



HOUSE OF LORDS

International Relations and Defence Committee

Corrected oral evidence: Implications of the war in Ukraine for UK defence

Wednesday 13 March 2024

11.30 am

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Members present: Lord Ashton of Hyde (The Chair); Lord Alderdice; Lord Bruce of Bennachie; Baroness Coussins; Baroness Fraser of Craigmaddie; Lord Grocott; Lord Houghton of Richmond; Lord Wood of Anfield.

Evidence Session No. 2

Heard in Public

Questions 11 – 19

Witnesses

[I](#): Dr Ulrike Franke, Senior Policy Fellow, European Council on Foreign Relations; James Black, Assistant Director, Defence and Security, RAND Europe.

Examination of witnesses

Dr Ulrike Franke and Mr James Black.

Q11 **The Chair:** Good morning. Thank you for joining us, Dr Franke and Mr Black, especially Mr Black, who had to get up very early, so we are very grateful. This session will focus on drone warfare in Ukraine, and it is the committee's second public evidence session on the inquiry into the implications of the war. The session will be streamed live on the Parliament website, and a transcript will be sent you so you that can check it.

In the interests of time, please introduce yourselves when you answer the first question, and just to make it easier we will indicate which one of you should answer first so that we do not get any complications on Zoom. Obviously, do not feel you need to answer every question. We have a lot to get through, so we will try to keep our questions brief. Can I remind members that if they have any interests pertinent to the inquiry to declare them when they first speak? In doing that, I should say that my wife is a shareholder in BAE Systems.

With all that covered, I will start. Every night on the news, we see pictures of drones in Ukraine. What role have the small reconnaissance and kamikaze drones played, and how has their use evolved?

Dr Ulrike Franke: Thank you for the invitation. I am a senior policy fellow at the European Council on Foreign Relations, now based in Paris. I have been working on the impact of new technologies in war for over a decade, looking specifically at how drones are changing or revolutionising warfare. I wrote my doctoral thesis on this quite a long time ago. For many years I argued against this narrative of drones being the revolutionary technology. There was a feeling that drones were revolutionising warfare, and I always cautioned against this and said, "It has an impact, and it's important, but let's not overhype it".

I have to say that what we are seeing in Ukraine is so fundamental and important that I am starting to change my mind on this a little. Labelling drones as revolutionary is subjective, so I am not going to stay on this but, to answer your specific question, I genuinely believe that the impact of these smaller drone systems for intelligence, surveillance, and reconnaissance (also referred to as ISR) and strikes, specifically for kamikaze strikes, cannot be overestimated, overemphasised, or exaggerated.

Drones have become ubiquitous. They are omnipresent on the battlefield, and I keep being surprised by the numbers, which are truly staggering. At this point, we are talking about hundreds of thousands of small drone systems being used, and lost, every month. Volodymyr Zelensky, the Ukrainian President, has announced that he wants to produce 1 million drones this year. The numbers are incredible, as are those of the different drone systems that are used in Ukraine. I have heard different accounts, and the exact number does not matter, but it is somewhere between 60 or 70 or possibly even 80 different systems. You may know

that European militaries in general use somewhere between five and 10 different systems. My main knowledge is of German armed forces, but I think there is a single German drone system that has more than 100 units. Again, we are talking about hundreds of thousands in Ukraine. That is the first point.

The second point, which is striking, is the continuous use of civilian drone systems in this war. There are not many military drones around, but there are many civilian ones, which partly explains why the numbers are so high. To this day, most of the small systems that are being used, the quadcopters and the FPV—the first-person view drones that are flown using goggles—are civilian and basically always Chinese-made drones. Their use has continued throughout this war, which surprised me to some extent, because I thought that after the first wave of civilian drones the military industry realm would pick up and take over, but that has not happened.

So we are still talking about a lot of civilian drone systems being used, which explains the high number being lost, because the disadvantage of civilian systems is that they are not battle-hardened or robust. Sometimes you lose them the moment you put them up in the sky, and they may not be as effective as they should be because they are not built for this purpose. I am not going to cite specific figures, but according to reports coming out of Ukraine the numbers of drones reaching their targets or successful strikes are low, unfortunately. This is something I worry about.

The kamikaze element of drone use in Ukraine is notable and relatively new. For decades, armed military drones were reusable: they fired rockets or dropped bombs and came back. In Ukraine, kamikaze drones or loitering munition—the definition, somewhere between drone and missile, is disputed—has been playing a very important role on both sides. Maybe that is something you would like to get into. These first-person view drones are predominantly kamikaze drones: they are used once, they are flown into the target, they explode, and they are destroyed. This is noteworthy and is a development that started with the war in Nagorno-Karabakh between Armenia and Azerbaijan. This was the first time kamikaze drones had a real role to play and made an impact, but today this is also extremely important in Ukraine.

I will not talk for long as we have many questions, but I have a final thought. At the moment we see an unbelievably fast cat-and-mouse game between drones and counter-drone systems in Ukraine. The development and innovation cycles are really fast, measured sometimes in days or weeks. A new system, or a new modification, appears that has the upper hand and gives one side an advantage, but then counter-drone systems immediately react to it, and often the system needs to go back to be modified or it is useless. These cycles continue, so there is an enormously fast cat-and-mouse game happening there. Of course, this is a big challenge to industry and to operators, as there is a lot of trial and

error and back and forth happening. That gives a first idea of the situation.

James Black: I agree with much of what has been said, although at the moment I am more on the evolutionary than the revolutionary side of the argument. I will come back to that in a second. First, I will focus on the tactical and then move to the more strategic impact.

These technologies need to be seen in the context of wider developments. We are seeing the rollout of a proliferation of different kinds of sensors such as radar, GMTI, acoustic, infrared, satellite imagery, et cetera, and that of digitalised command and control systems that increasingly integrate artificial intelligence in an analytical layer. We also see the fusing of lots of different forms of sensor data, so it is not just the more traditional military platforms with their sensors but the drones that we have been talking about today. Then we have civilians on the ground who are increasingly able to provide input.

There is an Uber-isation of things such as long-range fires, where you are able to integrate data about where things are in the environment at relative speed and increase the tempo of your long-range fires co-ordination. Then there is follow-up battle damage assessment using drones to see if you have hit the target, what the effect has been, whether you need to fire again, those sorts of things.

The combination of all those activities has led to several key tactical impacts. The first has been affecting the offence/defence balance. Since that first very successful counteroffensive by the Ukrainians in late 2022, it has been very hard for either side to concentrate forces in a way necessary to achieve a breakthrough, especially when going up against defence in depth with well-prepared fortifications and trenches. Going up against anti-tank weapons or artillery, or the vast number of tactical UAS that Ulrike has referred to, has made it very hard for people to move without being seen or to concentrate forces. As soon as you put too many assets in close proximity to each other, be they people or vehicles, you present a very juicy target for the enemy.

It is worth stressing that the prosecution of targets is still largely being done by traditional military means, particularly artillery. We have to recognise that you can watch YouTube videos of kamikaze drones or small quadcopters dropping grenades into Russian tanks, but that does not necessarily reflect the true impact that you can still have in the volume of fire from artillery. It does not reflect the destructiveness of anti-tank guided missiles, and certainly not the volume of fire that you could achieve by using fighter jets and bombers if either side was able to achieve air superiority. We have seen the insertion of an extra layer between the land and air domains, which is helping with ISR and strike; it augments the existing capabilities that both sides have, particularly offering new defensive options in the absence of air superiority, so it has affected that offense/defence balance.

Similarly, it has affected the cost asymmetry. If you want to shoot down a drone, there are some increasingly low-cost options, and both sides have invested heavily in electronic warfare, which I am sure we will talk about later. However, ultimately, we are talking about relatively cheap drones being shot down by much more expensive systems, so there is a cost asymmetry, which is rather unpalatable for the defender.

The other thing is the increasing lethality of the conflict, which is grinding away at both sides in terms of blood and treasure and has clearly had a big human impact. This has been significant at tactical and operational level, but we have not seen a decisive impact on strategy, where neither side has been able to achieve the upper hand. We know that these technologies are for commercial use by nature, which means that if one side comes up with an innovative way of using drones—we have seen that with the Ukrainians and FPV drones—the other side is very quickly able to emulate what they are doing and acquire and deploy similar systems using similar tactics. So they cancel each other out pretty quickly in this constant race to learn and adapt.

To come back to your point about how the role of drones has evolved over time, we can see in the narrative arc of the war that there has been a cat-and-mouse of learning and adaptation. Early on, it was very much the large, more traditional military drones, such as the Turkish-made TB2, that were impactful in the first week or two of the conflict. But as soon as Russia started deploying its electronic warfare systems and air defences, that fell away, because those systems were simply too vulnerable and would have been shot down. Over the course of the war, we have seen different types of drones—quadcopters, FPV, suicide, ISR, et cetera—come and go in prominence in the conflict. I am sure that will continue over the war. We have also seen developments outside the air domain in uncrewed systems on land and particularly at sea, which I am sure we will talk about later.

The Chair: That is very helpful, thank you. I want to follow up on the strategic level, particularly with some maritime aspects, but we will come to that later.

Q12 **Lord Wood of Anfield:** Thank you, that was fascinating. On the issue of long-range kamikaze drones, you said that they have provided new lethal options where there is no air superiority. Could you say a little more about how they are being used effectively and what we have learned from the conflict in particular?

James Black: Both sides in general have failed to achieve air superiority, which is particularly galling, I suppose, for the Russians, given the asymmetry in the size of their air forces. The Ukrainian air defence, improvised as it may be given the range of western and Soviet systems it has had to cobble together, has done remarkably well in keeping the Russian air force at bay. Russian air force's own underperformance, not least in pilot training and knowledge of doctrine, has obviously not helped them. In the absence of air superiority, both sides have been going after

high-value targets on either side: military and more political and symbolic.

For military targets such as long-range fires, HIMARS (High Mobility Artillery Rocket System), air defence, higher-value electronic warfare systems, logistic hubs, command-and-control hubs, ammunition dumps, railway sidings and bridges, drones have proven useful, but we have to emphasise that they are part of a wider toolkit of effectors. They have been particularly useful in helping to detect targets in the first place, and we have already talked about their ISR role. They have been helpful in saturation attacks: ultimately to grind away at the stockpiles of interceptors, air and missile defence systems, and then to overwhelm those and enable other attacks often involving stand-off munitions, more traditional cruise missiles or, indeed, aircraft to get through where they otherwise would not have been able to. We have seen drones used in kamikaze capacity themselves as the effector. Most have a pretty limited payload and, consequently, warhead, so they are not as effective as slamming a cruise missile into something. None the less, they can cause significant damage.

Some systems are relatively vulnerable. With radar or some electronic warfare systems, we are talking about quite complex electronics where you do not need to destroy the entire vehicle to have quite a big impact on its operation. They have been effective, but we also have to note that they have limited range. As we already said, they are vulnerable to air defences and electronic warfare. They are certainly not a magic wand that solves your problem of suppression of enemy air defence.

In terms of other targets, we have seen drones used for more political and symbolic attacks—in the case of Russia, trying to grind away at the Ukrainian will to fight by going after critical national infrastructure such as power grids but also civilian targets and sowing terror in Ukrainian cities. Clearly, that has not worked, and terror bombing in air campaigns throughout history have proved to be not terribly successful most of the time.

The Ukrainian side has launched a number of long-range strikes into Russian territory. Those have some impact in disrupting industrial production if they hit certain key facilities, but largely it has a political and symbolic impact, demonstrating to the Russian people that this is not a special military operation; this is a full-blown war that is not going terribly well. It also demonstrates to the Ukrainian people that they are able to reach out and strike in that way, which of course is good for morale and the will to fight that I have alluded to.

Q13 **Baroness Fraser of Craigmaddie:** In the maritime field, we note that Ukraine, which does not have a navy, seems to have made a significant impact on Russia's Black Sea fleet using underwater drones. Is this impact significant, and what are the strategic implications for maritime warfare? Do drones represent a new vision in maritime warfare? Strategically, we noted that recently the MoD signed an MoU with Subsea International for subsea defences. What conclusions should we draw from

Ukraine's use?

James Black: This is one of the areas where drones have been most strategically decisive. They have denied Russia a victory rather than enabling Ukraine to do enough in the maritime domain to win the war outright. They have depleted the Black Sea fleet by destroying a number of its assets. The Russians have kept much of the rest of it in ports, either out of fear for the safety of those vessels or because they need to conduct maintenance and repairs because they have had some sort of damage. That in turn has made those ports more vulnerable, as they are static. We have seen attacks against ports using both underwater uncrewed systems and air strikes using more traditional means, including UK and French-donated cruise missiles. Although there may be air defences around those facilities, they can of course be attrited or destroyed.

Strategically, that has denied Russia the opportunity to continue with its attempt to blockade Ukraine economically, particularly to restrict grain and other exports, which had a wider impact on inflation and food security or insecurity in parts of the world, particularly in the Middle East and north Africa, places that are especially dependent on Ukrainian exports of grain. Beyond that economic blockade, drones stopped the Russians acting militarily against Ukraine on its southern coast. In particular, it was not able to conduct amphibious landings, which could have threatened areas towards Odessa, and this in turn has freed the Ukrainians to station fewer troops on that front than would otherwise have been necessary, because there is less threat. This has enabled forces to be redeployed in the east of the country where they are outnumbered by the Russians in general. This more efficient use of Ukrainian ground forces, rather than having them pinned down to counter the threat of a potential amphibious assault, has proved beneficial for both defensive and offensive operations.

There has also been the broader political and symbolic nature of the victories achieved at sea. The sinking of a flagship clearly is a bad day for any country and has cut through a lot of the Russian propaganda about how well their "special military operation" was supposedly going early on in the conflict. To your broader point about where this takes us with these technologies and the utility to the UK and others, their application in maritime, which is a comparatively uncluttered and uncongested domain, has certain benefits that are slightly different than elsewhere. It is relatively easy to discriminate between a military and a non-military target at sea because there are not that many ships and boats around compared to operating in an urban environment on land. It is therefore easier to distinguish and, consequently, you can potentially use higher levels of autonomy.

There are significant cost asymmetries between an unmanned surface or underwater system and the ships they are going up against. There are also significant asymmetries in the time it takes to reconstitute and regenerate any losses at sea. You cannot just rebuild a ship quickly. That will take you 10 years, and getting the crew you need to man it is again a

really long-term investment. Russia certainly does not have the naval shipbuilding capacity, particularly in light of sanctions, that it used to, so these are not losses that they will be replacing within a generation. That has an outsized impact compared to taking out artillery on land, where it admittedly has a local tactical impact, but you can replace artillery systems in a relatively short turnaround time. So we are seeing those becoming increasingly important.

We have seen a wider emphasis on subsea critical national infrastructure, including data, submarine cables, oil and gas pipelines and stuff like that, coming out of the back of this conflict, including the Nord Stream incident and other issues that we have seen in the Nordic-Baltic region. For the first time, we saw the Joint Expeditionary Force, led by the UK, activate a response option to do joint naval patrols to protect subsea critical national infrastructure. Underwater systems provide both an offensive and defensive role as part of that threat and mitigating that threat. Certainly, this is one of the areas that has been most interesting and striking. Things would have looked very different if Russia had managed to achieve amphibious assaults in the south-west of Ukraine over the last couple of years. That would have upended the conflict, and we certainly would not have the Ukrainians in as good a position as they are today.

Dr Ulrike Franke: Everything that has been said is very interesting and correct. I will just add a few points.

First, we are seeing high numbers of drones being used, but not necessarily because they are the best system for the job. This is an important point, because the story coming out of Ukraine is how effective, important, and efficient drones are. This is true in part, but very often we also see drones, especially FPV drones, being used because other capabilities are not available. If you want to fight a tank, an anti-tank missile is better than an FPV drone, but Ukrainians do not always have these systems, so they use a drone instead. So the reason for the high numbers of drones being used is partly the fact that other military systems, most importantly ammunition, are not available.

Secondly, it is important to point out that long-range strikes are more of a Russian tactic and strategy than a Ukrainian one. Russia has been using drones and missiles to hit Ukrainians behind the front line and to terrorise the civilian population. It is clearly part of its logic to destroy the critical infrastructure, and Russia is taking this very seriously. For a while, it just kept sending troops, and Ukrainians became very good at fighting them, so it held back the troops and sent bigger waves of drones, which could not be shot down so easily. This is clearly part of its tactics.

Ukraine, however, has been doing this much less. It has been striking a few targets inside Russian territory, primarily military targets, and there have been a few strikes on Moscow. In my view, those were primarily signals being sent to the regime and to the Russian people that Russian territory is not necessarily safe, but the level of strikes has been nowhere near those conducted by Russia.

As a final point on the maritime side, it is crucial to point out that the use of naval drones is one of the big innovations coming out of this war. They have existed for a while, of course, but as far as I know they have not really been used in a military confrontation, and right now they are playing a role. This is not the most important thing militarily, but psychologically the successes that Ukrainians are having in sinking the "Ivanovets" and other Russian ships is crucial for their morale. At the same time, it sends strong signals to Russia that their systems are not safe, so there is an important psychological impact on both sides.

As for future developments, I do not think we can underestimate these maritime and naval components. They are definitely something to watch.

Q14 **Lord Grocott:** Mr Black has partly answered the question, but perhaps Dr Franke would like to add her thoughts. The basic point is that drones give you very good information about the deployment of troops, the status of land forces and so on. Do you have any observations on the lessons this provides for western land forces?

I would also like to put to you a broader question that is not specifically about drones. We were sold the idea that, as AI and technology of all sorts develops, it sanitises the battlefield, or at least makes it safer for many of the people doing the fighting, because they are fighting at a distance. It seems to me, however, that from what we now know about drones and the battlefield, such technology makes it an even more dangerous place than before. I am not suggesting that you can make the equation that advanced technology means less hand-to-hand fighting, but advanced technology does mean that you know far more accurately where your adversaries are. What thoughts, if any, do you have on that?

Dr Ulrike Franke: You are absolutely right that what we are currently seeing—or, rather, have been seeing over the last few weeks and months—is that because of drones and other sensors and capabilities to gather intelligence, the front line especially has turned into a so-called transparent battlefield. That has made it extremely difficult to do manoeuvre warfare, because it is extremely difficult to amass troops and make any surprise attacks unless you are willing to lose troops. That may be what Russia is going for.

Of course, the transparent battlefield and more information does not necessarily mean more intelligence, and it certainly does not mean lifting the fog of war. We need to be careful not to equate seeing more with knowing everything, but what lessons should we learn from this? We need to fight the symptoms of this development, or else we need to work with it, so topics such as camouflage are becoming important. Smaller, leaner, more modular troops that are able to act on their own while being part of a larger whole are also part of the answer.

However, you also need to find the cause. Here, counter-drone systems become incredibly important. Ideally, when you mount an attack or a manoeuvre, you need to be able to take the enemy drones out of the sky

or make them blind. So we should invest in counter-drone systems, but also make sure we can operate while using these counter-drone systems.

What do I mean by that? One of the big growth areas that has been shown to be very effective in the war in Ukraine is electronic countermeasures, which means interrupting and jamming links between drone operators and drones. Sometimes you need to go very wide, but that may interfere with your own signals, so you need to be able to operate without being able to communicate as you normally would, because you are trying to cut information and signals throughout the space.

A final point on this narrative of sanitising the battlefield is an interesting development. We discussed remote controlled warriors, cubicle warriors, all these things, during the war on terror when drone attacks were flown by people very far away in the US or the UK.

However, what we are seeing right now in Ukraine is a very different situation. Drone operators are in the field, and we should not forget, as I was saying, that they are using a lot of commercial and civilian systems. These systems need to be jailbroken before they can be used because they send information everywhere. They send out your GPS, who you are, where you are, where the operator is, all these things, so drone operators are extremely exposed and, of course, targeted. I am not saying that the narrative was wrong at the time, although it was sometimes overemphasised, but the idea that this was a war where people are outside the battle space, where robots are fighting the war, is just not the case, because we are talking about smaller systems that are being used on the battlefield.

Another story, of course, is the Russian use of Lancet or Shahed-136 kamikaze drones that are being sent over Ukrainian cities to terrorise the population. Here, it is the same as with missiles, the operators who sent them are far away and in safety, so that element still remains. The idea of remotely piloted drones, pixels on the screen, seems very sanitised, but largely speaking it is not the reality of what we are seeing at the moment.

Q15 **Lord Alderdice:** I remind the committee of my interest as executive chairman of the Changing Character of War Centre at Pembroke College, Oxford University, and, perhaps more particularly, as a retired psychiatrist.

Something that has interested me about what you have been describing is the psychological changes in war. First, you described a greater degree of insecurity for those who are on the battlefield because, due to the position of drones, hiding is more difficult and camouflage is more problematic. However, you also mentioned those who are operating drones from a distance. Initially, people felt that meant they were away from the war, and safe, and getting on with their lives and so on, but it does seem as though people find it extremely disturbing to be in a war and not in a war: to say goodbye to their children in the morning, go to

the office, kill a bunch of people, and return home in the afternoon. Are either of you aware of any studies, in particular anything published, on the psychological impact of drones and drone warfare?

James Black: I would caveat that in a lot of cases, as Ulrike said, the drone operators are actually in a trench somewhere very close to the front line: they are not necessarily distanced from the conflict, either physically or psychologically. Certainly, they are exposed to direct threat themselves; they are being targeted, as has been mentioned, and they are dying in large numbers as a result. But they also, of course, have a close-up view of their targets, particularly if they are an FPV drone operator where they are slamming the vehicle that they are watching through their headset into a target. In many ways, that is quite close to the experience of being a sniper and to the experience of being in ground close combat, which so many Ukrainians are at the moment.

You raise a really interesting point about the panopticon effect on the battlefield at the moment: the idea that people are being constantly watched and feel that any movement, or indeed any electronic signature that they let off by turning on their mobile phone or making a radio transmission for instance, will be detected and will soon be followed up by Russian artillery or a drone attack. That certainly has an impact, and it has an impact on how we do things like command and control.

I want to nuance and caveat the previous conversation about the transparent battlefield, which is that there are two major declarative statements that have come out of the conflict. One is that the battlefield has become transparent, and the other is that electronic warfare is everywhere and is having a huge impact. Those are mutually exclusive statements, so they cannot both be true.

What we actually have is a battlefield where space is becoming more transparent, and in other ways becoming harder to move information around in. We have lots of sensors detecting stuff, but you cannot necessarily get the data and translate it into information, or intelligence, and move that around the battle space, because as soon as you start transmitting something, that transmission will be detected and you will quickly be targeted. Thus, we are seeing forces having to be much more selective, not just about hiding in a physical sense, camouflage, but in the electronic sense that I mentioned of signature management.

They are also having to be much more mobile and very selective in what, when and to whom they transmit communication, because they know that as soon as they do they will have to move, because they will have given away their position and it will be targeted. So forces are both more dispersed, and more mobile; they are in smaller, disaggregated units. It is also potentially harder for different echelons, including senior higher up commanders and headquarters, to interact with lower levels, depending on what the electronic warfare picture looks like and depending on the amount of jamming.

So you have different windows in time, or bubbles in space, where you have more or less access to information, and more or less ability to communicate, depending on whether you have the upper hand in contesting the access to the electromagnetic spectrum. You are jamming, they are jamming, and that is inducing a situation where a lot of mental flexibility is required from Ukrainian troops in how they operate. At times, they are having to operate on their own with very little ability to reach back to high-level commanders to get information or orders. At other times, they can do that seamlessly, calling in long-range fires to support them in an instant, using AI-enabled apps and drones for ISR, and all the things we have been talking about. It is moving between those different states, between being connected and disconnected, being seen and unseen, which forces the Ukrainian troops to operate in very different ways and demands quite different skills and aptitudes from them at different times.

It is certainly a lesson in adaptation for our own forces: that we will have to require people to operate in quite a different set of command and control conditions than traditionally. We will need to emphasise things like mission command, which is the western culture of delegating down as far as you can a clear intent of what you are trying to achieve, and leaving it up to more junior individuals in the military hierarchy to think creatively about how to solve problems, because you will not always be able to talk to them, and if you do talk to them, you might give away your position and make yourself vulnerable.

That is having a psychological impact, as you have said, but it is also playing out in the doctrine, tactics, techniques, and procedures that people are having to adopt to survive.

Lord Alderdice: Thank you. Dr Franke, do you have you any comments to add?

Dr Ulrike Franke: Regarding the psychological impact on operators, there were studies on PTSD—post-traumatic stress disorder—among Reaper operators in the US. The problem, as you know better than I do, was that it was a bit difficult to prove that these issues were due to drone operating rather than other pressures. At the time, US drone operators were at work and at war 24/7. There were not enough operators, so there was no downtime, no vacations, and those things would have contributed to the psychological impact. So the studies I know of are not conclusive.

There is some work being done on the UK Reaper operators, but as far as I know, again it is not clear whether there is a specific element of drone operating that puts higher psychological pressures on operators. Anecdotal evidence certainly suggests that, and I have spoken to many drone operators before, especially those who flew or manned aircraft, who say that it can be quite taxing. But I would not be able to say that this has, in a way, been solved.

However, some countries have reacted to these concerns. Germany, for example, has a rule that drone operators, even those who pilot drones from a distance, need to be stationed near the battlefield and the troops they are safeguarding, although not, of course, in danger. The point of such deployment is that you have a link to the troops and the situation, and this is thought to help reduce any additional stress that drone operators may feel.

Q16 Lord Bruce of Bennachie: Part of my question has been answered, so I will refocus it. In a war like this, there are two things—systems or weapons—and then they respond and it all changes very quickly. First, as things evolve further, will these cheap drones have to become more sophisticated, in which case they will not be so cheap? Secondly, we have been told that if you look at the full resources of the West versus Russia, we can outplay them. However, if all these technologies are relatively cheap and technically relatively easy, how is it possible to get an advantage?

Additionally, to what extent are these really limited to the specifics of this particular conflict, or do they require us to rethink our air defence systems in light of other potential conflicts that might have been informed by this, or might not, if this is very specific?

James Black: They are both really good questions. The first question about the constant back and forth between measure and countermeasure and the pursuit of a short-term advantage is something we have seen play out throughout history. I guess what we are seeing here that is perhaps different with this technology and this conflict is the pace at which that learning and adaptation is happening and, of course, the scale and the numbers of systems that are being employed.

It is important to note that there is both a hardware and a software system to these capabilities. Although the hardware can be adapted, and we are seeing it being adapted at relative pace—enabled by things like 3D printing and additive manufacturing—it is the software, particularly where things have been changing really quickly. Where there has been a much closer relationship between MoD and industry, that has enabled almost 24/7 updates to the software to better deal with either flight, navigation and targeting, or to deal with things like electronic warfare threats. That software feedback loop is very quick and is quite unlike what we have seen with traditional hardware, where clearly it takes a lot longer to iterate a new generation of tank or fighter aircraft.

The other big difference has been, as you say, the sheer numbers, which raises questions of cost. Do we end up in a situation where these systems will have to become more sophisticated? Some trends drive you towards more sophistication and potentially therefore to more cost, but it is also worth emphasising that there are trends that drive you towards less and less cost. Ultimately, the main one is the economies of scale that we are seeing because of the huge ramp up in production. The UK and Latvia are leading a coalition of countries to support Ukraine by producing 1 million drones. That is a scale quite unlike the almost artisanal batch production

of most military equipment, and there are some real opportunities to drive efficiency and ultimately therefore to drive down cost.

On your broader question about how this impacts our approach to air and missile defences, it is clear that these systems are part of a wider toolkit. They do not replace traditional missiles or aircraft—far from it—but they enable you to saturate enemy air missile defences. This has driven a renewed interest in a couple of areas. One is counter-rocket artillery and mortar (C-RAM). The other is in integrated air and missile defence (IAMD).

The really interesting thing there is that we are seeing an exposure of the gaps that have existed in western air defences over the last 30 years. We have been fighting in places like Iraq and Afghanistan where we have had air superiority and there has been no meaningful air or missile threat. That has all changed now. What we are seeing in the Red Sea, in Israel and Gaza, and in Ukraine is the proliferation of more sophisticated but also cheaper and more plentiful air threats. That threatens to overwhelm any kind of high-end sophisticated system like a Patriot missile.

It also threatens the economic sustainability of air defences because you cannot shoot down a \$100 drone with a \$1 million missile. That will not work for very long. So that pushes us towards the need for greater geographic coverage for our air missile defences to include the UK—the UK homeland in a major conflict would be directly targeted—but it also means a broader diversity of the toolkit: we need cheaper, more cheerful options of taking down things like drones. We have seen the successful test firing of a directed energy weapon, or a high-power laser, in the last month or so by the UK. That is an example of an area where you can bring in new technologies that offer a much cheaper way of dealing with those less sophisticated threats, so you can prioritise your high-end air defence systems for dealing with the most sophisticated threats.

Dr Ulrike Franke: You raise a crucial point. I very much believe that there is a place for sophisticated—and, yes, more expensive—drone systems in our arsenals, but we need to be very careful not to look to Ukraine and say that it is all about small, cheap systems that are disposable and can be lost immediately. In fact, the war in Ukraine reminds us of the importance of quality and sophistication. There is a reason why we are talking so much about western tanks and western aeroplanes and things like that—it is because they are better. Sophistication and higher price are not something that we need to abandon. We need to think much more about modularity in these sophisticated systems—the ability to exchange, modernise, or even just change certain parts of your system as a response to a change in context or a change in enemy capability, and things like that.

This is crucial, because, as you alluded to, this war, any war, has a specific context, and it is happening on Ukrainian territory; it is a land war. There are several unique aspects to it that may not be present in any future wars. They might be, but they do not have to be. In another type of military confrontation that we may see in the South China Sea or

somewhere like that, this situation or context would be extremely different. You would not have a military confrontation over Taiwan with quadcopters. So that is another context we need to think about.

I would emphasise the importance of sophisticated systems. In a way, we need both quality and quantity, which is a question of price. I definitely would not discount a more sophisticated system and say that it is all about small and cheap, because it is not.

Q17 Lord Houghton of Richmond: My question is slightly prompted in the hope you have seen, or are aware of, the defence drone strategy that UK MoD has just published. I would love you to offer some brief critique of that. My own view, for what it is worth, is that it smacks slightly, and perhaps understandably, of being a bit of a PR exercise. There are some highly aspirational things in there, such as becoming world-class, with best ever collaboration and those sorts of things. However, it does not really get to the sort of things you have just been talking about—prioritising balance of investment across a capability block. Perhaps you could give a critique of what you have read about the strategy, and anything more you would add towards turning that into the reality of balance of investments in this whole area of drone/counter drone.

James Black: Annex A of the strategy alludes to three different tiers of drones based on cost but also on survivability. You have your disposable systems that you use once or twice and then get rid of, which as a consequence need to be cheap but available in vast numbers. You have more attritable systems where it is not the end of the world if you lose them after a few missions. Then you have the more high-end sophisticated systems that Ulrike has just been talking about where you get annoyed if you lose them because you have probably spent quite a few million on them.

It moves us towards thinking about those different tiers, and there are some broader questions about how you manage a force based much more on a high/low mix of quality and quantity, and a more disaggregated and heterogeneous force than we perhaps have been used to having.

What is important about the drone strategy is that it points to a lot of the more, frankly unsexy, reforms that need to happen. A lot of those are things like speeding up procurement cycles, changing how we do requirement setting, and changing our approach to architecture—having more emphasis on open systems architecture, which is the software and digital side that Ulrike has just been talking about, with hardware modularity, and, as a result, avoiding vendor lock-in and having a different relationship with industry. Those are things that, importantly, need not to happen in isolation. We are seeing a broader push to reform procurement and acquisition within defence in general.

The Integrated Procurement Model has just been announced by the MoD. We have had a number of initiatives around, say, AI and data and digital to drive better acquisition procurement of products and services. It may

be a heavy software component rather than hardware but, certainly, there is a lot more to be done on all those fronts.

As a critique, I would say that it is important to see the UK signalling a greater interest in uncrewed systems. It is important that they are not seen as somehow siloed from wider discussions about what the force mix should be and, consequently, about what those balanced investment decisions should be, as you alluded to. These are no different to any other capability in many respects. They need to be seen as part of a broader portfolio, and we need to make some joined-up choices about the balance between crewed and uncrewed systems, between people and machines, and how we are using different levels of autonomy and automation for different tasks based on things like our risk tolerance, as well as policy and legal and ethical concerns.

So, yes, it is an important signal, but it has to be seen in a wider context of MoD reform, and we do not want to address this technology in a silo just because there is a lot of hype and excitement surrounding it at the moment.

Dr Ulrike Franke: I would have loved for the strategy to be more concrete on many things, but I am happy to yield my time for us to move to the next question.

Q18 **Baroness Coussins:** Thank you. Actually, you have both largely answered the question I was going to ask but let me just see whether either of you have anything to add on the relationship with private sector companies.

Given the process of procurement in which you have already identified the tension between low-cost and strategic sophistication, is there anything you can add about what we have learned from the experience in Ukraine for how the UK and other NATO countries should adapt their procurement and training programmes in order to avoid the classic procurement trap of going for the lowest-cost bid? On the other hand, we need to avoid spending more for sophistication when even that is likely to be overtaken in strategic and technical capability terms within six months.

Dr Ulrike Franke: There is a lot that western and NATO forces can learn from Ukraine when it comes to working with the private sector, because a close co-operation with the private sector is something the Ukrainians have worked out quite well. I have had many conversations on this with Ukrainian decision-makers, and what really struck me is how much they very quickly embraced the private sector into the war, and how much the private sector went to the MoD and said, "We want to work with you".

Of course, this is a war situation and there are things that you do in war, can do in war, and must do in war that you would not necessarily do in a peacetime scenario. There are very fast innovation cycles where a system or a new capability is brought on to the battlefield, tested in real life if you like, and immediately sent back to the manufacturer with notes from

the soldiers of what works and what does not, and is then changed in this way.

This has worked pretty well as far as we are able to tell, but there is always a caveat. Western countries need to think about the private companies they may want to work with, or have to work with, in a conflict situation and to establish relationships today. This goes a little beyond drone warfare, but the important bit here is that in Ukraine we are seeing a lot of civilian goods and services that are not necessarily military in nature becoming relevant in a war situation. The big US tech companies, for example, are operating in the war in Ukraine.

All western countries could, and should, think about benefitting from the capabilities that we, as armed forces, as countries, may need to rely on the private sectors for, and about whether we have relationships in place with these companies to work with them in that case. States and private companies are learning something from this war in Ukraine, where civilian firms are playing an important role in the military effort, and we did not see that in previous wars in that same way. That is a challenge for states and for MoDs, but also for the companies themselves, because they will have to work much more closely and much more with the military.

Q19 Lord Alderdice: Are there any other lessons from the war in Ukraine that you would like to highlight, or recommendations that you would make to the UK or to other NATO countries that we have not covered?

James Black: There are many in relation to other aspects of the war. Specifically in relation to this technology, it is about emphasising that the pace of technological change has changed and that the origin of that technological change has changed. It is no longer being driven by government R&D or by big defence companies. It is commercialised, it is democratised, it has proliferated. The nature of the supply chains for those technologies has changed. A lot of these drones, or at least the components, are coming from China. Consequently defence, and by extension government, needs to recognise that it has different forms of leverage to shape the market and to shape innovation. It cannot be as directive.

Even if the UK spends billions on drones, ultimately it will not have that big a global impact, because this is a dual-use technology with a big commercial and civil dimension to it. That drives you towards international collaboration, so you are maximising the “bang for your buck” through economies of scale, and towards a closer relationship with industry, as we have just alluded to, and emphasises things like agile and spiral development. The new Integrated Procurement Model announced in the last couple of weeks contains a lot of things that RAND has been banging on about for decades: looking at the 60% and 80% solution, buying that and not going for the 100% gold-plated solution, spiral-developing it over time—those sorts of things.

The war teaches us about the importance of resilience, not just in the mass of our military, but in the industrial base and supply chains. We have to supply the military with what it needs and, indeed, to protect those from attack, because they are being hacked, they are being sabotaged, they are coming under attack in Ukraine from Russian strikes. That requires us to have a slightly different conversation about defence resourcing and the level of spending, and about the level of risk that we are willing to accept.

We cannot approach things like procurement with the emphasis on compliance with bureaucracy in the way you can in peacetime to maximise value for money for the taxpayer. You need to approach it with a much more risk-taking attitude. The Ukrainians can do that at the moment because it is an existential threat for them. I am sure we could do that if we were in an existential threat situation. I am sure we would be able to innovate really quickly, but I would quite like us to do it before a war rather than during a war. Changing the culture around risk and backing that up by slaying whatever sacred cows you need to slay in investment programmes, structures, processes, or cultural things is the crucial thing for me. Let us learn those lessons now rather than six months into our own war.

Dr Ulrike Franke: There are two lessons for me that are related to, but not exclusive to, the topic of drones. The first is the lesson that quantity has come back to the West in the last years and decades. Maybe it never left. It happened during the Cold War, along with some of the offset strategy—the idea of offsetting the numerical superiority of the enemy with higher quality and sophistication on our side. We should not abandon this idea, but quantity plays a role, as this war reminds us. In a way, we are unfortunately seeing that you need quality and quantity at the same time, and that, of course, is a challenge and a question of cost.

I briefly touched on the second lesson in my last answer, but it is crucial and something I have been thinking about a lot: the rising role of private and normally civilian companies in warfare. In this war in Ukraine—not just with drones but with other capabilities—we have seen private companies be the only actor able to provide capabilities that have been crucial for Ukraine’s defence efforts: cloud computing, putting data in the cloud to make it secure; cyber defences; satellite-based internet connectivity; the number of drones in this battle space; AI-enabled facial recognition—the list could go on and on.

Some of them are vital, and they all came, and come from, private civilian companies rather than states. Often, states would not be able to provide this. There are lessons that we need to learn here that have to do with the capabilities that as states we need to be able to provide, as well as how to work with these companies and say, “Okay, we can’t do everything, and it’s fine for the private sector to do some of these things”.

Importantly, there are lessons for the companies themselves, because not all companies are necessarily aware that their goods and services

might be relevant in war. This war of Russia against Ukraine is, legally speaking, a very clear-cut war. It is an illegal aggression by a nuclear power against a neighbour. There is no question about whom to side with.

However, I can imagine future military confrontations elsewhere in the world where it may be less clear to companies who to side with when there may be business interests on both sides. Companies need to think much more about how to deal with this, and maybe regulations from the state can help here. This war has revealed the role that private companies can play. Technological development—really high-end, cutting-edge technological development—is no longer happening in states or in military-funded laboratories but primarily in private companies, and that has created a change in the balance of power between the state and the private sector, which is something both sides need to grapple with. Drones, and other new technologies, really drive this point home.

The Chair: That was an enormously helpful and very interesting session. I am sorry that I kept on pressing you to be briefer. We could go on talking for another hour, but I am afraid we do not have time. Thank you for all the information you gave us.