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Science and Technology Committee and Defence Committee

Oral evidence: [Commercial and recreational drone use in the UK](#), HC 2021

Tuesday 11 June 2019

Ordered by the House of Commons to be published on 11 June 2019.

[Watch the meeting](#)

Members present: Norman Lamb (Chair); Martin Docherty-Hughes; Vicky Ford; Bill Grant; Dr Julian Lewis; Stephen Metcalfe; Carol Monaghan; Gavin Robinson; John Spellar; Graham Stringer.

Questions 1-161

Witnesses

[I](#): Tim Johnson, Policy Director, Civil Aviation Authority, Richard Parker, Chief Executive Officer, Altitude Angel, and Anne-Lise Scaillierez, Director, Association of Remotely Piloted Aircraft Systems UK.

[II](#): Professor James P. Scanlan, University of Southampton, Brendan Schulman, Vice President of Policy and Legal Affairs, DJI, and Sir Brian Burridge, Chief Executive Officer, Royal Aeronautical Society.

Written evidence from witnesses:

- [Civil Aviation Authority](#)

- [ARPAS-UK](#)

- [DJI](#)

- [Royal Aeronautical Society](#)

Examination of witnesses

Witnesses: Tim Johnson, Richard Parker and Anne-Lise Scaillierez.

Chair: Welcome, all of you. Thank you very much indeed for attending this morning. May I invite Members present and witnesses to declare any interests that they think are relevant to this inquiry, and the nature of those interests? Could you also introduce yourselves briefly before we get on with the questioning?

Anne-Lise Scaillierez: Good morning. My name is Anne-Lise Scaillierez. I am here as a director of ARPAS UK, the UK drone association. Our members are primarily commercial operators, but also universities and academia, the emergency services, product manufacturers and software providers, as well as some individual pilots.

Tim Johnson: My name is Tim Johnson. I am the policy director at the Civil Aviation Authority.

Richard Parker: My name is Richard Parker. I am the founder and chief executive of Altitude Angel. We make traffic management solutions for drones in the UK and abroad. We represent about 120,000 registered users, primarily pilots of drones in the UK, who use our safety tools on a daily basis to understand where they can and cannot fly their drones.

Q1 **Chair:** Thank you very much. What is the prime purpose of drone regulation at present? How effective do you think the existing regulations are? As a supplementary question, to what extent can a regulatory approach deter those wanting to misuse drones?

Tim Johnson: From the Civil Aviation Authority's perspective, our focus is very much on the safety of those who use airspace and the safety of those on the ground. I think the purpose of the regulatory regime is to enable sensible, innovative, economically and socially valuable activity to happen, while protecting against some of the downside risks. Our focus is very much on the safety of those. In the UK, we have had a long-standing regulatory regime that sets out some clear rules on the basis on which drone activity can take place legally and lawfully. That is supported by an enforcement regime that allows the enforcement authorities to take action where unlawful activity is taking place.

Q2 **Chair:** How effective are they?

Tim Johnson: We think that at the moment the laws are very clear.

Q3 **Chair:** So they are fit for purpose, as far as you are concerned.

Tim Johnson: The key point from our perspective about the opportunities and risks presented by drones is that it is a complex and evolving environment. New opportunities for the use of drones are emerging all the time, as well as an understanding of what some of the risks are.

Q4   **Chair:** Does that imply that you need to keep the regulatory framework under constant review?

Tim Johnson: Absolutely. Over the last year, we have seen a couple of instances in which the Air Navigation Order, which sets out the basis of that regulatory regime, has been updated. It will continue to evolve at both a domestic and an international level. We have seen ICAO, the global aviation regulator, beginning to set some standards, and the European Union has also just agreed a new regulatory framework for drones within the European Union.

Q5   **Chair:** Is that consistent with what we have here, or does it introduce new requirements that result in our having to review our own regulations?

Tim Johnson: In large part, it is very similar to the regime that we have in the UK. It will introduce some new types of drone activity, as well as things like product standards marking for drones, so there are some new elements, but in the majority of cases it reflects where we are in the UK at the moment.

Q6   **Chair:** Do the other two witnesses agree with what has been said, or do you have a different view about the prime purpose or the effectiveness of the regime?

Anne-Lise Scaillierez: I agree fundamentally with what was reported by Mr Johnson. I would say that the primary goal of regulation today is to manage and mitigate the aviation-related risks: air-based risk, or risk of collision in the air, and ground-based risk, or risk that a drone falls and hurts a person or damages property. The regulation is absolutely fit for purpose for the operational scenarios that are currently allowed under the CAA regulation.

There are, however, other risks with drones, with regard to privacy and security misuse. At ARPAS UK, we are concerned to a certain degree with those risks, because they affect societal acceptance. That is a challenge to us, because it can limit or affect the expansion of the use of drones for good purposes, which is what is happening today on the ground because of those misuses.

Q7   **Chair:** The supplementary question that I asked was about whether the regulatory approach does anything to deter those wanting to misuse drones. Have you any comments on that?

Richard Parker: I am happy to jump in. The regulations today do a lot to prevent accidental misuse; they discourage that quite clearly, but there is nothing in any regulation that I am aware of that will prevent wilful and deliberate misuse of a drone in a particular way.

Q8   **Chair:** What about the penalties for misuse? Are they strong and effective enough?

Richard Parker: I think the penalties are very clear. I would not want to comment on whether or not they are effective enough in the wider scheme

of things, but certainly the majority of people who fly drones today do so willingly and in compliance with all regulations and the law. It is those few who fly in deliberate contravention of the regulations that the regulations themselves cannot help with.

Q9   **Chair:** Before you come in, Tim, let me direct a further question to you. We have talked about the need to keep regulation under constant review because of the evolving nature of this and the extent to which it is a growing market. Is the Civil Aviation Authority equipped to regulate this industry? Do you have the resources that you need? Do you have the level of expertise necessary to effectively regulate?

Tim Johnson: I will take the first question. In terms of our role our focus is very much on aviation safety. We have a team that advises on the regulatory framework, on issuing commercial approvals to operators that come to us and ask for it. We have an innovation team who want to understand the potential benefits and how they can be introduced safely. So I think we are well resourced for those functions that we currently have. The primary enforcement activity and responsibility sits with the police forces, and responsibility for privacy and counter-drones—they are issues that we are part of the stakeholder group in, but the lead agencies are outside the CAA. Our focus, as I say, very much is on aviation safety.

In terms of your question about the enforcement regime, the Air Navigation Order sets out the basis on which operators can fly drones. For endangering the safety of another aircraft, the penalties range from five years in prison and an unlimited fine. So if you get to the point where there is an endangerment of aircraft, and there is a case, there are some considerable penalties there, and also less severe penalties for lesser offences; but there is a framework in place that sets out what lawful drone activity is, and there is an enforcement regime behind that.

Q10   **Chair:** Presumably you keep in very close contact with sister regulators around the world. Is that right?

Tim Johnson: Yes, absolutely. I think particularly when there is a new technology, changing the nature of activity within aviation, in that instance we would always expect to, and we are working very closely with colleagues, both at a global level and at a European level, to understand what the issues are across aviation. The history of the last 50 or 60 years is that there is a common rule set that applies globally so everybody can understand the rules that apply. So both at an international level but also at a domestic level we are working very closely with other parts of Government who are in the lead for the different elements of the overall drone policy.

Chair: Thanks very much. Before I bring in Graham, I should just say we very much welcome the Chair and members of the Defence Select Committee joining us here on the Science and Technology Select Committee. I should have said that there are two inquiries under way for the two Select Committees but this session overlaps both so we have brought the two Committees together, in effect.

Q11   **Graham Stringer:** Just on the final point you made, are there any major divergences between how other aviation authorities are dealing with drones and how the UK is dealing with drones?

Tim Johnson: Different regulators are at different points in their appetite, if you like. First, everyone is focused on safety risk. All aviation regulators across the world—that is their core DNA. I think we have seen some countries, of which I think the UK is part, but I would also put America, New Zealand and some parts of Europe, who understand that drones is a potentially significant change to the nature of aviation activities in the country and want to understand both what the opportunities are but what the risks are as well. So I think you have seen a number of countries, including the UK, embracing and wanting to understand what this new technology can do both in terms of benefits and what the risks are, and understand how those risks might be managed.

Q12   **Graham Stringer:** Is the implication of that that some countries are not seeing it as a benefit—just as a threat?

Tim Johnson: No, I think this reflects the fact that globally some countries want to see themselves as leaders in particular fields and other countries are happy to be more in the following category.

Q13   **Graham Stringer:** Is there anything that you think is missing from the draft drone Bill, or anything that is in it that should be taken out?

Tim Johnson: On the drone Bill, we support the extension of enforcement powers, and in the Government's consultation it talked about additional stop and search powers and also fining powers. From our perspective, those are welcome additions to the regime, which already sets out what is legal and what the enforcement mechanisms are. So this is an addition to an existing regime. The Government is expected to make an announcement in due course about the final nature and shape of the Bill, but from what we have seen already—

   Graham Stringer: You are broadly content with it.

Anne-Lise Scaillierez: Maybe I can complement some of the answers with regards to the international approach. Generally speaking, the rules about unmanned aviation are derived from those for manned aviation. Manned aviation is a limited club of partners, which includes, of course, the CAA for the UK. So, generally speaking, among the tier 1 countries of aviation, there is a consensus about what can be achieved and how we can organise the development of our drone operations. There are some countries that do not necessarily welcome drones, and they are primarily countries that are at war, in fact. Otherwise, countries understand that there needs to be a balanced approach to ensure safety and security but, at the same time, a need to foster economic growth, because there will be a lot of economic growth potential behind the use of drones.

The upcoming EU regulation around drones, what is called the open category—pretty much for recreational use or leisure drones—is very similar to what is currently in place under the CAA regime. There are, maybe, a few differences in terms of additional elements to ensure safety

and security. One of these is with regards to registration. I understand that, for the EU framework, drones of any mass but carrying a sensor would also be required to be registered, for privacy reasons. I also understand that there will be some product standards with regards to what is called direct remote identification. That means that the drone would, at regular intervals, emit key information, such as the operator's registration number and the drone's serial number, altitude and position, and some other basic information. I also understand that geo-fencing, or geo-awareness, would be another feature that would be mandatory for drones over 250 grams. At the first stage, geo-fencing or geo-awareness is the ability to send warnings to the remote pilot if the drone is coming near a restricted or no-fly zone.

Richard Parker: I would definitely echo a lot of my colleagues' comments. It is worth bearing in mind, however, that the regulations today do a lot to support the way we want to use drones today but the pace of change in drone technology is so vast and quick that already we have technology that is far more capable than the regulations will permit us to use.

There are very interesting use cases available for reducing the cost of running public services, inspections and deliveries—we have all seen the stories. But in our opinion, one thing that is critically missing right now is some oversight of what it is most important to deploy to make that happen. For example, we talk about regulating areas of high risk and about what you can and cannot do with drones, but we do not talk about the systems or processes that we need to deploy in order to embrace them in locations such as in and around airports and in urban areas, to support more interesting uses of drones as we go forward.

I think we always have to bear in mind that when we talk about deploying anything in the aviation world it is going to be here for a very long time. Our choices today will matter an awful lot in what we are able to do in the very near term, certainly from a more automated perspective and a more beyond-the-visual-line-of-sight perspective, from a drone operations use case scenario.

Q14 **Graham Stringer:** Do you think there should be more in the regulations about compulsory training for people who fly drones?

Tim Johnson: A change to the regulations, which will come into force later this year, will require anyone using a drone of more than 250 grams to register with a UK drone registration system, and as part of that, there will be an education and competency test.

Q15 **Chair:** What does that amount to?

Tim Johnson: As part of the registration scheme, users will be given access to or be required to look at some online material that sets out the rules about what types of drone activity are permitted and not permitted, and there will be a test at the end of that.

Q16 **Chair:** So is it just an online test?

Tim Johnson: It will be an online test.

Q17   **Chair:** It will not be a practical test of actually using one.

Tim Johnson: No. This is aimed at making sure the widest possible range of people and those who are legally required to do so are registered and understand the basic rules. If an operator—perhaps a commercial operator—wants to undertake a much more sophisticated type of operation, they will be required to present a safety case.

Q18   **Chair:** And you are comfortable with that balance, are you?

Tim Johnson: I think, for the more complex operations, it is entirely right that a separate safety case approval is going to be required. The purpose of the drone registration scheme is to educate as many users as possible about the basics of the law and what they can—

Q19   **Chair:** And you think the balance there is right, do you?

Tim Johnson: Yes, at the moment.

Chair: Richard?

Richard Parker: I agree. I think you got to the point I was going to make, which was that today commercial operators—folks who are using the airspace for commercial gain—are heavily regulated, effectively. They must complete a lot of training, which includes a practical assessment as well, so they are among the most responsible users. We absolutely welcome the efforts from the CAA to require all drone operators to undertake a basic knowledge test.

Q20   **Martin Docherty-Hughes:** We are talking about users and getting them aware of legislation. What about producers? Could you first of all tell us who the largest producer of drones in the world is?

Richard Parker: I would imagine that, as a manufacturer of drones, it would be DJI, Yuneec—there are many.

Q21   **Martin Docherty-Hughes:** China?

Richard Parker: China, I believe, produces a lot of drones, yes.

Q22   **Martin Docherty-Hughes:** Given that two of the largest producers of drones of any type are in the People's Republic of China, are we going to engage with them to make sure that their drones and people who purchase their drones in the United Kingdom follow our regulations?

Richard Parker: I would not want to speculate about where drone manufacturers should be involved in this process. What I would remind the Committee of is that the regulations in the UK are very clear. It does not matter where you buy your drone or who makes your drone; you are still bound by those regulations.

Q23   **Martin Docherty-Hughes:** That is great, but as a member of the Defence Select Committee, I am concerned that the largest producer of drones—small, medium or large—is one of our largest economic and

political structure opponents in the world. That has not attracted any thinking in any shape or form? How we engage with users is a critical part of this and, to push the point, the producer of the drones should be involved in the education.

Richard Parker: Actually, a lot of drone manufacturers, and particularly some of the largest, will educate users on basic safety rules. The challenge for drone manufacturers is that they sell products in 180 countries. They possibly do not have the unification that they require, from a manufacturing perspective, of local regulations to be able to programme all those vehicles with the relevant training, which is why it is important for a country, essentially, to provide that training to its populace and make it readily accessible, which, again, the CAA is doing here in the UK.

Tim Johnson: Can I just add that the EU drone regulation has just been agreed and sets out very clear manufacturing standards? That will include, as Anne-Lise said, things about geo-limiting and height limiting as well. I think what we are seeing is some of the inbuilt systems in the drones containing some of that information.

Q24   **Martin Docherty-Hughes:** Finally, would you be confident, after the United Kingdom leaves the European Union, that those regulations would remain commensurate within the UK?

Tim Johnson: We are working on the basis that that drone regulation will get implemented in UK law, but clearly that regulation has been passed since the end of March, when the—

Q25   **Chair:** Has there been any comment from Government as to whether it will be?

Tim Johnson: Not yet, no. We know that a number of regulations have been passed in the EU between the end of March and today. Government will need to look in the round at those and decide how to treat them in the context of the different scenarios. But as of today, we are working on the basis that the drone regulation will start to get implemented in July of next year, so we are taking the practical steps to make sure that can be implemented.

Q26   **Stephen Metcalfe:** The registration scheme comes into operation in November, I think?

Tim Johnson: It will open on 1 October, so everyone can be registered by the end of November.

Q27   **Stephen Metcalfe:** Just so that we're all clear, who is required to register?

Tim Johnson: All operators of drones of more than 250 grams.

Q28   **Stephen Metcalfe:** What constitutes a drone? Is it any use of airspace?

Tim Johnson: As currently defined, it is an unmanned aircraft.

Q29   **Stephen Metcalfe:** So model aircraft would be included in this?

Tim Johnson: As the Government made very clear as part of their consultation, that definition does include model aircraft.

Q30 **Stephen Metcalfe:** I just wanted you to clarify that, because obviously model aircraft have operated for decades, so far as I can remember, without any need for registration. Registration for any use of an unmanned air vehicle will educate, because the online test is part of it, but do you think it will counter the misuse or unlawful use of unmanned airborne vehicles?

Tim Johnson: The purpose of the registration scheme is to educate and register those who operate lawfully. We are designing it in such a way as to make it as easy as possible for people to access and use and take the online test, but it is for those who are aware of it and choose to operate lawfully. We are planning a widespread national education campaign in the autumn of this year to make sure that those who operate are aware of the scheme and of their requirement to register.

Q31 **Stephen Metcalfe:** But I suppose, like many of these things, it is those who will use them in a sane and sensible way who will be required to register and pay a certain fee. Those who will potentially misuse or have other aims that they want to achieve through the use of drones may or may not register, but it won't stop them doing that. What else can we do to stop the misuse and unlawful use of drones?

Tim Johnson: We have a regime in place at the moment that is backed up by some enforcement measures. The Government are proposing to give the police new enforcement powers, which will help in that regard. Ultimately, it is very difficult indeed to avoid any unlawful use. With cars and drivers on the roads today, we have a registration scheme and drivers need driving licences, and the vast majority of people comply, but there is a small proportion of people who consciously choose not to.

Q32 **Stephen Metcalfe:** You said it was over 250 grams?

Tim Johnson: Correct.

Q33 **Stephen Metcalfe:** What is that weight based on? I suppose it is mass, rather than weight.

Tim Johnson: It is.

Q34 **Stephen Metcalfe:** What made you decide on the 250 grams threshold?

Tim Johnson: That is aligned with the threshold that a number of other countries' and the EU's regulations are based on. That is generally regarded as the point at which a drone is so small and light that the risks are incredibly small.

Q35 **Chair:** What percentage of drones does that capture?

Tim Johnson: At the moment—this is one of the reasons we are doing the drone registration scheme—we do not have a comprehensive analysis of who owns what drones and what weight they are.

Q36 **Chair:** Anne-Lise, do you have a view?

Anne-Lise Scaillierez: No, actually, I do not. It may be worthwhile asking a manufacturer, which may have a better understanding of the market size.

Q37 **Stephen Metcalfe:** I suppose the point I want to get to is that, if the registration scheme is designed not necessarily to tackle misuse and unlawful use but to educate the public on how to use their drones in a sensible fashion, why have a threshold at all? If we are not saying that registration reduces the risk but is really just to get in touch with the public, people can invade people's privacy as much with a smaller, sub-250 gram drone as they can with one that is over 250 grams. Presumably it presents security and privacy threats and would cause some distress if it were to stray into restricted airspace. What is the logic behind having the threshold if the registration scheme does not stop unlawful use?

Tim Johnson: The education scheme is primarily aimed at aviation safety and keeping the public and those who fly safe. Other agencies have clear rules on privacy-related issues, but at the moment the drone registration scheme is focused on that particular element. What we are focused on is getting an initial service in place by autumn this year. We expect that over the coming months and years there will be further functionality that we can add to the drone registration system to strengthen education and awareness of the rules. My colleagues might be well placed to talk about a unified traffic management system—

Stephen Metcalfe: Which I think we will come on to in a minute.

Tim Johnson: We very much see this as a foundation block for that in the long term.

Q38 **Stephen Metcalfe:** I'm not sure that I fully understand the threshold. This is an opportunity to educate people about privacy and security issues as well. That threshold does not seem to address that part of it, but we will come back to that. There is also a registration fee, which I think is £16.50 or so.

Tim Johnson: We are consulting on a proposal of £16.50.

Q39 **Stephen Metcalfe:** If you are consulting and it is to be introduced on 31 October, you haven't got long left.

Tim Johnson: The consultation has just closed and we are analysing the responses we have received. We will make a decision in July.

Q40 **Stephen Metcalfe:** And each drone, model aircraft or any other unmanned airborne vehicle has to be registered individually—is that right?

Tim Johnson: It is the person—the operator—who needs to be registered. There will be a registered operator responsible for the safe operation of the drones, and they can own a number of drones. They can oversee what we call remote pilots. For example, if you are a company you might register the chief executive as the operator and there might be two or

three people under the management of that individual who go out and do some of the work at a local level. The registration scheme applies to the operators—in that case, the chief executive—but we are requiring all operators and pilots to do the education element of the scheme.

Q41 **Stephen Metcalfe:** In the example that you gave, it would only be the one fee of £16.50.

Tim Johnson: Correct. Based on our analysis so far, we expect the majority of people who use drones to be operators and not remote pilots.

Q42 **Stephen Metcalfe:** Okay, fine. Some concern has been raised by the model aircraft clubs, but some of the more outlandish claims that you have to pay a fee for every aircraft and every user are probably not accurate?

Tim Johnson: Yes. Drone operators or unmanned vehicle operators would pay, not the remote pilots.

Q43 **Stephen Metcalfe:** Thank you. That is very helpful. Finally, some concerns have been raised about people who might choose to evade registration. Is there anything that can be done to mitigate against that if people choose not to do it?

Tim Johnson: There is an enforcement regime behind it and a fine of up to £1,000.

Chair: For using without registration?

Tim Johnson: Yes.

Q44 **Stephen Metcalfe:** But how will it be enforced? It is unlikely we will set up a team of people to go around checking people.

Tim Johnson: The enforcement is one of the responsibilities of the police. If they come across a drone user, they will be able to ask for evidence of registration. They will be able to see the registration number and check back with our system that the person flying it is the person—

Q45 **Stephen Metcalfe:** So the likelihood is that, on a random basis, no one will get checked. Where a pilot is causing a nuisance and the police become involved, there might then be a check. Realistically, although the system might say that, we are not going to set up a whole team of officers to go around checking recreational drone use. Is that the way it will have to be?

Tim Johnson: The police will have the powers and the opportunities to ask people for evidence of registration—that is part of their other suite of powers generally—but we are not planning on setting up a separate dedicated team to enforce this particular element. It is going to be part of that broader suite of enforcement powers.

Q46 **Gavin Robinson:** I have two brief questions, Tim, if you do not mind, both of which arise from an earlier exchange. I have a model aircraft group in my constituency that has operated for over 30 years right next

door to George Best Belfast City airport. Could you give some clarity as to why you think it is important that they are included, given that no issues have arisen previously for their hobby and pursuit? Secondly, is it right that it would take only the chairman of that club to register, given the analogy you gave of the chief executive doing it on behalf of a company?

Tim Johnson: First, model aircraft and drones are both unmanned and they are both aircraft because they gain flight using lift, whether that be through fixed wings or rotary wings. The Government consulted last year on the proposal to create a registration scheme and to include model aircraft. In its 7 January response, it was clear that it expected model aircraft to be part of the scheme.

Q47 **Gavin Robinson:** Yes, but the Government also stood on a manifesto that said there was no need for unnecessary regulation, so I am wondering about the necessity to include model aircraft in this registration scheme. Are you aware of previous issues, a history of incidents or difficulties surrounding model aircraft?

Tim Johnson: We know that model aircraft have been, for a long time, part of the aviation community. They regard themselves as aviators. Like anything that flies, it is not in absolute terms a risk-free activity. What we are asking people to do, and what the framework we are operating in has asked, is for modellers to register and undertake some basic tests.

Q48 **Gavin Robinson:** And they can do that on a club basis—the official of the club can do that on behalf of the entirety of the club, as you said a chief executive could register. Is that right?

Tim Johnson: Under the law, yes. They could register, but there will be some legal responsibilities that, in that instance, the club would bear, and it is a matter for them as to whether they would wish to do that. We have had a very large response, from the model community in particular, to our consultation on the drone registration scheme charging, and we are maintaining a dialogue and having a dialogue with them. We absolutely understand this is—

Q49 **Chair:** Is it the same fee irrespective of the number of drones or other aircraft that the person registered holds?

Tim Johnson: Yes. We are proposing, in the initial iteration of the drone registration scheme, a single £16 fee irrespective of the number—

Q50 **Chair:** So the club that Gavin talks about will have a single £16 fee.

Tim Johnson: Under that model, yes. One of the genuine challenges that we have in arriving at the fee is some uncertainty about the number of drones and drone operators in the UK. We have looked at a number of benchmarks internationally and have got what data we can, and we have produced an estimate of 170,000 drone operators in the UK. That is the best available information. One of the things we have asked for as part of the consultation is whether parties have information that will allow us to increase the confidence of our estimates with that. Unlike other countries,

the Civil Aviation Authority is funded by those it regulates, so we are having to establish this scheme on a "user pays" basis to make sure—

Q51   **Chair:** Would it be possible for 200 drone users to get together and say, "We've formed a club and we need only one registration"?

Tim Johnson: If that club was willing to take on the legal responsibilities of being the operator, yes.

Q52   **Gavin Robinson:** The second aspect of my question was about the purpose of the regulations. I think you have outlined that this is about educating lawful and safe use, but in trying to discourage dangerous use we look at a spectrum. That is about dealing with those who are stupid or reckless in their use of drones, as opposed to those who may have a sinister intent. Is it right to say that you do not believe that the regulations in any way touch on the dangerous misuse or appropriation of drones for sinister, nefarious or terrorist-related purposes?

Tim Johnson: The existing regulations make very clear what legal drone activity looks like and how to go about securing that. They are aimed at those who operate legally within the spirit and to the letter of the law. They are not aimed at—and no piece of legislation can absolutely and of itself deal with all of those issues. The registration scheme is about maximising the number of people who know that if they fly a drone, they are flying an aircraft, and that there are some responsibilities that go with that. We want all drone operators to be aware of that. That is what this scheme is focused at. Clearly, there will be another suite of opportunities that other agencies might consider to deal with some of those other elements of the drone community and those who consciously choose to act outside the law.

Q53   **Vicky Ford:** I am confused. Take the analogy that if a car is driven dangerously, you know that car is identified by its number plate, which tracks it back to the owner, tracks it back to the driver, so even if the car has had a crash and been abandoned, you find out who was driving it. If a drone is being driven dangerously and has a crash and causes an accident, how do you track that drone back to the individual?

Tim Johnson: One of the requirements of the registration scheme will be for the operator to display their registration number on the drone itself and, if they have multiple drones, to put that registration number on. It will be a relatively straightforward process to do that.

Q54   **Dr Lewis:** I appreciate that you are not counter-terrorism experts and that your main interest is in the regulation of the lawful use of these machines, but the Defence Committee's interest is in the malevolent use of drones. We live in an age where airliners have been used as guided missiles against buildings and road vehicles have been used to mow down pedestrians. Do you see any way of preventing a small and determined group of people who want to use drones to cause economic chaos or, even worse, to bring down airliners on crowded, inhabited regions? Is there anything in these regulations that will inhibit their ability to do so? If there isn't, do you have any other recommendations?

Tim Johnson: The existing regulations are very much focused on aviation safety. That is our focus and we will continue to be relentless in that. We have an interest in what other counter-measures are put in place to satisfy ourselves that any systems or processes that are put in place do not interfere with aviation systems—whether that be radar or communication systems—around airports. As you rightly said, other agencies are in the lead to think about what those counter-measures might look like.

Q55   **Dr Lewis:** Is there anything, for example, to stop people manufacturing in their garages unregistered drones that would be capable, if deliberately used for the purpose, either singly or in a swarm, of bringing down an airliner?

Tim Johnson: Ultimately, all the regulatory framework and the law and the way in which we enforce it can do is focus on those who act lawfully and, where evidence of unlawful action exists or takes place, ensure that there is an enforcement regime around that that allows the authorities and the enforcement agencies to intervene.

Q56   **Dr Lewis:** I just want to press this nightmare scenario a little further. Perhaps the others would like to come in with any ideas they have. We know that cars can be used recklessly or can even be used as weapons, but when that happens, only a limited number of victims—tragic though it is—results. However, let's imagine a scenario in which a group of terrorists get together and decide that they will mount an attack to bring down low-flying aircraft, perhaps approaching or just leaving a major airport, on a residential area. We are talking about numbers that would run into possibly the thousands. If that were to happen, first, is there any sign of any system being thought of, let alone one that is already in existence, that could stop that, and secondly, if there isn't, how many airliners would have to be brought down and how many thousands of people killed before society would simply say, "Enough—we cannot put up with this", and there is going to have to be some rather draconian system to stop these devices being used as weapons, even if we would like them to be able to be used properly, for sound economic reasons?

Tim Johnson: In the medium term, our view is that integration of drones into airspace and airspace use, and to enable that to be done safely and efficiently, could be achieved through something called unified traffic management; I am sure my colleagues can add to this in a moment. Underpinning that is the principle that anything that flies should be electronically visible to other things that fly, and therefore the aircraft flying can avoid each other and use the airspace safely and expeditiously.

That will require a number of new policies and technologies to be in place. The Government, through the Department for Transport and its aviation strategy, are consulting on something called electronic conspicuity, which is the policy—if implemented—that will make sure that everything that is flying is electronically visible.

That would give a better picture of everything that is flying around and allow a much more system-wide understanding about who is flying where.

That is clearly dependent on participation in that system, and operators being aware of their responsibilities and actively participating in the system, to make sure they are visible and following the rules.

Q57 **Chair:** Are you basically saying that dealing with a terrorist threat, or a threat for other purposes, of the sort that Julian describes is the responsibility of the police and not of the Civil Aviation Authority?

Tim Johnson: Our focus is on aviation safety; lead on counter-terrorism sits with other agencies. Clearly, on issues like this, the agencies work closely together on such issues, and I have talked before about what our interest in those systems would be from an aviation perspective, but other agencies are in the lead.

Richard Parker: It is definitely worth calling out that these types of topics naturally cross-cut a lot of different concerns. The goal of a registration system, for example, is not to prevent a terrorist attack. However, it can be a very useful tool for airport security operators; from being able to access that information, they can work out which drones, of those that are in the vicinity of the airport, are legitimate and which are not.

Today, to my knowledge, although a number of sensors are gradually coming on to the market that can answer different parts of the detection scenario, they all suffer from a similar problem, namely that they still cannot tell you which ones should be there and which ones should not.

If we cast our mind's eye forward just a few years, to when there are more commercial-use drones permitted—for example, you are authorised to use a drone today in and around an airport, provided that you have permission from the airport—it becomes more important than ever to make sure that digital tools are available for all of the different services involved in protecting us, to access that information about the identity of that operator.

At the moment, the way the registration system is designed, you can only really understand who is at fault once you have recovered the drone. In the most tragic scenarios that would mean once the terrorist has detonated the vehicle, for example, but I hasten to add that I am not aware of any regulations for any technology today that prevent that kind of misuse.

Of course, we talk about registering cars and types of firearms, for example, but those most intent on doing the most damage will ignore those regulations.

Q58 **Dr Lewis:** Are we looking to a time where any drone that flies will have to have a transponder showing its identification? Is it not the case that if a swarm of drones below that 250 gram weight limit was used to attack a low-flying airliner, that would still be just as effective in causing that airliner to come down?

Richard Parker: From a technology perspective, I think what you are saying has some merit. I also think that there are lots of other flying things that weigh less than 250 grams that swarm together that could bring down a plane. That said, there is a very small weight limit on those vehicles, which means that they cannot possess a lot of the sensor equipment necessary under today's technology to be able to perform that kind of function. Yes, it is feasible to look at orchestrating that from the ground, potentially using some other intelligence, but, again, it becomes very difficult from a technical perspective to prevent that type of work or to build a system capable of that kind of targeting. That is a military kind of technology—not something that is available easily in the civilian market.

Chair: We are running behind time. We need to be quite tight. Over to you, John.

Q59 **John Spellar:** Very briefly, of course it is very useful to have the registration system to clarify the landscape and then to have enforcement against those who are just gratuitously breaking it, but do we not then need a much more joined-up approach to act in real time to kinetically or electronically take down those where we are uncertain about their provenance, but when they could be a terrorist attack? Is that happening? Are discussions taking place as to how that could happen?

Tim Johnson: There is a genuine question about what that unified traffic management system looks like, both from a technical perspective and in terms of the economic and financing model that sits behind that. I think at the moment, airport operators, airlines and the relevant agencies work closely together within the existing framework, but—

Q60 **John Spellar:** In real time? They may work together, but are they working together in real time?

Tim Johnson: That is where we will ultimately get to. At a local level, that happens in an airport or around an airport, but on the system-wide, regional and national level, we are not there yet, but that is where we are heading.

Richard Parker: If I may add to that, information sharing is the primary goal of an unmanned traffic management system. A key component of that UTM, as a manufacturer of UTMs, is having access to identity information to be able to share that with different participants involved in security, legitimate drone operations and so on. It is somewhat saddening today that the registration system will not permit any kind of connectivity into a UTM to permit the kind of real-time sharing that you are proposing. I would hasten to add that from a technology perspective, there is no reason why that could not happen sooner.

One key challenge, as a manufacturer of UTMs today, is that there apparently is not a single body responsible for overseeing the different requirements of the commercial industry, the aviation safety standards and the security services. UTM crosscuts all those concerns, and we must appoint a champion—someone in the UK who has the responsibility to determine what is required to mitigate some of the risks we are talking

about today, as well as to welcome the very legitimate uses of drones that many people seek to embrace.

Q61 **Carol Monaghan:** First, what is a typical range for a 250-gram drone?

Richard Parker: I am happy to offer my expertise here, but I hasten to add that I am not a manufacturer. I would suggest the range would be not very far. It is probably extremely affected by the weather. It depends on the type of weather, the temperature and the wind speed.

Q62 **Carol Monaghan:** With not very far, are we talking 5 metres or 50 metres?

Richard Parker: I would suggest it is no more than a few hundred metres, potentially.

Q63 **Carol Monaghan:** Okay. Tim, you mentioned electronic conspicuity. If we are talking about a tiny drone of less than 250 grams, what sort of electronic signal would that be emitting? Would that still be conspicuous?

Tim Johnson: What we are seeing is that the technology of the chipset required to broadcast at least the position locally is getting smaller and smaller as technical and manufacturing advances happen. We are seeing that getting smaller and smaller. Some of the drone manufacturers, I think, are beginning to include this as part of their set. We will determine the requirements of electronic conspicuity with the Government, but if there is a requirement for them to be on very small drones for them to fly legally in the UK, the drone manufacturers will need to respond to that.

Richard Parker: If I might also add, many drones are very small, as you point out, and that limits what they can carry. However, it is not strictly necessary to have the transponder on the drone itself. Most drones are controlled today by, maybe, a mobile phone or some other controller. It is quite common for manufacturers to look at putting a kind of relay for the drone's actual location to pick up that information from the controller and relay that elsewhere. That is another common mechanism you see around the world.

Q64 **Carol Monaghan:** Somebody with malevolent intentions does not necessarily need to carry something, as has already been mentioned by Dr Lewis, it could actually be a swarm of them.

Richard Parker: I believe anything with malicious intentions probably is not going to carry any transponding technology at all.

Q65 **Carol Monaghan:** We have already heard the idea of the unmanned traffic management system mentioned a couple of times. A number of responses talked about the need for such a system. For the benefit of those who may be watching, NATS has described such a system as: "A known environment where we can see all traffic manned and unmanned, identify individual aircraft and know where each is heading, accommodate all traffic safely and efficiently". What are the potential benefits and drawbacks of such a system?

Richard Parker: I am happy to jump in. I will speak first to the benefits. You would not have to spend very long googling for the potential use cases to various different industries and public services for the advantageous use of drones. It is quite common to see drones being deployed for safety of life type of scenarios. The challenge today is that it is not possible to use drones in all the ways that people wish to because there is no unifying traffic management system.

Broadly speaking, the regulations require all of us, however we operate a drone, to keep that drone in our line of sight. A UTM is a potential foundation requirement for helping to remove that for legitimate authorised use of drones. If we wish to see those benefits, we require some understanding, some technology, which can bridge the gap between the heavily regulated, heavily human dependent field of air traffic control today.

We trust air traffic controllers with our safety every time we fly. It seems logical, given that we have one sky and we need to share it with unmanned traffic, that we need systems that can also bridge the gap, so that the folks who are looking after the manned aircraft can also see the unmanned aircraft.

Q66 **Carol Monaghan:** Do you see that applying particularly around airports and other sensitive establishments or do you see it being pretty much all airspace?

Richard Parker: In my experience, people can jump to their 50 or 100-year scenario and we can imagine millions of autonomous vehicles—whatever picture of the future you hold, you could be absolutely correct. However, it is important to remember that in order to make the first steps in this scenario, we already have great regulations for effectively carving up higher risks within the air space today.

To your point on airports, I think airports make logical choices given that they cover quite large urban areas in many respects. The restriction zones extend for many nautical miles around the airfields. It makes sense that if you are looking to be deploy a UTM, you would look first to do it in those areas that are controlled. There is no requirement from a technical perspective, at least, to wait until we have some as yet uninvented technology to suddenly see all aircraft in the sky, including those which are perhaps even less than 250 grams.

Anne-Lise Scaillierez: If I may add, on the question of the 250-gram threshold, historically that threshold was established in the USA when they set up the registration scheme based on security studies. It was a threshold that was assessed as the harmless threshold, so you cannot hurt anybody with that kind of drone. The EU regulation also has a paragraph on that threshold. It states that it is based on security studies about harmlessness. When it comes to the idea of a swarm of drones, I have to say that currently, on the commercial market, there is no such thing, and the focus is really about data capture. That is really where the focus is, and I am not aware of significant swarming technologies in the commercial

market other than for shows, just like the—I think it was Intel that produced a show at the Olympics opening. Beyond that, I am not aware of existing solutions available on the market, so clearly it is not a technology that would be available for a random person in their garage. I think it is more a military-grade technology, at least for now.

When it comes to UTMs—the benefits—we certainly agree that UTM has a lot of benefits and merits, especially when it comes to facilitating operations around dense areas of traffic, such as airports. The downside of UTM—I'm not sure, really. Maybe it would be about the cost, and who is bearing the cost of the UTM.

Tim Johnson: I am conscious of time, but just to really briefly add to that, colleagues have talked about the benefits. Some of the questions for us are around the operating model, the services model and the financing. At the moment, the UK's air traffic control system is largely funded by commercial aircraft, operators who pay fees, and the military pay elements. I think if we are to see new classes of airspace user making use of services or infrastructure, the question is, "Who is going to pay for that, and what is the mechanism that sits as part of that?" Through the Department for Transport's aviation strategy and the work we are doing, we are beginning to think about what that might look like.

Q67 **Carol Monaghan:** I was about to come on and ask how the Government might support. You, Richard, have talked about a champion in this area, and you are talking about Government funding in this area, so that message has been received. Thank you.

Finally, can I ask about the technological advancements that will be required to enable the creation of such a system? Richard, maybe it is best directed to you.

Richard Parker: I would like to set the field initially, and just say I think we have all of the technology that we need today to be able to welcome drones in controlled airspace in many locations; however, to caveat that with not beyond visual line of sight, and that is one of the reasons—

Carol Monaghan: Not—sorry?

Richard Parker: Not beyond visual line of sight today. To do that, we must establish first a registration and identity system. We must have some mechanism of electronic conspicuity, and that has to go beyond just drones; that has to include all aircraft, all users of the airspace. Otherwise, the function of a UTM is severely impaired, because it cannot "see" everything in the airspace.

To Mr Johnson's point, we have questions around who is going to be responsible for those systems, how that information is going to flow into them, and what the regulation is for those types of systems. To my knowledge, no such regulation exists today, but we are already seeing great steps being taken around the world. The UK is pretty high up there, in terms of pushing the boats and really wanting to try new things. Today, we are seeing national air traffic services deploy technology to six airports,

including London's Heathrow, which enables legitimate drone operators to request permission to fly and receive that permission digitally. It is a great first step; we must roll this out ubiquitously so that other people can share in the exchange of that information.

Coming back to the technologies here to manage that flow of information, there is limited technology available today for a drone to make much of its own decisions, but again, this is where the role of a UTM can help by passing flight plans, approving routes ahead of time, and so on.

Tim Johnson: Can I quickly add to that? As well as our focus on aviation safety, as the CAA I think we recognise we have a role in facilitating innovation—so understanding what innovations are coming, understanding what the safety and economic implications are, and then helping companies understand what the regulation framework is, where the flexibilities are, and particularly help them with a safety case and work through that.

We have just launched an innovation hub, and we have selected six companies to work with over an initial period, including Altitude Angel, where we are really trying to identify these particular technologies or innovations and wanting to help create safe spaces to trial some of these things, partly so the industry can benefit and understand what the opportunities and the risks are and how they might be managed. Secondly, it is as important for us as a regulator to learn and understand from these technologies, so that we can better anticipate how the regulatory and policy frameworks might need to evolve.

Anne-Lise Scaillierez: Maybe I can add that similar experimentation—actually, operation—is happening in the USA. It is called LAANC: low-altitude authorisation notification capability. It is fundamentally about automating the application and the approval process for drones to enter into restricted areas around aerodromes. It is in partnership between the equivalent of the CAA and the industry. As far as I know, it is going out smoothly. It is applying now only to the equivalent of the commercial operators. It is being rolled out in hundreds of aerodromes in the US, I understand.

Q68   **Chair:** But only in the US?

Anne-Lise Scaillierez: In the USA, yes.

Richard Parker: It is worth adding that NATS are evaluating today the trial of similar technology here in the UK. The technology I referred to is called airspace user portal, and it is publicly accessible today in those six evaluation airports. I believe there is a plan to roll that out. It is broadly very similar to the LAANC system in the US.

Q69   **Carol Monaghan:** Where are these airports?

Richard Parker: Heathrow airport and a few others. I would have to get back to you and submit the full list.

Q70   **Chair:** Can you provide us with more information?

Richard Parker: Yes, I can, absolutely. I will follow up directly after.

Chair: Thank you very much. A very quick question from Martin and a quick answer, please, before we go on to Bill.

Q71   **Martin Docherty-Hughes:** On the future technology side, I am looking for some reassurance. I am sure you probably think that AI has something to do with any kind of unmanned vehicle and its ability to have what some people would say is non-human engagement, but AI is only what it says on the tin—artificial—it is not real. I am looking for some clarity. Would you accept that, if there is to be any type of AI equipment in the sky, it really should have and require human engagement and ownership of that process?

Richard Parker: If I may, I will start the conversation on that.

Q72   **Chair:** More of a quick answer than a conversation.

Richard Parker: Understood

Q73   **Martin Docherty-Hughes:** Is there acceptance that it is only artificial and not real, and requires a human being to be in overall control of it?

Richard Parker: The role of artificial intelligence in a UTM system is extremely limited, if it is there at all. When it comes to equipment on board the drone, I will leave that to the drone manufacturers to decide what they feel is appropriate on their machines.

Q74   **Chair:** Was someone pining to come in?

Anne-Lise Scaillierez: I would just complement that, when it comes to the use of artificial intelligence for the safety and airworthiness aspect of the drone, we cannot prove what is happening behind AI. Therefore, when it comes to developing modules such as autopilot or the brain, if you want, of the drone, it is highly unlikely that AI is used today, because you cannot prove it is safe if you don't know how it works.

Q75   **Bill Grant:** If I could follow on from Carol and question of the unmanned traffic management systems, and what they term the beyond visual line of sight aspect of drones. You will be aware that NATS created—other stakeholders were involved—Operation Zenith, based at Manchester airport. What lessons can be learned from that particular operation, namely Operation Zenith, for the creation of a national, or indeed international, unmanned traffic management system, which I suspect would have to be integrated to existing airspace management?

Tim Johnson: Richard, do you want to answer? You were very directly involved with the trial.

Richard Parker: Again trying to keep the answers brief, if the Committee wish to have a look at the information that was learned, there is a website you can go to—operationzenith.com—which highlights some of the key facets.

We learned that much of the technology required to support incredibly complex drone operations, even in heightened security environments, such as a busy international airport, exists today. We also learned that there is no magic or silver bullet solution for detecting rogue drones, but there are some very good and capable systems.

We also learned, particularly when it comes to securing facilities such as an airport, a perfect solution does not exist but there are probably a number of sensors that must come together unified by a UTM system.

A very interesting aspect was that we also learned that, in the removal of humans from the loop, an inordinate amount of humans is required to do that safely. I would commend Operation Zenith again for the fact that there were about 170 different individuals from 25 organisations that came together to prove that, even with today's regulations, you can do some incredible work with drones safely, in and around an airfield, which also involves manned aviation.

Tim Johnson: I support that. I think the way forward is to identify these opportunities to trial and test, and understand some of the interactions, what the safety case looks like, who needs to co-operate. From our perspective, Operation Zenith was a really good piece of work. Richard has talked about the lessons learned; I think that, over time, there will need to be more such trials to test the different elements of UTM. Your point that we should think about the roll-out plan, both on a systemised basis locally, then regionally and nationally, will be inevitable.

Q76   **Bill Grant:** Still on the beyond visual line of sight operations, can you give us some reasons why you believe they are essential for traffic management systems, and can such a traffic management system be integrated into the existing ones? You touched on contacting controllers. Who would fund that additional pressure on the management of airspace?

Tim Johnson: UTM poses some quite fundamental questions around the infrastructure required to support it and the role of manned and unmanned aviation and how they work together. I have no doubt that some of the existing air traffic management systems would need to be updated and capable of integrating a broader suite of sensor information and technology. The key question then is who has ultimate control of the system when you have a mixture of manned and unmanned aircraft. Those are really important questions: we haven't got answers to them today, but we absolutely know that those are the fundamental issues. We will get to understanding what the issues are through the trials in Operation Zenith and some of the things that we will be doing through our innovation sandbox to test them.

Richard Parker: It is important to remember that UTM is predominantly software; therefore the costs of running the software do not vary considerably, based on the number of facilities or the type of traffic that you wish to handle. A significant goal of UTM is to integrate into existing air traffic management networks, or ATM. If a UTM operates as a silo, we will have a huge challenge. That was a significant takeaway from

Operation Zenith, where all of this was integrated into the tower at Manchester ATC, at no cost other than the time cost to Manchester airport.

Q77 **Bill Grant:** You are suggesting two things here—an integration system, and you hinted at a silo system for UTM.

Richard Parker: Actually no—it is quite the opposite. UTM shouldn't be a silo.

Q78 **Bill Grant:** Right; thank you. Still on the beyond visual line of sight operations, and notwithstanding parcel deliveries and so on, what opportunities lie in the field of movement of drones—not necessarily near to airfields or airports, but in wider urban or rural areas? Where do you see this going—beyond visual line of sight capability?

Tim Johnson: Currently, we have about 5,000 entities which have permission from us to operate commercially. They are a big range. Some of them include blue light services—the police and the fire brigade being able to use drones. We have seen surveying companies looking at assessing agricultural land, surveying power lines, tops of buildings, insides of chimneys. There is both the volume of information that these operators are saying that they can get from drones, compared with conventional means of surveying, and also, as part of their argument, the positive safety aspect: they are saying that rather than putting a person up to a power line, inside a chimney or on top of a building, they can send a drone. The volume and quality of information will be larger and, from a health and safety perspective, they don't need to put somebody in quite the position of risk that they did before. In terms of user capability, we are seeing a really big range of operators come forward.

Anne-Lise Scaillierez: Perhaps I can complement that, from the commercial operator side. Clearly the ability to fly beyond visual line of sight would be key to unlocking the potential for economic growth, because when you think about it, VLOS is quite restrictive. It is a few hundred metres, whereas there are many operations where it would be beneficial to go beyond that direct visual link with your drone.

You mentioned emergency services or search and rescue. When you go out and try to find a missing person, clearly it would be beneficial to be in a position to go beyond a few hundred metres. That is also true for commercial applications such as infrastructure monitoring, through to the inspection of pipelines or, as is happening today, the inspection of offshore oil and gas facilities. Clearly, enabling BVLOS would have a very key positive impact on—

Q79 **Chair:** What about final mile deliveries? Is that envisaged and, if so, what is the timescale?

Anne-Lise Scaillierez: Yes, there are a lot of headlines with regard to Amazon last mile package delivery, as well as flying taxis. As it happens, on a day-to-day basis this is not the real life of commercial operators today. It is very much about eye in the sky, VLOS and data capture. It is true that there will be a further pass with regard to transporting, so the

drone would not only carry sensors to bring data but could carry small payloads, or very large payloads such as people. Right now, a few solutions exist that are purely prototype. Certainly nothing is available on a very wide basis.

Q80   **Chair:** Is it a question of time? Is it when rather than if? Is it still quite uncertain whether this will happen?

Anne-Lise Scaillierez: I think it will happen, but there are several hurdles. The first would be societal acceptance of drones being used for that purpose, because some studies have shown that the public perfectly understand the use of drones for emergency services, data capture and so on, but there may be some concerns about using drones for last mile delivery or flying taxis. In terms of technology, I am not an expert but I would say that there would be some need of further assurances, if you change the scenarios where the drones can fly, in terms of product airworthiness. I think it will happen, but probably not in the immediate future.

Q81   **Bill Grant:** Do you all believe that you need a management system for that traffic, for the UTMs? Is it essential that you have a system that records and knows where these miniature aircraft or drones are to protect the registered flying public who are flying in airlines, or is there no risk between the two?

Richard Parker: We believe that it is an essential part of infrastructure requirement for a country to establish a centralised repository of what is moving through the sky and where it is planning to go, but we would caveat that we do not think it is at all necessary to have just one system that prohibits other folks like Amazon and Uber from being able to develop services and from being able to access that system. While there might be one central co-ordinating repository, it is worth mentioning that a UTM as we have the opportunity to deploy it here in the UK has the potential to create a flourishing ecosystem for many different companies, and all sorts of commercial and public services use.

Q82   **Bill Grant:** And the management system part of that would protect the existing and future flying public?

Richard Parker: Absolutely, its goal has to be safety.

Q83   **Vicky Ford:** I wondered whether you wanted to comment on Rwanda using drones to deliver blood transfusions to remote, inaccessible areas. I understand that a third of the blood is now delivered by drone.

Anne-Lise Scaillierez: I absolutely want to comment, because I am working on medical drone delivery. It is clearly one of the most shining examples of a positive use of drones, including for transport purposes. It is an American company, Zipline, that is behind the scenes in Rwanda and in Ghana, I think. To a certain extent, I very much look forward to a UK-based solution emerging with similar technological expertise and positive impact.

Q84   **Martin Docherty-Hughes:** I was wondering how the new regulation will

help small and medium-sized providers of services to get into the economic framework that we are all talking about, which the system will help us with. All I have heard so far is a lot about Amazon and other large conglomerates cornering the market in either data capture or selling their services. Where does this fit in with small and medium-sized businesses across the whole of the UK and Northern Ireland that want to get into the market? How effective is it to enable them to grow, and how effective is it for young entrepreneurs and business people who want to engage in this market when it is already crowded by people like Amazon who, these days, basically tell them how to do things?

Tim Johnson: In our role of facilitating innovation, we have set up a framework that, first, allows anyone to approach us and say, "Look we are thinking of doing this, can you point us in the right direction? Can you give us some early advice?" We try to make that as open and transparent as possible. Secondly, where we are doing trials—for example the six companies that are in the sandbox at the moment—one of the fundamental principles is that we take the learnings from them, not the commercial intellectual property rights that sit with the companies. We take the regulatory and system learnings from the trials and we make them transparent.

Q85 **Martin Docherty-Hughes:** Are any of these small and medium-sized companies, or are they all large companies?

Tim Johnson: It is a mixture of companies. Amazon is one actor, and others include Altitude Angel and the national science and technology organisation NESTA. We have a range of organisations. One of the principles is to take the learnings and make them public and transparent so that everyone in the SME sector can understand how the regulations work, what the boundaries are, and ensure that these learnings are accessible.

Chair: Do you have anything to add to that, Richard?

Richard Parker: Just that a UTM is a critical component in levelling the playing field for everybody. It provides the same access to the sky, whether you are Amazon or anyone else.

Q86 **Martin Docherty-Hughes:** Yes, but Amazon is going to make a fortune out of this. What are companies like Amazon going to put into the system?

Richard Parker: There are many different use cases for drones. Amazon and its drone deliveries is but one.

Q87 **Martin Docherty-Hughes:** So they won't be putting anything into it. My worry is that Amazon is going to get a lot of work done for it and yet is paying nothing into the system.

Richard Parker: There is a long-standing precedent that if you are going to use airspace for commercial gain, then you pay for access to that airspace. I do not see the need to vary that beyond that paradigm. Those

that place the greatest burden on the system itself are those that pay the most. That welcomes everybody into the system

Chair: Thank you all very much indeed—interesting stuff. We appreciate your time.

Examination of witnesses

Witnesses: Professor James P. Scanlan, Brendan Schulman and Sir Brian Burridge.

Q88   **Chair:** Welcome and thank you for coming. Please declare any interests and the nature of those interests as you introduce yourselves.

Professor Scanlan: I am Professor James Scanlan at the University of Southampton. For many years I worked in the aircraft industry for Airbus, Rolls-Royce and British Aerospace. At the university we build a large number of drones, from small to very large. Last week we flew a very large drone.

Q89   **Chair:** What sort of size was the drone?

Professor Scanlan: The large drone has a maximum take-off weight of 350 kilos. We flew it last week. It is designed for delivering humanitarian aid, carrying large quantities of aid to places like South Sudan. I have a private pilot's licence and I routinely fly around Hampshire so have a big interest in providing safe and fair access to airspace.

Chair: You have no interests that you wish to declare?

Professor Scanlan: No.

Brendan Schulman: I am Brendan Schulman. I am in charge of our global public policy function at DJI, the world's largest manufacturer of small drones. By some measure we have an estimated 70% market share of the kinds of drones used for personal and professional applications today. I also am in charge of many of our safety functions, including geo-fencing, remote ID and our built-in knowledge test. I have no other declarations.

Sir Brian Burridge: Good morning. I am Brian Burridge and I am the chief executive of the Royal Aeronautical Society, which is an engineering regulator and a learned society. We describe ourselves as being independent, evidence-based and authoritative.

Chair: Thank you. You have no declarations?

Sir Brian Burridge: No declarations.

Q90   **Chair:** You will have seen from the last panel that if everybody comments, we get behind. Please keep your comments succinct and do not feel you have to respond to everything. I would like you to comment on the effectiveness of the drone regulation system and how it can be

improved, or perhaps how it needs to be improved as this evolves. Who wants to start?

Sir Brian Burridge: For many of the reasons that were set out in the previous session, regulation is necessary. It needs to be proportionate and it needs to be as effective as possible. In being proportionate, an additional factor that probably was not brought out earlier is that we recognise that both model aircraft flying clubs and, indeed, people who are interested as hobbyists in drones have a significant part to play in encouraging young people into aerospace and aviation careers. Given all our combined STEM efforts—and there are a lot in aviation and aerospace—we need to be mindful that regulation does not, in some way, disproportionately blunt that.

Secondly, on the cost, we have responded to the consultation and there are a number of organisations that feel that the CAA should do the maximum to reduce the cost by applying some creativity to using the website for advertising or whatever. Thirdly, we very much applaud the ability to educate and to ensure that changes in regulation and standards are brought to the attention of as wide a community as possible. We are just puzzled why model aircraft clubs that have been running for many years are not seen as the nexus of one group of airspace users. We would want to see more recognition of that when, ultimately, the system comes in.

Brendan Schulman: If I may?

Q91 **Chair:** Yes, and please focus on what we would do to improve, if necessary, the current regulatory system.

Brendan Schulman: Sure, I'll focus right on that. We have the privilege of seeing these regulatory frameworks emerge worldwide. The UK is on the right track in terms of the most important aspect, which is to provide access to the technology. We see drone technology already saving lives, already improving the economics of doing your job, and also creating art and a lot of fun.

What is of concern now with the framework here, as alluded to in the earlier session and just now, is the proposed cost for registration. Although we believe that registration and knowledge testing, as we have set out in our recent "Elevating Safety" white paper, are core fundamental aspects of a responsible framework for regulation of all those good uses, there is a lot of risk if you do not do it right. A core aspect of registration, particularly in the taskforce that I worked on three years ago in implementing the very first model for registration around the world—the FAA registration taskforce—was to keep it free or as low-cost as possible, because we really need to encourage voluntary compliance. This is technology that is out there and widespread.

Q92 **Chair:** Do you worry that if it is put out of reach, people will just avoid it?

Brendan Schulman: Exactly. My understanding is that the proposal or suggestion is over £16. That is more than 12 times the cost of registration

in the United States. Frankly, I do not understand why it would cost so much, and I worry that everything that follows from registration—things such as remote ID and UTM—will be subject to a negative impact if that cost is too high.

Q93 **Chair:** Obviously, the technology is evolving very rapidly. Can regulation keep pace with the changes?

Sir Brian Burridge: There are signs that our regulators understand that difficulty. Reverting to my experience in uninhabited air vehicles in the early 1990s, the regulator was way behind. We have heard already this morning about both the NATS vision for the initial integration of airspace and also the CAA's innovation hub—their sandbox. They really are leading in the way that a regulator should, but none of us is under any illusion that the speed of advance of the technology is not very challenging for a regulator to get ahead of.

Brendan Schulman: I would say that regulation cannot keep ahead of technology. That is really not the story with any technology around the world. The good news, though, is that the industry itself, and in particular DJI, has stepped up to do things that we can to address the safety and security risks, including geo-fencing, altitude limits, and built-in knowledge testing of our customers before they take their first flight. We have had in the UK since 2017 a built-in knowledge test, so before you fly our drone for the first time, you will be tested on the basic rules of safe operation.

Q94 **Chair:** Presumably every drone could have that built in, but some other manufacturers do not do that. Is that right?

Brendan Schulman: I think the capable ones could, but most importantly the official test is coming. We very much support knowledge testing, again if it is accessible and reasonable. That leads to compliance with the rules, as well as the importance of conspicuity or, as we call it, remote ID, which is to allow an enforcement and accountability mechanism. These are all things that the industry is working on and has led in terms of solutions to many of the questions and concerns that you have raised this morning, even before regulation. We think that we can do it sooner, and in fact we have.

Professor Scanlan: It is very difficult to predict what the best regulations will be in the future, so my plea is to ensure that we support research and do more and more trials. My team was involved in Operation Zenith, and that was a fantastic step forward because we actually put the technology to the test. We are planning a very big trial in the Solent region for medical delivery. Zipline was talked about earlier. We are proposing a very big trial to prove the technology—to do a trial not for two or three days but for six months or more, to thoroughly understand a multiple of vehicles sharing the airspace, and the technology and tools required to make sure that that is undertaken safely. There is a third group of people here: researchers and experimentalists. It is about supporting them, and helping us to get fast response from people like the CAA, to allow us permission to, for instance, go into danger areas.

Q95   **Chair:** Do you find the CAA responsive generally, or are you implying that there is sometimes a tardiness there?

Professor Scanlan: It has been patchy, to be honest. The CAA recently led on the innovation sandbox that was mentioned earlier, which is very good now, but they are bombarded with huge numbers of applications, and they have to go through lots of complex risk analyses on a case-by-case basis.

Q96   **Chair:** Okay. I take it that there is never an issue with manufacturers having difficulty in keeping up with the regulations; it is more the other way. Is that correct?

Brendan Schulman: Most of the regulations are related to the operation of any drone, so from a manufacturer point of view we do not. Our focus is on educating the customer about what the rules of operation are so that they can use the product safely and responsibly.

Q97   **Chair:** Is there any country that leads the way in terms of the design of a regulatory system that keeps pace with technological change?

Brendan Schulman: I think that they are all coming into alignment. We see the framework being pretty well understood—visual line of sight, altitude limits, and some kind of qualification for commercial use. Those things all have variations worldwide. A few years ago, there was a question of timing: who is doing it first, and who is getting there? You could have said a few years ago that Australia was leading with the first framework, and then Part 107 in the United States came out a couple of years ago. That was the first comprehensive set of commercial rules there. I think everyone has basically caught up, now we see the Europe-wide framework emerging. I think we are all roughly in the same place.

Q98   **Martin Docherty-Hughes:** You will all appreciate that the regulation is about the operation of the drone, and not some of the other elements around the drone. I am a member of the Defence Committee—Mr Schulman, I am sure that you know where I am going to go with this, given that China is a major producer. The United States Department of Homeland Security recently accused Chinese-made drones of sending sensitive flight data back to their manufacturer. I am sure that you would maybe like to disagree with the United States Department of Homeland Security. I am not saying that I do agree with it; I am just putting it out there because it is a major concern for those of us on the Defence Committee.

Brendan Schulman: We actually agree with it. I think I know the memo you are talking about from a few weeks ago—from the Department of Homeland Security—relating not to any specific company but to drones manufactured in China as a whole. Our company is based in China. We agree with, and are aligned with, that memo, because it outlines the practices for keeping data safe and secure when the drone is used in a critical function—a sort of high security environment. We have been working hand in hand with agencies in the US Government to develop what those standards are and to ensure that we meet them. So we

actually have a solution and are totally in alignment with all the points in that DHS memo as to the considerations for using a drone in a critical environment.

Q99 **Martin Docherty-Hughes:** Is DJI bound by the Republic of China's rules on citizens' support of the national intelligence activities?

Brendan Schulman: Are we bound?

Q100 **Martin Docherty-Hughes:** By those rules in the People's Republic of China, as a Chinese company.

Brendan Schulman: As the manufacturer, we manufacture in accordance with the rules and regulations in each country in which we sell products.

Q101 **Martin Docherty-Hughes:** And those in which you manufacture them?

Brendan Schulman: The factory being in China? Yes, it complies with Chinese law.

Q102 **Martin Docherty-Hughes:** Therefore, your company is bound by those regulations supporting the national intelligence activities of the People's Republic of China.

Brendan Schulman: I would have to understand more about the nature of your question.

Q103 **Chair:** Do you understand the requirement to co-operate with security services, for example in China, as binding you to meet Chinese intelligence requirements of you to provide them with information?

Brendan Schulman: With user information?

Chair: Yes.

Brendan Schulman: We do comply with subpoenas—that is true of any tech company—if we have information. For example, we have co-operated in the investigation of a collision between a DJI drone and a helicopter in New York City. That was a co-operative investigation with the NTSB.

Q104 **Martin Docherty-Hughes:** Forgive me, but we are talking about data being transferred from use within the United States or across the European Union back to the manufacturer in the People's Republic of China, commensurate with Chinese regulations on supporting national intelligence activity. Could you advise me whether or not your company supports the People's Republic of China's regulation in terms of that piece of legislation passed by the Congress of the People's Republic?

Brendan Schulman: There are two aspects to this. There is the data that we have or don't have, and there is what we make available upon a legal Government request. In the first instance, we do not have user data unless the user syncs that data with our systems. If you go back a couple of years, we did a third-party independent security review of our technology, which confirms that our users have control over the data they generate using the drone. We have also gone further; we have implemented what we call local data mode. Effectively, you can take your

drone and, if you are operating it in a way that is private, you can turn off any transmission between the drone and the internet, including our servers. Furthermore, we have created a FlightHub Enterprise edition, which provides commercial companies with added data management tools, as well as a Government edition, again developed in collaboration with US Government agencies that have those concerns.

Q105 **Martin Docherty-Hughes:** We are not in the United States. Is it a simple yes or no? If someone turns on that data, plugs in their drone and downloads data from it, is your company able to send that information back to the manufacturer in Xinjiang?

Brendan Schulman: We are the manufacturer in Xinjiang.

Q106 **Martin Docherty-Hughes:** So that's a yes.

Brendan Schulman: To whether we are the manufacturer? We are the manufacturer.

Q107 **Martin Docherty-Hughes:** So that's a yes.

Brendan Schulman: We are the manufacturer.

Martin Docherty-Hughes: So maybe you want to say yes or no—

Chair: Martin was asking you about whether they could be required to send it to the Chinese Government.

Q108 **Martin Docherty-Hughes:** First, let's get to the point at which people are sending it, willingly or unwillingly, back to the manufacturer in Xinjiang. You have not answered the first question about DJI being commensurate, or implementing the legislation of the People's Republic of China in terms of supporting national intelligence activity, which includes handing over any type of data requested by the People's Republic of China.

Brendan Schulman: If the data requested is pursuant to a legal request—

Q109 **Martin Docherty-Hughes:** In the People's Republic of China, not within the European Union, and not within the United Kingdom or the United States.

Brendan Schulman: If the data were requested pursuant to law in any country, including China, we would provide it in accordance with law. I would need a specific example—

Q110 **Chair:** In other words, there is a potential risk to our national security if the Chinese state requests you to provide them with data from usage here.

Brendan Schulman: I would disagree, because we don't have the data that puts the security of this country at risk.

Q111 **Martin Docherty-Hughes:** How do you know that?

Brendan Schulman: Because every user of ours has control over what data they send to us. If you are operating our drone in a way that is critical—if you are not just taking a picture of your garden or backyard but are using it to collect information about a power plant or something sensitive—don't send us the data.

Q112 **Chair:** And you have no means of accessing that data?

Brendan Schulman: That is correct.

Q113 **Martin Docherty-Hughes:** So you disagree with the Immigration and Customs Enforcement agency in Los Angeles, which said that DJI was "selectively targeting government and privately owned entities within" the United States critical infrastructure and law enforcement sectors "to expand its ability to collect and exploit sensitive U.S. data"?

Brendan Schulman: We don't just disagree; we hired an independent firm to prove the negative. I would welcome your reading the Kivu report, which we released about a year and a half ago and which disproves all the allegations in that memo, which, by the way, was not an official release of ICE or the DHS. It was one or two agents in the field office in Los Angeles; it was never approved as a release of that agency. None the less, we knew we had to disprove it, and we did.

Q114 **Martin Docherty-Hughes:** I am not disagreeing or agreeing with their assumption, but let me go back to the main premise—you will forgive me, as a Defence Committee member. You are bound, as a manufacturer within the People's Republic of China, into supporting the national intelligence activities of that state.

Brendan Schulman: We respond to legal requests wherever we are required to respond.

Martin Docherty-Hughes: We will leave it there. Thank you very much.

Q115 **Gavin Robinson:** With the settings of any drone, is the default position that the data transfers until you choose to turn it off, or do you proactively have to choose to turn it on?

Brendan Schulman: No, the default is off. Again, I would welcome you to read the Kivu report; we are happy to provide a copy to all of you. There is no default on data transmission. The way our technology works is this. You fly the drone; you can take the pictures or video or do what you want with it, and if you want to back up your records for purposes of maintaining a fleet, or just as a back-up record to your activities, you may choose to do so, but you don't need to. In fact, you can turn off all the data transmission if you want additional protection. There is no default sharing of any kind.

Q116 **Chair:** But if you want to back up that data for your own purposes, does that enable you, as a company, to access it?

Brendan Schulman: That back-up of the data goes to servers within the country in which the user is located.

Q117 **Gavin Robinson:** That you control or that the individual who is backing it up controls?

Brendan Schulman: In FlightHub Enterprise edition and in Government edition, that data goes to your own server, so customers who need that added assurance can have it.

Q118 **Chair:** So if a company chooses to back up data for its own purposes, that does not allow you to access that data.

Brendan Schulman: The user has complete and total control over the data that they collect—

Q119 **Chair:** So the answer is no, you cannot access that data if they choose to back it up.

Brendan Schulman: It depends on where they back it up. I want to be precise and understand exactly what data we are talking about, what type of user and which solution of ours they are using, because there isn't just one—

Q120 **Chair:** It sounds to me as though there are circumstances in which a user backs up data that you then have access to and which you could then be required to supply to the Chinese state.

Brendan Schulman: We do provide support and technical assistance for our products, so a consumer product that is being used in a non-sensitive application would have a capability of backing up records to us if the user chooses, and that would then make those records available in various different—

Q121 **Chair:** If it was in a sensitive environment and they wanted to back up, are there any circumstances in which you could access that data?

Brendan Schulman: Well, we would not recommend a user who is operating in a sensitive facility or operation to back up data with us. In fact, we have the tools available for that user to control the data and to keep it secure, in alignment with the DHS memo that recently came out.

Q122 **Stephen Metcalfe:** I think you were all here for the earlier session. I want to go back to the role of the CAA in registering—I think the phrase was unmanned airborne vehicles. Do you think that that will do anything to tackle the potentially dangerous use of drones, or is it another layer of bureaucracy?

Sir Brian Burridge: It must at least contribute to avoiding inadvertent misuse, if you will, through an education system and, indeed, a system of air information about where you can fly and where you can't fly. That must, to a certain extent, avoid the accidental intrusions that you could get. But if someone chooses not to register—the same way as the people out there driving cars without insurance—that will be the case, and will continue to be the case until there is a very effective criminal system by which to bring sanction.

Professor Scanlan: I would say that recently, the CAA has become very sophisticated in being able to facilitate and start to control who has access to the airspace, and registration is very good and very effective. Honestly, I know of unnamed universities in the past that have simply flown things— scientists who do not know anything about aviation technology who wanted to gather some data—and they are now fully aware that they are not allowed to do that. They need to go through due process; they have to write a risk analysis and register properly through the CAA, so I think it is good. I think it is working.

Q123 **Stephen Metcalfe:** So you think it will tackle the inadvertent misuse, but not the malicious misuse.

Professor Scanlan: I sat through the previous session. Terrorists and criminals will not follow regulations, and there is a lot of technology they could assemble and put together and do very annoying, very dangerous, very economically damaging things with.

Q124 **Stephen Metcalfe:** I also asked, if the registration scheme is about educating people and getting them to comply and understand the impact the use has, whether or not the 250 gram threshold is a sensible line to be drawn. Actually, some of the issues apply both sides of that mass.

Professor Scanlan: Well, 250 grams is the weight of a bullet, so 250 grams can do a lot of damage. You can put a lot of kinetic energy into 250 grams, but I think it is a reasonable, fairly sensible limit.

Sir Brian Burridge: It is arbitrary in a sense, but it falls in line with what most other nations are doing. In terms of the kinetic energy of something below 250 grams, obviously it is much less than something above 250 grams—not to gainsay the rules of physics.

Brendan Schulman: That 250 gram number came out of the registration taskforce that I was a member of. We only had a few days to come up with a threshold for registration, so it was a matter more of convenience than science. Actually, we subsequently did a whole white paper on why that number is extraordinarily conservative with respect to the target of that task force, which is to protect people from injury if they were to get hit and therefore allow for accountability, because the thing that hits them and hurts them would have a registration number—like a licence plate—on it.

It is important to look forward to the emerging solutions for other things, like security and safety, and their registration leads to remote identification. We take what is hopefully a simple, low-cost or even free registration requirement that really, no one should have much of a problem with—and that was the goal when we worked on it originally, four years ago—and move it to remote identification so that when a drone is still in flight and has not hurt or hit anything, you can still identify who is flying. Registration is the building block of these other solutions.

Q125 **Stephen Metcalfe:** Will these proposals affect you, as a manufacturer, in any way?

Brendan Schulman: As I said earlier, the registration cost is something of concern, because I think it will do two things. No. 1, those who want to comply with it might be discouraged from using or buying a drone; obviously, that would have an impact. No. 2, we worry about voluntary compliance. We want people to be educated and understand the rules and be compliant with them, which is why it is so important not to have excessive barriers in the way between their desire to fly and do something good with a drone, and the compliance that is required.

Q126 **Stephen Metcalfe:** Sir Brian, you mentioned model aircraft clubs in your introduction. Were you reassured at all by anything the CAA said earlier? There is some confusion about whether the individual aircraft needed to be registered, or whether a club could register as a whole.

Sir Brian Burridge: What we would like to see is club membership being an element of the registration, rather than having to register separately. We have seen model aircraft clubs over the years acting entirely responsibly, providing training, encouraging young people, and in some cases providing insurance and legal advice. We think that if anything is a benchmark of how this should all look, they are it.

Professor Scanlan: I would like to reiterate that. I am a very proud BMFA member, and I fly at Winchester Model Aeroplane Club. They have an exemplary safety record, and actually they have a very powerful interest in making sure it is safe, because they control the insurance of their members. They have an interest in making sure that the premiums are as low as possible. They are fantastically safe, and I completely concur with Brian's point that we need group registration, rather than individual registration.

Q127 **Stephen Metcalfe:** Do you think, therefore, that model aircraft should have been exempted from this, or is it now just a question of making the system work?

Professor Scanlan: Yes, model aircraft, but not model aircraft clubs like the BMFA.

Brendan Schulman: If the cost is low, it really should not matter.

Q128 **Vicky Ford:** This is about inbuilt safety. How can the effectiveness and prevalence of in-built safety features be improved, and how can manufacturers prevent such safety measures from being circumvented?

Brendan Schulman: I am happy to speak on behalf of DJI, the leading manufacturer. We have done a lot over the course of several years to build in as many safety features as we can to address what I might call the obvious concerns: flights near airports and flights at high altitude—the kinds of flying that would pose a risk to others. That started years ago with geo-fencing. Taking airports, for example, we used the GPS receiver on board the drone to automatically stop the drone from flying into locations that might be of concern. That was one of our principal safety means built into the drone.

As of about a year and a half ago, we implemented what you would call conspicuity or remote ID. Every drone is broadcasting, like a transponder in the immediate area, its make, model, heading and altitude, and it shows you where the pilot is standing. We call that solution AeroScope. We built it in years in advance of any requirement or regulation anywhere, and it is making a huge difference. We have all kinds of great stories from our security partners about AeroScope being used at stadiums, airports and VIP events, including protecting the Head of State of a European nation during a scenario. We are already doing things that have made a difference, and we are continuing to do that.

Chair: Vicky asked how you stop circumvention.

Q129 **Vicky Ford:** If you are using that geo-fence, how do you stop people hacking into it and taking it down?

Brendan Schulman: It is important to remember the different people we are trying to address here. There are the careless and clueless. Our safety features are designed to keep people out of trouble if they do not know better, if they are being clueless or if they are maybe on a dare and say, "Hey, let's take a picture of an airport." We want to get in the way of that and create an impediment to that reckless or careless use.

When it comes to criminal or intentionally malicious activity, we are in a different set of solutions. That is where remote ID comes into account. You can detect the drone and then take steps using solutions that we do not manufacture, commonly known as counter-UAS technologies, to mitigate the threat once you have identified it as a threat. To get to that point, you need registration and remote ID as the building blocks to the counter-UAS solution, which is the solution to a criminal operation. Geo-fencing, altitude limits, knowledge testing and our latest commitment to ADS-B, which is to detect ADS-B signals in surrounding traffic, are all there to enhance the safe operation of those who are responsible or do not know better.

Q130 **Vicky Ford:** Brian, I will come to you. I just want to take that line about detecting the drone. In the future, when you have stealth drones that are not using GPS, how will those be detected? Is that a risk?

Brendan Schulman: I think there is a policy question as to what drones, if any, are exempt from the future remote identification requirements. There has been some discussion about that. I think security agencies and law enforcement may want an out from conspicuity. That is not our decision; it is for all of you and the CAA to figure out what drones, whether they are small and harmless or being operated by a security or safety agency, may not need to be transmitting a remote ID.

Sir Brian Burridge: I am not aware of any commercially embedded anti-tamper systems in commercially available drones in the way that such things would be embedded in, say, defence equipment for export.

Professor Scanlan: I have a couple of points around safety. I have a particular interest in safety, particularly with large drones. Manned

aviation has a very safe record now, but it has been developed over decades. It is based on what I call the "magnificent 7" principles. A couple of those principles are reporting of incidents—so, mandatory reporting of incidents—and things like airworthiness directives and service bulletins, where manufacturers are required to promulgate faults and issues. I think that is a very important principle that we will need to adopt in the future, so that if I buy—

Q131 **Chair:** It is not there yet, but that is an innovation that ought to come. Is that right?

Professor Scanlan: I think it is a regulation that will aid safety. I can buy a manufacturer's drone, and he may well know there are some faults, but is not obliged to inform me that there are faults with that product.

Q132 **Vicky Ford:** Is it important that there are international standards on this and not just domestic standards, such that we work towards international safety standards, and not only of the equipment itself but also, as you said, of the reporting?

Professor Scanlan: I think it is mandatory that we have international standards. It will become an international business.

Q133 **Vicky Ford:** And that is being developed through what platform? At the moment, is that being developed at the European level, at the UN level—who is the leader in this area?

Professor Scanlan: There is an EASA group looking at this and making recommendations, and they have produced drafts of documents. There is international collaboration going on to do that, and it is essential.

Q134 **Vicky Ford:** And you would strongly recommend that we should continue to take part in that—?

Sir Brian Burridge: As a generality, international standards promote investment in research and technology in a particularly efficient way, compared with having to stovepipe it for different markets.

Q135 **Dr Lewis:** It is back to terrorism again, I am afraid. If there are going to be thousands of these devices in the air at once, will a time ever come when everything is so automated that individually controlled drones will have to be physically prevented from entering the airspace?

The reason I ask that question, and this will give you all a little more thinking time, is that that could conceivably be a response to the worry about terrorists using unauthorised drones, because you were all here for the earlier session—I will come to you, Brian, in my follow-up, so you have a little more thinking time in advance—when I asked how many times would airliners have to be brought down over populated areas and thousands of people be killed by terrorists or psychopaths using unauthorised drones before draconian restrictions were demanded by society?

So it seems to me that we can go either one way or the other: either we will let individuals be able to commit mass murder with these things, until

eventually the whole system has to be shut down; or we will develop some complex system that has a means of preventing unauthorised people entering the airspace. Is the latter conceivable? Is it practicable? Or otherwise, what is to prevent this from becoming our equivalent of the mass school shootings that disfigure American society?

Professor Scanlan: I listened to the previous session, and I know Altitude Angel very well; I work very closely with them. I think, first of all, that knowing what is meant to be in the sky is a massive step forward. We have been working on a radar system—a Doppler radar system—that can see our tiny drones at 10 km to 20 km. So, detection is possible and if you take the knowledge of what is meant to be there with very sophisticated detection systems, you can at least know that you have got some intruders.

It is very difficult to know what to do about those intruders, and there are all sorts of technology and ways being talked about with regard to dealing with drones, but drones are quite difficult to deal with, as you can imagine.

However, I think the technology is there to understand if you have got an intrusion, and then you can take action. For instance, you could tell aircraft to divert very quickly.

Q136 **Dr Lewis:** Sorry, with a drone—an unmanned drone—how would you do that?

Professor Scanlan: Well, if you are managing an airspace and you detect intruder drones, that is an alarm situation, in which case you would tell—

Q137 **Dr Lewis:** Okay. So you would alert the aircraft that was the target—?

Professor Scanlan: You would alert the aircraft and tell them to avoid the airspace. I think there are some mitigations that are very credible that can be put in place now.

Q138 **Dr Lewis:** I am thinking of the days when I used to do research in the National Archives in Kew. I would look up as I approached the building and you would almost feel that you could reach up and touch an incoming airliner. I remember thinking at the time, "What could somebody do to an aircraft like that with, say, a shoulder-launched missile or something of that sort?" Fortunately, we do not have shoulder-launched missiles or other devices that can reach aircraft over populated areas—or have not had such devices until now. These could constitute such devices. I accept your point that they may become detectable, but what can we do to stop psychopaths or terrorists using them in that sort of scenario?

I should just mention, because it has not been mentioned, that you had a very distinguished career in the Royal Air Force. That is why I look to you, Sir Brian, to tell me whether we have to close the whole system down, or will there be one way sometime, when it is all so automated, that anything that is individually controlled will somehow be shut out?

Sir Brian Burridge: It is conceivable in the fullness of time that you could totally automate the entire system. I will come to the challenges that that

represents, but to go back to your position in the National Archives in Kew, if there was anybody with ill intent in and around that area, it would be the subject of intelligence-led policing. That is the first point. This does not just come out of a clear blue sky.

Secondly, in decision making about those things, situational awareness is key. To give a very basic example, at Gatwick before Christmas, the ability first for the airport to determine whether there was a drone or not and secondly to be able to locate, identify its type and track it is exactly the information you must have to be a decision maker. Making the decision is not itself without risk, because aviation is a system of systems. It is all joined up. If you change one part and say, "This runway is now closed" and you have got aircraft en route, you are transferring the risk to the air traffic control system to be able to cope with the unexpected and to crews to be able to cope with the unexpected. This is not a simple, straightforward question.

Detection is key. The technology is there, by integrating a particular sort of radar that is much more precise than a standard air traffic radar with an optical sensor, so that you can cue an optical sensor on to your drone, identify it and then track it optically, along with some electronic support measures. That is the system that was deployed at Gatwick and was subsequently deployed at Heathrow after Christmas. The technology is there.

Once you have the situational awareness, then as we heard earlier, you then provide warnings to airspace users. It is about the ability and investing in being able to provide decision makers with that situational awareness, which has been the same since manned portable missiles were seen to be a threat in the UK.

In terms of the prospect of a totally automated system, one of the big challenges as we move from where we are now into either beyond visual line of sight UAVs, but more particularly into totally autonomous ones, is certification. By that, I mean certifying the software in the sort of vision you are creating of a totally automatic environment, where the software will be non-deterministic—in other words, you cannot audit a decision that the machine is taking in the sense of being able to predict it, because it creates its own route to the answer.

Certification of those sorts of systems is still an area that is not fully understood, other than to recognise that probably in that area, the only way you can certify is through extensive modelling, because you could not afford to build the number of prototypes you would need to prove it physically. So, the answer is in my view that public acceptance is one of the drivers. If there is an occasion where this goes wrong because of a drone intruding, once is the answer to your question.

Q139 **Chair:** Can I just ask Brendan something? I think DJI has intelligent flight features that allow users to track, locate and follow a person. Could these be hacked and used in a malicious way?

Brendan Schulman: Those are features that help frame the shot for cinematographers. For example, if you want to follow a bicycle in a race and keep it in the centre of the frame, that is the tracking that is going on in those intelligent flight modes. It is not the identification or following of people throughout.

Q140 **Chair:** I understand it is for a sound purpose, but could it be hacked to be used for malicious purposes?

Brendan Schulman: Those features? I cannot immediately imagine how you would do that, because you could manually follow somebody or fly in a circle—those are cinematography tools. This is off-the-shelf technology, so focusing on the real problems that can be solved is our approach to both regulation and the safety features. What are the realistic and real concerns that people have? We are not yet at a stage where the swarm is really even on the horizon. I think a witness on the last panel mentioned that that does not exist. We know things that do exist, and we have been implementing solutions to those for years, such as geo-fencing and now remote ID. Once you can identify all the compliant, co-operative drones, those that are malicious stand out. That enables a response. And let us not overlook good police work and intelligence work, which is useful at disrupting plots, regardless of technology.

Q141 **Carol Monaghan:** We have been hearing a lot this morning about electronic conspicuity and the importance of it when operating safely. How do we ensure that custom-made or homebuilt drones could be electronically conspicuous?

Professor Scanlan: I can say a little bit about that. We now equip our drones with transponders. Unfortunately we are using certified transponders at the moment, which are very expensive, quite heavy and consume quite a lot of power. There are transponders on the market that are incredibly small and lightweight, and actually cost a few hundred dollars or less—less than a hundred dollars. The technology is emerging, and it will not be long before I can buy a little unit that is 20 grams, uses very little power and is in the order of a few tens of pounds. I do not think there will be any excuse for not carrying a transponder of some description in the future.

Q142 **Carol Monaghan:** Do you think that would be somehow linked to the licensing of the person operating the drone?

Professor Scanlan: I believe so, yes.

Brendan Schulman: I agree with Professor Scanlan. The hope—I think we are going in this direction already—is to standardise the remote ID broadcast means through something like a wi-fi signal, and make that technology very affordable so that it can either be added to a home-built drone or integrated into the radio communications system. Every drone that is built at home will have a radio control mechanism, which is a receiver on board the drone that is listening to the control signal. In the near future, you could have that receiver transmit or broadcast the remote

ID signal, including the identification information. I think we are heading towards a solution for all drones that would include the home-built.

Sir Brian Burridge: The importance of that is that it is compatible with the vision that the National Air Traffic Service put out, which you read earlier—it will all integrate into the whole. In the same way as a manned aircraft is required to have certain equipment, and when you register it you have to certify that it has—that will be the same.

Q143 **Carol Monaghan:** This won't help if we are talking about those operating maliciously but, Brendan, you are saying that there could be something in the signal that is coming from the receiver itself. Do you think there is the potential that somebody building their own drone for malicious intent could somehow have to have that in it, or could they bypass it?

Brendan Schulman: The technology is readily available and has been for years. Realistically—even in the draconian situation that you outlined, Dr Lewis—you are not going to stop the availability of technology. The focus has to be on those who want to be compliant, and that is the vast majority of operators. Give them the tools to comply at minimal cost and burden and then we will have a good system to address many of the concerns that have been raised today. When it comes to malicious actors—people building their own technology—that is about good police work, detective work, intelligence, and counter-measures like that.

In the operational environment, if a drone appears that is not broadcasting remote ID and is not co-operating, it will stand out and there will be technology solutions developed by companies other than ours to detect if you are using radar or some other type of technology, and then counteract by jamming, firing a net or something else to take that rogue drone out of harm's way. Those solutions are being developed, although not by us.

Q144 **Carol Monaghan:** I believe you have developed a system, AeroScope. Are there lessons we should be learning from the applications of AeroScope?

Brendan Schulman: We used our existing technology on all our drones to develop a remote ID solution that works today. The lessons are that you can do that, using existing technology. It can be cheap and affordable. It does not cost anything; it just exists on the equipment that is already in use in the vast majority of drones out there. It is solving problems. We have seen it in use in facilities and special events around the world—they are really terrific stories—proving the utility of remote ID and that that solution will work once it is reliably deployed. As an industry, we have proven that remote ID will work and can be implemented with low or free cost and minimal burdens.

Q145 **Carol Monaghan:** I understand that AeroScope was being trialled at Gatwick airport prior to the incursions in December last year. The BBC reported that the executive overseeing the airport's response to the attack stated that "whoever was responsible for the attack had 'specifically selected' the drone which could not be seen by the DJI Aeroscope drone detection system that the airport was testing at the

time."

The problem, of course, is that AeroScope is only going to detect DJI drones. How could that be adapted in order that it can detect all drones that are operating?

Brendan Schulman: On the point in our "Elevating Safety" paper three weeks ago, we really do need all manufacturers to implement remote ID and it needs to be standardised. Bringing all the other drones in over the next short while is a goal of the entire industry. Again, DJI is not waiting for regulation to catch up. We are trying to solve and have been solving problems for years. Remote ID is one of those solutions and we expect and hope that other manufacturers will join us in remote ID solutions.

Q146 **Chair:** And you agree with that?

Sir Brian Burridge: Yes.

Q147 **Chair:** So this this needs to be a requirement?

All witnesses indicated assent.

Q148 **Martin Docherty-Hughes:** On registration, in my part of the world as a Scottish constituency MP, along with my colleague to my right, who is my neighbouring constituency MP, we have a large rural element to Scotland and a lot of it attracts tourism. A lot of people will be visiting the whole of the UK in terms of tourism and bringing their drones with them.

First, how does their non-registration have an impact within the UK or EU framework? Also, the other element we have heard a lot about is malicious intent. What if the malicious intent is not the individual, but data collection? That is the critical security element for some of us in this joint Committee session. What if someone coming from abroad does not know that there is a no-fly zone across my constituency—a huge part of it and also in Sutherland and Paisley—or that there is a prohibited zone around Coulport and Faslane nuclear submarine base, or a restricted zone around Hunterston power station in North Ayrshire, about 40 minutes from my own constituency? That data is a critical threat to those locations— critically Faslane and Coulport, but also Hunterston—if another state actor accesses that information when it is downloaded on to the system. The threat is not the major malicious issue; it is about data and knowledge. Would you accept that?

Professor Scanlan: We fly DJI jet drones—

Q149 **Martin Docherty-Hughes:** It is not just DJI; they are from Amazon and everything else. I am not just having a go at DJI. There are other non-state actors, not just Communist China.

Professor Scanlan: If we take a commercial drone, modern commercial drones simply will not allow you to fly in those areas, even if you want to. They are well geo-fenced off, so all of those security concerns that you have are very well publicised. They are all no-fly zones, and some of the technology that Altitude Angel has produced provides publicly available

maps to allow you to see where you are not allowed to fly. If you buy a commercial drone, it is geo-fenced.

Q150 **Martin Docherty-Hughes:** Okay, I will give you an example. I took the opportunity to travel to North Ayrshire the other week. I took my dogs down to a place called Portencross, which is right next to Hunterston power station. Someone 100 yards from Hunterston power station—a nuclear power station—was using a large civil drone. I am either lying or the person there was not using a drone and it was a figment of my imagination. Why was someone using a drone around a nuclear power station on the west coast of Scotland? It was last Saturday afternoon.

Brendan Schulman: I don't know. Maybe that person was inspecting the power plant for the power plant. There is no such thing as a location that is totally inappropriate for drones. What we have learnt in our geo-fencing—

Q151 **Martin Docherty-Hughes:** You are completely contradicting Mr Scanlan's proposition.

Brendan Schulman: No. The power plant could easily want to use the drone to inspect and do something useful at the power plant.

Q152 **Martin Docherty-Hughes:** Let me clarify: the person was not inspecting the power plant. They were clearly over to the left, utilising it to take photography and playing with their friends.

Brendan Schulman: As of about three years ago we added nuclear power plants to our geo-fencing system. We now use Altitude Angel as our exclusive source of geo-fencing data for all of Europe. We are happy to add locations that may be highly sensitive. If that is not a power plant user and just someone having fun, but potentially causing a security alarm, we want to help that person avoid creating an incident by adding the geo-fencing. If it is not already in our system, we would be happy to work with Altitude Angel and have it added to our system. It probably already is. Why are you shaking your head?

Q153 **Martin Docherty-Hughes:** I am just concerned. I am not assuming, for instance, that it was one of your products. It could easily have been someone else's.

Brendan Schulman: We would love to have other manufacturers do geo-fencing as well.

Q154 **Martin Docherty-Hughes:** First, please do not think I assume it is a Chinese product. What I am getting at is that you have a nuclear power station on the west coast of Scotland, not very far from the United Kingdom of Great Britain and Northern Ireland's nuclear submarine fleet. I had been told that these zones are excluded for drones, and then I saw somebody using one around a nuclear power station 14 miles, if less by sea, from a nuclear submarine base.

Sir Brian Burridge: The drone owner was non-compliant, ergo they had ill intent. There is this grey area in people's minds between compliance,

illegal activity and, "I'm going to take some photographs to put on social media." This is not uncommon with proximities between aircraft and drones in regulated airspace. If that person was flying a compliant drone, the geo-fencing would have avoided the spectacle that you saw. It was clearly not compliant, but probably the operator just did not think they were doing anything wrong.

Q155 **Martin Docherty-Hughes:** Could it happen up at naval base Coulport and Faslane, the home of the United Kingdom of Great Britain and Northern Ireland's nuclear fleet?

Sir Brian Burridge: I feel sure there are other measures to deal with that.

Professor Scanlan: If the maps are not up to date, people like Altitude Angel will need to determine no-fly zones. It might in the future include— For instance, we fly off the south coast and there are noise-sensitive areas. There are bird-breeding areas and nature conservancy areas. They are now going on to our maps and we avoid them. The maps need to be up to date.

Q156 **Martin Docherty-Hughes:** What you are advising me—

Chair: Time is short.

Martin Docherty-Hughes: Last question, Chair. It is a non-active nuclear power station, but it is still a nuclear power station. You are advising me that it is not on a map, and I think it has been there since the 1960s. It is one of only a couple of nuclear power stations north of the border. I don't know about anybody else on the Committee, but I am terrified.

Professor Scanlan: I could fish out my smartphone now and check those locations for you. From a manned aviation perspective, all nuclear facilities are danger areas and you are not allowed to fly in those, so I would be very surprised if Altitude Angel hasn't highlighted all of those in the UK. I would be very happy to pull out my smartphone and check that for you.

Martin Docherty-Hughes: I can see it in front of me, but my query is that there was a drone being used a couple of hundred yards from the power station.

Chair: If you and the first panel have any further comments you want to send in, please do so. I am conscious we want to try to finish at 12, so can I bring in Julian for the last questions?

Q157 **Dr Lewis:** I have a few questions, which I will condense as much as I can, to deal with other inbuilt safety technologies. How effective are the current sense-and-avoid and return-to-home technologies? What role does drone lighting play in reducing risks and increasing safety?

Brendan Schulman: We have had return-to-home for many years. In the past couple of years we have added obstacle-sensing technology. The combination of those two is really effective. If the drone loses its radio control signal to the pilot on the ground, or if the battery is running low, the drone will wait for the signal to be reacquired. If it doesn't or battery

power is low, it will automatically return to its launch location and land itself.

There may be things in the way of that path home. That is where the obstacle sensing really makes a difference. It can move around buildings and avoid them along the way. We have seen those being especially useful at property damage and personal injury situations, where the drone might cause harm or damage.

In terms of the lighting, we have integrated 3 nautical mile visibility lights in some of our Enterprise products, in recognition of an emerging standard in the United States that requires such lighting for operations at night under waivers. That is inexpensive; it is just a bright LED.

Lighting can be very effective but, again, needs to solve a particular problem. You wouldn't want to just light up the drone in a way that is overly bright that could cause too much visibility, particularly for people on the ground who might not want to be bothered by it. It is a balance of understanding the needs and problems we can solve, and coming up with technical solutions.

Sir Brian Burridge: Just to add to that, the creation of international standards, particularly around sense and avoid, is very important, because then the research is all aimed in the same direction.

Q158 **Dr Lewis:** When it comes to beyond visual line of sight operations, do those require an enhanced sense-and-avoid technology?

Brendan Schulman: We believe so. I think there are two aspects to beyond visual line of sight operation. There is the drone itself and then there is other traffic in the area. Obviously, you don't want those two things to meet.

There was a lot of talk earlier this morning about UTM and its role in beyond visual line of sight operations. We believe that that is the way to address a managed traffic environment. We think there will also need to be solutions on board the drone that can detect and avoid other air traffic, particularly if the UTM system is not available or is having a latency or connectivity issue. There will need to be something on board the drone to detect other traffic, at least as a failsafe. In some areas that are not very dense in terms of traffic, those on board technologies might actually be enough to do the BVLOS.

Q159 **Chair:** Do you think there should be a regulatory requirement?

Brendan Schulman: For BVLOS operation? I think it is very important that solutions for beyond visual line of sight operations are not imposed on those who do not need or want to fly beyond visual line of sight.

Chair: Sure.

Q160 **Dr Lewis:** Finally, are there any other inbuilt safety technologies that you believe should be developed further, or indeed initiated? Which safety features overall, if any, do you think should become mandatory, both for

commercial and recreational drone activity?

Brendan Schulman: I have reviewed a number of technologies already and I don't want to repeat myself, in the interest of time. On the mandatory point, I think it is really important to understand that, as much as we have done as a company, we do not want to see those safety features being mandatory, because that then locks in a solution that we have today. It does not allow us to upgrade it.

Geo-fencing, for example, is something that we have upgraded twice in the past four years. We started with circles and moved most recently to runway shapes that look like bowties and are three-dimensional, because the technology could support a better geo-fencing system. We are wary of mandates that would lock in a specific technology solution. We would rather do it ourselves and upgrade it and make it the best it can be over time.

Q161 **Chair:** Any other comments from either of you?

Professor Scanlan: I would say, in terms of safety, redundancy is very important on platforms—if the main flight computer goes down, having a back-up system and back-up power on the large drones. We are addressing that already through the CAA. They asked for a safety case and you have to respond.

Chair: Good. Thank you all very much indeed. We appreciate your time.