NON-PAPER

Roadmap for drone operations in the European Union (EU)
The roll-out of the EU operation centric approach

Drone technology brings radical changes. The drone technology creates opportunities for new services and applications. They represent a tremendous opportunity both for our 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.

Drone technology will pose a regulatory challenge. Today's aviation safety rules are not adapted to drone operations. Given the broad variety of types of drones being used under very differing operation conditions, the regulatory framework must move from an aircraft centric approach towards an operation centric approach. The particular risk of a particular type of operation is the starting point. In addition to safety, concerns related to privacy and data protection, security, liability and insurance or environment will also be taken into account.

The global drone technology needs a large single market. To facilitate free circulation and for safety reasons, all drones must be covered, even small ones. And the rules must be kept proportionate to risk to ensure that small and medium sized enterprises as well as start-ups are not hampered by heavy and costly rules and procedures. And the performance based rules will seek to rely on industry standards as far as possible. At the same time, the common rules (e.g. on the geofencing mechanism and its data interfaces) will allow competent authorities to reflect local circumstances or conditions, (e.g. local authorities may identify concrete areas of airspace that need to be geo-fenced) and should not lead to a one size fits all policy.

This roadmap describes how drones could be safely operated in the EU airspace and how the operation centric approach will be rolled out in the EU in the coming years to maintain the high EU levels of safety, privacy and data protection, security, or environmental protection. The annexes list the concrete actions that will be undertaken in the coming years.

1. How will drones safely fly in the EU airspace? [1]

Drones are aircraft. If drones are operated alongside 'manned aircraft', all existing aviation rules and procedures must be respected, but will steadily be accommodated to all airspace users. Hence the need to develop the missing "detect & avoid" or "command and control" technologies (see chapter 6) to fly in accordance the traditional "Instrument" and "Visual" flight rules. And there will be drones, for instance to relay transmission or for energy production purposes, that will fly above the current routes used by commercial airlines. This will require airspace rules for very high level operations.

But there are smaller drones that are able to fly now – as they are flying already in some Member States. And technologies are evolving fast. These smaller drones are expected to fly in the lower airspace, defined as the airspace up to 150m (500ft) above the ground or sea level as appropriate. In the lower airspace, the drones are able to fly well separated from manned aviation. This chapter

[1] This chapter is based on the JARUS concept of operations, prepared by Eurocontrol and sent out by the JARUS secretariat ion 14 March 2016 for discussion and consultation amongst JARUS members. Therefore this concept is not to be considered as the official EU concept of operations. It merely gives a picture of how low level drone operations could be organised in future, as this category of operations raises most questions. This does not prejudge the final decision that may also get inspiration from other proposals on the table, like the unmanned air traffic management system developed by NASA. EU work concerns all types of operations. This chapter will be updated when the discussions with JARUS members will make the concept of operations even more robust.

focuses on how the drone traffic and drone operations could be organised in the low level airspace – with the view to setting the regulatory agenda and drive other actions.

The JARUS "concept of operations" proposes to organise the drone traffic in a way similar to road traffic. The concept proposes to divide the low level airspace – where normally no 'manned' aircraft fly, except for special low flying operations [2] – in three classes, with a buffer to separate drones from 'manned' aircraft, as long as manned and unmanned aircraft are not able to safely share the same airspace.

The concept would require, apart from drones where the pilot keeps direct visual contact ("visual line of sight"), eventually detect and avoid systems in each drone and aircraft. The backbone of the communication system [3] would be based on existing communication infrastructure and open to a range of different technologies (satellite, radio or telecom). The communication system would also allow the easy identification of drones and their operators. The whole route network should be based on a state airspace assessment, where routes are determined on the basis of safety, security, privacy and environmental considerations. Like the road police can determine the driving conditions (speed, noise, time), the competent authorities can set conditions and modalities for the use of the aerial network. Operators will be aware of what aerial routes to fly and respect permanent or conditional no-fly zones.

The challenge will be to come to global consensus on a concept of operations for operations at the very high and especially at the very low level that go beyond the traditional "manned" aviation operations; and then to organise the transition from the current situation where some Member States allow drone operations towards an EU wide system with common rules.

2. What rules for drone operations? The roll out of the EU "operation centric" approach

The drone technology will be as disruptive for businesses as it will be challenging for regulators. The types of operations that need to be regulated not only cover the traditional commercial air traffic; drones are able to perform operations that were simply not possible with manned aircraft, much closer to people and buildings. That is why the regulatory framework must well protect peoples' safety, security, privacy and environment. [4] On the other hand, the drone technology is expected to evolve substantially in the coming years and it is impossible to anticipate now what this technology will bring in future. Hence the need to shift from the current prescriptive aircraft focused approach to a performance based and operation centric approach.

The starting point of the new approach is the focus on the specific risk of a particular operation. Rules and procedures should be kept proportionate with the identified risk. As the range of possible operations with drones goes from harmless operations (a drone operation with no meaningful risk at all or generally accepted as a risk free operation) to traditional operations with risks equivalent to 'manned aviation', the rules and procedures must be made much more flexible. In addition, technological evolution should be promoted. Hence rules should only define the required performance or functional requirements. Industry standards could then be developed to provide means to satisfy the requirements – whilst leaving scope for alternative technological solutions.

In all, the operation centric approach could be organised in three layers. The first layer concerns the principles of the approach. More specifically, the building blocks of the operation centric approach are given in the review of Regulation 216/2008 on the EU aviation safety rules. The technical rules will be

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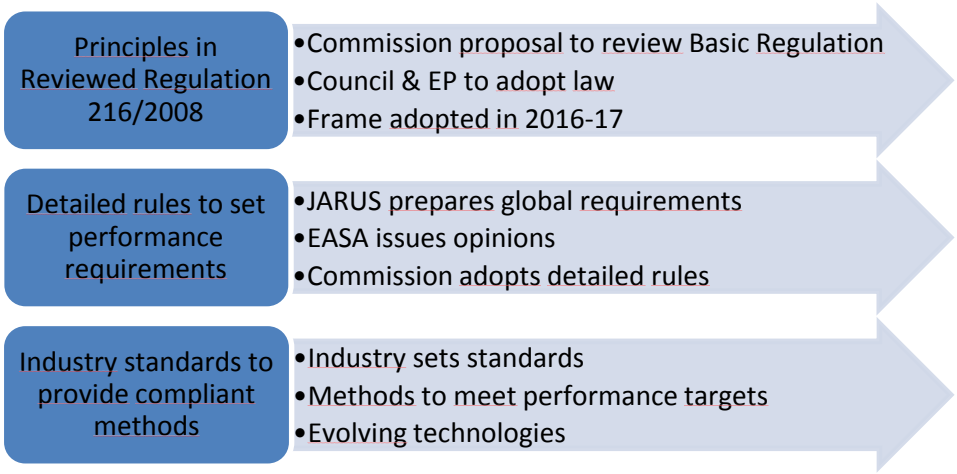
2 This does not mean that the low level airspace is devoted to drones only. The challenge is to reconcile the current traffic of rescue helicopters, military, aerial work or general aviation with drone traffic.

3 Including for command and control.

4 New safety rules will contribute to a better application of existing privacy and data protection rules. See under 2.1.

developed by the European Aviation Safety Agency, to the extent possible, on the basis of international consensus reached in the Joint Authorities for Rulemaking on Unmanned Systems (JARUS). The detailed rules will take the form of Commission Regulation. The detailed rules should precisely describe the required performance levels for drone operations. Thirdly, industry may support the development of standard ways to satisfy the regulatory performance targets. Standards are not mandatory as such, but facilitate compliance with the rules. Industry driven standards are deemed the most flexible tool to support technological innovation and to boost business opportunities.

Graph 3: The three regulatory layers of the operation centric framework



2.1 The building blocks for operation centric rules

The proposals to Review regulation 216/2008 [5] provide the principles and the building blocks for an operation centric approach:

- The principle is laid down in Article 4: "Measures taken under this Regulation shall correspond and be proportionate to the nature and risk of each particular activity to which they relate…".
- The wording of the Regulation reflects the necessary flexibility, like "…situations ... taking due account of the nature and risk of the particular type of activity concerned….".
- Use of lighter rules: the Regulation will contain the building blocks; the detailed rules will become Commission Regulations; extensive use of industry standards [6] will be made.
- The rules will be drafted in terms of performance objectives, leaving it to industry to establish the standards that comply with the requirements.
- The standard procedures certification and licensing to demonstrate that requirements are complied with are completed with lighter procedures to deal with lower risk operations: declarations, market surveillance mechanisms. [7]
- Qualified entities are given a clear institutional role in the oversight process as to complete the authorities' tasks and provide more flexibility.

In line with the global developments within the international JARUS group of drone regulatory bodies EASA [8] has proposed three risk categories for drone operations, an ‘open’ category for 'low' risk operations where the risk for people on the ground or in the air is minimal; ‘specific’ for medium risk operations where the risk of the particular operation would need to be assessed in view of the type of

5 See annex 2.

6 This assumes the relevant industry partners assume their responsibilities to come up in due time with adequate standards.

7 In the meaning of Regulation (EC) 765/2008.

8 http://www.easa.europa.eu/system/files/dfu/204696_EASA_concept_drone_brochure_web.pdf; http://easa.europa.eu/document-library/notices-of-proposed-amendment/npa-2015-10.

operation, the territory overflown, the particular drone or the quality of the operator; and 'certified' category for high risk operations, equivalent to 'manned aviation'.

The three articles on drones (articles 45-46-47) and the specific annex IX in the proposal to review the EU safety rules [9] must be read in this wider context and should be conceived as the keys to unlock and steer the operation centric, performance based approach for these three categories. Article 45 assures that drones can be operated safely in the airspace, without too stringent requirements. Article 46 creates the various approval mechanisms for safe drone operations, where new approval systems go beyond the traditional aviation approvals. Article 46.1 creates the certificates for approvals of operation, the technical state of the drone and the pilot. The latter support, when necessary for the risk of the operation, the operational approval. Since the term 'certificate' assumes an 'authorisation', this article can be used for approvals for both high and medium risk operations. Article 46.2 establishes the use of declarations as a possible means to approve drone operations. Declarations can be used for high, medium and low risk operations, but are envisaged to be primarily used for medium or low risk operations. Article 46.3 enables the use of a non-aviation approach to ensure the technical compliance of drones with the regulation. This approach is envisaged for low risk operations, which includes operation of mass products sold through retail shops. It will allow industry to self-declare the conformity of the products placed on the market with the regulation, eventually supported by harmonized standards.

To maximise the accessibility of the European market the involvement of EASA and the national aviation authorities of the member states must be carefully balanced. Industry is served best with common European regulations for drones and common European approvals, which will allow it to operate in the whole European Union with one single approval. [10] For easy access and reduced administrative costs, industry should be offered the possibility to deal with local authorities regarding acquiring approvals and being kept under local oversight. On the other hand, the most efficient division of tasks is that common rules entailing mutual recognition [11] are developed at the European level.

The three articles on drones in the reviewed EU safety rules produce exactly such a careful balance. The EU would be responsible for defining the common rules and assuring that approvals based on the common rules are valid for the whole Union through the system of mutual recognition. For the regular interaction like granting approvals, keeping oversight on organisations and serve as a primary point of contact, the national aviation authorities would be responsible. EASA is to make sure that national aviation authorities act similarly in approving and keeping oversight, so that the drone industry only has to deal with one regulatory framework with the same rules applied in the same way throughout the EU.

For high risk operations, which will have a similar regulatory system to manned aviation, the division of tasks should be similar to the division of tasks for manned aviation.

2.2 Enforcement of drone regulation: how safety rules facilitate enforcement of existing rules in other areas

As from the conception of drone rules, enforcement must be one of the driving forces for rule development.[12] For enforcement and oversight of drone rules, the involvement of several authorities is foreseen. Beyond the aviation safety inspectors of the national aviation authorities, there is the local police, the market surveillance authorities, the data protection authorities or security forces – in contrast to traditional "manned" aviation, where aviation safety inspectors have an exclusive oversight and enforcement competence. The reason for this difference is the radically different risks that need

9 COM(2015)613

10 Possibly completed by local endorsements – see below graph 1.

11 The mutual recognition of safety rules does not prejudge national rules on privacy or national security rules.

12 This makes the case for a strong EASA consultation process with the national competent authorities.

to be managed and overseen. The risks that drone operations entail, especially with smaller drones in the open and specific categories are more similar to general policing tasks (like neighbour issues) than to traditional aviation risks; or give rise to serious privacy or security concerns. This means in practice that the police forces [13] will need to be put in a position to enforce drone rules and that aviation authorities will be far less involved in the oversight of low risk operations. Police then could liaise with other authorities, like those in charge for privacy and data protection.

In the "open" category, where the level of risks is low, the required level of safety will be ensured through a combination of requirements on the drone (specific functionalities or maximum performance for instance) and operational or competence requirements. [14]

Operational rules could be enforced by the police (the same way police enforces traffic laws) [15] and product requirements would be enforced by the market surveillance authorities like other applicable product requirements (electro-magnetic compatibility for instance). This would prevent that aviation authorities are involved in the authorisation and oversight of a large number of low-risk operations allowing them to focus on the more risky operations.

The 'general' police officer will have to assume the new role for the safety protection of other airspace users and people and items on the ground. This is already the case in many Member States. This makes the case for a highly automated tracking system to avoid too many interventions. Tracking information and identification of the operator should be readily available at least to authorities on each operation. [16] Future rules must be easily comprehensible for both the police and drone users in general to raise awareness and to promote adherence. Expertise learns that the local police needs assistance in its new role. Rules must be easily enforceable and violations must be quickly and accurately determined. Police officers should be appropriately trained and equipped with effective tools (apps, measurement tools, etc.).

3 The essence of the operation centric approach

The core of the operation centric approach is the specific risk of a specific (type of) operation. The operation of the same drone over a city centre or over the Atlantic entails a completely different risk. To take due account of the actual risk, the traditional "aircraft centric" approach must be extended to an "operation centric" approach. Types of operations are broken down in three categories.

A first category covers all low risk operations which should be as "open" as possible to drone users – "buy and fly". As the drone operator may not be acquainted with aviation and aware of the risks, the safety features must above all be embedded in the aircraft. The purpose is to keep the mass produced drones into this category and make sure that these drones are kept within a "bubble" without integrating with other air traffic. [17] Open operations would in principle not require a prior approval from the aviation authority. [18]

A second category would cover operations with an increased risk. The "specific" risk is in principle [19] assessed through a standard risk assessment process. An authority approves the proposed risk mitigation measures and approves the operation. The third category operations is the certified

13 It is up to the Member States to designate the competent authorities to carry out those enforcement tasks.

14 Affordability and feasibility are important parameters to assess the proportionality of the imposed requirements.

15 Each Member State decides on the nomination of its 'competent authority' and the use of police forces. In any case, the system should be fully automated and violations of the rules should be minimal.

16 The exact scope of the tracking requirements must be assessed not only in terms of safety (e.g. including the harmless category or not) but also in terms of privacy and security (camera or not).

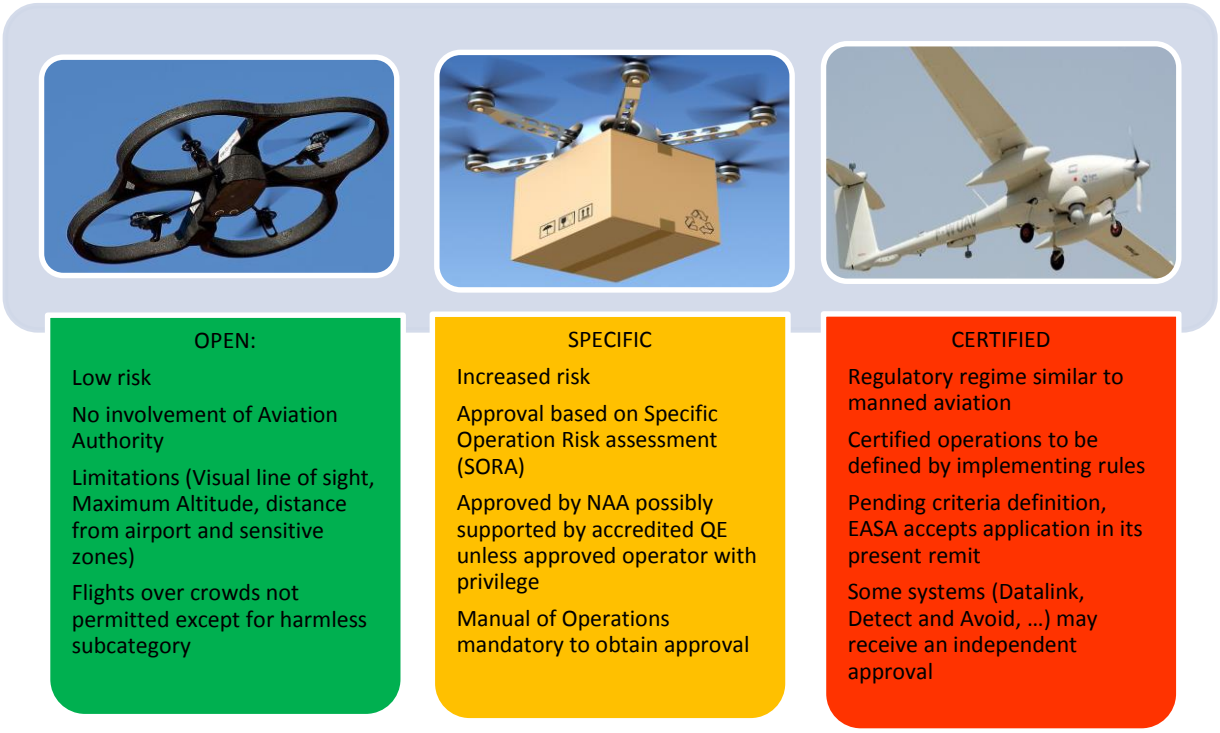
17 The embedded safety features can be completed by pilot competence requirements for subcategories.

18 This principle does not prejudge professional users to have an operator approval and adequate insurance.

19 See below. In practice standards operational scenarios will be developed with standard mitigating action to promote drone operations and avoid an unnecessary administrative burden for industry and authorities.

category, where risks are equivalent to current manned aviation operations and hence imply the traditional safety measures and processes (certification and licensing).

Graph 4: The three categories of operations in the operation centric approach



The operation centric approach is based on following principles:
Proportionality: is the key objective of the regulatory framework. The requirements associated with each drone operation should remain proportionate to the risk of each operation.

Operation-centric: instead of focusing on the aircraft (aircraft centred approach), the focus shifts to the particular risk of a particular drone operation.

Risk-based: the level of risk depends on a range of factors, such as the energy[20], the size and the complexity of the drone; the population density of the overflown area; the design of the airspace, the density of traffic and the services provided therein. As the risk may also come from whatever ***the purpose of the operation***, the regulatory framework applies to both commercial and non-commercial operations. [21]

Performance-based regulation: is a regulatory approach that focuses on desired, measurable outcomes instead of focusing on the method or the technical solution. It can be objective-based, process-based or performance-standard-based. A key element is the development of non-binding documents such as Industry standards, certification specifications and acceptable means of compliance or guidance material. In addition, a proposed methodology for independent auditing may be required.

Progressive: the three categories of operations were established with the idea that the regulatory complexity is proportionate to the operational complexity, so that operators are able to move

20 Kinetic, potential and internal energy of the unmanned aircraft.
21 The case of model aircraft will be addressed through provisions in the IRs recognising that the way they are organised, their experience; their safety culture, etc. provide an equivalent level of safety to the one intended by the IRs.

seamlessly from one type of operation to another, without having to make big leaps or that the rules become a hurdle to advance in operational complexity.

Smooth: the introduction of drones in the aviation system should not create an undue burden for other aviation stakeholders. [22]

3.1 Categories of operations

The first priority is to develop implementing rules that give clarity on the exact categorisation of "open" and "specific" drone operations. Open category operations are those that do not require a prior authorization of an aviation authority. This does not mean that there are no rules –it merely means that the "operational envelope" is well described and limited to particular low risk operations, taking place in a limited airspace bubble where there is no or very limited risk of interfering with other air traffic. As soon as the operation falls outside the operational envelope of the open category, the rules of the specific category apply. The certified category kicks in as soon as passengers are transported or human lives are seriously endangered.

Already by mid-June 2016, more detailed ideas should be given, so that these ideas could back the political agreement in the Transport Council to work towards the operation centric approach, support the national regulatory process and guide the standard-setting process. The implementing rules would be formally adopted shortly after the Reviewed Regulation 216/2008 is amended. In parallel, the work on the 'certified' category could start as large drones are already within the EU regulatory scope: today large drones can receive an airworthiness certificate or a permit to fly.

In order to provide even more concrete support for the political process, , EASA will develop "prototype" implementing rules for the "open" and "specific" categories rules by the end of July 2016. These "prototype" rules will allow starting the debate on concrete proposals and not only on general intentions.

Based on the first deliverables from JARUS, consultations can be launched on dedicated subjects, e.g. airworthiness specifications for unmanned aircraft and safety risk assessment process for specific operations. A first set of rulemaking deliverables can be found in Annex 4

3.2 Performance requirements for low risk operations

The affordable access to drones and their easy operation give the possibility to almost everybody to become a pilot. However, not everybody has a strong aviation safety culture and is aware of the safety consequences of his or her actions. Safety features that are embedded in the drone can help mitigating the risk. Performance limitations, mandatory geographical limitation and identification are two concrete measures that help – at least to a certain extent - non-aviation experts to start flying drones.

The idea is to impose such product requirements through the mechanisms defined by the Community harmonization legislation (conformity assessment, CE marking, market surveillance, etc.) and already used to ensure conformity to the requirements applicable to drones. [23] The use of CE marking has big advantages. It reassures the customer that the drone is safe and compliant with the regulation; it introduces a well-known system of compliance for the manufacturer or the importer; and the market monitoring mechanism can trigger an EU wide warning system when unsafe or non-compliant products are found. The penalty then is that unsafe or non-compliant products must be taken from the market.

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[22] This principle has been introduced in response to a number of comments on A-NPA 2015-10 that clearly perceived unmanned aircraft as intruders in the aviation system.

[23] Several product safety directives are already applicable, like the Radio Equipment Directive (2014/53/EU); the Electromagnetic Compliance Directive (2004/108/CE); the general Product Safety Directive (2011/95/CE); the restriction of the use of certain hazardous substances in electrical and electronic equipment directive (2011/65/CE); and in certain cases the Toys Directive (2009/48/EC).

EASA working in close cooperation with the Commission will come up with product requirements applying to drones operated under the open category. They will cover in particular mass produced drones intended for low risk operations. This work stream is a matter of priority, as clear requirements need to guide the standard setting bodies in their activities. Standards would be needed in particular for identification and geo-fencing. In order to support the conformity assessment process to be performed by the manufacturer, harmonized standards should be developed by ESOs and published in the JO of the EU.

Activities are already ongoing at national level to define technical requirements applicable to drones operating in the open category. Synchronisation at EU and international level has to be initiated as soon as possible in order to agree on basic. The product requirements will reflect operational envelopes suitable for this type of drones. EASA in close cooperation with DG GROW will work with the national aviation authorities to come up with the most appropriate product requirements for various types. Concerning the identification and limitation functions EASA can define a commonly used data format (e.g. for map data) that should be used to provide the information in an open web interface. This information could be made available through service providers, presented through a smartphone app, or directly uploaded to the drone. In the future, also features like interoperability with systems for manned aviation or autonomous cooperation and 'traffic management' for low-level operations can be assumed that will probably be required once traffic in urban environment becomes denser.

The legislation must also define the compliance assessment procedures imposed to the manufacturer. These procedures must be selected amongst those laid down in Commission Decision No 768/2008/EC. To avoid imposing unjustified heavy procedures, they must be selected in close link with the definition of the requirements and the sub-categories of products to which the requirements are imposed, considering the type of production (mass production or small series, etc.) and industry involved (SME, larger companies, etc.).The implementing rules should also "grandfather" [24] activities that do not pose a risk for the aviation system, such as models operated in associations.

EASA will come up with product requirements for mass produced drones, mainly intended for low risk operations. This work stream is a matter of priority, as the safety performance objectives need to guide the standard setting bodies in their activities. Activities are already ongoing at national level. Synchronisation at EU and international level has to be initiated as soon as possible in order to agree on basic principles and create appropriate standards. The product requirements will reflect operational envelopes suitable for this type of drones. EASA will work with the national aviation authorities to come up with the most appropriate product requirements for various types.

Concerning the identification and limitation functions EASA can define a commonly used data format (e.g. for map data) that should be used to provide the information in an open web interface. This information could be made available through service providers, presented through a smartphone app, or directly uploaded to the drone. In the future, also features like interoperability with systems for manned aviation or autonomous cooperation and 'traffic management' for low-level operations can be assumed that will probably be required once traffic in urban environment becomes denser.

The implementing rules should also "grandfather" [25] activities that do not pose a risk for the aviation system, such as models operated in associations. In order to make quick progress EASA has put in place two tasks forces on geo-limitation (or geo-fencing) and on the impact of an unmanned aircraft and a manned aircraft. These task forces take stock of existing measures and best practices and should produce in the very short period recommendations on the way forward.

[24] Equivalent safety findings will be made based on the safety culture of the operators involved or on the way the associations are organised.

[25] Equivalent safety findings will be made based on the safety culture of the operators involved or on the way the associations are organised.

3.3 Performance requirements for specific risk operations

When operations exceed the limitations of the open category, the operation comes under the specific category rules. Here the competent aviation authority approves the operation. In theory, the risk of each operation must be assessed to come up with mitigation means that keep the risk to third parties to an acceptable level. The risk assessment takes account of a range of factors, such as:

- the area of operation (population density, areas with special protection, terrain characteristics and obstacles, GNSS coverage);
- the environmental conditions (day/night, electromagnetic environment);
- airspace aspects (effect on ATM system, class of airspace, segregation, and air traffic control (ATC) procedures);
- the design of the drone (functions provided, redundancy and safety features);
- the type of operation (standard operations or emergency procedures);
- pilot competences and organisational factors of the operator; and
- the effect on the (social) environment (privacy, noise, emissions, wildlife sensitive areas …).

As the range of specific operations is huge, the combination of mitigating action will also vary widely. Hence the need to find common sense solutions and reduce the administrative burden for both the operators and the administrations. One of the proposals is to develop standard "operational scenarios" that could apply to a range of applications, like:

- Video/photography use in urban environment;
- Industrial inspections (power lines, railways, etc.);
- Precision crop dusting and agriculture monitoring;
- Large tethered vehicles to produce electrical energy.

The industry or standardisation bodies can provide standard solutions that could be technical (design characteristics) or operational (procedures) to address the risks of these standard operations. Mitigating action can be manuals and procedures tailored to the operational scenarios. The purpose is to guide operators and to simplify the approval process. The objective is to have an endorsement by the regulators so that these standard scenarios could be mutually recognized. This should drastically reduce the burden for both industry and authorities. EASA then could publish the industry standards as acceptable means of compliance. The national authorities keep additional control in the endorsement process and they determine the access conditions to the airspace. These conditions may apply to safety (e.g. what type of drone to fly over a city centre), security, privacy or environmental performance (e.g. only electric propulsion systems and fly sufficiently high to minimize the noise impact).

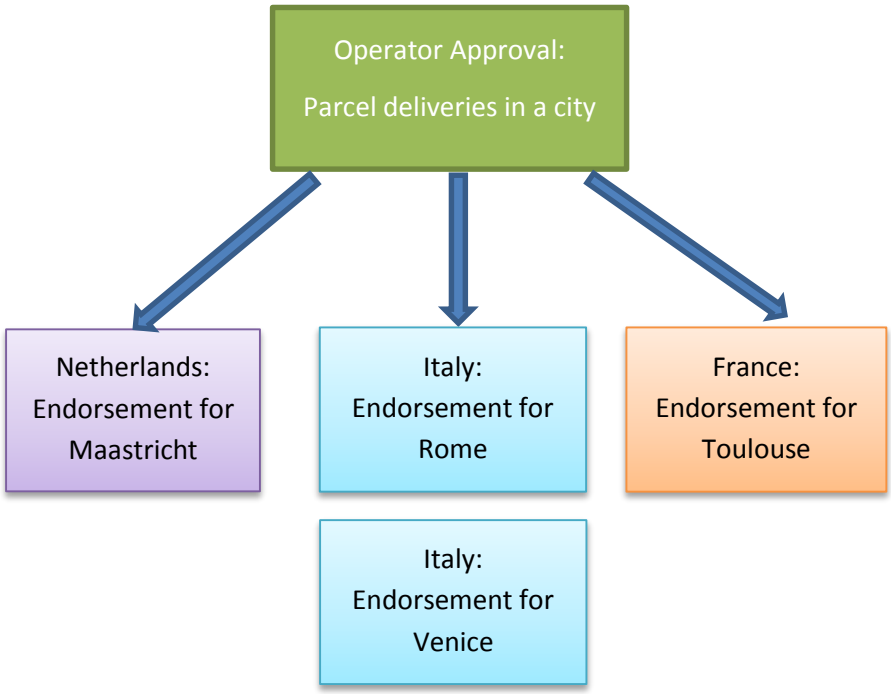
The Competent Aviation Authority of the State of the operator will issue an operator authorization that will be recognized throughout the EU. Other national or local authorities might add local limitations and conditions like for road traffic rules.

- Application for an operation authorization to the competent authority of the State of the operator.
- Preparation of a Specific Operation Risk Assessment (SORA), and Operations Manual.
- Issuance of the operation authorization by the Aviation Authority

The operator is an approved EU operator. Before operating in a Member State:

- Endorsement of the operation authorization by the Competent Aviation Authority of the State where the operation takes place with addition, if applicable, of local limitations related to airspace, authorisation of frequency spectrum, environmental, security and privacy issues.

Graph 1: the complementarity between an operator approval and local endorsements



The operation centric approach allows a scalable or step-wise approach so that the rules remain proportionate to the risk of the operation. For example, an operator could start delivering parcels in a remote area before moving to a city with a drone under the specific category and grow into a cargo company operating regularly a fleet of different drones between different cities and sharing airports with manned aircraft. Privileges could be granted to the operators in the certified category to make changes to their approval, for example, to add a new drone model to their fleet.

For subsidiarity reasons, the competent civil aviation authorities of the State where the operators have their principal place of business should be responsible for the issuance of the operator approval. [26] This scheme also explains the relationship between the operator approval that benefits from mutual recognition and the 'endorsement' which has a local component and is issued by the national competent authority where the operation takes place.

3.4 Performance requirements for certified risk operations

When the operational risk is equivalent to "manned" operations, drone operations would be subject to the traditional licensing and certification. A typical case would be large cargo aircraft flying long range over populated areas and/or in controlled airspace; or, "drone cabs". The implementing rules will determine the exact thresholds between specific and certified operation categories. [27] They will be based on the overall complexity of the aircraft and the risk level posed by the operation. Certification might also be requested on a voluntary basis by organizations providing services (such as remote piloting) or might relate to specific (sub)-systems (such as detect and avoid systems or the remote control station).

[26] The general rules applicable in aviation will apply.

27 The implementing rules will be consistent with ICAO work in this area.

4. High ways and speed ways in the air: how to organise low level operations

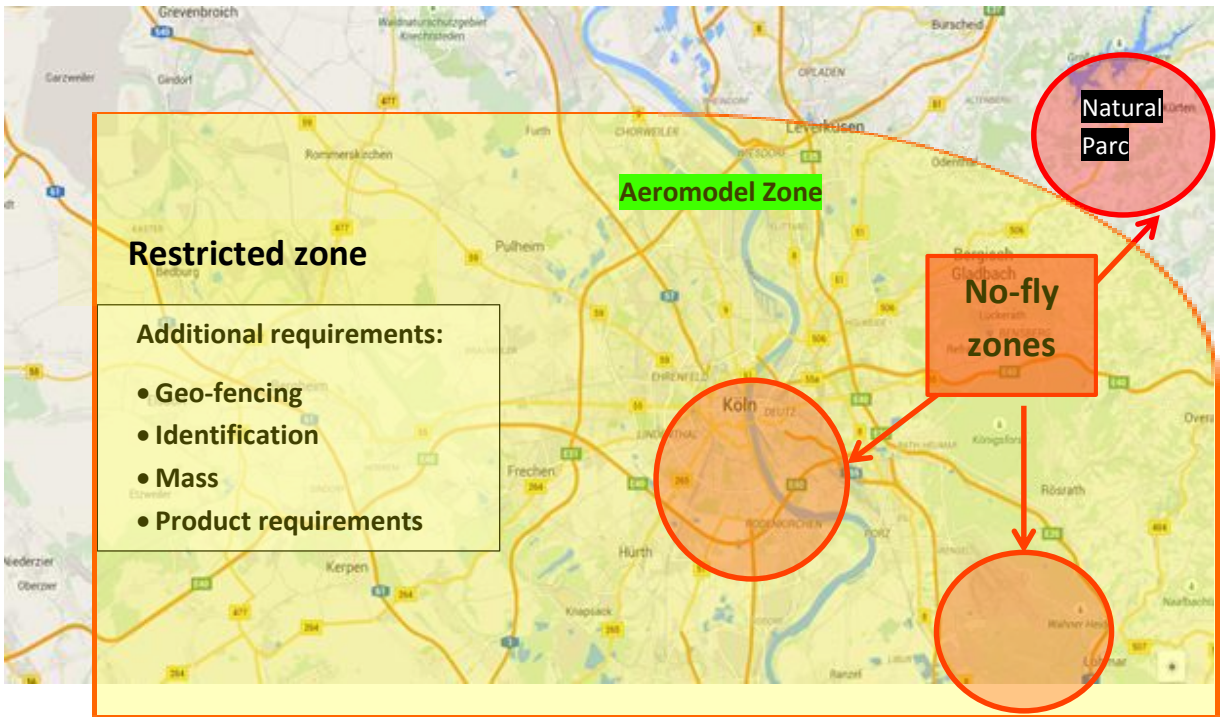
The rules on the organisation of the airspace, the so-called "Standardized European Rules of the Air" (or SERA), are based on globally applied ICAO provisions. They divide the airspace into classes and each class is defined in terms of traffic that is allowed to fly in it, depending on the flight rules, aircraft equipage and pilot qualifications (including all traffic from commercial air traffic jets to gliders or helicopters) and the services rendered (for instance full air navigation services or just flight information to the pilot). The airspace classes cover the airspace from ground level and although most traffic takes place over 150m (500ft), there is also manned traffic taking place below that height (especially training flights, balloons, state aircraft, rescue operations with helicopters, aerial work flights, gliders, etc.).

The rules for low level operations below 500ft will hence have to build on the existing rules of the air and standard air traffic management principles. The purpose is to harmonize the aerial highways and speedways at the European level and leave their actual use for competent national/local authorities to decide. The Commission will come with concrete proposals to complete the current rules of the air with rules on low level airspace in the various classes as described higher. These rules will also establish the system to declare no fly zones (so-called geofencing). The rules will enable the Member States to undertake airspace assessments to devise aerial route networks and come up with a local application of the rules that reflect the needs of a particular city or region.

Safe unmanned low level operations will require communication and tracking capabilities. The existing communication and surveillance infrastructure for manned aviation is in many cases already reaching its full capacity and can also not always be used, from a technical point of view, for low level operations. Low level operations will therefore have to rely on another infrastructure that will provide the communication and tracking capabilities and at the same time be compatible with existing surveillance and air traffic service solutions. To allow tracking, the operator of an unmanned aircraft must be easily identifiable with a unique I-Drone, similar to number plates for cars or registration of aircraft. As a matter of urgency a feasibility study is to be undertaken to identify what infrastructure is most suited to provide the communication and tracking capabilities for these low level operations. Then the exact information content will have to be defined to enable the operators to safely fly, together with the tracking requirements for traffic planning, safety, security or privacy purposes.

Geofencing – qualifying specific airspace as conditional or no fly zones – is a concrete measure to improve safety. The measure can also be used for security, privacy or environmental protection. The rules will establish the institutional framework for managing the EU "geofencing" system. The system should be EU wide – its application local. The rules will determine which authorities can drive such dynamic geofencing system. So could mayors set the conditions to overfly city centres, specific residential areas or beaches. Police and security forces could determine security sensitive zones. These conditions should then be clear for manufacturers and for operators in a dynamic way. Therefore the data format and the data base management should become standardized.

The supporting communication and tracking system will build on existing initiatives and solutions. The current and future mobile 4G and 5G networks could be suitable candidates. The communication and tracking services could be provided at the local, regional or national levels and will also manage and feed the (dynamic) geofencing system. Just like road traffic now makes way for an ambulance, so will unmanned private low level air traffic make way for low level medical or other urgency unmanned aircraft.



The provision of the infrastructure and its management can be given to national or regional level, depending on which entity would be best placed, like the air navigation service provider, the national aviation authorities or other regional entities. These issues need all to be integrated in an overall EU Unmanned Air Traffic Management system.

5. Standards to make technologies evolve

Drone technologies are developing fast. That is why the operation centric approach also intends to move to performance based rulemaking. Detailed rules will set specific performance objectives, functionalities or processes. Industry standards will propose technologies or methods to comply with the rules. This implies an important responsibility for industry to support the definition of standards.

The low level of existing standardization makes the integration of complex and sophisticated systems in controlled airspace quite challenging. International standards are critical in creating the global commercial market. Standards must give drones access to a globally harmonized airspace.

Whereas the needs for standardization are large and manifold there are also clear priorities, such as standards for identification, geofencing, detect & avoid28 and command & control. 29 The standard development process is going on worldwide. The challenge is to improve the efficiency of the standard setting process and to better build on existing standards:

The first responsibility of the regulators is to confirm their intention to work with industry standards and to come up with clear performance based rules. The highest priority will be given to the detailed rules for product safety requirements, where embedding technology appears to be the basis for an effective mitigating strategy – possibly completed with limitations, operational rules or pilot competence requirements; and for identification and geofencing.

The industry is expected to invest in the industry setting process and seek ways to speed up the standard setting process. Low level technologies are not traditional aviation technologies and input from “new players” like mobile phone or internet providers offer a promising opportunity, for instance

28 Detect & avoid enables the pilot to maintain safe separation between the UAS and other aircraft and is key to moving from Visual Line of Sight operations to Beyond Visual Line of Sight operations. In any case, fully autonomous aircraft will require adequate detect & avoid systems.

29 Command & control addresses using radio-frequency spectrum to ensure safe flight.

to assess to which extent existing standards could be used as a basis or to provide additional expertise. [30] And further efforts are needed to obtain from the International Telecommunication Union (ITU) additional frequency allocations for beyond-line-of-sight operations.

The Commission and EASA intend to steer the standard setting activity with the cooperation of the various standardisation bodies and with contributions from other authorities, including from JARUS. The objectives of this top-down approach are to ensure the timely availability of the necessary standards, encourage the development of synergies and avoid duplication of work. [31] The standard setting activities need to be integrated in the research agenda.

6. International harmonisation

International harmonisation on drones is important, especially as there are approximately 60 countries worldwide that are designing and producing drones, compared to the considerably smaller number of countries designing and producing manned aircraft.

Even operators of very small unmanned aircraft request globally harmonised rules for their operations. The operation is local but the market is global. Various and different authorisation systems hinder the market. ICAO and JARUS are the international bodies for discussions on drone rules.

6.1 International Civil Aviation Organization (ICAO)

ICAO, the United Nations specialised agency for international aviation, intends to provide an international regulatory framework for drones through Standards and Recommended Practices (SARPs), with supporting Procedures for Air Navigation Services (PANS) and guidance material. Those requirements will underpin international drone operations throughout the world in a safe, harmonized and seamless manner comparable to that of manned operations.

The starting point is Article 8 of the Chicago Convention. This article by and large prevents the international circulation of drones except when the Contracting State concerned has issued a specific authorization. ICAO has since 2003 been working on drones (duly called "remotely piloted aircraft systems"). [32] Currently ICAO is running a specific drone panel that should eventually lead to guidance and standards. The challenge is to reconcile the traditional ICAO approach (aircraft centric licensing and certification) and remit (international transport flying under "instrument flying rules") with the flexible approach that is more appropriate to the small drone market (the operation centric approach).

Smaller drones are not engaged in international transport and raise issues beyond safety, like privacy or data protection. It is generally expected that drone operations will eventually engage in international transport. Hence the need to work towards the adoption of rules that would support the development of a legal framework in the ICAO contracting states. Europe will invite ICAO, in the longer term to develop a global framework for smaller drones to ensure global consistency, on the basis of work undertaken by the Joint Authorities for Rulemaking on Unmanned Systems (JARUS). In the meantime, ICAO is invited to assess potential limitations to drone operations and focus on new challenges such as liability, airspace, technological, security and legal aspects.

30 Many SMEs are also entering the drone technology and particular attention should be given to the interest of these emerging companies that do not have the possibilities to follow the standard development process.

31 A list of standards together with their associated priorities is included in Annex 5.

32 The first discussions in ICAO started in 2003 and in 2007 ICAO set up the Unmanned Aircraft Systems (UAS) Study Group which developed Circular 328 AN/190 on 'Unmanned Aircraft Systems (UAS)'8, an amendment to Annex 2 (Rules of the Air) and to Annex 7 (Aircraft Nationality and Registration Marks). The next step was the development of the RPAS Manual (Doc 1—19 AN/507). ICAO has now set up a Remotely Piloted Aircraft Systems Panel (RPASP), which should produce draft standards and recommended practices (SARPs) and guidance material for unmanned aircraft by 2018 focusing its work on international operations.

6.2 Joint Authorities for Rulemaking on Unmanned Systems (JARUS)

JARUS is a cooperation of (currently) 45 civil aviation authorities worldwide and its aim is to develop harmonised rules for unmanned aircraft recommending a set of technical, safety and operational requirements for the certification and safe integration of drones into airspace and at aerodromes. European Commission and the European Parliament have recognised JARUS as the most pragmatic 'working engine' to develop the necessary rules. This will ensure harmonisation worldwide and JARUS is expected to contribute to the ICAO work. The EU is, therefore, fully engaged in JARUS and provides significant resources.

The JARUS work provides guidance material to help each national authorities write their own requirements and avoid duplicate efforts. The endorsement of JARUS guidance, even at a high level, facilitates acceptance of airworthiness and operational approvals between CAAs globally. However, each State or Regional Organization will need to decide how to use the harmonized provisions developed by JARUS. JARUS work addresses unique regulatory needs shared by its members such as the need to develop a "Concept of Operations" to define the level of regulatory involvement for different classes of RPAS and the need to address very low level operations of RPAS.

JARUS does not seek to duplicate the work of ICAO or international standards bodies.[33] JARUS members participate in these and other international drone efforts and JARUS will continue to coordinate its work so that it is complementary to any related work conducted by ICAO or international standards bodies. JARUS should also find the appropriate ways to take advantage from industry expertise and establish an effective working relationship. Industry is expected to engage in the technical working groups of JARUS and so facilitate the development of industry standards in the standard setting bodies.

7. Cooperation with State Aircraft and the military

State aircraft activities are for example military, police, custom, fire-fighting, civil protection, border patrol, maritime surveillance, etc. Drones are developed quite often for "dual use" and the same drone could undertake state and civil activities. For this reason synergies should be further developed and overlaps avoided. In addition, state aircraft, in particular military drones, have developed a flying background that may reveal useful in the regulatory process. Combining research efforts is indispensable since there are projects conducted in the military and civil world. The European Defence Agency and the SESAR Joint Undertaking are coordinating their R&D efforts. Certification and standard setting could be other areas of cooperation. EASA is already conducting some certification work of dual-use drones and discussions on airworthiness standards are taking place. The challenge is to deal with differences in safety objective and in continued airworthiness [34] or to overcome military security classification. The collaboration is fostered by the "opt-in" provision proposed in the review of Regulation 216/2008. This option allows Member States to bring specific state activities under civil rules. The European Defence Agency facilitates the harmonization of national regulatory frameworks regarding airworthiness and air traffic management, and ensures consistency between the approach developed for unmanned state aircraft and the general approach for unmanned aircraft.

The civil-military cooperation should also be viewed within the future EU defence action plan to be adopted in 2016. Certification is a critical area to further develop important civil/defence synergies EASA would play a central role in making the military and civil airworthiness approaches converging or in increasing its certification activity for dual-use products by EASA.

[33] Like RTCA, ASTM, EUROCAE or ASD-STAN.

[34] An aircraft is certified for civil activities but the military could use the aircraft under completely different operational conditions that are not foreseen under civil rules, for instance far steeper approach and take-off angles.

8. Drone research - The need for a new innovation ecosystem

8.1 Drone technology as part of the digitalization process

The drone hype should not drown a deeper examination in the technology behind the drone phenomenon – that remains surprisingly nascent. [35] Commercial drone technology is advancing all the time and each innovation leads to new capabilities, more applications, and more widespread use of these machines. The fundamental question remains, however, how to integrate these devices safely into airspace where manned aviation operates. To address such over-arching challenge, innovation has to spearhead novel solutions in terms of:

- System safety and data gathering;
- System certification;
- Command and control link issues;
- Control station layout and certification;
- Ground and airborne sense and avoid; and
- Environmental impacts.

A new EU innovation blueprint is therefore necessary to tackle the full range of issues in a holistic manner. The emergence of drones has to be understood as another step in the digital revolution. The latter relies on networks that bring together multifaceted expertise across product design, development, and operation and associated services. In addition to hardware – e.g. lighter products and battery efficiency – the software perspective is pivotal to ensure value generation in the new production and service chains. These will command enlarged partnerships between the drone industry partnerships and other digital and intelligent systems and telecommunication sectors, to deliver the end-to-end service concepts and retail strategies customers dream upon.

Supporting research and opportunities to test drones across the Union is pivotal. These opportunities should become embedded in a wider policy of innovation in product and service development – in close collaboration with universities or research institutes. [36]

The next generation of innovators —the start-ups mushrooming in the digital wave — are expected to take drone technology to the next level. This makes the digital-focused communities and the education system at large critically important. [37] Training and education is not just about higher education. Forward-thinking high schools around the world have already discovered this potential on their own, adding drone technology courses to their standard curriculum. These courses are popular, and have connected participating schools and students with drone companies and researchers in the real world.

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35 Due to the limited payload capacity, the current battery life of even the most sophisticated consumer drones is struggling to get near half an hour, whilst their poor durability leaves many users wanting. And the teething problems don't stop there. Many drones currently use standard wireless signals and radio frequencies that are vulnerable to unstable connectivity. Worse still, hackers can steal data or footage from drones, while hijacked drones are not unheard of.

36 The US FAA has six test zones is to conduct critical research into the certification and operational requirements to safely integrate drones into the national airspace over the next several years, in collaboration with universities. Also Japan has specific drone test sites.

37 This is exactly why the US FAA chose leading university partners for each of their six official test sites.

8.2 The current state of drone research

The potential business opportunities generated by the drone industry has eventually pushed for the mushrooming of research and development activities at EU, national and regional level. However, many of these activities emerged in a disparate manner hampering the creation of necessary synergies between them, thinning their disruptive potential. In terms of coverage, the focus of such efforts concentrated mostly on technologies - such as detect and avoid, command and control, airport operations, airspace access, and contingency and security including cyber-resilience – with a clear deficit on operational, certification and other ancillary questions that are paramount for a sound and robust market development.

At EU level, whilst a myriad of relevant research activities are now up and running, including notably aspects dealing with:

- Air traffic integration by SESAR;
- Small RPAS identification and geo-fencing by the JRC;
- Generic drone research under the Horizon 2020 Programme;
- Military applications under the aegis of the European Defence Agency.

A key underpinning problem is that such R&D efforts are to a large extent performed by traditional aviation actors, adopting mostly concepts and approaches akin to the aviation sector. This constitutes a strong barrier to innovation originating from fast pace sectors – such as informatics, telecommunications, robotics or advanced materials – which are often waived away by the aviation community. This creates a pernicious circle; potential new actors do not get sufficient access to "aviation" funding that can prime their interest and create win-win scenarios; while aviation "insiders" feel crowded out by the new actors. [38]

Novel, more embracing and enlarged, schemes of cooperation are therefore required to bridge the gaps between such diverse communities. This will entail seeking innovative ways of funding and govern R&D structures that embody a higher fit-for-purpose capability. Notably, it is crucial that R&D eventually results in tangible outcomes with a potential to rapidly penetrate the marketplace, matching the swift drone-related product and service development cycles we witness elsewhere. To that extent, the following concrete actions are proposed in the short term:

- Apply alternative funding and integrate innovative technologies under development, in a first phase, in the aviation exploratory research and later to applied research; and at the same time reach out to interested companies that want to engage in drone operations but do not have a traditional aviation background;
- Increase SESAR drone activities in the next Multi Financial Framework with a strong leadership to implement R&D. The SESAR Joint Undertaking is best placed to assume this responsibility and become accountable for delivering concrete results for all airspace users.
- Enhance the coordination with national projects and projects led by other EU Joint Technology Initiatives and agencies, including the European Defence Agency;
- Streamline the R&D activities with the regulatory and standard setting activities.
- To establish an for drone research by inventorying the relevant activities carried out at EU, national and regional level, and where feasible, pooling results and resources;

In the longer term additional and wider actions should be developed:

- Define a **Master Plan** for drone research, that embodies a vision of the drone market, the steps necessary to reach the latter, and the role of the public authorities in enabling such a vision;

[38] While some companies claim to need much more public R&D money, other companies bluntly say they want to develop themselves the necessary technologies – and also contribute to the ensuing standards.

this will necessary entail the consideration of aspects such as product innovation, end-to-end services, regulatory, standardisation and certification aspects, spreading the whole of cycle of drone-related products, processes and operations;

- Create a blueprint of **Ancillary Measures**, in fields as diverse as education and training, venture capital, public procurement, that can attract a whole new community of entrepreneurs into the EU drone industry, creating a new momentum and spearheading disruptive concepts into the latter;
- **Heighten the visibility** of the EU drone industry, by devising high-profile challenges and prize initiatives, with a global dimension, contrasting EU products and services with other foreign initiatives.

9. Drone regulation awareness raising plan

Rules as such are not sufficient for safe drone operations that also respect the right to privacy and data protection. The rules must be actively promoted in the drone community and explained in an understandable way. This is all the more important as many drone operators are often unfamiliar with aviation and the safety implications of their actions. Also privacy concerns are also often overlooked. Finally operators must be made aware of sufficient insurance coverage. The adoption of European rules will simplify their promotion and allow EU wide campaigns.

Providing such knowledge is achieved by the training delivered in view of obtaining a pilot license. However, when pilot training and/or license is not required, like in some parts of the open category, this knowledge must be transferred in a proactive way through efficient awareness raising plan. Awareness actions will in consequence primarily target the Open category. The new European safety rules will be explained as well as the implications of the existing insurance, privacy and data protection legislations. As European safety regulation further develops, awareness material covering specific operations will also be developed to promote and explain the new European rules.

In the Open category, a particular focus will be put on the users of consumer products. The main promotion tool for this category consists in leaflets provided with the drones when placed on the market.[39] These leaflets will summarize the safety, security and privacy rules through dos and don'ts presented in a synthetic and understandable way. They could be accompanied by promotion campaigns using video, animations, posters, etc. Given the fact that a huge amount of users are (young!) recreational users the most modern, quick understandable forms of communications should be used, like banners on the specific internet sites, appropriate social networks, apps etc. Another important initiative will be the setting up of a website providing detailed guidance and information. Conference and business events could also be excellent occasions to present the regulatory approach and discuss it with stakeholders. The adoption of European safety rules will simplify the awareness raising by allowing EU wide campaigns.

Another dimension of the awareness raising plan will target law enforcement agencies. In order provide the specific enforcement tools the legislation needs to be explained in a simple and clear way with clear criteria and examples of legal and illegal behaviour.

10. Overview of how and when drone operations can be launched

Translating general drone articles into a coherent operation centric approach will take a process going far beyond pure rulemaking. Regulatory actions must be coordinated with R&D and standard setting activities. Only such combined action can create a fortuitous investment climate and job opportunities based on drone technologies.

The annexes describe the more concrete actions. Each chapter in the roadmap has a dedicated annex.

39 Also home-builds require attention though.

Annex 1 – The adoption of a concept of operations from an airspace and air traffic management perspective

Objective: JARUS members to agree on a vision on how drone operations could be organised in the future in the lower and higher airspace and how this concept of operations fits with the current and future 'manned aviation' system. EU then to build on this global consensus.

Form: concept of operations paper developed by EUROCONTROL and promoted at the global level through JARUS. This paper should become a centre piece in the JARUS work and provide a template for the development of the low level infrastructure in various parts of the world.

Substance: the proposal provides a coherent vision on how drone operations could be developed in the coming years, growing into a mature system able to cope with intense drone traffic – especially in the lower level. This system should steadily evolve to a system of the internet of (flying) things where also manned aviation (like smaller 'general aviation' aircraft or state helicopters) will be integrated.

The specific EU actions are found in the fiche on the rules of the air.

Process and timing:

JARUS will adopt the "Concept of Operations" paper in the coming months and should adapt the priorities of its working programmes accordingly. The JARUS paper will be assessed in view of other ideas and concepts, like the NASA UTM concept. The concept of operations will become the basis for operations in the period 2018-2023. The EU should also take position on the feasibility and societal acceptability of the concept. This is linked with the adoption of the rules of the air.

Annex 2 – The adoption of drone rules and the principles of the operation centric approach

Objective: introduce the basic drone rules at the EU level and lay the foundations for the operation centric approach.

Form: proposal of the Commission to the European Parliament and Council on common rules in the field of civil aviation and establishing a European Union Aviation Safety Agency.

Substance: the proposal provides EU competence to lay down the regulatory framework for drone operations and the tools to roll out an operation centric approach. The proposal contains three specific articles on drones.

- Article 45 refers to "Essential Requirements" in Annex IX specifically devoted to drones and drone operations. Essential Requirements are the principles that should underpin all aviation activities, in this case drone design, production, maintenance and operation. The annex has two parts. The first part of essential requirements applies to all drones covered in the Regulation. The requirements relate to safety, but impose the obligation to an operator to respect existing rules on privacy, data protection, liability, insurance, security or environmental protection. Safety rules hence should be framed in such a way that they contribute to the correct application of these existing rules. The second part of the essential requirements cover drone operations for which an authorization or declaration is required. They relate to the traditional aviation areas of airworthiness, organisations, operators and operations.
- Article 46 explains how drone manufacturers and operators can demonstrate how they comply with the requirements. The novelty is the extension of the range of traditional "means of compliance" (certification and licensing) is broadened with declarations, product safety rules. The rules would allow no requirement at all in function of the particular risk.
- Article 47 overviews all the areas where more detailed rules will need to be developed.

The articles must be seen together with the other articles of the Regulation, as explained in chapter 2 of the roadmap, that bring about the operation centric approach. In addition, this initiative will also amend the rules on accident investigation and occurrence reporting.

Process and timing: the Commission has adopted its proposal for a European Parliament and Council Regulation on 7 December 2015. The legislative process is ongoing. The Dutch Presidency has started the discussions and aims at a partial political agreement during the June 2016 Transport Council. A Parliament first reading is expected in the autumn. The formal agreement on the Regulation is expected in the course of 2017. The partial agreement in June will already form a solid basis to develop the operation centric approach and to come up with guidelines. Once the Regulation will be adopted these guidelines would immediately after become detailed rules in the form of Commission Regulations.

Annex 3 – The body of the operation centric approach

Objective: develop and adopt the necessary detailed rules to implement the operation centric concept.

Form: EASA will produce opinions for Implementing rules and decisions for associated acceptable means of compliance and guidance material. The work will to the extent possible be based on JARUS activities. The EASA work will also guide industry to adopt standards.

Substance: the opinion will contain following provisions:

1. Establish and delineate categories of operations and the risk factors:

Establish three categories for the operation of unmanned aircraft taking into account the nature and risk of the particular activity:

— 'Open' category (low risk): low risk operations do not require a prior authorization and are limited to a specific operational envelope. Safety is principally guaranteed through safety features embedded in the drone. Clear product safety requirements will be set in terms of safety performance objectives. Ensuing non-binding standards will be developed. This leaves sufficient flexibility for fast evolving technologies and offers a formal basis for issuing CE conformity marking. There would be several subcategories within the "open" category. In any case, the weight of drones in the open category would be (initially) limited to 25kg.

— 'Specific' category (medium risk): a specific operation requires an authorisation by a national authority. As soon as the drone operation goes beyond the operational envelope of the open category, the operator is required to carry out a risk assessment. The operator proposes a set of specific risk mitigating measures which the authority then approves.

— 'Certified' category (higher risk): when the risk of an operation is equivalent to the risk of "manned" aviation, the requirements for drone operations will be comparable to those for manned aviation. The traditional aviation acquis (certification and licensing) is applicable.

2. Create performance objectives for the open category:

The rules will provide for the effective identification of the drone and its owner/operator and will determine performance objective and operational limitations for the open category of operations to be operated safely with regard to people and property on ground and the presence of other air traffic. Performance objectives could take the form of:

- maximum weights and speeds
- presence of defined design features and functionalities such as geographical limitation system, identification and registration

Operational requirements for the Open category will include limitations such as:

- zones where active geographical limitation system is required;
- zones where a maximum take-off weight is defined;
- zones where identification and registration is required;
- zones with additional environmental protection requirements; and
- no fly zones.

- The open category operations will be subject to specific operational limitations:
  - flights over crowds are not permitted;
  - the pilot remains responsible for the safe operation and safe distance from uninvolved persons and property on the ground; and

- the minimum safe distance for people which are not involved in the operation in the highest-risk subcategory of the 'open' category is proposed to be 50 m. [40]

- The open category will have subcategories with (for the moment) drones up to 25kg and with a "harmless subcategory". To each subcategory a specific set of product safety standards will be attached.
- The harmless category would have following basic requirements:
  - drones would only be subject to market regulations (and local restrictions);
  - requirements for the operator should be limited (avoid careless or reckless operations);
  - the manufacturer of a "harmless drone" would put clear operating instructions with do's and don'ts on leaflets in the box.
- Specify the requirements that manufacturers and importers of drones must respect within dedicated product legislation and how they can demonstrate that the rules are well respected. These requirements will relate to safety, environmental protection, performance-limiting and identification functions and will drive the standard setting process;
- Specify the information to be given to respective customers on applicable operational limitations.
- Specify the requirements for operators for the various subcategories, such as:
  - only engaging in operations of direct visual line of sight of the pilot;
  - the obligation of using a drone that has embedded operational limitations, so that the drone cannot fly higher than 150 m above the ground or water.
  - the responsibility to safely separate from any other airspace user(s) and to give right of way to any other airspace user(s); and
  - demonstrating adequate pilot competence according to the performance of the drone.

3. Create performance objectives for the specific category:

- Determine the operational conditions for the specific category operations to ensure integration with other air traffic;
- Propose the steps that should be undertaken to obtain the authorization, whereby the operator should:
  - provide the competent authority with all the information required for a preliminary applicability check of the category of operation;
  - provide the competent authority (or QE) with a specific operation risk assessment covering both the unmanned aircraft and the operation, identifying all the risks related to the specific operation, and proposing adequate risk-mitigation means; and
  - compile an appropriate manual containing all the required information, descriptions, conditions and limitations for the operation, including training and qualification for personnel, maintenance of the unmanned aircraft and its systems, as well as occurrence reporting and supplier oversight procedures.
- Propose practical ways to limit the administrative burden for companies and authorities by agreeing standard scenarios as proposed by industry, which would benefit mutual recognition:
  - cover the most commonly used operational scenario's;
  - propose a combination of mitigating measures including standard manuals and procedures;
  - foresee a simplified administrative procedure;
  - work on existing national practices so that these de facto could be grandfathered;
- Provide guidance how the system of mutual recognition could work and how the local conditions could be met;
- Specify the limitations and conditions that the operation authorization could contain:
  - conditions and validity of the operator approval;
  - ensuring that all involved personnel is sufficiently qualified and familiar with the relevant operational procedures and conditions;
  - responsibility for collecting the required information on permanent and temporary limitations and conditions and to comply with any additional requirement or limitation defined by the

[40] This proposal from the EASA technical opinion is under discussion, as it does not appear to be fully in line with the performance based approach.

competent authority of the State where the operation takes place or for requesting specific authorisation.

4. Amend existing rules for manned aviation to include certified operations [41]

In principle the traditional aviation rules and procedures apply to certified operations. The foreseen actions here focus on introducing drone specific aspects to existing rules:

- Adaptation of implementing rules for manned aviation to introduce licences for remote pilots, the Remote Operator Certificate (ROC), and unmanned aircraft specific elements like 'ground control station' for the 'certified' category (as soon as deliverables from JARUS [42] are available). The rules will define how the operator can qualify for a remote operator certificate and can obtain adequate privileges in order to authorise/modify its own operations.
- Specify modalities how organisations responsible for the design, production, maintenance and training can demonstrate compliance by holding respectively design, production, maintenance and training organisation approvals when required due to the risk posed by the operation.
- Specify how parts or equipment might be approved independently from the drone itself. The rules will define the required processes based on the 'European Technical Standard Order (ETSO)' process. The process for release and continuing airworthiness oversight needs to be adapted as equipment might not be installed on certified unmanned aircraft. This might cover ground stations or qualified 'detect and avoid equipment' installed on unmanned aircraft in the 'specific' category.
- Community Specifications will complete detailed rules, covering a broad range of different unmanned aircraft configurations, defining the safety and environmental protection objectives. Industry standards will be referenced allowing for fast reaction on technical and operational developments.

5. Establish ad hoc task forces on specific themes to feed rulemaking

EASA has established two specific task forces.

- The **task force (TF) on Geo-limitation** with a limited number of national experts (FI, FR, PL, UK) will produce a report by 30 June 2016 with a set of recommendations and the way forward to implement them, focusing on unmanned aircraft in the "Open" category and on the risk of conflict with other airspace users (in particular, CAT).

The task form will perform:

- Survey of national measures, data quality of operational environment and zones, and state-of-the-art solutions.
- Assessment of performance-based objectives and standards.
- A consultation process with stakeholders based on a questionnaire and interviews.

A second task force will study **the impact of an unmanned aircraft and a manned aircraft** (large aeroplanes, rotorcraft, General Aviation) with aircraft and engines manufacturers' representatives. This task force will:

- Review all relevant occurrences including the occurrences collected by the European Member States,
- Analyse the existing studies on the subject of impact between drones and aircraft,
- Study the vulnerabilities of aircraft (windshields, engines, and airframe) taking into account the different categories of aircraft (large aeroplanes, general aviation, and helicopters) and their associated design and operational requirements,
- Consider the possibility to do further research and perform actual tests (for example on windshields).

[41] These actions were already announced in the EASA Technical Opinion of 18.12.2015. The actual timing also depends on the legislative process on the review of Regulation 216/2008 and the pro-active production of 'rules' as acceptable means of compliance in the period up to the formal adoption of the review of Regulation 216/2008.

[42] Or from ICAO, whatever rules are first delivered and appear to be best suited.

The task force will consult the European Member States and other relevant stakeholders as well as foreign authorities. At the end of July, it will publish its results and will organise a workshop with stakeholders to present and discuss its findings and recommendations.

Process and timing: [43]

- The consultation process for the open and specific categories will be published in [Q2/2016] in parallel to the necessary impact assessment and preparatory work.
- EASA will publish "prototype rules" for open and specific categories to be published by end July 2016.
- The tow Task forces in place will report by the end of July 2016.
- Rules for the 'specific' category will be based on the JARUS risk assessment process and are foreseen for [Q4/2016].
- A preliminary draft for acceptable means of compliance/ guidance material (AMC/GM) for open and specific categories should be available by [end 2016].
- Community Specifications for unmanned aeroplanes/rotorcraft are foreseen for [Q2/2017].

[43] These dates are tentative. Their feasibility must still be assessed in view of the steps of the regulatory process, including the obligation of appropriate consultation and impact assessment and in view of interdependencies with external activities, such as progress with JARUS deliverables.

Annex 4 – The development of the aerial route network, including the system of geofencing

Objective: lay the foundations for a low level route network, taking due account of safety, security, privacy and environmental considerations. That also includes the mechanism to make the use of specific airspace subject to particular conditions (geofencing) and a system of the identification of the drone or the drone operator/owner.

Form: EASA opinion for a proposal of the Commission to amend Commission Implementing Regulation (EU) No 923/2012 laying down the common rules of the air and operational provisions regarding services and procedures in air navigation – together with the necessary assessment studies to identify the most appropriate technologies and communication & tracking infrastructure – completed with communication standards and protocols.

Substance: the development of the aerial route network will require regulatory and support actions.

Regulatory action on rules of the air:

- Development of the "rules of the air" where the lower layers of the air now are not (systematically) regulated. The Commission will come with a proposal to amend the "Standardized European Rules of the Air" (SERA) on the basis of Single European Sky rules. The proposal will provide common rules on the organisation of the lower airspace, defined as below 500ft (150m) so that competent authorities can develop the local aerial route network in function of local safety, security, privacy or environmental requirements.
- The rules should also foresee the institutional set-up of an EU Unmanned Air Traffic Management system.
- Establish a "geofencing" system, and determine which authorities can drive such dynamic geofencing system. The rules will so define the process whereby competent authorities will be able to define no-fly zones or conditional fly zones. These conditions should then be clear for manufacturers and for operators

Support action on rules of the air:

- Identify the most appropriate infrastructure and technologies to provide communication and tracking services for the low level drone traffic, preferably based on existing technologies and infrastructure, like the telecom infrastructure.
- Qualify the communication and tracking services in the framework of the Single European Sky and regulate the content and interoperability of these services, so as to steer the development of the necessary standards or protocols.
- Develop the communication protocols and the necessary standards for the traffic information feeding the low level 'air traffic management' and planning.
- Development of the communication information to allow the operators to organise their activities. The information should provide the situational awareness of the traffic density, route information ("notice to airmen", e.g. informing them on close airspaces).
- Liaise with the privacy and data protection authorities so as to give them access to the necessary information to apply existing privacy and data protection rules.
- Determine interfaces and acceptable data format standards (e.g. for map data) that should be used to provide the information on no-fly or restricted zones in an open web interface. This information could be made available through service providers, presented through a smartphone app, or directly uploaded to the drone.
- Industry will develop standards for geographical limitation that will be endorsed by the Agency. The standard would then be referenced in the market regulations system in order to ensure that consumer products comply with these standards.

Process and timing: [44]
EASA will come with more concrete ideas on geofencing by mid-2016 to start developing a geofencing platform.

EASA will elaborate an opinion on the rules on the air targeting [the end of 2016] so that Commission can adopt these rules by [mid-2017].

Annex 5 - **Standardisation activities**

Objective: develop and adopt the necessary standards supporting the implementing rules and acceptable means of compliance or guidance material.

Form: Minimum Operational Performance Standard (MOPS) and Minimum Aviation System Performance Standards (MASPS), Euro Norm adopted by Standardisation bodies, recognition by EASA as acceptable means of compliance or guidance material.

Substance:

EASA and the SESAR Joint Undertaking, with the cooperation of the European Defence Agency, will ensure the effective coordination between research activities and standard setting.

The list of standards and the priorities of the standard setting process are described in the table below.

[44] These dates are tentative. Their feasibility must still be assessed in view of the steps of the regulatory process, including the obligation of appropriate consultation and impact assessment and in view of interdependencies with external activities, such as progress with JARUS deliverables.

Table 1: Overview of standard setting priorities

		Open Category		Specific Category			Certified Category	
	Market Regulations	Operation	"standard scenario"	"safety assessment"	"BVLOS"	"local"	National IFR	"ICAO"
Product safety toys		n/a	n/a	n/a		n/a	n/a	n/a
Product safety consumer		n/a	n/a	n/a		n/a	n/a	n/a
Product safety professional		n/a				n/a	n/a	n/a
Geographical limitation systems			n/a	n/a		n/a	n/a	n/a
map format							n/a	n/a
data-Exchange							n/a	n/a
Identification								
Registration								
Low Level ATM	n/a						n/a	n/a
Performance based rules	n/a						n/a	n/a
"ATM" Data link	n/a						n/a	n/a
Vehicle Performance Standard	n/a						n/a	n/a
"Airspace" rules	n/a						n/a	n/a
Pilot competence	n/a							
C2/Remote control								
Specific standard scenarios	n/a	n/a		n/a	n/a	n/a	n/a	n/a
Small drone standard	n/a	n/a						n/a
Design and production		n/a						
UA airworthiness standards	n/a	n/a	n/a	n/a	n/a			
Detect and Avoid	n/a	n/a						
Recovery Systems	n/a	n/a						
Automatic Take off/landing	n/a	n/a						
Ground Control Station	n/a	n/a	n/a	n/a				
Pilot Workplace	n/a	n/a	n/a	n/a				
Handover Process	n/a	n/a	n/a	n/a				
CPDLC	n/a	n/a	n/a	n/a				
Operation&Oversight	n/a	n/a	n/a	n/a				

	on track due to: existing basis or productive working group
	quite on track due to agreed principles and running working group or only supportive standard
	less critical compared to orange or due to existing alternatives
	critical due to; challenging task, absent of coordinated working group, lack of international agreement
	highly Critical due to: extremly urgent need, absent of appropriate drafting body, lack of technological solution, controversial

Process and timing: standard setting bodies to coordinate to see which existing standards could be used or to assess which organisation is best placed to produce the standard.

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Annex 6 **– International cooperation**

Objective: engage in international activities so that EU rules will be based, to the maximum extent, on global consensus

Form: engagement in multilateral international bodies such as ICAO and JARUS, completed with bilateral contact for specific issues

Substance:

EASA and EU Member States should sufficiently engage in JARUS activities. In addition, work in ICAO should be started to work from an international transport angle and seek consistency with what Member States are developing for smaller drones.

Annex 7 **– Cooperation with Member States on state aircraft**

Objective: facilitate the work of state functions like search and rescue, disaster management, enforcement activities.

Form: the work, at the request of member States, could take a wide range of activities, from including enforcement considerations in the conception of the rules, training of authorities' personnel, conceiving standard scenarios under the specific operations category to avoid burdensome risk assessments, ensure effective communication between various authorities etc. The European Defence Agency works actively on the convergence of national processes for unmanned state aircraft and on the links with the civil approach.

Substance:

Member States or public bodies can propose specific actions.

Proposed action: further develop cooperation with State aircraft activities and in particular with fellow Agencies such as the European Defence Agency, the European Maritime Safety Agency and the EU border management agency Frontex.

Annex 8 **– Research and Development activities**

Objective: increase investment return of R&D activities by improving the coordination of ongoing activities and focus new activities on areas with biggest R&D needs**.**

Form: set up a coordination form between Commission, SESAR Joint Undertaking, EASA, EDA and Eurocontrol to steer the coordination activities.

Substance: make better use of ongoing R&D activities, as here briefly described:

- The SESAR project includes into the current Industrial Research work programme several projects dealing with air traffic insertion technologies for big drones with a foreseen budget of 40M€. This is not sufficient to reach enough mature concepts by the end of the SESAR 2020 programme (2024). SESAR will also deal with small drones within the framework of the next call of Exploratory Research (9M€) and future very large demos.
- The EU and the US are bilaterally cooperating on NextGen – SESAR harmonisation and interoperability issues on the basis of a Memorandum of Cooperation between the SESAR Joint Undertaking and the US Federal Aviation Administration. This wide coordination activity with

FAA and - under the FAA umbrella - NASA as well as U.S. Academia. This provides for unprecedented cooperation opportunity between SESAR and e.g. the NASA UTM programme.

- The SESAR Joint Undertaking will conduct a "market outlook study" assessing the need for future drone operations in the European Aviation System. The study will help establishing the proper links between SESAR and other on-going activities such as the ones managed by the European Defense Agency, the European Space Agency, the European Maritime Agency, EASA and the Commission Joint Research Centre or potentially identifying needs for additional budget. The drone market outlook study" will form the basis for the detailed coverage of drone activities in the European ATM Master Plan.
- EASA also contributes to the research activities of the European Defence Agency (EDA), the European Space Agency (ESA) and the SESAR Joint Undertaking (SJU). EASA co-chairs the Safety and security group of ACARE, co-manages the OPTICS initiative aiming at analysing aviation safety research outputs, and is leading the effort to develop the strategic research plan (SRIA) for aviation safety and security which will have a specific focus on drones. Beyond these activities, the Agency has identified the following ones and is discussing with other organisations how to best finance them:
    - Proposal for acceptable levels of safety especially for the operation of small unmanned aircraft in urban areas, above crowds and for low-level operations beyond visual line of sight;
    - Development of a tool for registration, identification and (geo)-fencing of certain small unmanned aircraft operations;
    - Identification of options for the environmental regulation of small unmanned aircraft;
    - Definition of a concept for traffic management of all types of unmanned aircraft operations including low-level airspace design, traffic rule, security of landing zones, the role of the human, interception rules and techniques, and devices for electronic conspicuity and autonomous operations.
    - Electric propulsion (especially small drones are making extensive use of electric propulsion).
- The European Defence Agency (EDA) has in place a comprehensive programme on military drones insertion into civil airspace aiming at achieving enough maturity for year 2020. Sense and avoid (MIDCAS project), contingency and automation (ERA project) and communications (DESIRE) add almost 100M€ budget of technology development widely common to the civil needs (dual use technology).
- The Joint Research Centre (JRC) is working on identification and (geo)-fencing enabling small drone insertion. The European Maritime Safety Agency (EMSA) and FRONTEX are also considering drones as a very promising tool for their areas of application therefore being involved on R&D projects. Under the Horizon 2020 R&D Programme, several projects are taking place mainly in the field of drone applications (AEROCEPTOR, ICARUS, AIRBEAM, PERSEUS, etc.).
- The Horizon 2020 programme is currently funding the Future Sky project which, coordinated by the European Research Establishment for Aeronautics (EREA) and with the participation of industry, aims to coordinate national R&D work programmes including also a specific focus on drones as most of the EREA members such as ONERA (Fr), NLR (Ne), DLR (De) or INTA (Sp) count on specific drone R&D programmes.
- Furthermore, a lot of public funding is devoted, at Member State level, to specific drone technologies. Vast drone ATI projects such as ASTRAEA in UK or specific border surveillance operations (MINERVA), development activities (SIVA and MILANO) and testing sites in Spain (C.E.D.E.A and ATLAS in Andalucía and Rozas in the North) are going on. In Germany, UK and France there are also projects where private innovative partners such as DHL, Amazon or SNCF are liaising with institutions (CAA's) to develop specific technology and concept of operations supporting drone services business cases. Most of the European universities involved in aeronautics also carry out drone programmes focusing on swarms, automation and on ATI.

In order to overcome the 'chicken and egg' problem, the actions foreseen should generate enough confidence in positive business cases and leverage private investments.

- There is scope for improving the coordination of ongoing efforts and on more focusing on the integration of drones into the aviation system. Integration of drones into the aviation system is crucial to allow operations beyond visual line of sight.
- Enhance cooperation between military and civil initiatives must create more synergies. As technology is in itself neutral, drones are an archetypical case of dual use technology The Commission upcoming Action Plan for European defence industries will foster civil-military cooperation in the next multi financial framework and aim to solve traditional IPR issues. In the short term the signature of a memorandum of Cooperation between SJU and EDA will enhance this cooperation.
- Attract non-traditional aviation industrial players into the drone low level operations technological developments benefiting from this "low hanging fruit" and cross-fertilising the "upper hanging" bigger drones market.
- Provide enough public budget and funding to be realistic and generate private confidence.

There are many parallel activities ongoing:

The majority of these initiatives, as is generally the case in research are independent from each other and difficult to coordinate. The European Commission, supported by EASA, intends to better coordinate and plan such initiatives. EASA now co-chairs the Safety and security group of the Advisory Council for Aviation Research and Innovation; EASA co-manages the OPTICS initiative aiming at analyzing aviation safety research outputs; and EASA is leading the effort to develop the strategic research plan (SRIA) for aviation safety and security.

In addition, a concrete action would be to establish an inventory of all (European and Member States) research activities that could be consulted before launching new research programmes thus avoiding duplication of efforts. [45]

Annex 9 **– Awareness raising actions**

Objective: raise awareness of drone pilots who are not aware of the safety implication of their operations

Form: various actions will be organised**.**

Substance:

A website accessible at DRONERULES.EU will provide guidance material, learning tools and case studies on safety, privacy and insurance issues.

Legislation will foresee specific leaflets in the boxes in which drones will be marketed.

[45] Eurocontrol has been working on a "dashboard" of R&D activities. This could serve as a basis.