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IMPACT ASSESSMENT

Accompanying the document

proposal for a REGULATION OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL

on common rules in the field of civil aviation and establishing a European Union Aviation Safety Agency, and repealing Regulation (EC) No 216/2008 of the European Parliament and of the Council

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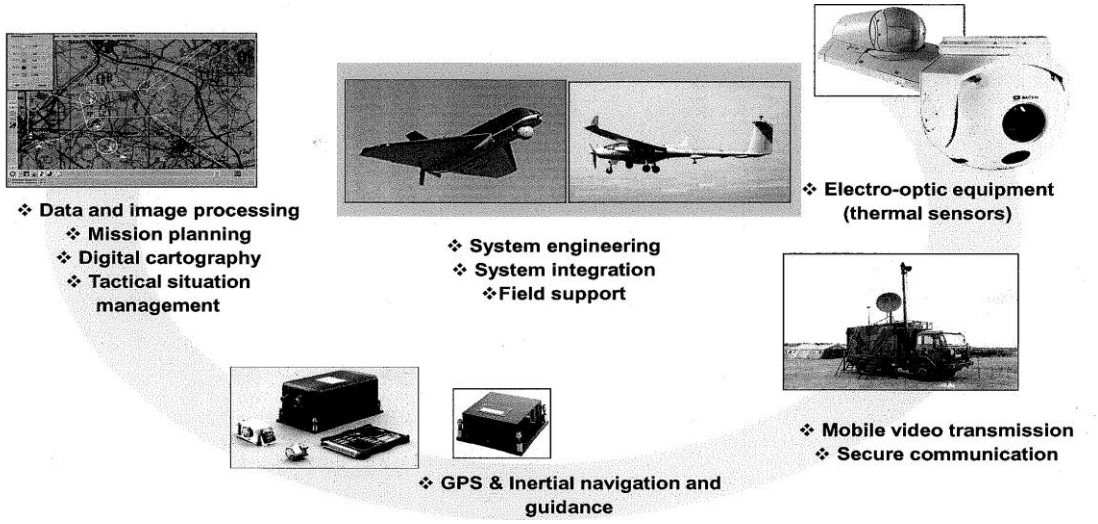
SECTION 1: INTRODUCTION AND POLITICAL CONTEXT

Unmanned aircraft have been considered a possibility since decades. Their existence is acknowledged in the Chicago Convention, which regulates international civil aviation since 1944. In reality such aircraft have until recently been used almost exclusively by the military. Technological progress has now reached a point where civil aviation applications have become technologically feasible and economically viable. It is the combination of innovation in ever lighter and stronger materials, software development, data processing and miniaturisation at ever lower cost which makes this development possible. Annex VI provides general background information on drone technology.

Graph 1: The bundle of drone technologies



Source: Safran presentation, 2015 [1]

In particular the category of remotely piloted drones, called Remotely Piloted Aircraft Systems (RPAS), has been expanding rapidly in recent years. It is estimated that about 10% of civil aviation will be unmanned in just ten years' time from practically none today. [2] Just as the productivity of many jobs now depends on internet or mobile phone use, drone services will become an important tool and part of many businesses, supporting the competitiveness of various industries. The most obvious sectors where drone applications have already started are agriculture, television and movie industry, and aerial services such as inspections of pipelines, railway lines or electric lines. Drones will also become integrated in transport and logistics chains. Finally, there are more innovative sectors, such as energy provision or satellite coverage where drone operations may enable new methods of production and delivery.[3] In the longer term, drone technology may not only enable new applications but also transform air transport itself, as technologies steadily take over more and more tasks from humans also on

1 This graph represents military equipment, but is of course also applicable to commercial operations.

2 Marsh&McLennan, (2015) p1.

3 Annex IV provides more background information.

large aircraft. [4] Drones thus carry the promise of a disruptive technology, opening up previously impractical unavailable or uneconomical aerial applications and replacing existing services at a dramatically lower cost.

Drone manufacturing, operation and maintenance are likely to see strong growth. The public consultation found that all stakeholders envisage applications to develop within five years for professional activities (99%) or for daily life purposes (80%). [5] Together with the contribution of new drone services to the competitiveness of other sectors, a strong direct and indirect impact on growth and jobs may be expected.[6] The world market is forecast to more than double by 2022 and represent by then around 4bn euro per year. Europe would represent about 25% of the world market.[7] In terms of jobs, for Europe, employment is estimated to increase to about 150,000 jobs by 2050 in manufacturing [8] hence excluding drone operator services employment. In the USA, a study forecasts that in the first three years of integration of drones in the national airspace more than 70,000 jobs will be created with an economic impact of more than $13.6 billion. The number of jobs created through new drones activities in the US is estimated to exceed 100,000 by 2025. [9] In any case, drone activities start off mostly in countries where drone rules are adopted – see Table 1.

The full potential of drones will only be realised if they can safely fly in non-segregated airspace – alongside manned aircraft. [10] This is not the case today, as drones face operational restrictions and diverging national standards. A number of other legal, operational and technical issues linked to the civil use of drones, like liability and data protection, also hamper their deployment.

1.1 EU LEGAL CONTEXT

Drones fall under the definition of aircraft, as laid down in the Chicago Convention system. This means that the aviation rules, principally safety rules, apply to drones and drone operations.[11]

In the EU, Regulation (EC) 216/2008 ("Basic aviation safety regulation") establishes the principles for EU safety rules and division of tasks between EU and national authorities. Detailed safety rules have been adopted in the form of Commission implementing regulations covering all aspects of aviation safety: airworthiness, operations, crew licensing, rules of the air. The EU is competent for regulating unmanned aircraft above 150kg, with some exceptions. [12] The weight criterion was not introduced to regulate the bigger unmanned

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4 See also Annex VI for more information.

5 The exceptions are the air navigation service providers where only 40% did see daily applications happen in such short time period.

6 Annex VI provides an overview of the most commonly referenced market studies.

7 TEAL group 2013 Market Profile and Forecast

8 Estimate provided by ASD, the AeroSpace and Defence Industries Association of Europe.

9 AUVSI, (2013), *"The Economic Impact of Unmanned Aircraft Systems Integration in the US"*, 574p.

10 Segregation – keeping the drones away from manned air traffic – is burdensome and complicated to manage and reduces the overall capacity of the aviation network. After all, it is expected that manned aviation will evolve to single-pilot operations and, eventually, to unmanned operations.

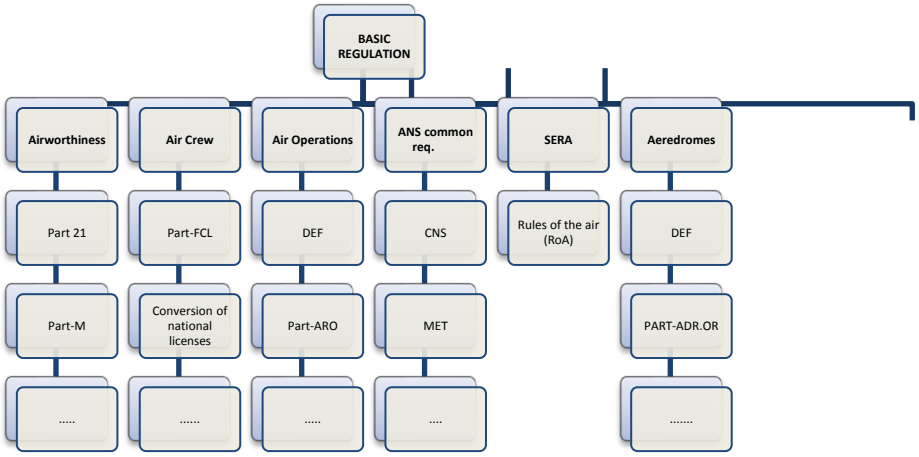
11 Other relevant rules concern liability, privacy and data protection, and environment. They are given in Annex IV.

12 Except those used for military, customs, police, search and rescue, firefighting, coastguard or similar activity or services (article 2 basic regulation) or specifically designed or modified for research, experimental or scientific purpose to be produced in very limited numbers (annex II Basic regulation).

systems, but to avoid that the EU would regulate model aircraft. The current regulatory framework is ill suited for drones and drone operations and would lead to burdensome regulation.[13] No specific rules have been developed yet, but the European Aviation Safety Agency (EASA) has received two applications for type certification.

The basic aviation safety Regulation functions at three levels – as compared to more typical EU product safety rules which functions in two layers. Typical product safety directives lay down quite specific requirements which are then detailed in European industry standards. The standards serve as acceptable means of compliance but are not strictly speaking binding. In aviation safety regulation, the basic Regulation only lays down the general framework, including procedures and essential (safety and other) requirements. Detailed binding rules are adopted in delegated acts.[14] The essential requirements and the underlying delegated acts address the following core areas in respect of flight operations: airworthiness (the aircraft must be capable of flying safely); operations (how flights are planned, prepared and executed); and air crew (what specific knowledge, competences and skills flight crew must have). The three core areas are completed by requirements for the "infrastructure", i.e. aerodromes and air traffic management (the safety requirements for the 'infrastructure' of aviation).

Graph 2: Regulation (EC) 216/2008 and the structure of delegated acts [15]



The essential requirements translate in a series of delegated acts. For instance, airworthiness needs to give detailed rules to make an aircraft airworthy ("Part 21") and to indicate how the aircraft must be properly maintained ("Part M"). For air crew, detailed rules determine exactly what competences flight crew must acquire to obtain their license ("Part FCL"). The technical rules may be completed by specific industry standards. In aviation, most standards are developed by the aviation specific body EuroCAE.[16]

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13 Supported by the public consultation. See Annex III for more details on the consultation process.

14 Delegated acts are European regulations adopted by the Commission that amend and complement legislation adopted by the European Parliament and Council. In this case, the substance of the delegated acts could be compared to the Annexes of the Product Safety Directives, like e.g. the Machinery Directive (2006/42/EC).

15 The technical terms indicate specific areas, as explained below.

16 The European Organisation for Civil Aviation Equipment is a non-profit organisation dedicated to aviation standardisation since 1963, where CEN/CENELEC/ETSI are providing "general industry" standards. The US counterparts are the SAE (Standards of Automotive Engineers), RTCA (Radio Technical Commission for Aeronautics) and ASTM (American Society for Testing and Materials).

The basic EU framework for aviation safety regulation, which is mainly established by Regulation (EC) 216/2008 is complemented by other EU legal instruments. The most relevant in the safety area are the rules on accident investigation and on occurrence reporting and analysis.[17] These rules refer to Regulation (EC) 216/2008 and also exclude drones below 150kg. As drones are aircraft and become integrated in the aviation system, significant drone incidents should be reported and accidents should be investigated if that contributes to the overall safety of the system. Beyond safety, other relevant rules relate to EU product safety regulation, privacy, insurance and environmental rules. Section 2.4 below and Annexes IV and V provide more details.

In the absence of a specific EU regulatory framework on lighter drones below 150 kg, certain aspects of these drones are already subject to product safety directives under the general market surveillance framework of Regulation (EC) 765/2008.[18] This is the case e.g. for the General Product Safety Directive 2001/95/EC, which provides that economic operators must guarantee the safety of consumer products placed on the EU market. Similar horizontal legislation also applies to materials that are used in aircraft manufacturing, where especially the chemical treatment is sometimes safety critical. [19]

The Radio Equipment Directive 2014/53/EU provides that equipment must effectively use the radio spectrum and not cause harmful interference. The Machinery Directive 2006/42/EC provides obligations to manufacturers, including labelling and providing information to the end user on the safety risks of the product. The smallest drones which are only used for leisure may also fall under the scope of the Toy Safety Directive 2009/48/EC. These directives however do not contain any precise reference to drones.[20]

Privacy issues are covered by Article 8 of the European Convention for the Protection of Human Rights and Fundamental Freedoms and Article 7 of the Charter of Fundamental Rights of the European Union. The right to protection of personal data is set out in Article 8 of the Charter of Fundamental Rights of the European Union, in Article 16 of the Treaty on the Functioning of the European Union ('TFUE') and is regulated in Directive 95/46/EC of the European Parliament and of the Council of 24 October 1995 on the protection of individuals with regard to the processing of personal data and on the free movement of such data. The processing of data is regulated in Regulation (EC) No 45/2001, [21] insofar as it is carried out by Union institutions and bodies in the exercise of activities all or part of which fall within the scope of Union law.

As regards environmental performance, drones are not subject to the noise and gaseous emissions standards laid down at EU level, such as the directive on noise emission in the environment by equipment for use outdoors. [22].

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17 Annex IV gives the exact references.

18 See AnnexIV.7 Product harmonisation legislation

19 EASA and the European Chemicals Agency have established a working relationship with regard to the implementation of REACH.

20 See Annex IV.7 for more details.

21 Regulation (EC) No 45/2001of the European Parliament and of the Council of 18 December 2000 on the protection of individuals with regard to the processing of personal data by the institutions and bodies of the Community and on the free movement of such data

22 Directive 2000/14/EC of the European Parliament and Council of 8 May 2000 on the approximation of the laws of the Member States relating to the noise emission in the environment by equipment for use outdoors. This statement applies to drones with a weight of less than 150kg.

1.2 EU POLICY CONTEXT

For years drones have been used for military purposes. The European Summit of 19 December 2013 on the Future Defence Policy made a commitment to enhance Europe´s military (drone) capabilities, including through regulatory as well as R&D activities; and welcomed efforts to integrate drones into the European civil aviation system as from 2016.[23]

This impact assessment constitutes the follow-up to the Commission Communication "A new era for aviation – Opening the aviation market for remotely piloted aircraft systems [RPAS] in a safe and sustainable manner" published on 8 April 2014. This Communication concluded that "the RPAS market poses a real opportunity to foster job creation and a source for innovation and economic growth for the years to come. It also poses new challenges related to safety, security and respect of citizens' rights which must be tackled before RPAS can be used on any serious scale in a civilian environment. The lack of harmonized regulations across Europe and of validated technologies forms the main obstacle to open the RPAS market and to integrate RPAS in European non-segregated airspace. Industry is urging rapid steps towards the establishment of an enabling RPAS regulatory framework."[24]

The Transport Council, in its meeting of 8 October 2014, welcomed the Commission initiative to start working on a European regulatory framework for drones. The EU Presidency, with support of the Commission, organised a high level conference on drones, where the aviation community established the basic principles for the integration of drones in the aviation system in the so-called "Riga Declaration".[25]

This initiative is part of the European Commission's "Aviation Package for improving the competitiveness of the EU aviation sector", included in the 2015 Commission Work Programme. This package also includes a wider revision of the basic aviation safety Regulation (EC) 216/2008 that should reflect 10 years' experience of the EU aviation system. The revision should make the aviation system more flexible and performance based. It is therefore envisaged to include in that proposal also the necessary new framework rules relating to drones, in line with the conclusions of this impact assessment.[26] The proposal will then open the way for the adoption of more detailed rules with their own regulatory impact assessment once the legal basis is created. Drones will in particular benefit from the greater flexibility that the safety framework will offer, as the rules and procedures would become better accommodated to the risk of the operation – which in the case of drones ranges from practically none to risks equivalent to risks associated with manned aviation.

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[23] The Council… underlines the need to intensify EU-level cooperation on RPAS. In this regard, it encourages the European Commission to establish the regulatory framework for an initial RPAS integration into the European Aviation System by 2016. It supports appropriate R&D activities for this integration to be undertaken by SESAR (Single European Sky ATM Research) Joint Undertaking as soon as possible, as well as close synergies between EDA, SESAR Joint Undertaking and the Member States in the development of technologies needed for air traffic insertion and anti-collision and complementarity between EASA and EDA in the development of a pertinent certification system;

[24] COM/2014/207 final.

[25] See Annex VII - http://ec.europa.eu/transport/modes/air/sign-up/index_en.htm.

[26] The new basic aviation safety Regulation would implement policy option 2, while leaving open the precise way of implementing suboption 2.1.

1.3 INTERNATIONAL CONTEXT

There are no international rules on drones yet except for the requirement under the Chicago Convention on international civil aviation to obtain a specific authorisation to operate a drone from the national competent authorities.[27]

The **International Civil Aviation Organisation (ICAO)**, the UN body dealing with international civil aviation created in 1944 by the Chicago Convention, has adopted a circular and an RPAS manual, introducing some basic definitions and principles on the rules of the air.[28] ICAO recently launched an institutionalised process to develop standards and recommended practices. Such ICAO standards are included in Annexes to the Chicago Convention. They are binding on States, but they require transposition into national law in order to affect the participants in civil aviation such as aircraft operations. Also, the standards are often quite generic and require additional detail in national law to be made truly operational. Most of these standards are now transposed in the European ICAO States through EU Regulations. The same would be applicable for any new ICAO standards on drones. Two important limitations are to be noted. Firstly, ICAO standards are binding only for international traffic, i.e. in practice only for large drones used in specific operations which require crossing borders. Secondly, States (in this case the EU) may deviate from ICAO standards and "file a difference" to ICAO, provided their alternative approach is able to meet the objectives of the ICAO standards. This offers a degree of freedom to organise drone operations inside the EU, with the caveat that alternative approaches may not be recognised by third countries for operations in their airspace. The ICAO Manual on Unmanned Aircraft states recognises this where it states "states may agree mutually upon simpler procedures through bilateral or multilateral agreements or arrangements for the operation of specific remotely piloted aircraft or categories of remotely piloted aircraft. This will reduce the workload on RPAS operators and the state authorities. The same objective may be reached through regulatory measures at regional levels."[29] Finally, it should be remembered that the need for "filing differences" is greatly reduced when the EU and its Member States are effective in shaping ICAO rules to meet our needs. European States carry considerable weight in ICAO both through their number and the size of their aviation industry, and through the expertise they bring to the discussions at ICAO.

The **Joint Authorities for Rulemaking on Unmanned Systems (JARUS)** was set up as an ad hoc intergovernmental forum to discuss drone regulation. It enables exchange of information and best practices among a large number of industrialised states but it cannot adopt binding rules.[30] EU Member States and EASA are engaged in the JARUS process (EASA now chairs it), as it offers an opportunity to work towards a global consensus on the approach to drone regulation. The EU experts will also drive the ICAO process and will ensure coherence between the activities of the two organisations. The EU is committed to follow as far as possible the JARUS process and find consensus; however, the JARUS

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27 Art. 8 of the Chicago Convention.

28 Amendment 43 to Annex 2 to the Chicago Convention on the rules of the air. See annex for the reference.

29 Chapter 3 of the ICAO RPAS Manual, Doc. 10019 AN1507 of 2015

30 JARUS is an international group of Aviation Authorities, comparable to the former Joint Aviation Authorities, with an ever growing global membership. At the moment of preparation of the report, the membership included AT, Australia, BE, Brazil, Canada, CH, China, CZ, DE, DK,SP, FI,, FR, GR, Japan, Ireland, Israel, IT, MT, NL, NO, PL, Qatar, Russia, Singapore, South Africa, SV, UK, USA are members, together with Eurocontrol and EASA.

process should not prevent the EU from adopting the necessary rules to regulate drone operations in Europe when consensus may not be found (in due time).

Non-EU countries are also working towards the adoption of drone specific rules to allow civil operations. Active countries for the operations of civil drones, for instance Japan, Canada, New Zealand and Australia, have adopted national rules. In Japan, the regulations were conceived specifically for the agriculture sector and are managed by the Ministry of Agriculture. Only recently, Japan amended its aviation act to regulate drones in a more general way.[31] Australia has adopted specific drone rules for commercial air work (e.g. aerial photography). The requirements include a pilot licence, but the level of the requirements is relatively easy to meet. The recreational use of drones remains free and only flights that risk mixing with manned aircraft are forbidden. Also New Zealand has very few limitations for operations with drones up to 25kg, as long as the operation is not conducted close to an airport, remains in the line of sight of the pilot and below 400ft, and the operator has the consent of people whose land is overflown.[32] Canada has been providing over 3,200 operating certificates in the period 2007-14 on the basis of a risk assessment of the operator for individual operations or for a type of operations ("blanket certificate"). Recreational use of drones up to 35kg is free. Currently Canada is reviewing its rules in order to reduce the number of cumbersome individual risk analyses. The U.S. Federal Aviation Administration has adopted a roadmap[33] and is mandated by the U.S. Congress to allow drone civil operations starting from 2015. Progress has been slower than expected, and the US has, until now, pursued a quite restrictive policy. Based on the ICAO 'authorization process', the Federal Aviation Authority (FAA) has been granting individual exemptions to operators from 2012 onwards. Given the increasing backlog, the FAA has recently moved to blanket exemptions until a general rule for small drones will be adopted (expected for 2017).[34]

Industry is also involved in the above forums of ICAO and JARUS, and is working towards the development of industrial standards. The standardisation body for aviation EUROCAE has established two specific working parties on drones. However, the standard-setting agenda is difficult to decide in the absence of a clear regulatory agenda.

SECTION 2: WHAT PROBLEMS ARE TO BE ADDRESSED?

2.1 DESCRIPTION OF THE MAIN PROBLEMS

2.1.1 The current regulatory system hampers market development

The existing aviation rules do not properly address the specificities of drones. Drones include many different types of aircraft performing a variety of different missions, ranging in terms of maximum take-off weight from grams to more than ten tons, in terms of maximum speed from hovering to more than 1,000 km/h, in terms of flight endurance from a few minutes to

[31] Since the security forces found a drone on the roof of the Prime Minister's building in April 2015, the authorities have introduced operating restrictions to ban flying in the vicinity of official buildings, dense residential areas and particular places that attract crowds.

[32] http://www.caa.govt.nz/rules/Part_101_Brief.htm

[33] https://www.faa.gov/uas/media/UAS_Roadmap_2013.pdf

[34] See Box 2 p. 18 for more details.

months and in terms of lift technology from rotor to fixed wing to lighter than air. This means that drones are able to perform a wide range of operations that was not at all conceivable with manned aviation.[35]

Compared to traditional aviation, drone operations would cover a wider span of risk, from very low risk operations to operations with risks equivalent to manned aviation. In addition, it is expected that, in terms of numbers, most drone operations would represent a low safety risk, e.g. crop spraying which takes place away from other air traffic and outside residential areas. Drones and drone operations are expected to outnumber, potentially quite significantly, the number of aircraft currently in use because of their low cost and multiple uses, including many new applications. Today's aviation rules and oversight system were developed for a much smaller population and number of movements than what we can expect in the future.

Graph 3: The wide range of drones and drone operations

[35] See Annex VI for more details.

Given the innovative design and concept of operations of drones, it is impossible for drones to meet some of the most basic requirements and underlying assumptions of conventional aviation, such as having a pilot on board or taking off from an airport. Especially smaller drones cannot apply many of the methods and technologies used in large manned aviation to ensure safety, e.g. the filing of flight plans and communication with air traffic control, or the carriage on board of radars, transponders and collision avoidance systems. Those methods and technologies are either disproportionate to the operational risk, too difficult (heavy) to carry or present such high cost that most drone services would be uneconomical.

In the absence of dedicated rules for drones, drone operations at the moment need to be allowed to derogate from the standard rules by means of *individual authorisations*. This approach is not sustainable considering the expected growth in the number of drone manufacturers and operators starts to grow, as individual authorisations are resource-intensive for the administration and costly for the applicant. [36]

Moreover, individual authorisations typically imply strong operational limitations (e.g. a limited geographical zone, or time of day) because these authorisations are not capable of solving some of the key underlying issues, such as the safe interaction of drones with other aircraft in the air.

Experience illustrates the impact of (the absence of) dedicated rules on the market. Japan is the oldest and most telling experience. The Japanese market was regulated in the nineties for agricultural purposes only. This has resulted in a high number of operators not found in any other sector in the Japanese economy or in any other country.

The conventional aviation approach is the starting point for regulating drones in states which already developed and adopted rules, resulting sometimes in complex processes to obtain authorisations and therefore very limited numbers of operations. New concepts, like an 'operation centric approach' – whereby the rules and the evidence required to demonstrate that the rules are complied with, are made proportionate with the risk of a particular (type of) operation – are slowly taking hold, driven by JARUS and based on experience, in a limited number of countries, like Finland, Switzerland and Austria – and are getting more and more support through this truly global reflection and discussion process. Also the UK and France have put in place relatively accommodating rules on drone operations.

The number of operators in the EU is concentrated in those Member State who managed to put in place dedicated rules for drones, and their numbers grow rapidly. For example, the number of commercial operators in France grew from less than 100 in 2012 to more than 1,000 in 2015. The Polish CAA issued not a single Operator Certificate in 2012 and only five in 2013; the number grew to 316 in 2014 and up to mid-2015, already more than 1,000

[36] Or for the administrations, as authorities are not acquainted with the new phenomenon. All categories of participants of the public consultation confirmed differences in national legislation (91%), lack of common rules applicable to all types of drones (91%) and gaps in the current EU legislation (93%) as important barriers.

certificates were issued. However, because of the operational limitations, nearly all the authorisations concern low risk operations with small drones. More sophisticated services such as goods delivery can in practice not be deployed, limiting market and business opportunities.

Table 1: Number of approved commercial operators[37]:

Country/ region	Number of approved commercial operators
Australia	*100+*
EU	*2,500+*
Japan	*14,000+*
South-Korea	*130*
USA	*1,000* [38]

Further upstream, the difficulty to bring drone services to the market also prevents investment decisions to be made in relation to drone design and manufacturing. Despite having a strong industrial basis in aeronautics (a yearly turnover of close to €140bn and employment of 500,000 specialised personnel), including numerous small and medium-sized companies in the supply chain, Europe risks missing the opportunity to become a leader in this new industry. Numerous market surveys on drones have been conducted.[39] In general these studies forecast a market of several billion euro a year (often including military and state operations).

What is more, the difficulty to start legal drone operations has pushed some operators to do so illegally. Authorities report increasing difficulty to deal with this phenomenon. [40] Irregular operations are likely to represent particularly high safety risks, besides other public policy concerns.

2.1.2 Drone operations cause risks which are not adequately addressed by existing rules

Drone operations present a number of issues which are not, or much less, present in civil aviation in general. They concern safety, security, privacy and data protection, environmental protection and liability. [41]

With regard to safety in the air and on the ground, although drones do not carry people on board, a drone crash may depending on the energy involved in the crash potentially cause injuries or fatalities on the ground or in other –manned– aircraft. Even small drones can interfere with air traffic: many drones can climb hundreds or even thousands meters high,

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37 Frost&Sullivan, 2015, *Unmanned Aerial Systems*, Presentation UAV DACH, April 2015.

38 For the US: there is no general rule allowing commercial operations. Since the publication of the Small UAV rule consultation in January 2015, the speed of granting exemptions has been increased significantly. At the moment of drafting of this report – August 2015, more than 1,000 exemptions were granted – see http://www.faa.gov/uas/legislative_programs/section_333 and UAVSI (2015).

39 See an overview in annex V.

40 Koen Meuleman, president Belgian drone association, in UK House of Lords, 2015, p. 20. At the moment of preparing this report, 17 Member States do not have specific drone rules in force.
The Dutch Inspectorate published a report in June 2015 on the number of incident reports on model and drone incidents in the period 2013-14. About 25% of the reported cases concerned professional activities without the required authorisation;

41 In the case of liability and insurance a dedicated study (see section 2.3) indicated that the current legislative framework sufficiently covers drones. Even if some MS have raised concerns in this respect there is no sufficient evidence that the current rules on insurance would be prohibitive for drone operations. The problems concern the levels of the fees and above all enforcement. Consequently, amending the rules on insurance is out of scope of the current initiative.

where they could collide with commercial jetliners, especially near airports. [42] Several events of drones flying in close proximity with other aircraft have been reported and have worried the pilot community.[43] Although in theory the necessary rules are in place to prevent such risks (e.g. it is forbidden to fly at such altitude), those rules are often not enforceable. The likelihood to be caught flying illegally is small given the difficulty to link a drone to its pilot. Moreover, drones have limited safety features because of weight and cost limitations and are vulnerable to loss of power or loss of control (e.g. because the communication link with the pilot is lost), or to collision because of pilot error. Remote pilots may also lack awareness of the risks they are taking if they have had no aviation training. There is a serious risk that these safety incidents could multiply with the growing number of drones. [44]

Concerning *security*, as noted in COM(2014)207 and reflected in the draft European Parliament own initiative report of MEP Jacqueline Foster, [45] drones offer new opportunities for illegal activity including surveillance (espionage, target reconnaissance) or the carriage of an offensive payload [46] (bomb attack, or even the delivery of weapons to a prison courtyard). [47] While such criminal offenses may also be carried out with traditional aircraft such as helicopters, such traditional measures are much less accessible (cost, skills required, registration/identification) and are more easily detected than drones. These unauthorized and illegal uses will be the main security threats of drones. Furthermore, due to the remote command and control technology, drones have greater vulnerability in certain respects than manned aviation, and remain particularly exposed to hacking where a legitimate drone may be taken over for criminal purposes. The fact that drone operators may remain anonymous poses a serious problem to law enforcement authorities, who have difficulties to intercept or prevent certain operations or to identify or apprehend the operator. These risks need yet to be resolved.

Security issues should be considered from the system perspective, where especially its robustness against external attacks should be assessed. In particular, command and control appears to be a weak link in the security chain. In this context, safety and security aspects are intrinsically linked. A suboptimal safety approach will also lead to a suboptimal security outcome. SESAR, the Single European Sky Air Traffic Management Research, is already working on these technologies, which may then be translated into rules for drones falling under national or European competence.

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42 For instance, The Telegraph, “Drone was 'within 20ft' of crashing into passenger plane landing at Heathrow” 12.12.2014, online version.

43 The European Cockpit Association has adopted a particular position on this issue to express its concerns (ECA, 2015). https://www.eurocockpit.be/pages/remotely-piloted-aircraft-systems-drones.

44 Many individual incidents have been reported in newspapers and it takes time before these numbers will be well reflected in official reports. In the UK the CAA, together with the pilot association BALPA launched a drone operator awareness initiative (http://www.caa.co.uk/application.aspx?appid=7&mode=detail&nid=2468);
In the US pilot safety reports on drones have increased from 238 reports in all of 2014 to more than 650 until early August 2015 (– see FAA: pilot reports of close calls with drones soar in 2015 - https://www.faa.gov/news/updates/?newsId=83445)..
The Dutch inspectorate also observes a significant increase of incidents with a model aircraft or a drone involved (http://www.ilent.nl/Images/Infoblad%20Drones_tcm334-366571.pdf).

45 Own-initiative report “Safe use of remotely piloted aircraft systems (RPAS), commonly known as unmanned aerial vehicles (UAVs), in the field of civil aviation”, available as a draft (2014/2243(INI)) at the time of writing. This includes an opinion of the LIBE committee.

46 Payload is the technical term used to describe all things that a drone can carry. This may be cargo, but also all kind of cameras or sensors.

47 Data link is also considered a weak link in the overall ATM community and is therefore a priority in the drone activities of the SESAR work programme.

In addition, drones can invade *privacy* in ways which other aircraft cannot do, by flying very close to persons or into their "private space" such as a home garden. Moreover, many drones carry recording or sensing equipment, be it for navigation or for the purposes of photography or remote sensing. The data captured by that equipment is likely to be stored and/or processed, raising data protection issues. Strictly speaking, the data protection issue is caused not by the drone itself but by its payload (camera, sensor), which may also be mounted on other vehicles or on fixed structures and is already subject to general privacy and data protection rules. In other words, drones raise indirect privacy and data protection concerns, by increasing the possibilities for deploying such cameras and sensors.

Specific analysis has shown that there does not appear to be a need to amend the legal framework in this respect at EU level. [48] These rules are currently under revision and the adoption of the new General Data Protection Regulation would further help to ensure a better protection of the data subject's rights when data are processed by introducing new tools like the accountability principle, the data minimisation principle, Data-Protection-by-Design approach, the obligation to carry out a Data Protection Impact Assessment, etc.

In principle, the security and privacy/data protection risks are addressed by the existing legislation. However, there are serious concerns about the extent to which the existing legislation can be enforced effectively by competent authorities. The main problem with oversight concerns the light category of drones that could be easily obtained and controlled and for which it is difficult to identify who is the actual operator. The enforcement authorities – aviation authorities, privacy and data protection authorities, security forces or police – currently are missing the basic user information to enforce the rules and effectively intercept an operation.

Even if today these issues remain limited in scale, and problematic occurrences have been limited, they have often received strong media attention, leading to concerns in the sector about potential public opposition. [49] Studies have shown that public support already varies significantly depending upon the application or the location. [50]

Concerning the *environmental* risks, most drones rely on electrical power and therefore emissions are not a major issue, but noise should be addressed. The challenge will be to deal with the smaller drones, which may be flying closer to residential areas and people and may cause noise nuisance. Specific drone noise standards and/or operating restrictions may be needed. [51] When combustion-engine drones will replace manned aircraft in some operations,

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48 *Privacy, data protection and ethical risks in civil RPAS operations*, Rachel L. Finn, Anna Donovan and David Wright, Trilateral Research & Consulting, LLP, Laura Jacques and Paul De Hert, Vrije Universiteit Brussel, November 2014.

49 See European Commission (2014), "*Civil drones in society – Societal and ethics aspects of remotely piloted aircraft systems*", JRC Science and Policy Reports (Philip Boucher), Luxembourg, 50p. http://publications.jrc.ec.europa.eu/repository/handle/JRC91671.. This study also refers to surveys. Many positive press articles have appeared since, see e.g. The Guardian (2014) on Humanitarian Drones to deliver medical supplies to roadless areas.

50 See European Commission (2015), "*What comes to mind when we talk about civil drones? An early exploration of citizens' perspectives on civil drone development*", JRC Science and Policy Reports (Philip Boucher), Luxembourg, 46pp [limited distribution]. See also European Commission (2015), "*Ethics dialogues: Experiencing ethics through 'things': open IoT, civil drones and wearable sensors*", JRC Science and Policy Reports (Philip Boucher, Susana Nascimento, Lucia Vesnić-Alujević and Ângela Guimarães Pereira), Luxembourg, 80pp, http://publications.jrc.ec.europa.eu/repository/handle/JRC93162.

51 For instance, the City Zürich has introduced instructions for drones that would significantly restrict the operations, also for electric drones – see Martin Steiger, (2014), "*Regulierung von Drohnen im zivilen Behördeneinsatz in der Schweiz*", in Sicherheit & Recht, 2014/3. In the US, the FAA has started an outreach campaign to states and other partners to make

the level of emissions will be reduced as they are typically lighter. In cases where drones are equivalent to traditional aircraft, equivalent noise and gaseous emissions standards are to be applied to contain the environmental impact. [52]

Furthermore, unavoidably *accidents* with drones will happen, which raises the question of dealing with damage to people and property. Liability and compensation regimes are well established in the world of air transport, but if drones operate outside those regimes liability and compensation may become an issue. Also, contrary to traditional aircraft, which are all registered, it is currently very difficult to establish the identity of the owner/operator of a drone.

While the number of drone operations is expected to grow rapidly, a similarly rapid growth in incidents may cause economic and social damage to the sector. If the underlying issues are not adequately addressed, the public may actively oppose development and apply pressure upon the political leadership to impose strong restrictions on drones. This could be avoided by addressing the risks early on, and preventing incidents to the greatest extent possible. If, however, regulations are too conservative and restrictive, development of drone-based services may not reach their potential, leading to missed opportunities for jobs and growth.

2.2 THE UNDERLYING PROBLEM DRIVERS

2.2.1 Problem driver 1: Responsibilities for drone regulation are divided, leading to diverging requirements in the internal market

Some EU Member States are developing or have developed national rules for simple operations, well below 150kg. By the middle of 2015, specific drone rules have been adopted in AT, DE, DK, ES, FI, FR, IE, IT, NL, PL, SE and UK. Other countries have established only a high level framework or are in the process of adopting rules, notably BE, HU and MT. [53] This means that the exemption process still applies in 17 Member States. [54] The main features of the existing national regimes are shown in Table 2.

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people aware of drone no-fly zones: https://www.faa.gov/uas/no_drone_zone/. Also private initiatives have popped up to declare such no-fly zones (for safety, privacy or environmental reasons).

52 Some initial noise tests in the US indicate that noise levels in overflight at 150 meters can be in the order of 25 to 55 dB(A) SEL. When correcting these levels to distances that may be common for some of the proposed task (delivery of packages) the actual noise levels perceived by citizens could go up by another 10 or more decibels. If such operations would be of a frequent nature this could well reach levels where the noisier drones would be considered annoying by a significant percentage of the population.

53 The draft BE legislation has been published for consultation.

54 In the public consultation especially the operators confirmed the exemption process as very problematic. Different authorities apply very different standards and these change over time and under circumstances. To some extent, the evolving standards reflect a growing expertise of both the administrative side and the operators' capabilities.

Table 2: Main features of selected Member State drone legislation

Member State	Drone categories	Categories of permitted operations	Area allowed to be overflown
AT	Below 5kg MTOW (maximum take-off weight) Between 5-25 kg Between 25 -150 kg	VLOS (visual line of sight) only	Undeveloped, Unpopulated, Populated, Densely populated
DK	Below 7kg MTOW Between 7-25 kg Between 25 -150 kg	VLOS only – <100m AGL (above ground level)	150m from road and buildings; never over densely built-up areas
FR	Below 2kg MTOW Between 2-25 kg Between 25 -150 kg	S1= VLOS < 100m distance from pilot S2= VLOS, within 1,000m distance from pilot - <50m AGL S3= VLOS, within 100m distance from pilot S4= observations – 150m AGL	S1= unpopulated area S2= unpopulated area S3= populated area S4= unpopulated area
DE	Below 5kg MTOW: Länder Above 5kg: federal competence	VLOS only, <100m AGL	
ES	2 main categories: Below/Above 25kg	<2kg: BVLOS & AGL<120m <25kg VLOS 500m and AGL<120m >25kg: subject to the imposed by CAA	**<2kg :** only away from habited places **<25kg :** only away from habited places **Above 25kg:** specific conditions
IT	2 main categories: Below/Above 25kg CAA may provide simplified procedures for drones <2 kg	"V70": 70 m (230 ft) max AGL and 200 m radius "V150": 150 m (500 ft) AGL and 500 m radius	At least 150 m from congested areas and at least 50 m from persons and property
PL	Two main categories: Below 25kg MTOW Between 25 -150 kg	- VLOS - BVLOS (in segregated airspace)	Outside aerodromes and landing side (5km); outside controlled traffic zones, and R, D airspace zones.
SE	Below 1.5kg MTOW or <150 joule Between 1.5 and 7kg or <1,000 joule Between 7 -150 kg	S1= VLOS , Below 1.5kg S2= VLOS, 1.5 and 7kg S3= VLOS, >7kg S4= BLOS Always < 120 m AGL	Distance RPAS/persons and property: >50m
UK [55]	Below 20kg MTOW excl. fuel/incl. battery Between 20 -150 kg	Max speed : 70 kts; 400ft AGL < 500m distance from pilot	>150m from buildings >100m from people

Terminology:
MTOW: maximum take-off weight;
AGL : above ground level;
VLOS: visual line of sight (pilot must be able to always see the aircraft;
BLOS: beyond visual line of sight.

The weight criterion is used in most of the countries, in conjunction with other criteria such as the area overflown, the line of sight and the altitude above the ground level. The problem is

[55] IE has adopted similar rules**.** The member States not included in the table have an exemption regime where CAA treat the applications and where additional authorizations from other administrations may be necessary, e.g. to fly with cameras over city centres.

that the weight is a real cut-off threshold, which suddenly renders operations with somewhat heavier drones impossible, even if the risk to third parties does not increase, for example, flights over non-populated area in restricted airspace. The cross-border provision of drone-based services, like infrastructure inspections, or the roll-out of EU wide operations organised according a particular operational model, such as home deliveries, is severely hampered. The need to meet diverging requirements simultaneously forces operators to meet the strictest requirements on all criteria (weight, operations area, altitude, speed, line of sight, etc.). In some cases, national requirements are mutually exclusive. Moreover, authorisations must be obtained separately in each Member State as there is no mutual recognition.

The fragmentation of rules also affects manufacturing. It tends to be "structuring", i.e. manufacturers will design their aircraft in a way to fit a particular regulatory environment. It is impossible to devise an aircraft type optimal for all national markets, even if it was to be used for the same type of operations. However, the ability to market drones across borders is indispensable for creating economies of scale and lower product development costs by avoiding the need for different types or models for different national markets. The need for cross border market access also applies to drone operations. For instance, a highly specialised offshore infrastructure inspection company must be able to operate beyond its home country to serve niche markets in other countries with offshore infrastructure if it wants to create a sufficiently large client base. The box below illustrates the difficulties.

Box 1: Daily problems of an SME:

Gatewing, a Belgian SME, produces a successful drone which is globally marketed as far as Australia. Its newest product weighs 2.5kg and operates best at 120m above ground level for aerial inspections. The Company has difficulties entering the Swedish market, given the threshold of 1.5kg. [56] *It is not worth to develop a drone for the Swedish market, where companies have taken this threshold as a given. The same Company is obliged to sell the old version of its drone in the French market, which just falls within the 2kg limit. It cannot sell its newest product, as this is 500g heavier even though the extra 500g accounts for equipment which makes it safer to operate.*

Similarly, Gatewing is confused as its drone has to produce a specific noise in case of emergency according to Danish law, while it must remain below a specific noise level in all circumstances according to Austrian law.

Gatewing sold on a regular basis drone systems in Spain. The market was closed for six months before the adoption of drone rules half 2014. Since the adoption of national rules, the Spanish market has become the most important market in the EU.

In the online consultation a vast majority of respondents identified differences in national legislation (91%), lack of common rules applicable to all types of drone operations (91%) and gaps in the current EU legislation (93%) as important barriers. [57] These views are shared across the various categories of stakeholders. Regulators concur with the views of other stakeholders that differences in national legislation (79%) and lack of common rules (83%) pose barriers to the industry.

For companies the segmentation of the market with diverging national rules, if rules already exist, does not constitute a fertile basis to develop drone activities.

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[56] Beyond the threshold of 1.5 kg the practical modalities are heavier and the company has experience that these are more difficult to respect by customers.

[57] See Annex II for more details.

2.2.2 Problem driver 2: Individual authorisations are too costly and too time and resource intensive

ICAO in principle forbids drone operations with unmanned vehicles, unless States give individual "special authorizations" for each operation of unmanned aircraft on their territory. [58] In some cases, additional authorisations are required to cover the payload or service, e.g. for filming or photography. In Europe all drone operations still require special authorisation, with the exception of certain low-risk operations with small drones in some Member States who have put in place generic regulation. However, even for those operations a general licence or authorisation is still required.

Box 2: The US Exemption process: [59]

Commercial activities are forbidden in the US. Six test sites were recognized late 2013. Operators must request a special FAA commercial Section 333 exemption. The first such exemption was granted in 2013 for a drone overflying the arctic waters.

More exemptions are granted on a piecemeal basis to industries with the greatest needs – oil and film industries. The GAO stated in its 2014 US Congress testimony that "During our ongoing work, FAA has granted seven section 333 exemptions for the filmmaking industry as of December 4, 2014. FAA officials told us that there were more than 140 applications waiting to be reviewed for other industries, for uses such as precision agriculture and electric power line monitoring, and more continue to arrive." In March 2015 the FAA started issuing 'blanket' exemptions to speed up the process. By August 2015, the number of exemptions had risen just above 1,000. [60]

Amazon, a US online retailing company, also applied for an exemption. By the time the FAA granted the exemption, Amazon declared that it already was obsolete, as the drone mentioned in the request was already replaced by a newer model. Amazon moved for testing purposes to Canada, the UK and the Czech Republic.

A very high number (83%) of respondents to the online public consultation cited the burdensome character of the current national authorisations process in the EU Member States, both in terms of cost for administrations and industry. Individual authorizations give rise to a lack of legal certainty with regard to substance and duration. The applicant simply does not know exactly whether his specific operation will be approved and the treatment of the requests for exemption can take from weeks to months, depending on the complexity of the operation, [61] and operators find it hard to keep a client on hold for such a long period before being able to conclude or execute a contract. Moreover, if the number of drone operations and drone operators continues to grow, the authorities will have difficulty to cope with the number of applications in the absence of additional trained staff, which may lead to further delays.

Some states do not charge (yet) the operators for obtaining a permit, like in France, Malta or Spain, or charge below cost price, e.g. in Swiss where fees are legally restricted to SF700 or in Sweden where the rates for an approval is about SEK3,800 (about €380). In the Netherlands and the UK the rates are most cost covering. A Dutch certificate of airworthiness costs €4,640 (renewal at €928); an operator certificate costs €1,856 (renewal at €232); and a training school approvals costs €825. In the UK the permissions depend on mass, with an

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58 Article 8 was part of the original text conceived in 1944..

59 This case is best documented and is also representative for the EU states without drone rules, as demonstrated by the on-line consultation.

60 GAO, (2014). Meanwhile the FAA has reviewed its exemption policy and facilitated the process. See: http://www.faa.gov/uas/legislative_programs/section_333/ and AUVSI (2015).

61 This is an estimate given by experts. The average assessment time to obtain an exemption was around six months in The Netherlands.

initial application costing £112 (£56 for renewal) for aircraft weighing 7kg or less; for aircraft between 7 and 20 kg, this charge is double; in addition, companies must pay for the appropriate pilot competency assessments (private charges).

In general, companies do not complain about the amounts charged (if charged only once); the real cost are the numerous hours of work required to produce the necessary documents, like an operations manual or a safety management manual, especially if these documents have to be tailor-made for each Member State. The costs to develop a handbook for a specific regulation can be estimated at about €6,000 (based on 80 hours at EUR 75/h); for a safety and maintenance manual at about €12,000 (based on four weeks of work for the development of the plan at EUR 75/h). The cost of attending a training school is estimated at about €1,000. [62] It is especially the multiplicity of these diverging rules which make these costs soar for companies. There are no precise estimates known of this administrative burden on overall turnover of SMEs.

Especially drone operators (82%) and industry associations (91%) qualify individual authorizations as very problematic. This view is not shared by the issuing authorities: only 30% of the regulators consider individual authorisations problematic.

Individual authorizations constitute a bottleneck for developing drone activities and are a burdensome process for administrations.

2.2.3 Problem driver 3: The existing methods of civil aviation regulation are not always well suited to the specificities of drones

The main shortcomings of the current aviation rules are the contradictions between the (1) concept of operations of manned as opposed to unmanned flight, (2) the perception of risk, and (3) the difference in the nature of the operators and manufacturers.

Firstly, the fact that the existing aviation rules were conceived for large manned aviation makes them not well suited for drone operations. In the conventional concept of operations, the pilot on board is central to the safety of operations. There is no definition of a "remote pilot" nor of a "ground station", which means drones are unable to meet current safety rules. Concepts of control of drone operations, such as "line of sight" are missing. Besides, drone technologies provide another step of automation that may allow for remotely piloted aircraft systems, single-pilot operations or further automation where one pilot could be in charge of several drones at the same time, for a swarm of drones, or where the command of a drone is transferred in flight from one ground station to another.

In terms of navigation, drone operations are not bound by airports, which are in fact specific fixed points of entry and exit of the airspace. Different types of drones are able to fly from right above the ground with very low level operations, at a few meters from persons or property, to 15-25 kms, far higher than the flight levels currently used for commercial air traffic. The European harmonised rules of the air in general do not regulate civil or commercial flights below 500ft (about 150m), exactly where smaller drones would operate intensively – or where also larger drones would be more present, as their take-off or landing are no longer confined to traditional airports. Operations below 500ft are not systematically regulated in national rules and reserved mainly for special missions of light aircraft and

[62] Costs taken from the Notification 2015/0035/NL of the Dutch Ministry of Infrastructure and Environment in preparation for its drone proposal. The cost for a working hour was assumed €75 on average.

helicopters with which drones could easily interfere in the absence of specific rules. [63] Drones are also incapable of meeting the most basic requirements of separation (from obstacles) as currently applied in civil aviation, at least in most of the expected types of operations.[64]

Secondly, the perception of risk is fundamentally different: manned aviation is considered to be always risky as at least the pilot is at risk in case of an accident. In the case of drones and especially smaller ones, most accidents would involve only the loss of the drone and possibly other material damage. What needs to be managed in the case of drones, is the risk to others – be it people on the ground or other aircraft. Risk can be mitigated in many cases by staying clear of people on the ground or other aircraft. In other situations, the potential risk factors need to be analysed in their own right, to identify the most relevant contributors and decide the most appropriate risk mitigation measures.[65] Clearly, the level of rigour applied to safety management in manned aviation, involving strict controls on aircraft design, production and maintenance; pilots; operations, with (in most cases) ex ante licensing and continuous monitoring, is disproportionate to the risk posed by many drone operations.

Thirdly, most manufacturers and operators involved in the drone sector are unlike those involved in civil aviation generally. With the exception of the lightest end of leisure aviation, traditionally civil aviation has involved a relatively limited number of specialised organisations, both in manufacturing and operations. They are capable of ensuring compliance with a large number of detailed aviation-specific rules, and to adapt their organisation to the complex requirements of aviation safety regulation. They are also individually overseen by a public authority. In the drone sector, the number of actors involved and the nature of their business – which is typically not aviation-centric, will make it difficult to sustain an intrusive regulatory approach in an effective way. The affordable and easy operation of drones gives the possibility to almost everybody to become an airspace user by operating a drone, but it cannot be assumed that all actors have a strong aviation culture and are aware of the safety consequences of their actions.

These shortcomings can be found not only in the basic aviation safety Regulation (EC) 216/2008. Also other legal instruments are not really fit for dealing with unmanned systems either. For instance, under the normal application of the rules on accidents investigation or incident reporting, an accident between two (smaller) drones would trigger a full and expensive accident investigation, while having to report any drone incident however small would impose an excessive burden on the operator. The negative consequences limited to small material loss with no safety implications certainly do not justify such excessive requirements. [66]

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[63] For instance, only in DE some 100,000 missions were flown by rescue helicopters. This number results in some half million low altitude operations (on average 2.5 take-off and landings per mission). If one adds police or military helicopter flights, more than 1M low level operations take place in DE alone (Rüder and Scheck, 2014).

[64] The Standardized European Rules of the Air specify: SERA 5005 (f) minimum height in VFR: Except when necessary for take-off or landing, or except by permission from the competent authority, a VFR flight shall not be flown: 1) over the congested areas of cities, towns or settlements or over an open-air assembly of persons at a height less than 300 m (1 000 ft) above the highest obstacle within a radius of 600 m from the aircraft; (2) elsewhere than as specified in (1), at a height less than 150 m (500 ft) above the ground or water, or 150 m (500 ft) above the highest obstacle within a radius of 150 m (500 ft) from the aircraft.

[65] The Swiss Federal Office of Civil Aviation developed a useful risk assessment methodology.

[66] Some national investigating authorities have already been involved in drone accidents. The European group of accident investigation authorities ENCASIA has started developing a specific manual on drone accidents. A ballpark estimate of a light aircraft accident investigation would be in the range of about €15,000 for the investigating authorities (in addition to costs for the ministry of justice or the police etc.). With a ballooning of drone numbers, accidents are expected to increase. Not every accident or incident between two drones would deliver safety critical lessons.

All categories of respondents concur with this analysis (93%), including regulators (92%) and 100% of the twenty industry associations that replied on the online consultation.

2.2.4 Problem driver 4: The oversight and law enforcement authorities lack proper information and instruments

Over time, manned aviation has developed its own oversight and law enforcement mechanisms, especially driven by the civil aviation authorities. While large drone operations will fall under the conventional aviation enforcement mechanisms managed primarily by national civil aviation authorities, especially operations of smaller drones will lead to another set of challenges for enforcement authorities. This issue was particularly highlighted when a number of drones overflew French nuclear plants or the Paris city centre. Also incidents of drones flying in the close vicinity of airports have been reported. Drones are also found flying over crowded beaches, causing safety, (environmental) nuisance and privacy problems. Authorities are struggling how to respond. Police forces may be first in line to respond to inquiries from concerned citizens. There are no common tools in place to prevent infringements in an automated way and police forces have no means to enforce the correct application of the rules.

As drones are a new phenomenon, experience needs to be built up as to how existing rules on safety, data protection and privacy, security and environmental protection, or liability/insurance can be implemented. Guidelines are often not available, and those who are engaged in drone operations have insufficient awareness of the rules.

This view is supported by stakeholders views expressed in the public consultation which point that for example for privacy there is no need for new rules, but rather a better application of existing rules, with a closer collaboration between the civil aviation authorities and national data protection authorities.

Moreover, if an incident or accident happens, [67] enforcement authorities encounter problems with the identification of the operator and enforcing operator liability – where the drone has no number plate or other means of identification, where the operator may not have sufficient insurance, or has been flying illegally. [68] These problems do not arise in civil aviation in general: all aircraft are registered and ex ante controls establish compliance with rules and requirements; and non-complying operators can be grounded at an aerodrome. There are currently no requirements for drones to be equipped with embedded identification, privacy by design, security by design, communication/interception or geofencing [69] capabilities as a precondition for placing on the market. The control of operations is performed differently depending on the Member State, but is often based on individual authorisations. However, even with the requirement for authorisation of each operation, the ease of misuse of drones requires efforts to prevent and eliminate any potential unauthorised or improper use of drones.

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67 See evidence and warning of pilot associations in previous footnotes under section 2.1.2.

68 For instance the Danish Ministry of Transport report (2015) identifies the lack of identification as one of the most important issues to be tackled. Without such identification, enforcement becomes near impossible.

69 Geofencing is the capability to forbid drones to fly in a particular airspace. Airports can be "geofenced", meaning that the GPS and autopilot of the drone know that it cannot fly into airport areas. Geofencing can therefore also be used for security or environmental purposes.

With regard to safety, 28% of the respondents found that drones should not be allowed to overfly city centres at low altitude. Only a fraction of the operators (20%) and industry associations (14%) find such low altitude flight problematic. The exceptions are here the air navigation service providers, where 75% find such low level flights problematic. On enforcement, stakeholders generally agree (76% in general - 85% for regulators) that drone operations pose particular enforcement problems.

2.3 MOST AFFECTED STAKEHOLDERS

Drones will become, eventually, a normal part of the daily life of every citizen, in a professional context and in a private sphere as a customer or private drone operator. All citizens may also be impacted in their fundamental rights if no appropriate protective measures are taken.

Besides citizens, the stakeholders most affected by the regulatory deficit are the EU drone industry (drone manufacturers, payload developers, operators and ancillary service providers such as training organisations), the Member States (with specific administrations like civil aviation or data protection authorities) and EASA. The fragmentation between EU and national competencies and between the national rules leads to regulatory complexity that is especially problematic for SMEs which are most active in developing new technologies and innovative types of operations. [70]

As drone technologies offer innovative ways of working and new services, businesses that could benefit from drone services are affected in their efforts to remain competitive, from traditional aerial services over logistics companies to big industries like construction, mining, transport, energy provision. The barriers to efficient use of drones hamper these companies growth potential and can reduce their competitiveness versus companies in other parts of the world benefiting from drone services.

Existing civil aviation operators, especially general aviation and helicopter operators – as well as other operators at and around airports – are affected by the arrival of large numbers of relatively unsophisticated drones, which could diminish safety in the airspace where they also operate. Model aircraft enthusiasts could be affected if they are captured in new drone regulations.

[70] See box 1 highlighting the daily problems of an SME. "Fragmentation is hampering competitiveness" was endorsed by 77% of the respondents of the online consultation and by 89% of the industry associations.

Table 3: Overview of affected parties by the problem

Stakeholder	*Description*	*Key interest*
EU citizens	All EU citizens affected by risks related to drone operations and as possible clients of drone services or users of drones for private purposes	Access to innovative services with high welfare and job potential, but with properly addressed safety, security and privacy risks
Drone manufacturers and operators	Drone manufacturers and operators with many SMEs and start-ups.	(i) need for (clear) rules for producing and operating drones to make a business case and take investment decisions; (ii) produce rules proportionate to risk to keep regulatory burden as low as possible
Member States (civil aviation, data protection, law enforcement authorities	Regulating and enforcing authorities in aviation, privacy or security	(i) Ability to cope with demands/expectations of growing drone sector (need to develop regulations, organise licensing and oversight); (ii) Need to enforce public policy (safety, privacy, security)
Industry in general	Many businesses may include the use of drones in their operating environment	Ability to include drone services into their value chains to lower costs or provide innovative services
Airspace users	Commercial airlines performing daily ca. 27,000 flights in the EU, together with hundred thousand private pilots	Airspace users (especially general aviation and helicopters) want to keep "their" airspace safe. Model aircraft enthusiasts do not want to be affected by drone rules.

2.4 BASELINE SCENARIO

Under the baseline scenario the identified problems would not be addressed and most likely be aggravated with the growing popularity and use of lighter drones. Available drone market forecasts assume that the legislative framework will follow the technological developments and would not hamper the market development (see Annex VI). The legislative framework for drones is widely anticipated in all markets, so it is hard to assess what if the current situation is maintained. Nonetheless, it is also quite evident that specific rules for drones at Member States level usually lead to rapid expansion of drone operations (see 2.1.1.).

Concerning the increasing risks caused by drone operations, there are again no official reports known showing the trends in the number of incidents and accidents with drones. [71] One should, however, not dismiss an increasing number of press reports on such incidents, with safety experts fearing it might be a matter of time before a drone brings down a passenger plane.[72] The restrictive legislative framework does not seem to address all risks, as they are not effective in preventing unauthorised or inappropriate use of drones. Consequently, with no policy change the risks are expected to become more serious.

[71] The US FAA has published, in August 2015, a list of drone incidents. A Dutch report analyses incidents with drones and models alike for the period 2012-14.

[72] http://www.dailymail.co.uk/news/article-3251543/Drone-owners-forced-register-devices-tracking-database-four-near-misses-aircraft-past-month-alone.html

Below the expected evolution of problem drivers is presented.

a) Evolution of problem driver 1: Responsibilities for drone regulation are divided, leading to diverging requirements in the internal market

As things stand, it is likely that divergent and patchy approaches to the drone rules between Member States will develop for drones below 150kg, as described in the section on problem driver 1 above. It is, however, difficult to predict in which direction the national regulations will go, but current experience shows that it is highly unlikely that uniform rules would be adopted, despite the work at international level.

At the international level, ICAO has produced some guidance material for countries which is used for Member State action and to facilitate the application of individual authorisations. The ICAO process that could lead to formal requirements started in autumn 2014, and concrete results could be expected in coming years only. If successful, these generic international requirements would then need to be translated into national or European jurisdictions to become enforceable laws. This would mean that full harmonisation could not be guaranteed.

In order to advance more quickly, a number of European and other aviation authorities have grouped together in JARUS, Joint Authorities for Rulemaking on Unmanned Systems. JARUS is a flexible structure that should be able to produce proposals for requirements for drones in a timelier manner. As a purely voluntary intergovernmental body, JARUS has suffered from a lack of clear and decisive governance, although recently improvements were made by clarifying leadership and secretarial support. In addition, JARUS cannot adopt rules by itself. They need to be transposed into national law. The past expertise, also from the Joint Aviation Authorities, clearly demonstrates that the transposition would most likely lead to different versions of "JARUS rules" and an attempt to coordinate the transposition into national law on a voluntary basis has in practice no chance to deliver a real single market in Europe.[73] For instance, some Member States are proposing rules that go against some fundamentals of an operation-centric approach like sticking to the distinction between recreational and professional use (while also expertise in other states have demonstrated that this distinction does not function) or imposing 'means of compliance' that are disproportionate to the risk, for instance requiring a private pilot licence for a chimney sweeper who from time to time wants to inspect the roof with a drone or for the photographer who wants occasionally take a picture with a drone. Besides, not all Member States are in a position to follow the JARUS work. At best, the JARUS process will contribute to sharing best practices and helping countries to avoid mistakes made by first movers, and probably contribute to conceptual similarity of approaches between States. If industry standards are developed harmonisation could benefit, but JARUS has so far not been able to steer standard-setting work.

The EU's SESAR programme is planning to work on developing technologies and standards, inter alia to improve "command and control" and "sense and avoid" capabilities of drones. These technologies are important to make drones fly and react like manned aircraft, so that the "rules of the air" can be respected. At the end of the day, the purpose is to integrate drones in the aviation system where safety depends on the actions of various actors and where drones have to adapt to the rules of the other air traffic. This is comparable to the road sector, where the advantage of driverless cars cannot be used if such driverless cars had to drive on separate

[73] Such divergence in national rules and practices is for instance revealed during EASA standardization inspections, whenever new areas which used to fall under international requirements, be it from ICAO, JAA or Eurocontrol, came within the scope of applicable EU rules.

lanes. On the other hand, if driverless cars are to enter the traffic and share the roads with piloted cars, they must be able to follow all traffic rules. Under the baseline scenario, the results from this work could then be integrated by Member States and EU/EASA, each within their area of competence. The streamlining of R&D work of SESAR with the subsequent regulatory validation by EASA should increase the pace of innovation.

All in all, differences in national drone rules are expected to continue restricting the ability of companies to take advantage of cross-border markets. This would lead to further fragmentation of the EU market, hampering development of both manufacturers and operators, and, indirectly, for the wider economy.

b) Evolution of problem driver 2: Individual authorisations are too costly and too time and resource intensive

Some Member States might continue pursuing a proactive approach, abandoning where possible the individual ex-ante authorisation in favour of generic operating rules to favour the growth of the drone sector, whereas other Member States will stick longer to an ad-hoc authorisation policy. In general, though, there are no developments in the pipeline that would eliminate the system of individual authorisations for any segment of individual authorisations. As mentioned above the work in ICAO could facilitate individual authorisations, but would not replace them with blank approval of certain operations.

The product market legislation, which generally applies to the lightest category of drones and allows for placing some drones on the market, does not address the issue of operation authorisations. Only aviation authorities that are in charge of the implementation of the rules of the air and can impose capability limitations on small drones or a unique identification tool or a national register in the context of operations in civil airspace, allowing for a 'type-approval' operations. However, there are no institutional links foreseen in the existing legal instruments between aviation authorities and industry that would enable industry to respond to specific aviation requirements (e.g. small drones should only be authorised to fly at a certain distance from an urban environment or airport, to be used by persons having received minimum aviation safety training and who are listed in a national register). As exactly these aviation safety requirements would support mutual recognition, the current situation of divergent and fragmented national approaches hampers the true development of the internal market for lighter drones.

Finally, the baseline path is likely to put pressure on Member States' public administrations, which may in turn constrain drone market development. In those Member States where such staff is paid from the general budget and not from industry fees, the authorities will have difficulties to cope. If authority approvals become a bottleneck, the effect will be to "ration" access to the market and to slow down innovation.

c) Evolution of problem driver 3: The existing methods of civil aviation regulation are not well suited to the specificities of drones

There is no work on-going to make the currently existing civil aviation rules better suited for the specificities of drones. The revision of the Regulation (EC) 216/2008 has still not be been proposed by the Commission and "a possibly reviewed Regulation (EC) 216/2008" cannot be treated as a baseline. There is also not much work on-going to amend the rules for drones above 150 kg, but for this category the current approach is less problematic, as it requires similar level of supervision as manned aircrafts. Consequently, a single market could be developed for drones above 150kg within the current legislative framework. Based on concrete certification applications from manufacturers EASA would work out a certification basis and related operational requirements, which could serve as a basis for the adoption by the Commission, where needed in the form of Commission Regulations under Regulation (EC) 216/2008. However, it is expected that the civil market for large drones will

remain limited in the short to medium term, as market pressure is clearly being felt strongest in the smaller segment.

Moreover, for drones below 150 kg it would be also difficult for Member States to come up with their own more 'drone tailored' rules, as they would not fit well in the general civil aviation framework e.g. the current rules of the air do not foresee civil or commercial flights below 500ft, so only individual authorisations at Member States level can approve drone operations at low altitude. The lack of proper coverage in the EU legislation of the concepts of 'remote pilots' or 'ground station' will not assure a uniform approach to safety.

d) Evolution of problem driver 4: The oversight and law enforcement authorities lack proper information and instruments

The current organisation of market surveillance remains a further challenge, caused by the patchwork of numerous provisions spread across several different pieces of EU legislation. Although the ongoing revision of the EU framework on product safety and market surveillance [74] is expected to strengthen market surveillance capabilities in the Member States, it remains to be proven how these changes are able to cope with a rapidly expanding drone market and the related safe use of the airspace.

Concerning privacy and data protection, drone operators must respect citizens' privacy and data protection fundamental rights and comply with the existing EU and national rules: these rules are technology neutral, regardless of whether the data are collected by a smartphone, CCTV or a camera on a drone. Specific analysis has shown that there does not appear to be a need to amend the EU rules.[75] Nevertheless, the new General Data Protection Regulation[76] should ensure, when adopted, a better protection of the data subject's rights when data are gathered by means of a drone using new tools like the accountability principle, the data minimisation principle, data-protection-by-design approach, or the obligation to carry out a data protection impact assessment. As regards privacy, Member States will continue to develop rules and administrative procedures they deem necessary in combination with their aviation safety rules to ensure further protection of the right to privacy, for which no secondary legislation exists at EU level.

In all, on privacy/data protection, the problem appears to be not primarily a regulatory deficit, but an enforcement deficit, where police and security forces lack the appropriate tools to enforce. Despite the existence of a general legal framework, a growing number of security and privacy incidents are occurring. Some Member States are actively developing ways to address security and privacy issues but this process is in the early stages. It would be accelerated by exchange of information and best practices, which could occur through established European networks of data protection authorities and police services, but this is yet to be developed. Enforcement is hampered in the absence of drone design features to enable identification of the operator, to prevent it from entering certain areas ("geofencing") or to prevent it from being hijacked or stolen through cyber-attack. A single Member State would in practice have difficulty to impose the necessary product standards on (global) manufacturers. As long as these issues are not resolved, public acceptance of drones will be affected and Member State authorities may restrict the legitimate sale and operation of drones,

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[74] COM(2013)74 final

[75] Trilateral Research & Consulting and VUB, (2014).

[76] The Commission proposal COM/2012/01 is still under discussion in the European Parliament and Council and could be adopted by the end of 2015.

slowing down market development. At the same time they will often fail to curb the unauthorised or even criminal use of drones because they lack enforcement tools.

Finally, growing expertise with drone activities, also from non-EU states, shows that the baseline path is likely to put pressure on Member States' public administrations, which may in turn constrain drone market development. In those Member States where such staff is paid from the general budget and not from industry fees, the authorities will have difficulties to cope. If authority approvals become a bottleneck, the effect will be to "ration" access to the market and to slow down innovation.

All in all, there is a serious risk that the current situation will lead to further fragmentation between national markets and between the national and European safety approaches. Manufacturing industry and operators, often SMEs, will struggle with a multitude of national and European safety rules, leading to a suboptimal take-up of innovative technologies to support jobs and growth. The combined application of un-adapted EU product (safety) rules and national requirements will cause problems of mutual recognition and hinder product markets. The lack of relevant common product standards will also reduce the capacity of administrations to effectively deal with citizens' concerns in the field of safety, security, privacy and data protection, environmental protection, and product and operational liability.

SECTION 3: WHY SHOULD THE EU TAKE ACTION?

Article 100(2) TFEU provides a legal basis for the EU aviation policy. As it stands, large drones (above 150kg) are already covered by EU rules adopted on that basis, namely Regulation (EC) 216/2008. In addition, Article 114 TFEU provides a legal basis for harmonisation measures concerning the EU's internal market. The question as to the appropriate legal basis for any possible EU legislation on drones remains to be determined at a later stage, in particular in function of the aim and content of the intended measures.

Taking into account that the new technologies allow ever lighter drones to interfere with "manned aviation", for which already EU rules exist, the intended EU legislation on drones should also cover all types of drones in order to act coherently and thus prevent that drone operations negatively impact the safety of existing aviation activities.

Drone manufacturing has a cross-border dimension since many drones are bought online, are imported or at least have imported parts. Mutual recognition in the internal market is difficult to achieve in the presence of detailed national standards and rules. If type design certification is carried out at the national level, manufacturers would see their investment and transaction costs increase as they attempt to meet diverging requirements in small segmented markets, thus hampering also their global competitiveness. From the perspective of drones as "aeronautical products", national markets do not provide sufficient scale to develop such global technologies. For instance, critical safety measures such as the identification of the drone or geofencing require industry standards that, for instance, determine the exact technical requirements for an electronic chip that sends out the identification signals. National rules cannot deliver regional or global solutions for manufacturers, who would be confronted with a high number of different technical specifications. And such strong safety measures are exactly required to contribute to the adequate enforcement of existing rules e.g. on privacy, where, in an ideal world, police officers could be given an app to easily identify the drone (owner).

Also with regard to drone services, many operators are developing cross-border activities. For instance, infrastructure inspections, from oil rigs to rail tracks, are being organised at an international level. The point is that even if the operations have a limited scope (e.g. inspect

an oil rig or a bridge and do not cross borders), operators should be in a position to use the same drone and the same operating requirements with the same pilot at different places in Europe to really develop their businesses, especially if they operate in niche markets. Large delivery companies have expressed their intentions to organise their services at the European level which requires common rules.

Subsidiarity should, however, apply at the level of the implementation of the common operational rules, e.g. Member State authorities will carry out local risk assessments and decide which airspace shall be open or closed to drone operations, and under which conditions. Most of the light drones operations have a local dimension and it should be for the local authorities to assess the level of risk and authorise the specific type of drone operations. This way a mayor should be in a position to impose local restriction to protect particular residential areas, comparable to the situation where municipalities decide to restrict road traffic in city centres and declare pedestrian-only streets.

In addition, as is the case for civil aviation in general, Member States remain responsible for most oversight tasks and they thus mostly manage the direct relationship with manufacturers and operators. As a general rule Member States remain responsible for enforcing (common) safety, security, privacy and environmental rules.

In addition, it is intended to rely as much as possible on industry standards as the drone sector is a high technology and fast developing sector. However, industry needs a stable basic regulatory framework to plan and rightly focus their investments and innovation efforts in drones.

Finally, the initiative should also be such as to facilitate the enforcement of EU and national rules in areas such as security and privacy in relation to drones. For instance for security, safety operational measures such as a registry of operators or geofencing capability should make security enforcement measures more effective. [77]

The public consultation revealed that the consulted stakeholders widely support action at the EU level. Some 80% of the respondents agree with a full harmonization of the drone rules with an implementation by national authorities. This view is shared by national regulators (82% support – with none against), by drone operators (81%) and by associations (71%). Only 15% of respondents find that the drone technology is not sufficiently mature to be regulated (none of the regulators is of this opinion; 30% of individuals find regulations premature). Two of the fourteen replying authorities find that regulating small drones should remain a task of the competent national authorities.

Only EU basic rules for the whole range of drones, regardless of weight, offer a consistent regulatory framework for drone manufacturing and operations in the EU internal market, and have the ability to overcome the main problems identified in this report.

[77] See problem description under 2.2.4.

SECTION 4: WHAT SHOULD BE ACHIEVED?

4.1 GENERAL POLICY OBJECTIVE

The general policy objective is to enable the development of drones and drone services in a safe, secure and sustainable manner and in full respect of citizens' fundamental rights.

The aim of this initiative is, in accordance with the logic of the current safety regulatory framework as established in Regulation 216/2008,[78] not to address each of the specific problems in detail, but to adopt, in the first instance, the basic principles and essential requirements within the EU aviation safety framework for the safe development of drones in the EU. This will be achieved through setting essential requirements complemented by the necessary empowerments for the Commission to adopt the necessary more detailed implementing rules. These detailed rules would be adopted in due course on the basis of a separate impact assessment where appropriate, and followed by the development of adequate industry standards. These empowerments and the adoption of the detailed rules on the basis thereof would of course be subject to the general requirements of the Treaties in this regard (Art. 290 and 291 TFEU), inter alia as regards the control exercised by the European Parliament and the Council (for delegated acts) and the Member States (for implementing acts).

4.2 SPECIFIC OBJECTIVES

The **first specific objective** is to adopt common rules to create a single market for drone manufacturing and drone operations so that manufacturers may easily place their products on the market and operators may provide drone services to the economy.

The most important EU legal instrument to be reviewed in this context is Regulation (EC) 216/2008 to specify the responsibilities of the EU and abolish the current threshold of 150kg that defines which aircraft and aircraft operations fall within its scope; to identify existing or new actors competent for safety management and oversight; and to establish the principles of the EU safety policy, imposing safety requirements on the aircraft, the operator and the (remote) pilot.[79] [80] These rules should be complemented by detailed rules specifying how different category of drone operations should be authorised and supervised.

The **second specific objective** is to mitigate the specific risks and problems arising from the use of drones, notably in the fields of safety, security, privacy and data protection, and environment. Addressing those issues will be critical to ensure public acceptance of drones as an increasingly common part of daily life.

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[78] Currently under review. The fundamental approach taken in this Regulation to work with Essential Requirements, Delegated Acts and Standards is not put into question.

[79] Regulation 216/2008 is currently under review and a separate impact assessment was undertaken. This impact assessment report on drones takes the other into account to ensure coherence between the two parallel reports. This report also goes beyond safety and assesses the need for regulatory action in other fields like privacy, liability, security or environment; and it gives special attention to internal market aspects.

[80] In case of SMEs operator and pilot may be the same person/function. For bigger companies the operator is the company responsible for providing the drone service, with the help of a pilot or several pilots.

With respect to aviation *safety*, in practical terms, the EU rules will need to be specifically adapted to the manufacturing and operation of drones and in order to open the market they need to provide modalities for safe drone operations. While addressing the safety issues, the initiative should also consider security, privacy and data protection, liability and environmental aspects. Particular attention will be paid to enforcement of rules applicable to mass produced small drones. Correct application of the rules should be facilitated by embedding safety features: small drones should not be able to fly too high or too far. And the pilot of the drone should always be identifiable.

As regards *security*, measures need to cover the design and manufacturing processes, together with the operation of the drone or of the airspace. The EU already provides for rules in the security area, namely airport inspections as adopted after 9/11. In drones especially command and control are security sensitive – which already may be covered under (cyber) safety certification. The intended framework should foresee the possibility for the Commission to adopt detailed rules. For operations, geofencing capabilities are a good tool also to deal with security issues, including avoiding accidental intrusion into a security sensitive area.

Concerning *privacy/data protection*, the initiative does not intend to establish new substantive rules, but only to make sure that the proposed safety solutions would also facilitate compliance with the applicable privacy and data protection rules. For instance, an identification or tracking requirement for each drone needed for safety monitoring would also help complying with the transparency obligation of drones' operations and facilitate enforcement action for the data protection authorities in case of infringement of the applicable privacy/data protection rules. Moreover, the scope of this report is limited to drones as "flying devices" and not to regulate cameras and sensors as such. These items have to respect existing relevant rules, including privacy and data protection.

With respect to *environmental protection*, the essential requirements should also cover environmental standards on nuisance e.g. from noise and gaseous emissions.

A very large majority of participants in the public consultation of all stakeholder groups support these overall policy objectives. 97% sees the need for EU action as drones are a promising source of jobs and growth. At the same time, the right balance should be struck between the development of the drone market and provision of the adequate protection of safety, security and privacy (91%).

The aim of this initiative, in accordance with the logic of the current safety regulatory framework as established in Regulation (EC) 216/2008, [81] is to adopt, in the first instance, the basic principles and essential requirements within the EU aviation safety framework [82] for the safe development of drones in the EU. The essential requirements provide the legal basis for more detailed rules to be adopted by the Commission, which will be adopted in due course, so that these more detailed rules can be introduced into the EU legislative framework by means of delegated acts and further lead to the development of industry standards. While this initiative would introduce the obligation for drone identification, the identification requirement needs to be detailed (which drone needs to be identifiable at which distance and what information exactly needs to be given) in the Commission acts adopted on the basis thereof. Then the industry standard can be developed to set the exact technological modalities

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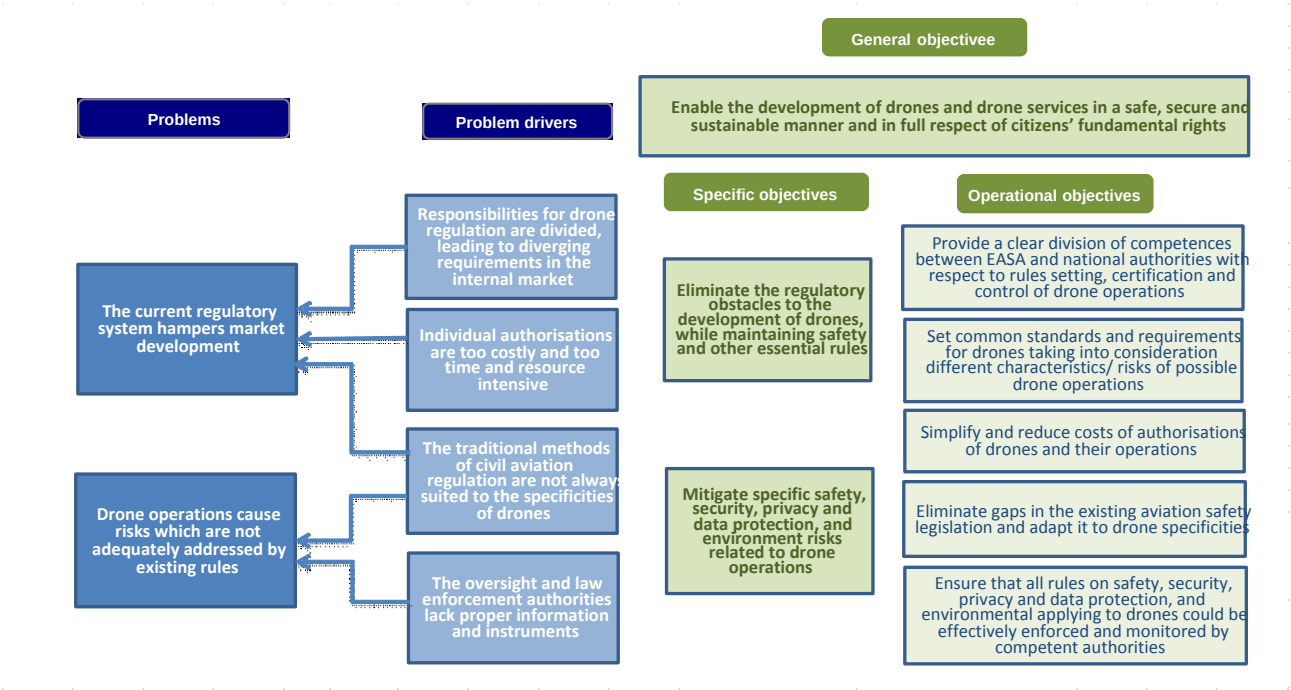
[81] Currently under review. The fundamental approach taken in this Regulation to work with Essential Requirement, Delegated Acts and Standards is not put into question.

[82] As explained in 1.1,

(e.g. electronic chip with specific technical characteristics, e.g. emission power and on interoperability).

The impacts of these specific measures will be assessed separately when necessary (e.g. through a Regulatory Impact Assessment by EASA). The concrete safety measures that could be taken, such as mandatory registry of operators, the identification of drones or the geofencing capacities then should not only help to maintain the current high levels of safety, but also to contribute to the correct application of existing rules in other areas like privacy. For instance, when a person finds a hovering drone above his or her private garden an intrusion on privacy, the identification of the drone (e.g. through an app available to the police or to the general public) imposed by safety rules, helps to enforce the right to privacy.

Graph 4:: Problem tree with corresponding objectives



4.3 CONSISTENCY WITH OTHER EU POLICIES

This initiative is an integral part of the Commission's "Aviation Package for improving the competitiveness of the EU aviation sector". It is also consistent with the strategic objectives of the European Commission. Drone manufacturing and operations will contribute to 'Jobs and Growth' and a 'Deeper and Fairer Internal Market with a Strengthened Industrial Base'. Leadership in developing the drone industry will also strengthen the EU as a "Global Actor", as a standard-setter and exporter of aviation products and services.

The initiative also intends to make the design and operations of drones more consistent with the wider aviation policy framework, which is to a very large extent harmonised at EU level. Drones will become another aerial vehicle to provide services in the European aviation market within the context of Regulation (EC) 1008/2008 on common rules for the operation of air

services in the Community.[83] As drones share the same airspace with other aircraft, the safety of drone operations must remain coherent with the overall aviation safety policy, based on Regulation (EC) 216/2008. Finally, drone operations must also be consistent with air traffic rules as laid down in the EU Rules of the Air. [84]

As this initiative would go beyond the formal aviation certification procedures and introduce flexible verification methods to check conformity especially for low risk drone operations, the consistency of the initiative with the product safety framework needs particular attention. [85]

SECTION 5: WHAT ARE THE VARIOUS OPTIONS TO ACHIEVE THE OBJECTIVES?

5.1 GENERAL CONSIDERATIONS

The starting point of the analysis was the Commission Communication on drones (COM(2014)207) that identified a number of areas as concerns, which might require regulatory action, including safety, security, privacy, liability and insurance, or environment. During the development of this impact assessment, it has emerged that a number of those issues identified in Section 2 will not require new action at EU level, or do not call for consideration of different options. The scope of the actions that are to be analysed in this impact assessment can therefore be narrowed, as described below.

Essential requirements on safety, security and environmental performance

All aircraft and aircraft operations in the EU are subject to "essential requirements" laid down in the European Parliament and Council Regulation No 216/2008. Most of these high-level requirements relate to safety (e.g. "the aircraft must be designed and built in such a way as to be able to fly safely in all the conditions for which it is intended"), but also other considerations are made e.g. in relation to environmental performance or security. The essential requirements for drones and drone operations will follow the same logic as those for other aircraft: they will include requirements relating to the capability and reliability of the drone (called "airworthiness" for conventional aircraft), to the conduct of the flights ("operational rules"), and to the skills of the pilot ("pilot licensing").

The essential requirements are a limited number of overall general principles that determine the safety of a flight, that do not change over time with evolving business models, types of operations, or evolution in technology. At the same time, the essential requirements determine the scope of the detailed rules to be adopted by the Commission, which give the detailed operational substance of the requirements. *That is why the essential requirement must cover all determinants of aviation safety and are not different under the three policy options, as shown below in* ***Table 4****.*

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83 This regulation focuses on "air services" (a flight or a series of flights carrying passengers, cargo and/or mail for remuneration and/or hire) and does not make a distinction between manned or unmanned aircraft.

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

85 The current product safety rules were described in section 2.4. Section 5.3 on the description of the policy options describes the interaction between this initiative and the current product safety rules.

For instance **for safety**, on airworthiness, the essential requirements will state that the unmanned aircraft must be designed in such a way that experience has shown it is safe; and that these aircraft must be safely controllable and manoeuvrable; for operations, the essential requirements will state that the operations must be conducted as to minimize the risk for people on the ground and in the air; and that the operator is responsible for all commands.

For environment and security the essential requirements will determine the necessary "embedded" security and environment features of drones. For security, the requirements would relate to data-link that should be made robust against cyber-attacks. For environment the essential requirements should ensure the environmental sustainability of the aircraft in the same way as other aircraft are already required today. The enforcement of security or environment objectives can be facilitated through measures that will be developed on the basis of the safety essential requirements, like the mandatory identification or geofencing capabilities. *The essential requirements for security and environment will not differ under the three policy options.*

Privacy and data protection

Firstly, the policy options presented below do not detail different ways of addressing the problems related to the area of privacy and data protection. The public consultation, the formal opinions of the data protection authorities, the Ministers of the Transport Council and an external study have during the course of the impact assessment process delivered a broadly shared view[86] that there is no need for new EU legislation in this area, as the existing EU rules are technology neutral and adequate to address the issues identified. The on-going revision of the EU data protection legal framework, will, if and when this leads to a new Regulation as proposed by the Commission, help to further improve the means available to protect personal data and privacy.

The focus will need to be on facilitating the *enforcement* of the existing framework. The relevant authorities are aware of this need and have the necessary legal instruments to do so. They need to develop practical *guidelines on how the existing rules shall apply to drones and to their operators*.

In addition, the product (safety) rules which will be adopted on the basis of the current initiative will include measures to aid their enforcement, such as the introduction of electronic or physical means to identify the operator/owner of a drone. Those measures will also benefit the enforcement of other, existing, rules in the field of data protection, privacy, security and liability. The need to support all these different objectives will be reflected in the "essential requirements" to be adopted under this initiative (see Table 4). The detailed rules will contain practical requirements, e.g. on how a register of drone operators/owners will be managed. The stakeholders, including authorities, responsible for privacy, security, etc. will be consulted on those detailed rules as part of EASA's process related to the preparation of the Commission acts in question.

Insurance and liability

Similarly, the questions of insurance and liability will not be examined, taking into account the specific study[87] that concluded that the current insurance framework under

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86 The public consultation revealed a limited number of stakeholders are in favour of specific drone rules in this area, especially aviation regulators and air navigation service providers.

87 See under 2.2 Consultation; under 3.2.3.3 the description of the rules in place; the Steer Davies Gleave (2014) study in Annex I; and the results of the online public consultation in Annex III.

Regulation EC/785/2004 on minimum insurance requirements for air carriers and aircraft operators provides sufficient cover and protection also for drone operations; and taking into account the results of the public consultation. The study concludes that the problem lies in the *absence of drone safety rules*, which triggers illegal (and hence un-insured flying) and the *application of the rules*, where reliable information on drone operations and drone incidents collected under future safety rules will help to provide the evidence base to set the appropriate insurance fee levels. Also the question of identifying the owner/operator of a drone will need to be addressed, but this is also needed for safety and other reasons.

Rules on air navigation

Furthermore, the *rules of the air for low level operations* will have to be developed in any policy scenario aiming at opening the airspace to drones. These are implementing rules developed on the basis of ICAO work, and which are under discussion in the framework of Single European Sky. They apply to all air traffic regardless of whether a particular aircraft is regulated under national or EU law (see annex IV). Such adapted rules of the air would provide "traffic rules" that local authorities could use to regulate drone traffic over particular zones or cities, just as cities are now able to define pedestrian areas or one way streets. The detailed impacts of the changes in these rules are not in the scope of this impact assessment and will be analysed once a new implementing regulation is prepared by EASA.

Accident investigation

With regard to accident investigation and occurrence reporting, it is also clear that these rules will have to be amended to reflect the investigation and reporting of relevant incidents involving drones, i.e. where such incidents can yield information that will help to improve safety in the future. Thus, again all policy options above baseline envisage the *amendment of the rules to extend the scope to drone-relevant accidents and occurrences*.

Implementation responsibility

This report does not examine in detail the division of *implementation responsibility* (i.e. who is in charge of certification, oversight of operations or licences). Today, implementation responsibility in aviation is shared between the Member States and the EU, including the EASA Agency. A radical reassignment of responsibilities related only to drone certification and oversight either to the Member States or to EASA would run counter to the cooperative system functioning today in civil aviation oversight. Besides, the future modalities of this system are the subject of a parallel impact assessment on the revision of Regulation (EC) 216/2008 governing EU aviation safety policy. This report concluded that the cooperative system should be maintained and reinforced. Therefore, this impact assessment solely focuses the analysis on the *regulatory responsibility* of the national versus EU level and the nature of the regulatory techniques and instruments to be used.

In conclusion, the options presented below are limited to examining which instruments should be used to set the product (safety) and operational (safety) requirements for drone operations, and more specifically on how compliance with those requirements will be controlled. For the other areas for which concerns were identified the rules would be aimed at facilitating the enforcement of existing rules, for instance on privacy, data protection or liability. The present initiative does not relate to the adoption of new substantive rules concerning these latter areas.

5.2 DISCARDED POLICY OPTIONS

- Voluntary initiatives/ soft law

As drone operations are aviation safety critical, any approach based purely on voluntary action has been discarded as not realistic in terms of delivering high safety performance in a way that is coordinated with other air traffic. However, this does not mean that every drone operation must be regulated top-down; the regulatory framework can rely on industry self-assessment or self-declaration of conformity (from operators) and industry standards for drone design (from manufacturers).

- Maintaining the current division of tasks between EU/EASA and MS

Also a minimalistic approach is discarded, whereby the aviation safety Regulation (216/2008) is slightly amended to include basic drone concepts, such as definitions of "remote pilot in command", "ground station", and "drone system". These changes would facilitate the proper regulation of drones above 150kg, which is already within the scope of that Regulation, but they would not address the problems identified for lighter drones, which are likely to dominate the market for the foreseeable future. The impact of such policy option would be very similar to the baseline scenario as described in section 3.4.

- New division of regulatory tasks on the basis of weight categories

A policy option with a different weight criterion for allocating responsibilities between the EU and national level on the basis of mass is not considered.[88] The 150kg limit was introduced in the EU aviation safety Regulation at a time when the technology was such that only large, mainly military, drones were flying. Today, the situation is very different: most drones appearing on the market are well under 150 kg. There is broad consensus between stakeholders that the existing division of tasks between EU and national authorities does not correspond to a regulatory logic. Introducing another weight criterion, e.g. 5 or 25 kg, would be equally arbitrary. It is widely considered that weight is not the only, or most appropriate, criterion to properly indicate the risk of drone operations. For instance apart from mass the speed of a drone also determines the force of an impact and subsequently the safety risk it creates, and the most important risk factor is in fact the nature and environment of any given drone operation (e.g. hovering over crowds). Besides, some risks could be mitigated by the installation of safety systems on board (e.g. a parachute) and thus make a heavier drone safer than a lighter one.

Besides, excluding even the lightest or the least risky category of drones from the scope of the European legislation would harm the wider, existing EU aviation safety policy. Even the smallest drones can pose a risk to regular aviation and hence it is important that the basic rules are harmonised at the EU level, even if they are limited (e.g. a simple requirement not to fly above a certain level), while Member States are given the opportunity to properly assess the local risks and apply the rules accordingly.

- A stand-alone legal regime for drones outside the civil aviation safety Regulation (EC) No 216/2008

Initially, it was envisaged to consider a stand-alone Regulation governing all aspects of drone operations. This Regulation would address all the issues identified in the 2014 Commission Communication through drone-specific rules on safety, air navigation, security, privacy and data protection, environmental protection, liability. Progressively, it became clear that in most of those areas no new EU rules were needed, as the existing EU legal instruments would also

[88] The participants of the public consultation agreed that the current weight criterion is obsolete and the rules must focus on additional risk factors such as the speed of the drone (89%); the reliability of the system (96%); the place where the operation is carried out (96%); and the type of the operation (92%).

cover drone operations. The areas where new EU rules are needed are safety (and security), air navigation, and environmental protection. These areas are already covered by Regulation (EC) No 216/2008 for conventional aircraft. Therefore, although drones present their own specificities and are quite different from conventional aircraft in a number of ways, it would still be preferable to embed the special drone rules within the wider civil aviation framework. This will favour mutual consistency between the different segments of aviation, which is important in particular as all aircraft must safely interact within the same airspace. Moreover, it may be expected that drone technologies migrate to conventional aviation in the future, e.g. where remote piloting would become a support function even for manned flights in the interests of safety and/or operational efficiency, thus blurring the distinction between manned and remotely piloted aircraft.

5.3 DESCRIPTION OF THE POLICY OPTIONS

- **PO0 – baseline scenario**

PO0 is the baseline scenario as described in paragraph 2.4. Drone safety rules would be developed on the basis of the existing division of tasks between the EU and national authorities. The EU is competent for drones with an operating mass of more than 150kg. EASA is competent to prepare detailed rules for that category, to be adopted by the Commission, and for the type certification of large drones. Member States are responsible for rulemaking for and certification of drones below the 150kg threshold. The baseline scenario also assumes the continuation of voluntary coordination of national rules based on the ongoing work in JARUS. Existing EU internal market product rules apply.

- **PO1 – extension of the conventional EU aviation regulation to all drones**

PO1 would integrate drones in the EU legislative framework using the conventional civil aviation approach with the existing certification and licensing procedures, as some Member States do when adopting national rules. [89] This would mean integrating all drones into the existing EU aviation safety policy framework, in particular Regulation (EC) 216/2008 and other relevant legal instruments. It would involve legislative amendments to expand the current scope of that Regulation from heavy drones (above 150kg) to all drones. The "essential requirements" developed for manned aviation would be adapted to drone operations (to cover specificities such as remote piloting) and included in the amended Regulation, including rules and procedures regarding the certification of the aircraft, certification of the operator and licensing of the pilot. It would thus affect all companies involved in the "airworthiness" of drones, including software developers or maintenance companies, and all personnel dealing with drone operations, including training providers or inspectors.

Under this option EASA would prepare specific opinions covering all aspects of drone operations, on the basis of which the Commission could adopt these as detailed rules that could be amended in a flexible way to reflect the evolution in technology. Among these, EASA would develop the so-called "certification basis", i.e. the design standards to be met by drones in order to obtain a type certificate. Every manufacturer would need to apply for a certificate before placing a drone on the market. National aviation authorities would ensure

[89] See higher under 2.1.1. For instance, some Member States introduce a drone pilot licence with reference to either ultra light aircraft requirements (as in FR) or to the private pilot licence (like in BE).

appropriate oversight by checking the certificates and operating licences, issued on the basis of common rules.

In line with the existing approach for 'manned' aviation, such opinions and rules could include security or environmental certification matters as well, as e.g. security and safety certification are very close for the "command and control" function. All manufacturers and operators would be known to the authorities and relevant safety information such as databases on drone operators or on drone operations could be made available to privacy authorities and security and law enforcement agencies. Drones and drone services would benefit from mutual recognition throughout the EU.

Relation of PO1 to the planned review of Regulation (EC) 216/2008

If a new basic aviation safety Regulation is adopted based on the Commission proposal envisaged for later in 2015, without that new Regulation containing any specific rules on drones, more options for operation centric and proportionate regulation will become available to supplement the conventional approach for "manned aviation". [90] Option PO1 would correspond to the "conventional approach" to aviation safety which will still be part of that Regulation and would co-exist alongside the new risk-based and flexible approaches. It is important to evaluate this option as it has been the default approach in aviation for many decades and, for example, has up to now still inspired the work of ICAO or the U.S. FAA on drone regulation.

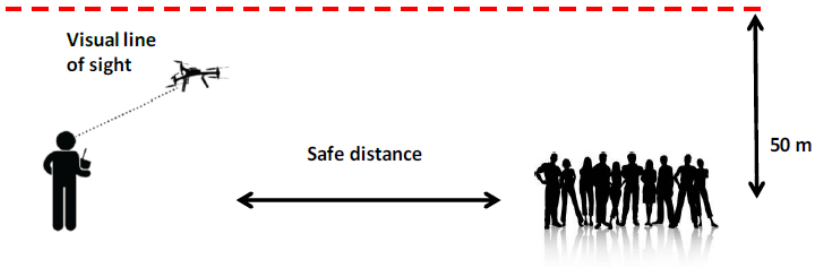
For example, certain more detailed rules to be adopted on the basis of that new Regulation could allow the replacement of the EASA type certificate with a manufacturer declaration, or the EASA certification basis could be wholly replaced with an industry standard. Under this new Regulation, if and when it is adopted, the Commission, supported by EASA, would choose the most appropriate approach for those rules to be developed on a case-by-case basis. Whereas the detailed rules are to be adopted in the form of delegated acts or implementing acts, as appropriate, the main substantive rules and essential requirements to be included in the framework aviation safety Regulation must lay down the main product and operational requirements, e.g. to lay down whether product conformity may be established by means of a manufacturer declaration or only by means of a (EASA) certificate, or whether pilots must obtain a licence in all cases or not. The choice of option will thus affect the drafting of the new basic aviation safety Regulation.

- **PO2 – "Operation centric" EU legislation on drones**

Under PO2 the Commission, with the help of EASA, would develop a departure from the conventional approach to aviation safety regulation and develop an operation centric approach to integrate drones in the EU aviation system. Similarly as in PO1, the scope of Regulation (EC) 216/2008 would be amended to include all drones and a set of essential requirements would be included in the amended Regulation. The starting point of this approach would be the risk of a particular (type of) operation. It would allow for regulatory differentiation from low risk operations to risks of operations equivalent to 'manned' aviation, and thus for "proportionate" rules and "scalable" methods to demonstrate that the rules are complied with. This approach is developed by JARUS and introduced in some Member States like AT, FL and CH. Other Member States are following these principles too, like the UK and FR.

PO2 builds on PO1; it does not involve a replacement of the conventional approach described in PO1, since for the highest risk operations, such as drones operating from airports and in the same airspace as manned passenger transport aircraft, the rules and procedures would be equivalent to the conventional aviation approach, entailing formal certification and licensing by aviation authorities. In addition to certification of the aircraft, certification of the operator and licensing of the pilot as foreseen under PO1, PO2 would include scalable rules reflecting the range of risk profiles in different operations and would enlarge the range of compliance demonstration procedures with more flexible instruments that are suited to apply to low risk operations, such as operator declarations instead of certificates, or, for very low risk operations, no demonstration of compliance of the operator at all. Although the precise detailed rules to be developed by EASA and adopted by the Commission would be subject to appropriate separate impact assessment at a later stage, the following could be anticipated by way of illustration of a scalable, operation centric approach. For example, for the operation shown in the graph below, no specific prior authorisation might be required from the authorities for the drone, the operator or the pilot.

Graph 5: Description of a low risk operation within established safety parameters



This, however, would not mean that these drones are not regulated, but that rules could be limited largely to aircraft embedded requirements (e.g. for identification or geofencing purposes, or maximum performance such as a speed or distance limit). Detailed rules would set the precise operational limitations, and essential requirements would be translated into standards that could be developed by industry and could be recognised by EASA and national aviation authorities. Manufacturers or importers could self-declare the conformity of their products. Enforcement would be left to police and other authorities, like data protection authorities or security forces, but in principle not to the aviation authorities.

For operations involving higher risks, the rules and procedures would be scaled up gradually depending on the risk assessment of the operation. The conventional approach would apply to drones and drone operations at the higher end of the risk scale, and enforcement in that category would be for aviation authorities.

As is the case today for implementing rules adopted under Regulation (EC) 216/2008, EASA would prepare specific opinions following public consultation and regulatory impact assessment, covering all aspects of drone operations. They would then be adopted by the Commission as delegated acts, supported by guidance material issued under EASA's authority. As in PO1, national aviation authorities would ensure appropriate oversight.

Drones and drone services would benefit from mutual recognition throughout the EU, as all drones and drone operations which meet the common rules would be able to cross border with one certificate or declaration, without further national rules or procedures. The uniform application of the rules is overseen by EASA.

When required and similarly to PO1, the rules and industry standards could include security ("security by design") and environmental (in line with the "outdoor noise" rules) issues – again on the basis of the type of operation that the drone is expected to perform. Also information on drone operators and operations could be made available to enforcement agencies and data protection authorities.

The "essential requirements" reflecting this approach would be consistent also with the general objectives and methods of planned revision of Regulation (EC) 216/2008, which aims for a more risk-based and proportional approach by expanding the regulatory options available to EASA and the Commission.

Relation of PO2 to the planned review of Regulation (EC) 216/2008

If a new basic aviation safety Regulation is adopted based on the Commission proposal (without specific drone rules), the rules would fit the approach under PO2, giving more scalability in the means to demonstrate compliance with the basic safety rules. For example, certain more detailed rules could allow the replacement of the EASA type certificate with a manufacturer declaration, or the EASA certification basis could be wholly replaced with an industry standard. Under this new Regulation, if and when it is adopted, The Commission supported by EASA would choose the most appropriate approach in the detailed rules to be developed on a case-by-case basis. Whereas the detailed rules are adopted in the form of Commission acts, the substantive rules and essential requirements to be included in the "revised" Regulation (EC) 216/2008 must lay down the main product and operational requirements, e.g. to lay down whether product conformity may be established by means of a manufacturer declaration or only by means of a (EASA) certificate, or whether pilots must obtain a licence in all cases or not. The choice of options will thus affect the drafting of the "revised" Regulation (EC) 216/2008.

- **PO2.1 – sub-option applying EU product legislation to low-risk drone operations**

PO2.1 is defined as a sub-option of PO2. It builds on PO2 and would add product safety mechanisms used in other sectors in the internal market (including market surveillance mechanisms) for drones used in operations involving the lowest level of risk. It is expected that most drone operations will take place in the lower risk category. These mechanisms could therefore cover the large number of mass produced drones which are offered for sale in retail shops and on the internet, to hobbyists and certain professionals (e.g. photographers).

Concretely, PO2.1 proposes for the lowest risk operations, to complete the *operational* aviation rules and restrictions introduced in PO2 (e.g. defining the perimeters to which low risks operations are confined) with a *product legislation* mechanism which is based on the "New Legislative Framework"[91] covering the essential requirements for placing a product on the EU market. PO2.1 would hence introduce the possibility to rely on market surveillance mechanisms to ensure the compliance of these types of products before being placed on the market (manufactured or imported in the EU).

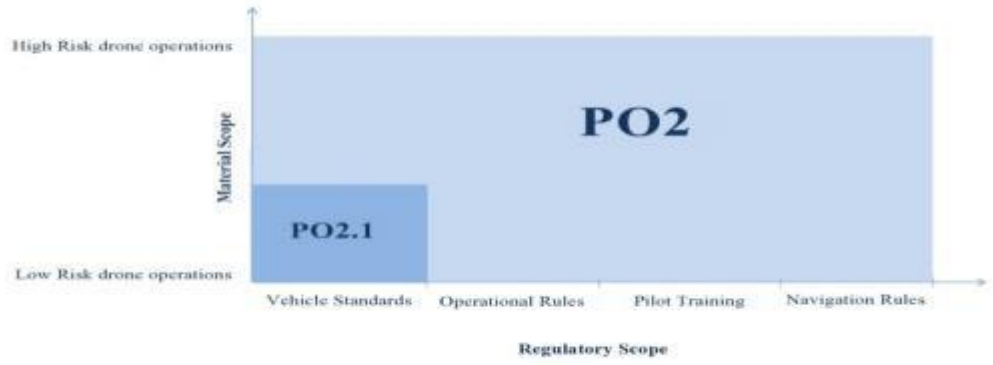
[91] Under the so-called "New Legislative Framework" Regulation (EC) No 765/2008 and Decision No 768/2008/EC bring together all the elements required for a comprehensive regulatory framework to operate effectively for the safety and compliance of products with the essential requirements for protecting the various public interests and for the proper functioning of the Single Market.

CE marking could indicate conformity of the non-mandatory harmonised standards developed by industry as acceptable means of compliance with the requirements. Similarly as in PO2, these harmonised standards could cover not only safety, but also other areas of public interest such as environment and security. The CE marking could also provide essential information to Member States' authorities as well as other relevant parties such as distributors. PO2.1 could also include a requirement for the publication of a user manual explaining the technical use of the drone (including the operational restrictions), the associated risks (safety, security, privacy, etc.) and the related obligations (insurance, registration).

The conformity assessment is under the responsibility of the manufacturer, with the possibility of the involvement of a third party (notified or in-house accredited conformity assessment body). Depending on the risk covered, different conformity assessment modules would be provided.

The graph below shows how sub-option PO2.1 fits into PO2:

Graph 6: How PO2.1 relates to PO2



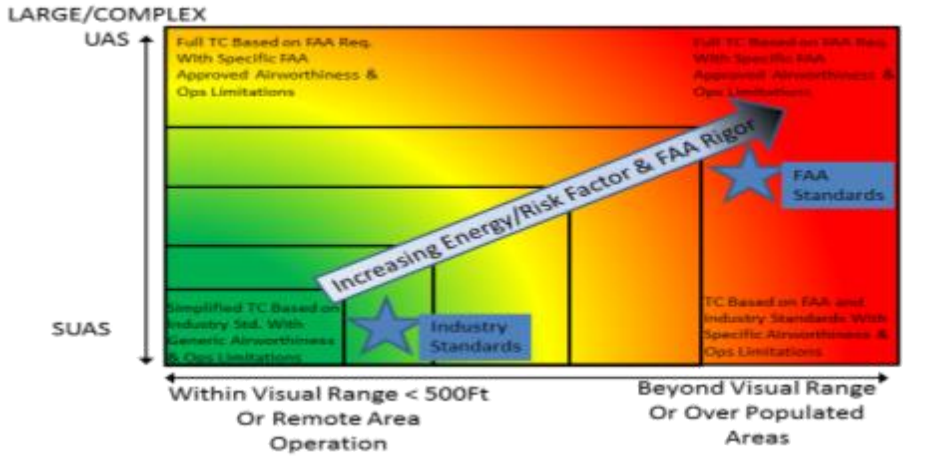
PO2.1 differs from PO2 only in relation to the (mass market of) drones performing low risk operations. All other drones would follow the approach described under PO2. This dimension is represented on the Y-axis in the graph above. Moreover, PO2.1 only deals with product standards (e.g. embedded altitude limitation; how to avoid that the blades are dangerous for the user; how to avoid harmful radio interference, etc.). The operational, pilot and navigation rules would follow the approach defined in PO2, even for the lower risk operations. For example, the operational rules could limit flight altitude to 50m to avoid that the drone becomes a danger for the other air traffic e.g. a low flying police helicopter. The product standard may specify which methods can be used to limit the flying capabilities of the drone effectively to 50m altitude.

Then it is up to the drone manufacturer to decide for which market to produce. The process is illustrated in **Graph 7** below. [92] If the manufacturer wants to go for the mass production of low risk drones (pictured in the bottom left corner of **Graph 7**), he must meet the standard laid down for this category and may then place his product on the market without the involvement

[92] This graph is taken from an FAA presentation in 2014.

of the civil aviation authorities. The operator of this drone will, however, be subject to the operational, pilot training and navigation rules laid down under civil aviation law. Ideally, the drone standard reflects the operational restrictions imposed by civil aviation authorities on low risk operations ("safety by design"). However, embedded safety may not prevent all risks, e.g. geofencing technology may not be able to prevent flying over crowds even if such operations are prohibited for untrained pilots. The operator thus remains liable for exceeding the operational limitations. The manual provided with the drone should provide information on the operational limitations linked to the operation of that type of (uncertified) drone. If the manufacturer deems his drone capable of performing a wider span of operations with higher risks or if he cannot meet the low risk product requirements, he cannot offer the drone under the product safety standards of the low risk category. The manufacturer will fall under the rules described in PO2 (the top right corner in **Graph 7**).

Graph 7: How PO2.1 is triggered [93]



Acronyms:
TC – type certificate – certificate issued for a specific type of aircraft;
UAS: Unmanned Aerial Systems;
SUAS: Small Unmanned Aerial Systems.

PO2.1 could be implemented in either of two ways: in the form of detailed rules adopted in the framework of the aviation Regulation (EC) 216/2008, or in the form of a new product safety Directive. Under aviation rules there would be three levels of rules. Firstly, Regulation (EC) 216/2008 would contain the basic principles and essential requirements, which EASA and the Commission would develop further in detailed rules, adopted as Commission acts. They would in turn be supported by industry standards, giving specific methods on how to comply with the requirements. A new product safety Directive would combine the first and second levels in the 'aviation approach' into a single legislative text; the standards would be identical to the aviation approach.

This legislation, whether developed under Regulation (EC) 216/2008 or as a separate product safety Directive, would in any case also need to ensure consistency with horizontal EU product legislation (e.g. Radio Equipment Directive or the General Product Safety Directive).

93 The graph exactly demonstrates the choice that the manufacturer must make; and its shows that the approach of regulatory intensity in accordance with risk is well shared at the global level.

PO2.1 would in principle replace those horizontal product safety rules (e.g. the EMC Directive) in respect of drones, as has been the case for other product-specific legislation. [94]

With regard to enforcement under PO2.1, Member States would ensure the effective surveillance of their market and take appropriate measures to withdraw non-compliant products, while the Commission would facilitate the exchange of information between market surveillance authorities (e.g. by listing non-complaint drones under the RAPEX information system – this is the system under the market surveillance legislation by which information on non-conform products is notified EU wide). While under this sub-option there is no formal intervention of the civil aviation authorities (EASA or national authorities) on the conformity of drones with product specifications. The *operational* rules and oversight would remain within the purview of the civil aviation Regulations and oversight authorities, as envisaged in PO2, the aviation authorities remain the source of the operational limitations that need to be embedded in the product safety standards.

During the advanced public consultation of EASA, the overwhelming majority of stakeholders agreed with the market monitoring approach for low risk operations. A limited number of stakeholders urged to apply this approach also beyond low risk operations; and a limited number of stakeholders, including air navigation service providers and the pilot association were critical to the idea of calling upon non-aviation authorities.

Relation of PO2.1 to the planned review of Regulation (EC) 216/2008

If a new basic aviation safety Regulation is adopted based on the Commission proposal (without specific drone rules), PO2.1 would add additional flexibility. Whereas PO2.0 already foresees industry declarations, PO2.1 makes a particular means of compliance possible ("CE marking") and establishes the link with the product safety surveillance mechanism that would alleviate the tasks of CAAs.

* * *

Table 4 below summarises how each option would work in practice, and how each option builds on the previous one (additional elements shown in bold).

Essential Requirements

The concrete proposal to be included in the basic aviation safety Regulation would take the form of a number of "Essential Requirements", similar to the existing ones for "manned aviation": aviation must remain safe, regardless of the technology used; and covering the three main domains "Airworthiness", "Operations" and "Air Crew". The cells regarding the Essential Requirements are filled with an example to show how these could look like for the three main domains "Airworthiness", "Operations" and "Air Crew". As explained in Section 5.1, the three policy options would not differ with regard to the Essential Requirements. The essential requirements would also concern (cyber) security (data link) and environment (noise and emissions).

[94] For example, Directive 2014/90/EC on Marine equipment, Directive 2012/27/EU on energy efficiency and Directive 2012/19/EU on waste electrical and electronic equipment are examples where the 'new approach' was applied in other areas and on other legal basis.

Methods to demonstrate compliance with the Essential Requirements

The difference between the conventional aviation approach under PO1 and the operation centric approach analysed under PO2 lies fundamentally in the "scalability" of the means of compliance in function of the risk of the particular operation or type of operations, and the ensuing delegated acts. The compliance with the essential requirements can be demonstrated with a range of methods or, in some cases, it may even not be necessary to demonstrate compliance at all. For simple operations under PO2, the methods of compliance will be easy to fulfil, or even non-existent, but under PO1 a pilot for example would always have to demonstrate his competence through a licence prior to flying even simple operations. In case of complex operations with a high risk for people on the ground or in the air, the demonstration requirements would however be the same under the two options (e.g. a pilot licence is a precondition for flying). Under PO2.1, CE Marking – focusing on features of the product – is added to the list of methods to demonstrate that the product complies with the airworthiness requirements. PO2.1 is similar to PO2 with regard to the other means of compliance.

Table 4: Practical implementation of the different policy options

	OPTION 1	**OPTION 2**	**OPTION 3**
Provisions included in the basic aviation safety Regulation (new proposal based on this impact assessment)			
Essential requirements for airworthiness	"Drones shall not have hazardous design features …."		
Essential requirements for on operations	"Drones shall be operated in a way that minimises the risk to people on the ground and in the air…."		
Essential requirements for air crew	"Pilots shall possess the required knowledge and skills …."		
Available methods to demonstrate compliance			
	Prior third party authorisation (Certificate or Licence)	**No prior autorisation required** **Self-declaration** Prior third party authorisation (Certificate or Licence)	No prior authorisation required Self-declaration **CE marking** Prior third party authorisation (Certificate or Licence)
Delegated Acts to be adopted on the basis of the new basic aviation safety Regulation			
	Details the essential requirements	Details the essential requirements, **including how to assess and mitigate different levels of operational risk**	Details the essential requirements, including how to assess and mitigate different levels of operational risk
	Details the modalities for demonstrating compliance through prior third party authorisation	**Details which means of compliance is required in which case (i.e. depending on the operational risk)**	Details which means of compliance is required in which case (i.e. depending on the operational risk)

		Details the modalities for demonstrating compliance, **including for self-declaration**	Details the modalities for demonstrating compliance, **including for CE marking**
Industry standards			
	Industry-wide agreed means to comply with certain essential or detailed requirements		
Enforcement			
	Aviation Authorities Data Protection Authorities	Aviation Authorities Data Protection Authorities **Police**	Aviation Authorities Data Protection Authorities Police **Market surveillance authorities**

Delegated Acts

The detailed rules to be adopted by the Commission (probably delegated acts, but that remains to be determined) give the detailed operational substance of the requirements and also indicate the method to demonstrate compliance. The options differ significantly at the level of these detailed rules. In particular, under PO2 and PO2.1 these rules will need to lay down the precise criteria to distinguish between "low-risk" and "high-risk" operations and on that basis clarify which method to demonstrate compliance operators will be required to conform with. These criteria should be developed in the Commission acts because they are likely to be highly dependent on technological development and market developments which cannot be easily foreseen. It will be necessary to have the ability to adjust those criteria in the light of developments and on the basis of experience, including feedback from accident and incident investigations. This would not be possible if those criteria are fixed in the basic aviation safety Regulation.

Industry Standards

Industry standards may be straight derived from essential requirements when these are sufficiently clear.. In such case, a detailed rule may simply refer to a standard. In most cases however, industry standards will be elaborated on the basis of the detailed rules, for example on highly technical aspects such as the precise features of a geofencing capability. Industry standards are already used to complement Commission acts for conventional aviation, but they could play a much bigger role in a new and as yet largely unregulated area such as drones, provided the industry is capable of developing them (in time). The intention is to prefer industry standards over detailed provisions in delegated acts where possible.

Enforcement authorities

For enforcement, the conventional approach of PO1 foresees enforcement by aviation authorities. Safety rules, like the identification requirement or geofencing, would allow other authorities to enforce existing rules under their jurisdiction. In this respect there is no difference between the analysed options. Under PO2, in addition to the aviation authorities, it is foreseen that general enforcement services (i.e. police forces, subject to subsidiarity) would become competent for the enforcement of rules related to simple drone operations, notably where no prior authorisation is required to operate and where private citizens would tend to call the police rather than contact the civil aviation authorities. Under PO2.1, the oversight

would be extended to the placing on the market of drones, market surveillance authorities controlling the compliance of the product with the related requirements. For the enforcement of the rules covering other areas, like privacy/data protection or security, there is no difference between options 1, 2 and 2.1.

Table 5 explains how the various policy options tackle the identified problem drivers.**Table 5: Overview of the policy options and linkage to the identified problem drivers**

POLICY MEASURES LINKED TO THE PROBLEM DRIVERS	*POLICY OPTION*			
	0	*1*	*2*	*2.1*
Driver 1: Responsibilities for drone regulation are divided, leading to diverging requirements in the internal market				
1. Baseline scenario	X			
2. Common EU regulatory framework for all drones and division of responsibilities under EASA system		X	X	X
Driver 2: Individual authorisations are too costly and too time and resource intensive				
3. Baseline scenario	X			
4. Introduction of common safety requirements for all for all drone operations		X	X	X
Driver 3: The existing methods of civil aviation regulation are not well suited to the specificities of drones				
5. Baseline scenario	X			
6. Developing implementing rules and standards specific to drones – as opposed to manned aviation		X	X	X
7. Adapting the rules on the basis of the risks of operations			X	X
Driver 4: The oversight and law enforcement authorities lack proper information and instruments				
8. Baseline scenario	X			
9. Enabling consideration of other aspects (security, privacy…) in the safety standards and requirements for drones		X	X	X
10. Applying market surveillance mechanisms for demonstration of compliance for low risk drones				X

The three considered policy options address the first two problem drivers. Common rules will establish a clear allocation of tasks and responsibilities (driver1). These rules will replace the unsustainable and costly system of individual exemptions (driver 2).

All policy options also will provide the legal basis to develop concrete detailed rules to cover the identified safety issues (driver 3), such as remote piloting or the use of drones by operators outside the aviation sector (who lack aviation training). Further on driver 3, the rules of PO1 will take the traditional 'aircraft' based approach, while PO2 (and subsequently the sub-option PO2.1) will focus on risk of a particular (category of) operation (s) as a starting basis with the view to keeping rules proportionate. This will lead to scalable rules and more adapted procedures to assess conformity.

The three considered POs may also offer possibilities, including a legal basis, to facilitate the enforcement of 'non-safety' legislation. For example, embedded technology allowing the identification of the drone could help in the application of privacy laws; embedded geofencing capabilities will avoid that drones fly over security/privacy sensitive areas (driver 4).

The add-on is PO2.1 that introduces a specific market instrument to facilitate the putting on the market of low risk drones (as to be defined within PO2), that would complete the rules on actually operating the drone (e.g. the standard that limits the drone of flying higher than a certain height , for instance 50m high).

In all, the three options are internally consistent as they tackle the identified problem drivers.

The policy options presented in the online-consultation did not go in such detail as do the policy options presented in this section. However, the underlying principles correspond. The stakeholders are not satisfied with the current situation. None of the regulators could agree with the baseline scenario. An overwhelming majority of consulted stakeholders agree (91%) that an EU initiative should lead to mutual recognition of licences and certificates, with 100% support of regulators and industry associations. All categories of stakeholders also agree to move away from the current weight focused approach (PO1) towards a more operation centric approach (PO2). There is also broad agreement among consulted stakeholders are nearly unanimous that other factors should be taken into account: speed (89%), reliability of the system (96%), place where the operation takes place (96%), the type of the operation (92%) and the quality of the drone operator (93%). These views are broadly shared between the different categories of respondents, where all regulators are 100% in agreement on these items. [95]

SECTION 6: WHAT ARE THE IMPACTS OF THE DIFFERENT POLICY OPTIONS AND WHO WILL BE AFFECTED?

Drones are a new phenomenon and evidence of their (economic or safety) impact is in many cases either unavailable or preliminary. Where available data are available, they have been provided, but given that the market is still in its infancy in many cases such data should be taken with a caution. In other cases the report completes general data with specific information or information from the public consultation. It may be some time before impacts of drone operations are reflected in official reports. For instance, while newspapers regularly report on drone safety incidents, there are hardly any official reports quantifying the impact.

Also, considering that the proposed policy options would only set the framework, the precise impact e.g. on reducing administrative costs or on market growth, cannot be quantified before the detailed rules are developed. Besides, putting adequate drone rules in place is only a precondition for market growth and not a guarantee of a certain growth rate, so this initiative is more an enabler for subsequent legislative and market changes. Furthermore, the authorisations of specific operations will to a large extent remain at a local level, so there will be a degree of variability in the extent to which safety, security, privacy and environmental concerns are addressed, which again makes it difficult to make even rough estimates on the level of resources needed.

Given the high degree of assumption when assessing the impacts, it is also difficult to be very precise in identification of differences in the impacts on different market players. It is clear that manufacturers would be more concerned with product rules while operators with rules on operations and pilots. At the level of the initiative, though, there will be no rules that would favour one group over the other (e.g. putting more responsibility on manufacturers and less on operators). Besides, as mentioned before the initiative will not touch upon the division of competences among different public bodies. Consequently, the impacts are described in a general manner and do not make distinctions among public authorities and business stakeholders.

[95] Only one regulator of the fourteen found that the place of the operation was not so crucial.

6.1 ECONOMIC IMPACTS

6.1.1 The internal market dimension

All policy options above baseline would better stimulate the development of the internal market compared to the baseline, where the fragmentation hinders the swift development of the drone market. The market for small (civil) drones is expected to evolve rapidly with robust figures in the coming years, estimated between a few hundreds of millions to billions per year.[96] Several of those studies also take the introduction of drone rules as a condition for the market to take off. Adoption of additional EU rules would thus be positive for drone market expansion. There is no study known which would estimate the productivity gains in user industries following the application of drone services, like the transition from fixed lines to mobile phones improved the productivity of so many workers in the overall economy.

In Europe, many operators complain that operating drones remains arduous and that obtaining authorizations a burdensome and slow process. [97]

The considered policy options would all set the frame for internal market for drone manufacturing and services and hence constitute a huge improvement as compared to the fragmented market that would result under the baseline. The difference lies in the efficiency and speed with which the objectives can be achieved.

PO1 would set a solid foundation for the internal market by creating harmonised rules for all drones and their operations. By incorporating drones under the manned aviation rules the legal certainty and coherent approach to aviation should be assured, eliminating the national differences and barriers for entering national markets. This would benefit in particular the segment of heavier drones (but below 150kg), as instead of a set of various rigorous requirements in Member States, common rules would be proposed.

However, even if applying some flexibility and proportionality under the current EASA system, the rigorous requirements for approval of new risk mitigation methods or burdensome validation of new technologies would not be advantageous for the low risk category of light drones that are mainly used by private persons or small companies. Experience gathered from the application of the large commercial aviation rules on the light aviation community (“general aviation") has taught that heavy-handed approach of commercial aviation may lead to overregulation and bad compliance, and eventually affects the smooth functioning of other segments of aviation market. Furthermore, companies involved in drone manufacturing and operations are often not familiar with the aerospace working environment. For them learning and adapting to the EASA system approach would be very burdensome both in time and cost and consequently would negatively impact the commercialisation of drones and expansion of services using small drones. Thus, despite the overall positive effect of harmonised rules on the functioning of the internal market, option PO1 could be less advantageous for the development of smaller drones market segment in cases where the rules in given Member State were less rigorous than those planned under PO1, like Finland or Austria.

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96 An overview of existing market studies is given in annex VI.5.

97 Le Monde, 8 September 2015. The tone in this article reflects the numerous other articles on this issue and the outcome of the public consultation. For instance, Redbird, a French drone company, wants to expand beyond the FR market, as expressed by its CEO: "Si nous voulons atteindre une taille critique qui fasse de nous un interlocuteur au niveau mondial, il n'est pas concevable de rester en France." (Le Monde, 8.09.2015 - http://drones.blog.lemonde.fr/2015/09/08/pluie-de-dollars-sur-les-drones/), even if FR was one of the first states to introduce drone legislation that promoted drone operations.

PO2 would be more advantageous for the market growth of drones with low risk operations and fast evolving technologies. It would allow for setting concrete performance objectives at implementing rule level (on the basis of general principles set by this initiative and then elaborated in industry standards) PO2 is the most promising way to keep the regulatory burden proportionate to risk. Harmonised legislation and European standards would allow for easier marketing of drone products across national markets. It would also allow operators and pilots, offering sometimes highly specialised niche services (e.g. inspection of offshore installations) to be recognised and offer their services abroad. By applying rules proportionally to the risks and the scalability of the evidence required to demonstrate the safety of the operation ("means of compliance"), the market segment of smaller drones should not be stifled by overregulation. That is especially important for SMEs active in the smaller drone market; and for payload developers, who need a seamless transition between classes of operations in terms of regulatory burden and risk mitigation, to avoid that a somewhat heavier payload would lead to a drastically heavier authorisation procedure.

The **sub-option PO2.1** would be even more appropriate for the manufacturers of mass produced types of drones falling under the low risk category.[98] Industry standards do already partly exist and most EU companies are familiar with conformity assessment procedures. It would apply the CE marking system to low-risk category of drones (to be defined in the detailed rules), which is a widely known and applied system in the EU, and consequently allow for easy compliance with respect to procedural requirements. This approach would also facilitate new market entries for companies which are not familiar with aviation safety regulations. However, while it can be reasonably assumed that the general framework on market surveillance provided by the EU harmonisation legislation is appropriate to ensure the conformity of the product "drone", it remains unlikely that the same mechanism can be used to monitor the safe operation of drones by private, and in particular by professional users. Operations are not monitored through the product market surveillance and the co-legislators might strictly limit the application of the EU product legislation to very simple operations by private persons only. Consequently, companies using CE marked drones for more risky operations would still be subject to verification and possibly authorisation by competent aviation authorities or qualified entities.

On the top of harmonisation of the rules, the benefits of the proposed policy options in terms of stimulating the growth of the internal market will stem mainly from the proportionality of requirements to the risks. However, the level of requirements will only be set via the following Commission acts setting out detailed rules, so it is impossible at this stage to estimate in a quantitative way what impacts the policy options considered here would have.

6.1.2 Impact on competitiveness

It is expected that the proposed POs would improve competitiveness of the EU drone industry as compared to the baseline situation and facilitate access to third country markets, not only because the products could be certified or validated (and then recognized in third countries on the basis of Bilateral Safety Agreements), but above all because EU companies would expand their operations, gain valuable operational expertise which would allow them to compete in the global market.

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[98] Depending on the module chose for demonstrating compliance, PO2.1 might not be appropriate for custom-made drone types which are produced uniquely or in small quantities.

It is clear that many companies await clarity as to the manner in which the drone market is regulated before making any investments. The rapid rise of (blanket) exemptions by the FAA, from six in the course of 2014 to 1,000 in August 2015 is raising the market expectations in the US that the FAA would soon open the market. [99] Investments have been pouring in the US recently and US drone companies have been able to attract some $100M investments, including from big Silicon Valley companies. The investments have been made not only in drone manufacturers but also in companies specializing in aggregation and analysis of big data, so that a shift can be observed from manufacturing and operation to provision of (high value) services. DJI, the Chinese manufacturer, that attracted $75M investments, would facilitate this evolution and would equip part of its drones with the capability to transmit all data in real time.

The conventional certification processes of **PO1** are considered a quality mark for EU products for a global market. The experience from the aeronautical manufacturing sector is that most third countries do not impose additional conditions beyond holding the EASA airworthiness certificate for placing products on the market. Generally speaking, the EASA certificate in PO1 is a powerful advantage for the products and operators when entering foreign market compared to the baseline, where individual certificates are issued by Member States.

However, in case of low-risk drones the process of a formal certification procedure might be too burdensome in terms of time and cost for EU manufacturers and consequently make them less attractive for investment and less competitive versus companies in other regions where it would be cheaper and easier to place on the market and operate low-risk drones. Due to the complex authorisation system it could also take too long to market new promising technologies, thus not enabling the EU companies to gain a competitive edge. This would affect directly the competitiveness of drone businesses, but also indirectly that of other industries which would like to integrate drone services in their value chains (see Box 3 below). In particular SMEs not familiar with the requirements of the civil aviation safety system would be deterred from incorporating drone operations into their business processes.

Box 3: Indirect competitiveness gains: example of cost reductions achieved by integrating drones in existing business processes

The US conducted a large scale law enforcement census of aviation use of the 900 aircraft operated in the enforcement agencies. [100] *The median cost per aviation unit for an average fly time 1,100 hours was $347,000 for operations; $167,200 for maintenance and $80,000 for fuel – or about $540 per operational hour. The operations concerned vehicle pursuits, counterterrorism, firefighting, search and rescue. The swift introduction of drones can reduce this cost to a fraction of 'manned' aviation. Only the cost of the purchase of the aircraft is a multiple of the cost of a drone (several hundred thousands or even millions for a helicopter compared to $13,700 for a drone unit with sufficient capabilities to execute similar missions).*

These costs for the US Department of Justice are indicative for all public authorities and private businesses which are shifting manned aviation operations towards drone operations. So intends the French railways company to deploy drones on a wide scale for infrastructure verifications instead of helicopter or ground inspections. The training for a large commercial helicopter to carry out aerial surveillance work amounts to about $150,000; training a drone operator could cost as little as $2,000. [101]

99 Le Monde, 8 September 2015, referring to a CB Insight report, due to be published later this year.

100 See Volpe (2013) p. 73.

101 Marsh (2015) p. 17.

The flexibility of **PO2** to deal in a proportional way with the wide range of operational risks and fast evolving technologies would allow for faster deployment of new technologies and consequently allow for building the competitive edge of EU companies. In addition, the rules and standards developed under PO2 would be more in line with the rules in third countries with regard to substance (following JARUS) and process (involvement of an aviation authority), while still being set via internationally recognised EU system, involving also EASA. The similarity between the EU rules/risk approach and third countries rules would facilitate the access to these third countries' markets.

Sub-option **PO2.1** seems to be more flexible for industry to make the low-risk drones available on the EU market. It is the market segment where costs will be an important factor requiring easy complying with and non-burdensome rules for companies to be price competitive. Under this option, conformity assessment procedures would be adapted to the risks involved and the public interest to be protected which would ensure an efficient and cost effective way forward.

However the drone market is a global market and trade negotiations over the last decades have shown that third countries, such as the US, often have a different approach and do not accept the EU validation process, especially if performed by non-aviation authorities. It can be assumed that these countries take a regulatory approach which is based on the "conventional approach" (PO1) i.e. which is quite prescriptive and requires an authorisation process involving the public authority, and hence are reluctant to recognize this validation process.[102] All in all, it is assumed that PO 2.1 would have similar benefits to PO2 due to uncertainties about the recognition abroad of CE marking as a proof of airworthiness.

As mentioned above drones would also have a positive impact on the competitiveness of companies in various sectors by enabling performing some activities more efficiently and effectively e.g. filming, surveillance, infrastructure or crop monitoring. The difference between the POs also depends on the speed at which the rules could be delivered, their adaptation to the market specificities and their recognition abroad. Once again it is extremely difficult to give any quantifications of the impacts of the proposed options, given the detailed rules will be adopted via delegated acts and the fact the international market regulation is not well established and difficult to predict.

6.1.3 Impact on innovation

All proposed POs would improve innovation compared to the baseline situation, where fragmentation hampers investment and the development of EU wide businesses. National markets, segregated by a patchwork of national rules, do not provide sufficient scale for developing standard-setting global technologies. The EU level can provide sufficient scale. Also, the lack of any drone rules in more than half of the EU Member States, and the lack of specific drone rules for a large section of (larger/higher-risk) drone operations in practically all Member States create uncertainty and forces companies to postpone important investment decisions, also in research. [103] Although the analysed POs will also take time to deliver fully-fledged drone rules, announcing a clear direction for future rules (e.g. by publishing a proposal for an EU Regulation, or through EASA consultations on proposed rulemaking) would help to shape expectations and give more market predictability necessary for long-term R&I decisions of companies.

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[102] So do the draft Belgian rules prescribe a real private pilot licence for all drone pilots, as soon operations have a professional character, even for operations with smaller drones.

[103] See higher in 6.1.2.

PO1 would have the merit of setting a clear and tested general framework over the baseline. The conventional certification method to be applied to drones under PO1 has over the past decades delivered robust progress on innovation in materials, designs and automation. Fly by wire is a good example. [104] However, large passenger aircraft are developed by a small number of companies and over a long time period (in the order of 10 years), allowing for on-going interaction between the company and the oversight authority and the ability to adapt the so-called "certification basis" (the product standard) to the new technologies. The same method is unlikely to be effective for quickly developing technologies where the focus is more on continuous update of software rather than testing fixed-type hardware. Smaller drones market is also likely to involve numerous dispersed companies, many of whom are SMEs or start-ups unfamiliar with aviation safety management processes, for which product development in cooperation with market oversight authorities (aviation authorities) would be an impediment. The certification methods and requirements under PO1 would not prevent innovation as such, but they would be perceived as a high barrier for many companies and would not be able to keep up with the speed of innovation, especially in the smaller and/or custom-made drone markets.

PO2 would address the shortcomings of PO1 by relying on conventional certification methods only for those drone projects which are similar in design and in development time as traditional aircraft. Other drones or drone components would benefit from reliance on industry standards and self-declaration or other forms of third-party conformity assessment which are sufficiently flexible to meet the industry's needs. It would have very positive impact on innovation, in particular in the lighter segment of drones and among SMEs, which would no longer be stifled by tight connections with the regulator. On the basis of the available evidence it is hard to assess the differences in impact between PO2 and PO2.1 on innovation.

6.1.4 Administrative burden for drone manufacturers and operators

The administrative burden on manufacturers and operators stems from the cost, in terms of price and duration, of obtaining conformity assessment (e.g. certification) and of operating authorisations (licences) and of maintaining these certificates or licences ("continuing oversight", as market surveillance is called in the aviation sector). [105]

Under the baseline, in the absence of effective mutual recognition, sales or operations throughout the EU require multiple (in principle 28) certification and licensing procedures to be conducted for drones below 150kg. Drones above 150kg benefit from the single EASA certification and mutual recognition, like other aircraft. Moreover, the EASA certificate is considered to be a reference approval globally, and in effect opens many third country markets without further time-consuming procedures. Common European rules under **PO1**, PO2 and PO2.1 would expand those benefits to all drones and hence already significantly reduce administrative costs for businesses.

PO2 would go beyond PO1 in keeping manufacturing and operating costs for businesses low. The cost of authority oversight is proportional to the level of involvement, i.e. certification work is invoiced at cost price (even if in practice flat fees are now used, they are calculated on the basis of average real cost). As the involvement of authorities would be low for the lower-risk end of the drone market, the initial cost would also be low. The costs of a certification are

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104 Fly by wire is the technology that replaces the "traditional" mechanic and manual flight control by an electronic interface, so that the pilot's commands are transmitted "by (electric) wire". In the time of its introduction, it was a technological revolution for the aviation community. Now it is a well-established practice.

105 See higher under 2.2.2 where more details on costs are given.

avoided for the manufacturer. In the case of self-declaration of conformity, the cost would be lowest. The operator, at least for the lowest risk operations, would in principle incur no cost at all - the requirements are embedded in the vehicle. When the operator falls outside the lowest risk, costs will be kept low by specifying requirements by type of operation. This would in particular reduce costs for SMEs which can very precisely choose the type of drone (and the required safety assurances) in function of their particular operational needs. The purpose of the operation centric approach is exactly to make operators aware of the risk and hence the associated costs of the product/service. Given the wide range of risks, the costs for operators will vary from nil to a couple of thousands euros, depending on the complexity of the operation.[106]

Where continuing oversight relies on existing market surveillance, as in **PO2.1**, there would be a limited recurring cost for the manufacturers (again depending on means for demonstration of compliance to be set in the necessary detailed rules). For this option, however, there may still be a small cost related to operational authorisations (e.g. the cost incurred by the authority to review a risk assessment submitted by an operator) or to continuing oversight (called "continuing airworthiness oversight" for traditional aircraft). Another advantage of PO2.1 over PO2 could stem from the fact that CE marking system is better known among non-aeronautical companies than aviation safety rules are and could be more easily followed. As PO2.1 addresses mass production, the resulting additional cost per product is insignificant. Thus, PO2.1 is considered as slightly less burdensome than PO2.

Of course, the impact of these costs on competitiveness and on the end user price will depend strongly on the scale of production, as it is typically a fixed cost. Whereas mass-produced drones could probably support even the cost of conventional aircraft certification, for custom-made smaller drones this cost would be prohibitive and it would effectively prevent such products from being developed. Again the real administrative burdens could only be estimated in light of the detailed rules set out in Commission acts.

As all drone activities are of safety concern (even operations of low risk can have disastrous consequences in terms of aviation safety), no blanket derogations or exemptions can be granted to SMEs and micro-enterprises. However, as explained in 6.1.1 the burden for the SMEs would be kept as light as possible at the lower risk end of drone operations, regardless the size of the company. Safety remains the overriding principle.

Finally, a one-off negative impact could arise with the introduction of new EU rules notably for those drones which have already been marketed under national laws. In future detailed rules, grandfathering provisions will need to be considered to address the costs of the introduction of new rules.

6.1.5 Impact on resources of national administrations, EASA and Commission

In general, as the proposed options would lead to drone market opening, there is a risk that the workload for oversight authorities would increase compared to the baseline. The increase of drone activities should be balanced against the greater efficiency of oversight and enforcement tools in the case of common rules as compared to their efficiency in case of national rules.

Most administrative costs are borne by industry, in accordance with the user pays principle, so the increased cost of resources should be covered by the increase in revenues from the fees.

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[106] See 2.2.2 on the costs of a regulatory handbook or a safety manual. If less safety aspects need to be considered, the safety manual will be simpler and less costly.

Besides, considering that most Member States would eventually allow for certain drone operations, a common oversight under EASA system should be more advantageous, especially following the planned revision of Regulation (EC) 216/2008, and less resource incentive for public administrations. In this context, it is very difficult to give any quantitative impacts on resources of the proposed options, before the responsibilities and division of tasks is specified in the follow-up detailed rules and only some general considerations of the impacts of the policy options are considered below in terms of optimal allocation of resources.

In addition to the traditional 'aviation' costs, data protection monitoring may lead to an additional burden for national administrations, where close monitoring or notification of drone operators and operators may need to be required to provide the evidence for data protection authorities or even for citizens who may want to know which operator has been flying close to his property.

For (police) enforcement cost (and need for additional personnel) is also hard to estimate, as it depends on the chain of parameters, such as the number of drones flying; the quality of the rules (with regard to their enforceability); the behaviour of the pilots (e.g. depending on the efficiency of awareness campaigns or on the quality of the training); and the technology (to which extent can tracking, monitoring and supervision be automated). [107]

It is estimated that no additional resources would be required for the European Commission and EASA to establish new rules stemming from any of the proposed policy options. [108] EASA deals with the regulatory drone activities within the current resources envelope; Member States would save a limited amount of resources insofar as the Commission and EASA would take over the rulemaking tasks from them. This is especially important for Member States which have not yet adopted specific drone rules. Additional certification activities by EASA would be financed through fees and charges paid by industry, which may require increased (industry-financed) staff levels. The division of tasks for oversight and authorisation of drone operations would be shared between EASA and Member States in line with the existing collaborative system.

Under the baseline, Member States would have to cope with the growth of the drone sector on the basis of national legislation and would not be in a position to rely on the mutual recognition of products and services. In that sense, all analysed POs are an improvement as compared to the baseline (for Member States in which drone operations are allowed).

PO1 would require a quite intense involvement of authorities in certification and validation tasks and in "continuing oversight". Notably the national aviation authorities would be challenged to deploy the appropriate resources to manage the licensing and oversight of the expected large numbers of drone businesses, using quite different modi operandi from traditional aviation (e.g. unlike drones, traditional aircraft can always be located at an aerodrome). This may exceed the workload of authorities required under the baseline as most of the Member States have less resource intensive rules applying to the lighter category of drones – but is compensated by the mutual recognition effect of the certificates and licences.

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107 Technologies exist that allow for simultaneous tracking of hundreds of thousands of drones at a global scale. These tracking platforms can develop into a world-wide fully automated tracking system. The chip (of a particular provider) connecting to the tracking infrastructure weighs (currently) 31g and be installed in the overwhelming majority of drones.

108 Currently three EASA officials are working on developing drone rules – coming from other departments and combining these tasks with other responsibilities.

PO2 would offer a substantial improvement in terms of optimal use of resources as compared to the baseline, as easier and more flexible procedures would be introduced. However, the main task of national authorities, i.e. the operating authorisations and the continuing oversight will still be necessary at every location. This burden can be partially reduced by relying as much as possible on risk-based oversight techniques and by subcontracting or delegating the activity to "qualified entities", which is the equivalent of "notified bodies" under Regulation (EC) No 216/2008 [109] These costs are passed on to the industry. [110]

However, this possible burden reduction depends on actual uptake of this possibility, including the question of financing. The growth of the drone sector will increase workload for other authorities such as the national data protection authorities or police (to deal with accidents or security incidents), but this is also expected for the baseline. Their task, however, will be facilitated to some extent by embedding certain features such an identification capacity into drones on the basis of agreed product standards. The effective additional burden for e.g. police will depend on a range of factors, such as the number of drones flying around, the effectiveness of awareness campaigns, the behaviour of drone operators, or the degree of annoyance of the general public, that triggers the concrete call to the police.

PO2.1 would create least costs for national aviation authorities. PO2.1 puts the oversight burden for the lowest risk but with the highest number of drones on the existing market surveillance mechanisms.[111] This of course would require some additional work for market surveillance bodies, as it is the case whenever a new product appears on the market. It is a separate issue going beyond this impact assessment to assess if these bodies have adequate resources to cope with new technologies of drones, but already under the baseline they are responsible for the surveillance of light drones placed on the market. Option 2.1 would provide more clear rules in this respect and facilitate this work. Overall, the reliance on already existing mechanisms and infrastructure, covering also other product markets to achieve larger economies of scale, would be less costly than the alternative whereby aviation authorities need to expand and maintain a dedicated aviation mechanism covering drone activity outside traditional aviation channels (e.g. on-line sales). However, this advantage would only apply to the (limited) segment of drones (with large numbers however) covered by an internal market Directive, and the aviation authorities would still need to ensure oversight of operations.

6.2 SOCIAL IMPACTS

6.2.1 Impact on aviation safety

All POs, including the baseline, aim to guarantee primarily air safety. The difference lies in the efficiency and effectiveness of the safety strategies. The selected POs are superior to the baseline also from a pure safety perspective, as safety evidence could be used to improve the

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109 Qualified entities or notified bodies are organisations that perform aviation safety duties, like audits or certification tasks, either on behalf of the Civil Aviation Authorities or on its own behalf.

110 See 6.1.4.

111 See EP Report A7-0033/2011 on the Revision of the General Product Safety Directive and market surveillance and in particular par. 35 recognizing the flow of products bought online that do not comply; and par. 36 calling on COM and Member States to ensure proper training of officers and to improve communications between customs and market surveillance authorities.

system at the EU level; and authorities can focus on better implementation instead of rulemaking.[112]

Including all aspects of drone regulation under the EU framework would ensure a comprehensive approach to aviation safety and offer the best assurance to avoid safety hazards arising from gaps, inconsistencies or overlaps among the different segments of the aviation sector. **PO1** would use the robust conventional aviation certification and licensing processes to mitigate safety hazards and keep the aviation system safe. The EASA safety system is one of the safest in Europe so applying it to drones would also assure a high level of safety provided it can be properly enforced. However, experience in light or leisure aviation has taught us that overburdening low risk operations could lead to a climate of indifference to rules or to illegal operations. Stringent enforcement measures would be required to maintain PO1 effective in delivering the highest level of safety.

PO2 should be more suited than PO1 to assure compliance as the rules would be more adapted to the type and level of risk of drone operations. The risk based safety framework would allow for setting appropriate safety performance targets for which industry would come up with the appropriate standards. Both the rules and the procedures would offer flexibility necessary to cater for the divergence in risks that drone operations entail. In doing so, manufacturers, operators and authorities can focus efforts and resources where the risk is greatest, leading to better implementation and enforcement in practice. It is hard to clearly foresee if PO1 would provide safer framework than PO2, as the safety gains of the former would come from restrictions of certain operations while the gains of the latter would stem from better covering all drone related risks, while at the same time allowing for more operations increasing the overall risks. This is the reason why some Member States prefer PO1, even if in the long run this solution might not be sustainable from the perspective of market and technology development.

The sub-option **PO2.1** would address safety features of some category light drones [113] with product safety and general market surveillance mechanisms. Some safety benefits could be delivered here by alleviating the tasks of the aviation authorities. However, the challenge would be to make sure that the product safety standards are well coherent with the overall aviation safety chain and fully reflect the high safety culture of traditional aviation. Another challenge would be to connect product market surveillance well with the aviation sector oversight, which is still responsible for all drones operations, causing potential coordination problems. Consequently, there are concerns that this dual safety oversight could increase the safety risks compared to PO2, even if it would be still better than the current baseline.

6.2.2 Impact on employment, working conditions and qualifications

There are no known studies on the concrete impact on employment – the available ballpark figures given in the market studies [114] refer to the potential of the drone sector, but do not help us to assess the different POs. In general, the impact on employment will greatly depend on

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112 Safety evidence is given under section 2.

113 All drones will be covered by safety requirements. The exact scope of those covered by product safety requirements will have to be determined by more detailed rules. In any case, it would be mass produced drones for recreational purposes or simple professional operations.

114 The mostly cited studies were produced by TEAL Group or Frost&Sullivan. AUVSI has produced estimates on employment. This study is however quite focused on the US situation. See Annex I for full references and Annex VI for details on available market studies.

the extent and speed to which the drone sector can expand (see sections 6.1.1 and 6.1.2), and more particularly how SMEs, active in the drone sector, get opportunities to develop.

PO1 will sustain employment in the traditional aeronautical industry. SMEs that are able to cope with the required certification processes will be able to develop their activities; however, the heavy procedures may become a hurdle for many other SMEs to enter the drone market. This could have stifling effects on employment growth in drone companies, with consequences for employment and working conditions in the wider economy. The more strict requirements under PO1 (most national authorities are likely to put in place a lighter regulatory framework) is expected, nonetheless, to be offset by the opening and growth of the European market. However, it is extremely difficult to give more precise estimations what would be the overall impact on employment, especially considering that there is no reliable baseline to refer to.

PO2 offers the most promising ways to kick-start the drone market and hence create employment. As rules are kept proportionate to risk, the threshold to start using drones in other industries, including for SMEs, will be kept as low as possible. Drone operators can easily enter the market and their growing expertise makes them evolve towards more complex operations. The same applies to the sub-option **PO2.1,** which could even have some more positive impacts on jobs in the low risk category market segment, but this difference is difficult to assess and is not expected to be significant.

Notwithstanding the positive effects, one could also expect some shift in employment. While new jobs will be created in drone sector, some jobs might become redundant. Dull, dirty and dangerous operations (such as infrastructure inspections) will be the first areas where the small drones will be used, leading partially to better working conditions but also reducing some jobs e.g. in helicopter operations. It is an open discussion if automation creates or reduces employment, despite positive experience in the past, but it seems that the vast opportunities to make complex and dangerous operations easier and more accessible via drones should have a positive effect on job creation. Besides, drone services will offer mainly new applications that do not affect any labour intensive market segment with high level of employment. Hence, it is expected that expansion of drone technology should have a net positive job creation effect.

In addition, mastering drone technologies improves the productivity of workers and hence makes companies more competitive. It also contributes to the "employability" [115] of workers: drone skills can be used in many industries and unemployed workers can use these skills as an asset to find quicker a job.

6.2.3 Impact on security

Option **PO1** is expected to better address the security risks than the baseline. Applying conventional aviation rules to drones under PO1 would make it possible to consider the whole security by design chain, as from the conception of the system, over the testing of critical subsystems, like the command and control functions, over the actual use. Several security aspects have significant overlaps with safety as both intentional and unintentional interference can exploit the same weaknesses, e.g. securing the data link between the remote pilot and the drone. Also geofencing is a measure from which both safety and security may benefit.

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115 Employability skills are the non-technical skills, knowledge and understandings that are necessary to gain employment and participate effectively in the workplace.

The impact of **PO2** would also be more positive than under the baseline scenario. Safety measures would be developed together with security performance objectives. Also industry standards could effectively deal with security, as long as they concern the drone and can be embedded. They could require applying specific means like geofencing or an identification capability. However, the security benefits under this option could be slightly lower than under PO1. In case of PO1 operations would be more restricted so the potential misuses with security impacts would be less. Under sub-option PO2.1 the same results could be achieved as in PO2 provided security also considered in the product safety essential requirement applying to the lightest drones.

6.2.4 Impact on privacy and family life

The analysed POs would not propose any specific substantive rules in the area of privacy and data protection for the reasons described in section 5.1. Besides, any embedded design privacy and data protection would mainly apply to the payloads (or drones with payloads) and go beyond the competencies of EASA as a body regulating aircrafts and not their payload, i.e. the cameras and sensors.

However, all options would allow for adopting safety measures that would also help in enforcing privacy and data protection rules, in particular identification requirements or geofencing. The baseline, which relies on national law, is less likely to be capable of imposing such product specifications effectively in particular on global manufacturers. There are no significant differences between the POs to be identified or quantified, considering the general level of the initiative, and the possible positive impacts on privacy are attributed solely on the basis the POs could assist effective enforcement of the existing rules once the follow-up Commission acts are adopted.

6.3 ENVIRONMENTAL IMPACTS

Again it is difficult to estimate the overall environmental impacts given that many developments of different nature have to be considered. On the one hand drone operations will to some extent substitute other transport activities and reduce the environmental impact (electrical engines, or smaller combustion engines than traditional aircraft – or taking vans from the road). Drones can also be beneficial to improving our environmental monitoring, management and protection capabilities (natural resources monitoring; wildlife, fisheries, pollution monitoring; detection of environmental crimes) using their ability to perform long endurance monitoring tasks. They can also enable precision agriculture with optimisation of water, fertilisers and energy use. More in general, drones can support the digitalisation of traditional operations with potential benefits in terms of optimisation of resource use. Besides, by stimulating innovative drone activities specific options would contribute for example to green electricity production or other measures of energy efficiency improvement (see Box 4). Thus, option PO2.1, followed by options PO2 and PO1 would be expected to have more positive impacts on environment than the baseline (in line with the degree they are positive to market growth and innovation).

Box 4: Wind turbine drones in the skies: the differences in POs applied

An energy utility company X wants to make best use of drone technologies and launch a series of high flying wind turbines at levels higher than commercial aircraft fly. Under PO1 the drone would need full certification; the company becomes a certified operator; and the drone pilot will be fully licensed with a specific endorsement of 'high sky operations'. PO2 would assess the concrete operation – from where the wind drone could be launched, where it best could fly and where it could conflict with other air traffic. A list of adapted mitigating actions would be established; Company X would choose the appropriate mitigating actions where e.g. a weakness in one area, e.g. slow climbing speed, could be compensated by a strong measure, e.g. temporary segregation of the airspace. The operator would have to demonstrate his capabilities for this particular operation; the pilot has to show, in a convincing way, his navigating skills for this drone. Approach under sub-option PO2.1 would not differ from PO2, as high flying wind turbines could not be qualified as a low risk operation and the product market rules would not be applicable, meaning the same measures as in PO2 would be used.

On the other hand drones will enable new services and thus increase air traffic, higher noise and emissions. This impact will offset to some extent the positive effects of better environmental performance (more for PO2.1 under which the increase in drone activity would be the highest, then slightly less for PO2 and PO1). It is impossible to assess the magnitude of those impacts as they will depend on the precise environmental standards for drones and future market developments. However, overall it seem reasonable to expect that lighter drones will have better environmental performance than manned aircrafts and for light drones the emission level should be less of an issue as most of them have electric engines. Consequently, the total impact is assumed to be positive compared to baseline with no distinction between the options.

In all, the two POs are an improvement as compared with the baseline. The two POs cover environmental standard setting for drones, which falls in the existing remit of EASA. Some of those operations will replace existing operations and reduce the environmental footprint of aviation, but there will be new, additional, operations too. Some of these will have indirect environmental benefits by improving resource use e.g. in agriculture. The direct impact of drones on emissions and noise is not clear-cut.

6.4 CONCLUSIONS

The results of the previous sections in terms of the impacts of the various POs can be summarised in the presentation below. The impact is "quantified" from '+++' as very positive impact to '---' very negative impact. The signs are approximate, but where they were in particular difficult to assess they were put in brackets.

Table 6: Summary table of impacts as compared to the baseline

	Policy Option 1	*Policy Option 2*	*Policy Option 2.1*
Economic impacts			
Internal Market	+	++	+++
Competitiveness	+	++	++
Innovation	+	+++	+++
Regulatory costs for business	+	++	+++
Resources of national administrations, EASA and Commission	−	0/+	+
Social impacts			
Aviation safety	++	++	++
Employment, working conditions and qualifications	0/+	+	+/++
Security	++	+	+
Privacy	+	+	+
Environmental impacts			
Emissions and noise	(+)	(+)	(+)

These conclusions correspond with the impacts as assessed by stakeholders of the online consultation (see Annex III part 2) – to the extent that the policy options are comparable. There is consensus across all categories of stakeholders that the current situation is not satisfactory. Stakeholders agree that EU action as described under PO2 [116] would have the highest positive impact, with significant differences comparing to PO1 and the baseline. Sub-option PO2.1.has some slight differences in impacts compared to PO2, but they will to a large extent depend on the way any of these options would be implemented.

SECTION 7: HOW DO THE OPTIONS COMPARE?

Table 7 above shows the need for regulatory intervention. Each of the considered EU actions is in overall terms an improvement on the baseline scenario. This section provides an assessment of how well the policy options contribute to the realisation of the policy objectives set out in Section 3.

116 This PO corresponds more or less to PO3 of the online consultation.

7.1 EFFECTIVENESS

As civil aviation is highly regulated, unhindered cross-border trade and services in the EU internal market is in practice only possible on the basis of common rules and standards. All options are therefore more effective than the baseline in delivering a framework which will help the market to develop.

The strong point of **PO1** is the full integration of drones in the aviation system, providing tested rules and implementation mechanisms. It addresses the regulatory failure by assigning tasks clearly and by setting clear rules for authorisations and oversight. Under this option also the need for standards dealing with security, environmental and even privacy/data protection areas could be addressed, while the rules would be adapted to drone specificities. The weakness, however, lies in the impact of the conventional aviation methods on the smaller drone market. As the experience in the general aviation sector, especially leisure aviation, has shown the smaller drone market might be overburdened by this approach, leading to suboptimal implementation or outright illegal operations. Ensuring compliance would require enhanced enforcement action, which would be difficult considering the dispersion and expected large number of drone operations. This would hamper the effectiveness of PO1 in practice.

PO2 is more effective in meeting the objectives than PO1. In PO2 the focus on the risks of an operation as a starting point makes that the rules more adapted to different operations. By establishing clear rules and implementation mechanisms at EU level, PO2 is effective at eliminating the regulatory obstacles. It would also allow addressing indirectly security, environmental and privacy/data protection issues like under PO1. Nonetheless, owing to its more proportional approach this option is likely to deal effectively with enforcement. The rules are expected be more accepted by operators, and by allowing for risk-based oversight would help the authorities to focus their efforts on the critical aspects of safety. By making it possible to allocate oversight tasks for the low-risk category of drones to police or other non-aviation authorities, authorities should be more effective in coping with large numbers of drone and drone operators expected in the future.

The effectiveness of sub-option **2.1** is similar to PO2; it proposes to rely, for the enforcement of product related rules, on another enforcement tool to achieve the objectives compared to PO2 (but for a high number of drones). Basing product requirements of the lightest and simplest drones on a product safety approach well known to industry and leaving the enforcement of product rules to market surveillance authorities should facilitate the compliance and awareness of the rules with regard to mass-produced small drones used in low-risk operations. The RAPEX system provides in addition a Rapid Alert System for dangerous products. However, one should acknowledge the known weaknesses of general market surveillance mechanisms which does not screen systematically all products but is based on a surveillance plan established by each Member State, which in some cases lead to unsatisfactory incompliance ratios, limiting their effective ability to monitor the mass market of lower-end drones. It has to be noticed the Commission launched in 2013 a package of legislative and non-legislative measures to strengthen market surveillance of products in the EU. Consequently, the effectiveness of PO2.1 and PO2 is assumed to be at a similar level, as neither civil aviation authorities would be in a position to guarantee a 100% watertight verification system.

7.2 EFFICIENCY

The processes under **PO1** were mainly developed for large passenger air transport. Such intrusive processes are appropriate for drone operations that entail an equivalent risk to manned aviation. For low risk operations, even if the processes are simplified as much as possible under the "conventional aviation" rules, they remain burdensome (e.g. there will be always a need for a certificate even if it would be easy to obtain). Hence, despite PO1's ability to address the specific objectives effectively, it does not do so very efficiently. It in particular do not address the fact that the conventional rules have a heavy-hand approach to risk and do not allow for proportional mitigation measures. This finding is also confirmed by the impact assessment on the revision of the Regulation (EC) 216/2008 that should lead to a more risk-based and proportional approach where possible. Consequently, for the low-risk and light drone the cost of compliance under PO1 would be quite high and limit the overall reduction of costs coming from the harmonisation of the rules when compared to the baseline.

The main idea behind **PO2** is to improve the efficiency of the safety regulatory framework for drones. It would focus on particular risks of a particular type of operation and modulates the rules and implementation mechanisms accordingly. In doing so, it is able to pursue a more tailored approach for each segment of the drone sector instead of PO1's "one size fits all". It avoids overshooting the safety, security, and other protection requirements for the lower-risk, lower-impact operations, and thus keeps costs for those operations low and making it economically viable to develop new drone related products and services. PO2 thus serves better than PO1 the overall objective of the development of drones and drone services market.

Sub-option **2.1** presents even an additional advantage by relying on a legislative framework – product safety directives – which is well known to the manufacturing sector, also outside the EU. It leaves product oversight to existing general market surveillance bodies for the lower-end segment of drones. Even if this would require additional efforts from those bodies, the current system is well established and best suited with oversight of a new product that should be safe for the user and poses little additional risks. For aviation authorities this task would be very burdensome, given the high number of products and not justifiable by the low risks to the aviation traffic. This task is also not new for market surveillance authorities as light drones are already sold in the EU under the presumption of compliance with product safety legislation. The demonstration of compliance would be easier for companies which are familiar with CE marking but not with conventional aviation approaches to the demonstration of compliance. Consequently, this seems to be most efficient in terms of division of tasks and in achieving the specific objectives.

7.3 COHERENCE

All policy options are coherent with the overarching objectives of EU policy. They contribute to the safety in the aviation sector and to a well-functioning internal market by relying on existing EU regulatory frameworks and concepts from the EU aviation and internal market acquis, which have proven their worth. They are also coherent with, and supportive of, other policy domains such as security, privacy, and data protection.

Besides, they respect the basic Treaty principles, like free movement of goods and services, together with equal treatment. Furthermore, the proposed options are in line with the Juncker Commission priorities, namely a new boost for jobs, growth and investment (by supporting the development of drone market and drone services), a deeper and fairer internal market (by removing regulatory obstacles in the drone market), an area of justice and fundamental rights (by addressing privacy and data protection issues as well as security threats).

The approach under **PO1** would not be contradictory to the changes proposed with the expected revision of Regulation (EC) 216/2008, but it would not take the direction of the changes into account. In contrast, Options **PO2** and **PO2.1** would be very much coherent with the shift in the approach proposed in the revision of Regulation (EC) 216/2008 which advocates for making requirements more proportionate to the risks.

Nonetheless, PO2.1 would create a dual aviation oversight system for the light category of drones. This risks that there might be some gaps and incoherencies in the implementation of the legal framework, as airworthiness and operational aspects would be oversight separately, despite close links between them. This would require a good coordination between civil aviation authorities and the general market surveillance authorities to avoid the risk of gaps or inconsistencies, which have not been established yet. Consequently, the overall coherence of the legal framework under PO2.1 is lower compared to PO2.

7.4 PROPORTIONALITY

The proposed policy options do not go beyond what is needed to achieve the policy objectives. They would bring with the scope of the EU legislative framework all drones, but in doing so they rely on a well-established EU approach in the field of civil aviation and the internal market. In particular the safety critical need to coordinate drone traffic with other aviation traffic, which shares the same airspace on the basis of detailed common EU rules, provides a strong case for integrating drones and drone operations fully into the remit of EU law, particularly if one takes into account that in line with the wider practice in civil aviation, implementation remains largely in the hands of Member States authorities despite the existence of the European Aviation Safety Agency.

Option PO2 aims to limit the burden of this regulation on both public authorities and industry by applying an approach which is proportional to risk and avoids burdensome over-protection. Sub-option PO2.1 does not differ much in terms of proportionality from PO2.

Option PO1, however, scores badly on this criterion, as it is expected that the large majority of drone operations will represent relatively low risks, well below those of passenger air transport. To some extent the requirements could be limited and made more proportional to the specific risks of various drone types, but this PO would not allow for significant simplification of heavy procedures under 'manned' aviation for drone operations of very low risk. Assuming that under all Member States would eventually develop proportional national rules (as it is now usually the case), PO1 is therefore inferior to the baseline on this criterion.

Table 7 gives a synthetic overview of the policy options' effectiveness with regard to the specific policy objectives defined in Section 4: What should be achieved?

Table 7: Effectiveness of envisaged Policy Options in light of specific policy objectives

Specific policy objectives	*Baseline*	*Policy Option 1*	*Policy Option 2*	*Sub-option 2.1*
EFFECTIVENESS				
SO1: Address the regulatory obstacles to the development of drones, while maintaining safety and other essential rules	0	++	+++	+++
SO2: Address specific safety, security, privacy and data protection, and environment issues to ensure public acceptance of drones	0	++	++	++
EFFICIENCY	0	+	++	+++
COHERENCE	0	+	+++	++
PROPORTIONALITY	0	--	+	++

7.5 CONCLUSIONS

The specificity of drone operations makes conventional aviation rules (PO1) sub-optimal in addressing all risks related to them in a proportionate manner. Whereas PO1 is effective and efficient in delivering on the objectives, it would be a step back from the baseline in terms of proportionality, especially in its effect on SMEs and in respect of low-risk drone operations.

PO2 and PO2.1 are both valid options: they are effective in addressing the problems and score well on proportionality. The focus on the different risk of different operations as the starting point is the best guarantee to keep rules and verification processes proportionate and to facilitate enforcement in the safety, security, privacy and environmental areas. Both the industry and the Member States agree on this approach. It is also the direction now taken in JARUS.

PO2.1 differs from PO2 only in relation to the product (and not the operational) rules affecting small drones. For that segment PO2.1 provides interesting options for the verification of the (self-) declaration of conformity and a market monitoring mechanism. Whether introduced on the basis of aviation rules or a specific product safety directive, these product safety mechanisms are well known in the industry and to the market surveillance authorities. PO2.1 scores better on efficiency by relying on mechanisms familiar to the manufacturing sector and to market surveillance authorities. The challenge will be to ensure coherence and to ensure a proper link with wider aviation rules and with the regulation of *operations* using those drones, which cannot be regulated in a product safety Directive and must remain within the remit of civil aviation rules and authorities. Therefore, PO2.1 may carry a slight coherence risk.

Finally, it is important to recall that, even if no new EU rules are called for in the fields of privacy, data protection and security, a complete and effective policy to achieve the safe development of drone operations in the EU will require that the measures under the preferred option be complemented by the other actions (operational objectives) described in section 8, including the development of guidelines and promotion/awareness material by the relevant

authorities in the fields of privacy, data protection and security.[117] The relevant authorities already have the means to do so.

By way of conclusion, PO2.1 is superior to the baseline on all criteria. It is the most efficient and proportionate option, and equally effective as PO2. Attention will need to be given to ensure coherence between the aviation rules and the product safety mechanisms. Overall, **PO2.1 is the preferred option.**

7.6 PROPOSED WAY FORWARD

The following actions could be envisaged to implement the preferred option PO2.1:

- The planned Commission proposal for a new aviation safety Regulation to replace Regulation (EC) No 216/2008, which is expected to be adopted before the end of 2015, would enlarge the scope of the Regulation to all drones, and include a new set of drone-specific "essential requirements" reflecting the operation-centric approach selected in this impact assessment. [118]
- As part of its engagement in the JARUS network, EASA is developing an approach to the detailed operation-centric drone regulation. EASA published a consultation document on 31 July 2015 that launches ideas to implement the operation-centric approach as developed within JARUS and based on expertise in Member States: how develop a categorisation of operations according to risk; how to best regulate the low risk operations; and which best practices can be built on. By the end of 2015, EASA intends to come forward with a technical opinion, based on this consultation. That opinion could serve as the basis for detailed rules to be adopted by the Commission on the basis of the future basic aviation safety regulation. On that basis, EASA will draft implementing rules which could be adopted as soon as the new EU legal basis is in place. Those detailed rules will be subject to their own public consultation and regulatory impact assessment; they are not covered in this impact assessment.

  Until such time as those detailed rules are adopted, the published draft rules prepared by EASA will help to shape the expectations and investment decisions of the industry and can support Member States in putting in place, or developing further, their national rules in such a way that the future transition to EU rules will be as smooth as possible. Member States will continue to submit their national rules to the Commission under regime of Directive (EC) 98/34/EC on the notification of technical regulations, and the Commission will evaluate those rules on that basis.
- EASA, through JARUS and in cooperation with Member States and industry, is determining an agenda for standard-setting. That agenda will focus on the standards needed to support the future rules and to deliver them within the right timeframe. This will imply, especially for a fast developing technology, that the Commission acts should be drafted in terms of performance objectives – not prescribing all the methods that would satisfy the objectives, which is a task for industry by setting the industry

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117 There was no need to consider different options for those actions, therefore they were not specifically assessed under the policy options and impacts sections. The rationale for this is explained in section 5.1 "Policy options - General considerations".

118 The necessary technical adjustments to the accident investigation and occurrence reporting Regulations would also be included.

standards. Manufacturers over the globe follow the standards and the work between the US and European standard setting bodies is coordinated – as manufacturers are interested in the due adoption of standards to develop their business, regardless of which standard setting body actually developed the standard.

- Meanwhile the Commission will also work within ICAO. With its specific focus on international air transport, it is generally expected that ICAO deliverables will focus on the more complex operations of remotely piloted aircraft systems, for which technologies are still not accepted for practical use. De facto, the principles of the drone approach will be driven by the experts within JARUS, including the European experts. Several of the key experts that have been working within JARUS are equally active in the ICAO context, and the outcome can be expected to be consistent across the different fora.[119] In any case, as explained in Section 1.3, the EU retains the possibility to "file differences" with ICAO standards, should this prove to be necessary.

- The Commission will need to consider the choice of the legal instrument to introduce the product safety mechanisms to cover the lower end of the drone market, notably whether to launch a separate legal initiative in the form of a product safety Directive. The category of drones subject to this legislation would need to be clearly defined. Manufacturers then are able to make a clear choice on the market they would like to serve: either they apply the product safety standards and are able to sell the low risks drones on the mass market; or they choose to target operations that carry higher risk and a different market segment.[120] In any case, a product safety initiative would be subject to appropriate impact assessment, which could benefit from the work at EASA. [121]

- The Commission will pay special attention to the enforcement of the rules and specifically with regard to operations of small drones. Without prejudice to Member States' competence, enforcement of small drone rules may fall within the competence of police forces. The police should then be in a position to easily assess a complaint and possible violation of the rules. The Commission will build on best practices in Member States where some civil aviation authorities are liaising with police to develop specific enforcement tools (tracking, apps etc.) to facilitate their task, which would be similar to car plate checking for road traffic control. Such enforcement tools would come on top of a wider strategy of better governance, starting with clear rules, awareness campaigns for the wider public, and embedded safety features of the drones (like the identification and geo-fencing).

- With regard to compliance with the relevant product safety legislation, the Commission will closely monitor the market surveillance activities in line with the individual plan established by each Member State. It may react where necessary, especially if there appear indications of serious incompliance ratios which may be reported through the Rapid Alert System for dangerous products.

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119 The chair of the ICAO panel (FAA – vice chair of JARUS) is vice-chair of JARUS; the vice-chair of the ICAO panel (UK) is an active member of JARUS.

120 See the description of PO2.1 in Section 5 for more explanation on the interaction between the two frameworks.

121 EASA Advance Notice of Proposed Amendment 2015-10 of 31 July 2015.

SECTION 8: HOW WOULD ACTUAL IMPACTS BE MONITORED AND EVALUATED?

As mentioned earlier the preferred policy option would only provide the regulatory framework that would need to be followed by more detailed rules and standards. The framework should make it possible to meet the following operational objectives:

- delete the current threshold of 150kg and provide a clear division of tasks between EU/EASA and national authorities with respect to rules setting, certification and control of drone operations with regard to drones below 150kg;
- set common (industry) standards and requirements for drones taking into consideration different characteristics/risks of possible drone operations;
- simplify and reduce costs of authorisations of drones and their operations;
- eliminate gaps in the existing aviation safety legislation and adapt it to drone specificities;
- ensure that all rules on safety, security, privacy and data protection, and environmental protection applying to drones can be effectively enforced and monitored by competent authorities.

The first step in monitoring the impacts of the initiative will be to verify if the expected outputs of framework have been delivered and if they led to the intended results. Table 9 presents how the immediate effects to be monitored.

Table 8: Output/results indicators

Operational objectives	*Core progress indicators*	*Source of data*
Operational objectives	*Core progress indicators*	*Source of data*
Provide a clear division of tasks between EU and national authorities with respect to rules setting, certification and control of drone operations	- Setting the division of responsibilities and allocating adequate resources* - Number of authorizations and certificates for different drone categories issued by EASA and national authorities	CAA EASA
Set common standards and requirements for drones taking into consideration different characteristics/ risks of possible drone operations	- Establishing of a risk classification scheme for drone operations* - Number of EU recognised standards on drones	DG MOVE EASA
Simplify and reduce costs of authorisations of drones and their operations	- Setting new authorisation methods for drones and their operations* - Cost of drone certification (airworthiness) - Cost of authorisation of drone operations	CAAs, Notified bodies Qualified entities EASA
Eliminate gaps in the existing aviation safety legislation and adapt it to drone	- Setting the drone rules*	Evaluation study

specificities		
Ensure that all rules on safety, security, privacy and data protection, and environmental applying to drones can be effectively enforced and monitored by competent authorities.	- Introducing specific measures in aviation rules important for the enforcement authorities* - Number of reported infringements in specific areas - Number of punitive measures on infringements in relation to reported infringements (as a measure of stricter enforcement policies)	CAAs National police reports Data protection authorities Evaluation study

* These are binary option indicators, measuring whether or not the necessary rules were proposed. It is assumed that the proposed rules will be comprehensive and complete in addressing the problem drivers (to be evaluated).

The timing for these outputs is not definite as many detailed rules will have to be preceded by consultations and separate impact assessments. Also the development of the appropriate standards will follow the work at international level so it is hard to set a benchmark and deadlines in this area. Given that there is no reference scenario for the baseline, it will be difficult to clearly measure the success of the initiative. The costs of authorisations will be compared to the current costs in various Member States, but one need to take into account that to make the system sustainable the fees should cover the authorisation costs.

The drone legislation will be solidly embedded in the EU aviation framework, with its comprehensive monitoring and indicators system, and the strong partnership between Commission, EASA, SESAR Joint Undertaking and Eurocontrol at the European level, and competent administrations at the national level. Each organisation will contribute to the monitoring of drone activities and functioning of the drone market. In addition, there is a permanent dialogue with relevant stakeholders, including industry bodies, which will provide additional feedback on the relevance of the proposed regulatory solutions.

With regard to monitoring the drone market functioning under the new regulatory framework, a collection of relevant indicators will be done on annual basis, The indicators will be collected from: the EASA open data bank on all the aeronautical products that it has certificated on a basis of safety and environmental standards (number of certified drone products), the national authorities data banks of approved operators (number of certified drone operators and pilots), Eurocontrol database on movements by aircraft which must file a flight plan (number of drone operations requiring authorisation). These indicators will show the effect of the EU drone rules. These indicators will also specify the drone types, so that a correct picture can be given on the status of open, specific and certified operations. In the case of the open category, national and industry reports would need to be used as there will no legal obligation to monitor low-risk drone operations.

As drones become part of the aviation system, drone incidents and accidents, which are defined as relevant for safety improvement purposes, will be reported or investigated under the revised accident and occurrence reporting rules. The existing data limitations should diminish over time as the data and reporting on drone accidents and incidents will be gradually accumulated. The safety information will be given in an anonymous way, but at least the lessons learnt from drone occurrences will well be reflected in the aviation expertise and included where needed in EASA's "safety risk portfolio" and the European Aviation Safety Plan, which steers future rulemaking activity.

The Commission, on the basis of exchange with EASA, Member States and existing stakeholder groups managed by EASA, will evaluate and review the efficiency of European rules on a regular basis as is the case for all civil aviation rules. Notably, EASA produces an annual aviation review, and the functioning of the overall system is regularly externally

evaluated as required by Regulation (EC) 216/2008. Such "Article 62 Panel Evaluation" is carried out every 5 years (the last one was prepared in 2013).

Table 9: Monitoring indicators of the possible impacts of the initiative on the drone market

Key indicators (source)	*Definition*	*Relevance*
Drone certification (EASA)	Number of drones certified.	This indicator would show growth of the most risky segment of drone market (large drones mainly)
Drone movements (Eurocontrol)	Number of flights performed in the ECAC region by drones which must file a flight plan.	This indicator would show trends in the use of larger drones.
Overview of national lists of approved operators (national administrations)	Number and type of all commercial operators approved by the national authorities	This indicator would reveal the growing use of drones and diversity of operations
Drone incidents and accidents (accident and occurrence reports)	Number and type of accidents/ incidents involving drones	The indicator would show the impact of drone operations on aviation safety and information on the specific risks and type of accidents involving drones
Size of the EU drone market and its growth rate (indicators to be developed - market monitoring study)	Total revenue of drone market/ number of companies manufacturing drones/ offering drone operating services	The indicators would show the drone market expansion

As indicated earlier, it is difficult to set the benchmarks for these indicators as the drone market is at early stage of development with many unknowns. The collected data will be compared with the currently available market forecasts and analysed more carefully in a qualitative way.

EXPLANATION OF SOME TECHNICAL TERMS

Chicago Convention is the international convention that regulates international civil aviation since 1944 and creating the International Civil Aviation Organisation.

Drones are unmanned aerial vehicles that are designed to fly without pilot. They can be either remotely piloted (in that case called Remotely Piloted Aircraft System or "RPAS") or fly automated, where the flight operator could be in charge for a number of drones flying at the same time.

EASA is the European Aviation Safety Agency, established by Regulation (EC) 216/2008. It is the "counterpart" of the US Federal Aviation Agency (FAA).

Essential Requirements are a limited number of overall general principles that determine the safety of a flight, that do not change over time with evolving business models, types of

operations, or evolution in technology. They are described in the basis aviation safety Regulation (EC) 216/2008

EuroCAE is the European Organisation for Civil Aviation Equipment is a non-profit organisation dedicated to aviation standardisation since 1963, where the three general industry standard setting bodies CEN/CENELEC/ETSI are providing "general industry" standards

Fly by wire is the technology that replaces the "traditional" mechanic and manual flight control by an electronic interface, so that the pilot's commands are transmitted "by (electric) wire". In the time of its introduction, it was a technological revolution for the aviation community. Now it is standard practice.

Geofencing is the capability to forbid drones to fly in a particular airspace. Airports can be "geofenced", meaning that the GPS and autopilot of the drone know that it cannot fly into airport areas. Geofencing can therefore also be used for security or environmental purposes.

International Civil Aviation Organisation is the UN body dealing with international civil aviation created in 1944 by the Chicago Convention

Joint Authorities for Rulemaking on Unmanned Systems (JARUS) is the group of national experts working on requirements for unmanned systems.

Payload is the technical term used to describe all things that a drone can carry. This may be cargo, but also all kind of cameras or sensors

RAPEX information system – this is the 'Rapid Exchange of Information System" under the market surveillance legislation by which information on non-conform products is notified EU wide.

Remotely Piloted Aircraft Systems (RPAS) are the drones that are piloted remotely.

SARPs are Standards and Recommended Practices, that are "secondary" requirements, not found in the Chicago Convention but in its annexes.

Segregation is the term used when drones have to fly in airspace well separated from "manned" aircraft. Segregating airspace is generally a burdensome and complicated manner to manage and it reduces the overall capacity of the aviation network. It could be compared by having to create separate lanes for driverless cars on the road, instead of driverless cars being able to use all road infrastructures. That is why drone integration is so important.

SESAR is the Single European Sky Air Traffic Management Research programme, managed by the SESAR Joint Undertaking.

Qualified entities or notified bodies are organisations that perform aviation safety duties, like audits or certification tasks, either on behalf of the Civil Aviation Authorities or on its own behalf, as described in Regulation (EC) 216/2008.

APPENDICES

ANNEX I - REFERENCE DOCUMENTS

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(45) ULTRA (2012), *D1.1 – Identification of gaps and new/modified regulations within the existing regulatory framework*, Madrid 218 p.

(46) ULTRA (2013), *D2.1 State-of-the-art report of civil UAS solutions and enabling technologies*, Madrid, 63 p.

(47) UVS International Association (2014), *RPAS: The Global Perspective*, Paris, 244 p.

(48) VOLPE, 2013, *"Unmanned Aircraft System (UAS) Service Demand 2015 - 2035 Literature Review & Projections of Future Usage"*, Washington, 151p.,

(49) Wong, KC (2001), *Survey of Regional Developments: Civil Applications*, Sydney, 8 p.

ANNEX II: PROCEDURAL ISSUES AND CONSULTATION OF INTERESTED PARTIES

Lead DG: DG MOVE

Agenda planning reference: 2015/MOVE/005

This impact assessment is prepared by DG MOVE to support legislative action in relation to drones manufacturing and operation. The associated roadmap was published in 2015.[122]

Organisation and timing

An inter-service steering group was established in April 2014 and involves DGs CNECT – EMPL – GROW – ENV – HOME – JUST – MARE - MARKT – LS – RTD – SG, together with EASA and SJU. A first meeting was held on 18 March 2014; the second took place on 19 December 2014; the third on 17 July 2015. A further meeting took place on 9 September 2015 in particular to discuss the modalities for acceptance by the Regulatory Scrutiny Board. Finally, a written procedure was organised on 23 October 215, prior to re-submission.

Process of consultation

During the last five years, the Commission services [123] have regularly organised or participated in meetings with private and public stakeholders: [124] industry associations, like ASD (Aerospace and Defence Industry Association) or UVSI (the Unmanned Vehicle Systems International), public partners (EASA, SESAR Joint Undertaking, European Defence Agency, Eurocontrol, JARUS), and Member States. One of the most concrete deliverable of this consultation process was the "Roadmap for the Integration of Civil RPAS into the European aviation System", which was delivered to the Commission in June 2013 by a group of experts from various organisations. The conclusions of these conferences, and of the Roadmap, call for concrete regulatory action, to establish a regulatory framework to allow drone operations and create a favourable investment climate.

The Article 29 Working Party and national Data Protection Authorities (DPAs) were consulted and preliminary views were received. The Article 29 Working Party included drones in its 2014 Working Programme to deliver an opinion in the course of 2015.

The European Data Protection Supervisor issued a specific opinion on drones. [125] It concludes that drones may pose a substantial privacy and data protection issue, as the drone is a platform that can be combined with "other technologies such as cameras devices, Wi-Fi sensors, microphones, biometric sensors, GPS systems … and become powerful surveillance tools." Hence, there could be an interference with the right to the respect for private and family life.[126] The EDPS recommends that drone manufacturers are encouraged to implement privacy by design "by default"; and data controllers to carry out data "protection impact

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122 http://ec.europa.eu/smart-regulation/roadmaps/index_en.htm

123 See for instance CSWD(2013): JRC(2015) or http://ec.europa.eu/growth/sectors/aeronautics/rpas/index_en.htm

124 http://ec.europa.eu/growth/sectors/aeronautics/rpas/index_en.htm

125 https://secure.edps.europa.eu/EDPSWEB/webdav/site/mySite/shared/Documents/Consultation/Opinions/2014/14-11-26_Opinion_RPAS_EN.pdf

126 Annex IX explains the relevant privacy and data protection legislation.

assessments". Finally, action is needed that would facilitate the identification of the drone operator. [127]

A specific public consultation process was organised in the framework of this impact assessment from mid-August to October 2014, published on *'Your Voice in Europe'*. [128] The detailed results of this consultation are presented in Annex III Part 2.

The Latvian Presidency of the Council and the Commission organised on 5-6 March 2015 a high level meeting with public officials and industry representatives to discuss existing and future policy on drones. The conference concluded on five important principles to guide the regulatory framework in Europe contained in the "Riga Declaration", which is reproduced at Annex VII. The Riga Declaration calls, as a matter of urgency, for the establishment of a strong EU drone services market with common rules, which promote drone operations by keeping them proportionate to risk, but at the same time adequately protect the fundamental rights of the EU citizens.

The Commission's minimum standards regarding public consultations have been met. [129]

External expertise [130]

The Commission has ordered several specific studies. The most important recent EU studies underpinning this report include: the deliverables of the FP7 project Unmanned Aerial Systems in European Airspace (ULTRA) analysing the regulatory framework from the perspective of integration of light RPAS in the European airspace [131], the study on privacy and data protection risks in RPAS operations [132] and the study on insurance aspects of RPAS. [133]

The study on privacy concludes that the European and national regulatory frameworks in place are largely adequate to address the privacy, data protection and ethical impacts of drones. The privacy rules have a horizontal application and are technology neutral. The problem is not the lack of rules but rather raising awareness of the drone industry about their obligations to protect privacy and about enforcing the existing regulatory mechanisms.

Similarly, the study on liability and insurance requirements confirms that general national liability laws cover drone operations. It highlights the need to ensure an adequate marking of the drone (e.g. fire-proof plate identifying the operator and/or the manufacturer) in order to ease the identification of the liable party. Furthermore, the study confirms the applicability of insurance requirements in accordance with Regulation (EC) 785/2004 [134] to the professional use of drones.

This impact assessment report also takes into account a number of reports published by the U.S. General Accounting Office on drones in order to help the U.S. Congress pursuing a

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127 This is exactly one of the principles of the Riga declaration.

128 See Annex III.

129 COM(2002)704.

130 See Annex I - Bibliography for an extensive list.

131 http://ultraconsortium.eu/index.php/deliverable

132 Trilateral Research and Consultation (2014).

133 Steer Davis Gleave, (2014).

134 Regulation (EC) No 785/2004 of the European Parliament and of the Council of 21 April 2004on insurance requirements for air carriers and aircraft operators.

better informed policy.[135] These reports are also relevant for the EU situation as the aviation regulatory framework is similar in the EU.

Beside the studies, EASA is building up expertise on the safety aspects of drones and has started to prepare the ground for future rulemaking and certification activities. It already issued two notices of proposed amendments in 2010 and in June 2014 to reflect the latest thinking on airspace management of ICAO.[136] EASA has also become active in both JARUS and ICAO. The knowledge gathered in those forums in recent years is equally taken into account.

Finally, the UK House of Lords published in March 2015 an authoritative report on the "Civilian Use of Drones in the EU". The report "support[s] the Commission's aim to create an internal market for …civil drones" and "the Commission's move towards adopting a risk-based approach to safety regulations for …drones." [137]

Consultation of the Regulatory Scrutiny Board

This impact assessment report was reviewed by the Commission Regulatory Scrutiny Board (RSB) on 14 October 2015. Based on the RSB recommendations, the report was revised as follows:

Future regulatory framework: describe more clearly the envisaged essential requirements and how they are identified, and clarify what will be left to delegated acts	A table was added at the end of the options section 5.3 (pages 43-45), showing the main envisaged essential requirements and the differences between the options in terms of the available means of demonstrating compliance. It shows more clearly how every option builds on the previous one. The text introducing the options section was expanded to clarify that the options examine different means of demonstrating compliance and ensuring enforcement, but do not differ on the essential requirements (page 43). It also explains how the essential requirements will be identified and how the delegated acts will be developed.
Future regulatory framework: clarify whether some identified problems would be addressed by other initiatives	Section 5.1 (pages 33-34) was expanded to cover all the issues (privacy/data protection, security, etc.) and for each of those indicate concretely how and where they will be addressed.
Options: Set out clearly what is an "operation centric" approach and how the options differ,	The description of option 2 has been modified to distinguish it more clearly from option 1 (Section 5.3, from page 38). Also the

135 See bibliography for a list of GOA studies.

136 Amendment 43 to Annex 2 to the Chicago Convention on remotely piloted aircraft systems (RPAS) into the EU Common Rules of the Air – currently put on hold to ensure consistency with the overall framework.

137 UK House of Lords, 2015, Conclusions 1 and 6 respectively, p. 67.

including with respect to enforcement	table at the end of Section 5.3 (page 442) shows the differences in enforcement.
Options: explain how different types of rules would co-exist	The description of option 2 in Section 5.3 has been clarified (pages 38 and 43 and following).
Options: provide more information on the discarded option of a stand-alone framework	This option is now explained in section 5.2 (page 36).
International context: explain how the initiative relates to work at ICAO and JARUS	Section 1.3 ("international context", page 8) now explains better the nature of the work in ICAO and JARUS. Section 7.6 ("way forward", page 64) explains how the Commission will manage the interaction with ICAO and JARUS in practice.
International context: provide more information on approaches in third countries	Additional information was added in section 1.3 (page 8) and in section 2.1.1 (page 10), notably on the regulatory approach in those countries where a significant number of drone operations are taking in place.
Baseline: give a more robust forward looking scenario of the likely evolution of problems	The problem drivers are better detailed and their evolution in the absence of further EU action (section 2.4 from p. 24 onwards).
Presentation: sector-specific jargon and acronyms should be avoided or explained	This has been done throughout the text and a list of technical terms was inserted at the beginning of the report.
Enforcement by police: highlight potential enforcement issues	The report mentions enforcement by police as an issue that requires specific action (see sections 4.2 on p.30 and 7.6 on p. 65).
Efficiency of market surveillance mechanisms	The report indicates how the weaknesses of the mechanism may be addressed and that the safety situation will be monitored (see section 7.1 on p. 61 and section 7.6 on p. 65).
Introduce more precise reference to privacy and data protection issues	More precise information is given in the EU legal context p. 7; the relevant annex gives the reference to the relevant opinions.

The Board reconsidered the revised report and issued a positive opinion on 5 November 2015.

ANNEX III : ASSESSMENT OF THE APPLICATION OF THE MINIMUM CONSULTATION STANDARDS

Part 1: Consultation build-up towards this regulatory initiative

The Commission has been financing, from early 2000, research projects to promote unmanned aircraft. [138] This research already proposed the progressive integration of RPAS into non-segregated airspace on an equal footing with manned aircraft, as long as RPAS are able to respect existing aviation rules and to follow well-established procedures and operations. In particular, it is essential that the safety level is in no way lowered and that RPAS operators do not pose a higher third party risk in the air or on the ground compared to manned aircraft.

The Commission hearing (2009) with stakeholders to assess ways to support the emergence of RPAS concluded that costs for entry should be kept low: "The European legislation should be very simple, covering essential elements like the certification of RPAS, training and licensing of the pilots and flight crew, responsibilities and obligations of all stakeholders, liability security and insurance issues, licence to operate, reliability of the components, maintenance matters, and security aspects. The legislation should take into account the specificities of Light RPAS, but should ensure the maximum safety and security level, maintaining the current overall safety level. Rules and standards should be in equation with the aviation standards currently applicable for manned aircraft (equivalent level of safety), but should put the lowest possible constraints on manufacturers and users."

The Commission and the European Defence Agency conference (2010) agreed to set-up a High Level Group to come up with recommendations on structural, institutional and regulatory measures. The open "panel" discussions focussed on the safety issues, radio spectrum requirements, the societal dimension and RPAS research and development. 139 The European RPAS steering group has meanwhile adopted a concrete action plan: "Roadmap for the integration of Remotely Piloted Aircraft Systems in the European Civil Aviation System". [140]

The Commission services have given a good overview of the state of the drones market in Commission Staff Working Document (2012)259. Taking action in defining the way forward, DG Enterprise and DG Mobility and Transport conducted, from June 2011 to February 2012, an extensive consultation on the future of RPAS through 5 workshops, titled the UAS Panel Process.

Considering the emergence of RPAS, their potential benefits for European citizens and economy as well as the current lack of an internal market in this area, DG Enterprise and Industry and DG Mobility and Transport, in close consultation with other Commission services, launched, on 23 June 2011 at the Paris International Air Show, a broad stakeholders' consultation, the "UAS Panel Process", with the aim to contribute to the development of a

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138 See e.g. INOUI (Innovative Operational UAS Integration), 6th Framework Programme. Currently, R&D efforts within the 7th Framework Programme are financed under ULTRA (Unmanned Aerial Systems in European Airspace) to provide more precise and operational research. Also the SESAR Joint Undertaking is actively working on the RPAS integration.

139 As described in Commission Services Working Document – see higher.

140 The European RPAS Steering Group adopted this Roadmap in May 2013. The coordinated actions should lead to a step wise integration of RPAS as from 2016.

Strategy for the development of civil applications of RPAS in Europe. Such a strategy is likely to require concrete steps to foster the development of civil RPAS applications in Europe, including through regulatory, R&D and complementary initiatives, leading to the insertion of RPAS into non-segregated airspace.

Building on various initiatives already carried out by the European Commission in the past 7 years[141], the "UAS Panel Process" has analysed the barriers to a full exploitation of civil (commercial, corporate and governmental non-military) RPAS in Europe and discussed possible ways forward to overcome them.

The "UAS Panel Process" was open to most relevant stakeholders and involved Eurocontrol, the European Civil Aviation Conference (ECAC), the European Safety Agency (EASA), the scientific community, European Civil Aviation Authorities, ICAO, JARUS, Ministries of the Interior (border surveillance, police forces), the European Defence Agency, Ministries of Defence, European Space Agency (ESA), international military organisations, non-governmental organisations, international stakeholders, European citizens and broad industry representation from SMEs to global players which manufacture and/or operate RPAS.

This process mainly consisted of two elements:

(a) a call to all interested stakeholders to provide information and comments on the need for a *Strategy for RPAS in Europe* and

(b) the organisation of 5 thematic workshops from July 2011 to February 2012. Each of these workshops was prepared by individuals with highly recognised expertise in the following fields: UAS industry and market, UAS insertion into airspace, UAS safety, societal impacts of UAS applications and research and development needs. Overall, the workshops were attended by more than 800 participants.

The Staff Working Document (SWD(2012)259) published in September 2012, reports the outcomes of this consultation. Main conclusions were:

- RPAS present an important potential for the development of innovative civil applications (commercial, corporate and governmental) in a wide variety of sectors to the benefit of European society by creating jobs and achieving useful tasks.
- To unleash this potential the first priority is to achieve a safe integration of RPAS into the European air system as soon as possible.
- This requires the development of appropriate technologies and the implementation of the necessary aviation regulation at EU and national levels. Issues like privacy and data protection or insurance must also be addressed.
- It also requires an increased coordination between all relevant actors (EASA, national Civil Aviation Authorities, EURCAE, Eurocontrol, JARUS, industry etc.) and between regulatory and technological developments.

Stakeholders on their side decided to elaborate an RPAS Roadmap that proposes a series of actions to be taken for achieving RPAS integration into the European air system from 2016. On 20 June 2013 at the Paris Air Show, the Roadmap was handed over to the European

141 The European Civil Unmanned Air Vehicle Roadmap (UAVnet/CAPECON/USICO, 2005), the INOUI study (Innovative Operational UAS Integration, 2007), the Policy Statement on Airworthiness Certification of UAS (issued by EASA in 2009), the Hearing on Light UAS (2009), the High-Level-Conference on UAS (2010).

Commission, who will play a crucial role in its implementation, developing the necessary regulation, supporting the development of enabling technologies and addressing privacy and other societal concerns.

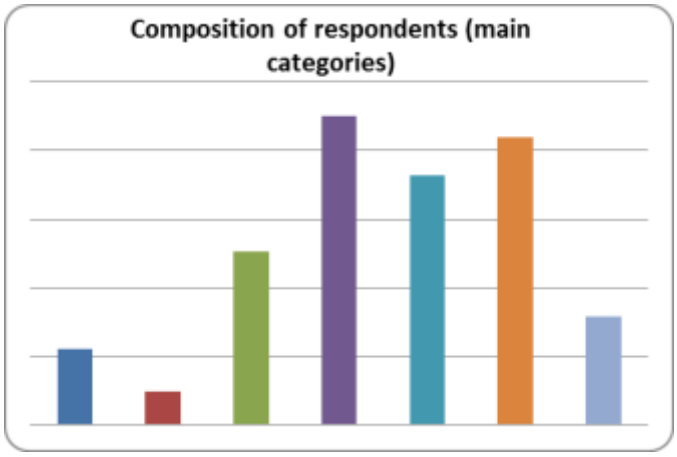
On 8 April 2014, the Commission has adopted a policy document which set out the Commission lines of action. These concern a mix of regulatory initiatives, R&D efforts and industrial support actions.

During the course of 2014, a consistent consultation process was managed with Member States, specialized authorities, industry stakeholders, NGO organisations. The most important were: meetings with Civil Aviation Authorities, consultations of stakeholders by JARUS and EASA, workshops on insurance and data protection/privacy, meetings with Data Protection Authorities. In addition, in the course of the impact assessment, a public stakeholder consultation took place and its results taken into consideration.

Part 2: Analysis of the Public Consultation on drones (here still labelled as RPAS)

Profile of respondents

253 individuals (23%) and organisations replied to the on-line public consultation on RPAS that was run from 14 August to 24 October 2014. The organisations mainly concerned RPAS operators (21%), R&D organisations & consultancy (18%), aircraft design, manufacturers and maintenance (13%), aviation associations (8%) and national regulators (6%).

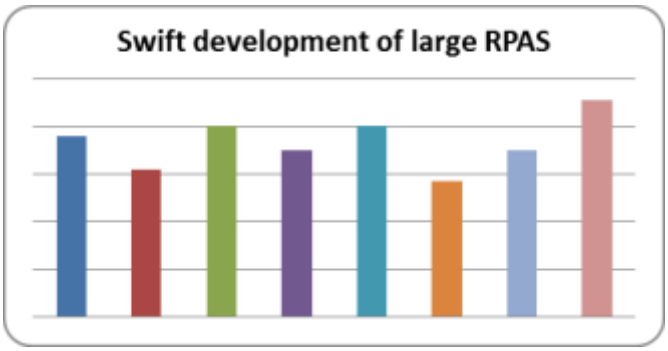


On X-axis, the categories of respondents: 1. National regulators; 2. ANSPs; 3. Design & maintenance; 4. Individual; 5. R&D and consultancy; 6. Drone operators; and 7. Associations.

Market development (Questions 1-10)

RPAS applications are mature and will create substantial business opportunities and commercial benefits (99%)[142]. Nearly all respondents foresee applications development within five years for professional activities (99%) or for daily life purposes (80%). Respondents see the market take off for all RPAS without making a substantial dichotomy between small and large RPAS; however more respondents see this happening for small (94%) than for large RPAS (76%).

142 The percentages given throughout the text refer to the number of respondents who agreed and strongly agreed, divided by the number of respondents who gave a substantial answer (so excluding the 'no opinion' replies.



On X-axis, the categories of respondents: 0. Total average; 1. National regulators; 2. ANSPs; 3. Design & maintenance; 4. Individual; 5. R&D and consultancy; 6. Drone operators; and 7. Associations.

Respondents are generally not of the opinion that the EU RPAS industry is lagging behind global competitors or that it is not competitive. In any case, an overwhelming majority finds that a strong and integrated RPAS market is the way to make the EU RPAS industry globally competitive (90%).

Current situation and issues to be tackled (Questions 11-27)

As with any new technology, RPAS also raise concerns. The public consultation confirms two major issues: the perception of safety and privacy. Only a marginal number of respondents (3%) claimed that RPAS should be kept out of the air because of safety or security reasons. Hence, the concerns are well identified and need careful management, including on environment or insurance. At the end of the day, the consultation confirms that, under specific modalities, potential benefits outweigh risks and threats (86%), including if RPAS start flying over city centres at low altitude. [143]

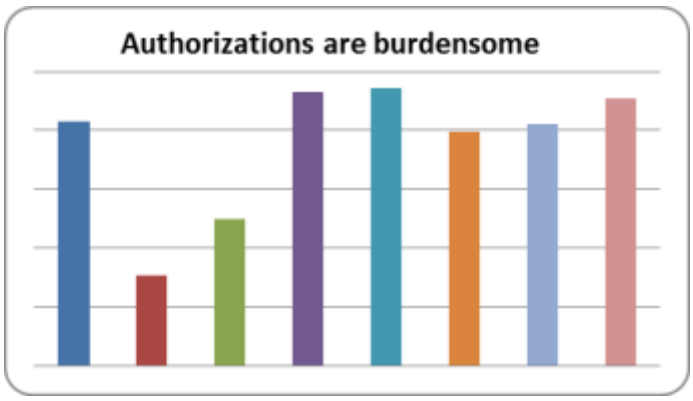
The principal causes for a suboptimal situation (Questions 28-47)

The consultation confirms fragmentation of the EU market, legal & technological uncertainties and safety, security and privacy issues triggered by RPAS operations as the major concerns which make the current situation unsatisfactory.

Firstly, a vast majority of respondents identify specific national authorizations for RPAS operations (83%)[144], differences in national legislation (91%), lack of common rules applicable to all types of RPAS (91%) and gaps in the current EU legislation (93%) as important barriers. Strikingly, only 30% of regulators consider national authorizations problematic but concur with the general consensus with regard to differences in national legislation (79%) and lack of common rules (83%). This divergence on specific authorization between regulators and regulated may require particular attention.

143 Only 29% of the respondents agree that RPAS should be forbidden to fly over city centres.

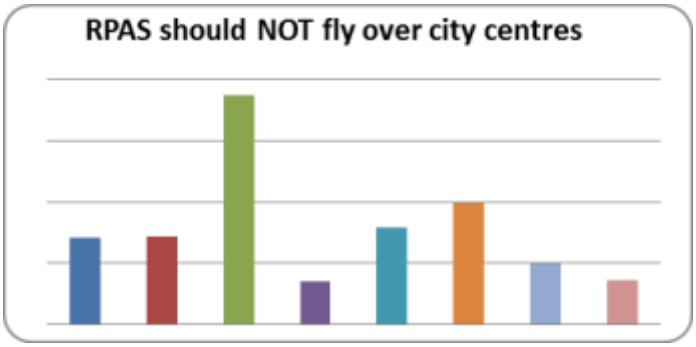
144 Nevertheless there were substantial differences among the respondents and only 30% of the national regulator found the duty burdensome.



On X-axis, the categories of respondents: 0. Total average; 1. National regulators; 2. ANSPs; 3. Design & maintenance; 4. Individual; 5. R&D and consultancy; 6. Drone operators; and 7. Associations.

Secondly, the public consultation confirms that technology driven markets like RPAS need a swift validation of technologies 67%) and light touch rules that allow innovative technologies to emerge (70%). Lacking international standards also cause uncertainty (88%).

Thirdly, most of the respondents are of the opinion that RPAS become cheaper and more capable thus there is a high risk of inappropriate use, even unwillingly (89%). However, only a small minority of respondents indicate that RPAS pose a danger to citizens as they can operate much closer to the ground (29%). This corresponds to general acceptance for RPAS flying over densely populated areas (71%).



On X-axis, the categories of respondents: 0. Total average; 1. National regulators; 2. ANSPs; 3. Design & maintenance; 4. Individual; 5. R&D and consultancy; 6. Drone operators; and 7. Associations.

Finally, existing rules on safety, security and privacy that apply to aircraft are equally applicable to RPAS. The consultation shows the need for specific provisions addressing use of RPAS (73%) or that a more coordinated approach in respect of implementation and enforcement of the existing regulations should be developed (76%). Less than half of the respondents (49%) are of the opinion that regulations cannot stop new threats. Similarly, vast majority of respondents state that a lack of harmonised insurance rules may lead to inadequate insurance coverage (89%).

The objectives of a possible EU intervention (Questions 48-49)

An overwhelming majority supports the overall policy objectives. 97% sees the need for EU promotion as RPAS are a promising source of jobs and growth. At the same time, the right balance should be struck between the development of the RPAS market and provision of the adequate protection of safety, security and privacy (91%).

Four main options to tackle the root causes (Questions 50-53)

The policy options are (1) to keep the status quo (7% of support), (2) build on existing competences to develop RPAS rules with preservation of current competence lines (35%); (3) introduce common rules and ensure local implementation gets most support (67%); and common rules with centralization of certification tasks in EASA is the second favoured option (60%).

What measures should be taken (Questions 54-89)

There is some urgency to come up with an enabling regulatory framework. Only a small minority of the respondents (15%) considers the RPAS technology not sufficiently mature or that international rules should first be developed (36%). The overwhelming majority is of the opinion that EU rules should reflect international standards (92%) – indicating the need to focus on the global market. Moreover, the new rules should apply equally to both light and heavy RPAS: the vast majority apparently agrees that the current 150kg division of competence is obsolete and the status quo gets little support (27%). Respondents strongly support the statement that safety rules should be harmonised at the EU level but implemented at the local level (77%) with lower support for central implementation by EASA (58%). The respondents like the possibility of having the choice of the certificating authority either national or European (63%). Moreover, the respondents support certification and licencing of lighter RPAS at local level (64%). In any case, there is a need for mutual recognition of certificates and licenses delivered in any Member State throughout the EU (91%).

Furthermore, the open consultation shows the need to move away from weight and take a set of factors into account, such as the type of the operation (92%), the quality of the RPAS operator (93%), the place of the operation (96%), and the reliability of the whole system (96%). Although, the consultation found some hesitation for shifting the responsibility from the manufacturer to the operator of the RPAS (54%), the majority of respondents agree that safety management systems of the operator are and effective tool to guarantee safety (75%). Respondents send a loud message of keeping safety rules proportionate to risk (93%) and with involvement of national authorities to issue authorisations for RPAS operations (78%). EASA, however, should be responsible for developing a common risk classification scheme (92%).

On security, only 41% finds that existing security rules can efficiently cope with threats. A small majority (59%) finds that closing gaps in safety rules would also improve security risk control, without having to introduce new security rules. In any case, the scope of EASA competence should be extended and the agency should integrate security considerations in its safety rules on RPAS (86%).

On the threat to privacy, a majority (68%) finds that the current regulatory framework is sufficient to deal with privacy issues and that national data protection authorities should remain responsible for effective enforcement of the right to privacy (76%). On the other hand, there is need for cooperation between civil aviation authorities and data protection authorities (79%) including data enabling identification of an RPAS operator. The need for specific data protection rules does not get a large majority (55%), but an overwhelming majority (88%) see the ability to identify the operator as the key to protect privacy.

The effectiveness of the policy options (Questions 90-145) [145]

The respondents assess the possible impact of the four identified policy options on the development of RPAS market and its potential to create jobs and growth. Doing nothing is not an option. The respondents rated the current situation as not satisfactory and gave weak support, with scores mostly between 30% and 40%. The second option – developing rules on the basis of current competences – gets some more support, mostly between 50% and 70%. The third option is rated as the most effective with support rates between generally 70% and 90%. The last policy option is also generally rated as effective, with somewhat lower ratings as for policy option three.

Table 9: Impact of policy option on policy objectives (PO)

Impact on:	**PO1**	**PO2**	**PO3**	**PO4**
Compliance costs for EU businesses	37	63	70	60
Compliance costs for national administrations	37	57	69	70
Compliance costs for EASA	35	57	56	47
Employment	43	69	87	78
RPAS market growth	41	70	87	79
Global competitiveness of EU operators	36	71	88	80
Global competitiveness of EU manufacturers	38	71	89	80
Innovation	43	74	89	81
Security	33	68	90	87
Safety in the airspace	34	69	89	86
Safety on the ground	32	66	88	85
Privacy protection	29	53	81	78
Citizens' trust in RPAS operations	29	60	89	84
Natural environment	38	60	78	75
AVERAGE IMPACT SCORE	**36.07**	**64.86**	**82.14**	**76.43**

Conclusions

In line with the conclusions of numerous conferences and studies, this public consultation with 253 respondents endorses all the more the need for urgent action at the EU level to tap the potential of RPAS. The contribution of RPAS technologies to jobs and growth is confirmed, for all ranges of RPAS.

The consultation confirms the view that the full range of RPAS is ready for development and that legal & technological uncertainty impedes a swift development. Specific authorizations and fragmentation are a real burden. Respondents identify safety and privacy as the most important concerns – which can be managed with an appropriate regulatory framework which keeps rules proportionate to risk and with a strong role for national authorities.

The current division of 150kg is generally deemed obsolete and EASA is to come up with a risk classification scheme where risk is made dependent on a range of factors. For security or privacy the consultation does point to the need for new rules, but more to a better application of existing rules, with a closer collaboration between CAA and national data protection authorities.

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145 The given percentage here refers to the number of respondents indicating a mixed and positive impact, relative to the total number of substantive answers.

The policy option with common safety rules and local application, together with improved implementation of security/privacy legislation is clearly considered as the most cost-effective way forward.

ANNEX IV: APPROACHES TO DRONE REGULATION

IV.1 Drones in the EU Member States

Today, every EU Member State has some drone activities, both for manufacturing or for operations. Only in Member States with drone legislation the (operating) activities are legal – unless an exemption was granted (based on the ICAO rule that all operations performed by unmanned vehicles must obtain a specific authorisation).

EASA is the competent authority for drones with an operating mass of more than 150 kg. For lighter drones a limited number of Member States has adopted drone rules – most have not. This fragments the European market. France has most approved operators: more than 1,000 on a total of about 2,500 EU operators. There are more than 100 RPAS manufacturers of very small to small drones with a weight below 150kg.

For drones above 150 kg EASA is currently working with two applications for certification:

- Camcopter S-100 rotorcraft from Schiebel (Austria)
- Atlanta aeroplane from Airbus D.S. (Spain)

Although there are no civil certification specifications for drones as of today, the Agency is working with the applicants to define a certification basis proportionate to the risk of the intended operations, the "operator-centric" approach – away from the "aircraft centric" approach.

IV.2 Drones in the world.

The US is generally seen as the leading drone country (followed by Israel). That is true for military drones (more than 7,000 – with substantial operational expertise in segregated airspace). Europe is a leader in civil drone operation when comparing the 2,500 European operators to the 2,342 operators in the rest of the world (of which 2,000 in Japan).[146]

1) Japan: With more than 2,000 operators and 20 years of experience, mostly for crop spraying drone civil operations are nearly exclusively used in precision farming. Japan was the first country to allow such farming activities in the mid-nineties and the number of operators boomed in a few years' time.

2) Israel: A very active manufacturing industry but focused on military drones. Thanks to the integrated civil-military air navigation services, drones can more easily be integrated in the airspace.

3) US: The FAA has already certified two models in the restricted category for aerial survey. Each operation requires a Certificate of Authorisation (COA) for public entities (e.g. Law enforcement, Universities, Military) and of exemption for commercial activities (around 30 are published). The first exemption was granted for an operation … above the Arctic. Most

146 Some sources put the number of approved Japanese operators at 14,000 (See Frost&Sullivan (2015);

exemptions were granted for oil and Hollywood companies; On 15 January 2015 the FAA published its long awaited Notice for Proposed Rulemaking for small drones (less than 25kg).

4) Others / mil /civil: Australia, China (many of the very small drones are manufactured in China) and South Africa are other active countries. Actually many countries (around 55) are developing drones because the technology does not necessitate heavy investments.

IV.3 How EU members and non EU members deal with drones – regulations.

Drone regulations and operating rules are in place in Austria, Czech Republic, Denmark, France, Germany, Ireland, Italy, the Netherlands, Poland, Spain, Sweden and the UK. There are approved flight schools in Denmark, UK and Netherlands and more than 500 approved drone pilots in the Netherlands and UK. [147]

All drone rules in place in Europe are tailored to the risk of the operation. Rules are "operator centric" instead of the classical "aircraft centric" approach of manned aviation. This shift in paradigm is necessary as the same drone can pose a different risk to third parties if it is operated on top of a football stadium or in the middle of the desert. The risk not only depends on the kind of machine, but on many more factor, like the area overflown, the expertise of the operator, the specific type of operation, etc.

For higher risk operations the Swiss FOCA developed a specific risk assessment process (GALLO). The process includes a total hazard and risk assessment to be approved by the authority and user friendly templates and guidance material. Austrocontrol and the French DGAC have similar processes with rules tailored to the risk of the operation. These examples of a practical approach are the stepping stones that the EU would use for developing its rules and processes.

The regulations already in place in a limited number of European States have allowed the - patchy - growth of civil operations in Europe. In countries like Switzerland the low risk operations like flying a two kg drone for video recording outside of the cities or populated areas and under direct visual contact of the pilot are open to small and medium companies without approval of the civil aviation authorities. The aviation authorities can concentrate their effort in the higher risk operations like flying over congested areas in cities, above crowds of people or far away from the pilots in line of sight. Self-declaration is also possible in other countries like in Spain.

Harmonisation of rules world-wide is very important. Two bodies deserve to be highlighted: ICAO and JARUS. ICAO is the world-wide organisation for Aviation and its standards and recommended practices (SARPS) are the basis for Member States rules. ICAO has set-up a specific panel to prepare such SARPS for drones where EASA and Member States are participating and have taken an active role. JARUS is a coordination body between National Aviation Authorities (EASA, EUROCONTROL and 18 of the EASA Member States are in there but also USA, Russia, etc.). JARUS is chaired by EASA and we plan to use JARUS to do the ground work and prepare rules that can in turn be proposed to ICAO and, to EU and other countries for adoption. One significant move for JARUS will be to incorporate Industry and the Military.

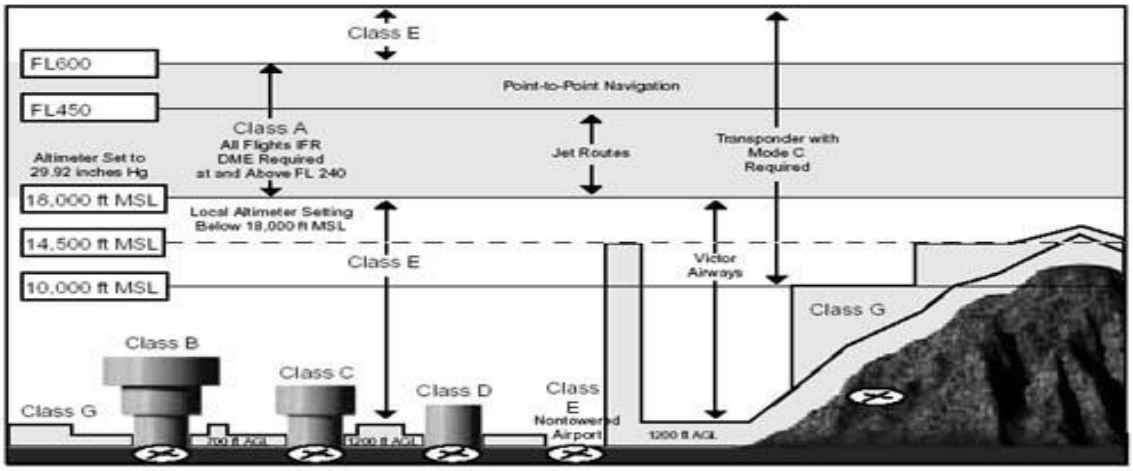
147 See higher table 2.

IV.4 How the airspace is shared among airspace users: commercial aircraft, smaller aircraft and drones – the importance of integration

Airspace is divided in several classes, from A to G. Class A is reserved for Instrument Flight Rules (mainly commercial air transport) where each aircraft receives air navigation service (i.e. an air traffic controller monitors all traffic in his zone under control). Classes B to D are given to the airspace in terminal areas. Class E is a kind of rest category – no air navigation services. Finally, Class G is in principle the lowest layers of the airspace, where each pilot has to watch for other air traffic (flying "Visual Flight Rules).

These classes start in principle as from 500ft. The airspace below 500ft has no rules – and hence would fit for (small) drone use. The integration of drones into the airspace has to be done in a different manner for the different classes of airspace and the different types of drone operation.

Graph 8: Overview of airspace classes



A flight in non-controlled airspace like class "G" under the direct view of the pilot (VLOS or Visual Line of Sight) has lower risk than the operation in the same airspace but far away from the pilots view (Beyond VLOS) because the class G airspace is used by general aviation aircraft and aerial work rotorcraft under Visual Flight Rules (VFR) and the separation with other aircraft has to be maintained by the pilot on board.

Most drone operations today in the EU ensure separation with other airspace users through the use of restricted airspace where only drones can be flown or keeping the drone at a maximum distance with respect to the pilot, under Visual Line of Sight (VLOS). This separation with respect to manned aviation has to be maintained unless it is demonstrated that the drone has the same capability to see and avoid other aircraft like the rest of aircraft with pilot on board can. The "see and avoid" technology is maturing and still needs validation. Hence the need to invest in the drone activities of the SESAR Joint Undertaking.

A stepwise approach is being followed in order to better understand the technology and ensure that the safety level of current manned aviation is not jeopardized. The ultimate goal is to fly drones under the responsibility of drone operators and cross borders in non-segregated airspace and over any populated territory.

Comparison US - EU

Approach / philosophy

military/security first	commercial/civil
tendency to give Drones specific treatment	Drones are aircraft and need to be fully integrated into the aviation system
strong vested interests approach (insider/outsider approach)	Drones will encompass, eventually, all aviation hence, drone is insider
US centred (as always)	open and internationally minded

R&D

Drones are linked into NextGen	Drones are fully integrated into the ATM Master Plan No specific Drone programme

Rulemaking

Preparation JARUS follower	Pro-active in JARUS
FAA rules (monopoly)	Combination national - EU rules Current patchwork of national rules EU rules under development EU law Commission implementing rules EASA guidance
Standards adopted by RTCA (but: not known how substantial)	EuroCAE is struggling and needs push

Timing

2015 as official deadline	2016
Delay already admitted	As from…

Operations

Military: 7,000 RPAs	???
State aircraft: ??	???
Commercial?	2,500 official operators – and growing 1 operator allowed to operate…..in Alaska Now several more: oil and film (biggest pockets)
6 US testing sites (Dec 2013)	Several testing sites, already for years incl. UK & ES.

The publication of the long awaited Notice for Proposed Rulemaking for small drones (below 25kg) on 15.01.2015 should be considered in this overall approach and philosophy. Firstly, this is just a consultation – not the publication of the rule itself. Secondly, the comparison shows that the FAA is not very favourable to smaller drones. That is well reflected in the

quite severe treatment of small drone – where the EU thinking is much more open towards the "open" category of low risk drone operations:

Pilot licence required

- No fly above people (not practical for flying in cities, the operator will have to fence the area overflown)
- Max speed and max. weight (we propose a max. weight + industry standard)
- No flights at night (in my opinion a drone could be seen at night better than during the day if it has enough lights and there are less airspace users)
- No objects can be dropped (no Amazon deliveries). We have not mentioned anything about dropping cargo, it might be better to drop rather than to land in bad weather.
- Aircraft must be registered

Also interesting:

- Wording: The pilot is called "operator", the machines are called "UAS".
- Max. weight is 25 kg with a micro UAS category up to 2 kg.

In all, the FAA has now shown its cards. The restrictive approach towards the small drones however does not mean that the US is unfavourable to drones in general. *It may be expected that the US will work hard to get bigger drones integrated in their national airspace system very soon.*

IV.5 Safety rules

Drones are aircraft – according to the ICAO. This means that the aviation rules apply to drones and drone operations. Safety rules allow aircraft to operate. This first part of this annex therefore focuses on aviation safety. The other part discusses environmental rules – some of which fall under the EASA remit.

Regulation (EC) 216/2008 – and EU rules in general – were principally conceived for "manned" commercial air traffic, as derived from the Chicago Convention, establishing ICAO and the current international aviation regulatory system in 1944. The conventional approach is based on the technologies developed after WWII. The system was able to cope with the major advance in aviation engineering and technologies, like progress in navigation[148], cockpit automation and the dramatic improvement in engine reliability. These technologies resulted in far higher reliability, safety records and a reduced number of crew in the cockpit, reducing from five in the fifties (two pilots, navigator, flight engineer and communicator) to the current number of two pilots, whose tasks are becoming more and more automated. The ICAO approach was taken over in European rules initially conceived for the A380 certification and then extended to other areas coming under EU and EASA competence.

Regulation (EC) 216/2008 is completed by other legal instruments, where the most relevant in the safety area are: (1) rules of the air, which regulate how aircraft can safely fly (based on

148 Even on the first jet powered commercial aircraft like the 707 in the 1950s required a four-crew cockpit with two pilots, an engineer and a navigator. An observation dome for star sightings assisted with navigation.

Single European Sky) [149]; (2) rules on accident investigation [150]; (3) rules on incident reporting [151] – how can we learn from safety lessons drawn from reported incidents.

The limits and the disproportionate effects of EASA detailed rules were highlighted when EASA rulemaking was extended to General Aviation, the sector of smaller aircraft, many of which are flown by their owners. "Traditionally much regulation has been blanket regulation, which aimed to cover all possible risks by saying something about everything although the vast majority of fatalities are caused by a small set of recurring causes." [152]

For general aviation, the blanket rules and their application "has led to a situation where persons participating in aviation only occasionally in their free time cannot actually remember all the rules, nor do they consider the majority of rules relevant to them." [153] The result is a culture of indifference and non-compliance. The Commission and EASA have accepted the limitations and have since 2012 started a process of simplification of rules and procedures to keep rules proportionate, to reduce the red tape of regulation and let safety oversight concentrate on the highest risks. [154]

IV.6 Insurance and liability rules

The study on liability and insurance requirements [155] confirms that general national liability laws cover drone operations. There is no harmonized liability framework in the EU. Damage caused by drones to third parties depends on national rules. Strict liability rules (i.e. the operator is liable without that the victim must demonstrate the fault) exist in the majority of EU states. For insurance, EU rules require drone operators to be sufficiently insured on basis of Regulation EC/785/2004. [156] This regulation offers a sufficiently functioning framework for insurance for drone operations. The problems encountered in practice concern the identification of the operator in case of an occurrence and the verification whether the operator was (sufficiently) insured. It may take a long time for victims to receive their compensation.

The study makes some practical suggestions, such as the need to ensure an adequate marking of the drone (e.g. fire-proof plate identifying the operator and/or the manufacturer) in order to ease the identification of the liable party, or a common insurance fund in case of an incident with an operator without insurance.

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149 Commission Implementing Regulation (EU) No 923/2012 of 26 September 2012 laying down the common rules of the air and operational provisions regarding services and procedures in air navigation and amending Implementing Regulation (EU) No 1035/2011 and Regulations (EC) No 1265/2007, (EC) No 1794/2006, (EC) No 730/2006, (EC) No 1033/2006 and (EU) No 255/2010

150 Regulation (EU) No 996/ of the European Parliament and of the Council of 20 October 2010 on the investigation and prevention of accidents and incidents in civil aviation and repealing Directive 94/56/EC

151 Regulation (EU) No 376/2014 of the European Parliament and of the Council of 3 April 2014 on the reporting, analysis and follow-up of occurrences in civil aviation, amending Regulation (EU) No 996/2010 of the European Parliament and of the Council and repealing Directive 2003/42/EC of the European Parliament and of the Council and Commission Regulations (EC) No 1321/2007 and (EC) No 1330/2007 Text with EEA relevance OJ L 122, 24.4.2014, p. 18–43

152 EC an EASA, "Roadmap for regulation of general aviation", Working Paper for EASA Committee, 18 November 2012.

153 IBIDEM.

154 See EASA website on the GA Roadmap.

155 Steer Davies Gleave (2014).

156 Regulation (EC) No 785/2004 of the European Parliament and of the Council of 21 April 2004 on insurance requirements for air carriers and aircraft operators

IV.7 Product safety rules

Introduction

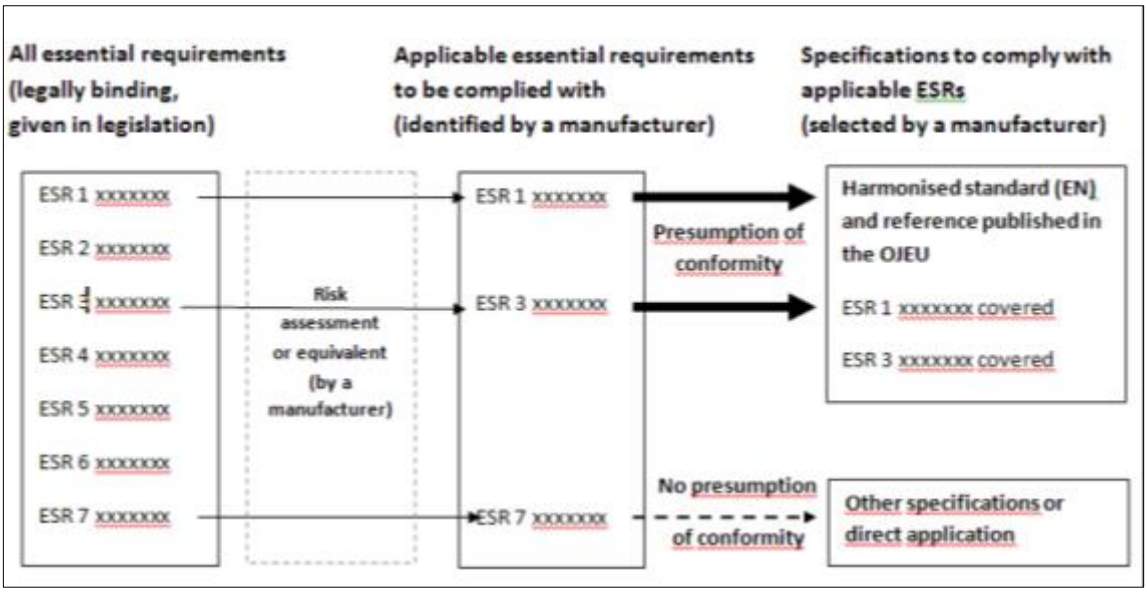
The Union Product legislation addresses product safety and other requirements insuring protection of people health. However, this legislation applies only from the moment a product is placed on the market until it reaches the end-user. Any operation or transaction by the end-user involving the product is not subject to Union harmonisation legislation. This means that this legislation can only contribute to ensure drone *airworthiness* for the operations presenting the lower risks. It must be combined with aviation rules addressing the safety of the flight to ensure the overall safe *operations*.

The Union harmonisation legislation presents the advantage that the certification of conformity falls under the responsibility of the manufacturer and not the authorities (like in general in aviation). Several legislations exist at EU and national levels to ensure that products placed on the market meet high safety, health, and environmental protection requirements.

In order to support the development of the Single Market and removal of barriers to trade, national rules have been harmonised in a number of sectors through the adoption of sector specific directives (Union harmonisation legislation).

Following the "New Approach" these directives only define essential requirements. In order to facilitate the presumption of compliance with these requirements, EU harmonized standards may be developed to define technical specifications of products that will benefit from an automatic presumption of compliance against the essential requirements covered by these standards, once published in the OJ. Compliance with harmonized standards is, however, not mandatory and other means of compliance may be used.

It is up to the manufacturer or his authorised representative (importer, etc.) to certify the conformity of its product with the relevant essential requirements of the applicable legislation. To demonstrate the conformity of its product with those essential requirements he must undertake a conformity assessment procedure, the first step of which consists in a risk assessment.



The conformity assessment procedure is defined in the legislation for each type of products. In case of low risk products or products manufactured according to EU harmonised standards this procedure can be limited to the establishment of a technical file. In other cases it may

require undertaking an EC type-examination procedure or a full quality assurance procedure with the involvement of a notified body.

Compliance with EU Product legislation is indicated by the CE marking. EEA states are not allowed to restrict the placing on the market of CE marked products, unless such measures can be justified on the basis of evidence of the non-compliance of the product.

As a general rule:

1) EU Product legislation does not apply when more specific legislation exists at EU level (however specific exemptions might be required in the legislation);

2) EU Product legislation applies when the product is placed on the market and to any subsequent operation which constitutes making available until it reaches the end-user. , **Any operation or transaction by the end-user involving the product is not subject to Union harmonisation legislation**.

Analysis of the relevant legislation

The following EU Product legislation might be relevant to drones:

a) General product requirements:
   - Outdoor Noise Directive 2000/14/EC
   - Radio Equipment Directive (RE) 2014/53/EU
   - Electromagnetic compatibility Directive (EMC) 2014/30/EU

b) Product safety requirements:
   - General Product Safety Directive (GPSD) 2001/95/EC to be replaced by a Consumer Product Safety regulation (CPSR)
   - Machinery Directive 2006/42/EC
   - Toys Safety Directive 2009/48/EC

Radio Equipment Directive (RED) 2014/53/EU[157]

Objective and scope

The aim of this directive is to protect the health and safety of the population with respect to electromagnetic emission, to ensure electromagnetic compatibility and harmful interference of radio equipment and an efficient use of radio spectrum (essential requirements, Article 3). The directive explicitly excludes airborne products falling within the scope of the Basic Regulation 216/2008/EC. The Directive will be complemented by delegated acts that define the essential requirements applicable to each category of products.

Relevance for drones

The Directive will apply to drones below 150 kg.

[157] Directive 2014/53/EU will be applicable as of 16 April 2016. Before that date the applicable requirements will be defined in the EMC and in the LVD

Electromagnetic Compatibility (EMC) Directive 2014/30/EU[158]

Objective and scope

The EMC Directive requires all electrical and electronic devices or installations to reduce the interference and disturbance with other equipment and to enhance their immunity. The directive explicitly excludes aeronautical products, parts and appliances which are covered by the Basic Regulation 216/2008/EC, from its scope.

Relevance for drones

The Directive may apply to drones below 150 kg, insofar as these are not covered by the Radio Equipment Directive.

Low Voltage (LV) Directive 2014/35/EU[159]

Objective and scope

The LV Directive ensures the protection of citizens from risks of electrical equipment with a voltage between 75 and 1500 V (direct current). It covers all health and safety risks of relevant equipment. The directive explicitly excludes specialised equipment for use on aircraft which complies with safety provisions drawn up by international bodies. For lower voltages the risks related to the use of electrical equipment are regulated under the General Product Safety Directive.

Relevance for drones

None, as far as the same risks are already covered by the Radio Equipment Directive.

Machinery Directive

Objective and scope

The overall objective of the Machinery Directive is to permit the free movement of machinery within the internal market, whilst ensuring a high level of protection of health and safety. It defines the essential health and safety requirements of a wide range of machines, parts and components. It formally excludes means of transport by the air.

Relevance for drones

158 Directive 2014/30/EU will be applicable as of 20 April 2016 and repeal Directive 2004/108/EC

159 Directive 2014/35/EU will be applicable as of 20 April 2016 and repeal Directive 2006/95/EC

In a first consultation, members of the Machinery Committee considered [160] that drones below 150 kg may be covered by the directive. Further clarification has been requested, which will also consider the applicability to remote control stations and possible gaps of essential safety requirements as currently formulated under the Machinery Directive.

Outdoor Noise Directive

Objective and scope

The aim of this directive is to protect citizens from noise emitted by specific types of equipment. It sets noise emission limits and provides a noise labelling obligation. The directive applies to a limited list of equipment, mainly outdoor machinery.

Relevance for drones

This directive does not apply to drones. The Commission has launched a study to assess a possible revision of the noise requirements and the types of equipment covered. Any change of these provisions will require the agreement of the co-legislator.

Toy Safety Directive 2009/48/EC

Objective and scope

The Toy Safety Directive lays down requirements for the safety of toys and applies to products designed to be used, whether or not exclusively intended for playing purposes, by children below 14 years. Annex I of the directive lists specific toys which are excluded.

Relevance for drones

The Toy Safety Directive does not specify whether drones are covered or not, but it can be reasonably assumed that only a limited number of very light drones of simple design do meet the definition of a toy.

General Product Safety (GPS) Directive 2001/95/EC

Objective and scope

The GPSD imposes general safety obligations which must be respected for many consumer products: "Economic operators shall place or make available on the Union market only safe products". It also establishes a market surveillance system which is tracking down and eliminating unsafe products from the European market.

On 13 February 2013 the Commission has proposed its revision[161] of this Directive in order to respond to the challenges of an increasingly global market and the need for further coordination and strengthening market surveillance activities.

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160 See minutes/opinion of the Machinery Committee as of …2015

161 COM(2013)75 final, Product Safety and market surveillance package

Relevance for drones:

Drones up to 150 kg are covered by the GPSD to the extent that the relevant risks are not covered by other EU harmonisation legislation. In return those risks which are covered by other specific harmonisation legislation, such as electromagnetic compatibility will not be covered by the GPSD.

ANNEX V – PRIVACY AND DATA PROTECTION RULES

Privacy is a broad concept referring to the right not to be observed in his/her own private life. Most drones operations (not only those involving personal data acquisition) run the risk to infringe this right. The simple fact that people see a drone operating close to them without knowing who operates it and for what purpose may create a change in their behaviour and hence infringe their right to privacy.

Privacy and data protection are two distinct but interconnected rights enshrined into the European law. The regulatory framework for privacy and data protection existing at EU level applies to drones. It is technology neutral to be able to cope with the constant evolution of technology. At national level, some Member States are considering the need to adapt some of their more specific privacy regulations (like the one on video surveillance or CCTV).

A dedicated study on privacy [162] concludes that the European and national regulatory frameworks in place are largely adequate to address the privacy, data protection and ethical impacts of drones. The problem is not the lack of rules but rather raising awareness of the drone industry about their obligations to protect privacy and about enforcing the existing regulatory mechanisms.

This view is supported by stakeholders views expressed in the public consultation which point that for privacy there is no need for new rules, but rather a better application of existing rules, with a closer collaboration between the civil aviation authorities and national data protection authorities.

In addition according to the Opinion of the European Data Protection Supervisor (see box below) "RPAS uses involving the processing of personal data constitute in most cases an interference with the right to the respect for private and family life … as they challenge the right to intimacy and privacy guaranteed to all individuals in the EU and can therefore be allowed only under specific conditions and safeguards. In any event, whenever personal data are processed by RPAS operated in the EU, which is common, the right to the protection of personal data … applies and the EU legal framework for data protection should be complied with".

In consequence, the use of drones for civil purposes must comply with fundamental rights to privacy and data protection and the related regulatory framework.

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162 See Trilateral Research (2014).

Box 8: The current privacy and data protection regulatory framework

Article 8 of the Council of Europe Convention on Human Rights ("ECHR") and Article 7 of the Charter of Fundamental Rights of the European Union ("the Charter") explicitly recognise everyone's right to respect for private and family life, home and communications. No secondary law exists at EU level concerning privacy, but Member States have developed legislations to cover specific areas (like video surveillance or CCTV). These legislations reflect the specificities of the national approaches to these different subjects.

Article 8 of the Charter recognises additional rights concerning to protection and processing (consent, access, rectification, fair processing, etc.) of personal data. More detailed rules on data protection are laid down in EU secondary legislation:
- the Data Protection Directive 95/46/EC which will likely be replaced by the proposed General Data Protection Regulation (GDPR)
- the Council Framework Decision 2008/977/JHA20 on the protection of personal data processed in the framework of police and judicial cooperation in criminal matters which might be replaced by a directive;
- and Directive 2002/58/EC concerning the processing of personal data and the protection of privacy in the electronic communications sector (Directive on privacy and electronic communications)

The application of the provisions adopted by the Member States pursuant to this Data Protection Directive is monitored in each Member States by the national Data Protection Authority (DPA). The DPAs gathered at EU level within the Article 29 Working Party has adopted an opinion on drones (1673/15/EN, WP 231). On its side, the European Data Protection Supervisor (EDPS) has adopted an opinion[163] *on drones in November 2014.*

163 EDPS Opinion of 26 November 2014 on the Communication from the Commission to the European Parliament and the Council on "A new era for aviation - Opening the aviation market to the civil use of remotely piloted aircraft systems in a safe and sustainable manner"

ANNEX VI : OVERVIEW OF MARKET DEVELOPMENTS AND MARKET STUDIES

VI.1 Overall developments

The development of drones started in the 1950s. Drones have been used by armed forces for decades. Recent conflicts and peace-keeping operations around the world have demonstrated their operational capacities and led to a quasi-exponential increase of military applications. Drones have become a crucial pillar for military activities. The European Summit of 19 December 2013 on the future defence policy called for enhancing Europe´s military capability including through regulatory as well as research and development activities.

But the civil applications involving drones have even bigger potential and it is expected that in the coming years civil applications will dwarf military ones.

Being remotely piloted, drones can perform tasks that manned systems would not be able to perform. They are well suited to perform long monitoring tasks (e.g. > 24 hours) or risky flights into ash clouds or in proximity of nuclear or chemical plants after major incidents. Drones can efficiently complement existing infrastructure (manned aircraft or satellites) to support governmental applications like crisis management, law enforcement, border control or search and rescue and firefighting. Drones can also deliver profitable commercial aerial services in various areas. Applications are, for instance, emerging in precision agriculture and fisheries, power/gas line monitoring, infrastructure inspection, communications and broadcast services, wireless communication relay and satellite augmentation systems, natural resources monitoring, media/entertainment, digital mapping, land and wildlife management, air quality management/control. Hundreds of potential civil applications have been identified[164]. Like the mobile phone, which was transformed from a communication device into a multi-service tool, the drones should be understood as a crossroads of innovation, which may lead to applications which are now difficult to imagine. Therefore, many more are expected to emerge once the technology is widely disseminated. Creativity, innovation and entrepreneurship will play a major role in the development of commercial aerial services.

The key technology for drones is in fact a combination of lighter materials, greater processing power, access to data, and progress in sensor capabilities. These technologies are also being used in manned aviation, where the next phase of automation is possibly the single-pilot operation. Eventually, drone technologies will feedback to manned aviation, which could, eventually, become unmanned.

In any case, drones make many more types of operations possible. As the small drones tend to gain in capability, these may take niche markets from incumbent aircraft operators or create new services, and may slowly enter the market of traditional aircraft manufacturers or operators. So could it be envisaged that smaller drones for cargo are developed, which are much quieter and hence able to also operate during the night at airport under night curfew.

The drone market is divided into the market of the platform, the aeronautical software (like navigation, surveillance, communication, stabilisation, localisation, detect and avoid, etc.), the payload (today mostly sensors), operations, and ancillary services, including training. As drone technology determines the direction of the aeronautical industry, it directs a sector of €140 bn and 500,000 European jobs (2013 figures). In addition, it may be expected that drone

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164 See "UAS Panel Process - Workshop 1 - Discussion Paper", UAVSI, Annex 5 and EC/EDA high level conference held on July 1st 2010.

operations will cover a much larger field of aerial activities than currently is the case. Aeronautical activities will also become integral part of many other industries like media, infrastructure surveillance and inspection, farming, construction, and many more.

VI.2 What is the advantage of drones today and in the future?

Today drones can already replace manned aviation when the risk of the operation is too high and cannot be mitigated by other means. Drones can be operated in contaminated or dangerous airspace, for example to gather data and support the first reaction after a catastrophe like a nuclear accident or an earthquake. They can also reach remote areas where terrestrial means of transport do not exist or are damaged and also places where normal aircraft cannot operate due to their size or performances.

Because UAVs are not burdened with the physiological limitations of human pilots, they can be designed for maximized on-station times. Additionally, drone pilots or operators can easily hand off controls of a drone without any operational downtime.

In the future the use of drones can reduce the cost of transport by air. Drones operated as freighters carrying high payloads at a lower cost reducing also the impact on the environment are becoming possible in the medium term; drones carrying small packages for the “last kilometre” could come soon (Experiments in France and Germany, Amazon plans its “Prime-air deliveries in the “near” future)

Drones may also be used as surrogate satellites (High altitude 20km) flying drones that can fly for days) in order to ensure full world Internet coverage (as promoted by Google and Facebook). Eventually drone technology will spin-off to manned aviation, where the “pilot” would be assisted by sophisticated automation or where the aircraft becomes fully automated.

Graph 10: A picture of the international supply of drone technologies

Source: Frost&Sullivan, 2015. [165]

From the demand side, EU companies want to use drone services to control costs or offer innovative services. From both demand and supply side, there is a strong European and/or global dimension. That statement is not only true for commercial users, but for all European citizens, who may buy through the internet on the global market.

Graph 11: A picture of the international demand for drone services (Unmanned Aerial Systems)

Commercial Uses for UASs

Fish and game monitoring/research	Aerial video/photography	Radiation measuring/atmospheric sampling
Oil pipeline inspection	Traffic/crowd monitoring	Search and rescue
Electrical wire monitoring	Small package delivery	Tunnel detection
Infrastructure inspection	Terrain mapping/surveying	Protection from MANPADS at large airports (Project Chloe)
Searching for natural resources	Construction site survey/monitoring	Charging wireless devices
Wildfire detection/suppression	Environmental monitoring/protection	Airborne wi-fi
Storm/natural disaster damage assessment	Archeology	Communications relays and temporary communications during outages
Man-made disaster damage assessment (i.e., oil spills)	Volcanology	Coastal/beach monitoring
Environmental change detection (floods, ice flows, erosion, etc.)	Atmospheric monitoring and measuring	Mineral detection
Flood potential monitoring	Hurricane monitoring/prediction	Avalanche monitoring/rescue
Meteorological study	Environmental rule compliance	Mining applications

Source: Frost&Sullivan, 2015.

165 Many consultants are closely following the drone market. This report regularly refers to a recent presentation of Frost&Sullivan that produced already in 2008 a report on the emerging drone market for the Commission – see Frost&Sullivan 2008.

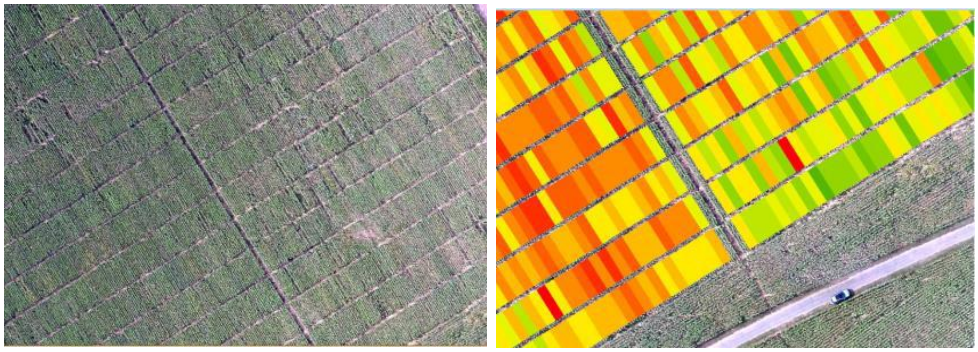
Box 6: Global market general overview: [166]

The US is strong with regard to military drones, where the US Army was an early adopter of the drone technology. The US is weaker with regard to commercial operations: the FAA still works on the basis of an exemption process. Some US companies therefore already developed their operations outside the US.
Africa has a great potential for drones, including for border patrol, wildlife conservation and agriculture.
The Asian and Pacific region has the highest number of commercial operations, especially thanks to the developed Japanese agriculture market. Australian and New Zealand markets are catching up fast, also due to the liberal rules.
The Middle East is transitioning from a drone purchasing region towards a drone developing region with strong industrial capabilities.
South American countries are steadily building indigenous drone capabilities. Brazil is the most active market.
Europe has a robust manufacturing capability, but "politics and red tape" can harm drone manufacturing and integration decisions.

Box 7: The productivity boost through precision agriculture

Farmers are confronted with ever pressing environmental requirements which impose a limited use of fertilizer or pesticides. This makes that some diseases can no longer be treated in the conventional way. Drones offer a way to apply precision farming, where the regular and detailed monitoring of crops allows for in immediate and dosed intervention, only where necessary. Affected crops could be immediately treated or out rooted. Precision agriculture based on drones produced evidence is expected to substantially improve productivity.

So could drones provide readily available information with a precision of a few centimetres on the growth evolution of plants, which enables the farmer to take immediately remedial action.



Source: Trimble

The development of drone technologies is supported by a dynamic industry. More than 400 drone developments across 20 European countries have been identified[167] involving companies of all sizes, from global aerospace and defence industries producing large systems for military and state applications to start-ups and SMEs developing small systems for commercial or corporate applications. The structure of the industry reflects the wide range of systems varying in size and performance (from the size of an Airbus 320 to a few grams).

166 See Frost&Sullivan, 2015.

167 See "UAS Panel Process - Workshop 1 - Discussion Paper", UAVSI

The development of large drones (>150 kg) has been the most dynamic growth sector of the aerospace industry[168] during the last decade. Drones technologies are a source of important spin-off to civil aviation and a key element of the future aeronautics sector. Presently, the U.S. and Israel dominate the sector although also other non-European countries show great potential to becoming strong competitors. The European aeronautics industry is still lagging behind and must quickly catch up to be able to compete on this global emerging market.

Drones are themselves multi-systems and involve a great variety of equipment and payloads. Beyond the RPAS manufacturers and system integrators the drone industry also includes a broad supply chain providing a large range of enabling technologies (flight control, communication, propulsion, energy, sensors, telemetry, etc.). The development of drone technologies is likely to create spin-offs with significant impact in many sectors.

SMEs represent more than 80% of the companies involved in the development, manufacturing and exploitation of light drone. Hundreds of developments of light drones (<150 kg) are currently on-going, often driven by start-ups, and associated with concrete applications. The expansion of the drone sector is actively supported in a number of European regions[169]. Boosted by local initiatives and policies, the cooperation between large industries, SMEs, research organisations and academia (universities) allow the development of local networks of drone expertise. Finally, innovative aerial services will help their customers to improve their own products and services or increase their own competitiveness. More than 400 drone developments across 20 European countries had been identified[170] in 2012 involving companies of all sizes, from global aerospace and defence industries producing large systems for military and state applications to start-ups and SMEs developing small systems for commercial or corporate applications. The structure of the industry reflects the wide range of systems varying in size and performance (from the size of an Airbus 320 to a few grams). This industry, part of it being unfamiliar with the aviation world, is looking to understand future regulatory developments before making further investments.

If their full potential is unleashed, drones are expected to bring important benefits to European citizens and the European economy as a whole – however, quantifying this potential is not so easy. The world market is forecasted to more than double by 2022 and represent by then $ 4,448 million per year. Europe would represent about 25% of the world market. [171] In terms of jobs, for Europe, employment is estimated to increase to about 150,000 jobs by 2050 in manufacturing [172] hence excluding drone operator services employment. In the USA, a study forecasts that in the first three years of integration of drones in the national airspace more than 70,000 jobs will be created with an economic impact of more than $13.6 billion. The number of jobs created through new drones activities in the US is estimated to exceed 100,000 by 2025. [173]

Drones therefore have a great potential to change the aviation landscape and society in general, provided that they have the proper regulatory framework to allow their development. Like any new technology, its uptake is expected to follow the typical S-curve, whose shape

168 World Unmanned Aerial Vehicle Systems Market Profile and Forecast, 2011 Edition, Teal Group

169 See for instance the AETOS cluster initiative supported by the French Aquitaine region

170 See "UAS Panel Process - Workshop 1 - Discussion Paper", UAVSI

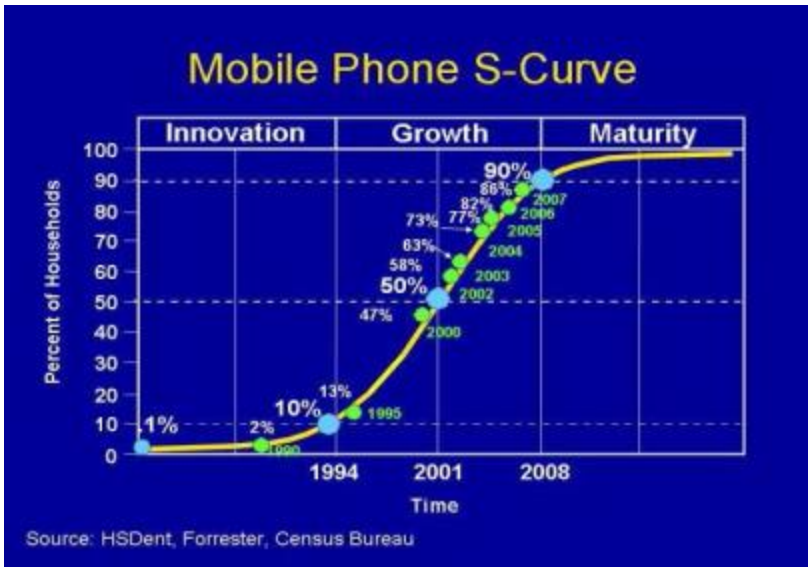
171 TEAL group 2013 Market Profile and Forecast

172 Estimate provided by ASD, the AeroSpace and Defence Industries Association of Europe.

173 AUVSI, (2013), *"The Economic Impact of Unmanned Aircraft Systems Integration in the US"*, 574p.

depends mainly on technological evolution, price and cost of major components, the regulatory framework and public acceptance.

Graph 13: S-shaped market development of new technologies



VI.4 Drone communication needs

A drone requires following communication links:

- Command and control link. Through which the drone is operated by the pilot sending commands to it. The pilot in command also receives information (control) about the status of the drone through this channel. It may be defined as a safety-critical system especially for the most stringent scenarios as those ones where the drone flies over population or surrounded by other airspace users. A safety-critical system may need to be protected in terms of frequency use.
- Payload link: The channel by which the payload information is and controlled. It will not be defined as safety-critical but protection may be needed against interception (data privacy) or jamming (security applications).
- Air Traffic Management related frequencies: ATC, ADS-B, detect and avoid, etc. The use of most of these frequencies is protected and reserved for aeronautical communications only. Drones, as any other airspace user, will just comply with the existing regulations for these systems though specific technical solutions and requirements may have to be defined.

Research is currently being carried out by SESAR Joint Undertaking to define precise requirements for all of these different links.

In general, national regulations in Europe for the use of civil drones do not define specific requirements in terms of frequency allocation. Requirements are specified in general terms, for instance, security[174] or integrity of the equipment.[175] Drones generally operate with open

174 "Spanish Estate official bulletin. Number. 163. 5th July 2014 Sec. I. Real Decreto-ley 8/2014, de 4 de julio, de aprobación de medidas urgentes para el crecimiento, la competitividad y la eficiencia"

frequencies as, for instance, aero-model tele-command frequencies or Industrial, Scientific and Medical (ISM) radio bands. These bands follow a regulation that defines maximum power emissions and the frequency band limits to use.

This is not enough for a wide, extensive and generalised use of drones in terms of Required Communication Performances and specially protection of spectrum in order to ensure no interference of the data link. Previous WRC12 and future WRC15176 has/will propose - regulatory means to facilitate the use of non-safety satellite service frequency bands for a very safety-critical application, the command and control link for drones in non-segregated airspace. Current R&D activities will identify the need of further regulatory measures for frequency allocation, especially for Line Of Sight (LOS) command and control link.

Aviation spectrum use: governance and legal requirements.

Aviation as a global and interoperable sector requires a harmonised allocation and use of spectrum. Two main international institutions have a role in regulating this at international level: ITU and ICAO.

The International Telecommunication Union (ITU), is a specialized agency of the United Nations (UN) that is responsible for issues that concern information and communication technologies. ITU coordinates the shared global use of the radio spectrum and assists in the development and coordination of worldwide technical standards. The ITU is active in areas including aviation. ITU also organizes World Radio-communication Conference (WRC) to review the use of the radio-frequency spectrum. It is held every three to four years. Last one was held in 2012. Next will be held in November 2015. UN Member States attend these WRC's.

ICAO aims at protecting aeronautical frequency spectrum for all radio communication and radio navigation systems used for ground facilities and on board aircraft. Therefore, ICAO defines its position at WRC's addressing all radio-regulatory aspects on aeronautical matters on the agenda. The ICAO Position for the ITU WRC's is developed with assistance of the Aeronautical Communications Panel (ACP) Working Group F (frequency). Member States and international organizations are requested to make use of the ICAO Position, to the maximum extent possible, in their preparatory activities for the WRC's at national level.

At EU level, The Network Manager, as one of its functions described in regulation 677/2011, will also provide the central function for the coordination of radio frequencies. NM is cooperating with the ICAO regional (EU) group, the FMG. DG MOVE can directly liaise with ICAO (in coordination with NM) to promote an EC position.

DG CNECT has the role of counsellor to CEPT ("Conférence européenne des administrations des Postes et Télécommunications") in which EU Member States (but also other states such as Russia) are represented. CEPT coordinates its MS's position to be submitted to ITU.

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175 "JOURNAL OFFICIEL DE LA RÉPUBLIQUE FRANÇAISE Texte 8 sur 308 10 mai 2012 2.6. Intégrité du système de commande et de contrôle de l'aéronef télépiloté"

176 ICAO Position for the ITU WRC-15. Agenda item 1.5

With this in mind, the way in which EC position in aviation frequency use can be represented at WRC is triple: through ICAO, through CEPT (both entities will promote EC position to corresponding MS) and directly through EU Member States.

At national level, the frequency managers, and/or ANSPs are in charge of ensuring that regulation is followed by spectrum users by providing access to it and monitoring its use.

VI.5 Overview of existing studies

Most studies focus on military applications and the manufacturing industry. In addition, they have a limited European coverage.

Frost & Sullivan

This study (Part 1, Part 2) was commissioned by DG ENTR in 2007. It is not as such a market study. It's main purpose is to identify the necessary actions to support the development of this technology in Europe.

Teal Group

1) Market forecast 2014 -2024 (1.995 $)

Teal publish a yearly update of their global market forecast. Mainly focussing on military; recent editions cover payloads as well. The general conclusions of this study are broadly shared by other studies.

2014: $6.4 billion
2024: $11.5 billion (doubling) , 86% military and 14% civil
Cumulative: $91 billion in the next ten years (89% military, 11% civil)
US will account for 65% of total worldwide RDT&E spending on UAV technology over the next decade, and about 41% of the procurement

Market and markets

2) UAV Market Forecast & Analysis to 2014 - 2020 (4.650 $) **10/14**

The Unmanned Aerial Vehicles (UAV) market research report includes the detailed study of the UAVs in the defence, commercial, and homeland security sectors. This report provides a detailed analysis of the UAV market, during the next six years. It discusses about the industry, market, and technology trends that are currently prevailing in the UAV market.

The UAV market report analysis categorizes the global UAV market on the basis of class, sub-systems, payloads, applications, funding, regional, and country analysis This study covers some European countries. It is interesting for its methodology, in particular segmentation of UAV classes and the choice of applications.

The UAV market over the next few years is expected to exhibit a robust growth of 7.73%, during 2014 to 2020. The global Unmanned Aerial Vehicle (UAV) market is valued at $6,762 million in 2014 and is expected to show a robust growth, reaching $10,573 million in 2020, thereby registering a CAGR of 7.73%, till 2020.

3) Small UAV Market - Market Forecast and Analysis (2014 – 2020) (4.650 $) 2/14

By Application (Military, Commercial & Civil, Homeland Security), by Payloads, by Propulsion System, by Geography

This report provides a complete analysis of small UAVs for civil, military and security applications for the next five years. It also gives insight into the regional trends for spending and analysing the market share. It provides in-depth analysis of small UAVs on the basis of various payloads used like nuclear, biological and chemical detection, meteorology, telemetry systems and camera systems. It talks about the leading competitors in the small UAV market and apart from the general overview of the companies; it also provides financial analysis, products & services, and key developments.

The global small UAV market is estimated to be $218.10 million in 2014 and is expected to be $582.20 million by 2019. The market demand for small UAV technology is increasing because it is considered as an effective, low-cost alternative to manned aircraft. The market overall has numerous players for mini UAVs from Europe and the U.S. The players from these regions have the technical know-how and have the capability to bring updated applications in the market. The current trend of the market is its transition towards faster and efficient payload systems that have the ability to reduce the weight of the UAV significantly.

Socolofi Research

4) International Military and Civilian Unmanned Aerial Vehicle Survey, 8/14 (840$)

The fourth edition of the annual International Military and Civilian Unmanned Aerial Vehicle Survey identifies, assesses and provides market intelligence on all of the world's operators and manufacturers of unmanned air systems with profiles for over 700 different UAVs aimed at the civilian and military market. Major programmes, requirements and other areas of relevance are assessed to provide a detailed picture of the development and operation of these systems.

Strategic Defense Intelligence

5) The Global UAV Market 2015-2025 , **1/15** (4800$)

The Global UAV Market 2015-2025 Report, provides readers with a detailed analysis of both historic and forecast global industry values, factors influencing demand, the challenges faced by industry participants, analysis of industry leading companies, and key news.

The Global UAV Market is expected to experience a CAGR of 5.66% during 2015-2025. North America and Europe are expected to be the largest UAV markets, with a cumulative market share of more than 67%. The UCAV segment is expected to dominate the UAV market, with a share of 34%

6) Current Trends and Future Business Dynamics – UAS, 5/14 ($)

"Current Trends and Future Business Dynamics - Unmanned Aerial Vehicles/Unmanned Aerial Systems (UAV/UAS)" is a new report by SDI that globally analyzes UAV/UAS industry demand prospects, key markets, top investment regions, major challenges. This report also examines trends which are currently affecting the industry. Furthermore, it highlights key application areas and identifies UAV types which are projected to witness increased investment.

Globally, demand for UAVs/UASs will increase by an average of 19% over the next five years. The highest percentage of industry players foresee the future of UAV/UAS shaped by usage in non-defence areas. 'Surveillance' will be the largest application area for UAVs in the military domain over the next five years. 'US', 'China' and 'Russia' will record highest increase in demand for UAVs over the next five years.

LUCINTEL

7) Global UAV Industry 2012-2017: Trend, Profit and Forecast Analysis, June 2012

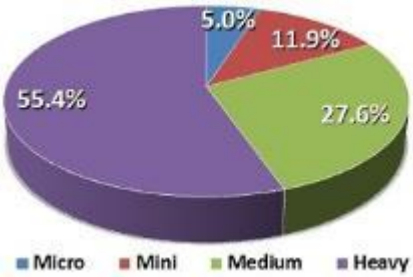
Study rather similar to the one from TEAL.

The global UAV industry experienced a robust growth over the last five years and is expected to continue its growth momentum reaching approximately US $10.7 billion in 2017.

Market info group

8) The Future of Unmanned Aerial Vehicles in Europe – Civilian and Military Market Outlook – 2013-2021, 10/12, (4.995 $)

This report analyses the state of Unmanned Aerial Vehicles (UAVs) in Europe with a focus on the defence and government applications market, and gives an overview of the future of private UAV markets. Specifically, the report examines, analyses, and predicts the evolution of technologies, markets, and outlays (expenditures) associated with UAVs manufactured and/or flown by these European countries: UK, France, Germany, Italy, Netherlands, Spain, Switzerland, Turkey, Sweden, Belgium, Greece, Romania, Denmark, Czech Republic, Finland, Bulgaria, Poland, Norway, Austria.
For each examined country, this report covers, in depth, these market sectors: Communications •Agricultural •Industrial •Fire Fighting •Border Control •Security and Law Enforcement
This work focuses specifically on benefiting government and private industry leaders who need to guide their institutions toward opportunity or away from risk. For their benefit, we include "Opportunity Alerts" in a number of places where such foresight will prove especially profitable.



UAVs in Europe – Military Market by Technology – 2020

9) Unmanned Aerial Vehicles (UAVs) for Commercial Applications Global Market and Technologies Outlook – 2011-2016 , 11/2010, (4.995 $)

This study is already a bit old but is focussed on commercial applications

Military and para-military applications for UAVs certainly came first and will remain the more mature for the next few years. But UAVs for Commercial Applications promise to soon generate an order of magnitude more economic activity than their

military predecessors. This report provides you with the data and analysis needed to understand a truly unique market. It does so by combining the background, technical explanations, government regulations and qualitative analysis that make the picture come alive. Readers benefit from realistic perspectives based on decades of front line experience. This is not the wishful thinking of industry associations. This insight produces three separate and plausible market Scenarios that, together, prepare readers for any likely market change over the next five years. The report covers all types of UAVs: •Stratospheric UAVs •Jet Stream UAVs •High Altitude UAVs •Medium Altitude UAVs •Low Altitude UAVs •Micro UAVs •Aerostats
The report identifies, analyses and forecasts these Commercial UAVs topics, among others: •Global On-Demand Imagery & Sensing Market •Global Persistent UAV Communication Market •Global Internet Access Served by Persistent UAVs Market Value by Region •Global Satellite Entertainment Revenue Forecast by Region •Payloads Overview and Analysis •Sensor Coverage Analysis •Suggested Operating Concepts •Market Forecasts by Market Sector •Market Forecasts by Region •IPTV Opportunities Analysis •Market Forecasts by Technology

Business Insider

10) THE DRONES REPORT: Market Forecast For The Growing Business Opportunity In Commercial Aerial Drones

The study predicts that 12% of an estimated $98 billion in cumulative global spending on aerial drones over the next decade (2013 – 2023) will be for commercial purposes.

WinterGreen Research

11) Commercial Drones Market (price 4.000 $) **1/15**

The study is designed to give a comprehensive overview of the commercial drone market segment. Research represents a selection from the mountains of data available of the most relevant and cogent market materials, with selections made by the most senior analysts. Commentary on every aspect of the market from independent analysts creates an independent perspective in the evaluation of the market. In this manner the study presents a comprehensive overview of what is going on in this market, assisting managers with designing market strategies likely to succeed.

Commercial Drones: Markets Reach $4.8 Billion By 2021

Visiongain

12) Small Unmanned Aerial Vehicle (UAV) Market 2014-2024 (price 4.000 $) **6/14**

Potential for Micro, Mini, Nano & Hand Held Drones in Military, Law Enforcement, Security & Civil Applications

The comprehensive report contains highly quantitative content, delivering solid conclusions benefiting your analysis and illustrating new opportunities and potential revenue streams to help you remain competitive. This definitive report will benefit your decision making and help to direct your future business strategy.

The small UAV market is likely to become one of the major economic and technological stories of the modern age, because of the wide variety of applications and the added value related to these unmanned machines. However, the world market for small UAVs is currently being restrained, largely by regulation of unmanned operations in civilian airspace. But impending regulatory changes are expected to unlock the huge potential of this technology. The report's analysis indicates that the small UAV market sector will reach $1.33bn in 2014 with significant potential for growth. Growth will be defined by the pace of development for UAV technology in the different countries, and will be driven by demand for small UAVs from across a range of lucrative sector applications.

13) Top 20 Unmanned UAS Companies 2014, 5/14 (2914$)

Although increasingly competitive, the global UAV market is currently highly consolidated with a few leading companies dominating global sales. Primarily this is a result of US dominance of the market over the past decade. However, incumbent positions are increasingly under threat from new and existing competitors offering a range of cost–effective UAV capabilities and innovative technologies. Considerable uncertainties will characterise the UAV market in the near future, especially regarding the uncertain legal and regulatory framework governing commercial UAV use.

AUVSI

AUVSI, the US industrial drones' association commissioned this study when FAA got the mandate to develop drones' regulation. It is limited to US and concludes that agriculture will be AUVSI's findings show that in the first three years of integration more than 70,000 jobs will be created in the United States with an economic impact of more than $13.6 billion. This benefit will grow through 2025 when we foresee more than 100,000 jobs created and economic impact of $82 billion. The study is however Contested.

Other market info

Small report UAV RoudUp 2013 ,
2015 CES Trends to Watch
National studies (ex: France and security market)

ANNEX VII– RIGA DECLARATION

RIGA DECLARATION
ON REMOTELY PILOTED AIRCRAFT (drones)
"FRAMING THE FUTURE OF AVIATION"
Riga - 6 March 2015

Today Europe is taking a decisive step towards the future of aviation. The European aviation community gathered in Riga to exchange views on how, and under which conditions, drones can help create promising new opportunities in Europe, offering sustainable jobs and new prospects for growth both for the manufacturing industry and for future users of drones in all sectors of society. Drones offer new services and applications going beyond traditional aviation and offer the promise to perform existing services in a more affordable and environmentally friendly way. They are a truly transformational technology.

The Latvian Presidency of the Council of the European Union, European Commission representatives, Directors General of Civil Aviation of the EU Member States, data protection authorities and leaders of manufacturing industry and service providers confirmed the importance of joint European action, building on the orientations given in the EC Communication on opening the Remotely Piloted Aircraft Systems (RPAS) market.[177]

The aviation community stressed the necessity for European regulators to ensure that all the conditions are met for the safe and sustainable emergence of innovative drone services. At the same time regulations must help the industry to thrive and adequately deal with citizens' concerns.

The aviation community established the following principles to guide the regulatory framework in Europe:

1. **Drones need to be treated as new types of aircraft with proportionate rules based on the risk of each operation.**

The provision of drone services must not be less safe than is accepted from civil aviation in general. The incremental integration of drones in the aviation system must not reduce the level of safety presently achieved in civil aviation. Although no-one is on board the drone, people in other aircraft or on the ground could get hurt in case of an accident or an unscheduled landing. The way safety is regulated must be proportional to the operational risk involved.

Rules should be *simple and performance based*, to allow a small start-up company or individuals to start low-risk, low-altitude operations under minimal rules and to develop, with light-touch risk-based regulation, similar to the modern product safety regulations applied in other sectors. Higher risk operations would be gradually subject to more stringent regulations or operational limitations. At the other end of the spectrum, where the operational risk is highest, such as with large drones operating alongside manned aircraft, the regulation will need to be quite similar to that applying to manned aviation, with strict standards on the

177 COM(2014)207 on a New era for aviation - Opening the aviation market to the civil use of remotely piloted aircraft systems in a safe and sustainable manner. See also the EESC opinion TRAN/553 of 15 October 2014.

design, manufacturing, maintenance and operation of drones, as well as on the training of drone pilots and maintenance personnel.

2. **EU rules for the safe provision of drone services need to be developed now**.

Safety rules, including on remote pilot and operator qualifications, should be developed at the European level by the European Aviation Safety Agency, building on the experience developed in the EU Member States. The essential requirements should be *harmonised at the global level* to the maximum extent possible, and full use should be made of the established cooperation in the Joint Authorities for Rulemaking on Unmanned Systems (JARUS) and at ICAO, and should be completed by international industry standard setting bodies. Important efforts need to be put into resourcing these activities, especially JARUS, in order to ensure that the progressive risk-based approach is consistent with what is done in the rest of the world.

This basic regulatory framework should be put in place without delay, in order to help the private sector to take well-informed investment decisions, and to provide a basic set of rules for the many operators who are increasingly eager to begin providing services. The *European Aviation Safety Agency* should consult stakeholders by the middle of 2015 on the regulatory framework for the operations of drones and on concrete regulatory proposals for low-risk operations. *By the end of 2015*, the Agency will use the results of the consultation to propose a position on these matters. The proposal for the revision of the basic European Safety Regulation, which the European Commission has announced for 2015, should contain the necessary new provisions and essential requirements for the progressive risk-based regulation of drones, based on the Agency's recommendations.

3. Technologies and standards need to be developed for the full integration of drones in the European airspace.

The success of drone activities and safety regulations also depends on the financial effort to develop and validate key missing technologies and the ensuing required standards. Both industry and public authorities stressed the need for *adequate investment* in the technologies that are required to integrate drones into the aviation system – the SESAR programme. CleanSky and other initiatives should complete the SESAR investments. That would create spin-off benefits for traditional aviation and so frame the future of flying.

4. **Public acceptance is key to the growth of drone services.**

The respect of *citizens' fundamental rights*, such as the right to privacy and the protection of personal data, must be guaranteed. Many drone services involve data-gathering such as filming, etc. The responsible authorities, such as the national and European Data Protection Authorities, should develop the necessary guidelines and monitoring mechanisms to ensure the full respect of existing protection rules, including in relation to drones. Rules need to clarify what is acceptable and what is not, and they require to be properly enforced.

Drones may cause nuisances and negative externalities, such as *noise*. These nuisances need to be addressed, possibly at the local level, to maintain public acceptance.

Drones also pose potential *security* risks. The design of drones can and should take into account those risks by using methods such as cyber-defence or geofencing. However, the malicious use of drones cannot be entirely prevented by design or operational restrictions. It is the task of the national police and justice systems to address those risks.

5. **The operator of a drone is responsible for its use.**

When a drone service is delivered in prohibited airspace, in an unsafe manner, or for illegal purposes, the authorities should be able to act and hold the operator accountable. Where lacking, this will need to be clarified in national law. Moreover, in order to enforce

responsibility, it will be necessary for drones to have at all times an *identifiable owner* or operator. The regulator should seek the least bureaucratic way to achieve this. For instance, the mandating of electronic identity chips on drones – "IDrones" – as is today envisaged in some states, could be formalised through a safety rule, which would contribute to the effective implementation of privacy and security requirements. Standardised web-portals in the Member States for the registration of operators and their operations could be another solution. The involved authorities need to work closely together.

Drone accidents will happen. Member States should clarify the applicable *insurance* and third-party liability regime and monitor the compensation mechanisms for potential victims. The establishment of compensation funds to cover victims of accidents caused by uninsured drone users, as used in the motor insurance sector, could be envisaged. *Reporting* on drone incidents should be integrated into the overall incident reporting requirements. Systematic and coherent incident reporting will improve safety and will be instrumental for insurance companies in their risk analysis on which third party liability insurance premiums are based.

To allow a short reaction time, the development of drone services and drone technologies needs close monitoring. To this end, the EU should establish an easy access for SMEs to information required for drone manufacturing and service provision, together with an observatory to keep track of the growing number of operations in Europe and the evolution of innovation. This monitoring will permit informed decisions relative to the establishment of priorities for future legislation. It will also help regulators to learn from experience and verify that the rules are fit for purpose, namely to ensure that new technologies and drone services can develop in full respect of the required high levels of safety, security, privacy and environmental protection. An annual progress report should be published.

The European aviation community gathered in Riga today is committed to working together on the basis of these principles to allow businesses to provide drone services everywhere in Europe as from 2016 onwards.