



Implementation of European Drone Regulations - Status Quo and Assessment

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Received: 3 March 2022 / Accepted: 24 July 2022 / Published online: 16 September 2022
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Abstract

The fast evolution of drone technology as well as the ubiquitous adoption from private and commercial users lead to the necessity to introduce new regulations covering the operations of Unmanned Aircraft Systems (UAS) in European Member states. The regulations implemented rules for multiple scenarios of normal and complex UAS operations as well as the collection of registration data from remote pilots and Operators. This research project tried for the first time to determine the status quo of the adoption of the novel EASA regulations of drones within the European members states. Data from National Aviation Authorities has been collected, accumulated, and analyzed towards qualitative and quantitative features.

Keywords Drones · UAV · UAS · European regulations EU regulations · Registrations · Operators · Remote pilots

1 Introduction

The first cases of Unmanned Aircraft Systems (UAS), also known as drones, go back to multiple, mostly military, applications. The name “drones” originates from the insect world, the name of the male worker bee, to underline and suggest the expandability of the unit. One of the first uncrewed aircrafts ever built and operated was the Aerial Target, which was an experimental radio-controlled monoplane designed by de Havilland, flown in 1917. [Fig. 1] During the Cold War many drones were used as aerial target practice for Surface to Air Systems or Fighter Aircraft. With the evolution of Command-and-Control technology as well as satellite communication and navigation in the 1980s, the use of larger platforms for reconnaissance missions became possible, followed by the use of the first armed platforms in battle, such as the Predator UAS. These military use cases were only regulated by the law of armed conflict and export and arms trade regulations [1].

Initially, regulations for civil, non-military uses were needed, when, during the mid-twentieth century, groups of model enthusiasts were founded worldwide to build flyable scale models of existing airplanes or helicopters. For a long

time, model flying, and aerobatics were the only civil application of smaller UAS with their own applicable regulations for recreational purposes. Model flyers were limited to designated flight areas and organized in model flight associations. The domestic regulations covered recreational use as leisure activity or sport with its own rules and insurance requirements. The use of model aircraft was also limited to a smaller audience due to the training and flight skill requirements for model pilots and aerobatics.

The Fédération Aéronautique Internationale, FAI - The World Air Sports Federation, which was founded in 1905, organizes international efforts to promote aeromodelling and amateur built aircraft together with 110 domestic Air Sport Associations worldwide. Under their auspices, organizations and civil aviation authorities were able to adopt harmonized standards and rules, such as flight areas or licenses and operate model airplanes, such as shown in Fig. 2 [2].

1.1 The Success Story of Drones and the Need for Regulation

As described in the previous section, the utilization of UAS was dominated by the military sector for many years, until technological developments, such as lower size, weight, power, and costs (SWaP-C) of onboard sensors, flight controllers, navigation aids and other essential components made it possible to construct UAS multicopter platforms to carry a wide variety of sensors and payloads.

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Fig. 1 Aerial Target, a British radio-controlled aircraft from the First World War (<https://www.iwm.org.uk/collections/item/object/205315299>)



Fig. 2 Examples of early model flying UAS (https://commons.wikimedia.org/wiki/File:Model_planeFortepan_17606.jpg)

Figure 3 visualizes the taxonomy of the different areas of applications and their respective needs for regulation. Fixed-wing model-flying dominated the aeromodelling community since these models were easier to fly and build than helicopter models. The dynamic creation of lift provided a more stable flight envelope in contrast to the stabilization needs of rotary-wing platforms. It took tremendous technological developments in industry sectors, other than aviation, to make drones as successful and easy to fly, as we know them today. In hindsight, the low SWaP-C can be attributed, in part, to the development of Micro-Electro-Mechanical Systems (MEMS) as sensors that found wide application in complex machinery and robotic systems. MEMS can measure e.g., acceleration, spatial movement or pressure and magnetic attitude. Examples could be seen in traditional aviation, spaceflight, and automotive industry. Meanwhile, the consumer electronics market had also a vast demand for MEMS. One important milestone was the launch of the first iPhone in the year 2007, which was followed by many similar products. Due to the vast market penetration of smartphones, in which MEMS played an important role as supplemental sensor devices, economies of scale made it possible to reduce the SWaP-C of these sensor systems. This paved the way for many additional use cases of MEMS in e.g., computer game controllers and furthermore flight controller systems for multicopter systems.

Today's standard issue flight controllers, like shown in Fig. 4, consist of multiple-redundant MEMS to constantly measure flight parameters for the drones' autopilot, supporting autonomous take-off, hovering and waypoint flights without the need for a remote pilot to provide manual input.

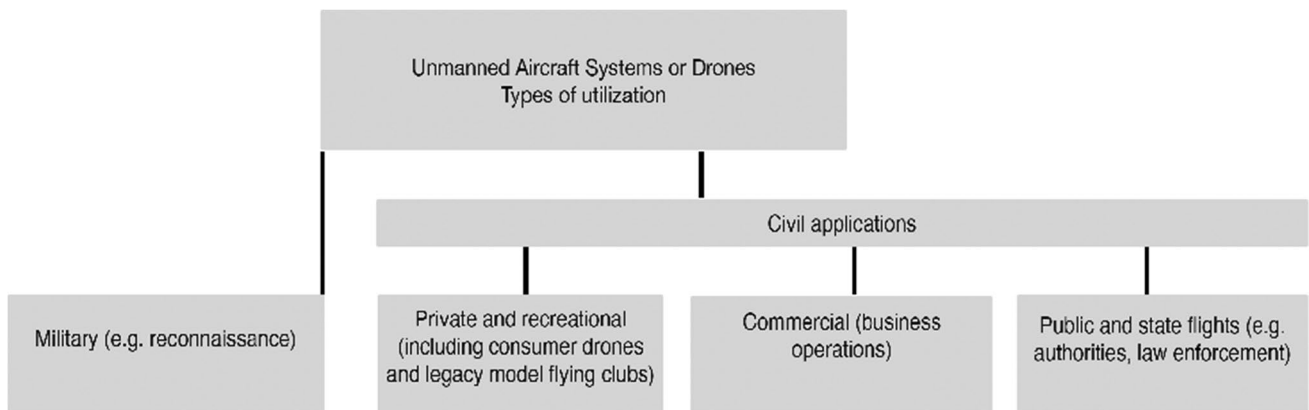


Fig. 3 Types of UAS operations. (military, civil: recreational, commercial, state flights)



Fig. 4 Standard flight controller, Pixhawk (<https://commons.wikimedia.org/wiki/File:Pixhawk.png>)

2 Regulation of Unmanned Aircraft Systems in Europe and Worldwide – Keeping the Pace

Traditional aeromodelling presented certain thresholds for utilization of model aircraft. To enter the community and to build and operate model aircraft, a very common way was to join a model flying club or other community-based organizations. Platforms were often quite complex and not easy to pilot, hence, model flyers needed motoric training and so-called “stick-and-rudder skills” for the remote operation of model aircraft. In contrast to that, the availability of highly automated drone systems opened the market to a whole new group of users. These new drone systems, often multicopter (rotary systems with four or more rotors/motors) were guided and enabled by enhanced and affordable autopilots based on flight controllers with multiple MEMS sensors. It also encouraged drone manufacturers worldwide to develop more advanced systems, not only for recreational purpose, but also for commercial operations.

New models with high-definition cameras to film or photograph leisure and sports activities addressed a faster growing client group in the private and recreational sector, opening the utilization of UAS to even larger audiences. Drones became smaller and “smarter”. Affordable consumer platforms showed impressive, until then never known, flight capabilities with highly autonomous performance.

While traditional model flying required the previously mentioned training and skills, these “smart” drones could be operated “out-of-the-box”. Not only were they very stable and guided by autopilot in hover and cruising flight. They also were equipped with Global Navigation Satellite System (GNSS) sensors to facilitate autonomous flights defined by a set of waypoints.

Lawmakers and authorities faced tough challenges with respect to the regulation and approval of these extremely technological advanced products. Suddenly, a high-definition

camera could be placed almost anywhere, posing new threats towards privacy, data protection and security.

As laid out before, most states worldwide, including European Union member states and other members of the European Aviation Safety Agency (EASA), had only limited, but proven regulations towards model aircraft operating for recreational purposes [3]. It was possible to administer and regulate recreational model flying through model aircraft clubs and associations. In the case of Germany, model pilot licensing, insurance and model certification was processed by one of the two domestic air sports associations with limited or no permanent regular oversight from the National Aviation Authority [4].

The capabilities of many consumer-electronic multicopter drones, as depicted in Fig. 5 the DJI Phantom Drone, were so effective and autonomous, that they could be used for professional purposes. This coined the term “prosumer” drones, with flight times between 10 and 30 minutes and price ranges starting from 500 Euro up to 5000 Euro [5].

As a result of these capabilities, a fast-growing commercial market developed for many applications in the drone business sector. Most of these commercial applications presented substitutes for existing operations performed by manned aircraft or helicopters, such as aerial filming and photography, agricultural sensing and effecting or even parcel logistics. Furthermore, in many industries, foremost the construction and maintenance sector, drones were able to replace industrial climbers, scaffolding and cranes to inspect infrastructure and building projects. An emergent economy of UAS manufacturers, operators and consultancies was the result, providing services and products to many commercial clients in all potential industry sectors.

Naturally, the outlined market growth led to many new “airspace participants” operating multicopter drones for



Fig. 5 DJI Phantom Drone (https://commons.wikimedia.org/wiki/File:DJI_Phantom_4_Pro_-_01.jpg)

commercial applications or private purposes, without any proper training, license, or applicable insurance.

In many European member states the regulations for UAS flights applied different standards and rules for recreational and commercial applications. This raised questions about the purpose and legality of such differentiation and discrimination.

It was recognized that not only the rulemaking differences for UAS operations in the recreational and commercial sector, but also the very different regulations in EU and EASA member states were slowing down the economic growth and prosperity of the market, as well as overall acceptance of the drones as toys and tools.

3 Implementation of EU Regulations for Commercial UAS and Recreational Model Flying

It was apparent, that regulations for drones would need to keep pace with the technological advancement and market demand. Based on the proposals of EASA and stakeholder groups a consensus was formed and, after a hearing and amendment period, the European Commission published, in 2019, a regulatory framework that lays the foundation for updated and harmonized rules and laws for the operation of commercial UAS and recreational model aircraft [6].

The two main elements of this regulatory framework for the safe operation of “civil” drones in the European skies were the Commission Implementing Regulation 2019/947 and the Commission Delegated Regulation 2019/945 [7]. “Civil” in this regard points to the application of the rules to all non-military applications, covering commercial, recreational, and state flights.

The regulatory framework adopted a risk-based approach, without distinction between private or commercial drone operations, but with consideration of weight, the specifications of the drone and the intended operation. Regulation (EU) 2019/947, which is applicable since 31. December 2020 in all EU Member States, created three categories of civil drone operations. They are defined as the ‘open’, the ‘specific’ and the ‘certified’ category.

The ‘open’ category covers lower-risk civil drone operations and is subdivided into three subcategories, namely A1, A2 and A3. To fly in one of the subcategories, remote pilots can choose to obtain an A1/A3 license and/or an A2 license, where the A2 license is suited for UAS flights nearer to infrastructure and persons, than A1/A3 [7]. A remotely piloted flight with lightweight sUAS in sufficient distance to persons and infrastructure would be a typical operation in the open category. Because the operational risks in the ‘open’ category are considered low, no previous operational authorization is required before starting a flight [8].

The ‘specific’ category covers civil drone operations with higher anticipated risk, where safety is ensured by the drone operator through obtaining an operational authorization from a national competent authority [8]. Every flight scenario that is covered under the requirements of the open category, falls automatically in the Specific category, e.g. flight over persons or Beyond Visual Line of Sight [9].

To obtain the operational authorization, the drone operator is required to fly under a Standard Scenario (STS) or with a Pre-Defined Risk Assessment (PDRA). For more complex flight profiles, the operator must conduct a Specific Operational Risk Assessment (SORA), to define initial and final air and ground risk levels and the respective mitigations [8].

The following parameters and instances are subject to regulation and registration under Commission Implementing Regulation 2019/947 in the Open and Specific Category:

- A1/A3 license (remote pilot with proof of completion of online training)
- A2 remote pilot license (pilot certificate of competency)
- Operator ID (legal entity, that operates drones)
- Operational Approval in the Specific Category
- LUC (Light UAS Operator Certificate)

In the ‘certified’ category, the safety risk is significantly higher, leading to mandatory certification of drone operator and platforms, using methods similar to methods used in manned aviation.

4 Research Motivation and Approach

The EU regulatory framework was designed as regulation with a mandatory implementation period and due date in EU member states. Since all 27 European Union member states of 2021 are members of the EASA, the authors intended to acquire a respective progress examination of the actual implementation status from EASA member states.

For a long time, quantitative statistics about the numbers of operators, remote pilots and UAS platforms have been subject to speculations within EASA member states. Individual UAS platforms are not subject to registration, only the owners are registered as operators with their respective ID. It is also not registered, hence not known, how many individual drones one operator has in possession and operation. Therefore, a total number of UAS, e.g. per member state, might only be estimated by an average number of UAS per operator. Another option to determine the total number of drones would be a registration system for each drone with a point-of-sale or time-of-first-flight approach.

Also, during the research period, it became clear that there is currently (first months of 2022) no central European statistical repository for data related to remote pilots, legal entities, and operational approvals.

However, to better determine the progress of the adoption of the regulations, especially of the Commission Implementing Regulation 2019/947, a transparent overview of the quantitative data for different member states is needed. This could help to identify trends and better describe the European drone market, including all persons, platforms and operations involved. Stakeholders would be able to better determine the status quo and plan for future actions. The results would be beneficial to several entities and stakeholders, such as European National Aviation Authorities, insurance companies, investors, as well as science and media.

4.1 Registration Aspects

The concept of registration is an essential aspect of the new European regulations under Commission Implementing Regulation 2019/947. Contrary to many assumptions and reports in the media, not the physical drone platform itself is registered, but the remote pilot and the drone operator. According to the regulation, drones do not need to be registered unless they are certified. The aspects of certified drones are not subject to this research project.

However, the drone operator, must register with National Aviation Authority in a central registry, which then issues an Operator ID. The drone operator can be a natural person (e.g. the owner of a drone) or a legal entity (e.g. a company operating multiple drones for commercial applications). The Operator ID registration is a singular administrative act, independent of how many drones are operated by the entity or the person [7]. Operator IDs are applicable for the Open and the Specific Category. The registration is valid for a period defined by the National Aviation Authority, after which it must be renewed. The registration number for UAS operators shall be established based on standards that support the interoperability of the national registration systems.

An example of a UAS operator registration number is 'FIN87astrdge12k8', where:

- 'FIN' is the ISO 3166 Alpha-3 code of Finland,
- '87astrdge12k' is an example of twelve (12) alphanumeric code,
- '8' is a specific checksum code

According to European legislation the national registration systems should comply with the applicable Union and national laws on privacy and processing of personal data and the information stored in those registrations systems should be easily accessible [10]. Fig. 6 depicts two small UAS with

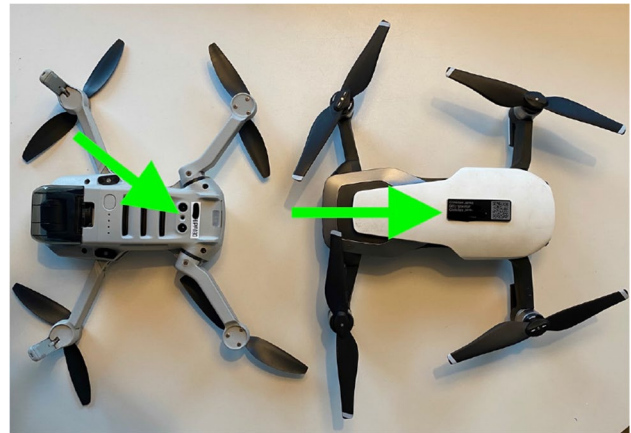


Fig. 6 Two small UAS with placard showing the respective Operator ID

a placard, showing an Operator ID issued by the German National Aviation Authority.

No registration is needed if a drone weighs less than 250 g and has no camera or other sensor able to detect personal data; or even with a camera or other sensor, weighs less than 250 g, but is a toy (this means that its documentation shows that it complies with 'toy' Directive 2009/48/EC) [7].

For persons acting as remote pilots, the registration process is very similar and pending on the subcategory. For the subcategory A1/A3, remote pilots need a proof of completion of online training.

To fly in the A2 subcategory, remote pilots need a certificate of competency, issued after an accredited training and exam. Figure 7 depicts a standard European remote pilot license with A1/A3 and A2 covered, issued to one of the authors of this project by the German National Aviation authority.

If an UAS operator wants to conduct a UAS operation that is not covered by the Open category, it automatically falls under the Specific category. This is the case when at least one of the general criteria listed in Article 4 of the UAS Regulation is not met (e.g. when operating beyond visual line of sight (BVLOS)) or when the detailed criteria for an Open subcategory are not met.

In the Specific category, there are several application and approval processes in place to limit the operation to the "specific" operation (hence the name) permissible under the risk-based approach. The operations in the specific category can be divided in three pillars, as depicted in Fig. 8.

Standard scenario (STS) refers to a type of UAS operation for which a precise list of mitigating measures has been identified in such a way that the competent authority can be satisfied with declarations in which operators declare that they will apply the mitigating measures when executing this type of operation [7].

Fig. 7 Remote Pilot Certificate of Competency in subcategories A1/A3 and A2

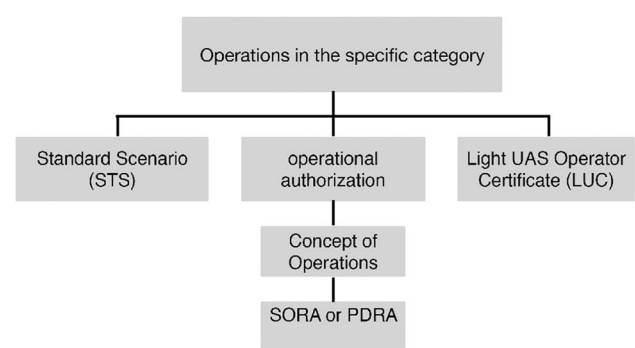


Fig. 8 Operation types in the specific category

An operational authorization must be submitted as an application to a competent authority. The process involves a risk assessment including adequate mitigating measures. When the competent authority considers that the operational risks are acceptable and adequately mitigated, it shall issue the operational authorization [7].

When the UAS operation meets certain operational characterizations described in a catalog, the risk can be addressed and mitigated within a predefined risk assessment (PDRA). When this is not applicable, a Specific operations risk assessment (SORA) must be conducted [7]. In addition to the abovementioned, a light UAS operator certificate (LUC) can be issued. This is a certificate issued to a UAS operator by a competent authority with certain privilege granted, to authorize its own operations without submitting an operational declaration; or applying for an operational authorization [7].

As earlier mentioned, the third operational category with higher risk associated is the certified category.

Article 6 of the UAS Regulation and Article 40 of Regulation (EU) 2019/945 define the boundary between the ‘specific’ and the ‘certified’ category. The boundary can be defined from an operational perspective and from the technical characteristics of the drone [7]. A UAS operation belongs to the ‘certified’ category when, based on the risk assessment, the competent authority considers that the risk cannot be mitigated adequately without several higher-level certification processes of UAS, UAS operator and remote pilot [7].

5 A. Data Collection and Treatment

For the accumulation of statistical data in this project, all National Aviation Authorities from EASA member states have been contacted, according to the public list provided by the EASA homepage drones’ section [11].

The designated national Points of Contact (PoC) for drone registrations and operations have been asked to provide current quantitative, statistical information as listed below:

- Number of A1/A3 and A2 remote piloted licenses issued in the country
- Number of registered UAS operator ID issued in the country
- Number of operators applied for operations in the specific category in the country
- Number of LUC’s applied and/or granted in the country

In many cases qualitative interviews with the respective PoCs were conducted, substantiating, and clarifying some aspects and challenges towards the implementation of the EU Regulations.

The survey was conducted over a period of seven months, from July 2021 to January 2022. All numbers constitute status quo, while in many cases pending cases and applications have been indicated, but not fully counted.

Table 1 represents the survey results. In cases where incomplete information was provided, or the statistical allocation was not detailed enough, a “n/a” is given. In cases where the National Aviation Authority has not responded, the countries are not listed.

6 Analysis and Discussion of Results

At first glance the survey results seem consistent, representing expected quantities according to country and population size. It became clear, that not all states have progressed with the implementation of the regulation towards the same level. The numbers of drone pilots (both A1/A3 and A2) per country, seem to fluctuate more than the number of the Operator IDs per country. 23 national designated national Points of Contact (PoC) for drone registrations and operations responded with substantial answers and numerical results and registration numbers. In some cases, it was not possible to get a qualified answer, or it was not possible to identify the responsible person or department within the authority.

Figures 9 and 10 represent a comparative analysis and visualization of the total reported registrations of A1/3 licenses and Operator ID per country. As baseline for the number of A1/A3 licenses, it must be stated that this number includes a large portion of recreational pilots, since no distinction is made between private and commercial operations in the risk-based approach.

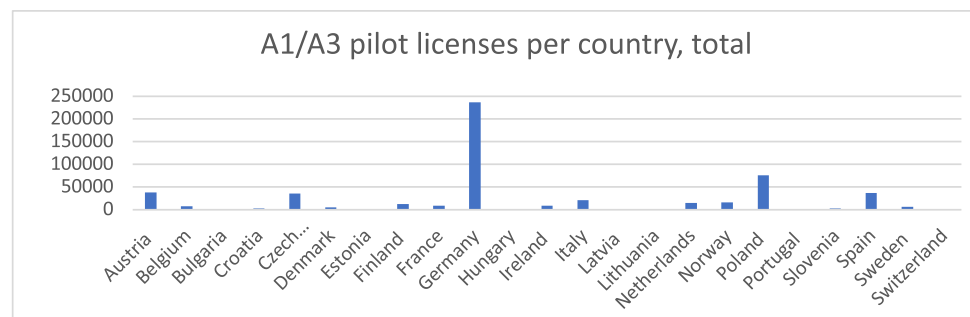
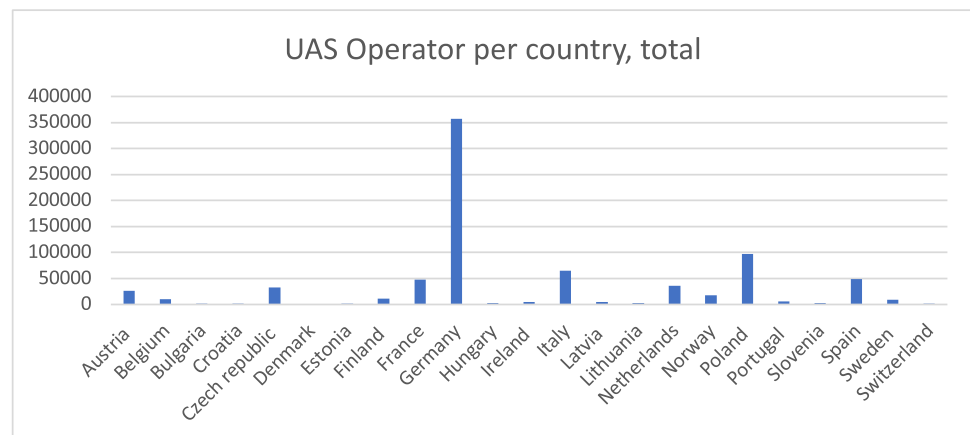
In Germany, for example, 115.500 out of the 236.900 remote pilots with proof of completion of online training, are recreational and hobby pilots. The two model aircraft associations in Germany processed a bulk-register with the German Department of Transportation and the National Aviation Authority, to better allow their members to comply with the new regulation.

In article 16 of Regulation (EU) 2019/947, the UAS operations in the framework of model aircraft clubs and associations are defined, after which model aircraft club and association may obtain from the national competent authority an authorization that is valid for all their members to operate UAS according to conditions and limitations tailored for the club or association.

Also, it is important to understand that the issuing of A1/A3 or A2 licenses for remote pilots is registered per issuing country, not by the place of residence of the drone pilot. The proof of completion of online training A1/A3

Table 1 Statistical results of survey among European NAA towards registration for Implementing Regulation (EU) 2019/947

No.	Country	A1/A3	A2 RPL	Operator ID	Specific	LUC
1	Austria	38,400	included in A1/A3	25,800	76	1
2	Belgium	7847	1467	10,697	240	0
3	Bulgaria	1180	60	1250	1	0
4	Croatia	2501	1101	1207	4	0
5	Czech republic	35,528	included in A1/A3	32,287	299	0
6	Denmark	4868	included in A1/A3	n/a	0	0
7	Estonia	1100	0	1533	1	0
8	Finland	13,000	0	11,000	5	0
9	France	8338	n/a	47,366	n/a	1
10	Germany	236,900	9107	357,000	34	0
11	Hungary	1302	362	2136	2	1
12	Ireland	8633	624	5041	9	2
13	Italy	21,565	7216	64,920	1985	0
14	Latvia	2004	93	4654	5	0
15	Lithuania	1709	79	2560	8	0
16	Netherlands	14,452	10,892	36,234	160	4
17	Norway	15,804	included in A1/A3	17,423	57	3
18	Poland	75,556	14,398	97,180	37	0
19	Portugal	875	22	6082	19	
20	Slovenia	3100	72	2740	3	0
21	Spain	36,968	15,334	49,003	263	2
22	Sweden	6600	n/a	9600	n/a	
23	Switzerland	1052	524	1677	n/a	n/a
	Total	539,282	61,351	787,390	3208	14

Fig. 9 A1/A3 pilot licenses per country, total**Fig. 10** UAS Operator per country, total

poses a relatively small investment in time and resources for the pilot, it consists of an online training completion and the passing of a theoretical online exam.

The A2 training - mostly done by commercial drone pilots - consists of the A1/A3 elements, also a practical training and a written exam at the National Aviation Authority or a recognized entity, leading to a higher investment in time and resources.

While the pandemic situation affected all areas of the workforce, shifting to home-office and remote work, many recognized entities offered A2 trainings and exams online. This situation, the open European market and mutual recognition of licenses resulted in many cross-border trainings and exams, where e.g. German residents holding a German operator ID conducted A2 online training and exam offered by Polish or Dutch recognized entities. Licenses under A1/A3 and A2 are recognized in the whole European Union, independent from the issuing state. Due to the lower effort needed to obtain an A1/A3 license in resources of time and money, the research team concluded, that these trainings and certifications are more likely to be conducted “in-country” by inhabitants with their own respective competent authority, certification body or National Aviation Authority. This assumption was corroborated in several qualitative interviews with the mentioned Points of Contact providing the information.

Since the effort to obtain A2 remote pilot licenses is much greater, the situation here is different. Mutual recognition and pricing competition create incentives to look for “out-of-country” offers for A2 licenses. Here, legal entities issue certificates for EU citizens from other countries. A2 pilot certificates of competency issued in one EU member state according to the described EU regulation, are valid in every other EU country. Considering this situation, it seems not prudent to further track and evaluate the number of A2 licenses per country.

The number of Operator IDs per country has more statistical value since, according to the regulation, UAS operators shall register themselves in the Member State where they have their residence for natural persons or where they have their principal place of business for legal entities. A UAS operator cannot be registered in more than one Member State at a time [7].

Looking at other parameters, the number of “Operators applied for Operations in the specific category per country” has at this time only limited statistical substance, since several member states have very different levels of progress and implementation of STS, PRDA and ConOps/SORA acceptance. The difference in progress and the ambiguity in this area explain the spikes in reported numbers, for example in Italy, and indicate differences in adoption and recognition of the surveyed parameters.

The number of LUC granted per country on the other hand is very significant, since this issuance can be seen as dichotomous, to be answered with a *Yes or No* only. The effort involved in the application, certification and recognition of a LUC is very high and requires significant resources in time and personnel as well as numerous aspects of documentation.

To better evaluate the progress of regulation implementation and the registration situation in each country, the research team visualized the reported total numbers with a ratio-per-inhabitant’s approach, as depicted in Figs. 11 and 12.

The A2 pilot certificates of competency are an indicator for the commercial operations of the UAS sector, since this higher-level certification is obtained mostly by commercial drone pilots, choosing the A2 sub-category with options to fly nearer to people and infrastructure.

Also, a statistical correspondence between A1/A3 licenses and the Operator ID can be determined according to the parameter-to-population ratio. The statistical correlation between these two relative parameters can be much better linked, than the comparison of the absolute registrations.

The correlation can be also explained by the fact that every remote pilot wishing to operate a drone in the A1/A3 subcategory, must make sure that the drone is marked with an Operator ID. However, the remote pilot must not be the Operator, hence the “owner” of the drone. For a high number of the

UAS Operator ID, it can be assumed that they represent a singular natural person, owning and operating one drone only.

Nevertheless, larger commercial entities are very likely to own and operate multiple drones as a fleet. In this case every drone would carry the same Operator ID. Also, many hobbyists build and own multiple platforms for their recreational purposes and model flying. It is important to express, that the data does not indicate how many drones are owned by one Operator, not in total or on average.

Major limitations to the presented research results are the missing data from National Aviation Authorities, that have not responded and differences in progress of the implementation of the regulations. Nevertheless, the accumulated numbers from 23 EASA member states for reported A1/A3 remote pilot licenses (539.282) and the reported Operator ID (787.390) indicate the magnitude of the European drone economy and landscape.

7 Conclusions and Recommendations

A valid and current overview of UAS statistics is the foundation for the evaluation of the European drone economy, as well as an evaluation of the adoption of regulations. The results of the survey towards the quantitative developments of the

Fig. 11 UAS Operator ID per country, per 100.000 inhabitants

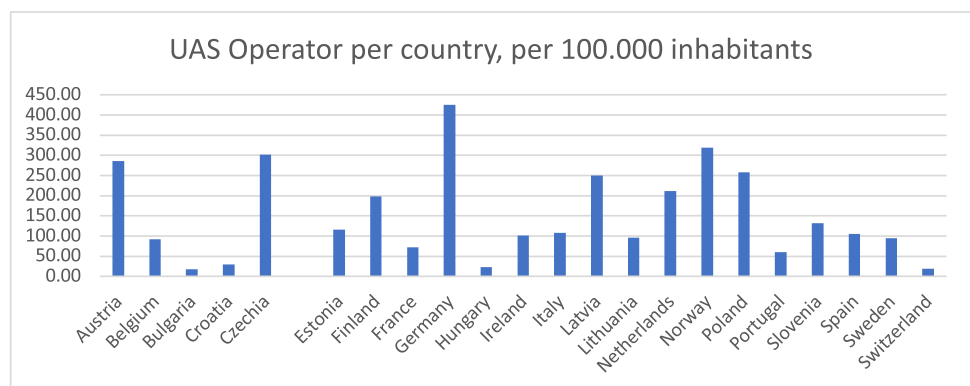
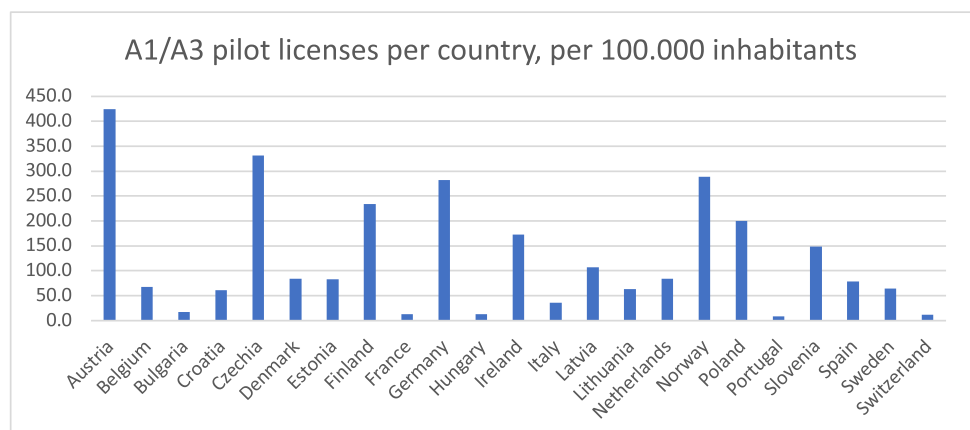


Fig. 12 A1/A3 pilot licenses per country, per 100.000 inhabitants



relevant parameters, indicating the progress of implementation of the EU regulation towards UAS, has shown differences in adoption and realization in the different categories. It can be assumed that within the next years, the fluctuations of reported numbers both absolute and relative will decline and stabilize.

As the drone economy will mature and grow an increase in numbers, especially for Operator IDs and A2 license can be anticipated.

One takeaway of the research project is, that despite the many options to quantify the number of remote pilot licenses, it is not possible to determine the number of drone platforms within the European Union member states. Collecting data points and numbers for registration and operation over longer phases will indicate trends much better. A centralized repository of UAS statistics, as early introduced in this research project, should be institutionalized, and periodically maintained.

Acknowledgments The research team would like to thank the representatives of the European National Aviation Authorities, which have responded with statistical data to the inquiries and made the collection of data for this repository possible.

Authors Contributions All authors contributed to the study conception and design. Material preparation, data collection and analysis were performed by Mr. Christian Janke. The first draft of the manuscript was written by Mr. Christian Janke and Mr. Maarten Uijt de Haag and all authors commented on previous versions of the manuscript. All authors reviewed and approved the final manuscript.

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Funding Open Access funding enabled and organized by Projekt DEAL. The authors confirm there was no funding involved in the research to prepare this manuscript.

Data Availability Not applicable.

Declarations

Competing Interests Not applicable.

Ethical Approval Not applicable.

Consent to Participate All of the authors declare the consent to participate in this manuscript.

Consent to Publish All of the authors declare the consent to publish this manuscript.

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