HELIOS

Commercial Unmanned Aircraft Systems

Breaking down the barriers to UAS deployment

HELIOS ADVISER

Analysis & commentary for
decision makers in the aviation industry

THE QUEEN'S AWARDS
FOR ENTERPRISE
2009

Contents

Introduction

The application and use of Unmanned Aircraft Systems (UAS) is ever increasing. Their use within the military environment has grown almost exponentially over the past ten years — largely driven by operations in Iraq and more recently Afghanistan, where they are routinely integrated into airfield and enroute operations.

The application and use of Unmanned Aircraft Systems has been driven by the military

However, this increase has not been reflected in the commercial market. Whilst a large number of potential applications have been identified for commercial and public safety use with the opportunity for significant cost savings, progress on the civilian side has been modest.

UAV or UAS?
The term 'Unmanned Aerial Vehicle' has gradually been replaced for many applications by 'Unmanned Aircraft System' to reflect the inclusion of ground stations and other aspects which go to make up the 'system' as a whole. The term UAS, initially adopted by the FAA, is now formally recognised by ICAO.

To date, growth in the civilian UAS market has been slow

But what are the reasons for the slow take-off of commercial UAS? What barriers need to be overcome to enable faster growth?

With no established process in place, bringing a commercial UAS to market, regardless of its category, is complex for both the manufacturer and potential user. There are a number of potential obstacles which have to be overcome to ultimately demonstrate to the regulator that the UAS is as safe as any other manned aircraft and will not impinge on or reduce the safety of other airspace users or the public in general.

There are a number of obstacles which have to be overcome to demonstrate that UAS are as safe as any other manned aircraft

The illustration below highlights the key barriers facing the UAS community. From design and manufacture through to operational deployment, without these key issues being resolved, the increased use of UAS and realisation of their benefits within the civilian environment are likely to remain extremely limited.

In reality, the methods for breaking the barriers depends upon the mission the UAS is designed for and the subsequent requirements to access various types of airspace. When UAS make headline news it is

normally to report on a small drone designed for crowd surveillance or a large UAS designed for long range missions around the globe. The reality, of course, is that UAS are of all shapes and sizes with a myriad of configurations to meet a wide range of requirements.

> **Types of airspace**
>
> - **Segregated:** reserved airspace that has been cleared of all public traffic to enable UAS operations
> - **Controlled:** airspace in which separation of aircraft is primarily the responsibility of air traffic control
> - **Uncontrolled:** airspace in which separation from other aircraft is the responsibility of the pilot requiring an 'out the window' view to visually acquire and avoid other aircraft

The table at the bottom of the page provides an illustrative snapshot of some of the common capabilities of UAS fulfilling a range of missions. This starts with the typical recreational model that, when equipped to fulfil commercial photography and surveying roles, becomes the basic UAS, progressing to large purpose-built UAS providing logistics support. Each incremental increase in mission complexity introduces a corresponding increase in airworthiness and certification requirements, as would be the case with a manned aircraft used for commercial revenue.

This paper addresses some of the issues pertaining to each barrier and how the mitigation differs depending on the UAS mission. In doing so we will consider the roles of the following four key groups in the UAS community in breaching these barriers:

This paper addresses some of the issues pertaining to each barrier and how the mitigation differs depending on the UAS mission

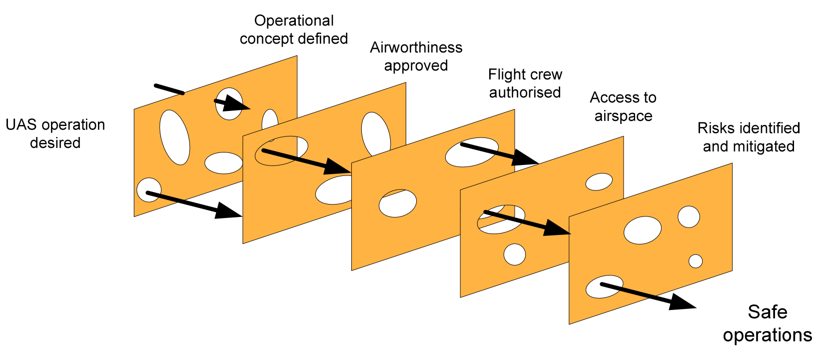
- **UAS airspace users:** who will utilise the various applications provided by UAS (at lower cost than manned equivalents). These people are the market drivers.
- **UAS manufacturers:** who wish to supply the market with the various products they are developing.
- **Non-UAS airspace users:** who wish to see current levels of safety and efficiency maintained or increased.
- **Air Navigation Service Providers (ANSPs) and their regulators:** who know that they will need to accommodate the needs of the UAS community and other airspace users safely and efficiently.

Potential mission	Airworthiness requirements	Airspace restrictions	Flight crew restrictions	Communication requirements
Recreational	No airworthiness	<400ft altitude, >150m from buildings, <500m radius	None	Line of sight
Aerial survey and photography, crowd surveillance	No airworthiness	<400ft altitude, >150m from buildings, <500m radius	BNUC-S or equivalent	Line of sight
Utility inspection	No airworthiness	Segregated airspace	BNUC-S, BNUC or equivalent	Line of sight / beyond visual range
Aerial survey, utility inspection	Airworthiness from accredited body	Uncontrolled airspace	CPL equivalent	Beyond visual range
Unmanned transport	EASA governing requirements	Controlled airspace	ATPL equivalent	Beyond visual range

Safety 

One of the key steps in persuading the regulator that UAS are safe to operate is a safety case that takes account of the airspace characteristics. The regulator needs to be certain that the operation of the UAS, on its own and its interaction with the public and other airspace users is consistent with agreed safety targets. The onus is on the UAS operator to provide justification that its operations are safe. In addition, the service provider needs to be able to demonstrate that the integration of UAS with other airspace users will not degrade safety. The development of such an in-depth safety assessment is key in determining the basis for technical and operational approvals.

The onus is on the UAS operator to provide justification that its operations are safe



Barrier model for safety analysis

So how is this accomplished? Safety is an evidence based argument supported by appropriate standards, specifications, design briefs and human factor considerations. It involves all airspace actors. Safety must be considered throughout the design process — indeed a number of system safety requirements should be specified before the system design is finalised. Within manned aviation international standards not only specify how a system or function will work, but also define the level of performance it should be designed to and how this can be proven. With no international or, for some countries, national standards yet agreed, there is a gap that in many cases prevents the use of commercial UAS within a civil context. Using UAS that are already proven in operational theatre does not resolve the issue of demonstrating equivalence with civil airspace users to national regulators when the minimum system specifications for UAS are not yet agreed.

The lack of agreed standards prevents the use of commercial UAS within a civil context

Obtaining the evidence for system performance can be difficult when the standards to which UAS systems are designed are not consistent with those currently agreed internationally for manned aviation. Even though the UAS' design may be predicated on established user requirements and sound engineering specifications, it can be complicated to prove the traceability and equivalence with the safety requirements for the airspace in which the UAS wishes to operate. This can be exacerbated when, due to airspace access restrictions, the UAS is unable to accumulate sufficient flight hours from which performance based safety evidence can be derived.

Developing a safety case requires coordination and consultation with many different actors

Developing a safety case to address such issues is a process that requires coordination and consultation with many different actors. Within the national context, obtaining regulator buy-in and support can help in achieving operational status. Considerations might include:

- Training and ongoing supervision for UAS operators and their procedures
- Assurance to the service provider that the introduction of UAS does not introduce any new risks that would endanger air traffic under its responsibility
- The risk of collision with persons or property is not increased

However, the detail required in a UAS safety case will depend primarily on the type of airspace the operator wishes to access to fulfil the UAS mission and whether this requires additional mitigations posed by the airspace classification or the intended proximity to other persons or aircraft. A small UAS operating within an altitude limit of 400ft and visual range is unlikely to require a safety case as extensive as another UAS operation in which interaction with other airspace users is expected.

Airworthiness

Airworthiness certificate: a statement of confidence that the regulator believes the UAS has been constructed with sufficient engineering scrutiny on a sound design basis

An airworthiness certificate is a statement of confidence that the regulator believes an aircraft has been constructed with sufficient engineering scrutiny on a sound design basis. It also requires that the aircraft will continue to be maintained and operated by suitably qualified personnel in accordance with approved standards and limitations.

This definition immediately raises questions when applied to UAS. What design requirements should manufacturers be meeting? What is the expected maintenance and life time of the UAS? What is the procedural basis for ensuring that those involved in the operation of the UAS are suitably qualified and have the necessary experience to operate the UAS within non-segregated and/or segregated airspace? Is the UAS suitably equipped to operate as intended within its concept of operations?

At European level, airworthiness requirements only apply to UAS over 150kg

For UAS over 150kg, the European airworthiness requirements stipulated within European Regulation (EC) No. 216/2008 apply. This states that the design and manufacture of a UAS must be in accordance with the relevant certification specifications as for manned aircraft and must be issued with its own certificate of airworthiness and permit to fly. As such, this certificate of airworthiness will be subject to annual review and the UAS vehicle inspection criteria and frequency will also need to be included in the operations manual.

Smaller UAS are the responsibility of the national regulator

Under current legislation, smaller UAS (<150kg) are the responsibility of the national regulator. For example in the UK, the CAA has published guidance regarding airworthiness and the requirements for small UAVs in CAP 722 since 2001. Whilst the design requirements for small surveillance UAS have, to a large extent, been derived from the existing requirements for model aircraft (CAP 658), their increasing utilisation as commercial UAS means that they have to follow the guidance within CAP 722 which is necessarily more prescriptive in terms of design, construction and test flight. And although there may not be airworthiness requirements for UAS that are below specified weight limits and engaged in missions outside core airspace, airworthiness is instead implemented through public protection — usually defined as operational restrictions when in proximity to people and buildings.

Type certification 

The type certification issued for the UAS may determine to an extent the operations which it may perform. The basis for this certification will therefore form a crucial aspect of the design and development of the UAS and the way in which it is integrated into the ground control segment. Manufacturers will argue that, without an existing firm basis for both airworthiness and type certification, they do not know what standard to build towards. Likewise, there is still a learning curve for the regulators and certification authorities. The basis for any type certification should be a pragmatic approach that provides a correlation to example activities and an assessment of the degree of duplication and redundancy of onboard systems and command and control links.

The type certification issued for the UAS may determine to an extent the operations which it may perform

Of paramount concern to the regulators in issuing any approval is the suitability of the aircraft to maintain stable and safe operations, and for the pilot to be capable of maintaining control of the UAS in any situation. It is now widely recognised that UAS as operators within the national airspace structure are compared in equivalence to manned aircraft. This is reflected in the general consensus that UAS are now referred to as aircraft and not models. However, not all requirements are comparable or transferable to UAS, but this distinction helps in addressing the operational aspects of certification including the need for sense and avoid capability to enable operations in non-segregated airspace.

It is now widely recognised that UAS are compared in equivalence to manned aircraft within the national airspace structure

At present, the lack of international regulations for UAS greater than 150kg and different national approaches to certifying those less than 150kg adds another layer of complexity for manufacturers and operators.

The lack of international regulations for larger UAS and different national approaches to certifying smaller UAS adds complexity

Crew licensing 

The question of licensing for UAS pilots still requires resolution. Access to airspace depends not only on the ability of the aircraft to meet all performance and airworthiness requirements, but also on the ability of the pilot in command to comply with the rules of the air. Does the UAS pilot have to complete a full flight course (i.e. JAR PPL, CPL, FCL) or is it simply sufficient that the flight crew be fully conversant in the rules of the air to be placed in charge of a UAS? Are there type requirements? And how many flight-hours experience have to be built up before a pilot can fly unsupervised?

Access to airspace depends also on the ability of the pilot in command to comply with the rules of the air

This issue is not new. During the past ten years of increased military use of UAS, the military have established their own training requirements for UAS flight crew. The US Air Force now recognises that UAS pilots are rated at an equivalent grade to flight crew that are qualified for fixed wing aircraft. Piloting a UAS within the national air structure and within the congested airspace that may be above a battlefield requires applied knowledge of the rules of the air and ICAO RT guidelines. Already flight-hour requirements

The US Air Force now recognises that UAS pilots are rated at an equivalent grade to flight crew qualified for fixed wing aircraft are being established regarding when a military flight crew may be permitted to assume command of a UAS — regardless of size or mission. But this has yet to be transferred to the civilian, commercial world.

The following table illustrates the two licensing regimes applicable within the UK. These regimes depend on the level of risk mitigation available within the operation, where mitigating factors include operations within segregated airspace, within visual range and low mass UAS.

Operating Mass (max)	One or more mitigating factors	No mitigating factors
7 kg or less	None, or BNUC-S, Industry Code of Practice or equivalent	BNUC-S, Industry Code of Practice, or equivalent
More than 7 kg to 20 kg	BNUC-S, Industry Code of Practice or equivalent	BNUC-S, or equivalent
More than 20 kg to 150 kg	BNUC, Industry Code of Practice or equivalent	BNUC, CPL(U), Industry Code of Practice, or equivalent
More than 150 kg	Industry Code of Practice, CPL(U) or ATPL(U) or equivalent	CPL(U) or ATPL(U) or equivalent

Source: Information merged from CAP 722 - Unmanned Aircraft System Operations in UK Airspace – Guidance (© Civil Aviation Authority 2010) and updated UK CAA SRG information on UAS pilot qualifications (see www.caa.co.uk)

Flight crew qualifications vary according to the capabilities of the UAS and the prospective operational environment

This clearly illustrates the concept that as the UAS size and potential mission requirements increase, the requirements in terms of crew capability increase. In this context emerging requirements start from the qualifications that are already established for model aircraft and progress as the weight of the aircraft increases. In simple terms, this varies according to the capabilities of the UAS and the prospective operational environment. UAS pilots flying missions in segregated airspace do not need the same awareness of the rules of the air or systems operation as would be required in controlled/uncontrolled airspace or beyond visual range of the controller. This is because such aircraft tend not only to be large, but also have increased levels of onboard redundancy, autonomy and stabilisation incorporated.

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Human factors and autonomy

In addition to training and licensing, understanding the role of the human in semi-autonomous or autonomous operations is another important consideration. What level of UAS 'intelligence' is appropriate for an autonomous operation and to what extent should a human share the decision-making during a mission? Equally, what level of human intervention is appropriate in contingent or emergency situations? These issues have taxed the minds of academics and the UAS industry as a whole for many years and, whilst the answers will potentially be different for each type of operation, the issue must be examined and addressed.

This is particularly relevant when considering the general principle of equivalence that is forming the basis for UAS approvals. The entire concept of operations for the piloting of UAS is different to that of manned aircraft. The interface to the environment is different. The flight crew have to cope with increased flight response latency. The information displayed to the flight crew may be presented in a different, more cluttered, format with more information available (such as payload and/or targeting information) compared to a standard manned aircraft. There is no external interaction with the environment. What then is the effect on the flight crew of such 'removal' from the scene of operation, both in terms of fatigue and situational awareness? Whilst the latter may not be an issue when a UAS is approved and equipped to operate in controlled airspace, within non-segregated uncontrolled airspace this needs addressing. Would the same ATC services be available to the UAS pilot and would there be any perceived differences from the pilot's perspective? This distinction in operations and the human factors impact will also vary with the type of UAS flown, e.g. beyond or within visual range.

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Small UAS (<7kg) operating missions within a limit of 500 metres and no higher than 400ft may not have this interaction depending on where the operation takes place. This operation is already understood and comparable to the model aircraft requirements – except when the surveillance has been approved for use in a built-up area or over people. But what happens when the UAS is permitted to operate beyond line of sight and is equipped with an approved sense and avoid capability? The responsibility still remains with the pilot for separation from other airspace users, but will vigilance be reduced through reliance on a more 'automated' surveillance?

For UAS in controlled airspace the responsibility remains with the pilot for separation from other airspace users

UAS involved in heavier missions, for example unmanned transport, have greater requirements in terms of airspace volume and take-off distances. This in turn may lead to requirements for operations from public or military aerodromes in which interaction with the local ATC will be required. Do the flight crew have the required training? Do they have sufficient experience in such an environment to be able to fly unsupervised? Has training included runway and taxi operations?

Larger UAS may have requirements for operations from public or military aerodromes in which interaction with local ATC will be required

An RAF pilot remotely controls a Reaper MQ-9 UAS © UK MOD Crown Copyright 2011

The more automated an operation becomes, no doubt the more relaxed users will become as their inherent trust in the system response increases — in turn potentially leading to complacency and a false sense of security. This issue will need to be considered fully as part of either a dedicated human factors study, or within the operational safety case by the UAS manufacturer and operator.

Procedures

UAS will need approval for operations in non-segregated controlled and uncontrolled airspace. It might be easy to assume that UAS should be capable of operating according to the same rules, using the same procedures, as all other airspace users. However, without necessarily the same out-the-cockpit view, there may be a requirement for a change in procedures particular to UAS operations. For example, what are the procedures in the event of loss of command and control of the UAS? And in what circumstances will a flight plan be required? What action should the UAS take to indicate to ATC or other airspace users that control has been lost, and what should the procedure for re-establishing control be? Is this as for current manned aircraft? The answers to these questions will be closely aligned to the intended operation, the airworthiness and type certification of the UAS.

Without necessarily the same out-the-cockpit view, there may be a requirement for a change in procedures particular to UAS operations

The level of alignment with current procedural requirements will depend on the airspace in which the UAS mission seeks access. Longer range UAS that may be engaged, for example, on a utility inspection flight may transit different classes of airspace and have to comply with the operational procedures required of each. However, for the urban canyon surveillance flight or aerial surveillance, the procedural impact may be negligible.

The level of alignment with current procedural requirements will depend on the airspace in which the UAS mission seeks access

However, even for such small missions, any procedures established should still remain consistent with the rules of the air and the principles of self separation. This would be expected to be covered under the airworthiness and operations approval of the flight crew.

Communications

By definition operation of UAS requires a remote, wireless link to the vehicle. There may be more than one such links to the UAS, for example maintenance of command and control, communication with local ATC and other airspace users and transmission of mission specific payload information. The integration of these links into the UAS is platform-specific and may entail the use of one or more frequencies in different bands.

UAS operations require interference-free frequencies to ensure continuity and integrity

This poses the question of which frequencies are currently available for the control of civil UAS and how this spectrum can be protected. Not only do there need to be sufficient frequencies available to support the intended UAS operation, but they need to be free from interference to ensure continuity and integrity. It is inevitable that frequency coordination will be required to ensure that other radio users (including other UAS) do not unintentionally interfere with a nearby UAS. This becomes more critical when beyond visual range UAS missions are considered.

No spectrum is currently reserved exclusively for UAS use. This may change as spectrum allocations to enable the growth of UAS globally are due to be discussed at the World Radiocommunication Conference in 2012. Without the availability of dedicated bands, UAS operators and manufacturers are left with few choices as to which frequencies to use. The options are:

No spectrum is currently reserved exclusively for UAS use

- Using an unprotected (licence exempt) band which may be full of other users
- Obtaining a license in an alternative spectrum band with sub-optimal characteristics
- Using terrestrial mobile communication networks or
- Paying for a satellite connection

Without a dedicated band, the most suitable option will always be a compromise for the UAS operator between the intended range, bandwidth, latency and immunity to interference.

Without reserved frequencies, UAS operators will have to compromise on the intended range, bandwidth, latency and immunity to interference

	Frequency bands		
	Military	Other Licensed	Unlicensed
BatIII			✓
CamCopter	✓		✓
Dakota			✓
Dragon Eye	✓	✓	
Fire Scout	✓	✓	
Hunter		✓	
Pointer		✓	✓
Raven	✓	✓	
Rmax	✓		✓
Scan Eagle			✓
Sentry HP	✓		✓
Tern XPV-1		✓	

Demonstration of the variability in frequency selection for different UAS due to a lack of reserved frequency

The use of a third party for communication raises economic issues for UAS that would need to be considered if no spectrum were to be allocated. Operations within non-segregated airspace will need to maintain open links with ATC. This may be included within the command and control datalink or may be separate dependent on the implementation. In such circumstances, the issues of cost for available bandwidth may influence the operational concept. For example, if the UAS is supporting a surveillance operation, is a live video broadcast feed required or can video be stored onboard for analysis post flight?

Arguably, the larger the UAS and its potential kinetic energy, the more robust a link should be required

Arguably from a certification and airworthiness perspective, the larger the UAS and its potential kinetic energy, the more robust a link should be required. UAS engaged on long range missions may be able to justify the cost of satellite communications, while in comparison, for the small UAS engaged in local aerial survey in segregated airspace use of unlicensed frequencies may be sufficient.

Public perception

Tabloid media tend to report on the potential for invasion of privacy as well as safety and noise concerns

In the UK, public perception of UAS has tended to be negative, thanks partly to tabloid media reports focusing on the potential for invasion of privacy as well as safety and noise concerns. UAS have been portrayed as remote drones involved in public surveillance and aerial photography. There is a need to convey to the public some of the benefits of UAS versus conventional manned aircraft, for example reduced noise and air pollution, when undertaking missions such as crop spraying, aerial photography/ surveillance or utility inspection. Without focused efforts to address public concerns resistance to their more general use is likely to remain.

There is a need to convey some of the benefits of UAS, for example reduced noise and air pollution

To counteract this perceived negative impact, a concerted effort needs to be made to sell the efficiency, environmental and agility benefits that UAS offer over manned aircraft operations. In particular the situational awareness and security enhancements that UAS-enabled operations could bring to the emergency and rescue services will need to be demonstrated. At a business level, innovative new UAS-based services open up new market opportunities to create jobs and secure a national competitive advantage.


29/03/2010

BIG BROTHER WATCH MANIFESTO

The spy drones that just won't fly away

You may remember that about a month ago, Merseyside Police experienced a topsy-turvy few days when - having paraded their fancy new flying CCTV drone as the latest in crime-fighting technology - the remote-controlled spy plane was then grounded by the Civil Aviation Authority for flying over residential areas without a licence.

UAS also offer a more environmentally-friendly way to execute an airborne mission than traditional manned aviation vehicles which are typically heavier, generate more emissions and noise, and consume more fuel. On the other hand missions involving UAS flying in street canyons and in close proximity to buildings are likely to generate a new type of noise nuisance — particularly if the aircraft is required to loiter for an extended period of time. In such instances, the safety of the UAS may be of more concern to the public.

At a business level, innovative new UAS-based services open up new market opportunities to create jobs and secure a national competitive advantage

As UAS also lend themselves to performing automated or semi-automated missions, the algorithms used to fly a given trajectory may be programmed to have optimal efficiency — meaning minimal contribution to climate change and reduced impact on air quality in the vicinity of operation. And the smaller size of UAS also offer the opportunity for a paradigm shift in power plant technology. Indeed many UAS today utilise novel power sources, such as solar, wind and sustainable biofuels — leading to other benefits such as persistence above a given target.

Integration

While the UAS community is pressing ahead trying to resolve the issues limiting UAS integration, work continues in the background within the context of the European Commission's Single European Sky initiative, the European Aviation Safety Agency (EASA) and EUROCONTROL's Safety Regulation Requirements (ESARRs). These bodies are dealing with the harmonisation of ATC service provision, airspace classifications and the maintenance of safety with the adoption of new operations for airspace users. However, their work is currently focused on the traditional airspace users: the military, commercial aviation and general aviation.

For UAS to achieve integration into the ATM system, they too need to be considered when developing operational and harmonisation requirements — including rules of the air. Programmes such as SESAR in Europe and NextGen in the US undoubtedly provide an opportunity to speed up the integration of UAS by designing them into the next generation systems from the start. The progression towards a trajectory based ATM system and the wider and dynamic sharing of data will result in an increasingly 'known' traffic environment in which it will be easier to accommodate UAS.

SES and EASA need to include UAS when developing operational and harmonisation requirements

An understanding of the role of the service provider and national regulator is also key. Both are closely engaged with projects such as SESAR and will be responsible for the implementation and operation of the next generation ATM systems. Early engagement not only ensures that UAS operators requirements are considered, but, in the case of service providers, also provides an opportunity for UAS manufacturers or potential operators to work together and learn from each other in areas such as automation or autonomy.

Conclusion

UAS offer promising environmental, cost and efficiency benefits for a whole range of applications from crop spraying and traffic monitoring to pipeline and power line surveillance. However, the extent to and speed at which these benefits can be realised depends on the ability of the UAS community to determine with national regulators the exact requirements to permit the different types of operations.

To realise its full potential, the UAS community must determine with national regulators the exact requirements to permit the different types of operations

The acceptability of UAS and the requirements placed on them is largely determined by the types of airspace that they are required to access in order to fulfil their mission. For civil UAS operations to expand in the same way as witnessed for military operations, clear guidance will be required that enables the national regulator and service provider to be sure that the introduction of UAS does not impact other airspace users and the general public or impinge on the existing high levels of safety.

As a result, in the short term it will be easier to gain access to controlled airspace where the separation of aircraft is the responsibility of air traffic control. Here the UAS only has to comply with current airworthiness capability requirements. Operations become more difficult to integrate when the UAS is smaller, involves a transit between controlled and uncontrolled airspace, or when the UAS mission involves access to more densely used airspace where a requirement to sense and avoid other airspace users is necessary.

These requirements must be comparable with current practices, but tailored to the unique operational and performance differences of UAS

So how do we ensure that UAS are eventually able to access airspace and operate with the same degree of flexibility as current users? Prospective UAS operators and manufacturers need to maintain an open dialogue with national regulators and ANSPs. They need to develop a set of requirements that are comparable with current practices, but tailored to the unique operational and performance differences of UAS. This will entail the development of more detailed operational descriptions and the additional capabilities to facilitate the demonstration of equivalence with other airspace users.

About Helios

Helios is an independent technical and management consultancy to the aerospace, transport and telecommunication sectors. Helios has been providing thought leadership to aviation since 1996, advising regulators, service providers, airspace users and industry. All of Helios' customers work in the complex regulatory domain, in safety critical industries and are supported by advanced technology.

Helios' headquarters is in Farnborough in the UK, with a branch office in Slovakia. Turnover is over £5m, with more than 70% of the revenue coming from exports, mainly within Europe. The company has significant expertise in the assessment of new technologies and their application into ATM and aerospace in general.

We combine a wide range of functional expertise into a consolidated set of services covering the entire value chain from policy, regulatory and strategy development through business and operational improvement to system engineering and managing the implementation of new technology systems.

Helios' focus on excellence was recognised through two Queen's Awards for Enterprise (2004, 2009). Since its inception the company has achieved consistent growth and now employs 40 staff.

We have provided support to a number of clients addressing precisely the issues identified within this paper. Our work with regulators and national service providers has enabled us to develop a thorough and practical understanding of the issues addressing UAS. At the European level we have intimate knowledge of the developments being driven within the context of the Single European Sky (SES) and SESAR.

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