BRIEFING PAPER
DIGITISE THE SKIES

THE ENTREPRENEURS NETWORK

ANTON HOWES & SAM DUMITRIU
The Entrepreneurs Network
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Executive Summary

- Unmanned aerial vehicles, commonly known as drones, promise to transform the economy.
- Drones have the potential to make it radically cheaper to inspect critical infrastructure such as roads, railways, and airports.
- Drones could deliver consumer goods, food, and medical supplies, spreading inner-city amenities into the suburbs and countryside, while cutting costs and traffic congestion.
- Drones could even be used for passenger transportation, increasing access for rural areas and between towns without the need for expensive new infrastructure.
- The technology already exists for drones to share the skies with manned aircraft, but it will only work if the other aircraft emit electronic signals, allowing them to be visible to the drones. This is known as electronic conspicuity.
- Many recreational aircraft, however, are not electronically conspicuous, and are currently not required to be. Becoming electronically conspicuous is costly to individual recreational flyers, who are opposed to having to bear the cost of enabling the drone industry. The government has so far only offered to pay for half of this cost.
- This paper argues that the government should require all aircraft to be electronically conspicuous, and should pay the full cost for recreational flyers making this upgrade. It will cost a maximum of £10m, and likely much less.
- The potential size of the drone economy, estimated by PwC to increase UK GDP by £42bn by as early as 2030, implies that bearing this one-off cost is likely to have a return of 420,000%.
- To avoid further obstacles, and signal its seriousness about making the UK the first country with crowded airspace to experience the drones' full potential, the government should create a Parliamentary Under Secretary of State position within the Department for Transport to specifically oversee the growth of the drone industry, and unlock the potential of our skies.

Introduction: The Potential of Drones.

With the rapid development of drone technologies, our skies may soon become dramatically busier. Unmanned aerial vehicles promise to transform industries, including logistics, transport, and the maintenance of infrastructure. Broadly speaking, the near-future promise of the new drone technologies falls under three categories, each of them likely to follow on the heels of the last — especially with the proliferation of drones that can travel beyond the visual line of sight (BVLOS) of their controllers. These will be the gamechanger.

In the immediate future, BVLOS drones are likely to be used for **inspection services**, for airports, railways, roads, buildings, and powerlines, as well as finding applications in agriculture. Their promise is to dramatically decrease the costs associated with sending people to great heights, or across great distances, in order to quickly identify problems that may require attention. With the reduction of such costs, the efficiency of infrastructure is likely to improve, as potential problems are identified and resolved sooner rather than later, reducing repair costs overall. For example, Innovate UK estimated that BVLOS drones could cut the cost of inspecting power lines, such as the Beauly-Denny powerline which links 615 steel towers over 220km, by more than a third.[1]

In agriculture, the ability of drones to quickly and remotely identify specific crops within a vast area that are in need of extra attention enables a new kind of precision agriculture, which cuts costs and, most importantly, reduces environmental impact. This application is the one most extensively already trialled by the Civil Aviation Authority (CAA), largely because of its simplicity. The relevant areas can often be blocked off from other kinds of air traffic, without having to worry too much about what a shared airspace will look like.

More complex, but also increasingly being trialled both by the CAA and abroad, is the use of drones for **deliveries**. In countries with relatively uncrowded airspace, such as Rwanda, drones are being used to routinely deliver medical supplies across great distances. The challenge in a country like the UK, however, is in integrating delivery drones into an airspace that is among the busiest in the world. If this can be done successfully, however, the effects could be dramatic. The rapid delivery of medical supplies, such as testing kits, vaccines, and perhaps even organs, could have a transformative impact on healthcare, particularly for rurally-situated medical centres, as well as helping to address geographical health inequalities. Beyond the use of such ambulance drones, however, we might envisage drones being used for more ordinary door-to-door deliveries, of mail, packages, and food — applications already being trialed in the US and Ireland. The effects of such an improvement to logistics technology is hard to predict, but as an immediate effect it would very likely extend access to many large city amenities, like restaurant deliveries, much farther

1 UK Research and Innovation. (2021). Future Flight Challenge: Socio-economic Study.

into suburbs and even the countryside. Remote areas, such as the Orkney Islands, which currently rely on infrequent cargo plane deliveries for mail could see especially large benefits.[2]

Still more complex, and likely much further in the future given its greater safety implications, BVLOS drones will likely be applied to **passenger transportation**. If issues with managing shared and busy airspace can be solved, then we would expect the development of rural air taxis and inter-city air taxis with a vertical take-off and landing, and perhaps eventually even urban air taxis, though this is a use case that may be less economically feasible due to problems of congestion, cost, and the need for landing space. Rural air taxis alone, however, would be a major new addition to our transport infrastructure. They would provide a faster alternative source of transportation to areas currently only served by roads, without the same problems of congestion, and without any of the major costs and delays associated with laying new tram – or railway lines.

All three use cases for drone technology are being explored by entrepreneurs and innovators all over the world, with some of them receiving major investment.

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The UK's top drone businesses[3]

	Funding Raised	Description
Hummingbird Technologies	£14.1m (Equity) £1.17m (Grants)	Drone management for inspection services, particularly in agriculture
Aveillant	£15.2m (Equity) £303k(Grants)	Holographic radar technology for drone detection, making UTM safer. Acquired by Thales Group in 2020.
Cyberhawk	£4.2m (Equity)	Energy infrastructure inspection services. Acquired by Magnesium Capital in 2019.
Blue Bear Systems Research	£7.25m (Grants)	Design and development of unmanned flight systems.
Sensat	£12.4m (Equity) £314k (Grants)	Infrastructure and construction inspection and aerial mapping services.
Dendra Systems	£10.9m (Equity	Aerial mapping for natural conservation efforts.
Evolve Dynamics	£1.18m (Equity) £15k (Grants)	Design and manufacture of mission-specific drones for emergency services, surveillance, and defence.
SLAMcore	£8.8m (Equity) £550k (Grants)	Sensory software for machinery, including drones
Altitude Angel	£11.3m (Equity) £1.2m (Grants)	UTM software
Animal Dynamics	£13.5m (Equity) £883k (Grants)	Drone hardware and software design
Neuron	£343k (Grants)	Sensor networks and data management for UTM

Sources: Beauhurst

2 IBID

3 Beauhurst. (2021) UK's Top Drone Companies.

With ever-cheaper and lighter batteries and components, and ever more sophisticated navigation systems, technological issues are rapidly being solved. The challenge, however, is from the regulatory side, especially as our skies are likely to become significantly more crowded.

The challenge is akin to designing the full infrastructure for the automobile, but while the technology is still in its infancy: like planning for motorways, traffic lights, petrol stations, roundabouts, vehicle licensing, and parking, when most roads are still overwhelmingly used by horses slowly pulling carriages, and most cars hardly go over 5mph. Regulators all over the world are understandably nervous about making decisions now that are not only unsafe, but that will lock in a particular technological pathway, at the expense of alternatives that may turn out to be preferable only many decades from now.

Ultimately, facilitating trials and experiments, and adjusting regulation in light of the results is the only way to avoid a problem of lock-in. This is the forward-looking approach that the CAA have adopted, testing entrepreneurs' proposals on a case-by-case basis, and updating rules as the industry develops. sees.ai, for example, in April 2021 became the first company in the UK to be authorised to trial the operation of drones beyond the visual line of sight of operators.

Nonetheless, as we will see, there are issues that go beyond the CAA's discretion that will likely need resolution at the political level before the industry can properly advance. It is one thing to set aside some airspace above railway lines for a drone inspection service, or to allow a drone delivery service to be trialled in a rural area, and quite another to integrate drones into the busy airspace in and around London, or even near rurally situated recreational airfields. What is needed is a way for the industry to go beyond just the segregated trial stage, and achieve scale. Failure to do this will likely result in drone companies giving up on the UK market and concentrating their efforts elsewhere.

The Challenge: Integration vs Segregation

The most prominent challenge for the UK is how to safely integrate drones into one of the busiest airspaces in the world. While daunting, finding a solution to it is likely to make the country one of the leading places for the further development of the new technology. Especially if a solution can be implemented quickly.

Concerns about noise may also need addressing, but these are likely to be secondary. A trial of drone deliveries in Christiansburg, Virginia, suggests that speculative concerns about safety and privacy problems immediately fall away when the public actually experience drone deliveries in practice.4 Although noise was the most commonly cited disadvantage, mentioned by a minority of 17% of poll respondents, even this minority is overwhelmingly favourable towards the technology. Noise reduction is, moreover, within the scope of future technological development, and setting maximum noise standards would be a relatively easy political or regulatory fix that could be applied after the technology has been allowed to become widespread. (Considering the lack of regulation of loud motorcycles and sports cars on the grounds of noisiness, electric drones intended for urban settings, which are already far quieter, are unlikely to provoke major opposition from the general public.)

The major challenge, then, is in how to integrate drones into skies – specifically the space below 10,000 feet, with some exceptions like the areas around aerodromes and airports – that have traditionally been the near-uncontested domain of recreational flyers. Known as Class G airspace, aircraft may currently fly when and where they like, without needing to notify Air Traffic Control of their presence and intentions, subject to very simple rules, with pilots taking full responsibility for their own safety. Understandably, proposals to integrate drones into Class G airspace has provoked considerable concern from recreational flyers — a close-knit and vocal group. If they are to safely share the skies, then Class G airspace will, in effect, become significantly more regulated for its existing users.

Up until now, the CAA's approach has been to segregate airspace for drone use, essentially carving out areas in which recreational flyers will not be permitted to fly. But while such an approach can work for limited trials, and may well be suitable for a handful of inspection applications, it is incompatible with the widespread proliferation of the technology, particularly for deliveries. Indeed, as the drone economy grows, existing users of Class G airspace may find that more and more airspace is denied to them by being segregated for exclusive drone use. Indeed, proposals for the creation of a new class of shared airspace for recreational flyers and drones has understandably been opposed by recreational flyers on the basis that it could de facto mean the removal of vast swathes of Class G, to be more regulated.

4 Nelsen, E., Guthrie, A., & Vinsel, L. (2021). When the Drone Is in Your Backyard. Issues in Science and Technology, 37(3), 29-31.

The only sustainable solution then, which can fully unleash drones' potential, will be to find a way for Class G airspace to be shared, and in a way that adequately addresses the concerns of its existing users.

Achieving an integrated Class G airspace, however, will involve solving a number of technical, regulatory, and political problems. Indeed, the drone economy is likely to be permanently stifled, even despite the best intentions of the CAA to support innovation, until the political problems can be resolved. Even trialling BVLOS drones in unsegregated airspace is likely to be impossible, from a safety perspective, until certain changes are universally adopted by the recreational flying community.

Electronic Conspicuity

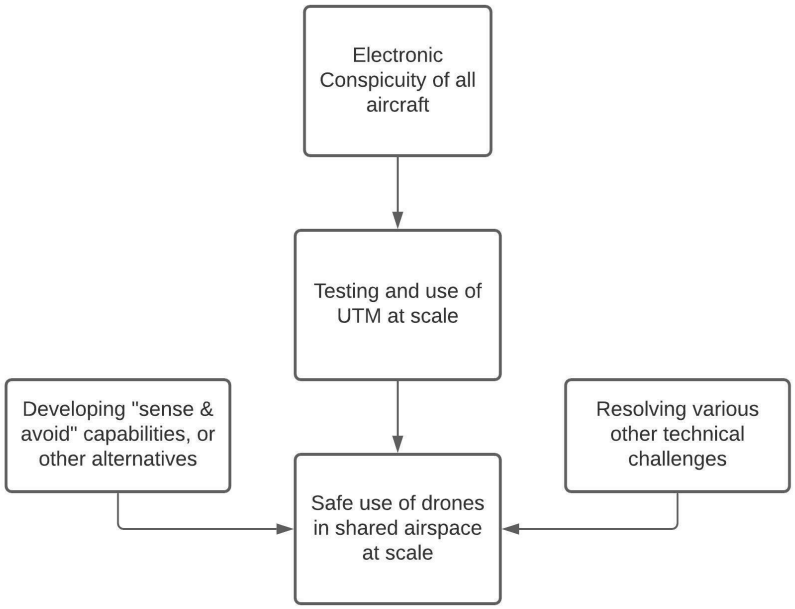
The main blockage is that right now many recreational flyers would, in effect, be invisible to drones.

Broadly speaking, the system whereby drones can safely fly around one another, in the absence of human air traffic management systems (ATM), already exists. It is known as Unmanned Aircraft System Traffic Management (UTM) -- essentially a series of protocols by which drones can electronically communicate their locations to one another and thus avoid collisions. Indeed, UTM would both allow BVLOS drones to share airspace with one another, and also communicate with traditional ATM, providing the potential for drones to be flown in the more highly regulated airspaces in and around airports and aerodromes.

The problem is that in unregulated Class G airspace, many flying objects - predominantly recreational flyers - are not required to be electronically conspicuous. That is, they have no electronic signature in the skies, which would allow UTM to know where they are, provide the information for drone controllers to adjust their routes, and thus prevent collisions. (Even Class D airspace, typically found around and above the aerodromes where many recreational aircraft take off and land, requires only a radio with which to update Air Traffic Control rather than any electronic conspicuity).

This is not to say that UTM is a panacea for the proliferation of drones. To fly safely in busy airspaces, drones will almost certainly also need to develop the capability to see objects in the skies around them and take evasive action - a capability known as "sense and avoid". How such a capability may be achieved for smaller drones is still a major technological obstacle. But any such capability will be worthless, at least for achieving a shared airspace, until Class G airspace is managed using UTM. Drones and other aircraft will need to have their permissions and protocols all managed if shared airspace is to be safe. Only then can various potential issues with using UTM at scale - such as ensuring it is sufficiently reliable and effective in a variety of conditions - be resolved through repeated trials, experimentation, and technological development. Rolling out UTM at scale, in other words, is downstream of ensuring that everything flying in shared airspace is electronically conspicuous. Drones themselves are already

required to be electronically conspicuous, and the CAA has set standards to that effect. To move forward, however, recreational flyers need to be electronically conspicuous too.



The principal issue with imposing such a requirement is cost. Unlike the nascent drone industry, there are many recreational flyers whose current setup, if they even have one at all, would not conform to electronic conspicuity standards. The cost of a typical signalling device, such as a Sky Echo manufactured by uAvionix, is a few hundred pounds. It is expensive enough to be an unwelcome extra cost for recreational flyers to have to bear, and indeed the recreational flying community understandably resents the idea that they should have to pay any cost at all, let alone a high one, for drones to become more widespread.

While the government may still choose to simply impose a minimum level of electronic conspicuity on all recreational flyers, this is likely to prove unpopular, and is difficult to justify. The alternative, that the drones industry should fund electronic conspicuity, would also be difficult to do. The industry is too young, small, and reliant on speculative financing, to be able to coordinate such a transfer. Not only would many drones companies still have to solve further technical and regulatory issues even after electronic conspicuity is achieved, but it would be unclear which companies should bear the cost, with first-movers already in the industry being punished for being first, but making an investment that then benefits their competitors as much as themselves.

It would be better, then, for the government to bear the one-off cost of making all aircraft in the UK electronically conspicuous, after which it would simply be a compulsory requirement for any new recreational flyers to bear. The cost would be tiny, especially in comparison to the potential size of the drones industry, estimated by PwC to increase UK

GDP by £42bn by as early as 2030, not to mention the much longer-term transformative effects of drone deliveries and transportation on people's lives.[5]

There are just under 20,000 registered aircraft in the UK, some of which will be electronically conspicuous already, though it is difficult to say exactly how many.[6] Taking the figure as a maximum, however, and given the typical cost of under £500 for a latest-generation uAvionix Sky Echo 2 or equivalent, **the maximum total cost would be £10m** — in practice, probably significantly less. Indeed, the Department for Transport has already offered a rebate of 50% of the purchase cost for such devices, up to a maximum of £250, available until the end of March 2022. Our argument here is that this cost should be covered completely, so that total electronic conspicuity can be achieved in the skies as quickly as possible. This is a very low, one-off price for the government to pay for setting up the aviation infrastructure of the next few decades, if not centuries. If the estimates of the drone industry's effects on the economy are broadly correct, it would essentially constitute an investment with a 420,000% return by the end of the decade. It should be implemented without delay.

Next Steps

Achieving universal electronic conspicuity in the skies is an important step that must be taken towards having more productive skies. But it will not solve all issues with the introduction of the drone economy, and is unlikely to be the only political roadblock that must be overcome. Decisions will have to be made, for example, about how UTM data will be managed and paid for. With the industry still in its nascency, future obstacles and issues are difficult to predict.

What the issue of electronic conspicuity reveals is that things cannot always be left to the Civil Aviation Authority to sort out. This is not because they are opposed to innovation. Indeed, they have so far been proactive at trialling new technologies and developing new regulations. But there will inevitably be issues over which they cannot simply exercise their discretion, and where the politics of the issue must be resolved – something that can often only be done by ministers.

As things currently stand, the Department for Transport has a Secretary of State, two Ministers of State – one for the railways, cycling, and walking, and one for HS2 – and three Parliamentary Under Secretaries of State: one broadly covering the roads; one the future of transport, including decarbonisation, self-driving vehicles, and spaceflight; and one for aviation, maritime, and emergency planning. Given this division of labour, it is clear that developing the drone industry is not a government priority. It is seemingly not envisaged as part of the future of transport, and merely sits under aviation, unspecified.

5 PwC. (2018) Skies Without Limits: Drones – Taking the UK Economy to New Heights.

6 Civil Aviation Authority. Statistics relating to UK-registered aircraft.

Given the potential of this sector to transform the UK's infrastructure, unmanned aerial vehicles deserve at least a Parliamentary Under Secretary of State of their own, in order to anticipate and rapidly deal with issues that hold the industry back – indeed, the need for this paper should itself be taken as evidence that these issues are not being dealt with rapidly enough. The creation of a new ministerial position to specifically support the growth of the drone economy would signal to entrepreneurs, investors, and companies already in the industry that the UK is serious about being the first country with already-crowded airspace, to make drone inspections, deliveries, and transportation a reality, and unlock the potential of our skies.

TENENTREPRENEURS.ORG

The Entrepreneurs Network
84 Eccleston Square
Pimlico
London
SW1V 1PX