DREAMS U–space Survey

October 2018

This project has received funding from the SESAR Joint Undertaking under the European Union 2020 research and innovation programme under grant agreement No 763671

DREAMS
U–space Survey

With a view to understand the perceived needs of the future users of U–space, drone operators and pilots, manned aviation pilots, authorities and other stakeholders, the DREAMS Consortium organised a public web survey on the Project website from February 28 to April 8 of 2018. The web survey was publicised through the DREAMS social accounts, drone trade associations, drone internet portals and the contact lists of the members of the Consortium.

The output of the web survey has been used in the Reference Scenario identification task, which is described in the DREAMS U–space Scenarios document which is also available for public consultation.

The present document has been created to share the results of the survey for the benefit of the European drone community.

For more information about the project, and to obtain other public documents, please visit the project website.

www.u–spacedreams.eu

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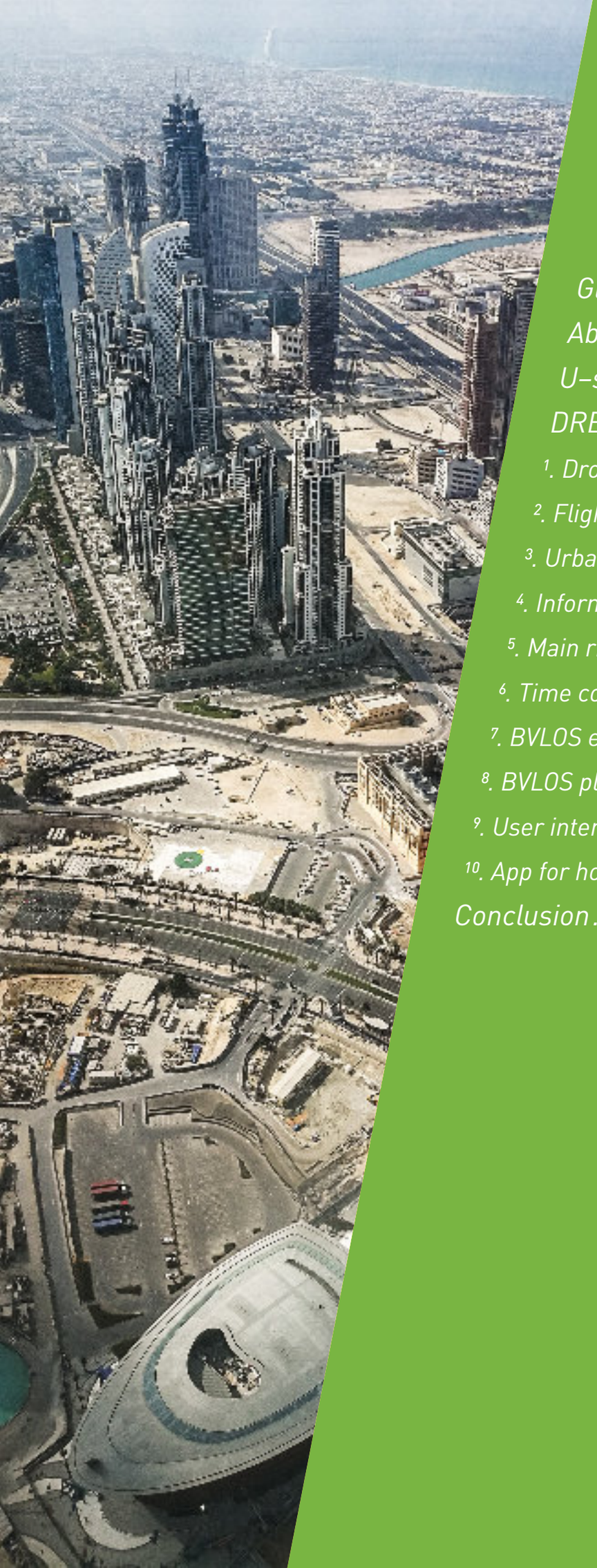


Contents

Glossary of terms

Term	Acronym	Definition
Above ground level	AGL	Altitude (of an aircraft) measured above the terrain.
Air traffic control	ATC	A service provided by ground–based air traffic controllers who direct aircraft on the ground and through controlled airspace, and can provide advisory services to aircraft in non–controlled airspace.
Beyond visual line–of–sight (operation)	BVLOS	An operation in which the remote pilot **does not** maintain direct unaided visual contact with the UAS at all times.
Command and control (link)	C2	The communication link required by the pilot to modify the behaviour of the drone and by the drone to indicate its state to the pilot.
Geofence		A virtual geographic boundary, defined by GPS, RFID, Wi–Fi or other technology, that enables software to trigger a response when a device enters or leaves a particular area.
Global navigation satellite system	GNSS	The generic term for satellite navigation systems that provide autonomous geospatial positioning with global coverage using GPS, Galileo and other satellite constellations.
Notice to airmen	NOTAM	A notice containing information concerning the establishment, condition or change in any aeronautical facility, service, procedure or hazard, the timely knowledge of which is essential to personnel concerned with flight operations.
Visual line–of–sight (operation)	VLOS	An operation in which the remote pilot maintains direct unaided visual contact with the UAS at all times.
Very low level (operation)	VLL	An operation taking place below 500 feet (400 feet in some countries) above ground level (AGL)

About DREAMS

WHAT IS DREAMS

Aviation has relied on dependable and readily available information to conduct safe operations, based on internationally agreed standards and procedures for its data quality, including origination, maintenance and distribution.

The new unmanned aviation will also require a comparable level of information to support the new operational scenarios that are envisaged. The variety and complexity of these scenarios, the number of operations expected (millions instead of a few thousand) and the fast evolution of drone technology requires a different approach, using concepts derived from the ICT and mobile telephony sectors but maintaining the same level of integrity and reliability of the information required by aviation.

The DREAMS project will analyse the present and future needs of aeronautical information to support the growth of unmanned aviation, ensuring the safety of operations.

DREAMS OBJECTIVES

- Fill the gap between the existing information used by traditional manned aviation and the needs of the new unmanned aviation
- Analyse and simulate present and future real world applications, to ensure that the system can be scaled as the market for drones grows and the number of applications increases
- Analyse and validate the technologies related to information exchange that will make possible the implementation of the future U–space concept for the management of drones in Europe

METHODOLOGY

DREAMS will analyse operational and technical aspects, environmental scenarios, technologies, safety, security and confidentiality aspects in order to identify potential U–space data (e.g. airspace structure, terrain, obstacles and weather), service providers (for authentication, flight planning, fleet management, geofencing) and facilities and how the information needs to be tailored for drone traffic management.

The DREAMS project methodology is based on the following steps:

1. Identification of reference scenarios and high–level U–space services
2. Elicitation of data and service requirements
3. Data and service availability analysis
4. Scenario selection validation
5. Validation of the results

DREAMS CONSORTIUM

IDS – Ingegneria Dei Sistemi S.p.A.

The Coordinator – is a company with more than 20 years of experience in the development of Aeronautical Information Management Systems and it is also a UAS manufacturer with a portfolio of drones ranging from less than 5 kg up to 25 kg.

Delft University of Technology – Faculty of Aerospace Engineering

Is the largest Aerospace Engineering faculty of Western Europe. It has performed pioneering work into autonomous airspace, detect & avoidance algorithms and micro–aerial vehicle (MAV) system design.

EuroUSC España, S.L.

Is a limited company established in Madrid, part of the European group EuroUSC, leading independent Accreditation Specialist for 'Operations, Airworthiness and Pilot Qualification' covering Unmanned Aircraft Systems (UAS) with a Maximum Take–Off Mass of less than 150 kg.

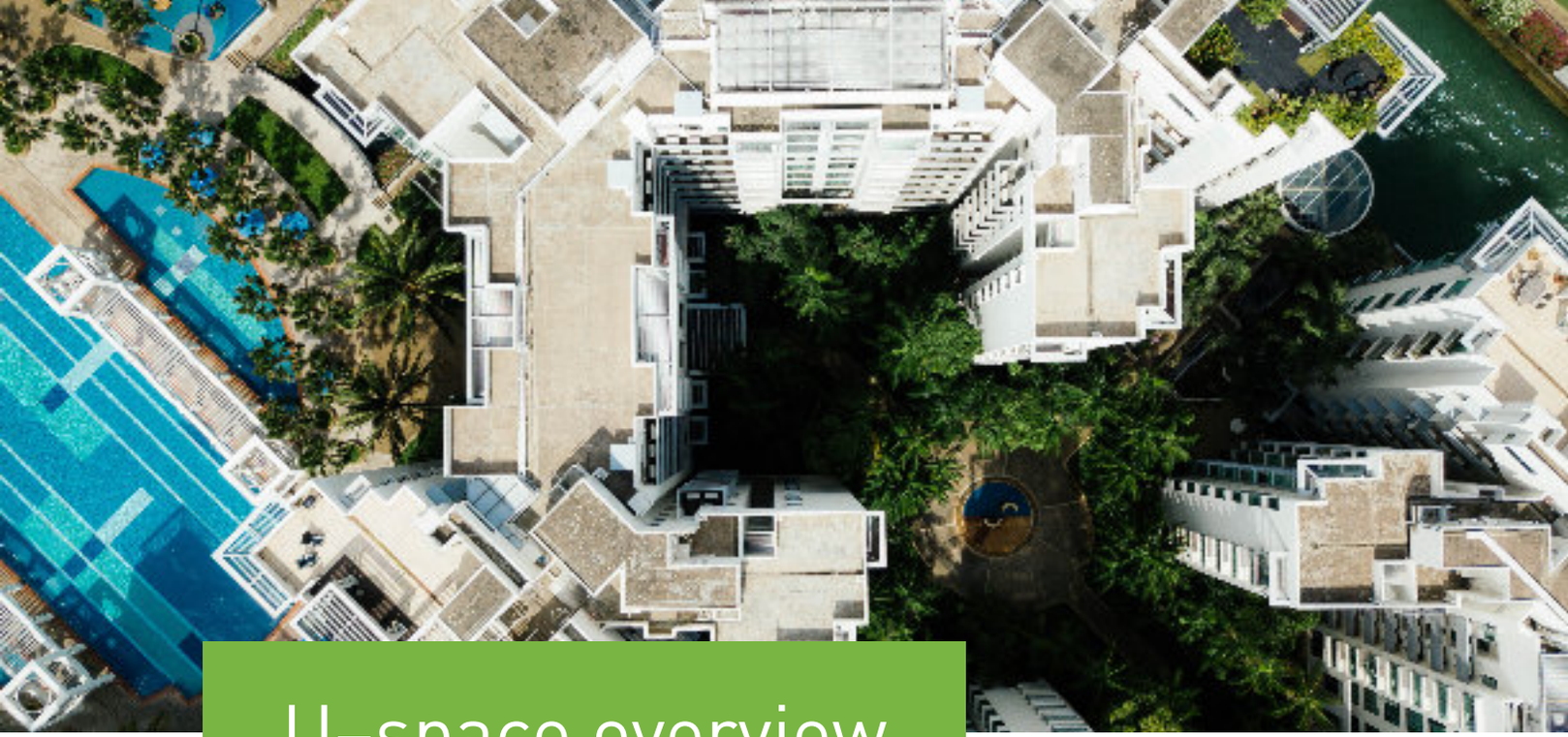
EuroUSC Italia SRL

Is a consultant company with practical experience on drones, internationally achievements in safety assessment, human factors, safety regulation, flight test of new prototype aircraft or new airborne systems and flight inspection of navigation aids. The company is also involved in Air Traffic Management matters and Aerodrome rulemaking.

TopView SRL

UAS operator authorised since 2014 – is an innovative SME focused on study, research and development of autonomous remote piloted systems for aerial, maritime and terrestrial applications, together with innovative products as custom payloads and IoT (Internet of Things) sensors.

The DREAMS Consortium is comprised of five organisations with a proven track record in drone operations



U–space overview

U–Space is a set of new services and specific procedures designed to support safe, efficient and secure access to airspace for large numbers of drones. These services rely on a high level of digitisation and automation of functions, whether they are on board the drone itself, or are part of the ground–based environment. U–space provides what is needed to enable and support routine drone operations, as well as a clear and effective interface to manned aviation, ATM/ANS for service providers and authorities.

U–Space will be capable of ensuring smooth operation of drones in all operating environments, including urban areas, and in all types of airspace, in particular to VLL airspace. It will address the need to support the widest possible variety of missions, and may concern all drone users, as well as every category of UAS, as defined by EU Commission proposed Regulation on unmanned aircraft operations. According to the criticality of the provided services, performance requirements will be established for both structural elements and service delivery, covering safety, security, availability, continuity, resilience and so on.

U–Space services will be delivered by service providers within the given U–space environment. They do not replicate the function of ATC, as known in ATM: instead, they will deliver key services to organise the safe and efficient operation of drones and ensure a proper interface with manned aviation, ATC and relevant authorities.

INITIAL SERVICES

The first two U–space services, which rely on agreed EU standards, are the following:

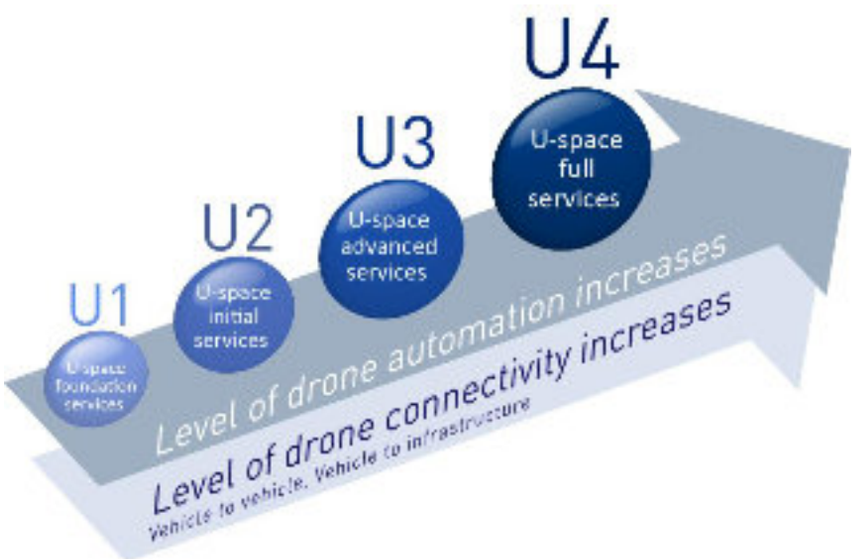
1. Electronic registration (**e–registration**): Draft EU UAS Regulation envisage that electronic registration will be mandatory for drone operators, except operators of drones weighting below 250 grams, as well as some classes of drones used in the **open category**, and all drones used in the **specific category**.

2. Electronic identification (**e–identification**): It will allow authorities to identify a drone flying and link it to information stored in the registry; the identification supports safety and security requirements as well as law–enforcement procedures.

U-space

[1] The diagrams and the U–Space Use Case example on this chapter have been extracted from the SESAR JU document U–Space Blueprint.

U–SPACE ROLL OUT



The progressive deployment of U–space is linked to the increasing availability of blocks of services and enabling technologies. Over time, U–space services will evolve as the level of automation of the drone increases, and advanced forms of interaction with the environment are enabled (including manned and unmanned aircraft) mainly through digital information and data exchange over a **cloud–based platform**.

- **U1**: U–space foundation services provide e–registration, e–identification and basic geofencing services
- **U2**: U–space initial services support the management of drone operations and may include flight planning, flight approval, tracking, airspace dynamic information, and procedural interfaces with air traffic control.
- **U3**: U–space advanced services support more complex operations in dense areas and may include capacity management and assistance for conflict detection. Indeed, the availability of automated DAA functionalities, in addition to more reliable means of communication, will lead to a significant increase of operations in all environments and may require a more robust framework.
- **U4**: U–space full services, particularly services offering integrated interfaces with manned aviation, support the full operational capability of U–space and will rely on very high level of automation, connectivity and digitalisation for both the drone and the U–space system.

By 2019, U–space is expected to be established with U1 services facilitating a great number of current drone operations while enabling new ones.

Also in 2019 pre–operational demonstrations of the initial U–space services (U2) will take place, as well as the first results from SESAR research and development projects, including the DREAMS project, paving the way for the roll–out of U–Space (U2–U4).

SUPPORT FOR MISSION PHASES

The diagram below and the example case of use on the following page show how U Space will provide support to all phases of a mission, when its complete deployment is finalised.

U–SPACE USE CASE EXAMPLE

A drone operator plans to fly a drone to carry a small package from a village to the city centre 30 kilometres away. She selects a suitable drone from her fleet and selects a drone supervisor who will not actually be piloting the drone, but will be supported by automated functions and tools allowing to monitor several drones flying at the same time.

1. Preparation of the drone mission

To prepare the flight, the drone operator uses information–sharing services, like meteorological conditions, combined with other U–space services, such as navigation and communication coverage services, flight planning assistance services and services providing the expected density of traffic in the mission area. Since the drone is registered, the system automatically links the elements described in the registry with elements of the flight request, in which full details of the airworthiness of the drone and its behaviour in emergency situations are described. For example, this information could include designated safe landing areas, or details of the equipage and capabilities of the drone. That way, if the drone fails at any point in its flight, it will behave in a predictable manner, minimising risk to people and property on the ground.

2. Submission of a flight request and reception of an acknowledgement

The planned route adheres to applicable regulation, airspace requirements (including airspace availability, temporary and permanent restricted areas) and requirements on specific drone equipment. If the flight requires an additional approval, then the request is submitted to the relevant entity and an answer is sent to the drone operator. The planned flight does in fact conflict with several other planned drone operations so, the operator is offered the possibility of a longer route or a delay to the drone's arrival by 5 minutes. She chooses the latter option and receives an acknowledgement, which includes the drone's 4D trajectory describing the entire flight. When the drone is airborne, it receives information and alerts and might alter its original route to avoid traffic, meteorological conditions or any changes to airspace accessibility. Throughout the flight, the drone broadcasts its unique identifier. The tracking service allows the drone flight path to be followed and supports other services like the situation awareness, which is provided, with some limitations, to a wide range of customers (e.g. drone operators, ATC, police).

3. Execution of the flight

The drone is equipped with a "detect and avoid" (DAA) system which allows it to avoid hazards. The DAA system navigates it around a flock of birds and an unreported obstacle (e.g. a crane). As it arrives in the city, it receives an alert on a modification of airspace availability on its route: a car accident has just taken place and the local police have set up a temporary highly restricted zone to automatically geofence the site. The geofenced zone is not actually empty as the police are using a drone to give them an aerial view of the accident, and this mission is approved. The incoming helicopter ambulance is a priority flight, and this information is shared to ensure drones crossing its path will route round it.

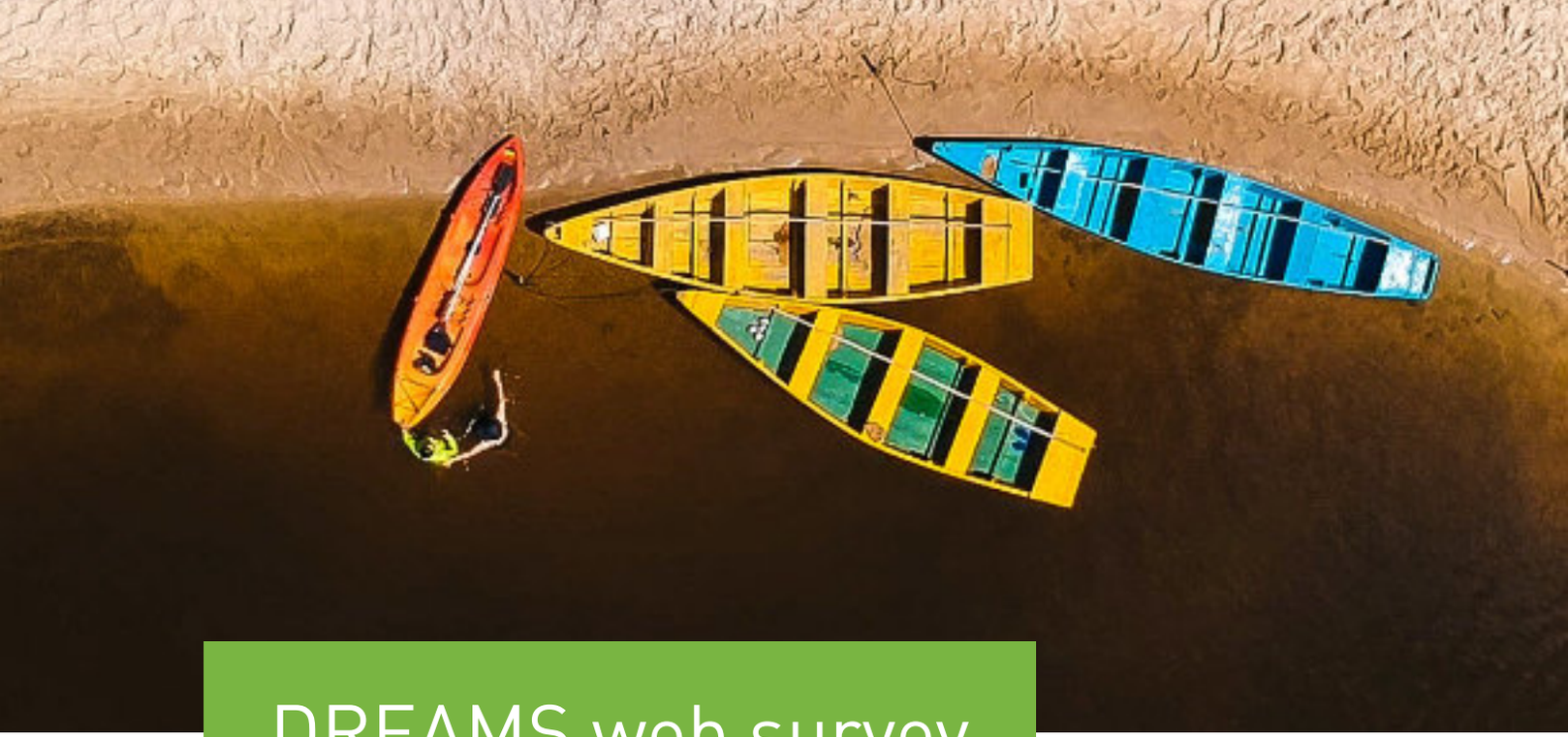
4. Mission completed

The drone arrives safely at its destination, delivering the parcel. It is now ready to be prepared for its next mission: a roof survey of a building 500 metres away.

U–SPACE SERVICES

The following table shows the services defined for the U–space implementation organised by the stage of development blocks (U1 to U4) for which they are planned. Services for the U4 block have not been defined yet.

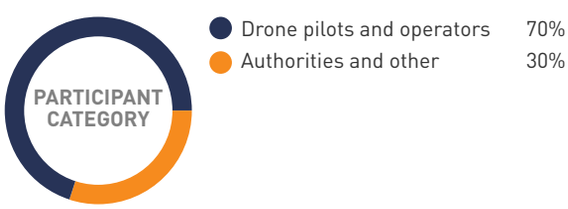
U1	U2	U3	U4
E–registration	Tactical geofencing	Dynamic geofencing	*[Pending definition]*
E–identification	Tracking	Collaborative interface with ATC	
Pre–tactical geofencing	Flight planning management	Tactical deconfliction	
	Strategic deconfliction	Dynamic capacity management	
	Weather information		
	Drone aeronautical information management		
	Procedural interface with ATC		
	Emergency management		
	Monitoring		
	Traffic information		



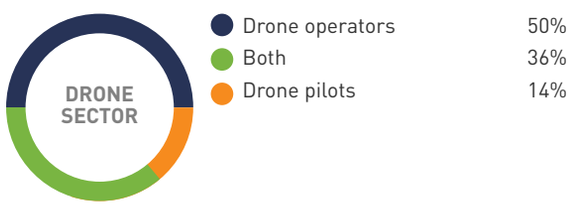
DREAMS web survey

The DREAMS Consortium organised a public web survey on the Project website from February 28 to April 8 of 2018. The web survey was publicised through the DREAMS social accounts, drone trade associations, drone internet portals and the contact lists of the members of the Consortium.

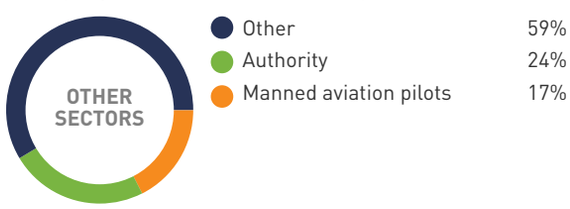
The web survey was completely anonymous. The only personal information that was recorded was a broad categorisation of the person participating in the survey.



Of the 154 participants in the survey, 108 (70%) were from the drone sector and 46 (30%) from other stakeholder categories. Based on this initial answer, the participants were presented a slightly different version of the questionnaire; participants from the drone sector were asked about their own intentions and expectations, while participants external to the sector were asked about their perceptions and estimations. The differences between the answers to the questions by the two groups indicate a substantial gap between the needs and expectations of the drone sector and the estimates of other stakeholder categories.



Inside the drone sector group, half of the participants described themselves as drone operators, about a third (36%) as both drone operators and pilots and 14% as drone pilots exclusively, confirming that many operators are still very small.



In what respects to the group of other stakeholders, only two sub–categories were available; authority (24%) and manned aviation pilot (17%). The majority of the participants (59%) on this group were classified as other stakeholders, which proves that the communication effort of the survey succeed in attracting a varied representation of other stakeholders that are interested in the future of the drone technology.

Many current operators are small uni–personal organisations

Drone applications 1

There is a considerable gap in the expectations regarding the future fields of applications of drones

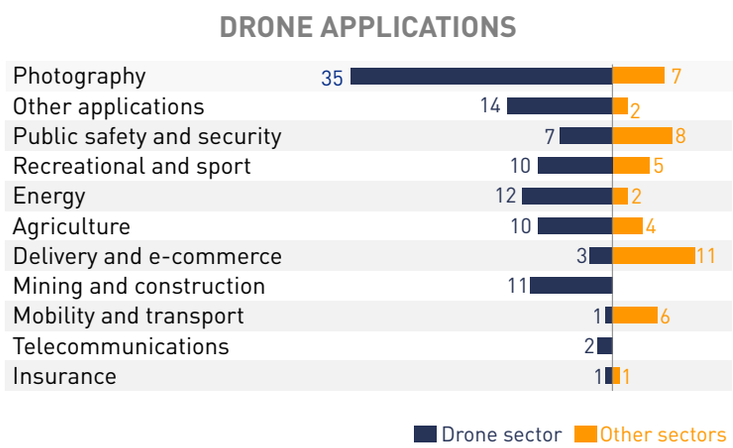
The first question was "*In what field of application do you intend to use your drones?*" or the related "*In what field of application do you expect the greatest growth?*".

Looking at the answers, it becomes evident a different perception of the most important applications. A fourth (24%) of the participants from outside the sector believe that the future growth will come from delivery and e-commerce applications, contrasting with a 3% of the participants from the drone sector. At the opposite side, one third (32%) of the participants from the drone sector believe that audiovisual applications will be the most important, versus 15% of the participants from other sectors.

Also of note is that the second and third applications most valued by participants from the drone sector (energy and mining and construction) were not considered important by participants from other sectors.

An unexpected result was that leisure applications (including drone racing) ranked very high for both groups of participants.

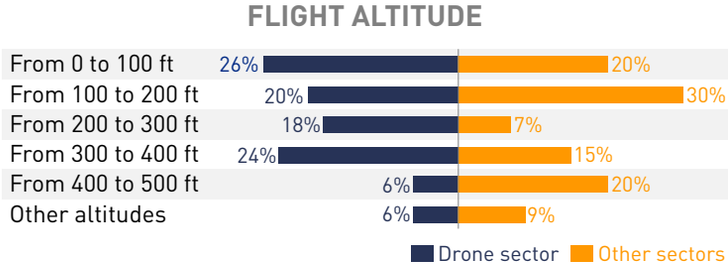
Finally, it should be noted that the category of other applications (16 responses in total) included infrastructure inspections (5) and survey and topography applications (3).



Flight altitude 2

The next question tried to determine what are the expectations with respect to the altitude of the flights. There were also differences between the two groups, but not as relevant as in the previous case. The most significant difference was in the 400 to 500 ft altitude range, maybe because participants from outside the sector are not aware that in many countries, operations are restricted to 400 ft AGL.

It is very significant that only one participant (an operator) expected to fly over 500 ft (up to 2,500 ft).

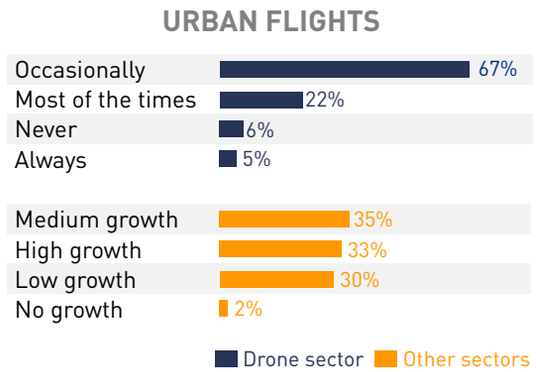


The consensus is that drone operations will be almost exclusively conducted in Very Low Level (VLL), at least in the near future

Urban flights 3

The question related to urban flights was made in a way that makes it more difficult to compare the answers from both types of participants. Drone users were asked "Do you intend to fly in urban environment?" while other participants were asked *"What growth do you predict for drone urban traffic by 2021?"*.

Nevertheless, the results suggest marked differences between both groups indicating that participants from the drone sector have lower expectations as compared with participants from outside the sector.



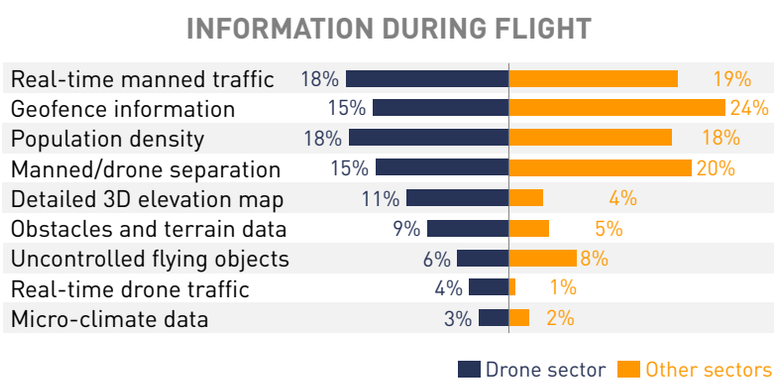
Urban operations are considered important, but maybe they will require more time than what is generally thought

Information during flight 4

The first question specifically related to U-space, enquired about the more important information during the execution phase of an operation.

The more common answers were real-time information about manned traffic in the area, information about geofences, population density of the area overflown and separation rules between manned and unmanned traffic, each mentioned by about 18% of the participants.

In this case, both groups provided very similar answers, although there were some discrepancies. The most significant were that drone users value more information about obstacles on the ground and detailed 3D models of the terrain, while respondents from other sectors value more information about geofence and separation information with manned aviation.

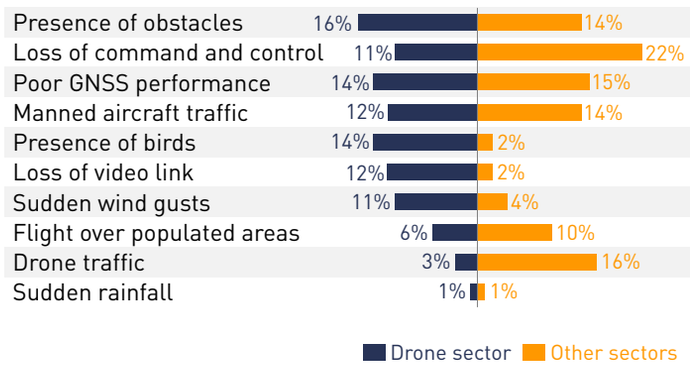


Main risks 5

The following question enquired about the main risks during flight. This was the issue in which more differences were detected between both groups of participants, demonstrating that drone operations are very different from tradionational manned aviation.

Participants from the drone sector are particularly concerned about the presence of obstacles on the ground, poor GNSS performance and presence of birds (or other unidentified flying objects), while participants from outside the sector rated loss of command and control as the main concern, with double number of answers, and other drone traffic, with more than five times more answers than participants from the drone sector.

MAIN RISKS



In contrast, presence of birds, loss of video link and sudden wind gusts are perceived as high risk from drone operators and pilots while not so much by participants froom outside the sector.

The perception of risks during the operation is completely different between drone users and other stakeholders

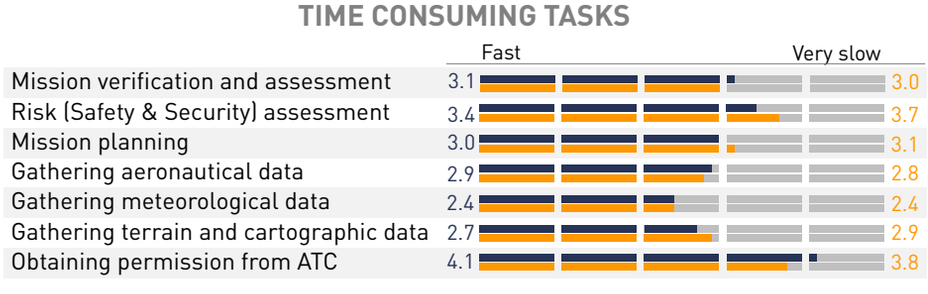
Time consuming tasks 6

Question number six tried to determine where are the bottlenecks during the planning phase of a mission.

Answers were consistent between both groups, coinciding that the more time intensive task is obtaining permission from ATC, followed by performing the safety and security risk assessments.

With respect to the first issue, participants from the drone sector have the impression that the interaction with ATC is slower, while in the case of the safety and security assessment, participants from outside the sector believe that it takes longer.

TIME CONSUMING TASKS



BVLOS execution info 7

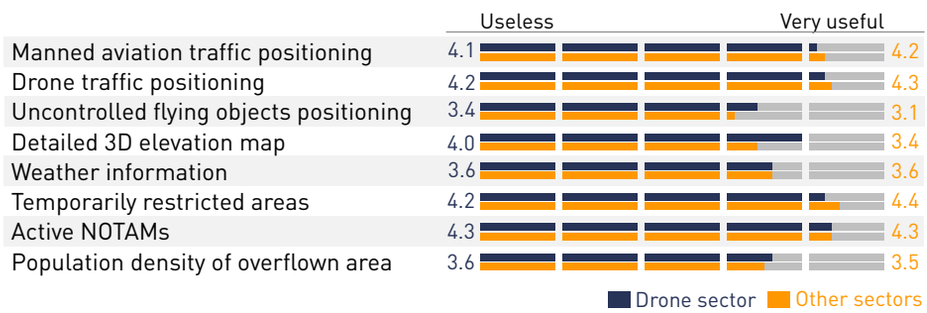
The following two questions were focused on the information required to unlock operations beyond visual line-of-sight.

On the first one, participants ranked real-time information during flight, indicating that the most useful information relates to positioning of other traffic (manned and unmanned), temporarily restricted areas and active NOTAMs.

In this case, the answers were very similar by both groups, which valued all the alternatives provided as useful or very useful.

The most important differences were found in relation to the information regarding uncontrolled flying objects and elevation data, which were valued substantially more by participants from within the drone sector.

BVLOS EXECUTION INFORMATION



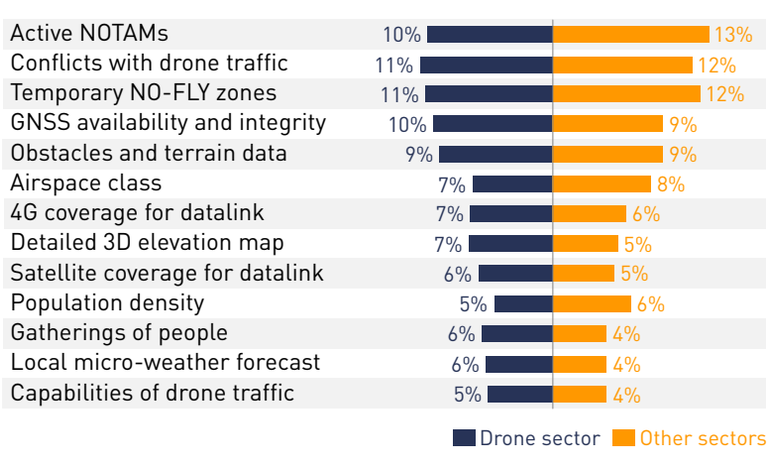
BVLOS planning info 8

The following question provided a number of categories of information that might be required during the planning phase of a BVLOS mission.

In general there was a good consensus between both groups with less marked differences.

The most valued categories of information were those related to active NOTAMs, possible conflicts with other drone traffic, GNSS availability and integrity and obstacles and terrain data.

BVLOS PLANNING INFORMATION

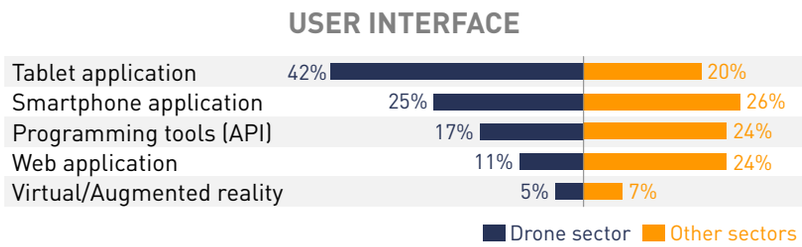


User interface 9

Question number nine enquired about the preferred user interface to access the U-space provided information.

This was also an issue in which marked differences were found between the two categories of users, although there was a consensus that virtual/augmented reality devices are not very useful.

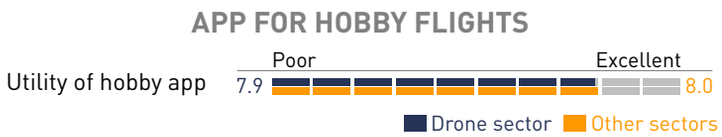
Participants from the drone sector had a marked preference for a tablet application (42%), followed by a smartphone application (25%) and considered that a web application is not enough.



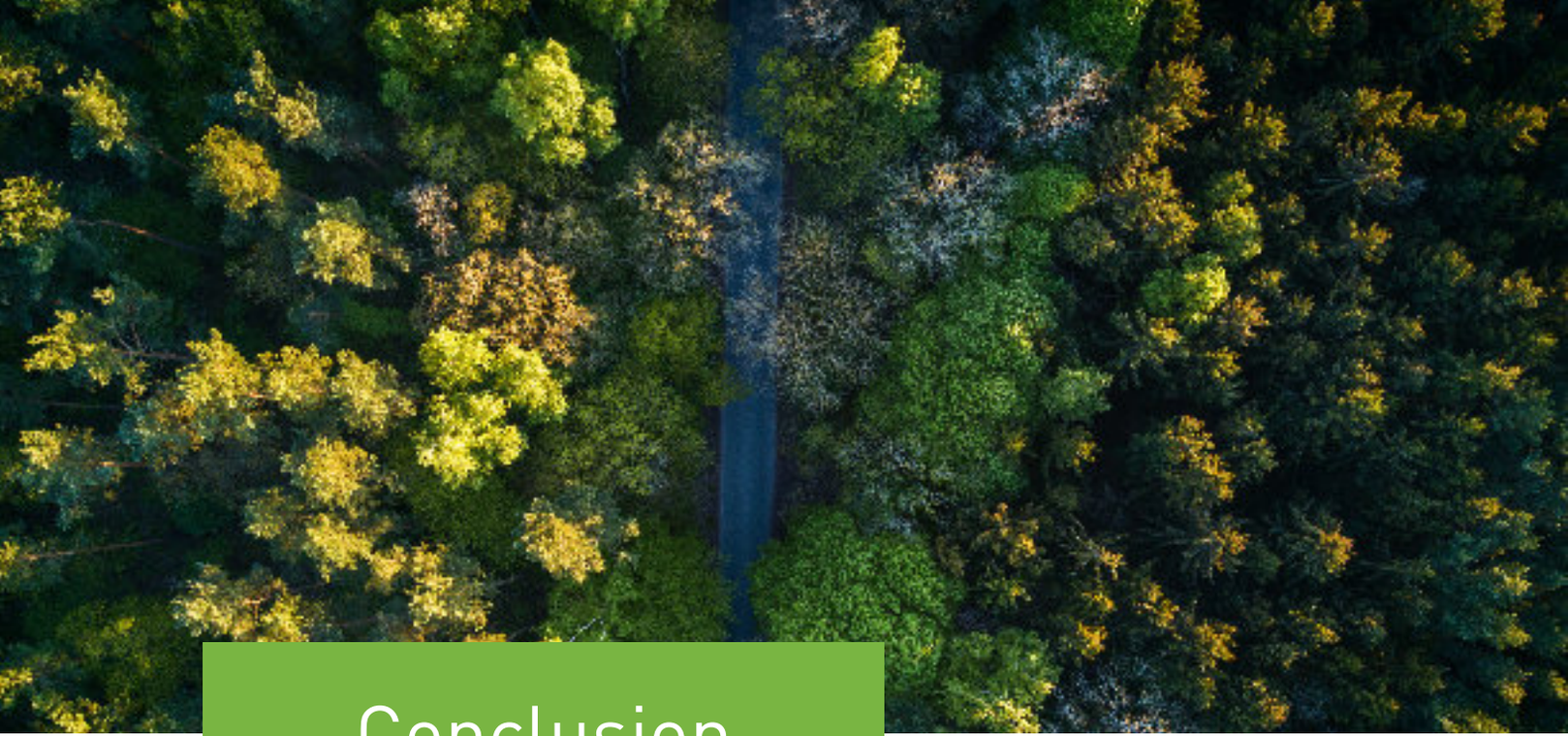
Participants from other sectors ranked the other alternatives (excepting the already mentioned virtual/augmented reality alternative) very similarly. Surprisingly, the tablet application alternative (the one preferred by drone user) was slightly lower than the other three.

App for hobby flights 10

The last question presented a hypothetical situation regarding a hobby user obtaining all the information required to know if a particular flight is possible, without requiring any particular knowledge about the regulation, the airspace, etc. through a tablet (or smartphone) application.



The participants in the survey ranked this solution as very useful.



Conclusion

The survey conducted on the project's website has proved to be very informative for the DREAMS Consortium and key for formulating the U–space reference scenarios, the first task of the project. A document describing the Scenarios will be also available on the DREAMS website.

Perhaps the most striking finding has been that there exists a **substantial gap** between the perceived risks and opportunities from the participants that are not involved in day-to-day operations and the experience and expectations of the participants from the drone sector.

The analysis of the detailed results of the questionnaire shows that these differences have their origin in two different causes:

- The **perception of the risk factors** involved on drone operations is completely different in the case of drone pilots and operators, that have real experience on drone operations, as compared with the perception of risk for other participants, who maybe are simplistically extrapolating their experience in manned aviation operations.
- The expectations of the participants in the survey from outside the drone sector are clearly **biased by market estimates and studies** originated by annalists and business advocates from outside the market, while the expectations of the participants might be short-sighted, considering only their present situation, without realising the opportunities and challenges that the future technological and regulatory advances, including U–space, will make possible in the future.

Whether the differences between manned and unmanned aviation will be maintained over time, because of their different nature, or the new operational scenarios that will be possible in the future will require an approach similar to that of the traditional manned aviation is not yet clear, but in any case, what the survey has clearly shown is that both the drone sector and other stakeholders, including the Civil Aviation Authorities (who only have experience in manned aviation), have to be aware that their **current experience might not be adequate to predict the future**.

Notes

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To get more information about the project DREAMS, please contact us at:

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