Co-funded by the
Erasmus+ Programme
of the European Union

Drones4VET project

TRANSNATIONAL REPORT ON THE USE OF DRONES IN CONSTRUCTION-RELATED ACTIVITIES

June 2023

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A. Document's purpose and methodology

Drones4VET project, co-financed by the Erasmus+ programme, addresses an identified gap in the training offered within the construction-related activities. To date, the education and training offer has solely focused on the mastering of the traditional techniques, mainly based in the manual and on-site surveillance, inspection and assessment of civil works, buildings and constructions sites. This approach to training has not in essence changed in the past decades. The advent of the new technologies, both from the point of view of the software/applications and the hardware/devices, has fundamentally altered the dynamics of the sector. Among these new technologies, drones are revolutionising the way of working of many companies in the construction industry as they begin to opt for aerial supervision (for both building and civil works), topography, cartography, preparatory works or even early-detection of anomalies of infrastructures. Embracing of these new changes is very important for VET students who want to guarantee their current and future employability and develop a successful career.

The present document intends to provide some conclusions extracted from the different national analysis carried out as a preparatory task within the project. Although these analyses have been drafted focusing on the national level, given the transnational approach of the Drones4VET project, it was considered advisable to point out the most relevant common points between the state of play in all countries participating in the project. **This transnational report will set the working basis and reference for the design of the Drones4VET training programme, as it contains relevant information about the current needs and future trends on the use of drones in construction-related activities.**

Specifically, the transnational report addresses issues such as: impact of the new EU-level legislation, professional profiles increasingly required by the labour market, possible synergies with other sectors or applications, among others.

Concerning the methodology applied, all the project partners have carried out the fact-finding at a national level according an agreed template and making use both of already existing information (secondary data) and pro-actively generation new data by means of surveys (gathering primary data).

Concretely, primary data has been gathered via two kinds of surveys, one addressed to companies active in the field of construction and another one for learners. The main goal of this methodology was to confirm with the business ecosystem that the assumptions made at the time of the application form were still valid and to orient the design of the Drones4VET training programme towards the real needs of companies, in order to boost the impact of the pilot course implementation.

Table 1. Distribution of the surveys carried out per target group and country.

Partner	Country	Surveys to companies	Surveys to learners	Total
CRN Paracuellos	Spain	40	56	96
BZB	Germany	25	39	64
FHKU	Austria	34	101	135
MTU	Ireland	30	87	117
CMQ Occitanie	France	41	-	41
TOTAL		**210**	**243**	**453**

Although no specific target, in terms of number of answers to the survey, was established in the application form, the number of answers received seem to be adequate to the purpose of the study. This methodology was not intended to be statistically representative. It was instead a mere preparatory exercise aiming at proving a set of insights and recommendations that can be useful for a better design and implementation of a tailor-made training programme focused on the use of drones within construction-related activities.

B. Introduction to the Drones4VET project

As mentioned in the previous chapter, drones have become more present in the media and in everyday life, as their potential applications include a wide range of economic activities within sectors like agriculture, transport, surveillance, maintenance, mapping or audiovisual arts, among others. However, the explosion in the use of drones has not been accompanied by the corresponding re-skilling and up-skilling of the workforce, leading to remarkable training gap that companies have faced mainly carrying out in-house training actions. Still, finding highly specialised drone operators is very complicated at present.

In this regard, several collaborative research projects addressing drones and Innovative Air Mobility have been funded at EU level through various joint research initiatives and EC funding Programmes, such as Horizon 2020, Horizon Europe and European Defence Fund (EDF), among others. On a smaller scale, Erasmus+ has supported different projects which help to foster digital transformation, make technology accessible, create new job prospects and, in general, improve skills matching in the sector.

Drones4VET KA220 project was approved under the Erasmus+ 2021 Call. It addresses the existing gap between construction industry and the current training offer, in particular, related to the use of drones. Partners will work on the design and testing of a transnational training programme focused on the use of drones in construction-related activities. Thus, VET students will be equipped with new and necessary competences for a successful integration in the labour market. The implementation of Drones4VET training programme will significantly improve their capacity and skills according to market needs, as the programme will be specifically designed to meet the current and future needs of companies. Apart from that, the Drones4VET partnership applies this project pursuing the following objectives:

- Enhancing quality and relevance of the VET learning offer of the participating training centres and others across Europe by the designing and testing of an interdisciplinary and transferable training programme focusing on the use of drones within the construction-related activities,
- Increasing VET students' skills with regard to the different possibilities offered by the use of drones in the framework of the construction sector.
- Connecting students with today's tools, opportunities and challenges of the mentioned sector.
- Increasing employability and career development of VET students in general and of VET construction students in particular.
- Increasing knowledge of the situation, prospect and trends of the construction sector at both national and EU level and exchange of expertise, skills and experience among the partners' consortium.
- Improving the digitalisation and sustainability of the construction sector by training skilled workers in the use of new technologies.

The following table collects the most relevant information about the Drones4VET project:

Table 2. Basic information on the Drones4VET project.

PROJECT TITLE	Transnational VET training programme in the use of drones within construction-related activities
ACRONYM	Drones4VET
PROJECT REFERENCE	2021-1-ES01-KA220-VET-000033094
DURATION	01-01-2022 to 01-11-2024 (34 months)
PROGRAMME	Erasmus + KA220-VET - Cooperation partnerships in vocational education and training
GRANT	382.145,00 €
NATIONAL AGENCY	Servicio Español para la Internacionalización de la Educación

Concerning the activities planned within the project, it is basically structured around two project results and some other complementary activities, as described in the following table:

Table 3. Drones4VET work plan structure

Action		Coordinator
PROJECT RESULT 1: Drones4VET Training programme		CMQ Occitanie
1.2	Transnational state-of-the-art report	
1.3	Design and elaboration of the training programme + first translations	
1.4	Promotion, recluting & Implementation of pilot training courses	
1.5	Evaluation from the students' perspective	
PROJECT RESULT 2: Capacity-building for educators		FH Kufstein
2.1	Levelling sessions for educators	
2.2	Follow-up sessions for educators	
2.3	Evaluation from the educators' perspective	
2.4	Handbook for educators	
Communication (transversal)		CRN Paracuellos
Website and social media profiles		
Logo and dissemination tools		
Press and news		
Participation in other events		

Finally, as outlined before, Drones4VET partnership encompasses the whole building sector, with the participation of five renowned training centres across five EU countries and one private research partner, all with great experience in cooperation projects and the development of highly specialized training:

Table 4. Drones4VET project partners

Partner	Country	Description
CRN Paracuellos	Spain	Public training centre delivering courses for the upskilling and reinsertion of workers into the labour market. Training offer comprises diverse courses from basic to advanced levels: Building surveying & inspection, modelling, energy efficiency, logistics… Labelled as a "National Reference Centre" (CRN as per its Spanish acronym), it provides a benchmark for the national qualification system and vocational training framework
Bildungszentren des Baugewerbes	Germany	Multifunctional educational service provider for the construction sector. Members include around 2,500 construction companies. BZB's activities range from apprenticeships, career guidance, qualifications and professional development courses. With three locations in Krefeld, Wesel and Düsseldorf, BZB is one of the largest training centres in Germany
Fachhochschule Kufstein FH Tirol	Austria	University of Applied Sciences that offers 24 economic and technical degree courses in close collaboration with regional and global companies, which ensures a strong practical focus. FHKU also provides research and development services to its scientific staff and external partners
Munster Technological University	Ireland	Multi-campus university with over 18,000 students and 2,000 staff. MTU's engineering programmes are characterised by a strong focus in industry and a well-established R&I eco-system for staff, students and industry partners. Moreover, MTU participates in national programmes which prioritise upskilling in areas of immediate need for the economy, offering courses for employed and unemployed
CMQ Occitanie	France	Made up of a network of public and private actors, vocational and high training institutions and professional associations. The actions implemented benefit young people, job seekers, employees and professionals. CMQ Occitanie offers a wide range of courses, from professional certificates to doctoral degrees, mainly focused on renewable energies and sustainable construction
DEX	Spain	Strategic consultancy firm specialized in social and economic development issues. It has worked on specific sectors –education, industry, tourism, ICT– and in different actions –internationalisation, innovation, training–. Besides that, Grupo DEX takes part and supports the participation of other organisations in national and transnational cooperation projects and partnerships

C. Overview of the use of drones in construction activities

Technological transformation is progressively taking place in the construction sector. Drones have become one of the most appealing trends in the construction industry over the past few years, with a considerably growth, higher than in any other commercial sector. Increasingly, construction companies are using drone technology for a variety of purposes on the worksite, from planning and design to monitoring and maintenance.

One of the most significant benefits of drones in construction is their ability to quickly and safely inspect job sites. By using drones, construction companies can obtain high-resolution aerial imagery and 3D models of construction sites that can be used for site planning, surveying, mapping, and progress tracking. This data can be used by engineers, architects, and other professionals to evaluate construction sites and design structures more accurately.

Drones are also used in construction to identify potential safety hazards and promote safer work environments. For example, drones can identify potential hazards such as fractures or cracks in buildings by collecting images and videos of the structures.

In addition to safety and planning benefits, drone technology can also improve efficiency and reduce project timelines. Using drones, construction companies can perform inspections more quickly, cutting down time compared to traditional inspection methods.

In this context, drone technology is impacting the labor market in several ways. On one hand, the use of drones is creating a demand for skilled workers who understand how to operate and maintain drones. This includes licensed drone pilots, software engineers, and technicians with knowledge of drone hardware, software and data analysis. On the other hand, the use of drones is also contributing to the automation of certain tasks, which could ultimately lead to the displacement of some jobs. For instance, drones can be used for tasks such as surveying or inspections, which could supplement or replace the work traditionally done by people.

Additionally, drones can make certain jobs safer for workers. By using drones to perform inspections, for example, workers can avoid potentially hazardous environments, such as on high platforms or in confined spaces.

According to the European Drones Outlook Study, considerable job creation is expected, both in direct and indirect jobs. In this context, one of the biggest challenges in the market is finding and retaining skilled professionals who can fill key positions in this emerging technology segment. Training has been outpaced by innovation and it can be difficult finding talent to fill drone-related jobs. This clearly shows there is a significant skill gap among the workforce, which could have a considerable impact on industry development.

As stated in the newly published European Drone Strategy 2.0 of the European Commission, one of the main actions to unleash the growth potential of drones is promoting the human dimension: knowledge, training, skills and competences. To ensure that workers have the requisite level of knowledge, the sector should develop and boost competency-based training, tailoring the training offer to specific learning goals in line with industry needs. Additionally, upskilling or reskilling programs would facilitate transitions in the labour market.

As stated in the EU Drone Sector state of play document accompanying the aforementioned strategy, partnerships between research, universities and industry on education may set up a joint approach to the social challenges related to digitalisation, training requirements and professional qualifications. Training programmes specific to drone technologies and the regulatory framework should be implemented in all Member States. Such academic and

vocational programmes across Europe would foster the competences and technological progress, and increase the public awareness and acceptance of drone utility.

Overall, while drone technology holds potential for job creation in certain areas, it is important to recognize that it may also lead to changes in the labor market and impact traditional job roles. Continued education and retraining programs may be required to prepare the workforce for these changes.

As outlined before, Europe drone industry is strongly segmented by applications:

- Construction,
- agriculture,
- energy,
- entertainment,
- law enforcement and surveillance,
- defence,
- delivery.

This list of potential applications is merely indicative, given that, as technology develops, new sectors are emerging in which drones have the capacity to act and bring benefits on multiple levels.

Construction-related activities, in which the Drones4VET project focuses on, hold the highest share, mainly due to the increasingly widespread use of this technology for measuring, imaging, inspection, mapping and land surveying.

However, despite the unquestionable growth in the use of drones at the level of the Union, not all EU countries are moving at the same pace. Several factors influence the practical uptake of this technology, among which can be mentioned:

- Average size of the companies that make up the productive ecosystem: countries in which SMEs make up a high percentage of the total of companies seem to present a relative underperformance, due to its reduced capacity to undertake capital investment.
- Average age of the construction sector workforce: countries in which the construction sector workforce is predominantly in the final stage of their working life are less likely to consider drone technology, while countries with a younger workforce specifically trained in digital technologies are more likely to include this technology.
- Availability of specific training courses targeting the use of drones in construction-related activities: those countries not disposing of this type of courses withing their public system, and therefore workers can only access to them via private training providers or in-house skilling are less likely to extensively apply this technology.

The marked heterogeneity in terms of sector development is demonstrated by the number of registered pilots in the different countries participating:

Table 5. Key figures of the sector in the five countries participating.

	Austria	France	Germany	Ireland	Spain
Nº of registered pilots	40.733	85.000	120.000	16.496	71.000

Source: country reports.

As mentioned before, to analyse the use of drones in the professional construction sector in more detail, Drones4VET partners have carried out a specific survey. The survey was distributed among companies in the countries covered by the project: Austria, France, Germany, Ireland and Spain. It addressed several aspects and combined different types of questions: Nominal questions, multiple choice, likert scales, and open-ended, used for qualitative and quantitative assessment. The template of the online questionnaire is attached as annex to this report (Annex I). Although the scope of the different surveys was national, some main takeaways can be extracted also at EU level.

The surveys carried out in the framework of Drones4VET project show that major concerns determining public perception and trust are:

- Safety and security problems.
- Air traffic management and airspace access restrictions.
- Data protection, user privacy and legal issues.
- Lack of specific regulation on risk prevention & security.

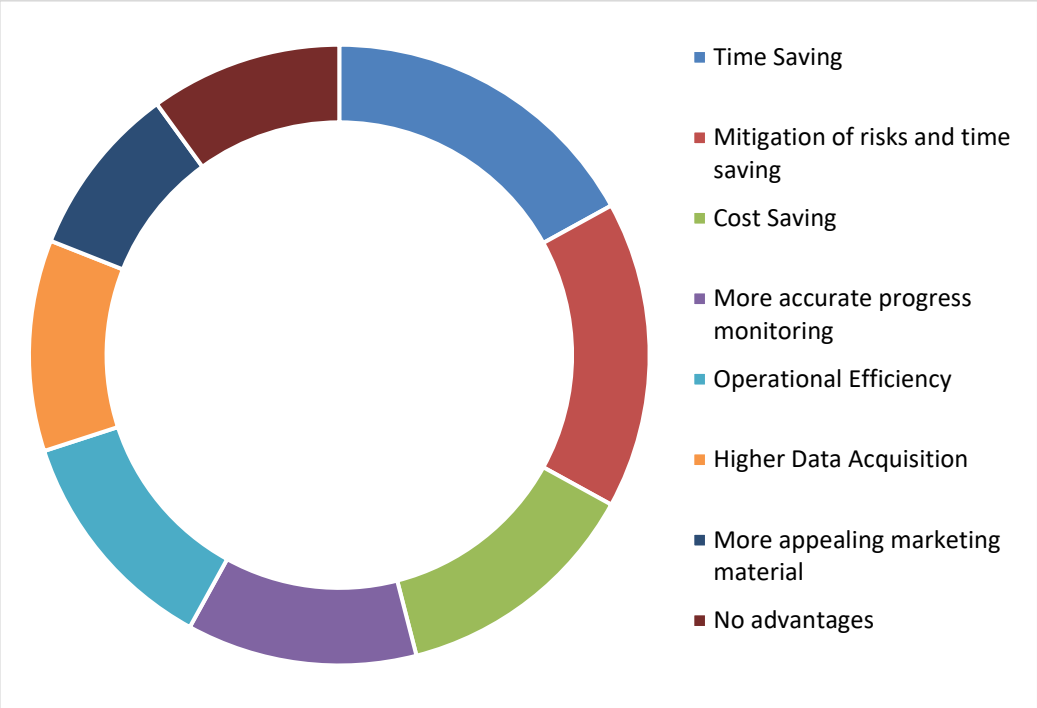
Survey results match EASA Societal acceptance of UAM operation study findings. Although 83% of the people interviewed initially showed a positive attitude towards UAMS, there are some general concerns on drone use:

- 44% of respondents were concerned about safety
- 39% of respondents were concerned about security
- 35% of respondents were concerned about environmental footprint

Half of the respondents would better trust Urban Air Mobility if common security and cybersecurity regulations were adopted at European level. Conclusions highlight the need to build confidence and trust in citizens in order to successfully deploy Urban Air Mobility in Europe.

For construction related activities, companies were asked to identify based on their experience, what advantages could be achieved through the use of drones. Respondents were not limited to only one answer and out of the 122 recorded responses that were chosen, the following hierarchy was observed:

Figure 1. Advantages that could be potentially achieved thorugh the use of the drones.



Source: surveys to companies (N=210).

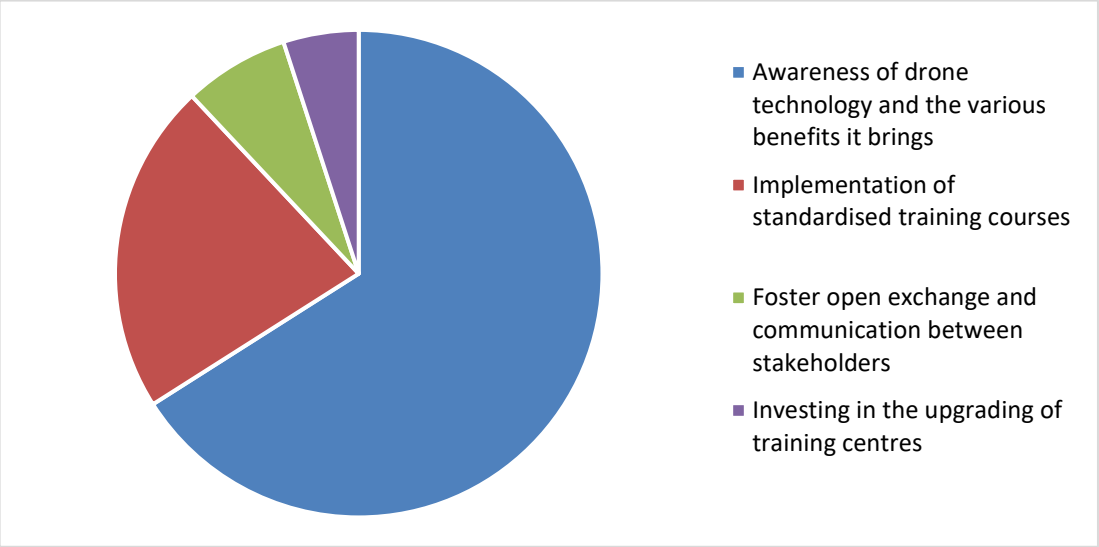
However, being this a key takeaway from the surveys, **companies reported some difficulty in finding suitably qualified professionals to fill drone related roles with 42% of respondents stating that it ranged from somewhat difficult to extremely difficult to find suitably qualified professionals. No respondents were recorded as noting it was easy to find suitably qualified persons. 58% of respondents recorded a neutral response.**

Companies were asked what in their opinion was the reason(s) behind such skills shortages with the following hierarchy of answers being observed:

- Lack of specific skills pathways
- Low adoption of innovative technology by companies
- Inadequacy of facilities or equipment to provide practical training
- Culture of drone technology is perceived as intimidating
- Slow implementation of new training programmes adapted to new trends in construction
- Fragmentation of the construction sector causing a broad gap between the education system and the industry
- Low investment in the implementation of upskilling or reskilling training programmes
- Trainees have limited exposure to this type of technology during their education or on their job apprenticeship.

When asked as to what the likely solution(s) to tackle this skills shortage could be, 66% agreed that an Awareness of drone technology and the various benefits it brings within the construction industry was the main solution. The hierarchy of recorded answers from the survey as to the potential solutions(s) was as represented in the following figure:

Figure 2. Ranking of solutions to tackle the skills shortage



Source: surveys to companies (N=210).

The respondents were asked if there were any other proposals that could be beneficial to tackle the issue. An additional 6 proposals were identified as follows:

- More exposure by the private companies on drone capabilities, legislative review on where they can be used etc.
- Provide workshops outlining what can be done by drones and the benefits they have. Provide relevant training or incentives to upskill employees to use drones.
- Cost analysis between the application of drones for certain tasks versus the traditional way.
- Safety benefits to all stakeholders within the Construction Industry
- Awareness of the potential uses and capabilities of Drone technology for the industry would improve the uptake of both workload and training for this field.

D. Conclusions and next steps

As mentioned at the beginning of the document, one of the aims of the present transnational report is to point out and describe, despite the heterogeneous situation of the sector within the different countries participating in the Drones4VET project, some common points or basic grounds to be taken into consideration in the transnational programme development.

In this sense, the transitional reports takeaways are presented in different categories:

DRONES INDUSTRY & MARKET	DRONES IN CONSTRUCTION-RELATED ACTIVITIES
✓ A highly specialized drone technology and industry is developing with a high growth potential. ✓ Drones are finding their way into a wide range of sectors; agriculture and forestry, security technology or logistics. ✓ The strongest growth, is currently in the area of photography, measurement and analysis services. ✓ Against the backdrop of the shortage of skilled workers, the use of drones speeds up and simplifies work processes where previously many employees needed a lot of time. ✓ More joined up thinking is required across government departments to realise the full potential of UA systems and the value this technology can add to our life's and the economy at large.	✓ Drones are only used sporadically, mostly with external service providers and for the use of photography and monitoring. ✓ While small and medium-sized companies generally work little or hardly at all with drones due to the digitalisation backlog, it is already no longer a rarity for large industrial companies in the construction sector. ✓ It is no longer a question of "if" drones will become part of the standard repertoire for every construction project, but only a question of "when". ✓ The changes in regulations and the large number of rules put off many professionals, that prefer traditional technologies. ✓ Clear and legible training for employers would allow a safe and faster development of the use of drones in construction activities. ✓ Winners of drone technology will be those companies that have developed and implemented their own drone and digitalisation strategy at an early stage.

TRAINING OPPORTUNITIES	LABOUR MARKET
✓ A key pillar of the successful adoption and integration of drones into European society will be the successful training of professionals across a range of different sectors. ✓ For flying the Drones (operator) there is a good offer of training courses for practical training. ✓ However, specialised training in the different application areas is missing (such as measurements, thermography, software applications, etc.). In this area, there is a gap in the education. ✓ Tailored European wide training programmes in the use of drones is a key pillar to unlocking the full potential of this technology in Europe.	✓ Drone technology contributes to increasing the attractiveness of traditional activities such as the construction sector among young people or potential trainees. ✓ New trained professionals will be needed in this sector due to its great growth at all levels. ✓ The traditional construction worker profile is changing rapidly. Transversal and soft skills are being increasingly demanded, as well as to be able to work in a highly digitalised environment. ✓ Now-a-days, it is extremely difficult to find skilled workers in the field of drone application to construction activities, being one of the main barriers to the widespread of the technology.

Therefore, it can be concluded that:

> Across Europe, although a highly specialized drone technology and industry is developing with a high growth potential, and Drone operator courses are extensively offered, specialised training in the specific application areas and technologies relevant to the construction sector is lacking. This has a negative impact on the availability of skilled workers that limits the capacity of companies - particularly SMEs – to introduce drone technology within their operations.

The Drones4VET training programme will specifically address the above-mentioned training gap by focusing, rather than on the operation of the drones itself, on the application of this technology to the most common construction operations. This will contribute to boost the practical uptake of the course and to facilitate that it can be taken into consideration by other organisations across Europe in the development of their own curricula.

DRONES4VET

Co-funded by the
Erasmus+ Programme
of the European Union

Country report on the use of drones in construction-related activities

Comunidad de Madrid

Comunidad de Madrid

Dirección General de Formación
CONSEJERÍA DE ECONOMÍA, HACIENDA Y EMPLEO

Spain

2022

Prepared by:

CRN Edificación y Obra Civil Paracuellos

Country report on the use of drones in construction-related activities

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OVERVIEW (AT NATIONAL LEVEL)

- Regulations (Standard Operating Conditions)

  As of 31 December 2020, the European regulations of UAS apply. This standard affects all drones regardless of their use or size.

  - Consolidated European legislation:

    Consolidated Implementing Regulation (EU) 2019/947 including changes to Implementing Regulation (EU) 2020/639, Implementing Regulation (EU) 2020/746, Implementing Regulation 2021/1166 and Implementing Regulation (EU) 2022/425. (https://eur-lex.europa.eu/eli/reg_impl/2019/947/oj).

    Consolidated Delegated Regulation (EU) 2019/945 including changes to Delegated Regulation (EU) 2020/1058. (https://eur-lex.europa.eu/eli/reg_del/2019/945/oj).

  - EASA management resolution approving national standard scenarios (STS-ES) for UAS operations in the 'specific' category under an operational declaration in accordance with Implementing Regulation (EU) 2019/947. https://www.seguridadaerea.gob.es/sites/default/files/0_20201202_resolucion_escenarios_estandar_nacionales.pdf)

  - Easy Access Rules for Unmanned Aircraft Systems (Regulation (EU) 2019/947 and Regulation (EU) 2019/945). https://www.easa.europa.eu/en/document-library/easy-access-rules/easy-access-rules-unmanned-aircraft-systems-regulation-eu

  - EASA Frequently Asked Questions on European UAS Regulations: FAQ UAS EASA https://www.easa.europa.eu/en/the-agency/faqs/drones-uas

- Strategic plan for the development of RPAs/drones in the country. Priorities

  - Business development and R+D+i of the drone sector:

    Development and promotion of quality training for drone professionals. It also proposes the development of a center of excellence and the promotion of the use of drones in the different administrative and business areas.

    The promotion of R+D+i I tasks with actions related to their promotion and financing.

- Disclosure of industry information:

  Global disclosure. To this end, channels of communication with the Administration will be created. It also highlights the importance of heterogeneous aeronautical training for all actors in the drone world. To bring the sector closer to the public, informative forums and conferences will be held at universities and colleges. In addition to disseminating material and informative campaigns that help promote aeronautical culture.

  Dissemination in productive sectors, for which a sector dissemination portal and an observatory will be created to collect, manage and analyze the information on this activity. This initiative assumes the existence of a knowledge space on technological innovations in the RPAS sector and the regulations around it. On the other hand, in 2019 the ENAIRE Foundation Award for Innovation in the Drone Sector was created to reward the innovative work of Spanish companies and help their public recognition.

- Coordination between Administrations:

  To promote the development of the drone industry in Spain, coordination between the different Administrations involved in it is necessary. To this end, an Interministerial Group has been created, led by the General Directorate of Civil Aviation. It will work so that there is an effective coordination between administrations that allows an orderly development of the sector.

- Government agencies with jurisdiction over RPAs

  Ministerio de Transportes, Movilidad y Agenda Urbana

  https://www.mitma.gob.es/

  Agencia Estatal de Seguridad Aérea (AESA)- State Air Safety Agency

  https://www.seguridadaerea.gob.es/

  ENAIRE DRONES:

  https://www.enaire.es/servicios/drones

- RPA operator qualification requirements / Pilot certifications needed

  A UAS operator is any natural or legal person who uses or intends to use one or more UASs for both professional and recreational purposes (including modellers).

Registration should be carried out in the Member State of residence or where the economic activity takes place, and it is not possible to be registered in more than one State at a time.

- Must be registered as an operator when using any of the following types of UAS:

  Use in the 'open' category any unmanned aircraft:

  - With an MTOM of 250 g or more, or which, in the event of a collision, is capable of transferring to a human a kinetic energy greater than 80 joules;
  - Equipped with a sensor capable of capturing personal data, unless it complies with Directive 2009/48/EC ("Toys Directive").

  Use an unmanned aircraft of any mass in the 'specific' category.

  The UAS pilot´s training required will depend on the UAS and the subcategory in which it is operated. This training and the corresponding examinations are carried out through the AESA Moodle platform after registering at the web site in the ´open´ category and in the ´specific´ category.

- The 'open' category covers transactions with UAS that involve a low risk and do not require authorisation or declaration.

  The 'open' category in turn is divided into three subcategories: A1, A2 and A3. The training required will depend on the UAS and the subcategory in which it is operated:

  - A1/A3 (together)
  - A2

- The 'specific' category covers transactions with UAS involving an average risk.

  Operate in **'specific' category under a standard scenario ('STS')**.

  - The **theoretical training** for STS can be provided by a training organisation, a UAS operator, or on its own account, always following the syllabus published syllabus. It is for EASA to carry out the examination of theoretical knowledge of the STS and, if

appropriate, to issue the corresponding certificate.

- **Practical training** is required for each scenario, provided by recognised entities or by declared UAS operators, which will consist of a continuous assessment and, obtaining an accreditation of practical skills for this standard scenario by recognised entities or UAS operators that have declared to provide such practical training.

Operate in 'specific' category upon request for an operational authorisation.

For these remote pilots, theoretical and practical training based on the concept of operation ('ConOps') is required. The training required shall be determined in the context of the application for operational authorisation.

- Key figures (nº of registered operators like corporations, SMEs…; registered aircrafts; …)

  Registration as UAS operator in AESA is free of charge and is done through its electronic site.

  The generated UAS operator registration number shall be included in all drones of the operator.

  Only if you are to perform operations in the 'specific' declaration or LUC category, it is necessary to enter the UAS in the profile of the UAS operator.

  Currently, the UAS must carry an identification plate with the following information:

  - Responsible operator
  - Brand and model
  - Serial number
  - Nº of registered operator
  - Contact information

INDUSTRY OVERVIEW

- Related activities linked to RPAs

  The main activities in which they use drones are listed below:

  - Audiovisual industry
  - Industrial inspections
  - Precision farming
  - Topography
  - Thermography
  - Surveillance and security emergencies building
  - Civil works
  - GIS
  - Logistics
  - Environment risk prevention
  - Defense
  - Archeology
  - Fire control
  - Fumigation
  - Reforestation
  - Fishing
  - Control wildlife
  - Livestock

- Developments

  In recent years, the drone sector has experienced an extraordinary evolution, not only in the global market, but also in the national market. The increasing number of applications in the field civilian life, made possible through continued technological development of these aircraft, point to an explosive growth to medium term.

  We find ourselves, therefore, before a sector with an enormous potential for expansion, in which Innovation and continuous technological progress are configured as fundamental elements to make their extraordinary development prospects a reality.

  We find ourselves, therefore, before a sector with an enormous potential for expansion, in which Innovation and continuous technological progress are configured as fundamental elements to make their extraordinary development prospects a reality.

  The use of drones for certain applications it is not new. Since the 1960s this type of

aircraft began to be used in reconnaissance missions by the US Army. Later, in the 1980s, these platforms were extended to civil applications. The first of These experiences were carried out in Japan, in crop fumigation tasks.

However, the development of technology and its reduction in costs, together with the improvement in efficiency and reliability of these systems has made it possible, More recently, there has been a wide diffusion of the use of drones.

In the European Union (EU) it is estimated that there is a fleet of between 1 and 1.5 million drones in use civil society, which has been achieved fundamentally by a strong growth of drones for recreational use, with increases of more than 100% per year in last years. From the above figures, it is calculated than 10,000 units correspond to drones for professional use.

The European market is estimated at 7 million drones in use recreational and 400,000 for commercial and government use for 2050. Precision agriculture, rapid transportation of parcels and critical goods such as medicines, inspections of large infrastructures, observation and surveillance, cartography, precision, emergency management, etc. are identified as some of the sectors in which drones can allow development of high added value and economic impact.

- Sector statistics

  The drone sector in Spain has grown by 9.4% in 2021, reaching the following figures:

  - Pilots: 51.000
  - Operators: 2.500
  - AS/Drones: 4.200
  - The turnover of the sector: 1.500 Millions Euros

- Sector challenges → Technology adoption and gaps (Drone adoption)

  Availability and effective and efficient management to allow the use of airspaces that allow the testing of technologies related to the operation of UAS and its management of traffic. Some of these spaces must have access to the maritime environment.

  Defend and consolidate the technological heritage generated in Spain by facilitating and helping in obtaining and maintaining patents.

  Development of new traffic management technologies that allow long-term

operations distances and place us as one of the first countries to be able to authorize this type of operations.

Support from the local, regional and national public administration for the development of new applications with high added value through the use of instruments such as Innovative Public Procurement and the Association for Innovation.

Encourage and promote the development of applications in the field of inspection and intelligent infrastructure monitoring, emergency management, observation and surveillance, traffic management, advanced mapping, smart tourism.

Development of digital systems with simple interfaces for the implementation of the UTM/U-space system in all its phases.

Identify aspects related to the use of the spectrum.

Creation of interoperable database systems that enhance both the UAS operator records such as the use of big data to improve security of operations and their integration into society.

Projects for the development of specific protocols for emergency operations.

Projects to demonstrate the feasibility of delivering goods with UAS.

Study projects of systems that allow inspections to be carried out by the authority remotely.

Development of certification bases for remote control stations on land and the certification bases for aerial platforms.

Detection, monitoring and mitigation of threats related to UAS.

Support the deployment of UAS detection systems as protection in the critical infrastructures.

Definition, development (technical and regulatory) and implementation of the Spanish system of electronic identification and tracking of unmanned aircraft.

Incorporation of electronic identification technologies and monitoring of unmanned aircraft to other traditional airspace users, especially at low altitude (microlights, general aviation, aerostats, skydivers, ...)

Integration of non-aeronautical data sources in current geoawareness systems (ENAIRE/Drones).

Precision navigation systems in urban environments and operation in infrastructures or strategic areas and generation of technologies to increase the

operational safety (collision detection and avoidance, shock absorption capacity, impacts etc).

Technologies that allow flight in confined spaces in a robust and safe.

Systems and tools that facilitate the homologation of hardware systems and software (HW and SW) for medium and high risk operations (levels M and H of the SORA).

Robust communications for operations beyond pilot visual range (BVLOS, for its acronym in English 'Beyond Visual line of Sight') and automatic systems.

Advanced interfaces on land.

Define what regulation would be necessary based on risk, focused on security, training and certifications and standards.

Integrated ATM + UTM, as digitized and automated services, within a

ecosystem to maximize flexibility and efficiency, in an environment driven by

Satellite-based CNS, performance-based operations and services personalized.

Modeling and simulation, fed with urban flow data, which allow understand how UAM can add mobility solutions to networks existing and future cities.

Establishment and validation of digital protocols for information exchange that allow communication and coordination between all the agents involved (Ground and air segment).

- Key takeaways from the survey (from companies & professionals)

  The drone sector in our country is dominated by small businesses and is dealt with in general of young companies. It is, as we can see, a fragmented, volatile market with strong growth.

  - 56% of the operators indicate that they have their own equipment compared to the remaining 44% who hire a service provider.
  - 70% of the operators indicate that they have between 1 to 4 employees for the use or management of the operator and only 30% have 5 or more employees, never exceeding 24 employees.
  - 50% of the operators indicate that they use drones occasionally, 35% indicate that they use them extensively and 10% very exceptionally.
  - 87% of operators indicate that they have expectations of using drone

technology to a greater extent.

- The drone applications most used by operators are Project Planning and Staking, Project Tracking and Communication, First Evaluation and Bid Preparation, and First Evaluation and Bid Preparation.
- Operators indicate that the tasks they perform most with drones are video and photography, digital models, project monitoring and thermography, respectively.
- The operators indicate that the tasks that they would be most interested in implementing in the future with drones are the monitoring of projects, the making of digital models, and video and photography.
- According to the operators, the main advantages of using drones are cost and time savings.
- 50% of the operators indicate that it is difficult to find qualified professional profiles in the use of drones, and 35% neutral.
- Operators indicate that the main reasons for the shortage of qualified professionals are lack of training pathways, students have limited exposure to this type of technology during their education and/or training periods, and low adoption of innovative technology by companies. Business.
- The operators indicate that the solutions to address this lack of skills Implement standardized training appropriate to the different jobs in the sector, favor communication and cooperation between companies and educational and training institutions and knowledge of the technology associated with the use of drones and its benefits in the construction sector.
- 80% of the operators indicate that they agree that the establishment of a standardized and certified training program would help promote the use of drones in the different sectors.
- 80% of the operators indicate that they agree that cooperation between the different institutions and companies would reduce the gap between existing training and the real needs of the sector.

TRAINING

- Specific training and licensing for RPAS pilots

  - The 'open' category covers transactions with UAS that involve a low risk and do not require authorisation or declaration. In 'open' category the UAS operator must register at the AESA website provided that the UAS with which it operates has a maximum take-off mass (MTOM) exceeding 250 g, transfers power in case of impact greater than 80J or is equipped with a personal data capture sensor such as camera or microphone.

    The 'open' category in turn is divided into three subcategories: A1, A2 and A3. The training required will depend on the UAS and the subcategory in which it is operated. This training and the corresponding examinations are carried out through the AESA Moodle platform after registering at the web site

    The different cases to operate in the three 'open' category subcategories are:

    Operate in 'open' category, subcategory A1, with UAS:

    - Of private construction with MTOM less than 250 g and a speed of less than 19 m/s; O
    - With a maximum take-off mass of less than 250 g without class marking and placed on the market before 1 January 2024; O
    - They have a Class C0 marking.

    In all the above cases, the training required for remote pilots shall be familiar with the manufacturer's user manual.

    Operate in 'open' category, subcategory A1, with a class C1 UAS; or in subcategory A3 with UAS having a class C2, C3, C4 or privately constructed UAS with MTOM up to 25 kg.

    In these cases, the training required for remote pilots will be, in addition to being familiar with the user manual, completing an online training provided by AESA followed by an equally online examination given by AESA. The agenda under discussion consists of 9 different subjects, resulting in 40 questions with a duration of 40 minutes.

    To obtain the "Online training pass test" certificate, you must pass the exam with at least 75 % of the correct answers and will appear at the end of any attempt as Apto. Once the test is passed, no action is required. When the certificate has been issued, the user will receive a notice in the email in which he/she has registered. The certificate is valid for 5 years and the renewal

process must be initiated with EASA prior to the expiry date. In the event that the 2 test attempts are exhausted and an unfit qualification is obtained, the remote pilot will receive a negative resolution and must re-register in order to get two new attempts and pass the test.

Operate in 'open' category, subcategory A2 with Class C2 UAS.

In this case, the remote pilot must have successfully passed case 2 and submit to AESA a statement that a self-training of practical skills has been completed during his/her registration for the exam. This self-training of practical skills must be carried out in an area where no non-participant person is endangered and at a minimum horizontal distance of 150 meters from residential, commercial, industrial or recreational areas.

When performing the self-training of practical skills, the remote pilot must take as many flights as he deems necessary to acquire a reasonable level of knowledge and skills to operate the UAS.

In order to obtain the certificate of remote pilot competence, the pilot must complete his/her self-practice declaration during the registration procedure for the examination of subcategory A2.

- The 'specific' category covers transactions with UAS involving an average risk. In 'specific' category the UAS operator must register with the AESA website and incorporate the registration number provided in the UAS with which it operates.

  The possible cases to operate in 'specific' category are:

  Operate in 'specific' category under a standard scenario ('STS').

  - The **theoretical training** for STS can be provided by a training organisation, a UAS operator, or on its own account, always following the syllabus published syllabus. It is for EASA to carry out the examination of theoretical knowledge of the STS and, if appropriate, to issue the corresponding certificate.
  - To obtain the certificate of a standard scenario, the remote pilot must pass the AESA exam with at least 75 % of the correct answers and will appear at the end of any attempt as fit. Once the test is passed, no action is required. When the remote pilot theoretical knowledge certificate has been issued, the user will receive a notice in the email in which he/she has registered.
  - The remote pilot theoretical knowledge certificate obtained is unique for

both national standard scenarios and as certificates issued under national standard scenarios are valid until 31 December 2025.

- After passing the theoretical examination before EASA, for the operation under a standard scenario, **practical training** is required for each scenario, provided by recognised entities or by declared UAS operators, which will consist of a continuous assessment and, obtaining an accreditation of practical skills for this standard scenario by recognised entities or UAS operators that have declared to provide such practical training.

Operate in 'specific' category upon request for an operational authorisation.

For these remote pilots, theoretical and practical training based on the concept of operation ('ConOps') is required. The training required shall be determined in the context of the application for operational authorisation. Guidance material on "training of pilots in 'specific' category under authorisation" has been developed, which details the UAS operator how to demonstrate the justification for compliance with remote pilot training, together with the subjects of theoretical knowledge and practical skills training, recurrent training, registrations, in addition to requirements of instructors and examiners.

- Description and comparison of the current training offer

The current training offer focuses a lot on the legislative part and the legislative part, being mostly merely theoretical and leaving in the background both the practical part (configuration and drone flights) and the administrative part of the normal activity of a drone operator. The final consequence is that the students do not obtain enough knowledge to function safely when carrying out the operations, as well as being able to carry out all the administrative procedures that are required of a drone operator.

Regarding training to specialize in a specific sector, we see how something similar happens, a lot of theory but little practice, as well as a lack of sufficient knowledge on the part of the trainers to be able to give them enough tools to be able to present in the form of report an acceptable product.

For this reason, the number of hours of flight and configuration of the drones should be increased, such as the subsequent production of the final product (videos, photos, report, ...) in the cabinet to be able to undertake or work for a company with all the guarantees.

- Key takeaways from the survey (from learners/trainees; maybe trainers?)
    - 80% of the students surveyed have university education.
    - 70% of the students surveyed indicate that they know drone technology and that they have used it on occasion.
    - The students surveyed indicate that the sector in which they want to develop their activity or are developing it is with 21.21% in Civil Works, 20.45% in Engineering and 17.42% in Building.
    - Surveyed students indicate that the drone applications they are most interested in are photography and/or video and pre-construction and site planning.
    - 80% of the students surveyed indicate that they do not know which are the most demanded or emerging professional profiles in the construction sector.
    - 40% of the students surveyed indicate that access to drone-related training that matches their interests is difficult, while another 32% indicate that access is neutral.
    - The students surveyed indicate that the main reasons for the lack or difficult access to training related to drones are the slow implementation of new training programs adapted to the new trends in the sector and the lack of training itineraries.
    - The students surveyed indicate that the possible solutions to address this problem of access to training would be the dissemination of the wide existing job offer for these professionals, knowledge of the technology associated with the use of drones and its benefits in the construction sector and implement standardized training suitable for the different jobs in the sector.
    - 90% of the students surveyed indicate that they agree or totally agree that the spread of drone applications in the different sectors and of the different related professional profiles most in demand in each of them would increase the number of workers with the proper qualification.
    - The students surveyed indicate that the most important aspects for effective learning and subsequent job placement are active internships, visits to companies when they use drones in real situations, and specialized and accredited teachers.

CONCLUSIONS

The UAS sector shows a potential for growth and development that can be an important economic driver of the Spanish economy and industry.

The special socioeconomic, educational and geographical conditions of our country place us in a privileged position to promote research and the industry of technologies associated with operation of UAS and obtain leadership in certain strategic areas of the sector such as Training in long-range operations, UAS applications in maritime environments and long-range operations, Certification of new traffic management systems, etc.

We are facing a completely new industry: Urban Air Mobility (UAM) and the new technologies (propulsion, structures, avionics/autonomous systems), infrastructures and business models will radically rethink urban and aerospace space.

The airports of the future will be all around us, in our homes and workplaces, on the roofs of buildings, on top of delivery vans and fire engines.

The UAM not only changes the way we travel but the way we live.

Taking into account the great importance of the construction, agriculture and logistics sectors in Spain, and on the other hand the socio-economic changes that are taking place with the rise of this new technology, new trained professionals will be needed in this sector due to its great growth at all levels.

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DRONES4VET

Co-funded by the Erasmus+ Programme of the European Union

Country report on the use of drones in construction-related activities

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2022

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MO/SC	MO/SC	Issued for Information	12/10/2022	A

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LIST OF ABBREVIATIONS

AAM	*Advanced air mobility*
AMC	*Acceptable Means of Compliance*
BIM	*Building Information Modelling*
BVLOS	*Beyond Visual Line of Sight Operations*
CAGR	*Compound Annual Growth Rate*
DESI	*Digital Economy and Society*
DUTO	*Declared UAS Training Organisations*
EASA	*European Aviation Safety Agency*
EC	*European Commission*
ECAC	*European Civil Aviation Conference*
EU	*European Union*
eVTOL	*Electric vertical take-off and landing*
IAA	*Irish Aviation Authority*
ICAO	*International Civil Aviation Organisation*
ICT	*Information Communication Technology*
JAA	*European Joint Aviation Authorities*
JARUS	*Joint Authorities for Rulemaking on Unmanned Systems*
LUC	*Light UAS operator certificate*
MTOM	*Maximum Take-off Mass*
MySRS	*My Safety Registration System*
NDP	*National Development Plan 2021-2030*
NPF	*National Planning Framework*
PDRA`s	*Pre-Defined Risk Assessments*
QR	*Quick Response*
RPAS	*Remotely Piloted Aircraft Systems*
S.I	*Statutory Instrument*
SME	*Small Medium Enterprise*
SORA	*Specific Operational Risk Assessment*
UAS	*Unmanned Aircraft System*
URL	*Uniform Resource Locator*
UTM	*Unmanned Aircraft System Traffic Management*
VLOS	*Visual Line of Sight*

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1 Overview – Ireland

1.1 Regulations (Standard Operating Conditions)

As one of the 27-member states of the European Union, drone usage in Ireland is governed under the European Unmanned Aircraft System (UAS) Regulations. These European regulations came into law in Ireland on 01st January 2021 replacing the now withdrawn Irish regulation S.I No. 563/2015 – Irish Aviation Authority (Small Unmanned Aircraft (Drones) and Rockets) Order, 2015. The UAS regulations may be summarised as:

- **Regulation 2019/947 - rules and procedures for the operation of unmanned aircraft**. This is referred to as the implementing regulation and sets out rules for the operation of drones (referring to an unmanned aircraft and the equipment to control it) and for personnel, including remote pilots and organisations involved in such operations (The European Commission, 2019a).

- **Regulation 2019/945 - Unmanned aircraft systems – design and manufacture requirements.** The delegated regulation covers three main issues: the technical requirements for drones and for remote identification add-ons; the rules for drones, accessories kits and remote add-ons available on the European Union (EU) market; the rules for non-EU drone operators conducting drone operations in the single European sky airspace (The European Commission, 2019b).

These EU regulations are applicable throughout all EU member states helping to standardise the rules, limitations, permissions and certifications for the safe operation of drones. The harmonised regulations will enhance the growth of the European Commercial Drone Market, the size of which has surpassed 3 billion USD in 2020 and is predicted to witness over 10% Compound Annual Growth Rate (CAGR) between 2021 and 2027.(Graphical Research, 2022)

The guiding principle of the implementing regulation is that the rules and procedures applicable to UAS operations should be proportionate to the nature and risk of the operation or activity. The regulations are safety centric however due to the unique capabilities of UAS, due consideration is also given to the potential privacy, security and data protection issues. Drone operations need to be adapted to the operational characteristics of the unmanned aircraft concerned and the characteristics of the area of operations, such as the population density, surface characteristics, and the presence of buildings (The European Commission, 2019a).The risk level criteria from both the ground and air as well as other criteria should be used to establish three

categories of operations as identified in 2019/947 which include, the '*open*', '*specific*' and '*certified*' categories, the defining criteria for which are summarised in sections 1.1.1 to 1.1.3.(The European Commission, 2019a)

Regulation 2019/945 primarily focuses on the technical aspects of UAS with new requirements for the design, manufacture and retailing of UAS. The regulation specifies Class identification labels (C-Markings) that are required to be fixed to a UAS meeting the defined criteria of the product standard. At the present time, the C-Marking acceptable means of compliance (AMC) standard is not available for UAS manufactures and so no C-Marked UAS are commercially available. The classification of drones as identified in Figure 1 has allowed for detailed specification of the types of drones (mass, speed, joules, payload, camera) permissible in the three categories of operations identified in Regulation 2019/947 (The European Commission, 2019a). UAS that do not comply with the C-Marking requirements in the future will be referred to as legacy drones.

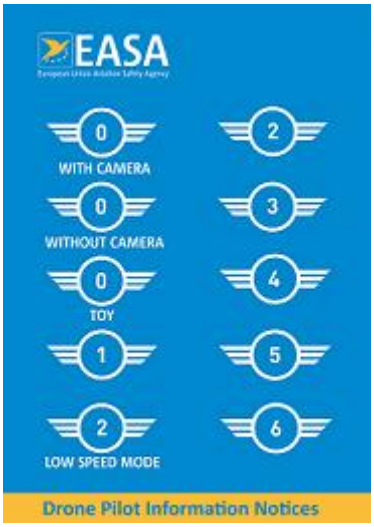

Figure 1 C-Marking Labels as per regulation 2019/945 (EASA, 2022)

1.1.1 Open Operations (Subcategories A1, A2 & A3)

Open category operations do not require any authorisation from an aviation authority or declaration by the operator before the flight. These are considered as sufficiently low risk operations categorised by simple rules followed by sufficiently competent and trained remote pilots. There are three key subcategories (A1, A2 & A3) within the open category where the mass and type of the UAS and distance from '*uninvolved persons*' are explicitly specified. '*Uninvolved persons*' means persons who are not participating in the UAS operation or who are not aware of the instructions and safety precautions given by the UAS operator. The rules that are common amongst each of the subcategories for the Open Category include:

- Operations are restricted to visual line of sight (VLOS) only, beyond line of sight (BLOS) is outside of the scope of these operations.

- The maximum take-off mass of the UAS must be less than 25kg. Refer to subcategories A1, A2 & A3 for the allowable UAS masses and allowable speeds for each subcategory.
- The UAS must be maintained within a 120m altitude from the closest point on the Earth's surface.
- The UAS must be maintained at a minimum horizontal distance from an uninvolved person. Refer to subcategories A1, A2 & A3 for further details.

The rules and restrictions for safe aviation within subcategories A1, A2 & A3 of the Open Category may be summarised as follows:

Subcategory A1 – Fly over people

The A1 subcategory within the Open Category of Drone operations is identified as being very low risk of harm to *'uninvolved persons'* due to the very low weight of unmanned aircraft permitted for use in the subcategory. The operating area for this subcategory may be defined as sparsely populated areas in uncontrolled airspace or controlled airspace with height restrictions. Refer to Table 1 for further details.

Table 1 Open Category of Drone Operations – Subcategory A1 UAS & Remote Pilot requirements (Dublin City Council, 2021)

Category	Aircraft Type	Distance From Uninvolved Persons	Flight Over Assemblies of People	Operating Area	Operating Airspace	Pilot Competency
A1 Transition Period	*'legacy'* <500g* *(Article 22 Operations)*	No Intentional Flight Overhead People	Not Permitted	Populated & Sparsely Populated	Uncontrolled Airspace Controlled Airspace within Height Restriction Zones. Some Restricted or Prohibited Geographic Zones with Permission from the Controlling Authority (e.g., Prison Service)	A1/A3 Proof of Online Training Certificate
A1	Private Built <250g <19m/s	Fly Overhead				Read User Manual
	'legacy' *(placed on market before 01 Jan 2023)* <250g *(Article 20 Operations)*	Fly Overhead				Read User Manual
	C0**	Fly Overhead				Read User Manual
	C1**	No Intentional Flight Overhead People				A1/A3 Proof of Online Training Certificate
	** From **01 Jan 2023** the Transition Period ends, and 'legacy' unmanned aircraft placed on the market before 01 Jan 2023 weighing 250g or greater are restricted to A3 Subcategory only (Article 20 Operations).* ***C Class unmanned aircraft may not be available on the market until late 2022 or after.*					

Subcategory A2 – Fly close to people

The A2 subcategory within the Open Category of Drone operations permits use of larger and more sophisticates UAS. Risk to uninvolved persons or assemblies of people is managed through specified minimum horizontal distances that the remote

pilots must maintain. There is also an additional competency standard and training (*A2 Category Training*) that the remote pilot must achieve in comparison to operations within the A1 & A3 subcategories.

Table 2 Open Category of Drone Operations – Subcategory A2 UAS & Remote Pilot requirement (Dublin City Council, 2021)

Category	Aircraft Type	Distance From Uninvolved Persons	Flight Over Assemblies of People	Operating Area	Operating Airspace	Pilot Competency
A2 Transition Period	*'legacy' 500g to <2kg* (Article 22 Operations)*	50m Horizontally	Not Permitted	Populated & Sparsely Populated	Uncontrolled Airspace Controlled Airspace within Height Restriction Zones. Some Restricted or Prohibited Geographic Zones with Permission from the Controlling Authority e.g., Prison Service	Open A2 Certificate of Competency
A2	C2**	30m Horizontally 5m with Low-Speed Mode				
	** From 01 Jan 2023 the Transition Period ends, and 'legacy' unmanned aircraft placed on the market before 01 Jan 2023 weighing 250g or greater are restricted to A3 Subcategory only (Article 20 Operations).* ***C Class unmanned aircraft may not be available on the market until late 2022 or after.*					

Subcategory A3 – Fly far from people

The A3 subcategory of the Open Category of Drone operations is considered as low risk as it permits large and heavy unmanned aircraft (up to 25kg) to be flown in flight areas that over 150m from residential, commercial, industrial, and recreational areas. Flying operations are restricted to uncontrolled airspace or controlled airspace with height restrictions. Risk to an uninvolved person is effectively eliminated by the requirement to have no uninvolved person in the flight area.

Table 3 Open Category of Drone Operations – Subcategory A3 UAS & Remote Pilot requirement (Dublin City Council, 2021)

Category	Aircraft Type	Distance From Uninvolved Persons	Flight Over Assemblies of People	Operating Area	Operating Airspace	Pilot Competency
A3 Transition Period	*'legacy' to <25kg (Article 22 Operations)*	No uninvolved person in the flight area.	Not Permitted	Flight area 150m horizontally from Residential, Commercial, Industrial & Recreational areas.	Uncontrolled Airspace Controlled Airspace within Height Restriction Zones. Some Restricted or Prohibited Geographic Zones with Permission from the Controlling Authority e.g., Prison Service	A3 Proof of Online Training Certificate
A3	Private Built *250g to <25kg*					
	C3* & C4*					
	'legacy' (placed on market before 01 Jan 2023) 250g to <25kg** *(Article 20 Operations)*					
	C Class unmanned aircraft may not be available on the market until late 2022 or after.* * From 01 Jan 2023.*					

1.1.2 Specific operations.

Specific operations require operational authorisation issued by the competent national aviation authority which in the context of Ireland is the Irish Aviation Authority (IAA), with certain exceptions. These operations are considered as medium to high risk operations that fall outside of the rules governing the limitations of the Open Category. Authorisation to fly in this category is based on a risk assessment and submission of an operations manual outlining operational procedures. Public bodies and private companies both need to register with the IAA as a UAS operator to operate in this category and all remote pilots must undertake *Specific Category* training. Some examples of operations that constitute the Specific Category of Operations include:

- Beyond visual line of sight operations (BVLOS) where the remote pilots are unable to see the UAS for some or all of the operation.
- Operations in controlled airspace or geographical zones not permitted within the open category.
- Where a UAS of 25kg or greater is required for the operations.
- When a flight altitude in excess of 120m from the closest point on the earth's surface needs to be achieved.
- For operations in built up and densely populated areas.
- Operations that require the dropping of payloads.

Where the operational intent of the drone operation falls outside of the limitations of the Open Category of Operations then the Specific Category is likely to apply.

Remote pilots operating in the Specific Category must comply with the procedures and limitations of the UAS Operators *'authorisation'* and their operations manual. Authorisation to operate in the specific category is primarily based on a risk assessment which should comply with Article 11 of Regulation 2019/947 "Rules for conducting an operational risk assessment". Amongst the criteria for risk assessments identified in Article 11 include the requirement to:

- **Describe the Operation**. The type of operation being conducted, the safety objectives, who is leading the operations as well as their competency levels and the environment in which the operations are being carried out.
- **Safety Assessment.** Identify all ground and air safety risks identifying and proposing operational and technical risk mitigation strategies to ensure the operation may be conducted as safely as possible.

There are three principle approaches or methodologies of utilising a risk assessment to obtain authorisation from the IAA which include:

UAS operator provided risk assessment - SORA

For non-routine or nonstandard operations, the UAS operator may be required to complete a *Specific Operations Risk Assessment* (SORA), a methodology developed by JARUS (Joint Authorities for Rulemaking on Unmanned Systems). This methodology provides the framework for Drone Operators to outline the risks and mitigation measures involved in their proposed operation and allows the aviation authority a systematic approach as to how the risks and mitigation measures may be assessed. The *'SORA'* is a 10-step process that includes the concept of operation definition, ground and air risk categorisation, an overall risk rating and operational safety objectives.(The European Commission, 2019a)

EASA provided risk assessment - PDRA

For more standard or routine operations, EASA has published a number of Pre-Defined Risk Assessments (PDRA`s) which permit clearly defined operations within specified operational and technical limitations. Where the operators proposed operation falls within these published risk assessments and associate limitations, the operator may make an application to the relevant aviation authority and "Authorisation" is granted based on the identified PDRA. As part of all PDRA applications, the operator is required to provide supporting documentation in the form of an Operational manual. There are currently 4 published PDRAs in circulation and it is anticipated that these will form the basis of the most common approach for a UAS Operator to acquire Authorisation within in the Specific Category.

Light UAS Operator Certificate ('LUC')

Local Authorites (Government Bodies) may apply to the national designated authority responsible for the implementation of national aviation regulations for a Light UAS Operator Certificate (LUC). A LUC allows local authorities assess the risk of drone related operations inhouse. It is up to the IAA in Ireland to assess whether the local authority has the competency required to assess the risk of a drone operation(s) inhouse. Where deemed sufficiently competent, a LUC certificate may be issued to allow 'inhouse authorise' of drone operations.

The *'LUC'* will outline what authorising privileges the Local Authority has but typically should allow for the authoristaion of *'PDRA'*s and to conduct operations using the Standard Scenario system. Where it is deemed that a high level of competency in assessment exists inhouse, those authorisies may authorise operations utilising the SORA process. The general requirments for an Authority to be considered as competent by the IAA are covered in regulaltion 2019/947 and include:

- a description of the UAS operator's management system, including its organisational structure and safety management system;

- the name(s) of the responsible UAS operator's personnel, including the person responsible for authorising operations with UASs;
- a statement that all the documentation submitted to the competent authority has been verified by the applicant and found to comply with the applicable requirements.

1.1.3 Certified operations.

Operations shall be classified in the '*certified*' category where the operation is conducted in any of the following conditions:

- When flying over assemblies of people which may be defined as gatherings where persons are unable to move away due to the density of the people present;
- When the operation involves the transport of people;
- When the operation involves the carriage of dangerous goods, that may result in high risk for third parties in case of accident.(The European Commission, 2019a)

These scenarios are recognised as some of the most complex operations that pose a risk similar in nature to manned aviation. In addition, UAS operations shall be classified as UAS operations in the 'certified' category where the competent authority, based on the risk assessment provided for in Article 11, considers that the risk of the operation cannot be adequately mitigated without the certification of the UAS and of the UAS operator and, where applicable, without the licensing of the remote pilot.[1]

1.2 Strategic plan for the development of RPAs/drones in the country. Priorities

Currently, there is no definitive strategic plan for the development of remotely piloted aircraft systems (RPAS) or drones in Ireland. The policy and regulatory landscape has struggled to keep pace with the rapidly evolving technology. In 2013, the Irish government published a "National Digital Strategy for Ireland, Phase 1" (Government of Ireland, 2013) which was closely followed in 2018 by the Irish National BIM Councils (NBC) publication "Roadmap to Digital Transition, for Irelands Construction Industry 2018-2021" (CITA, 2018). While not explicitly referenced in either publication, the utilisation of drones and other disruptive technologies for applications in digital construction and BIM has become synonymous. Leveraging such technologies to digitise the construction sector is a high priority in the NBC roadmap. In 2021, the Department of Public Expenditure and Reform published a National Development Plan (NDP) 2021-2030 (Department of Public Expenditure and Reform, Ireland, 2021). There are number of key priorities or investments that are planned for Ireland as highlight in the NDP (Department of Public Expenditure and Reform, Ireland, 2021):

1. Compact Growth – focusing on affordable housing and Urban Regeneration and Development
2. Enhanced Regional Accessibility – investment in active travel programme, enhancement of train and bus services
3. Strengthened Rural Economies and Communities – focusing on rural regeneration and development Fund, National Broadband Plan, supports for the remote working hub network and enhanced public transport through the Connecting Ireland bus programme
4. A Strong Economy, supported by Enterprise, Innovation and Skills – aiming at Green and Digital Transition, development of Technical Universities and national grand challenges programmes
5. High Quality International Connectivity – focusing on airports and ports development and investment
6. Enhanced Amenity and Heritage - Investments in the National Cultural Institutions, National Parks and sport related institutions.
7. Climate Action – retrofitting and flood relief schemes
8. Sustainable Management of Water and other Environmental Resources – Water and drainage
9. Access to quality Childcare, Education and Health Services
10. Other Sectors investment

The NDP 2021-2030 together with National Planning Framework (NPF) (Government of Ireland, 2022) combine to form Project Ireland 2040. The NPF sets the vision and strategy for the development of our country to 2040 and the NDP provides the enabling investment to implement that strategy This project focuses on number of areas aligned with the NDP document. As a result of this, one of the first enterprises

is a Build Digital Project (BDP) Ireland.(BDP, 2022). This is a first step into the incorporation and wider use of new digital technology in construction: "*The Build Digital Project will transform the Irish construction and built environment sectors by enabling all stakeholders, particularly SMEs, clients, and suppliers, to develop, maintain, and continuously improve their capabilities as digitally enabled, standards-based, agile, collaborative, and sustainable participants in the delivery of Project Ireland 2040*." According to Construction Sector Innovation and Digital Adopton Group, there are 7 innovation actions that will be delivered (Rudden, 2020):

- Construction Research
- Productivity and Sustainability Funding
- Modern Methods of Constrcution
- Construction Technology Centre
- Constrcution Skillnet
- ePlanning
- Build Digital Project.

Figure 2 illustrates the main linkages, actions and outcomes of the innovation actions identified above. Drones are a key focus area of the Construction Sector Group which are linked to the development of a new Construction Technology Centre which is currently under development.

The Construction Technology Centre (Enterprise Ireland, 2021) will be a industry led body together with Irish Government that with the right technical infrastructure will drive digitisation. Its key role will be focusing on:

- To provide funding avenue
- Share industry expertise
- Provide research and development capacity
- Become a collaboration platform of all construction industry stakeholders

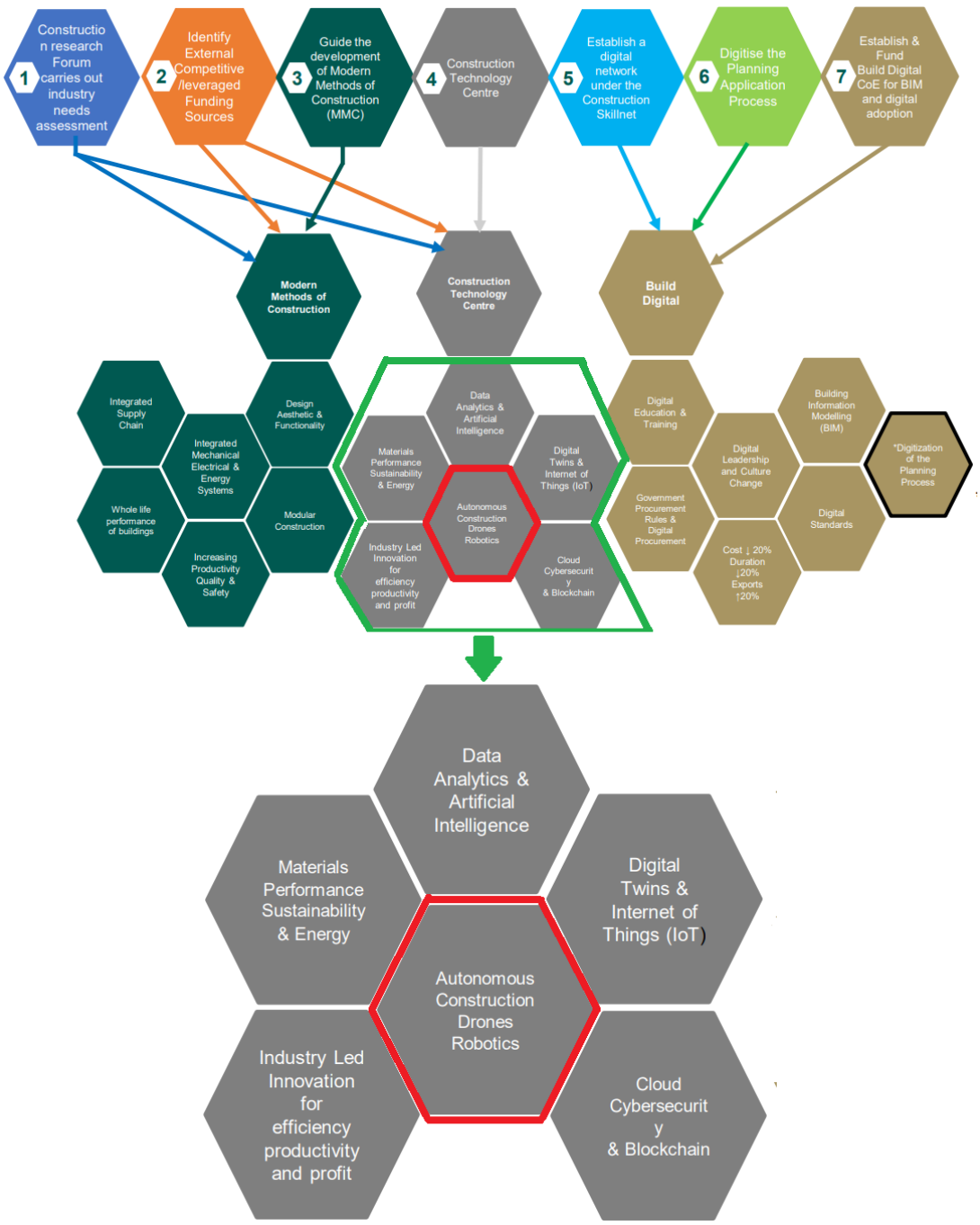

Figure 2 Construction Sector Group Innovation and Digital Adoption, Linkages, Actions and Outcomes (Rudden, 2020)

1.3 Government agencies with jurisdiction over RPAs

EASA (European Union Aviation Safety Agency), as established by the European Commission (EC) in 2002 (EASA, 2022), is Europe's leading agency responsible for civil aviation safety across the EU. EASA`s remit of responsibility includes but is not limited to:

- Draft implementing rules in all fields pertinent to the EASA mission
- Certify & approve products and organisations, in fields where EASA has exclusive competence (e.g. airworthiness)
- Provide oversight and support to Member States in fields where EASA has shared competence (e.g. Air Operations, Air Traffic Management)
- Promote the use of European and worldwide standards
- Cooperate with international actors in order to achieve the highest safety level for EU citizens globally (e.g. EU safety list, Third Country Operators authorisations) (EASA, 2022)

The Irish Aviation Authority (IAA) is Irelands designated national authority responsible for the implementation of National and European Aviation Regulations. The Authority ensures that Irish civil aviation operates to International and European safety standards and systems in accordance with international agreements. The IAA carries out a range of operational and regulatory functions and services on behalf of the Irish State relating to the safety and technical aspects of Civil Aviation including:

- Air Traffic Management
- Safety Regulation
- The Role of the National Supervisory Authority
- Single European Sky
- Legislation
- Commercial Services
- Aviation and the Environment
- Safety Assessment of Foreign Aircraft
- Policy on Consultation by Planning Authorities
- Non-Aviation Activities Impacting Airspace

Flying and operation of RPAs or Drones is regulated by EU regulation 2019/947 and the agency responsible for implementing and supervising is The Irish Aviation Authority (IAA)(IAA, 2022a). IAA also is responsible for provision of guidelines, regulating the use of drones warranting public safety.

The IAA is a commercial semi-state company responsible for three core functions:

- air traffic management and related services in Irish controlled airspace
- the safety regulation of the civil aviation industry
- civil aviation security supervision.

The table below represents detailed function that IAA is responsible for

Table 4 IAA Functions & Responsibilities (IAA, 2022a)

Functions	**Responsibilities**
Air Traffic Management	Air traffic control, ATC flight information, Alerting and search and rescue services, Aeronautical information, North Atlantic Communications.
Safety regulatory functions	Certifying and registering aircraft airworthiness, Licensing personnel and organisations involved in aircraft maintenance Licensing pilots, air traffic controllers and aerodromes, Approving and monitoring air carrier operating standards.
Supervision of civil aviation security	Inspections and Audits of:Airports, air carriers, cargo companies, airport suppliers, suppliers of in-flight services

In order to ensure the highest operating quality IAA operates in line with international standards:

- International Civil Aviation Organisation (ICAO)
- European Joint Aviation Authorities (JAA)
- EUROCONTROL
- European Civil Aviation Conference (ECAC)
- European Aviation Safety Agency (EASA)
- European Union (EU).

1.4 RPA operator qualification requirements / Pilot certifications needed

The Implementing Regulation 2019/947 - rules and procedures for the operation of unmanned aircraft, specifies unique responsibilities for both the UAS operator and the remote pilot. Article 2 of Regulation 2019/947 makes the clear distinction between the UAS Operator and remote Pilot as follows:

A ***UAS operator*** means any legal (government body or private company) or natural person (recreational pilot or sole trader) operating or intending to operate one or more UAS (The European Commission, 2019a).

A ***'remote pilot'*** means a natural person responsible for safely conducting the flight of a UAS by operating its flight controls, either manually or, when the UA flies automatically, by monitoring its course and remaining able to intervene and change its course at any time(The European Commission, 2019a).

Whether a public body, private company or sole trader, the enterprise carrying out the drone operations is required to be designated and registered as the UAS Operator with the IAA. Article 14 – Registration of UAS Operators and certified UAS, of regulation 2019/947, outlines a requirement for UAS Operators to register themselves:

a. when operating within the 'open' category, any of the following unmanned aircraft:

    i. with a MTOM of 250 g or more, or, which in the case of an impact can transfer to a human kinetic energy above 80 Joules;

    ii. that is equipped with a sensor able to capture personal data, unless it complies with Directive 2009/48/EC.

b. when operating within the 'specific' category an unmanned aircraft of any mass.

The vast majority of drone operations whether for commercial or recreational purposes, will require the ability to record data of some description (visual, audio, etc) thereby necessitating registration as a drone operator with the IAA. The only exception being where the UAS is privately built, less than 250g, has no sensors capable of capturing data and operating within the Open Category.

1.4.1 Registration and Training

Registration as a drone operator with the IAA is done through the MySRS (My Safety Regulatory System) portal in Ireland. This a purpose-built online platform for the management and issuing of RPA Licences/Certificates in Ireland. The first step in the registration process is to sign up for an account on MySRS where the operator will be required to upload identification in the form of a Drivers Licence, National ID or Passport. Once the operator's identification has been verified, they will be provided with login credentials for their own account on the MySRS portal and must pay the €30 fee to complete the registration process.

Once registered, the operator will need to complete the **online A1/A3 category training course**, this is the basic training requirement and foundation for all other training requirements. The training is provided within the MySRS portal and consists of a 20min slide show followed by a 40-question multiple choice exam. Where an applicant achieves a 75% or greater overall result, they will be able to download the A1/A3 proof of online training cert as per the exemplar certificate shown in figure 2. This certificate is issued by the IAA and entitles the operator to fly a RPAS in the A1/A3 Open category.

A1/A3 Category Training

A1 Subcategory: Drones weighing less than 500g or have a C0 or C1 label. Fly close to people below 120m and in sparsely populated and populated areas.

A3 Subcategory: Drones weighing between 500g and 25kgs or have a C2, C3 or C4 label. Fly 150m from Residential, Commercial, Industrial and Recreational areas below 120m

Figure 3 Exemplar A1/A3 Proof of Training Certificate (IAA, 2022a)

For open category A2, additional training to the A1/A3 training is required. In Ireland, all further training requirements are met through commercial UAS schools referred to as Declared UAS Training Organisations (DUTO). The additional training covers additional subject areas to enable an Open Category pilot fly within the A2 Subcategory. In Ireland, DUTO typically offer this training online through their own online portals which cumulates in a 30-question multiple choice exam.

A2 Category Training

A2 Subcategory: drone weighing 500g to <2kg, or has a C2 label. This legally permits a Remote Pilot with an unmanned aircraft weighing 500g to 2kg (4kg EU Class C2) to fly as close as 50m from 'uninvolved persons', or as close as 30m for those using EU Class C2 drones. Certification is valid for 5 years.

Table 5 Summary of the A1, A2 & A3 Category Training Requirements (Dublin City Council, 2021)

Subcategory	Type of Training	Where	Award	Validity	Notes
A1/A3	Open A1/A3 Proof of Online Training	Online - IAA MYSRS	Open A1/A3 Proof of Online Training	5 Years	- 9 core subject areas. - 40 multiple choice question online exam (MYSRS). - Each remote pilot will be required to open an account with the IAA's MYSRS online portal.
A2	Open A2 Certificate of Competency	Declared UAS Training Organisation (DUTO) – Commercial UAS School	Open A2 Certificate of Competency	5 Years	- 3 additional subject areas covered over A1/A3. - 30 multiple choice question exam. - Self-practical training. - IAA issue Open A2 Certificate of Competency on recommendation of DUTO. - Remote pilot must first hold the Open A1/A3 Proof of Online Training certificate.

1.5 Key figures (nº of registered operators like corporations, SMEs…; registered aircrafts; …)

Although Ireland has a relatively small population of approx. 5million, it has a rapidly growing number of UAS pilots and SMEs utilising drones for commercial operations. The most common SMEs include those involved in Geospatial Surveying, Construction and Photography. According to information provided by the IAA, currently there are **7,533 registered drone operators**. As of 2022, the breakdown of remote pilot certificates successfully achieved and subsequently issued by the IAA was as follows:

- For **Open category A1/A3** - **11,994** remote pilot certificates issued
- For **Open category A2** - **1,218** remote pilot certificates issued
- For **Specific category (STS)** – **284** remote pilot certificates issued

Currently, there are 2 companies that have obtained a LUC which is a Light UAS operator certificate allowing organisations proving to be able to assess the risk of an operation themselves.

According to EU/Eurostat that has initiated a smart statistics approach in order to retrieving information on drone related businesses in Europe there are 681 companies found on the Web with services related to drones usage (European Commission. Statistical Office of the European Union., 2022).

This search engine was used to find URLs of drone operating businesses since data for Ireland is not available.

	CLOUD	CONSULTANCY	DISTRIBUTION	FILMING_IMAGING	INSPECTION	INSURANCE	MAPPING	MONITORING	RENTING	SOFTWARE	SURVEYING	TRAINING
CLOUD	1	1	0	0	1	0	0	0	0	0	1	0
CONSULTANCY	1	4	0	1	3	0	2	1	0	0	3	1
DISTRIBUTION	0	0	4	0	0	0	0	0	0	0	0	0
FILMING_IMAGING	0	1	0	35	15	0	11	1	0	0	15	0
INSPECTION	1	3	0	15	22	0	11	2	0	1	16	0
INSURANCE	0	0	0	0	0	1	0	0	0	0	0	0
MAPPING	0	2	0	11	11	0	15	2	0	0	11	0
MONITORING	0	1	0	1	2	0	2	2	0	0	2	0
RENTING	0	0	0	0	0	0	0	0	1	0	0	0
SOFTWARE	0	0	0	0	1	0	0	0	0	1	0	0
SURVEYING	1	3	0	15	16	0	11	2	0	0	25	0
TRAINING	0	1	0	0	0	0	0	0	0	0	0	3

Figure 4 Drone company activities in the value chain and their co-occurrence in Ireland (European Commission. Statistical Office of the European Union., 2022)

As clearly visible from the above table, the main drone related services provided by companies in Ireland are photogrammetry and imaging, surveying, inspections and mapping. Services like using drones for goods deliveries are still in its infancy.

2 Industry Overview

Considering that Ireland is a relatively small country (about 5.12 million people (Citizensinformation.ie, 2022)) with a drone industry is rapidly evolving, however there is no top-down approach as mentioned in chapter 1.2. Usage of drones is in Ireland is mainly used for:

- Image/Video capture
- Land and buildings Surveying
- LIDAR scanning
- Mapping

Of course there are other areas of drone usage in Ireland that are perhaps less trasnaprent such as: security activities, coast guarding, archaeology etc.

2.1 Focus. Related activities linked to RPAs

Apart from day to day use of RPAs in different industries such as: Construction, Surveying & GIS, Farming, Audio/Visual, Environmental Activities, Defence Forces, Archaeology, Coast Guarding and Security; there are number of national and local initiatives that are emerging.

2.2 Developments

There are number of research driven projects between academia and industry. One of few recent initiatives is project approved in June 2022 by European Union, controlled by Future Mobility Campus Ireland (FMCI)(Derguech, 2022). It is a three-year project worth around €7 million partnering Irish and European stakeholders such as Shannon Group, IAA, Collins Aerospace (Ireland and France), Dublin-based Avtrain, Manna and Deepblue in Italy. FMCI is a first test bed in Ireland that will focus on advanced mobility technologies both ground related technologies (ie. Autonomous driving, micro-mobility and others) and air technologies such as: unmanned drones, eVTOL, AAM, UTM).

Another research institute worth mentioning is a local based development is a project "Accelerating the potential of drones for local governments" led by Dublin City Council and Smart Dublin co-funded by Department of Public Expenditure and Reform (DPER) (SmartDublin, 2022). Following collection of drone use best practices in Europe, the project focused on usage of drone industry in Ireland in 5 sub-sectors: public safety, health and environment, planning and development, transport and logistics and finally energy.

There were number of results for drone usage that will aid future decision making such as (SmartDublin, 2022):

→ PUBLIC SAFETY:
  - Fire safety site mapping,
  - Fire Services High Rise Emergency Air Support

- Firebreaks creation
- Flood risk mapping and planning

→ Health and Development:

- Defibrator Delivery,
- Medical Supplies delivery
- Urban areas sanitation
- Organ Transplant Delivery
- Pollution monitoring and control
- Critical infrastructure control

→ Planning and Development:

- Site Inspection and Enforcing,
- Aiding Construction and development for local Government buildings

→ Transport and logistics:

- Road maintenance and monitoring,
- Traffic surveillance
- Presence of drones in ports
- Post and other deliveries enabled by drones

→ Energy:

- Monitoring Energy Storage and Transmission Systems,

Another interesting output of this project was National Survey (902 responses) which 50% of responders knew about drone technology and uses and 46% had some idea. When asked about drone usage in Ireland, 84% of respondents were positive about the technology. It seems that public is expecting drone deliveries to be well in use by 2025. Amongst highest uses of drone technology according to responders would be:

- emergency response
- planning
- environmental monitoring and policing
- waste management
- traffic management
- policing

Amongst biggest concerns were privacy (75%) illegal activities (inl. Data hacking) 54% and safety (50%). As a final result worth mentioning was lack of knowledge of which agency is drone technology (less than 20%)(SmartDublin, 2022).

2.3 Sector statistics

According to a report delivered by Dublin City Council "*Accelerating the potential of drones for local governments.International best and emerging practice report*" (SmartDublin, 2022) in 2015, there were 5000 registered drones in Ireland, by 2020 that number increased to over 22 000. According to Statista.com (Statista, 2022) it

is predicted that Irish Drone sector is expected to show a volume growth of 25.8% in 2022. There isn`t many existing publications regarding Drone sector available at the moment apart from websites and blogs run by enthusiasts and companies providing drone related services. According to Statista (Statista, 2022)Drone sector Revenue in Ireland amounts to €1.87m in 2022 and it is expected to grow annually by 0.75% (Compound Annual Growth Rate 2022-2027). These figures consider consumer drones, hobbyist and under 5kg equipment. These figures, excludes however military, radio-controlled two-wing aircraft and helicopters, Commercial drones and accessories.

2.4 Sector challenges - Technology adoption and gaps (Drone adoption)

According to Dublin City Council report (SmartDublin, 2022) Ireland with relation to drones has number of strengths and weaknesses:

Table 6 Strengths and Weaknesses for Drone technology adoption in Ireland (SmartDublin, 2022)

Strengths	**Weakness**
Advanced capabilities in financing	Commercial drone manufacturing
Drone delivery	Uncertainty over regulations coming from the EU
Regulatory / Industry cooperation	Airspace access restrictions
Urban Air mobility planning	Length of time to get permission to fly
Uncongested airspace and an Irish Aviation Authority (IAA) with a dedicated Drone Support Division and dedicated full-time drone champion	The cost of administration
Drone test-site locations to support various drone services development	Poor weather
Regulatory agencies are readily accessible (IAA, ComReg, Data protection)	Problems with public perception & trust
Healthy economy	Unauthorised drones
Strong technology/ICT investment from very large global companies	Lack of awareness
Access to Drone R&D expertise, regulatory specialists and licensed operators	
Supportive and proactive local government and public agencies	

Looking at above table it is clear that Ireland is well placed to progress and increase use of drones, however there are few items that need to be developed (SmartDublin, 2022):

1. Nationwide use cases their positive impacts and benefits needs to be closely monitored
2. Increase recognition and awareness of drone technology in Ireland
3. Safety and privacy concerns safeguarding practices
4. Drone services – national strategy to increase public trust
5. To help grow the sector build a road-map with national and EU stakeholders
6. A high-level strategic review of the Irish drone industry to identify strengths and weaknesses, opportunities and threats
7. Development of drone testing zones and regulated training

2.5 Key takeaways from the survey (from companies & professionals

The Irish national survey of companies and professionals with regards to their drone related activities was sent to approx. 30 strategically identified enterprises around Ireland and to one professional user group based on LinkedIn with over 100 professionals working in AEC sector in Ireland. Microsoft Forms was utilised to assist in the distribution of the survey and to expedite the recording and analysis of survey results. The following section details some of the key findings however a full list of the recorded responses to all survey questions is available in Appendix 1.

In total, there were 30 responses to the survey from companies and professionals engaged in a diverse range of sectors including:

- 23.3% Engineering
- 10% Civil Works
- 6.7% Specialised Industrial Construction
- 3.3% Residential Building
- 3.3% Facilities Management
- 3.3% Surveying
- And some 50% of respondents identifying as "other" in relation to the sector that the company belonged to.

The size of the organisations (31 resonses) varied with 71% stating they had 100 employees or more (Large), 16% had between 0-25 employees (small) and 13% had between 25-100 employees (medium).

For drone related activities, over 60% of respondents noted that they hire drone service providers with just 40% stating that they had the inhouse expertise and licencing to conduct such operations inhouse. The number of employees involved in the use and or management of drones was shown to be:

- 1-4 employees in 32% of companies
- 5-9 employees in 13% of companies
- 10-24 employees in 6% of companies
- 25-99 employees in 3% of companies
- 45% of companies stated they had no employees involved

When asked on the frequency of usage of drone technology in the company:

- 6.5% reported extensive use
- 48% reported occasional use
- 39% reported rare use
- 6.5% reported no use

Interestingly, 74% of respondents expected drones to be used utilised more frequently in the future with only 26% stating they were unsure if there would be increased demand. No respondents were recorded as stating that drone usage will not increase in the future.

In relation to the prevailing applications for which drones are being utilised within companies and by professionals, the survey data recorded the following results based on the application choices that were available to respondents:

- 33.3% - involved in progress tracking and communication
- 30% - preconstruction and planning
- 30% - other
- 3.3% - used drones for job site risk mitigation
- 3.3% - first assessment and bid process preparation

Further to application usage of drones by companies and professionals, when asked which specific tasks are being developed using drones, respondents were not limited to one answer and so the following hierarchy of drone related tasks (118 Tasks selected by respondents) were observed:

- 21.2% - Surveying
- 19.5% - Photography and Video
- 12.7% - Progress Monitoring
- 11% - Asset Inspections
- 9.3% - 3d Modelling

- 8.5% - Measurements (Volumes areas etc)
- 5.9% - Digital Surface Terrain Models
- 5.1% - Thermal Imaging
- 1.7% - Equipment Tracking
- 1.7% - Security Surveillance
- Less than 1% Other

When asked which of the identified tasks are you willing to implement in the future, 3D Modelling, Measurements & Digital Surface terrain models saw the largest increases in selection at 18% 16%, & 11% respectively.

For construction related activities, companies were asked to identify based on their experience, what advantages could be achieved through the use of drones. Respondents were not limited to only one answer and out of the 122 recorded responses that were chosen, the following hierarchy was observed:

- Time Saving 17%
- Mitigation of risks and time saving 16%
- Cost Saving 13%
- More accurate progress monitoring 12%
- Operational Efficiency 12%
- Higher Data Acquisition 11%
- More appealing marketing material 9%

Companies reported some difficulty in finding suitably qualified professionals to fill drone related roles with 42% of respondents stating that it ranged from somewhat difficult to extremely difficult to find suitably qualified professionals. No respondents were recorded as noting it was easy to find suitably qualified persons. 58% of respondents recorded a neutral response.

Companies were asked what in their opinion was the reason(s) behind such skills shortages with the following hierarchy of answers being observed:

- Lack of specific skills pathways
- Low adoption of innovative technology by companies
- Inadequacy of facilities or equipment to provide practical training
- Culture of drone technology is perceived as intimidating
- Slow implementation of new training programmes adapted to new trends in construction
- Fragmentation of the construction sector causing a broad gap between the education system and the industry
- Low investment in the implementation of upskilling or reskilling training programmes

- Trainees have limited exposure to this type of technology during their education or on their job apprenticeship

When asked as to what the likely solution(s) to tackle this skills shortage could be, 66% agreed that an ***Awareness of drone technology and the various benefits it brings within the construction industry*** **was the main solution**. The hierarchy of recorded answers from the survey as to the potential solutions(s) was as follows:

- Awareness of drone technology and the various benefits it brings within the construction industry (66%)
- Implementation of standardised training courses that match the different jobs in the sector (15%)
- Foster open exchange and communication between companies and educational institutions to favour cooperation (7%)
- Implementation of standardised training courses that match the different jobs in the sector (7%)
- Investing in the upgrading of training centres (4%)

The respondents were asked if there were any other proposals that could be beneficial to tackle the issue. An additional 6 proposals were identified as follows:

- More exposure by the private companies on drone capabilities, legislative review on where they can be used etc.
- Provide workshops outlining what can be done by drones and the benefits they have. Provide relevant training or incentives to upskill employees to use drones.
- Cost analysis between the application of drones for certain tasks versus the traditional way.
- Safety benefits to all stakeholders within the Construction Industry
- Awareness of the potential uses and capabilities of Drone technology for the industry would improve the uptake of both workload and training for this field. The Drone Technology market can be seen as a gimmick with little to no knowledge on how to leverage the potential of the Drone Technology.

When asked as to how agreeable respondents were to the following statement, "***The implementation of standards & certification for operation will help to leverage drone operation***", 50% agreed, 43% somewhat agreed and 7% didn't know.

When asked as to how agreeable respondents were to the following statement "***Cooperation between educational institutions, industry and related stakeholders will reduce the gap between existing training and the real needs of the sector",*** 83% agreed, 13% somewhat agreed and 6% didn't know.

3 Training

3.1 Specific training and licensing for RPAS pilots

There are three key Drone Categories of Operation as outline in regulation 2019/947 (refer to the Section 1.1 of this report for a more detailed description of each). The training and licencing requirements that a Remote Pilot requires depends on which Drone Category of Operation(s) the Drone Operator will be exposed to when flying an UAS.

Regardless of the Drone Category of Operation to be employed, registration is the first step in the training and licencing of remote Pilots. UAS Regulation 2019/947 mandates for the issuing of all remote pilot certificates through a "designated entity" which in an Irish context is the IAA. The IAA has developed a purpose-built online platform called "MYSRS" which is a training and pilot certificate issuing portal in Ireland.

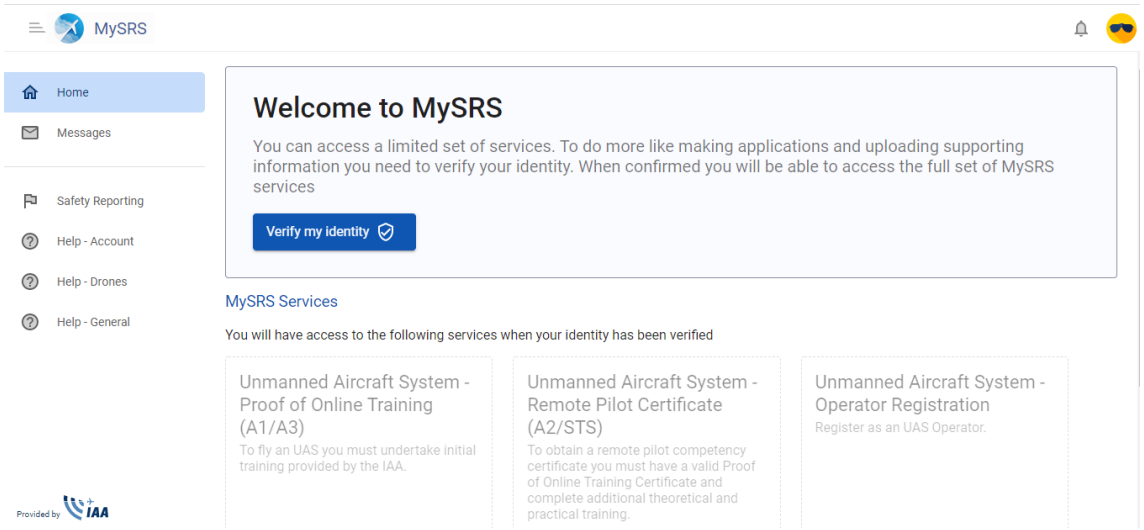

Figure 5 MYSRS Portal (IAA, 2022b)

Previously in Ireland, the now withdrawn Irish regulation S.I No. 563/2015 – (Small Unmanned Aircraft (Drones) and Rockets) Order, 2015, required unmanned aircrafts to be registered. The current UAS regulation 2019/947 requires the "Drone Operator" to be registered. Each unmanned aircraft that is to be flown by a drone operator, must have the UAS Operators registration number fixed to the frame. A QR (quick response) code may be used instead of the alphanumeric string. In Ireland, registration can be acquired for one or two years. The UAS Operator is required to re-register before the expiry date of the current registration period.

3.1.1 Open Category training and licencing

Remote pilots are required to meet the competency requirements of the category of operation that they intend to operate within. The **minimum training requirement is Open A1/A3** (refer to section 1.1.1 for further details) which in practical terms is necessary for remote pilots to operate a UAS of 250g or greater or a UAS with a sensor capable of capturing human data. The A1/A3 training consists of an online theory course/short online training videos followed by an online 40-question multiple choice theoretical knowledge assessment. This training may be completed on the "MYSRS" online portal. There is no requirement to undertake a practical flight test. The training is the foundational basis upon which all other levels of remote pilot competency is built.

For open category A2, additional training to the A1/A3 training is required. In Ireland, all further training requirements are met through commercial UAS schools referred to as Declared UAS Training Organisations (DUTO). The additional training covers additional subject areas to enable an Open Category pilot fly within the A2 Subcategory. In Ireland, DUTO typically offer this training online through their own online portals which cumulates in a 30-question multiple choice exam.

Subcategory A2 refers to drones weighing 500g to <2kg, or has a C2 label. This legally permits a Remote Pilot with an unmanned aircraft weighing 500g to 2kg (4kg EU Class C2) to fly as close as 50m from 'uninvolved persons', or as close as 30m for those using EU Class C2 drones. Certification is valid for 5 years.

Table 7 A1/A3 & A2 Training Details (Dublin City Council, 2021)

Subcategory	Type of Training	Where	Award	Validity	Notes
A1/A3	Open A1/A3 Proof of Online Training	Online - IAA MYSRS	Open A1/A3 Proof of Online Training	5 Years	- 9 core subject areas. - 40 multiple choice question online exam (MYSRS). - Each remote pilot will be required to open an account with the IAA's MYSRS online portal.
A2	Open A2 Certificate of Competency	Declared UAS Training Organisation (DUTO) – Commercial UAS School	Open A2 Certificate of Competency	5 Years	- 3 additional subject areas covered over A1/A3. - 30 multiple choice question exam. - Self-practical training. - IAA issue Open A2 Certificate of Competency on recommendation of DUTO. - Remote pilot must first hold the Open A1/A3 Proof of Online Training certificate.

3.1.2 Specific Category training and licencing

For operations that fall outside of the scope of the Open Category, the EU Specific Category is likely to apply (refer to section 1.1.2 for detailed description of Speciifc Category Operations criteria). Remote pilots require additional training to the A1/A3 minimum standard to fly in the EU Specific Category. Authorisation by the designated authority (IAA for Ireland) is required to fly in this category and is based on a risk assessment and submission of an operations manual outlining operational procedures. Remote pilots operating in the specific category are required to meet the competency standard outlined in the risk assessment which for PDRA and STS operations includes the following traning:

- EU Specific Category Training Theory Course
- EU Specific Theory Exam
- Practical Skills assessment

Remote Pilots must first complete the Open A1/A3 Training via the MySRS portal. Following this, the EU Secific Category training can be received at a designated entity which in the case of Ireland will be at one of the Declared UAS Training Organinstaions (DUTOs) as identified in in Table 8.

Table 8 Summary of the training requirements for the Specific Category (Dublin City Council, 2021)

Risk Assessment	Type of Training	Where	Award	Validity	Notes
PDRA/STS	Theory & Practical	Open A1/A3 Online - IAA MYSRS. Specific category theory - DUTO	Theory Remote Pilot Certificate of Theoretical Knowledge **Practical** Certificate of Completion of Practical Skill Training.	5 Years	- 9 core subject areas enhanced with additional course material. 4 additional subject areas - 40 multiple choice question exam (MYSRS). - Each remote pilot will be required to open an account with the IAA's MYSRS online portal. - Theory certificate issued by the IAA through MYSRS on recommendation of DUTO. - Practical certificate issued by DUTO.
SORA	As defined by risk assessment to include Theory & Practical	Open A1/A3 Online - IAA MYSRS. Specific category theory - DUTO	As required	As required	- Risk assessment will define training requirement. It is expected that as a minimum, the PDRA/STS course may be required. - Depending on operation, 4 Additional subject areas over PDRA/STS course may be required for example radio licence.

3.1.3 DUTOS in Ireland

There are a number of DUTOs in Ireland as identified in Table 7 which can provide the training requirements for remote pilots to operate within the EU Specific or A2 categories.

Table 9 DUTOS in Ireland (IAA, 2022a)

NAME	ADDRESS	EMAIL
SkyTec Ireland	Rochestown Cork Co.Cork	steveslade@skytecireland.com
Avtrain	Suite 317 Guinness Enterprise Centre Taylor's Lane Dublin 8	julie@avtrain.aero train@avtrain.aero
USpaceAero		support@uspaceaero.com
FlyRyte Drone Academy	The Media Cube DIADT Dun Laoghaire Co. Dublin	info@flyryte.com
EU Drone School	DeltaCopter SRL Rue De L'Industrie 20 1400 Nivelles Belgium	info@droneschool.eu
Survey Drones Ireland	Unit 6a Ballymount Cross Industrial Estate Dublin 24 D24 EC56	info@surveydrones.ie wfloyd@surveydrones.ie
Safe Drone	Westmanstown Conference Centre Clonsilla Dublin 15	mark@safedrone.ie

3.2 Description and comparison of the current training offer

As highlighted in section 3.1.3, there are a number of DUTOs offering drone related training services in Ireland. The primary training offer is the additional training required to operate within the A2 Open Category or EU specific category. This training is heavily focused on a theoretical knowledge of the relevant legislation, meteorology, UAS flight performance and technical and operational mitigation measures for both

ground and air risks. An example of some of the indicative content covered as part of these training offers is shown in Table 8. With the exception of practical flight exam as part of the EU Specific Training, there is little or no actual UAS flight training.

Some DUTOs recognise this and offer additional "flight training" which focuses more on the practicality side of UAS operations from the different flight modes to achieving best data capture through optimum camera settings.

Table 10 DUTOs Training Offer (Survey Drone Ireland, 2022)

Training type	Valid for	Content	Duration of the course	Cost
EU Open Category A2	5 years	• Open Category. • Meteorology. • UAS flight performance. • Technical and operational mitigation's for ground risk. • Geographical Zones – Ver 18. • Multiple Choice – Written Exam.	3-4 hours	149
EU Specific Category Theoretical Ground School Course	N/A	• Specific Category • Airspace. • U.F 101 Application to request Permission to Fly a UAS inside a Controlled Traffic Area. • Navigation. • Meteorology. • Technical and operational mitigation's for ground risk. • UAS Flight Performance. • SORA (Specific Operating Risk Assessment) Part One. • SORA (Specific Operating Risk Assessment) Part Two. • Technical and operational mitigation for air risks. • Human Factors. • Data Protection – Introduction. • Written Exam.	12 hours	750
Flight Training	N/A	• Introduction to Aircraft • Maintenance of Aircraft • Introduction to FM App • App Settings and Functions • Basic Flight Modes • Flying Basic Flight modes	Not specified	800

		• Camera Settings – Introduction to Shutter Speeds, Apertures (f-stop) Settings, ISO settings, White Balanced explained and others	

3.3 Key takeaways from the survey (from learners/trainees; maybe trainers?)

The Irish National Survey was disseminated to approximately 300 students, all of which were enrolled in third level education from level 6 up to level 9. Approx. 30 % (87 responses) of the students responded through the MS Forms platform with their answers. Some of the key takeaways form the survey included:

Question 1 was to determine which education level responders were:

1. 49 answers (56%) from Bachelor's Degree (NFQ Level 8)
2. 19 (22%) from Ordinary Bachelor's Degree (NFQ Level 7)
3. 1 answer (1%) from Adult learning/Continuing training
4. 18 from Masters students stood for 21%

Question 2 was to determine how familiar with drone technology survey respondents are. It seems that the majority of surveyed students (78%) understand drone technology but only 27% have used them in the field.

The majority of respondents (70) are interested in Engineering (or related disciplines i.e. Civil Works, Energy, Telecoms) as a future carrier path. Smallest number of respondents were into Mining (6 responses) on Telcom's (6 responses).

With respect to the usage of drone technology, students were quite consistent answering: areas of surveying, photography and preconstruction and site planning usage.

Majority (91% of surveyed) had clear understanding of in demand jobs; Building Information Modelling and digitisation stood for 66% of answers. There were no drones mentioned amongst answers.

Question 7 was trying to determine pathways leading to drone training, about 41% were neutral in their opinion. Majority of surveyed group 58% found it difficult to access information.

Amongst main answers for difficulty accessing information respondents highlighted three main reasons:

- Lack of specific training programmes – 49 answers
- Limited exposure in secondary education or apprenticeship – 42 answers

As the least issue lack of official training body (13 responses) and trainers (22) were highlighted.

One of the main solutions to aforementioned issues (69 responses) pointed to increase awareness to drone technology and implementation of standardised training courses (49 responses).

Alongside these answers, respondents gave a number of paths and solutions to increase exposure of drone technology sector to interested parties, such as:

- Funded training or incentives for companies to buy drones and train staff etc
- Enable access to drone technology in secondary schools and college, so people can gain an interest in them from a young age.
- Increased information on how drone technology is beneficial and how It can improve different aspects of day to day life or in each individuals career.
- Promotion and advertisement

Statement "Dissemination of drone technology applications and the related range of job opportunities within the construction sector, will increase the number of suitably qualified workers" was agreed in principle by 80%. Disagreed by 1%.

When asked about aspects of training for effective learning and insertion into the market answers were responders suggested:

- Active practice – 75
- Visits to real site – 55
- Up-to-date technological equipment – 41
- Training and demonstrations (respectively 38 and 49)
- Carrer guidabce – 9 responses

4 Conclusions

While Ireland is embracing the broad spectrum of digitalisation ranking 5th in Europe on the DESI Index (European Commission, 2022) government policy and regulation aimed towards exploiting the full potential of drones specifically has struggled to keep pace. The UAS industry in Ireland is rapidly growing organically and shows great promise across almost all sectors of the economy from agriculture, construction, photography, geospatial to transport.

Recent government backed projects such as the Build Digital Project (BDP, 2022), part of Project Ireland 2040 plan (Government of Ireland, 2022), will help to increase the adoption rate of technologies such as drones in specific industries such as construction. The new Construction Technology Centre which is in development will become a national hub in Ireland where drones and automation are one of the key focus areas further driving developments related to construction. However more joined up thinking is required across government departments to realise the full potential of UA systems and the value this technology can add to our life's and the economy at large.

A National survey of companies and professionals (C&P) utilising drones in Ireland was conducted as part of this report. Upon analysis of the results, 74% of respondents expected drones to be utilised more frequently in the future in Ireland. Just 40% of the respondents had the inhouse skills necessary to carry out drone related operations with 60% outsourcing their drone related requirments. Companies reported some difficulty in finding suitably qualified professionals to fill drone related roles with 42% of respondents stating that it ranged from somewhat difficult to extremely difficult to find suitably qualified professionals. No respondents were recorded as noting it was easy to find suitably qualified persons. Companies were asked what in their opinion was the reason(s) behind such skills shortages with the most popular anwer being "*Lack of specific skills pathways" and "training*".

A key pillar of the successful adoption and integration of drones into European and Irish society will be the successful training of professionals across a range of different sectors. Training in the form of the safe operation and licencing of drones but also in relation to the associated technologies. The technology surrounding the various applications for which drones will be used has the potential to crossover many areas of ICT (Information Communication Technology), from big data to AI (Artifical Intelligence). UAS training that aims to leverage such technologies will realise the greatest benefits across the various sectors.

With no current formal training in the usage of drones at VET or third level in Ireland, the Drones4VET programme has the potential to become the catalyst that will significantly enhance drone usage across all sectors of the Irish economy. As part of the national survey of C&P, when asked as to how agreeable respondents were to the following statement "Cooperation between educational institutions, industry and related stakeholders will reduce the gap between existing training and the real needs of the sector", 83% of the respondents agreed. It is clear therefore, that tailored European wide training programmes in the use of drones is a key pillar to unlocking the full potential of this technology in Ireland and Europe.

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6 Appendix

6.1 National Survey results for Professional

Figure 6 National Survey for Professionals, Question 1 results

1. Which sector does your company belong to?

More Details

Civil works	3
Residential building	1
Specialized industrial constructi...	2
Mining	0
Energy	0
Telecoms	0
Facilities Management	1
Surveying	1
Engineering	7
Other	15

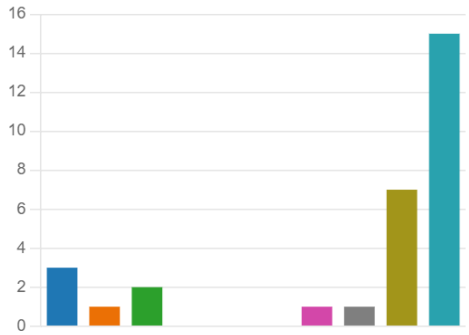


Figure 7 National Survey for Professionals, Question 2 results

2. What size is your Company

More Details Insights

Small (0 -25 employees)	5
Medium (25 -100 employees)	4
Large (100+ employees)	22

Figure 8 National Survey for Professionals, Question 3 results

3. Does your company have in-house expertise or does it hire a drone service provider?

More Details

In-house expert team	11
External service provider	19

Figure 9 National Survey for Professionals, Question 4 results

4. How many full-time, part-time, and contract employees are involved with the use or management of drones at your company?

More Details Insights

0	14
1-4	10
5-9	2
10-24	4
25-99	1
100+	0

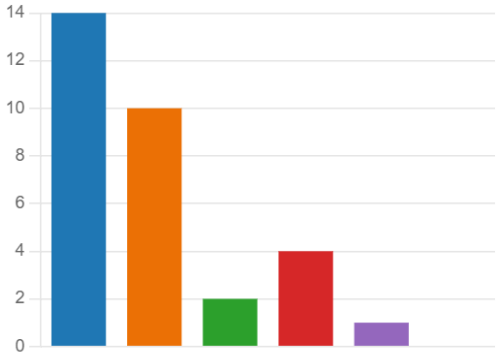


Figure 10 National Survey for Professionals, Question 5 results

5. Which one of these best describes the degree of drone technology use in your company?

More Details Insights

No use	2
Rare use	12
Occasional use	15
Extensive use	2

Figure 11 National Survey for Professionals, Question 6 results

7. Which applications has drone technology in your company?

More Details

Progress tracking and communi...	10
Preconstruction and site planning	9
Quality control and assurance	0
First assessment and bid proces...	1
Job site risk mitigation	1
Transportation of goods	0
Other	9

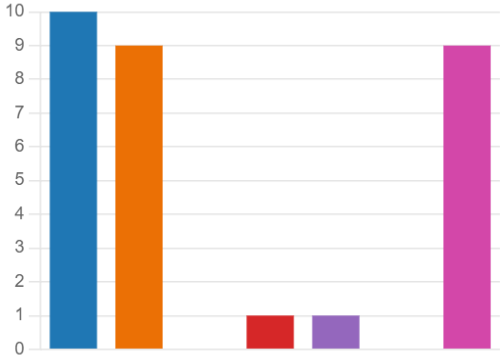


Figure 12 National Survey for Professionals, Question 7 results

6. Assessment of the future evolution of drone usage: Does your company expect the deployment of drones to be more frequent in the future?

More Details

Yes	23
No	0
Don`t Know	8

Figure 13 National Survey for Professionals, Question 8 results

8. In relation to the previous question, which specific tasks are being developed using drones?

More Details

Photography and/or video	23
Surveying	25
Asset inspection	13
Measurements (volume, area an...	10
Progress monitoring	15
Equipment tracking	2
3D modelling	11
Orthomosaics	3
Digital surface/terrain models	7
Thermal imaging	6
Security surveillance	2
Other	1

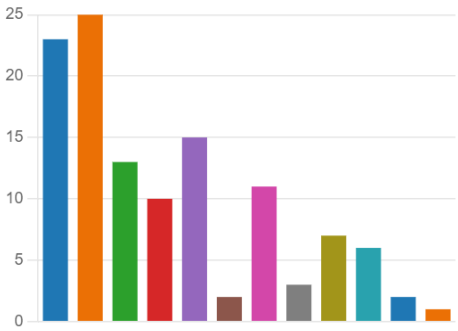


Figure 14 National Survey for Professionals, Question 9 results

9. In the near future, which tasks or services are you willing to implement in your company?

More Details

Photography and/or video	17
Surveying	23
Asset inspection	9
Measurements (volume, area an...	19
Progress monitoring	15
Equipment tracking	1
3D modelling	21
Orthomosaics	2
Digital surface/terrain models	13
Thermal imaging	5
Security surveillance	3
Other	3

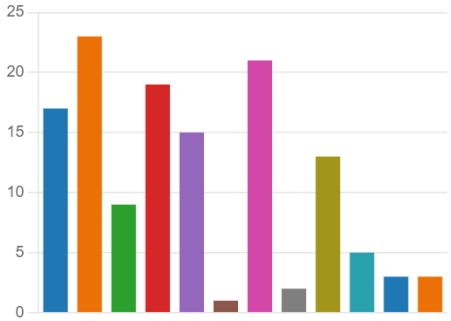


Figure 15 National Survey for Professionals, Question 9 results

10. Based on your company's experience, which advantages entails the use of drones in construction related activities?

More Details

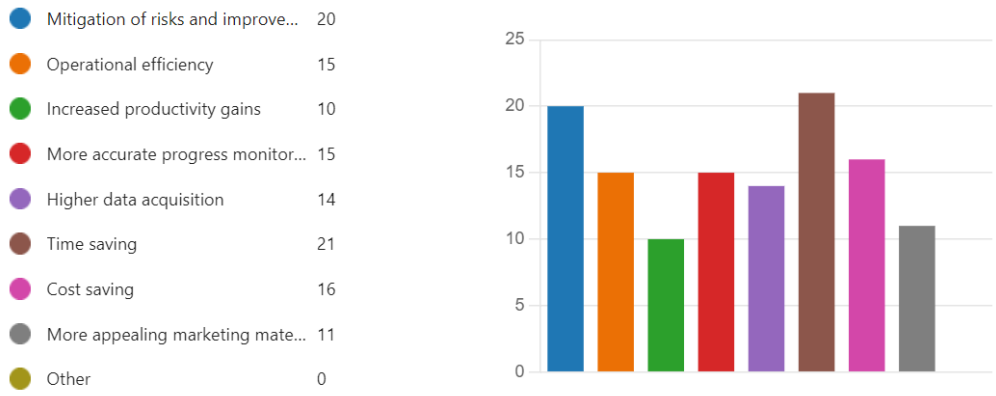


Figure 16 National Survey for Professionals, Question 11 results

11. Do you consider difficult to find qualified profiles to fill drone-related positions?

More Details Insights

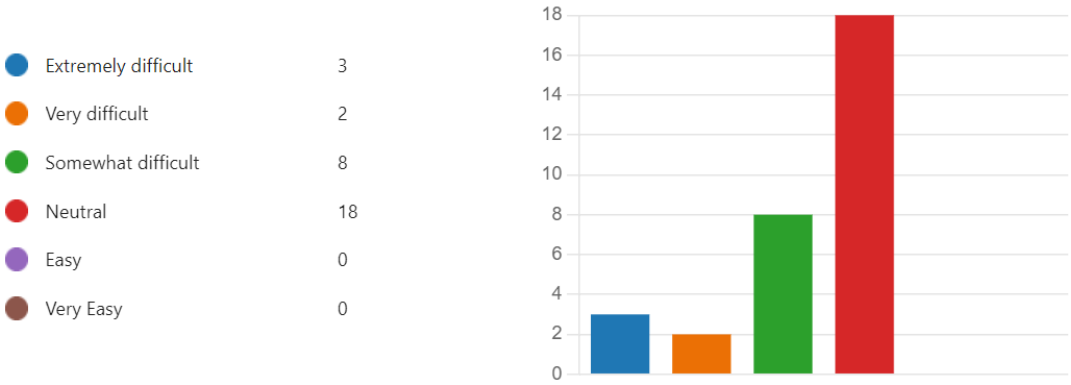


Figure 17 National Survey for Professionals, Question 12 results

12. If difficult, from your point of view, which are the reasons for the skills shortage?

More Details

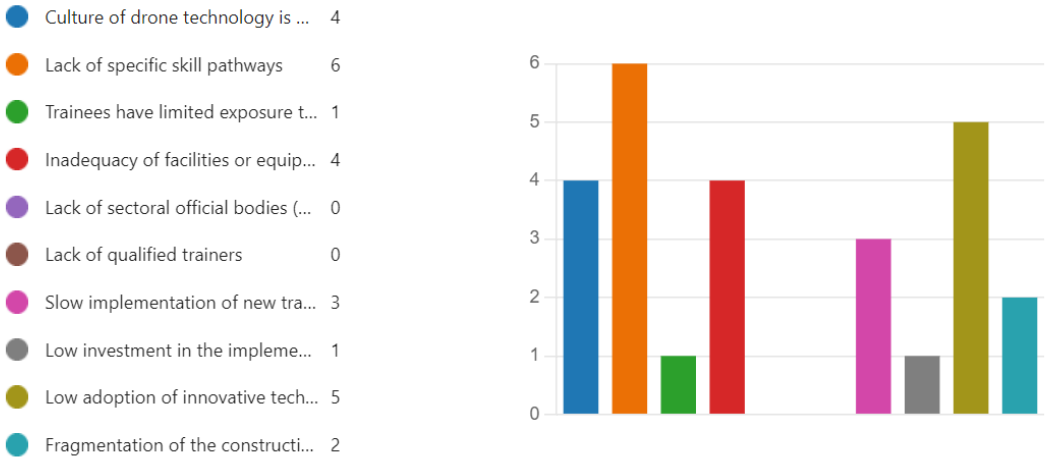


Figure 18 National Survey for Professionals, Question 13 results

13. In relation to the previous question, what could be the solution(s) to tackle this skills shortage?

More Details

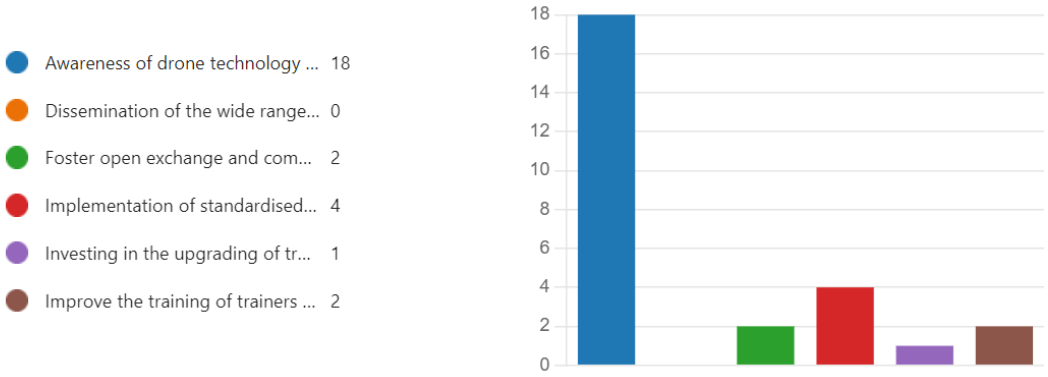


Figure 19 National Survey for Professionals, Question 14 results

14. Please briefly outline any other proposals that you think would be beneficial to address the problem:

More Details Insights

6
Responses

Latest Responses

4 respondents (**67**%) answered **drone** for this question.

Figure 20 National Survey for Professionals, Question 15 results

15. Please indicate your level of agreement with the following statement: "The implementation of standards & certification for operation will help to leverage drone operation"

More Details

Agree	15
Somewhat agree	13
Disagree	0
Don`t know	2

Figure 21 National Survey for Professionals, Question 16 results

16. Please indicate your level of agreement with the following statement: "Cooperation between educational institutions, industry and related stakeholders will reduce the gap between existing training and the real needs of the sector"

More Details

Agree	25
Somewhat agree	4
Disagree	0
Don`t know	1

6.2 National Survey results for learners/trainees

Figure 22 National Survey for Learners/trainees, Question 1 results

1. What level of education are you currently enrolled in?

More Details Insights

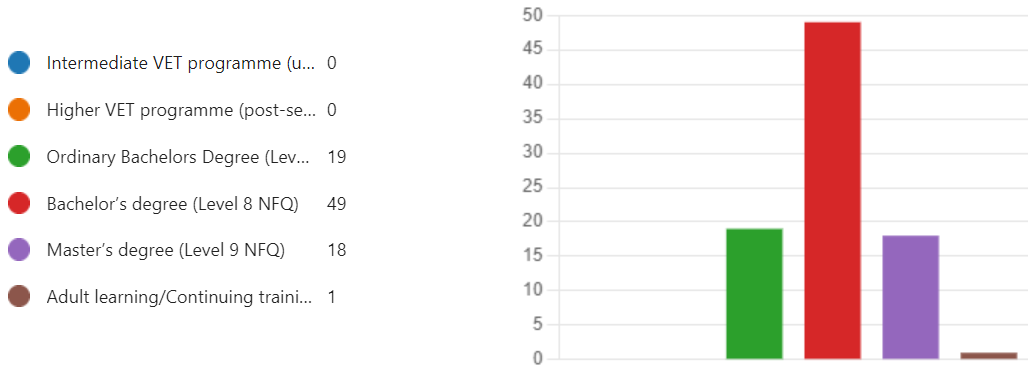


Figure 23 National Survey for Learners/trainees, Question 2 results

2. What is your level of familiarity with drone technology?

More Details

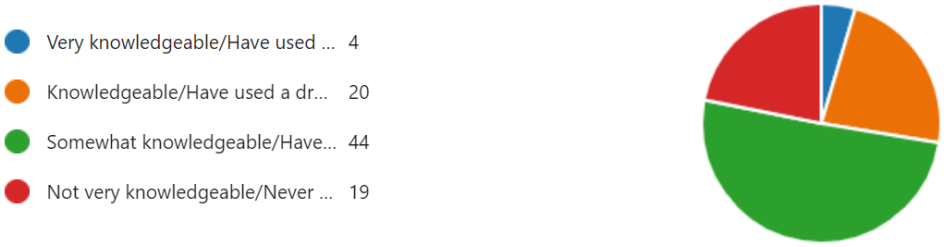


Figure 24 National Survey for Learners/trainees, Question 3 results

3. Are there any sectors which you are interested in as a future career path?

More Details

Civil works	47
Residential building	35
Specialized industrial constructi...	25
Mining	6
Energy	24
Telecoms	2
Facilities management	15
Engineering	70
Surveying	33
Other	3

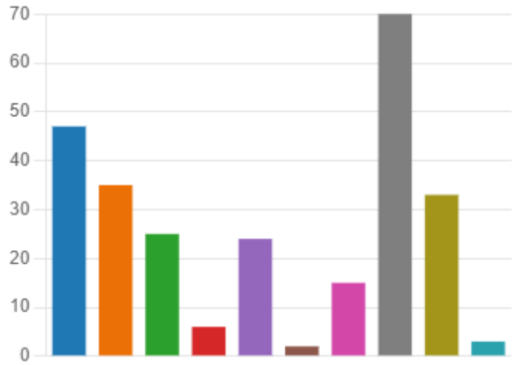


Figure 25 National Survey for Learners/trainees, Question 4 results

4. What applications of drone technology are you most interested in?

More Details

Surveying	56
Photography and/or video	52
Preconstruction and site planning	57
Quality control and assurance	22
First assessment and bid proces...	11
Job site risk mitigation	20
Transportation of goods	14
Other	2

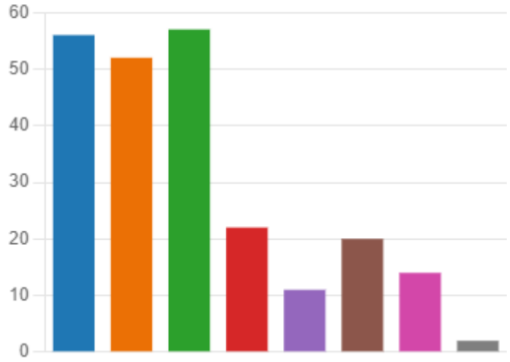


Figure 26 National Survey for Learners/trainees, Question 5 results

5. Are you aware of the most in-demand jobs or relevant emerging roles in the construction industry?

More Details

Yes	8
No	79

Figure 27 National Survey for Learners/trainees, Question 6 results

6. If Question 5 was answered "Yes" please specify below, if "No" please go to Question 7?

More Details Insights

8
Responses

Latest Responses
"Surveying "

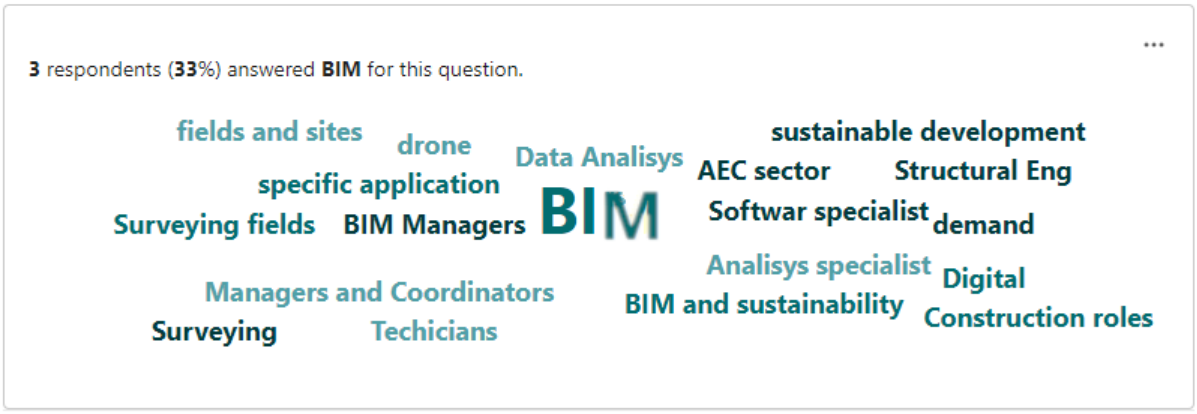


Figure 28 National Survey for Learners/trainees, Question 7 results

7. Do you find it difficult to access drone-related training pathways that match your interests?

More Details

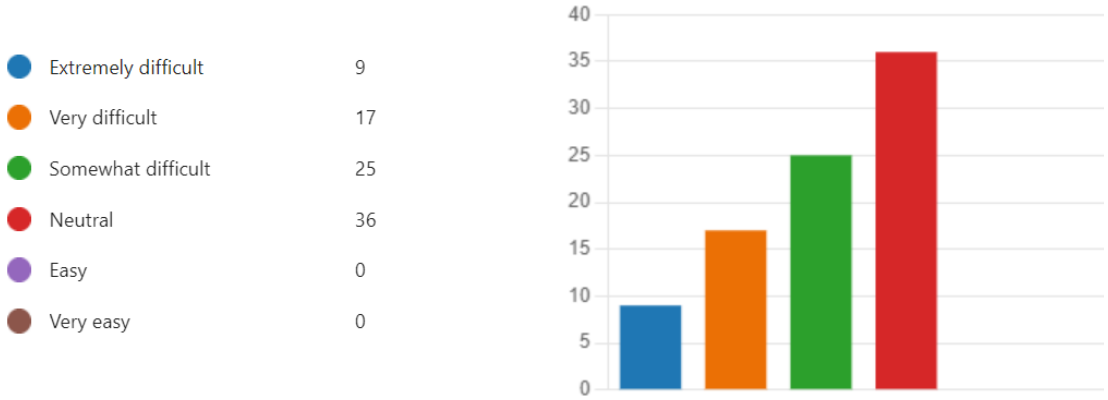


Figure 29 National Survey for Learners/trainees, Question 8 results

8. In relation with previous questions, if difficult, which are the reasons for the lack of drone-related training pathways?

More Details

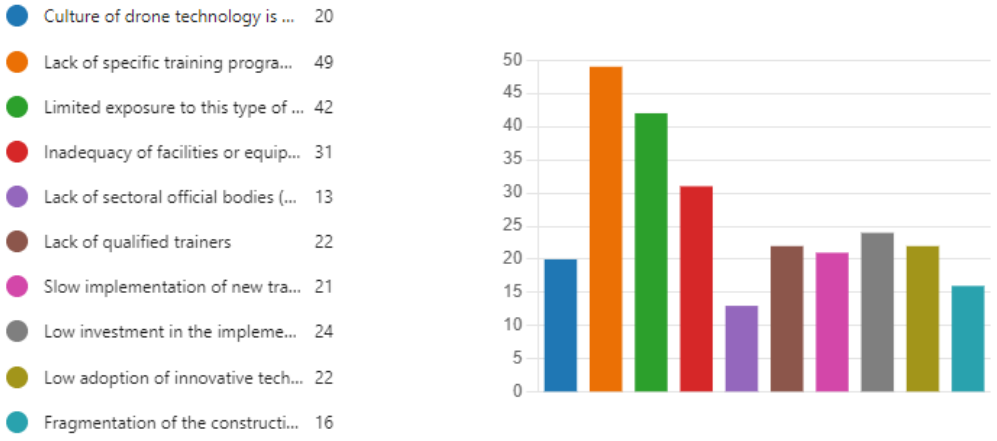


Figure 30 National Survey for Learners/trainees, Question 9 results

9. Based on your previous answer, what could be the solution(s) to tackle this issue?

More Details

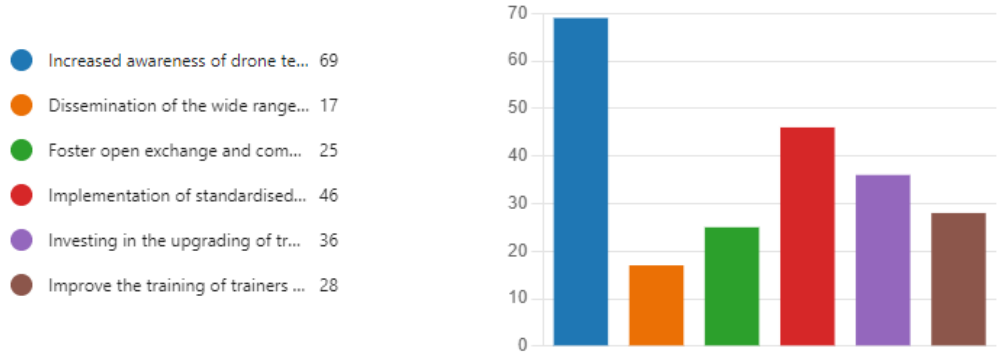


Figure 31 National Survey for Learners/trainees, Question 10 results

10. Please briefly outline any other proposals that you think would be beneficial to address the problem:

More Details Insights

12
Responses

Latest Responses

Figure 32 National Survey for Learners/trainees, Question 11 results

11. Please indicate your level of agreement with the following statement: "Dissemination of drone technology applications and the related range of job opportunities within the construction sector, will increase the number of suitably qualified workers"

More Details Insights

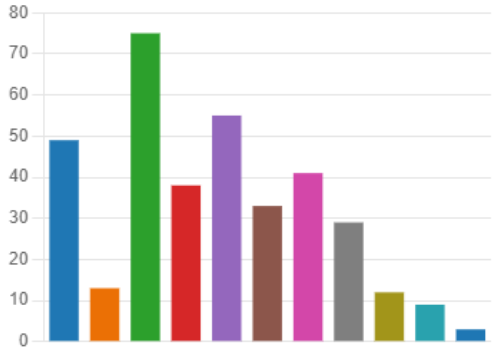
Agree	43
Somewhat agree	37
Disagree	1
Don`t know	6

Figure 33 National Survey for Learners/trainees, Question 12 results

12. Which aspects of training do you consider most important for effective learning and subsequent insertion into the labour market?

More Details

Relevant and up-to-date learnin...	49
Theoretical content	13
Active practice	75
Demonstrations by trainers	38
Visits to real work sites	55
Modern and well-equipped trai...	33
Up-to-date technological equip...	41
Qualified specialised trainers	29
Reinforcement pills to increase l...	12
Career guidance	9
Other	3



DRONES4VET

Co-funded by the
Erasmus+ Programme
of the European Union

COUNTRY REPORT ON THE USE OF DRONES IN CONSTRUCTION-RELATED ACTIVITIES

CAMPUS
DES MÉTIERS
ET DES
QUALIFICATIONS
D'EXCELLENCE
Habitat, énergies renouvelables
et éco-construction
Occitanie

FRANCE 2022

Prepared by : Régis Lequeux – Nicolas Privat – Eric Remola – Nicolas Vassart

TABLE OF CONTENTS

I- OVERVIEW (AT NATIONAL LEVEL)

Regulations (Standard Operating Conditions) and RPA operator qualification requirements / Pilot certifications needed

In France, the government produced texts regulating the air traffic of drones before Europe addressed the issue. Thus, French regulations currently coexist with the national application of European texts that have since been enacted (see below).

National legal corpus :

- Civil Aviation Code

- Code of transport

Registration

[Immat decree]: decree n° 2019-247 of March 27, 2019 relating to the registration of unmanned aircraft and amending the civil aviation code

[Arrêté immat]: Order of July 28, 2015, as amended, on the nationality and registration marks, the identity plate and the registration certificate of aircraft

Operation of unmanned aircraft

[Scé]: Order of December 3, 2020 on the definition of national standard scenarios and setting the conditions applicable to missions of civil aircraft without crew on board excluded from the scope of Regulation (EU) 2018/1139.

[Esp] : Order of 3 December 2020 on the use of airspace by aircraft without crew on board.

Law " Drones

Law No. 2016-1428 of October 24, 2016 on the reinforcement of the safety of the use of civil drones

Registration of aircraft

[Decree Enr]: decree n° 2018-882 of October 11, 2018 relating to the registration of civil aircraft operating without crew on board

[Enr Order]: order of October 19, 2018 on the registration of civil aircraft operating without a crew on board

Training of remote pilots

[For] : Order of 18 May 2018 on the requirements applicable to remote pilots who use civil aircraft operating without a person on board for purposes other than leisure

Warning lights and electronic or digital warnings

[Decree No. 2019-1114 of 30 October 2019 for the application of Article L. 34-9-2 of the Post and Electronic Communications Code

[Signaling Order]: Order of December 27, 2019 defining the technical characteristics of electronic and light signalling devices for aircraft operating without a person on board

Notice

[Decree notice]: Decree no. 2019-348 of 19 April 2019 on the information notice relating to the use of aircraft operating without a person on board

[Order notice]: order of April 19, 2019 on the content of the information notice provided with the packaging of civil aircraft circulating without a person on board and their spare parts

Sanctions

[Sanc]: decree no. 2019-1253 of November 28, 2019 on the criminal penalties applicable in the event of breaches of the safety obligations provided for the use of civil drones circulating without a person on board.

DGAC: The rules are grouped and studied by the Direction Générale de l'Aviation Civile, which issues authorizations, certifications, and flight restrictions through its various directorates.

https://www.ecologie.gouv.fr/direction-generale-laviation-civile-dgac

DSAC: The respect of international and national rules is the responsibility of the Direction de la Sécurité de l'Aviation Civile. Supervision and certification body, in particular for pilots.

SIA : The documentation is provided by the Aeronautical Information Service. Its website includes airworthiness (NOTAM, weather, flight plan...) and regulations.

https://www.sia.aviation-civile.gouv.fr/

Legal corpus of the single European flying area:

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

Since January 1, 2021, two European regulations apply in France because its airspace is part of the Single European Sky (and by transcription of the texts):

- Regulation (EU) 2019/947

- Regulation (EU) 2019/945

A revision in September 2022 integrates the changes introduced by :

Commission Implementing Regulation (EU) 2022/425 amending Commission Implementing Regulation (EU) 2019/947 as regards the postponement of the transition dates for the use of certain drones in the "open" category and the application dates of certain standard scenarios.

Decision ED 2022/002/R amending Decision ED 2019/021/R on "geographical areas", operational authorization forms in the "specific" category, a procedure and forms for cross-border operations, standard scenarios, the syllabus of training modules for remote pilots in the "specific" category, and a new predefined risk assessment.

The rules are consolidated and reviewed by the European Aviation Safety Agency EASA.

EXEMPTION: Not concerned are those whose use is limited to the following case: operation in the open category AND maximum mass of the UAS less than 250g AND impact energy of the UAS less than 80 joules AND UAS not equipped with a sensor that can collect personal data (unless it is a toy compliant with the directive 2009/48/EC)
We use cameras, so no exemption!

RPA operator qualification requirements / Pilot certifications needed

The main points that concern pilots in relation to the construction and training sector (drones taking pictures, sometimes heavy, having to operate in all areas, students in training) are the following:

There are three categories of flights, in summary:

Open category: low risk as much for people as for other aerial operations, flight in view of the drone from the pilot, mass less than 25kg, two sub-categories (A1 and A3) with simple pilot exams. No remote electronic identification if the drone weighs less than 800g.

Specific Category: moderate risk, out of sight flight, unlimited weight possible, electronic identification emission, cargo transport. Declaration or possibly request for flight authorization, French scenarios (S1, S2, S3), and soon European standards (STS01 and STS02). Pilot certified in theory and practice by a more advanced examination.

Certified category: high risk, transport of dangerous materials, people, dangerous tools... specific file of authorization request to be sent to the DGAC.

Vocabulary: "operator" and "exploitation" (RPA operator)
Flying a drone is often called in the regulations an "operation".
Operators are the legal entities (persons or companies) that own drones and use them. The pilots, who are employees, are themselves operators when they fly the drone and therefore bear the responsibility for the flight. A drone operation is the fact of using a drone, even for a simple flight.

Training of pilots - certifications: see end of document « TRAINING

Specific training and licensing for RPAS pilots"

- The ERASMUS+ Drones4VET program, if recognized by the authorities, could be a basis for certification for training.

Operator responsibility
In order to practice professionally, the operator must
- Declare his activity on the web portal administered by the DGAC: AlphaTango
- Write a European MANEX (formerly MAP "Manuel d'Activités Particulières", a little lighter): describing the modalities of implementation of his regulatory obligations; keep this document up to date.
- To write the Cerfa 12546: declaration of aerial photography and cinematography activity (if envisaged, which is the case for our civil engineering activity)
- To have an insurance RCA " Civil Aeronautical Risk ".
- Register your drones on AlphaTango
- Affix on the drones a rectangular plate of operator
- For drones over 800g to 25 kg, add the registration number UAS-FR-XXX
- Check the qualifications of the pilots according to the category of flight envisaged

- Maintain the flight qualifications of the pilots by continuous training or a follow-up of the missions in lieu of continuous training
- Ensure the airworthiness of the UAVs (condition, maintenance, compliance with changing standards)
- Monitor regulations

Before operating a mission, the operator must ensure compliance with the regulations of 17 December 2015:

- Prepare his mission beforehand (specific form recommended)
- If necessary, request a protocol with a civil or military aeronautical platform:
    - o Declare your flights to the competent local prefecture in a populated area or a place open to the public
    - o Declare your flights in S2 (out of sight) or if visual flight at more than 50 meters in a military training area
- Take note of the aeronautical documentation in force: NOTAM "Messages to airmen" and SUP AIP "Supplement to aeronautical information publications" as well as the weather.

In the open category, the operator does not have to make any declaration for his flights, he only has to respect the rules of the subcategories of the open category.
In the specific category, the operator must declare his flights but they are not subject to authorization if he respects one of the three conditions:
- operate according to a national standard scenario S1, S2 or S3
- OR operate in accordance with a European standard scenario STS-01 or STS-02 (not yet applicable in France before 2024)
- OR to hold a light UAS operator certificate (LUC) see below.

Summary of standard flight scenarios

open category

the open category flight consists in respecting all the rules below, and it allows not to have to declare its flights. Attention, for the professionals, it is necessary to "prepare its mission beforehand" thus to write a flight sheet (for example place, geo-cage settings, name of the owner and authorization, type of mission, pilot, drone used, weather...).

common prescriptions :

- o Low risk
- o Drone always in view of the pilot
- o Drone of more than 800g registered on the AlphaTango portal
- o Maximum altitude 120m/ground and +15m above very high buildings
- o Out of the public domain in built-up areas
- o If flight in built-up area: only above a private plot with owner's authorization and without risk of falling on a neighboring plot or the public domain (dist = V.e(2h/g) or 2.5m at 1m/s

and 30m high, 3m at 2m/s and 30m/ground V [m/s] horizontal speed of the drone, h [m] height/ground, g=9.81)

o With implementation of a geo-cage of limitation of evolution programmed in the drone so that it does not leave the perimeter of the subcategory: geovigilance

o Outside built-up areas: respect of the altitude and flight restrictions map published on the website www.geoportail.gouv.fr

o Respect of the flight restrictions issued by the DSAC in the form of NOTAM or other

o Night flights are prohibited

o Dumping, spraying, transport of dangerous goods prohibited

o Minimum age 14 years

o Drone certified in European class C1 to C4 from January 1st 2024. Currently (September 2022) no drone is sold with a class certification

o Drone without class but respecting weight and equipment criteria

o Flying from a moving vehicle is not prohibited but not recommended because it is impossible to monitor the airspace at 360°.

o Anti-fall parachute not mandatory whatever the weight (the parachute is only required in specific category S3 scenario)

o Professional operator: no obligation to declare his flights

o Professional operator: operator number stuck on the drone on a label of at least 5 x 3 cm

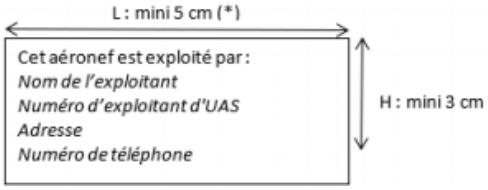


Table of specificities by subcategory, in addition to the above rules according to the type of flight

Subcategory open	pilot	Drone without european class	Drone european class certified	flight
Subcategory A1	CO A1/A3	prohibited	weight < 900g and class C1	Close to people but not to gatherings
Subcategory A1 limited **Up to january 2024**	CO A1/A3	weight < 500g	/	Close to people but not to gatherings
Subcategory A2	CO A1/A3 + exam A2 (=BAPD)	prohibited	weight < 4kg and class C2 Emission of the identifier if weight > 800g	At 30m from people. At 5m if low speed system
Subcategory A2 limited **Up to january 2024**	CO A1/A3 + exam A2 (=BAPD)	weight < 2kg Emission of the identifier if mass > 800g	/	At 50m from people.
Subcategory A3	CO A1/A3	weight < 25kg class C3 ou C4 **without european class from 2024** amateur construction Emission of the identifier if weight > 800g		At 150m from people and residential, industrial, commercial and recreational areas

Specific category

All flights that do not meet the criteria of the open category fall into the specific category.

To make things easier, the French rule applicable until December 2023 provides for three "scenarios" that need only to be respected in order not to have to request a flight permit. For professionals, it is necessary to "prepare the mission in advance", i.e. to draw up a flight sheet (e.g. location, geo-cage settings, name of the owner and authorisation, type of mission, pilot, drone used, weather conditions, etc.).

Common prescriptions:

- o "Moderate" risk (high risk: certified category, therefore authorization)
- o Maximum altitude 120m/ground and +15m above very high buildings
- o Drone of more than 800g: emission of an identifier specific to the drone coded by the manufacturer, registered on the AlphaTango portal and AlphaTango UAS-FR-number identification label stuck on the drone (in addition to that of the operator); warning light only for night flights (thus useless here because prohibited in S1-S2-S3). Drones weighing less than 800g can be voluntarily registered, which is useful for teaching purposes. WARNING: from 2024 onwards, a European type signal will also have to be issued... the two signals have not yet been split into one...)
- o Drone with a mass of more than 25kg or a dimension of more than 3m: forbidden, see specific regulations (out of subject here)
- o Drone with a design, maintenance and user manual
- o Drone equipped with a fail-safe emergency landing system in the event of a control link failure
- o Safety by cutting propulsion from the control regardless of weight, but the parachute is only mandatory in certain cases detailed in the scenarios
- o With the implementation of a geo-cage of limitation of evolution programmed in the drone control so that it does not leave the perimeter of the scenario: geo-vigilance
- o Height measurement by barometric sensor
- o NO overflight of third parties (people not involved in the mission) for all scenarios, which is quite difficult to achieve in scenario S3 which authorises flight in populated areas: one immediately finds oneself in an "out of scenario" situation and therefore requires authorisation. Passers-by in the street of a report are not considered as participants in the mission, unlike our students who are following a flight course.
- o Securing an area on the ground under the flight of the drones where third parties (people not involved in the flight mission) cannot enter

o Outside built-up areas (within 50m) or gatherings of people (within 150m); respect the altitude and flight restriction map published on the www.geoportail.gouv.fr website and the ICAO-VFR maps

o 30m from motorways, expressways and railways

o Respect of flight restrictions issued by the DSAC in the form of NOTAM or other

o Night flight is prohibited

o If piloting with virtual goggles "in immersion" (first person vision FPV): another person must see the drone and is responsible

o Dumping, spraying, transport of dangerous goods prohibited

o Minimum age 16 years

o Drone certified in European class C1 to C4 from 1 January 2024. Currently (September 2022) no drone is sold with a class certification

o Drone with no class but meeting weight and equipment criteria

o Piloted flight from a moving vehicle prohibited except from a boat

o Parachute not required regardless of weight (parachute only required in specific category S3 scenario)

o Professional operator :

o Mandatory declaration of his activity and the scenarios envisaged, with the drones used, renewable every 24 months

o Drafting and updating of a MANNEX

o Training and periodical verification of pilots' skills

o Each year in January, the operator operating according to the national standard scenarios must declare to the DSAC the number of flight hours performed according to the scenarios considered AND make a summary of the problems encountered and the measures taken to remedy them.

o Documents required at the place of flight :

o Drone operator registration receipt with mention of the declared scenario(s) in specific category

o Acknowledgement of receipt of the operator's activity declaration

o Certificate of design of the drone

o The updated MANNEX

o The pilot's certificates: CATT or CAPD and his identity document

o Authorisation to take pictures or other necessary authorisations from the DGAC

Professional flight: operator's number stuck on the drone on a label of at least 5 x 3 cm IN ADDITION TO THE DRONE NUMBER IF REGISTERED (>800g or voluntary)

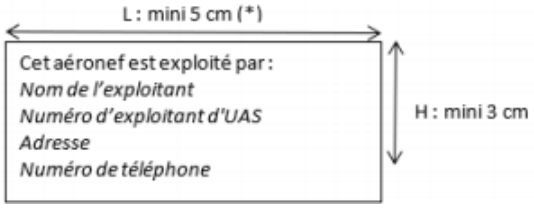


Table of specific scenarios whose rules complement the general requirements :

French scénario	Populated area	drone	Distance to pilot	Drone in pilot's view	Maximum flight Volume – third party exclusion zone ZET
S1	No	25kg max No homologation	200m	yes	Area around the drone, moving with it, radius 10m<V.e(2h/g)<30m **if** drone<2kg without parachute **et** height <50m **Or if** drone <8kg with parachute without height limit **if** weight >8kg : 30m without réduction
S2	non	25kg max under 50m height 2kg max if height >50m Recording of the parameters of the last 20 minutes of flight Cartography showing the position of the drone Engine shutdown independent of the remote control DSAC approval	1000m	Possibly not but notified on AlphaTango (between D-2 and D at 4am)	Fixed, all-flight zone of 30m around the entire projection of the entire flight area
S3	Yes, but without an overflight by a person outside the mission	8kg max (Except if captive) Push-pull rescue, engine shutdown, independent, audible warning, checkable before Approval required if weight >2kg	100m	Oui	Area around the drone, moving with it, radius 10m<V.e(2h/g) Et <30m si weight<4kg over 4kg the formula has no limit

European harmonisation: Standard scenarios STS-01 and STS-02 and European UAV classes C1 to C6

Although published and therefore soon applicable, the STS are aviation safety rules, not public safety rules, so they are complemented by French public safety rules (800g rule, exclusion of third parties...)

These scenarios will be declarative, just like the current French scenarios. It will be necessary to use EC drones under Regulation 2019/945 with a class certification. These new standard scenarios can be used from 2 December 2021, the French scenarios will still be valid until 2 December 2023 (for the time being).

- Scenario STS-01: "covers direct visual operations (VLOS) with a Class C5 (CE marked) UAS at a maximum height of 120m above a ground controlled area in a manned environment.

- Scenario STS-02: "covers operations that can be conducted out of sight (BVLOS), with the unmanned aircraft at a maximum distance of 2 km from the remote pilot and with airspace observers present, at a maximum height of 120 m over a ground controlled area in a low population density environment, with a Class C6 (CE marked) UAS."

There is no longer a difference between recreational and professional flights, each flight depends on the class of the drone. We remain in OPEN with C1 to C4 drones and then in STS with C5 and C6. From 1 January 2023, all newly built drones will have to meet the new requirements of European legislation. Each drone will be marked with a pictogram indicating its class in addition to the separate CE marking.

Definition of European classes (summary):

Drone classes range from C0 to C6. The higher the number, the higher the risk of using the drone.

C0 : Open category A1/A3. This category authorises the overflight of people (except for grouping).

Maximum weight 250 g

Maximum altitude 120 m

Visual flight only

C1 : Open category A1/A3, overflight of persons tolerated with explicit written agreement.

Maximum weight 900 g

Maximum altitude 120 m

Visual flight only

C2 : Open category A2/A3, flight distance to people of at least 5 m in slow mode and 30 m in standard mode

Maximum weight 4 kg

Maximum altitude 120 m

Visual flight only

C3 : Category Open A3, flight at least 150 m from populated, commercial, industrial or recreational areas

Maximum weight 25 kg

Maximum altitude 120 m

Visual flight only

C4 : Category Open A3, flight at least 150 m from populated, commercial, industrial or recreational areas

Maximum weight 25 kg

Maximum altitude 120 m

No automatic control systems

Visual flight only

C5 : Category Specific, drone intended for flight according to the STS-01 scenario

Slow flight mode (maximum 5 m/s)

Geo-vigilance system

Control tools for: flight height, engine shutdown system, etc.

C6 : Category Specific, drone intended for flight according to the STS-02 scenario

Slow flight mode (maximum 5 m/s)

Geo-vigilance system

Tools to control: geographical position, speed, height, horizontal and vertical boundary crossing indication, etc.

NOTE: Overflying private property: rights of the owner

With regard to the issue of overflying private property, Article L. 6211-3 of the Transport Code stipulates that "the right of an aircraft to overfly private property may not be exercised in such a way as to interfere with the exercise of the owner's right".

It is therefore up to the operator to assess, before the flight, whether it is likely to "hinder the exercise of the owner's right", for example in the case of very low-level flying, and in case of doubt to contact the owner and obtain authorisation or non-opposition.

Training Organisation

Any UAS operator can become a practical training organisation for student telepilots, customers (in the case of a school) or employees (in the case of an operator providing basic practical training to its telepilots). Since practical training flights in standard scenarios constitute activities in the Specific category, the training organisation must be a UAS operator that has declared itself according to the scenarios for which it provides training.

Its MANEX must specify that training is part of its activities and define the specific measures taken to ensure the safety of training flights. In particular, the instructor must be a remote pilot already authorised for the scenarios under consideration and must have his own control system or, failing that, must be able to access the control system at any time and under conditions which maintain flight safety.

The methods (training programme, progress booklet) and means (material and human) used to provide basic or additional practical training are also described in the operator's MANEX.

Progress booklet

The organisation providing the basic practical training must fill in a progress booklet.

The progress logbook is used to monitor and document the acquisition of practical skills. It contains detailed and regular progress reports from the trainers, including assessments to evaluate progress. It is signed by the student telepilot at the end of each training cycle. It is archived for five years. A copy is given to the telepilot on request.

Penalties

The following is punishable by imprisonment and a heavy fine
- using a drone in conditions that do not comply with the rules laid down to ensure safety
- for a remote pilot, to have a drone fly over an area of French territory in violation of a flight ban, through clumsiness or negligence
- to voluntarily infringe on the privacy of others:
- by capturing, recording or transmitting, without the consent of the author, words spoken in private or confidentiality;
- by fixing, recording or transmitting, without the consent of the latter, the image of a person in a private place.

The following is punishable by a fine:

- for the remote pilot of a drone weighing 800g or more,
- use a drone without having obtained the theoretical aptitude certificate and the training follow-up certificate (or the aptitude certificate for the functions of remote pilots);
- not being able to present these documents immediately in the event of an inspection
- not being able to present these documents within 5 days
- for the owner of a drone weighing 800g or more, to allow his drone to be used: without having registered it;
- by having provided, at the time of registration, inaccurate information on the characteristics of the aircraft or on the identity of the owner(s);
- without having affixed the registration number to the aircraft;
- without having equipped its drone with the electronic or digital reporting device.

Strategic plan for the development of RPAs/drones in the country. Priorities

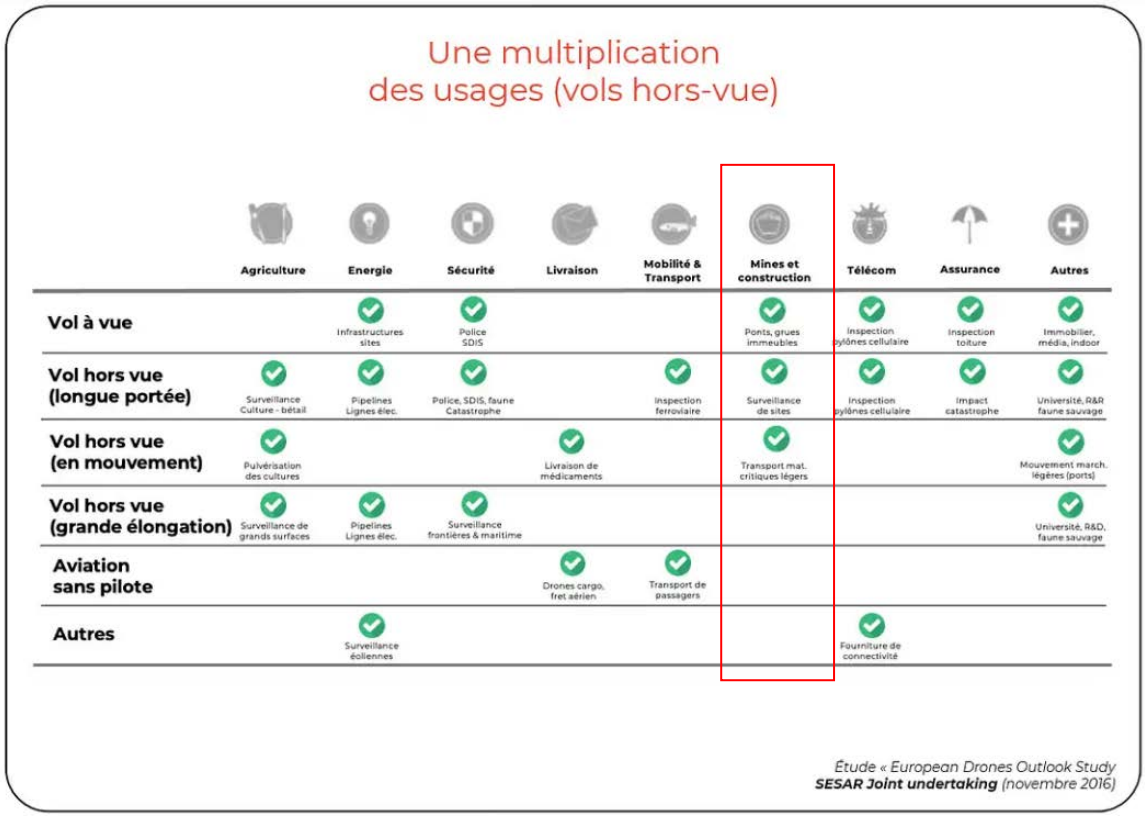
No strategic plan has been established for the development of RPAs, but the intrinsic reliability of the aircraft should allow the use of UAVs and the performance of these missions in complete safety within a few years. The main current difficulties identified still concern :

- The safety and quality of the telecommunications to be established between the drone and the ground control station;

- The autonomy of the UAV in flight through the capacity of the autopilot card to manage air risks (detection of moving objects in the airspace and real-time recalculation of trajectories).

Projections by institutional bodies

According to the study "Perspective de développement de la filière du drone civil à l'export" written by the DGE, the DGAC (Direction Générale de l'Aviation Civile) and the PIPAME on 5 June 2017, more than 70% of professional drone flights should be carried out by 2024 off-view. This study is supported by the "European Drones Outlook Study" of the SESAR Joint undertaking published in November 2016. This study estimates the European market at 400,000 drones (100,000 drones in France) by 2035, 70% of which will carry out out-of-sight flights.



DGAC development plan January 2020

- Invent the professional civil drones of the future (transport of people and goods)

- Open the way to the current industrial use of aircraft (without pilot on board in particular) in complete safety (flight over populated areas)

- Creation of an air traffic management system for drones (U-space planned for 2023):

o Registration of operators, drones

o Management of flight authorisations

o Management of conflict risks (between drones) or access to sensitive areas (geofencing)

- Harmonisation of regulations at European level

Government agencies with jurisdiction over RPAs

Direction générale de l'aviation civile (DGAC), to guarantee the safety and security of air transport by placing the logic of sustainable development at the heart of its action.

Fédération professionnelle du drone civil (FPDC), to defend and represent the interests of a professional sector, to structure a national network and to become the reference interlocutor for the public authorities.

Direction de la sureté de l'aviation civile (DSAC), to monitor the manufacture and maintenance of aircraft, in application of European regulations. It issues, for France, approvals for maintenance organisations, airworthiness certificates for aircraft and mechanics' licences.

Directorate of Air Transport (DTA), to ensure the functions of air transport regulator. It is the contact point for airlines, airports and their customers. As a partner of manufacturers and operators, the DGAC contributes to the activity of the aviation industry.

The Directorate of Air Navigation Services (DSNA) is the leading air navigation operator in Europe. As such, it has operational responsibility for air traffic control in French airspace, in metropolitan France and overseas.

General Directorate for Enterprises (DGE) to design and implement public policies contributing to the development of enterprises. Its action is at the heart of the government's projects for the country's economic transformation.

Interministerial Pole of Prospective and Anticipation of Economic Change (PIPAME)

Key figures

In 2014, for the French industry, the turnover was more than 50 million euros excluding recreational drones. At the end of 2014, France had 3,000 jobs in the professional drone sector.

In August 2015, there were 40 French drone manufacturers

In 2016, the French Civil Aviation Authority (DGAC) estimated that there were between 150,000 and 200,000 recreational drones in France, 98% of which were micro-drones (mass less than 2 kg). The turnover of the professional drone market in France amounted to €160 million in 2016, and has been growing every year by 20 to 30% since 2012.

In 2017, according to the DGAC, 500,000 leisure drones were sold in France in 2017. A business volume of 200 million euros.

In 2018 - Civil drone in France is represented by 7415 companies officially registered on the DGAC list as drone operators.

By 2024, the global civil drone market could be worth 1.42 billion euros and it is estimated that the sector will create 10,000 jobs in France by 2025 compared to 2014.

The number of registered professional drones (i.e. weighing more than 800 grams) is growing steadily: 9,582, 13,647 and 15,946 respectively between 2017 and 2019. These civil aircraft are owned by approximately 8,500 professional drone operators (manufacturers, training organisations, industrialists, service providers).

The annual growth rate observed has therefore been 29.6% over the last few years. This surge confirms the study of 20 June 2020 conducted by SVP, which estimates the annual growth of the professional civil drone market at 27.2% between 2018 and 2024.

France ranks 3rd in the world (source DGAC January 2020) for the number of users of remotely piloted aircraft.

In France: the turnover of the professional drone market amounted to €200 million in 2017, €160 million in 2016, with an increase of 20 to 30% since 2012. It will reach €700 million in 2020 (with the creation of 150,000 manufacturer and operator jobs combined).

In 2018, the activity in France was broken down into :

- 110,000 flight hours for the media and communication sector:

- Information and media: film shooting

- Photography

- Advertising

- leisure, communications

- and 60,000 flight hours for the construction and civil engineering sector:

- Real estate: inspection, BIM modelling

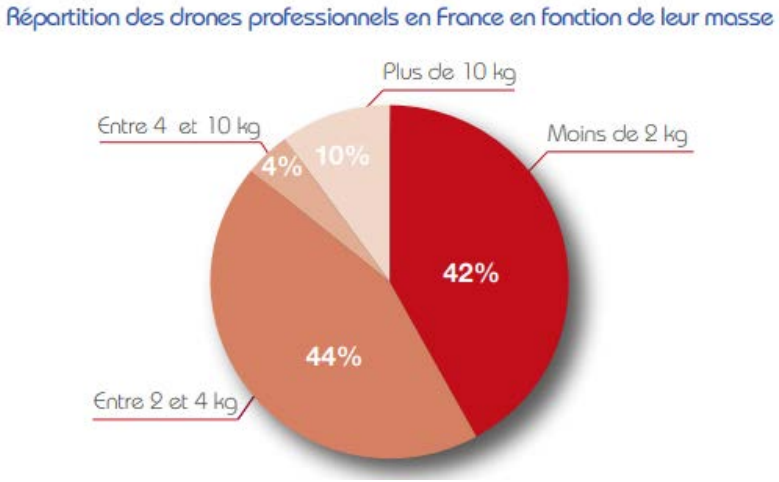
- Civil engineering: public works; monitoring and inspection of engineering structures, industrial sites, buildings, bridges, dams; mapping and volume calculation (cubing)

- Infrastructure and networks: monitoring and inspection of transport and energy networks (railways, electricity networks, pipelines, oil and gas pipelines), industrial management of mining and oil industry sites (excluding transport networks);

- Telecommunication mobile relay antenna: inspection

(sources DXAC/NO, Direction de la Sécurité de l'Aviation Civile, Direction Générale de l'Aviation Civile)

(source : Fédération professionnelle du drone civil – FPDC



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MAJOR GROUPS LISTED AS CIVIL DRONE OPERATORS IN FRANCE
- Energy: Technical inspection in high-risk areas: offshore platforms, methane tankers, nuclear power plants, mapping of radiation levels Cerap, Areva, Total

- Environment, construction and public works Underwater pollution control, air quality measurements, art inspection, building pathologies, improved management of large construction sites Groupe Monnoyeur

- Renewable energies Wind turbine maintenance and rapid intervention at height, dam inspection, detection of defective photovoltaic cells EDF Energies Nouvelles, Alstom

- Heavy industry: Observation of Seveso sites, detection of thermal and chemical leaks, pollution measurement, monitoring of sensitive installations ArcelorMittal

- Mining and quarrying: 3D imaging to evaluate extracted ore stocks, contour surveys to monitor the progress of Lafarge operations

- Networks: Observation of railways, high-voltage power line networks, pipelines and gas pipelines; recognition of incidents and malicious acts EDF, GRTgaz, ERDF, RTE, SNCF, RFF

II- INDUSTRY OVERVIEW

Focus → Related activities linked to RPAs

SECURITY

- o Surveillance and civil security professions (law enforcement)
- o Military (reconnaissance, surveillance, intervention)
- o Fire fighting (thermal inspection, locating people in danger)
- o Intervention in difficult environments (mountains)

ENERGY

Photogrammetry and thermal inspection on :

- o Power lines,
- o Dams
- o Solar panels
- o Offshore platforms
- o Wind turbines
- o Nuclear power plants

AGRICULTURE

Multispectral imaging (colour shades) for vegetation diagnosis :

- o Nitrogen levels
- o Moisture levels
- o Biomass
- o Water status
- o Plant stress
- o Chlorophyll content

ENVIRONNEMENT

1. o The aim is the protection of biodiversity:
2. o Movement of animal populations
3. o Monitoring of parks
4. o Monitoring the general condition of trees
5. o Forest mapping

- Monitoring the evolution of forestry

AQUATICS (MARITIME)

Underwater drones for inspection of underwater flora and fauna, fish farming

COMMERCIAL

Drone delivery (Amazon US)

Developments

POTENTIALLY LONG-ENDURANCE UAV SYSTEMS CERTIFIED FOR INTEGRATION INTO AIR TRAFFIC AND PROLONGED OVERFLIGHT OF POPULATIONS.

The applications of this type would be primarily surveillance operations requiring high altitude evolutions, in complementary use of other surveillance tools such as satellites (border surveillance, fight against illegal fishing, observation of large farms).

Because of the high altitude of operation, the sensors used must have high performance.

French sensor manufacturers would then have the opportunity to invest in the development of these missing technological bricks dedicated to the carriage on a low mass UAV (need for lightness and compactness); The evolutionary altitude of these systems also implies taking into account the problem of integration in the airspace, and therefore a need for certification of all the systems (aircraft, on-board systems, operators, pilots)

HIGH RELIABILITY UAV SYSTEMS FOR SPECIFIC APPLICATIONS.

In the field of building inspection, for example, developments are carried out in urban environments but remain limited to the immediate vicinity (about 1.5 metres) of the inspected object. If the drone (light - about 2 kg) has an on-board geofencing device that prevents it from moving away from the building in question, the safety requirements should not be as strict as for a drone intended for flying over crowds. There are currently no national or European civil standards for assessing the safety of a drone system.

In the current context of energy efficiency, the building inspection market presents real opportunities for the French drone industry, which has skills in topography, thermography, 3D modelling and BIM (Building Information Modeling). Certain technological expectations also seem to emerge from this sector, such as ultra-precise geopositioning devices (in the centimetre range) like GPS RTK (Real Time Kinematics). These technological needs could therefore constitute relevant orientations for the French players.

DRONE SYSTEMS WITH WIDE DISTRIBUTION FOR MASS PROFESSIONAL USE.

This scenario envisages the democratisation of the professional use of drones intended for mass use. Unlike the long-endurance drone described above, these machines can be piloted by any user and fly at a height of less than 150 metres. Sold on a large scale, these vectors have a lower level of technical expertise than solutions developed for a specific business expertise. Their fields of application are extremely varied but still demanding.

From a security point of view, scenario 3 seems to be the most prone to the occurrence of technical and human incidents, which would negatively impact the whole ecosystem. The implementation of security devices such as geofencing is therefore essential.

Sector statistics and challenges

THE GLOBAL MARKET

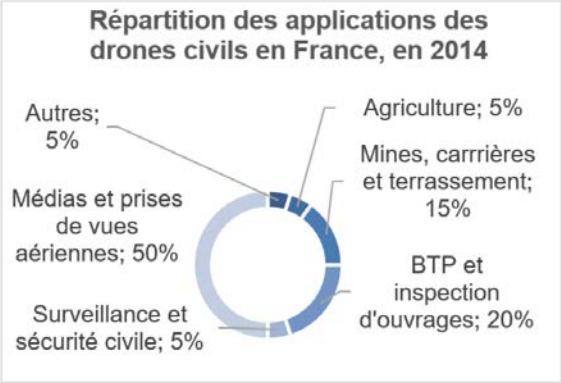
The civil drone market is a rapidly emerging market. The many factors that need to be taken into account in order to quantify the extent of its development potential make it very difficult to estimate figures, as demonstrated by the disagreement between the many studies published on the subject.

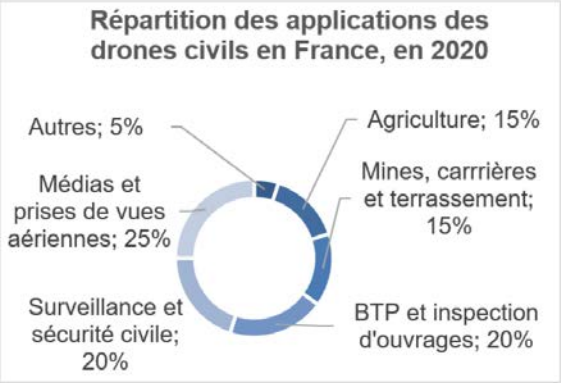
These forecasts are based on various key development factors, such as the completion of regulations on the integration of drones in airspace, financing to facilitate the acquisition of drones by buyers, or an insurance system to cover disputes. However, these factors are all barriers to the development of civil drones, which have not yet found solutions that would allow them to be used in a truly democratic manner. These estimates remain of interest in view of the trends they illustrate, and in particular in relation to the distribution of the market within the various segments of interest. The scarcity of competent pilots, the associated safety and security problems and air traffic management are other factors limiting the growth of the market

THE FRENCH MARKET

France is a forerunner in the field of civil UAVs, thanks in particular to the early introduction of regulations authorising experimentation. The introduction of regulations by the DGAC has in fact been a real engine of growth for the French drone industry

DISTRIBUTION OF CIVIL DRONE APPLICATIONS IN FRANCE IN 2014 AND 2020





BUSINESS OUTLOOK BY CUSTOMER MARKET IN FRANCE

Target market segments	Weight in the civil drone market	Annual sales growth	Example of applications
Leisure	30 %		
Information and medias	30 %	+	
Monitoring and inspection	15 %	++	Monitoring of electricity, gas or railway networks; Visual inspection of buildings and structures; Thermography
Earth and Life Sciences	15 %	+++	Precision agriculture; Mapping; Cubature measurement (quarries)
Civil security	10 %	+	

SEGMENTATION OF THE FRENCH AND EUROPEAN MARKET ACCORDING TO TARGET APPLICATIONS, IN 2020

	Segmentation	France	Europe
Infrastructures/réseaux	35 %	62 M€	385 M€
Génie civil	15 %	27 M€	165 M€
Industries minières et pétrolières	15 %	27 M€	165 M€
Agriculture, forêt, pêche	5 %	9 M€	55 M€
Sécurité civile	5 %	9 M€	55 M€
Sécurité chimique, biologique ou nucléaire	5 %	9 M€	55 M€
Environnement, météorologie, vie sauvage	5 %	9 M€	55 M€
Télécommunications	5 %	9 M€	55 M€
Maintien de l'ordre et sécurité publique	5 %	9 M€	55 M€
Cinéma, photographie, publicité, loisirs, communication	5 %	9 M€	55 M€
Marché accessible total	100 %	179 M€	1 100 M€

SYNTHESIS

The drone industry is still very young and in the process of being structured. Its development is therefore difficult to predict and could require a restructuring of the industry if the achievement of an acceptable level of safety for the use of drones makes their acquisition and operating costs significantly higher than those observed today. At present, the major obstacles to the development of the market lie in its fragmentation into a large number of niches meeting multiple needs and calling on a wide variety of professions. From the point of view of companies, drones raise the issue of adapting to change and introducing new skills.

Key takeaways from the survey (from companies & professionals)

This analysis follows our July/September consultation. It comes after a first analysis and completes it following a re-launch of the consultation.

Response rate, typology

41 responses out of 250 sent.

Three quarters of the responses were from engineering and surveying firms, whereas the initial panel contained about half. Their involvement is greater.

Public works and construction are equally represented at 12% each. This under-representation will require a review of our methodology to bring us closer to the practices of these companies.

There is therefore a greater interest among surveyors than in the rest of the civil engineering profession.

There was no response from specialists in the building envelope sector, although these companies could benefit from an inspection of the roofs to be renovated. It can be assumed that these companies are mainly involved in new construction, so it would be necessary to target companies involved in renovation/repair or insurance experts.

Current uses

Half of the companies indicate that they use an external service provider, but almost 60% have in-house experts, which contradicts the feeling we had during interviews with various companies in the spring. This score of over 100% indicates that some companies have in-house experts and also use external service providers, so a lot of work. The use of the specialist indicates an occasional and non-routine use of the drone, which is not yet a "work instrument", but rather a complementary tool for these companies. The use of the drone is increasing in the companies in the panel, to the point of having invested internally. Perhaps the service providers are overwhelmed or incompetent for the specific demands of the construction industry, forcing companies to have their own specialists.

This idea is reflected in the response on the number of people involved: 35% have no users, and 55% have 1 to 4. So a small, highly specialised team

Only 9% of companies use drones intensively, and 47% use them occasionally. This is still an improvement on our initial results from early 2022, when usage was mostly rare. Currently 35% use them rarely and 16% never use them. There is still a lot of room for improvement and certainly some information work to be done.

There are also interesting responses on the type of current use: the main use is for surveying (92%), and 30% also do site monitoring and communication (sample shots). Multiple responses exceed 100%. There is, however, a new use in site monitoring that we discovered during our interviews prior to the survey and which deserves to be trained.

Surprisingly, for all the other proposed uses there are only one or two user companies. We lack responses in the building envelope sector for roof analysis. The drone is however of great help in this case for renovation, both in diagnosis and costing, but these companies are rather conservative according to the discussions we had with trainers in the field. Here again, training and information work is necessary. Another possibility was proposed: quality control and assurance, an important issue in which the drone has a direct application, was again chosen by only one company.

In the more detailed tasks, topography is used as much to model the terrain digitally in order to produce topographic plans for structures as to determine volumes and surfaces (for processing, in quarries, in public works, etc.). Orthophotos are well used (one third of respondents), which may cover other uses such as site monitoring, which is neglected (10%), as well as the inspection of structures (13%), and there is room for development in this area.

The simple taking of photos and videos is highlighted, but as this is the basis of the work (the drone takes photos which are assembled to form a digital terrain model DTM), we do not know if the respondents only take photos or films, it is necessary to bring it closer to the 10% who do site monitoring and the 3% who practice thermal imaging. On this last theme we lack specialised companies.

3D modelling of structures (exterior/interior) is progressing with 26% of responses. The famous "digital duplicate" of existing buildings with a view to their conservation is beginning to emerge and the drone is particularly well placed to complete scans and enable the model to be assembled in BIM.

The current uses of drones in construction are mainly carried out by surveyors, or the surveying departments of large companies. The predominance of topographic surveying bears witness to this. The fact that many surveyors responded compared to other generalist or non-survey companies does not really distort the results, as the panel of companies surveyed does not give them the majority. The other companies lacked interest in the subject and did not bother to respond despite being re-solicited. We can see here that the use of drones by companies has considerable room for improvement, at least in the interest it should arouse. Construction companies are anchored in traditions and habits, and novelty is often perceived as a source of uncertainty and reduced profitability (through the use of resources that are not directly productive). This is true of BIM, which is struggling to establish itself in France, and also of the drone.

The two are similar in two respects: employees have to be trained in a new practice, and expensive hardware/software has to be purchased. The potential time saving is not directly visible enough and the low profitability of the sector makes us cautious. It is up to us to convince.

Future uses

The two uses that stand out are topography with 54% of development wishes and 3D modelling of structures with 50% (several answers possible). The proportions already seen for current uses remain the same, and are therefore consolidated.

On the other hand, a sector that is still not very prominent in current uses emerges in the wishes for the future: the inspection of structures, with 31% of respondents who see this as an interesting use.

58% of respondents believe that drones will become more important in their activities in the future, compared with 30% who do not "believe" in them and 12% who are undecided. It will still be necessary to convince and train newcomers so that companies no longer see drones as toys or even as an additional administrative and IT burden.

Second to last is surveillance, with 15%, bearing in mind that the construction industry is very prone to theft and damage to materials. This use is somewhat fantasised because a drone has a very short autonomy (20 minutes), so apart from a rapid intervention to a place where an intrusion has been detected, to identify criminals and report their movements, there is no permanent surveillance.

We were surprised to find that only 4% of respondents considered construction site monitoring as a future use. However, it seems to us that a scheduled drone flight of a few minutes every day is more efficient and accurate in terms of site progress than a fixed shot (often from the crane) because there will be fewer masks and the possibility of supplementing with specific manually controlled views, and the use of 3D.

The main advantages perceived by the future use of drones (several answers possible) are risk mitigation (41%) and time saving (60%). Increased productivity is, with 46% of respondents putting it first, a very important criterion in the professional use of drones in mapping for the construction industry. This last criterion is found in the criterion of increased efficiency and savings (30%). Next comes better data acquisition (39%), which is a logical result of the use in quarry quantity surveys, large-scale land surveys or remote monitoring.

The variety of items proposed shows a good distribution of interest in the professional use of drones in civil engineering in general, with a strong emphasis on its most widespread current use: topography. Other uses, such as site monitoring, modelling of structures or parts of structures with a view to their conservation, or direct intervention, must be anticipated by the trainers, because even if companies are currently waiting for these topics, they will be very demanding when the skills are presented to them, with the attendant productivity gains.

Drones training

Half of the respondents answered "neutral" to the question of the difficulty of finding employees capable of working with drones. This corresponds to the proportion of companies that do not have any user employees (55% said they had 1-4 drone employees). The following figures shed light on the reality of recruitment difficulties: only 11% found it "easy" to recruit for this skill, and nobody found it "very easy".

It appears that a high proportion of companies have difficulties (32%) or major difficulties (8% very difficult and 3% extremely difficult) in finding suitable drona profiles for the construction sector. This should encourage us to continue our training programme and to expand it.

On the causes of the lack of candidates, two reasons clearly stand out: a lack of specific training in the students' curriculum (57%) and a lack of exposure of students to drones during their training (50%). This result is higher than at the beginning of the consultation, and we are faced with a growing concern among companies about learning skills related to drones.

This invites reflection on the training courses in which piloting and image processing should really be taught (BTS, BUT, engineers) and on the courses in which the possibilities of drones should be shown (architects, engineers, landscape architects, developers, etc.) so that the use of this technology can be considered as soon as possible.

Next in the list of causes of the lack of candidates are institutional problems: for 30% of respondents, the education system is adapting too slowly to this technology and the changes it brings; 17% see this as the consequence of a lack of investment on the part of institutions, and 10% point to the lack of trainers, while 13% point to the inadequacy of equipment in training centres. We are encouraged to move faster. We cannot ask companies to always train their employees themselves in technologies that are no longer new. Curricula are the contracts that bind teachers and the world of work, in the case of drones they are not revised fast enough or not open enough, and most probably in many other fast moving sectors.

Finally 17% feel that companies themselves are fearful of drone technology, it intimidates them. It is possible that here again the lack of information, of professionally targeted advertising, the "toy" image of photo drones is to blame. And let's not talk about the natural inertia of the construction industry (comparable to the difficulties of deploying BIM...).

On the solutions to be provided, the response bars on the company side are almost all equal (knowing about drones, informing about professional prospects, cooperating) around 28 to 38%. On the training side, the respondents are more vehement: they need to :

- Implement standardised training (53%)

- Improve the training of trainers (34%)

- Invest in training centre equipment (25%)

The end of the questionnaire provides an opportunity to make some developments: most companies only "more or less agree" with the fact that new regulations would improve the use of drones... we can see here the traditional mistrust of professionals with regard to anything that

regulates their activity. If the question had instead highlighted the fact that these new regulations are clearer, uniform in Europe, and designed to promote professional use by avoiding the anarchic proliferation of recreational flights by untrained users, the rate of support would have been higher.

88% agree that cooperation between training institutions, industry and other stakeholders will reduce the gap between the existing training offer and the real needs of the sector. This speaks for itself, we are encouraged to develop our programme.

General conclusion on the survey

The survey confirms the validity of the ERASMUS+ initiative to develop a standardised training programme in the construction sector:

- The usefulness of drones is recognised

- Drones bring productivity gains

- The employees of construction companies are under-informed and this is blocking development

- It is difficult to recruit construction+drone profiles

- The companies concerned are demanding graduates trained to uniform and recognised standards

- Drone Training programmes do not adequately meet the demand in the construction sector.

It is also important to note, by broadening the debate, that European regulations on drones have been in place for a short time (3 years) but that each country is still in a period of transition between local regulations (if they exist) and the application of European texts. A common programme for the various countries would therefore enable better understanding between companies on good practices, better employability of personnel and, ultimately, general progress of the construction industry towards digitisation.

III- TRAINING

Specific training and licensing for RPAS pilots

- Basic training open category A1/A3 (CO A1/A3): register on the "ALPHA TANGO" website https://alphatango.aviation-civile.gouv.fr , follow an online training (video slideshow), then answer 40 random questions directly related to the training. You have to answer just 75% of the questions, but if you fail, you can repeat the questionnaire indefinitely (the questions change each time, but some of them are repeated). Valid for 5 years.

- Complementary examination open category A2 (CO A2): after having trained oneself to fly (thus in category A3), one must learn (in a training centre or on one's own) aeronautical meteorology, drone flight performance, risk mitigation and pass an official DGAC examination of 30 questions with a 75% success rate. (an online exam is in preparation). https://www.ecologie.gouv.fr/exploitation-drones-en-categorie-ouverte#scroll-nav__5

NB: this specific exam is often confused with the CATT (below) and not always offered, it is better to take the CATT (or CATPD) directly but it is harder.

- BAPD brevet d'aptitude au pilotage des drones: this document is the "licence" that indicates the pilot's ability to fly in open category A1, A2, A3. To be requested at the end of the first self-training (A1/A3) and/or A2 training and to be presented in case of control. (Equivalences are possible for holders of ULM, aeroplane, helicopter or foreign certificates who can demonstrate their practical experience of UAV piloting).

- Theoretical aptitude certificate of telepilot (CATT) to fly in specific category French scenarios S1, S2, S3 or theoretical aptitude certificate of drone pilot (CATPD) to fly in European scenario STS01 or STS02: more advanced training, close to the theoretical examination of ULM pilot (air spaces, rules of the air, operation of the drones, rules of exploitation, access to aeronautical information...) then examination of 1:30 hour in an official DGAC centre of 60 questions with a rate of success of 75%. This is not enough on its own: you must also follow a practical training course (see below). https://www.ecologie.gouv.fr/examens-theoriques-ulm-iulm-telepilote-lapl-et-ppl-et-h-bpl#scroll-nav__4

- Attestation de suivi de formation pratique ou attestation d'aptitude aux fonctions de télépilote (AAFT) : delivered by a training organisation (a declared operator for the scenarios he teaches, and as a teacher in his MAP or MANNEX) under his responsibility, and for certain scenarios only (S1 to S5). Completes the CATT to fly as a professional.

- Certificate of Professional Qualification CQP (not compulsory): Some state-approved organisations issue CQP's which make it easier to find work as a "dronist", and to get cheaper insurance as a freelancer. This certificate is not compulsory to practice professionally. Most of the time, these certificates are specialised in a theme. For example at the University of Normandy: https://www.cidn.fr/drone-normandie-innovation/formation-de-telepilote/

or privately: https://www.telepilote.org/ or https://telepilote-academy.fr/

They are based on the CATT + AAFT (compulsory) and a reinforcement of knowledge on the speciality envisaged (photogrammetry, cinema...)

- QUALIOPI certificate: to be able to professionally train pilots. This is a certification by a state body of the ability to establish a training course. Qualiopi is not a "drone" certification but a verification of teaching skills. It will only be granted to pilots who have passed the CATT and the practical training for the scenarios taught and who can justify a certain experience. Should qualified instructors working in training centres have their centres or themselves certified? This question will have to be decided by the administrative authorities.

- The ERASMUS+ Drones4VET programme, if recognised by the authorities, could be a basis for certification for training.

NOTA BENE aerial photography: You must fill in the Cerfa form n°12546 which authorises the aerial photography activity for 3 years (to be returned at least 15 days before the first flight).

NOTA BENE flight over a populated area: You must request an authorisation on the ALPHATANGO portal or fill in the Cerfa form n° 15476 at the prefecture. Declaration 5 days in advance valid for the days requested (if more than 7 days, specific proofs are required), and for a maximum of 1 month. Each flight must be declared in alphatango afterwards (authorised if there is no response), and the prefecture can still prohibit it exceptionally...

In other cases, the operator must be authorised by the DSAC before starting operations. Deadlines must be respected, which can be up to one month's notice.

For the training of our students

The procedures are no different, it is a drone operation always under the responsibility of the operator, who is the head of the establishment, who delegates to his pilots the right to train apprentices in compliance with categories or scenarios.

The training establishment must declare itself as the operator, and training can only begin once all the formalities have been completed.

The only exception is indoor flying, where the regulations do not apply; we have experimented with this in the gymnasium in order to begin our approach without risk. No other person than the teacher and his students must be in the enclosure.

The teacher-pilots must ensure that the students respect the characteristics of the planned flight: category (open or specific), open sub-category or specific category scenario. He/she bears sole responsibility, as if he/she were flying the aircraft. He must be able to regain control of a flight that "goes wrong" at any time: either by dual control or by direct intervention on the student's control.

This is not different from other school activities, the students are always under the responsibility of the teachers, this should not become an obstacle.

The advantage of an existing training establishment is that it is not obliged to be qualified by an organisation such as QUALIOPI.

Description and comparison of the current training offer

When consulting the training offer, it appears in general that private training organisations concentrate on a specific use of the drone after a training course of handling and theoretical examination:
- General photographic shooting
- Cinematographic filming / reporting
- Specialised security surveillance photography
- Specialised photography for technical surveillance of structures and infrared
- Specialised photography of natural environments
- Photogrammetry / cartography

The regulatory and theoretical part is largely emphasised because a national exam must be passed on this subject by the DGAC and the organisations fear that their trainees will not pass this exam, which is very clear in all the presentations consulted.

Practical training is always discussed in the context of the specific categories, whereas the open category is often sufficient, which is a good way of justifying fairly advanced training in the handling of drones. We have noticed that dual control systems are non-existent, except for heavy drones in courses related to safety or work for the cinema with professional onboard cameras, but this is very exceptional. The shots envisaged are generally taken with drones weighing less than 4kg, including with a professional performance camera.
The duration of the courses is generally at least 5 days, for discovery and simple applications, with 3 days of theory and 2 days of piloting. Passing the CATT (or CAPD) exam is the objective, but not the specialisation.

Once this is done, 2 to 10 days of training are needed to specialise.
The problem is often that the students stop after the first course and manage to improve themselves because of the high cost of the following courses. The cost of acquiring professional hardware and software puts a strain on their budget and they can no longer afford to continue their training.
Finally, and most importantly, there are no professional training standards for the various drone professions. The pilot qualification regulations only provide for flights and safety, and it is then up to each individual to demonstrate their know-how. It is therefore very difficult to compare the offers between the different training centres. Some forums exist, but who knows who writes in them? A competitor, the provider, or real trainees?

A coherent training framework should be proposed, the DRONE4VET project would perhaps be the beginning of a European standardisation of skills certification, as far as the construction sector is concerned.

Key takeaways from the survey (from learners/trainees; maybe trainers?)

1 - Response rate

Low, even among students more concerned with drones (BTS MGTMN with 4 returns out of 15), despite several email requests.

Summary made on 32 responses (higher professional training level) to date.

2 - Level of familiarity with drone technology

A third of the learners are familiar with or have already used a drone, a second third understand how it works without ever having used one, and a final third do not understand its operation well.

Note: 0% say they are very well informed about drones.

3 - Technological applications of drones that interest you the most

Taking photos and/or videos is far ahead with 84% (multiple answers possible), followed by quality control with 22%, preconstruction (and site) planning with 12.5% and 9% for transporting goods.

Note: Risk mitigation on site 0% (despite several possible answers).

4 - Awareness of most in-demand jobs or major new assignments in the construction industry

No to 66

5 - Do you find it difficult to access drone-related training that matches your interests

Not too many opinions as: "Neutral" comes first with 69%, followed by "Quite difficult" with 22% and "easy" with 9%.

6 - In the event of difficulty in accessing drone-related training, reasons given

Firstly, "Lack of specific training programmes" with 36%, followed by "Limited exposure to this type of technology during secondary education or apprenticeship" with 32% and "Insufficient facilities or equipment to provide practical training" with 29%.

7 - Solution envisaged to resolve these difficulties

The majority of respondents (multiple answers) proposed "Setting up standardised training courses corresponding to the various trades in the construction sector" with 53%, followed by "Raising awareness of drone technology and its various applications in construction work" with 50% and in third place "Investing in upgrading training centres" with 37%.

Note: "Improving the training of trainers" and "Disseminating the wide range of employment opportunities offered in the sector" came last in only 20% of cases.

8 - Aspects of training considered most important for effective learning

Active practice" was favoured in 74% of cases (multiple responses), followed by "Relevant and up-to-date learning content" for 39% of respondents.

Conclusion about the survey:
There is still a great deal of work to be done to develop trainees' knowledge of drones, to make them aware of the new occupations arising from these new technologies so that they can better understand the opportunities now available in the construction sector.
The development of drone practice is favoured by the trainees, as is the introduction of "standardised" training.

CONCLUSIONS

The usefulness of drones in construction is now well understood by professionals, as the survey results and the development of the sector prove. However, the changes in regulations and the large number of rules put off many professionals.
We see illegal use of drones (generally of low weight) due to the absence of operator declaration because of the administrative burden of operation, or due to non-compliance with the category criteria because of ignorance of the latter.

For the time being, the body of regulations has not been stabilised, and the application of the European rules has been delayed because the manufacturers themselves have not been able to certify their drones.
Operators are only just realising that this is aeronautical work and the rules it imposes are far removed from the concerns of construction professionals.

Thus, clear and legible training for employers, which highlights certified skills in relation to the work to be carried out for the flight, for the administration, for the maintenance and for the exploitation of the data, would allow a safe and faster development of the use of drones in construction.

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DRONES4VET

Co-funded by the
Erasmus+ Programme
of the European Union

Country report on the use of drones in construction-related activities

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Austria

2022

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1 OVERVIEW (AT NATIONAL LEVEL)

1.1 Regulations (Standard Operating Conditions)

The EU Aviation Basic Regulation ("Basic Regulation") in force since 11.09.2018 now clarifies that unmanned (autonomous) aviation is also part of civil aviation and thus the same basic requirements apply. Specific technical and operational requirements were determined by the Commission as of 1.7.2019 with the following two legal acts:

- Delegated Regulation (EU) 945/2019 on unmanned aircraft systems and third country operators of unmanned aircraft systems (manufacturing rules).
- Implementing Regulation (EU) 947/2019 on the rules and procedures for the operation of unmanned aircraft (operational rules). The regulation is in force since 1.7.2019 and will apply in all member states from 1.7.2020. A transition period with certain conditions applies until 30.6.2022 for unmanned aircraft of the open category that do not meet the requirements of the regulation.

The new rules apply to all parts of drones and are designed to ensure that manufacturers and users across the EU respect safety, privacy, personal data handling and environmental protection. Drones are classified into the following three categories according to the air and ground risk they pose in terms of potential collisions (people, critical infrastructure, other aircraft):

- "Open": low risk, therefore no approval required.

- "Specific": increased risk, approval by national authorities.

- Certified": high risk, comparable to conventional manned aircraft. However, there are no EASA (European Union Aviation Safety Agency) requirements for this category as yet.

In addition, points were established in the following areas:

- A registration of operators in a database and registration number on the aircraft,

- geosensitization (warning function in case of potential violation of airspace boundaries),

- direct remote identification (including device for aircraft position tracking,

- Use of real-time electronic communications or similar,

- Training or proof of knowledge (remote pilot),

- Establishment of "no-drone zones", i.e. areas where absolutely no drones are allowed (such as airports) by member states.

1.2 Strategic plan for the development of RPAs/drones in the country. Priorities

Among the most important forward-looking technologies are Artificial Intelligence, Internet of Things, Big Data, Blockchain, 5G, 3D printing, robotics, drone technology, genome editing, nanotechnology and photovoltaics.

Communication and interaction with society are supported in a variety of ways within the framework of sponsored projects.Innovation labs are a central instrument for this: One example is "Take Off: Innovation Lab AirLabs" (https://www.ffg.at/airlabs-austria) - Establishment and operation of a drone test infrastructure.

The innovation potential of drones is very large, with applications ranging from emergency response (fire/rescue), disaster response, conservation, and infrastructure monitoring.

The variety of possible applications is leading to a sharp increase in drone flights in the airspace and thus to increasing challenges in integrating drones into the airspace.

1.3 Government agencies with jurisdiction over RPAs

Federal Ministry for Climate Action, Environment, Energy, Mobility Innovation and Technology: https://www.bmk.gv.at/

Austrocontrol: https://www.austrocontrol.at/

Dronespace: https://www.dronespace.at

1.4 RPA operator qualification requirements / Pilot certifications needed

The "Open" category allows simple low-risk operations without the involvement of aviation authorities, even for commercial purposes. A permit to fly is not required. The category is intended to liberalize the use of drones, thus requiring the gain of experience. The risk to other airspace users is minimized by separating manned and unmanned aviation (e.g., by different flight altitudes). Risk to people on the ground is minimized by using drones with low kinetic energy and by establishing minimum distances to people/crowds. Flights over crowds are prohibited, but flights over uninvolved people in urban areas are allowed. Control in this category is through the executive branch as in normal traffic. Required: license and registered drone (insurance necessary with minimum coverage 750 tsd)

Category "**specific**": If the risk becomes higher, e.g. if better technical equipment of the drone is necessary for a specific mission or higher pilot competence is required, the category "Specific" comes into question. Here, the rules are stricter. A risk assessment must be submitted by the user for each use. This is reviewed by the aviation authority and the mission is approved on an individual basis. Exceptions are flights in unpopulated areas, where the (already registered) user has to prepare, evaluate and submit the hazard assessment himself. Legal info may approve. Proper documentation of such flights is required. The control in this category is done by the aviation authorities.

The category "**certified**" involves operations with the same or similar risks as in manned aviation. Therefore, the licensing and certification of pilots and drones are as strict as in manned aviation.

1.5 Key figures (nº of registered operators like corporations, SMEs…; registered aircrafts; …)

It is estimated that there are already up to 100,000 drones in Austria. This includes both the private and commercial sectors. Sales of drones for commercial use are around 1,500 drones (2021). In 2016, this figure was still around 1,000, an increase of 50% within these 5 years. (source: BRANCHENRADAR.com Marktanalyse GmbH)

Data from austro control: (2021)

- Drone pilot licences: 40.733
- Drone registrations: 27.177

2 INDUSTRY OVERVIEW

2.1 Focus → Related activities linked to RPAs

Drones can be used in processes throughout the whole life cycle of a building. The application areas are divided into three sections

Planning phase

- DTMs (Digital Terrain Model) and DSMs (Digital Surface Models)
- GIS & 3D modelling

Construction phase

- Monitoring construction progress
- Logistics
- Photography for marketing activities

Operation phase

- Measurement (laser scanning)
- Inspections for safety and maintenance
- Thermography
- Fire control

2.2 Developments

The U-space comprises various services and will support the management of safe and efficient drone operation while providing an appropriate interface to manned aviation and ANSPs. Unlocking the advantages of new technologies and incorporating various automated functions will make it possible for large numbers of drones to routinely enter the airspace in complex and crowded areas such as cities. The final stage of development is scheduled for completion in 2035.

The Development of innovative technological solutions and open up new types of applications is the prority of the future tasks. There are numerous projects that are due to be implemented in collaboration with logistics, infrastructure and telecoms providers. The first long-haul flight of an unmanned aircraft without line-of-sight control has already taken place and involved the remote inspection of high voltage power lines for Austrian Power Grid AG. Austrian National Railways (ÖBB) has also tested drones for the first time to check rail infrastructure in areas that are particularly hard to access. Another case, the first fully automated flight by a drone from the Red Cross district office in Lilienfeld to the nearby state

hospital, demonstrates how their use can save valuable time and resources when transporting blood products. (Austrocontrol)

2.3 Sector statistics

See key figueres before.

There is no specific data / statistics for each sector available.

2.4 Sector challenges → Technology adoption and gaps (Drone adoption)

The construction industry is probably benefiting most extensively from the new drone applications- in all construction sectors where UAS can provide valuable services. Until a few years ago, for example, inspecting was complex, poorly accessible structures such as slope stabilization or bridges was a time-consuming and expensive process.

The future will change as soon as fully autonomous systems are used and control is no longer required. Corresponding technologies such as LiDAR and image recognition with AI will create new potential. What is difficult at the moment is the safety on the construction sites with all the obstacles.

2.5 Key takeaways from the survey (from companies & professionals)

The construction sector, as well as the facility- and real estate management in our is characterized by small and mid-size companies.

- About 25% of the companies have in-house experts, 40% have external service providers and 35% have currently no demand.
- 90% of the companies, who have in-house experts have between 1 to 4 employees which are involved in the use or management of drones, 10% have 5 to 9 employees.
- 60% of the companies indicate that they use drones occasionally, 30% indicate that they use them rare and 10% have no use.
- 65% of companies indicate that the drone use will become more common in the future, 20% have no estimation and
- The most used drone applications are quality control, progress tracking and communication.
- Photography, measurements, digital modelling and thermal imaging will be developed for future tasks

- According to the companies, the main advantages of using drones are more appealing marketing material
- 30% of the companies indicate that it is somewhat difficult to find qualified professional profiles in the use of drones, and 65% neutral.
- The companies indicate that the solutions to address this lack of skills are the awareness of drone technology, the investing in the upgrading of training centers and the improvement of trainers and providers.
- 70% of the companies indicate that they agree that the establishment of a standardized and certified training program would help promote the use of drones in the different sectors.
- 65% of the companies indicate that they agree that cooperation between the different institutions and companies would reduce the gap between existing training and the real needs of the sector. 25% have no estimation.

3 TRAINING

3.1 Specific training and licensing for RPAS pilots

Category “open”

The drone license is mandatory for all persons who want to fly with drones in the category "open" (subcategories A1, A2, A3) with a weight of 250 grams or more. In most cases, this consists of online training (online course) and an online test of 40 multiple-choice questions. Training and test are provided free of charge by Austro Control and can be completed online at dronespace.at. After positive completion, the drone operator's license can be saved or printed out directly by the operator. The proof must be carried with each flight either electronically (e.g. on the cell phone) or in printed form.

The minimum age for piloting drones with a take-off weight of 250 grams or more and thus for obtaining the drone operator's license is 16 years, although there are some exceptions (e.g. for "toy drones"). Attention, the minimum age for the operator of a drone is 18 years.

The drone pilot's license is valid for five years.

The test for the certificate of knowledge for pilots can be taken in any European country and is valid in all member states. The online test covers topics such as flight safety, human performance skills, operating procedures, general knowledge of unmanned aerial vehicles, insurance, and data protection and privacy.

Depending on the weight (subcategories A1, A2, A3) of the drone, the requirements for pilots vary:

Drones weighing 250 grams or more: online training followed by an online test (40 multiple-choice questions). For all other drones in subcategory A1, it is sufficient to familiarize oneself with the user manual.

For subcategory A3, it is also necessary to familiarize oneself with the user manual and complete online training and online test.

For operation in subcategory A2, flight experience and the passing of a theory test at Austro Control are also required.

Category “specific”

The category "specific" allows flights beyond visual range (BVLOS). Use cases for this category are e.g. camera flights over cities with drones over 4 kg or flying over infrastructure.

An operating license is required for this purpose. The risk assessment (SORA) must be attached to the application. If the operation falls under a so-called "standard scenario" for various typical application scenarios (e.g. inspection wind turbine), the operator does not have to perform a risk assessment anymore, but only has to declare that the operation complies with the corresponding scenario and that the specified requirements are met.

Austro Control confirms that this declaration has been received, after which operation can commence. This is because a risk assessment has already been carried out for the corresponding type of operation within the framework of a "standard scenario" published by the authority and the necessary safety precautions and requirements have been defined.

"Light UAS Operator Certificate"

In the category "specific", a "Light UAS Operator Certificate" (LUC) can also be applied for instead of a single authorization by Austro Control. With the LUC, Austro Control entitles the operator to authorize his or her own flight operations in the category "specific" under certain conditions.

Training of remote pilots

The extent of the required training depends on the planned flight in the category "specific". If the operation does not fall into a "standard scenario", Austro Control will assess in the course of the operating approval whether the training to be proposed by the remote pilot is appropriate and thus make it the required training.

In the case of a "standard scenario", the remote pilot must hold a certificate of theoretical knowledge for operation under standard scenarios and an accreditation for completion of the STS-01 practical skill. In addition, the online exam must be successfully completed.

3.2 Description and comparison of the current training offer

Courses are offered by various providers for theoretical training and also practical flight exercises. Target groups of the courses are mostly users of the category “open”. For the flight trainings of the category specific, trainings can be carried out as well.

Special courses for specific application areas are also offered. (Ex. Fire brigade)

Only a few courses are currently available for the construction sector. Only theoretical seminars are offered here. Special courses with regard to the various options are not available.

Training offer

Provider	Infos	Link
Spektakulair	Courses for drone licences (A1-A3) and flight experiance	https://spektakulair.at/
Öamtc	Trainings fpr flight experiance	https://www.oeamtc.at/
Wifi	Courses for drone pilots (basic & advanced)	https://www.wifi.at
ARS Academy	Seminar using drones for building inspection (theory)	https://ars.at/

3.3 Key takeaways from the survey (from learners/trainees; maybe trainers?)

- The learners have less experience using drones, but understand how are they working (75%).
- The most interesting sectors for their future careers are residential building construction, facilities management, real estate agent and the energy sector.
- Most of them (70%) are not aware of the most in-demand jobs in the construction industry.
- The interesting fields of application are rather broad. The most cases which were selected are , photography, inspection, 3d-modelling and progress monitoring.
- 33% of the learners surveyed indicate that access to drone-related training that matches their interests is somewhat difficult, while another 63% indicate that access is neutral.
- The learners indicate that the main reasons for the lack or difficult access to training related to drones are the slow implementation of new training programs adapted to the new trends in the sector and the lack of skill pathways / training programs.

- The learners indicate that the possible solutions to address this problem of access to training would be the awareness of drone technology and its different applications in construction works and foster open exchange and communication between companies and educational institutions to favour cooperations.
- The learners indicate that the most important aspects for effective learning and subsequent job placement are active practice, relevant and up-to-date learning content, as well as up-to-date equipment and qualified specialised trainers.

4 CONCLUSIONS

In addition to the market of consumer drones, a highly specialized drone technology and industry is developing with a high growth potential. These small aircraft are finding their way into sectors, as in agriculture and forestry, security technology or logistics. The strongest growth, is currently in the area of photography, measurement and analysis services. The advantages of drones are obvious: costly settings such as barriers, scaffolding or days of downtime for scaffolding or days of downtime for measurements and inspections can be saved with their use.

The survey of companies shows that they use drones sporadically. Mostly with external service providers and for the use of photography, as well as construction site monitoring. The survey with the learners shows that they have dealt with the topic, but the application can only be classified to a limited extent. This can exist by the fact that some have not yet dealt with possible courses or training.

For flying, in the different categories training courses are offered for practical training. However, what is missing are trainings with specific application areas, such as the use of different analyses (measurements, thermography..) or software applications in combination with the testing of different drones. In this area, there is a gap in the education.

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DRONES4VET

Co-funded by the
Erasmus+ Programme
of the European Union

Country report on the use of drones in construction-related activities

Bildungszentren des Baugewerbes e. V. (BZB)

BZB
Bildungszentren des Baugewerbes e.V.

Germany

2022

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1 OVERVIEW (AT NATIONAL LEVEL)

1.1 Regulations (Standard Operating Conditions)

Which regulations apply depends on the type of use and the size and weight of the drone. In 2017, the national regulations (so-called drone regulations) governing the operation of Unmanned Aircraft Systtems (UAS) were published.

However, new EU regulations, DVO (EU) 2019/947 and DVO (EU) 2019/945, apply to the operation of UAS from 31.12.2020. The following regulations currently apply in all EU member states:

The operation of a UAS is divided into three operating categories: "open", "specific" and "certified".

In the "open" operating category, for example, a maximum flight altitude of 120 metres above ground applies and constant visual contact with the UAS must be ensured. Furthermore, the minimum age for remote pilots is 16 years and the maximum permitted take-off mass is less than 25 kilograms. No dangerous goods may be transported or other objects dropped.

If one of the specified requirements for the "open" operating category is not met, the UAS operation automatically falls into the "specific" or "certified" category. Further approvals must be obtained for this (see chapter 3 "Training").

With the EU regulation came the obligation to register operators. An operator (e.g. a company, group or individual entrepreneur) can own several drones and also employ several remote pilots. After receiving an allocation number, it must be attached to each UAS (e.g. as a small aluminium plate).

In addition to these EU-wide regulations, there are also national laws that must be observed. This means that a German drone pilot must still inquire about national regulations in other EU countries and vice versa. National regulations restrict, for example, UAS operations near airports or critical infrastructure. The regulations for UAS operations are laid down in Section 5a of the German Air Traffic Regulations (LuftVO). It lists, among other things, geographical areas for unmanned aerial vehicles that are mandatory for every remote pilot.

These are for example:

- Minimum 1.5 km lateral separation from the boundary of aerodromes that are not airports.
- Minimum 1000 metres lateral separation from the boundary of airports. In addition, all directions of approach and departure must be taken into account by

extending the runways by 5 km in each direction with a width of 1000 metres from the runway centrelines.

- Residential properties may be overflown at 100 metres to 120 metres under certain conditions (alternatively: consent of the owner).
- 100 metre separation to limit sensitive areas. These include: Industrial facilities, correctional facilities, facilities for the correction of psychiatric disorders, military facilities and organisations, facilities for the central generation and distribution of energy, facilities in which activities requiring a permit under Protection Level 4 of the Biological Substances Ordinance are carried out, properties of federal and state constitutional bodies, or supreme and higher federal and state authorities, properties of diplomatic and consultative representations, as well as international organisations as defined by international law, properties of police and other security authorities and hospitals.
- Minimum distance of 10 metres to federal roads, waterways and railway facilities. Additional application of the 1:1 rule (lateral distance of the aircraft from the mode of transport ≥ height of the aircraft above ground). Additional crossing of federal waterways permitted under certain circumstances.
- Nature conservation areas (except national parks!) may be flown over at 100 metres to 120 metres under certain conditions.
- Outdoor swimming pools, bathing beaches and similar facilities may only be overflown outside operating or bathing hours.
- 100 metres distance to accident sites, operational sites of authorities and organisations with security tasks (BOS) and armed forces.
- Air traffic control clearance required for drone operations in a control zone.

1.2 Strategic plan for the development of RPAs/drones in the country. Priorities

In 2020, the German government presented an action plan on drones entitled "Unmanned Aerial Systems and Innovative Aviation Concepts". With the action plan, the Federal Government is pursuing three goals to advance UAS applications in Germany. The three milestones, which will serve as guidelines on the way to the regular operation of UAS are as follows:

1. Germany wants to become a lead market and establish high safety standards.
2. Germany wants to bring automated and connected flying into practice.
3. The protection of personal data, privacy and the environment must be ensured.

Overview of key measures of the action plan and selected examples:

- New framework for the operation of drones
  - Development of a digital platform for unmanned aviation. In concrete terms, the aim is to enable networking and data exchange between the air traffic participants involved (cooperative air traffic) and to bundle all relevant information for drone operations on a central platform.
- Focused detection and countermeasures
  - Development of a roadmap for drone detection near airports.
- Strengthening Germany as a location for innovation
  - Research funding for drones and air taxis will be continued and expanded.
  - Establishment of specific temporary test fields, also cross-border with interested neighbouring countries.
- Creating more social acceptance of drones
  - Information campaign informing about the benefits and dangers of drone applications and highlighting measures to protect citizens.
  - Research projects investigating what noise and light emissions drones cause, what disruptive effects exist and how these can be reduced.
- Air taxis for passenger transport and as a possible emergency ambulance in air rescue services
  - The Federal Government cooperates in the development of regulations for air taxi certification at the European Union Aviation Safety Agency EASA.
  - A legal framework is being created to combine mobility services. The goal is a multimedia transport chain that includes air taxis. Focal points: Airfields should be interoperable for different air taxis; where possible, existing airfields should be able to be shared by air taxis.

1.3 Government agencies with jurisdiction over RPAs

In the federal structure of the Federal Republic of Germany, the aviation authorities of the federal states are responsible for all administrative acts in connection with the ascent and operation of drones for civil use. No new aviation safety authorities were established for this responsibility, but the tasks were transferred to existing authorities.

These are the aviation authorities of the 16 federal states:

- BW: State Aviation Authority Baden-Württemberg: Regional Council Stuttgart
- BY: State Aviation Authority Bavaria: Government of Upper Bavaria (Aviation Authority of Southern Bavaria) and Government of Middle Franconia (Aviation Office of Northern Bavaria)
- B: State Aviation Authority Berlin: Senate Department for the Environment, Transport and Climate Protection and Joint Higher Aviation Authority Berlin-Brandenburg (LuBB)
- BB: State Aviation Authority Brandenburg: Joint Higher Aviation Authority Berlin-Brandenburg (LuBB)
- HB: State Aviation Authority Bremen: Senate for Science and Ports
- HH: State Aviation Authority Hamburg: Authority for Economic Affairs and Innovation - Aviation Supervision
- HE: State Aviation Authority Hesse: Regional Council Darmstadt - Planning & Traffic and Regional Council Kassel - Planning & Traffic
- MV: State Aviation Authority Mecklenburg-Vorpommern: Ministry of Economy, Infrastructure, Tourism and Labour
- NI: State Aviation Authority Lower Saxony: State Authority for Road Construction and Transport
- NRW: State Aviation Authority North Rhine-Westphalia: Düsseldorf District Government - Transport Division and Münster District Government - Traffic Division
- RP: State Aviation Authority Rhineland-Palatinate: State Enterprise Mobility Rhineland-Palatinate
- SL: State Aviation Authority Saarland: Ministry for the Environment, Climate, Mobility, Agriculture and Consumer Protection
- SN: State Aviation Authority Saxony: Saxony Regional Directorate - Air Transport and Inland Navigation
- SA: State Aviation Authority Saxony-Anhalt: Saxony-Anhalt State Administration Office - Economy - Transport
- SH: State Aviation Authority Schleswig-Holstein: State Office for Road Construction and Transport Schleswig Holstein

- TH: State Aviation Authority Thuringia: Thuringian State Administration Office - Air Traffic

  In addition to the state aviation authorities, the Federal Aviation Authority (Luftfahrtbundesamt, LBA) and the German Air Traffic Control (Deutsche Flugsicherung, DFS) are also aviation authorities in Germany.

1.4 RPA operator qualification requirements / Pilot certifications needed

The new EU regulations standardise the requirements for drone pilots. From now on, there are two licences: the EU Certificate of Competence A1/A3 (colloquially also called "small EU drone licence") and the EU Remote Pilot Certificate A2 (colloquially also called "large EU drone licence").

Which certificate you need depends on how you want to use your drone and which drone classification it belongs to. It is important to know that drones are divided into five risk classes: C0, C1, C2, C3 and C4. These risk classes subdivide drones according to their risk, such as weight, design and safety functions. Furthermore, there are three application scenarios of drones ("open", "specific" and "certified"), with "open" being the most common main category.

The main category "open" is again divided into three subclasses:

- A1: Here, flight is also possible in the vicinity of people. Flights over outdoor crowds and uninvolved persons are prohibited.
- A2: Here, flights are only permitted at a safe distance from uninvolved persons with a distance of at least 30 metres. However, the distance may be reduced to up to 5 metres when the drone is in slow mode.
- A3: When flying the drones, no uninvolved persons may be present in the entire flight area. In addition, a distance of at least 150 metres must be maintained from residential, commercial, industrial or recreational areas.

Generally speaking, since 31 December 2020, all drone pilots must hold an EU drone licence. There are only a few exceptions, which are listed below:

- Drones with a C0 class
- Self-built drones with less than 250 grams ascent weight and a maximum speed below 19 m/s
- Until 31.12.2022: old devices with less than 500 grams ascent weight
- From 01.01.2023: old devices with less than 250 grams ascent weight

1.5 Key figures (nº of registered operators like corporations, SMEs…; registered aircrafts; …)

Number of drones in Germany

In Germany, there are 430,700 drones in circulation. The number of privately used drones exceeds the number of commercially used drones by a factor of 8. However, the market for private drones seems to be saturated, while the commercial use of drones is becoming increasingly popular: Since 2019, the number of commercially operated drones has more than doubled (+138%), while the number of privately used drones has declined (-14.5%).

- 385,500 drones in private use
  - Toy drones up to a value of €300 account for just about a third of this
  - The other two-thirds are so-called prosumer drones, which are equipped with a small camera and are used by their users for holiday photos, among other things
- 45,200 drones in commercial use

Drone companies in Germany

- Nearly 400 companies with a main focus on drone technology/unmanned aviation
- Characterised by a strong start-up culture
- Small workforce of around seventeen employees on average (2019: 12 employees)
- Low age of the companies of around six years (2019: 3 years)
- Average annual turnover of companies specialising in drones: €670,000 (2019: €330,000)

Market demand

- Estimated at a total of €840 million (2019: €574 million)
  - €738 million (2019: €404 million) attributable to the commercial drone market
  - €102 million (2019: €169 million) attributable to the private drone market
- Hardware market: €206 million (2019: €241 million)

- Software market: €33 million (2019: €37 million); includes, for example, software for flight planning, flight execution and data processing
    - 98% commercial and only 2% private
- Service market is the largest segment with €600 million (2019: €296 million)
    - 100% attributable to the commercial drone market; includes, for example, all services provided with drones by all companies in all industry sectors

Market forecast

- Number of drones is expected to increase to around 450,000 by 2025
- By 2025, one in three drones will be used commercially (an increase to 132,000, while private drones will decrease)
- Drone market to grow from €840 million to over €1.6 billion by 2025 (equivalent to an annual average growth rate of 14.5%)

2 INDUSTRY OVERVIEW

2.1 Focus → Related activities linked to RPAs

There are many areas of application for drones in the construction industry. What makes their application particularly attractive is the fact that drones can be used throughout the entire life cycle of a building, i.e. not only during the construction phase, but also in the preceding planning and design phase as well as during the use phase of a building.

Examples of key applications for drones in the construction industry include:

- Building inspection
- Construction site safety
- Visualisations (e.g. 3D models)
- Surveying work
- Monitoring of construction progress
- Communication
- Transport of components and tools

2.2 Developments

With regard to drone applications in the construction sector, rapid advances in technical development can be observed. Simply flying over and observing from above is a thing of the past. In addition to pinpoint surveying with an accuracy of 2-3 centimetres at a flight altitude of 100-120 metres above the ground and images in real time, there are many other developments worth mentioning.

Drones can fly autonomously using a GPS module that indicates where to stop and take a photo if necessary. With the help of such POIs (points of interest), all neuralgic points relevant to maintenance can be flown to, inspected and documented.

Drones that provide thermal images (infrared thermography) are now also available – prototypes have also been developed that use X-rays to inspect their surroundings. The recording of a thermographic model has several advantages. The smallest defects and flaws that cannot be seen with the human eye can be precisely depicted, such as millimetre cracks in the building's surface. Moreover, infrared thermography can be used to record the condition of materials, for example. The presence of thermal bridges and moisture can be detected and conclusions can be drawn about the energy efficiency of a building. In addition, thermal cameras can easily reach areas that are difficult or

impossible to reach for human inspections during "visual monitoring", which means optical surveys, observations and aerial photography.

Especially for Building Information Modelling (BIM), the data transmitted by drones will make indispensable contributions in the future.

2.3 Sector statistics

According to a survey (as of 2021) by the Institute for Construction Management at the University of Duisburg-Essen, only 30 percent of respondents from the construction industry use drones for professional purposes on the construction site (i.e. 70 percent are non-users). Of the 30 percent who actually use drones, they are applied for the following tasks:

- 32% for inspection, especially recordings of the building stock and structural inspection
- 29% for construction documentation
- 16% for measuring/surveying purposes
- 13% for advertising purposes
- 10% for the creation of 3D models

2.4 Sector challenges → Technology adoption and gaps (Drone adoption)

In addition to the acceptance of drones and emerging technologies in the traditional construction industry, which still has room for improvement, especially among small and medium-sized enterprises, the lack of digitalisation in some areas represents a major challenge.

Despite the fact that many business owners understand and recognise the benefits that new technologies can bring, it is still a rarity for smaller construction companies to invest in the introduction of a new technology for their business.

While drones are still mostly controlled manually, the future lies in automated flying drones. One challenge is the connection of drones with artificial intelligence. The integration of AI (deep learning) requires additional research and development work, for example to enable the collaborative use of the artificial neural network for monitoring the entire construction process.

Furthermore, data protection concerns and safety aspects are further obstacles on the way to a widespread use of drones in the construction sector.

2.5 Key takeaways from the survey (from companies & professionals)

Takeaway #1: At present, know-how regarding drone applications is only available to a limited extent.

- 15% said they do not currently use drones at all.
- 59% answered that they use drones only rarely, another 23% use them occasionally.
- Only 27% of respondents reported drone expertise within the company.
- 73% said they use external service providers when it comes to drone applications.

Takeaway #2: Companies are willing to implement various application possibilities in their company in the near future.

- The most frequently mentioned potential applications included surveying work, photography and/or video, equipment tracking and thermal imaging

Takeaway #3: The development of standardised training courses should be promoted.

- The most mentioned solution to tackle the skills shortage regarding drone technology is the implementation of standardised training courses that match the different jobs in the sector (65%).

3 TRAINING

3.1 Specific training and licensing for RPAS pilots

EU Certificate of Competence A1/A3 ("Small EU Drone Licence")

For the EU Certificate of Competence A1/A3 you have to complete an online training and pass an online exam. The exam consists of 40 multiple choice questions from the following 9 subject areas:

- Flight safety
- Airspace restrictions
- Air law
- Human performance and its limitations
- Operating procedures
- General knowledge of UAS
- Privacy and data protection
- Insurance of drones
- Aviation security

To pass, 75% of the questions must be answered correctly. The exam can be repeated several times if you fail. The small drone licence is valid for five years and can be extended by taking a repeat examination or a refresher course.

In Germany, the Luftfahrtbundesamt (LBA) offers both the online training and the exam. There is a fee of 25 euros. Click here to go to the website of the Federal Aviation Authority: https://lba-openuav.de

EU Remote Pilot Certificate A2 ("Large EU Drone Licence")

The large licence builds on the small one, i.e. it requires passing the online exam at the LBA described above.

The theoretical exam for the Remote Pilot Certificate A2 consists of 30 multiple choice questions from 3 subject areas:

- Meteorology

  Weather influences on the operation of a UAS (wind, temperature, air density), visibility, obtaining weather forecasts.

- UAS flight performance

  UAS categories and their operating ranges, centre of gravity position, mass and balance, securing payload, batteries.

- Technical and operational mitigation of risks on the ground

  Technical and operational measures, functions in slow flight mode, 1:1 rule, estimation of distance to people.

The examination is offered by centres designated by the LBA (see chapter 3.2).

The EU Remote Pilot Certificate A2 exam also requires at least 75 per cent of the questions to be answered correctly in order to pass. The large drone licence is valid for five years. The certificate can also be extended by taking a retest or a refresher course.

Each examination centre charges its own fee for the training and the examination acceptance – usually a low to mid three-digit amount. In addition, a fee of 30 euros must be paid to the LBA for the issue of the certificate.

Specific Category

The "specific" category includes all common operations that are not covered by the "open" category. It describes drone flights with an increased risk to other persons or to air traffic.

In the "specific" category, it is not permitted to fly over crowds of people, transport people or transport dangerous goods with a drone. The "certified" category was created for these special cases.

If a person wants to fly with a drone in the "specific" category, this is only permitted after a prior risk assessment. In addition, approval by the competent authority is required. The competent authority is always the authority in the country in which the drone operator is registered. Registration is mandatory in the "specific" category.

Approval by the authority can be obtained in three ways:

- Approval as part of membership in a model aircraft association
- Declaration of compliance with standard scenarios
- Operating permit: Will be granted after review of a risk assessment according to the SORA procedure by the competent authority

The exact requirements that will apply in the "specific" category in the future will only be determined by the ancillary provisions that are defined with the standard scenarios or issued in the operating licences.

As a drone pilot in the "specific" category, a whole range of knowledge is required. It is essential to be familiar with the following topics:

- Application of operating procedures
- Dealing with aeronautical communications
- Mastery of flight routes and automation
- Leadership, teamwork and self-management
- Problem solving and decision making
- Situation awareness
- Managing workload
- Coordination and handover
- Explaining procedures for cross-border deployment
- Compulsory registration

Beyond this, however, the authorities may demand further competencies that one must master as a drone pilot.

3.2 Description and comparison of the current training offer

While the EU Certificate of Competence A1/A3 is obtained online through the Federal Aviation Authority (LBA) by passing a multiple-choice examination, there are several providers who offer training courses, including practical training, for the EU Remote Pilot Certificate. Some of these are testing centres designated by the LBA, where the examination can also be officially conducted and a certificate acquired.

The following list provides an overview of the best-known training options throughout Germany:

Training provider	Info
AERIAL ACADEMY	Online courses for the EU Remote Pilot Certificate A2.
Airclip Service GmbH & Co. KG*	Online and face-to-face courses for the EU Remote Pilot Certificate A2 as well as industry-specific special training courses. **Testing centre appointed by the Federal German Aviation Authority (LBA)*

BORMATEC*	Online and face-to-face courses for the EU Remote Pilot Certificate A2 as well as further practical training and workshops on drone use for deer rescue. **Testing centre appointed by the Federal German Aviation Authority (LBA)*
CiS GmbH*	In-house training courses for EU Remote Pilot Certificate A2 as well as UAS training including flight practice and UAS user training for flight evaluation. **Testing centre appointed by the Federal German Aviation Authority (LBA)*
Copter-Expert GmbH*	Online and face-to-face courses for the EU Remote Pilot Certificate A2 as well as training courses for firefighters and security organisations. **Testing centre appointed by the Federal German Aviation Authority (LBA)*
Copteruni GmbH*	Online courses for the EU Remote Pilot Certificate A2. **Testing centre appointed by the Federal German Aviation Authority (LBA)*
Delta-Drone	Only on-site training for the EU Remote Pilot Certificate A2 as well as drone beginner courses and training for drone photography.
Drohnenflugschule24*	EU Remote Pilot Certificate A2 online via live webinar or as classroom or in-house training, as well as other specialised courses and flying lessons. **Testing centre appointed by the Federal German Aviation Authority (LBA)*
Drone Class	Online courses for the EU Remote Pilot Certificate A2.
droneLIONS Academy	Online and face-to-face courses for the EU Remote Pilot Certificate A2 as well as industry-specific special training courses.

Dronesperhour GmbH (DPH)*	EU Remote Pilot Certificate A2 online for self-study or as a digital seminar via videoconference as well as practical flight training on site. **Testing centre appointed by the Federal German Aviation Authority (LBA)*
Kopter-Profi GmbH*	EU Remote Pilot Certificate A2 online or in presence as well as further theoretical seminars and practical trainings around the operation of drones. **Testing centre appointed by the Federal German Aviation Authority (LBA)*
Kopterzentrale GmbH*	Training courses for the EU Remote Pilot Certificate A2 as well as drone seminars for company groups and as individual training, both in presence and as an online event. **Testing centre appointed by the Federal German Aviation Authority (LBA)*
Pro Fly Center	Online and on-site courses for the EU Remote Pilot Certificate A2 as well as courses for flying in the specific category.
RKM - RotorKonzept Multikoptermanufaktur GmbH*	Training courses for the EU Remote Pilot Certificate A2 online or in presence as well as application-oriented courses for advanced drone pilots, e.g. on infrastructure inspections, roof surveys or surveying with UAS. **Testing centre appointed by the Federal German Aviation Authority (LBA)*
RolaWind GmbH*	Online and on-site courses for the EU Remote Pilot Certificate A2 as well as courses for flying in the specific category. In addition, there is a large number of courses for the special category. Provider with additional workshops for the industry-specific use of drones (e.g. photogrammetry). **Testing centre appointed by the Federal German Aviation Authority (LBA)*

Seabirds.de GmbH*	Classroom training (one day) on the EU Remote Pilot Certificate A2. Additional practical courses can be booked on request. **Testing centre appointed by the Federal German Aviation Authority (LBA)*
TB Copters GmbH*	Online learning material and exercise manual for practical training as well as online examination for the EU Remote Pilot Certificate A2. **Testing centre appointed by the Federal German Aviation Authority (LBA)*
UAVDACH-Services*	Training for the EU Remote Pilot Certificate A2 and additional practical training courses in the handling of UAS. **Testing centre appointed by the Federal German Aviation Authority (LBA)*
U-ROB GmbH*	Choice of online or classroom training for the EU Remote Pilot Certificate A2. Provider of further training such as flight training as well as special training on drone applications, e.g. in industry and trade at 11 locations in Germany. **Testing centre appointed by the Federal German Aviation Authority (LBA)*

3.3 Key takeaways from the survey (from learners/trainees)

Takeaway #1: The vast majority of learners have little to no familiarity with drone technology.

- 56% of respondents said they had never used a drone and knew little about how they work.
- 36% said they have never used a drone but understand how they work.

Takeaway #2: The majority is not aware of the most in-demand jobs or relevant emerging roles in the construction industry.

- Only 36% answered yes to the question about awareness of relevant ermerging roles and most in-demand jobs.

Takeaway #3: The degree of digitalisation in companies and during training must be strongly increased.

- 35% of respondents cited limited exposure to the technology already during training as the reason for the lack of drone training courses.
- 29% of the respondents complained about the low adoption of new technologies in the companies.
- 18% of respondents complain about insufficient facilities or equipment for practical training.

Takeaway #4: There are several areas of application for drone technology in which the respondents have shown great interest.

- Almost half of the respondents (46%) were interested in photography and/or video.
- 30% were interested in the use of drones in connection with quality control and assurance.
- 14% indicated surveying as their drone application of choice.
- 10% were interested in the use of drones in connection with preconstruction and site planning.

CONCLUSIONS

The use of drones on construction sites is not yet a widespread phenomenon. While small and medium-sized companies generally work little or hardly at all with drones due to the digitalisation backlog, it is already no longer a rarity for large industrial companies in the construction sector.

It is no longer a question of "if" drones will become part of the standard repertoire for every construction project, but only a question of "when". It is therefore all the more important that construction companies deal with the megatrend of digitalisation in general and with drone technology in particular.

Against the backdrop of the shortage of skilled workers, this is all the more important, as the use of drones on the one hand speeds up and simplifies work processes where previously many employees needed a lot of time, and on the other hand also contributes to increasing the attractiveness of the construction sector among young people or potential trainees. In conclusion, the winners of drone technology will be those companies that have developed and implemented their own drone and digitalisation strategy at an early stage.

While there are nationwide training programmes for the two EU drone operator's licences, there are no construction-specific programmes for the diverse uses of drones on the construction site. There is an urgent need for action here, especially with regard to the use of drones in education and training in the construction sector.

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