pilot with the appropriate information according to Regulation. A level of security of the service will be defined
Geofencing	Ability to comply with geographical, altitude and time restrictions defined by the geofencing service. This capability covers the technology, processing and any required communication links, as well as management and use of geofencing information used in the provision of this service.
Open category	Defined by ToR RMT.0230 by EASA, a low-risk UAS operation category that, considering the risks involved, a prior authorisation by the competent authority before the operation takes place.
Remote pilot station	The component of the RPAS containing the equipment used to pilot the remotely piloted aircraft.
RPAS	A remotely piloted aircraft, its associated remote pilot station(s), the required command and control links and any other components as specified in the type design.
RPAS pilot	A person charged by the operator with duties essential to the operation of a remotely piloted aircraft and who manipulates the flight controls, as appropriate, during flight time.
Specific category	Defined by ToR RMT.0230 by EASA, a medium-risk UAS operation category that, considering the risks involved, an authorisation by the competent authority before the operation takes place and takes into account the mitigation measures identified in an operational risk assessment, except for certain standard scenarios where a declaration by the operator is sufficient.

Term	Definition
UAS Traffic Management (UTM)	A traffic management system devised by the FAA that enables civilian low-altitude airspace and UAS operations.[4]
U-space	U-space is a European 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 routine mission, in all classes of airspace and all types of environment - even the most congested - while addressing an appropriate interface with manned aviation and air traffic control.[5]
Visual line-of-sight (VLOS)	An operation in which the remote pilot observer maintains direct unaided visual contact with another remotely piloted aircraft.

Regulatory developments

Regulatory development in Europe was launched with the Commission's study on UAS in 2007. An ICAO Circular in 2011 (Cir 328 AN/190) was the first step towards an international regulatory framework for UAS, which advocated international harmonisation.

The Commission recognises the absence of a clear EU regulatory framework currently restricts the creation of a truly European market for drone services and aircraft, which limits the potential for jobs and growth creation in this new sector of the economy.[6]

That being said, over recent years, progress has been made to establish a clearer regulatory framework concerning RPAS at EU-level. In March 2015, the Riga Conference was held which saw the first high-level political discussion at EU-level on introducing RPAS into non-segregated airspace. Following EASA's Opinion No 01/2015, which supported the Commission's initiative to improve safety with a possible revision of the EASA Basic Regulation, the Commission produced a legislative proposal to amend the EASA Basic Regulation as part of its Aviation Strategy in December 2015.

This included removing the 150kg threshold to allow for regulation regardless of weight, to include the introduction of new rules for Unmanned Aircraft Systems (UAS) as well as a definition of 'unmanned aircraft'. The updated Basic Regulation is expected to be released by the end of Q2 2018 and, as outlined in EASA's Notice of Proposed Amendment (NPA 2017-05(A)) and Opinion No 01/2018, this will be complemented by a new Commission Implementing Rule (IR) that defines the measures to mitigate the risk of UAS operations.

In May 2018, the FAA released their Version 1.0 of the UTM Concept of Operations. This concept documents the learnings thus far through use-case development, insights on rulemaking, and the evolution of UTM Technical Capability Levels (TCLs). It reflects the collaborative efforts across the FAA, as well as the ongoing inter-Agency research efforts with NASA.

In June 2018, EASA released the 'Terms of reference' for rulemaking task to establish a regulatory framework to accommodate UAS in the European aviation system. Furthermore, MEPs approved an agreement reached between Council and Parliament negotiators on EU-wide principles for drones and drone operators to ensure a common level of safety and give operators and manufacturers the

[4] https://utm.arc.nasa.gov/index.shtml
[5] https://www.sesarju.eu/U-Space
[6] https://ec.europa.eu/transport/modes/air/uas_en

predictability to develop products and services. Currently most drones fall under differing national rules.

Technological developments

Under Horizon 2020, the EU has committed €44m of grants through SESAR on the integration of drones into European airspace.[7] One notable use of this funding has been towards the development and rollout of U-space from 2019, through a series of exploratory projects launched by the SESAR Joint Undertaking (SJU). A blueprint for the introduction of U-space was released by the SJU in April 2017.

In March 2016, EASA released a Special Condition on 'RPAS Human Factors'. Following this, as set out in the Warsaw Declaration in November 2016, to facilitate growing demand for drone services, it was agreed that there needs to be urgent action on the airspace dimension, in particular through the rollout of U-space.[8] Furthermore, progress was made as part of the 2017 Helsinki Declaration to develop legal requirements for drones and drone operations, and an effective standard-setting process that is adaptable to fast-evolving digital technologies.

From 2019, U-space is expected to enable complex and automated routine drone missions in all types of operational environments through, for example, e-registration and identification, geofencing, detection functionalities and interfacing with conventional ATC.

The current ATM Master Plan (2015 version) was updated to make explicit reference to RPAS. In Q1 2018, the SJU released an addendum to the ATM Master Plan, which included a roadmap for the safe integration of drones into all classes of airspace.

[7] http://europa.eu/rapid/press-release_MEMO-16-4123_en.htm
[8] http://www.sesarju.eu/sites/default/files/documents/reports/U-space%20Blueprint.pdf