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UNMANNED AERIAL VEHICLES
REVOLUTIONIZE ALL SECTORS

DRONES

INNOVATION TRENDS SERIE

01

Drones for everything

The world of remotely piloted aircraft ( ) systems is currently revolutionizing all sectors and has now even come to universities.

Graduation from the remotely piloted aircraft systems (RPAS) course. A group of around thirty students have been learning everything about the drone universe at the Valencia Polytechnic University. This 320-hour course is taught every four months, and students graduate knowing how to pilot and build their own drone. **And what are drones for?** "For everything", says bluntly Israel Quintanilla, Doctor in Geodesic and Cartographic Engineering.

The first graduates of the course, which is jointly directed and taught by airline pilots, industrial engineers, IT and telecommunications specialists, have included everyone from journalists to architects. And a number of engineers too. The course covers much more ground than the 50- or 60-hour courses taught in schools to obtain **a certificate to pilot a drone.**

Quintanilla highlights that in one year alone, 370 companies for operating drones have been set up in Spain, all authorized by the State Agency for Aerial Security (AEASA), which is responsible for regulating the use of this type of remotely piloted aircraft. **"This sector is much in demand and highly crosscutting".**

And to explain their success in such a short period of time he points out: **"The advantage of drones is that they're cheaper than satellites, helicopters or planes.** The quality is the same or better, as they fly lower. And the key is that I can **acquire data** when I want, and as many times as I need. **Top-quality data at a very low cost".**

To illustrate this point, he highlights the example of "a quarry, where you save yourself all the equipment. A drone helps you map it out without having to mobilize a lot of resources. In the case of farm crops you can see the evolution over time, whereas before you had to be content with a couple of multispectral satellite images and ask for another if you had enough budget. Drones are much cheaper".

The drawback is the duration of the batteries. "Autonomy is one of their limitations", points out Quintanilla.

The battery in fixed-wing drones lasts up to 40 or 50 minutes, and according to Quintanilla, this makes them suitable for carrying out surveillance flights or for emergencies; whereas multi-rotor drones are more versatile for inspecting static elements wind turbine blades, cathedrals and their battery lasts between 12 and 20 minutes. Military drones are a special case as they have around 14 hours' autonomy, can reach speeds of up to 250 km an hour and have a wingspan of 8 meters.

This sector is still in its infancy and its limits cannot even be imagined. Quintanilla believes that **with the new regulations, we can expect to see drones sharing airspace with manned aircraft before very long**.

Types of drones

The professor explains that there are two types of drones:

1. Fixed-wing: which are similar to planes as they have the same structure and aerodynamics but with smaller dimensions, and are powered by combustion engines or an electric battery.

2. Multi-rotor: these have several blades depending on the load they have to carry; tricopters with three blades, quadcopters and so on. They are capable of static and vertical flight.

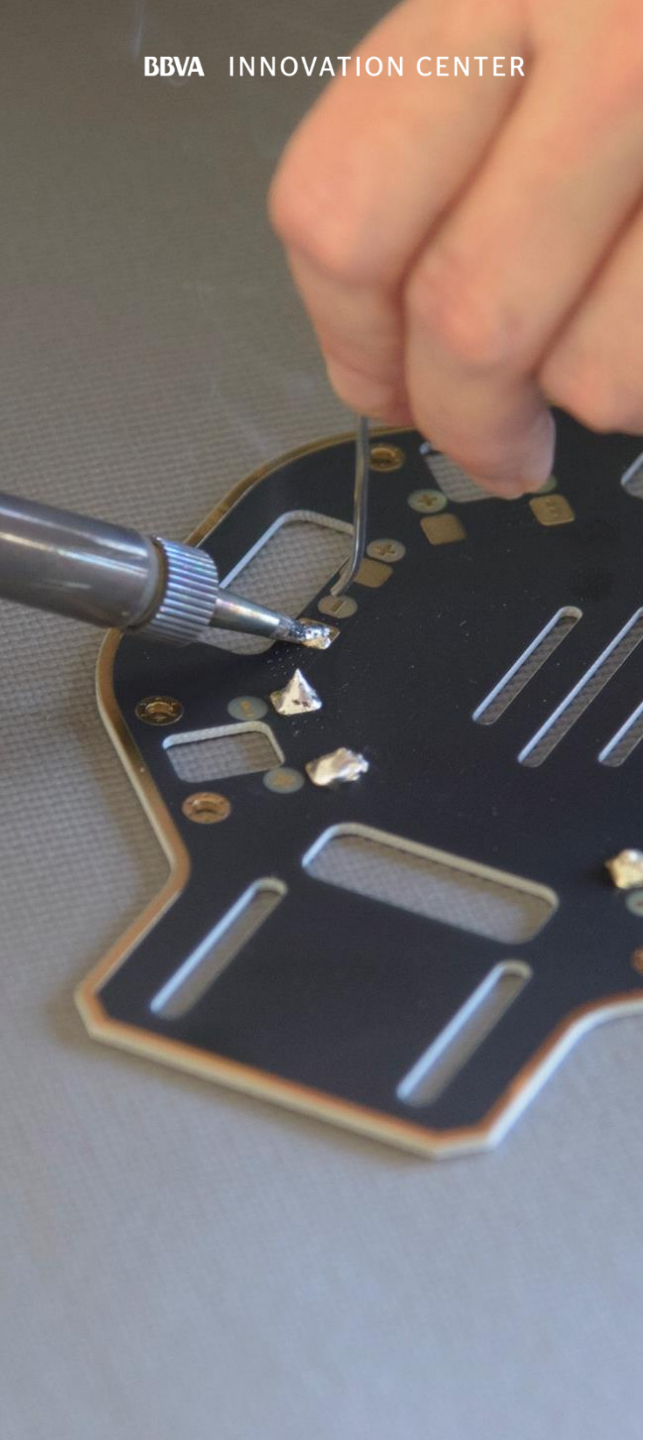
Basic rules for piloting a drone (AEASA)

The regulations allow an aircraft of up to 25 kilos to **record outdoors**, but it must be by day and in visual weather conditions, in areas outside built-up areas in cities, towns or inhabited spaces, or that are used by people to gather outdoors, in uncontrolled airspace, within the visual scope of the pilot at a distance of no more than 500 meters and at a height above ground of no more than 400 feet (that is, a maximum of 120 meters above the ground).

Regardless of whether an individual is authorized as a drone operator it should be noted that to take photographs or films with any type of aircraft –manned or otherwise– it is necessary to obtain **a specific authorization** from AESA for this type of activity, according to an Order from the Presidency of the Government dated 14 March 1957.

All drone pilots, regardless of the size of the aircraft, must fulfill a series of **requirements:**
Pilots must have or have had (in the last five years) a pilot's license (any license, including for gliders, balloons or ultralights).

Otherwise reliably demonstrate that they have the theoretical knowledge to obtain it (by some certified means of theoretical knowledge issued by a training organization approved by AESA, ATO, or in the case that this knowledge corresponds to an ultralight pilot's license, by means of an individual qualifying certificate after taking the corresponding theoretical knowledge exam).
Or if the maximum weight on takeoff does not exceed 25 kg, by means of a basic or advanced certificate issued by an approved training organization (ATO) after taking the corresponding course.



02

Inside a drone

It's not only pilots who are caught up in the drone fever but programmers too - in just 12 hours they can make a quadcopter fly ( ).

"They're cheap, and although it's not something you can program in a weekend, **we're not talking rocket science.**" José María Cañas, a professor at the Telecommunications Engineering School of the Universidad Rey Juan Carlos (URJC), is the director of the Drone Programming University Course. His classroom is full of engineers but a few technical college students as well. You don't need to be an expert in aeronautics to attend the course, though some programming knowledge is required.

It's not only pilots who are caught up in the drone fever but programmers too - in just 12 hours they can make a quadcopter fly. “We don't design them and we don't teach people how to pilot them. We develop the software for the robots." According to director of the Robotics Department of the URJC, **the low cost** - less than 500 euros - is what has made drones so popular.

What they can do

Then there's the potential they offer: **“We develop applications to control the robot autonomously.** For example, research prototypes where we can program the robot to recognize people on the ground and take photos, something which is extremely valuable for search and rescue operations. We're also working on making semi-autonomous robots that can pick up images of the cracks in a building and, thanks to the software, analyze them.”

Students develop applications to direct and control the drone's movements. They use the Python language and the Gazebo simulator to program the quadcopter's intelligence. To start them off, they're given various software components that have already been developed to direct the quadcopter and insert the code that controls their behavior. The students develop **applications that enable the drones to "pursue" objects.**

“The quadcopter's behavior is part perception, part control. The perception part picks up the **sensory data** - from the camera - and analyzes them **to extract information.** The control part decides which movement to make and issues instructions to the robot's engines," explains Cañas.

The reward for the best students is testing the real quadcopter, the Parrot AR Drone.

Cañas, who is currently preparing a more advanced programming course on aircraft manned by remote control for 2015-2016, stresses that these aircraft can be used in many fields but that **“there's still a long way to go and a lot to explore”.**

“In Germany, the national railway operator is using drones to fight graffiti. A judge has accepted images captured by drones to fine the vandals. Drones are being used as a deterrent, and that's just one example of the multiple applications that are emerging in this field," says the URJC professor to illustrate his point.

A stroll through the curiosities of the drone world (in)

'Divine Eagle', the world's biggest drone.
The American magazine Popular Science features photographs of the **giant Chinese aircraft** manned by remote control. It stands 6 meters high, is 15 meters long and weighs nearly 15 tons. The magazine describes it as the biggest in the world, surpassing America's RQ-4 Global Hawk. The military drone can detect cruise missiles and stealth bombers in the air as well as enemy ships in the open waters of the Pacific.
Parrot 'Mini' Hydrofoil, the nautical drone.
It slides across the water, or more precisely 5/6 cm above it, **and is controlled by a smartphone or tablet** thanks to a specific application via Bluetooth. Its maximum speed is 5.4 knots and it can only be used on freshwater.

More than 5,000 photographs.
Two thousand photos were submitted in 2014 and this year more than 5,000, proving just how popular the robots have become. The Dronestagram festival organized in association with National Geographic showcases **spectacular photographs of cities, nature and even dronies**-selfies taken by the aircraft.
The world's monuments.
Another amazing project is the one that Amos Chapple has been working on since 2005 and **which consists in taking aerial photographs of the world's most impressive monuments.** Although many countries ban these types of photos in cities, you can see the images captured on the Amos Chapple website.

03/INFOGRAPHIC

The future of drones

Initially conceived for military use, these unmanned aerial vehicles have gained prominence for their commercial uses, from mapping, video and photography, to crop monitoring and protection.

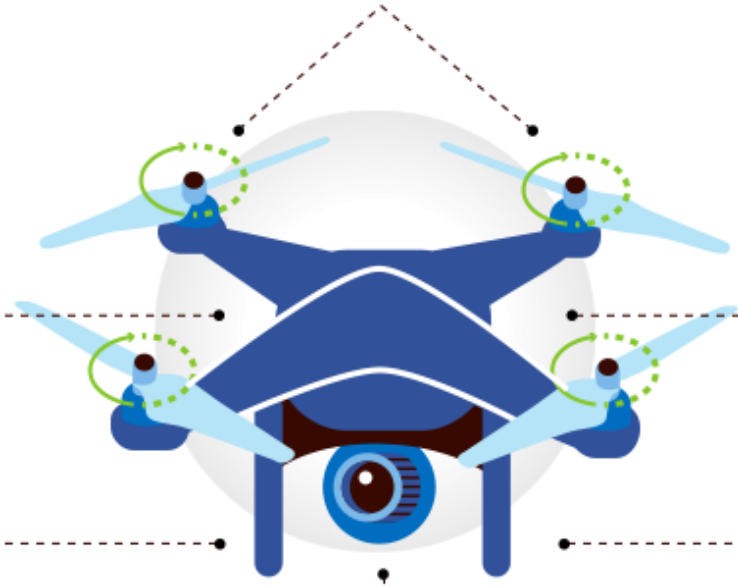
Share on Pinterest

Operation

Because of their ability to penetrate high-risk or difficult to access areas without human intervention, these aerial systems have now taken center stage.

Propellers
Dynamically balanced to eliminate the 'jello' effect caused by vibration.

Motor
25 minutes flight range and smart battery.



Flight
Precision flights and stable static mode.

Radar
Plane finder, virtual radar on the smartphone.

Camara
High quality with micro SD card included. Field of vision up to 140 degrees.

Wi-Fi
With Wi-Fi connection for flight data monitoring.

Uses

Altitude

Military use

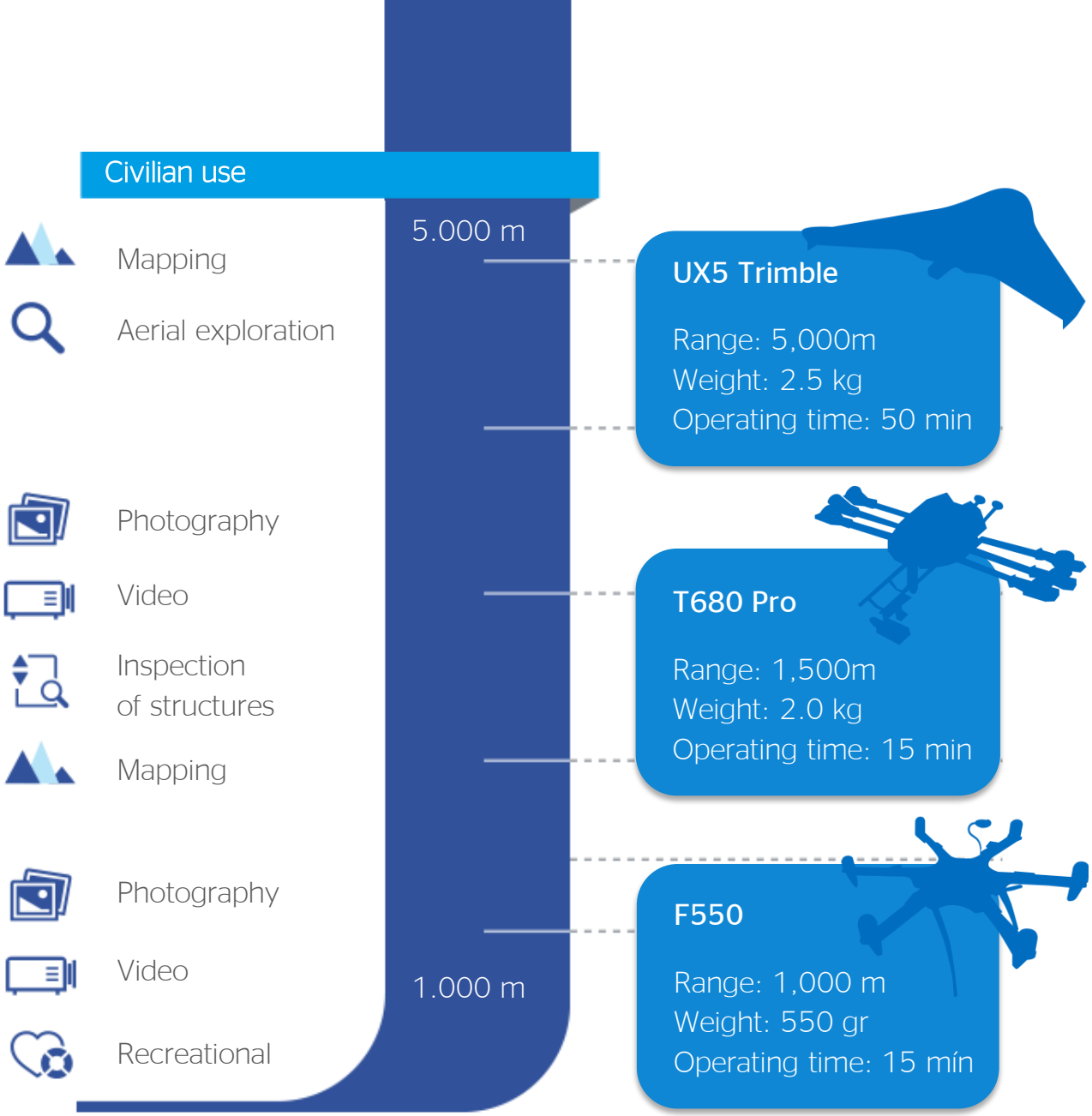
9.000 m

- Mapping
- Crop and forest management
- Fire control
- Gas emission
- Urban control
- Property management

UAV Dominator XP*

Range: 9,150 m.
Weight: 1.2 kg
Operating time: 28h
Speed: 354 km/h

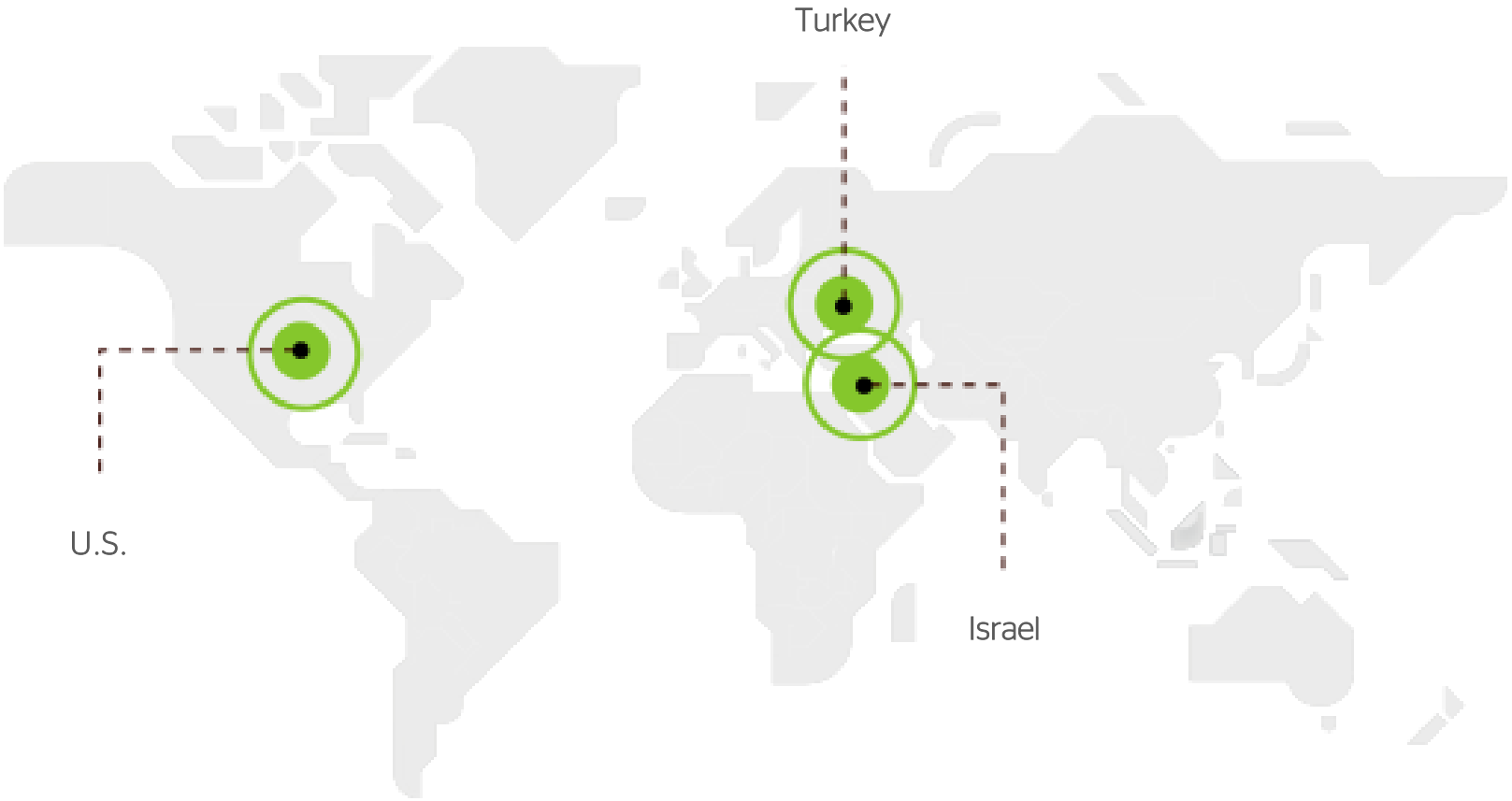
Uses


Civilian use
5.000 m
Mapping
Aerial exploration
UX5 Trimble
Range: 5,000m
Weight: 2.5 kg
Operating time: 50 min
Photography
Video
Inspection
of structures
T680 Pro
Range: 1,500m
Weight: 2.0 kg
Operating time: 15 min
Mapping
Photography
F550
Range: 1,000 m
Weight: 550 gr
Operating time: 15 mín
Video
1.000 m
Recreational

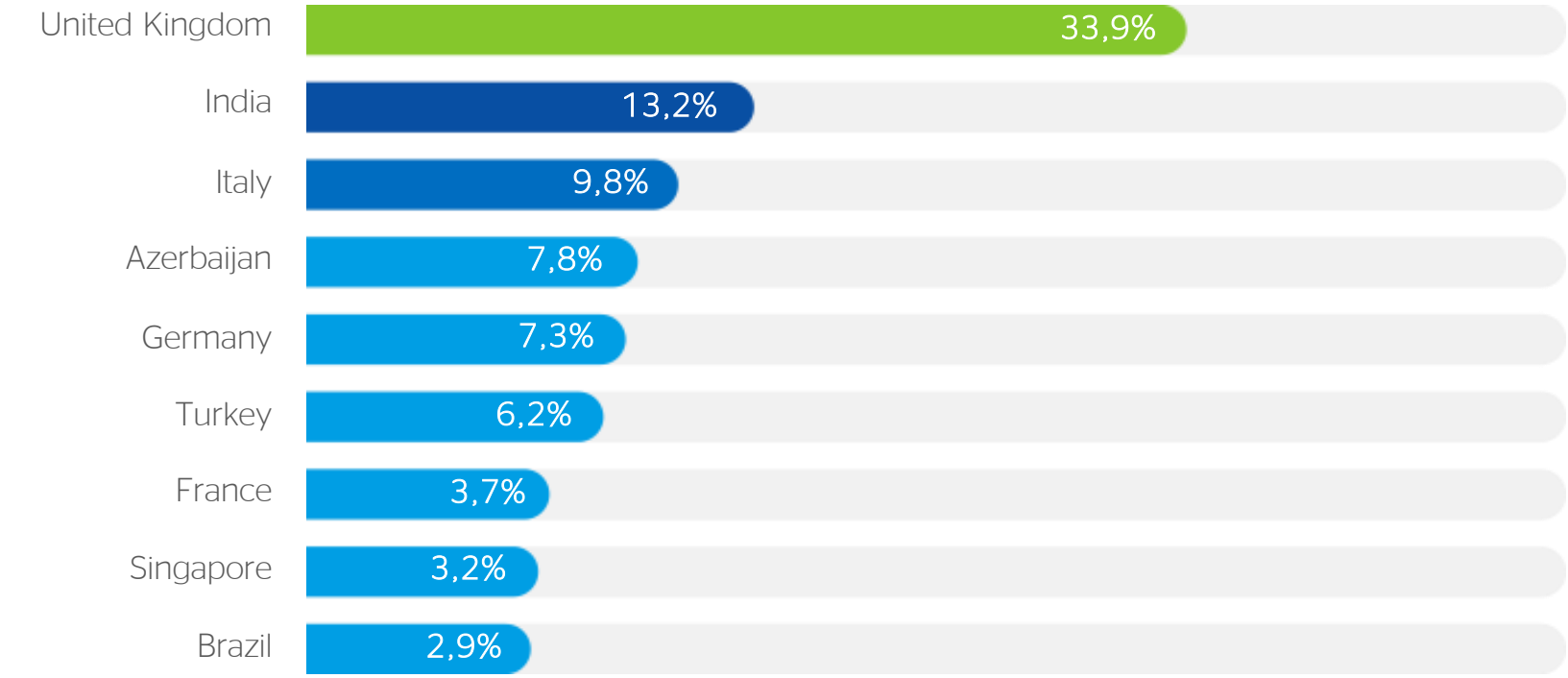
Location tracking

Since 2005, the number of countries that have acquired an unmanned aerial vehicle (UAV) has nearly doubled.

Countries with the largest number of drones



Countries that import the largest number of drones



04

"Drones can save lives"

Farming and emergency situations. These are two of the areas in which the drone sector is rapidly gaining ground. In other areas faster development is often hindered by legislation ( ).

Can Padró. Security&Safety Training. Seventy hectares beneath the Montserrat mountains, 50 kilometers from Barcelona (Spain). A boat anchored to the ground appears beneath a low hill. During the course of the year it is used to perform scores of **emergency drills**. Help arrives by land but from the air as well.

Several **drones** fly over the area **filming fire fighters, police and health workers** dealing with a critical situation. The footage provides a **comprehensive view of what**

is happening to the heads of operations as they make fast decisions to cope with and try to avoid a tragedy.

The drones were the last to reach Can Padró, the specialist emergency management center which, as manager Ana Rodríguez explains, "trains hundreds of professionals who deal with risk situations as part of their job". A pioneer in safety training, the center has an ATO license for **delivering drone courses** to Spain's National Air Security Agency (AESA), the body that regulates this sector.

And once it can be piloted, **a drone can be used to save lives.** Can Padró was recently visited by Jordi Folk, general secretary of Aedron (Spanish Association of Drones and Similar), who finds the topic of **emergencies** particularly fascinating. “It's where these devices can be used to save lives. If you get lost in a cave, they can find the exact spot, and very fast.”

In the case of a **catastrophe** or disaster, drones can be used where they would not normally be legal, as long as the operator is certified. Can Padró prepares operators for this. Piloting a drone is just one more step in the overall training for professionals who risk their lives trying to save others.

The legal debate in Spain

The legal framework for these devices is currently a hot topic of debate. In recent weeks representatives of Aedron have held meetings with members of AESA and a bill with new legislation for Spain is currently being finalized. As the current **legislation stands, it is illegal to fly drones over built-up areas.** A year ago the AESA banned drones from flying over cities after being shocked by what Folk describes as "videos of shocking reckless flights" on the Internet.

Folk mentions the regulation of the sector to avoid unauthorized practice by unlicensed persons. "Regulation puts us on a par with aerial work. We are not ground workers so we're governed by aviation legislation, **with demanding standards that require training and investment**," he explains. With the law in his hand, Folk says, "The current legislation regulates all commercial work. It says that you can't fly over houses or people, you can only fly in daylight, you can't fly above 120 meters, and you can't be more than 500 meters from the pilot. Everything that is not commercial is also more or less covered by these conditions. If you buy a toy drone, you have to fly it in a vacant lot and meet the same requirements."

A new bill contemplates "the possibility of flights in urban environments for aircraft weighing less than 10 kg in a defined area or more than 150 meters away from buildings and more than 50 meters away from people who are not under the operator's control. These types of operations have to be authorized for reasons of public safety."

The future of the sector (in)

Folk explains the importance of this change in legislation: **“The money isn't in the countryside, it's in cities.** It's currently illegal to fly over cities so we have to refuse 95% of the work we're offered." Ignorance of the law means that Folk, a photographer, often receives commissions for jobs that are illegal, which he turns down. The smallest fine is 4,500 euros.

“The people who are most benefiting from this are **retailers,** rather than trainers, pilots or operators. Retailers don't want it to get out that there are restrictions on using these devices because then they'll lose money. But we need to publicize the laws, and drones should only be sold in model aeronautics stores so that you know you're dealing with specialists."

There are no official figures on the number of drones in Spain, although according to Folk "it is **expected to grow exponentially”.** In his opinion, one of the sectors that "is investing the most in developing and using drones is **farming**. I don't know if it's because of the current legislation or because it has a lot of money and drones cut their costs enormously."

Who can pilot a drone?

"To **pilot** a drone," explains Folk, "you have to have a theory certificate, practical training specific to the model you are going to pilot, and a medical aviation certificate. You have to take a training course with practical and theory components. And pilots can't just work on their own. Every company that carries out aerial work with drones has to be registered with the AESA."

05 Europe sets its sights on civil drones

The European Union is keen to take the lead in a sector that has the potential to move up to 15 billion euros a year... provided that precise regulation is put in place ( ).

Europe has the highest number of civil drone operators –2,500 compared to 2,342 in the rest of the world– according to a recent European Union assessment report on drones. The European body is keen to **regulate a market** that has seen a boom in recent years. The EU aspires to lead the remotely piloted aircraft sector, and is urgently demanding the creation of a **worldwide regulation that would stimulate the market.**

To achieve this it believes it is essential to have **a common law in order to attract investors.** This legal limbo or improvised legislation –work is currently underway on a definitive law in several countries including Spain– is holding back the civil drone industry. These new regulations must be based on the principles of the Riga declaration of last March:

1. Drones should be regarded as **a new type of aircraft** (and must be governed by rules that correspond to the risks inherent in each operation).
2. It is imperative to draft European rules for operating drones as soon as possible and establish precisely the **security regulations** so as to encourage investment in the sector.
3. Technologies and standards must be designed to enable **the integration of drones into European airspace.**
4. Public acceptance of drones is essential for the growth of the services associated to these devices.
5. The drone operator is **responsible** for its use.

The EU's draft report, which is due to be debated in September 2015, notes that remotely piloted aircraft must coexist with planes even in the same airspace. It therefore specifies: "It is advisable to draw up a series of **clear, global and harmonized regulations** –based on an assessment of the risks– which do not impose excessively strict regulations on companies which could hinder the investment and the creation of employment" in the drone universe.

The report repeatedly underlines the potential economic importance of the large-scale use of drones. "The sector and the regulatory bodies must reach an agreement and work together to **ensure that companies are not reluctant to invest** in the development of the necessary technologies because of the perceived uncertainty in the legislation".

The risks (f) of using drones without regulation

The Article 29 Working Party (Art. 29 WP) –formed by all the European data protection agencies– is another group that has requested harmonization in all European countries. In its first ruling it highlights the risk the use of drones equipped with sensors represents for **personal data**, either by capturing images, sound or geolocation data.

It also considers that it is of "paramount importance" that the person responsible for **processing the data** and his or her supervisor should be clearly identified for each type of operation.

It stresses the need for manufacturers to adopt **privacy measures starting at the design stage** and by default, and suggests conducting impact assessments on data protection as a means of **determining the impact of drones** on this fundamental right.

To increase awareness among users it also recommends that sufficient information should be included in devices with smaller dimensions with regard to the intrusive potential of these technologies, and wherever (in).

possible, that there should be a clear indication of **where their use is permitted**. The operators of these devices should as far as possible avoid flying over private areas and buildings, even when this is allowed.

The EU is not the only organization set on regulating this sector to allow it to flourish. The Economist points out that the sector's potential will depend on its regulation. **According to the Commission, remotely piloted aircraft are expected to generate 150,000 jobs and profits of around €15 million a year in Europe** in 2050. These estimates will only become a reality if they are accompanied by **precise regulations that do not scare away investors and technology companies, or the public itself.**

United Kingdom Drone Code

Like the rest of Europe, the United Kingdom is waiting for EU legislation to be introduced on drones, but the country also has its own regulations in place. **Such aircraft have proliferated over recent years,** leading the Civil Aviation Authority (CAA) to launch a "drone code" in late July to raise awareness of the latest legal requirements and best practices when using drones.

"We launched the code on the 22nd and it received extensive coverage in the media and on Twitter. We provide guidelines on how to fly drones safely and legally," says Nathan Lovett, member of the CAA.
Lovett does not anticipate major problems despite the rising number of drones. "We think drone regulations are reasonable and proportionate. They do the job of **protecting the public without being too restrictive,** and they don't affect the pleasure of recreational use. We are aware that all new technologies may be used with criminal intent, and drones are no exception. Police services take such risks very seriously. In extreme cases people may be prosecuted."

With regard to potential problems (the most recent example came when an Airbus A320 nearly collided with a drone at Heathrow Airport), he called for responsible conduct from all parties. "At the end of the day, **it's down to each individual to behave properly** and abide by the law", he concluded.

SERIE INNOVATION TRENDS

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PREVIOUS ISSUES

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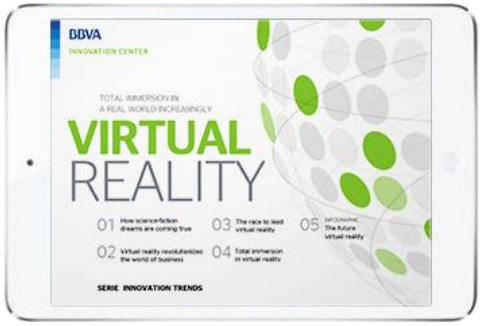

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