HOUSE OF COMMONS

Defence Committee

Oral evidence: F-35 and Carrier Strike update, HC 775

Tuesday 15 September 2020

Ordered by the House of Commons to be published on 15 September 2020.

Watch the meeting

Members present: Mr Tobias Ellwood (Chair); Stuart Anderson; Sarah Atherton; Martin Docherty-Hughes; Richard Drax; Mr Kevan Jones; Mrs Emma Lewell-Buck; Gavin Robinson; John Spellar; Derek Twigg.

Also attended: Gareth Bacon and Nick Smith, on behalf of the Public Accounts Committee.

Questions 1-40

Witnesses

I: Justin Bronk, Research Fellow in Combat Airpower and Technology, Royal United Services Institute; Nick Childs, Senior Fellow for Naval Forces and Maritime Security, International Institute for Strategic Studies; and Captain Royal Navy (Rtd) Dan Stembridge, Deputy Chair, Air Power Group, Royal Aeronautical Society.

Examination of witnesses

Witnesses: Justin Bronk, Nick Childs and Captain Stembridge.

Chair: Welcome to this Defence Committee hearing. We are taking evidence on the Ministry of Defence and armed forces' progress with the F-35 and Carrier Strike programmes. I am delighted to welcome three guests today. The first is Justin Bronk, research fellow in combat air power and technology at the Royal United Services Institute. We also have Nick Childs, senior fellow for naval forces and maritime security at the International Institute for Strategic Studies. Finally, we have Captain Royal Navy (Rtd) Dan Stembridge, who is deputy chair of the Air Power Group at the Royal Aeronautical Society. Thank you very much indeed for your time this afternoon; it is very much appreciated. It is Battle of Britain Memorial Day today and I know that you are all otherwise engaged and doing other things, so we very much appreciate your taking time out to help us with our inquiry. Members of the Defence Committee are all present in this hybrid mode, and I invite Sarah Atherton to open up the questions.

Q1 **Sarah Atherton:** Hello, gentlemen, and thank you for giving us your time this afternoon. I want to start with an assessment of the delivery of the F-35 programme and the Carrier Strike capability. Putting aside the integrated review, because we are going to discuss that later, what are your main concerns about the F-35 programme? Nick, Dan and then Justin, please.

Nick Childs: In terms of the two programmes together, my main focus has been on the Carrier Strike element and the Carrier programme. In that respect, if you take things from the very beginning of the whole programme—a very long gestation period as far as the delivery of the carrier itself is concerned—it has been well on track as far as the most recent delivery requirements are concerned, and the ships themselves seem to be performing well. In terms of the overall package, clearly the carriers to some extent are ahead of other elements of the programme, including the F-35, as far as their ability to deliver capability. As far as the maritime context is concerned, that is still building up.

I think the main concern is going forward. Are there those extra enabler capabilities that need to come together in terms of the whole programme as far as Carrier Strike is concerned in order to deliver the force capability's potential that the Carrier Strike has intrinsically in it? Those enablers include things like the Crowsnest programme, the support capabilities as far as the task group is concerned, and particularly the support shipping. As for the overall potential for the future, the hope of certain additional enablers—[*Inaudible*.] complete the package as far as an overall capability is concerned regarding, for example, issues like, potentially in the future, organic refuelling capabilities and intra-theatre lift capability.

Chair: Okay, who would like to go next? Dan?

Captain Stembridge: I echo a lot of what Nick said. In my last job, before I left, I was the commander of the UK Carrier Strike air wing and spent time on board Queen Elizabeth. She is certainly a very capable ship. She is the only one, along with her sister ship, Prince of Wales, specifically to operate fifth generation aircraft. That shows throughout the entire design of the ships. So, things are progressing fairly well in that respect. I echo his points on joint enablers and the supporting elements to deliver that Carrier Strike, but it must be put into the context of whatever the threat is that you are going to operate against. When people talk about what is required for that task group to deploy it, that will certainly depend on where it is that you are sending it and what you intend to do with it.

In terms of the air system and F-35 in particular, the concerns for me would primarily be around the delivery profile and therefore the speed at which you are buying those aircraft, which affects the overall forward available fleet and also the total numbers, and I think also the attribution to task. There is still confusion, or a lack of clarity, over the distinct attribution to task. That does not necessarily mean for a particular deployment, but it means for the force generation of that platform, that air system, and also the through-life capability management of it. It is still currently attributed. The understanding is, is it attributed to Carrier Strike? Is it a Carrier Strike aircraft that can deliver to Combat Air, or is it a Combat Air platform that is also able to operate from the ship? I do not deny that you want to have that flexibility, but the lack of clarity over attribution leads to some less than good decisions being made.

The final one is about unmanned air systems. Looking to the future of it, we need to make sure that unmanned air systems that we look to bring into both Combat Air and Carrier Strike are maritime capable.

Q2 **Sarah Atherton:** Dan, you spoke about clarity. That leads nicely on to a few smaller questions. How many operational aircraft do we have at present at Marham? Do you know that?

Captain Stembridge: I don't know the exact figure, and I am not sure whether for these means we can use it specifically over those that are available. It is not where you would wish to be for the delivery of Carrier Strike, but we do have plans to buy more. For me, it is about the speed at which you buy them and then the overall fleet.

Q3 **Sarah Atherton:** Because the delivery rate is something that I am rather concerned about—48 aircraft by 2025—and I know you just touched on the delivery rate. Do you have any concerns about the delivery rate around covid or the serviceability issues?

Captain Stembridge: I haven't heard of any specific issues. It is providing a challenge to all the services, particularly when you combine that with pre-deployment quarantine requirements and post-deployment quarantine requirements. That is adding a significant strain to all the armed forces, I believe.

Q4 **Sarah Atherton:** Thank you. The same question to Justin.

Justin Bronk: In terms of where I see the programme as a whole, I think the bedding in of the F-35 in terms of generating a sustainable, maintainable capability and building knowledge of the jet, both on the RN side of the things and in the RAF—of course, it is a joint fleet—is going very well. The rate of capability increase, in terms of integrating UK-specific weapons in particular, is perhaps not what we would have liked, but block 3 software is now fully integrated and block 4 is "presumed to be funded" for integration by, I think, 2025.

The number of jets at Marham specifically is now 18.[1] There has been one more delivered this year since the figure of 17 was last made public—it is 18 now—with 17 more to be delivered between now and the end of 2022. The discussion around the delivery rate between '22 and the end of '24, which should make up to the final number of 48, is still ongoing between the UK authorities and Lockheed Martin.

I spoke to Lockheed Martin very recently about their covid production impact. They have had an impact of between 18 and 21 aircraft reduction in total production this calendar year, but they anticipate that that will be spread out in terms of not hitting any one customer by more than one or two aircraft. Given the scale at which the UK is buying at the moment and the scale of the production line, maybe one or two aircraft is the potential upper end of the impact of covid on their potential to deliver. Whether we are paying for and taking them is another question. It would be one or two at the most, and they intend to make up any losses next year, because there is considerable slack in the production line at Fort Worth. That area is probably not cause for concern, presuming that we can settle the contracts and pay up on time. Forty-eight should be perfectly deliverable by the end of 2024.

My personal concern about the F-35 programme as a whole is along similar lines to Dan, in that the F-35's capabilities are, in effect, double or triple-hatted at this point, in terms of where those mission effects are anticipated to be delivered. Obviously, it is at the centre of Carrier Strike, and that is a significant programme for UK defence as a whole. It is also the core of the RAF's ability to penetrate defended air space, in terms of air space defended by modern air defence systems. That is not just the Russian threat. Algeria, for example—hardly a near peer—operates S-400 systems, is buying Chinese HQ-9, and has a range of medium systems and very high-end Krasukha-4 electronic warfare.

In the 10 to 15 years going forward, I would suggest that penetrating airspace defended by modern threat systems will be theatre-entry standard for what we now assume are relatively semi-contested interventions overseas in north Africa and the middle east. The F-35 is the RAF's current main answer to that. If you are also relying on that for the

[1]Note by witness: I now understand that three of the Marham aircraft are currently in the US, meaning 15 airframes are in the UK at present.

core of a carrier strike that you may be looking to deploy—for example, to the far east—that is a difficult ask for a fleet of 48 to 60, which I would assess as the minimum-ish for a 12 to 24 deployable force on the carriers on a regular basis.

Of course, you also have the Army looking at how they plan to fight in a future where high-end war fighting is once again a thing. The air contribution will, by necessity, be mainly on SEAD and strategic efforts up front, and in terms of how they then target what they hope to produce in terms of long-range precision fires or Army aviation, for example, they are relying on the F-35 being there too.

There is a huge reliance being placed in all three of the armed services on what the F-35 can bring. My concern is not whether the airframe itself and the training that we have put around it for operators are sufficient to give the capability required, but that there are just far too few of them to cover all that.

Q5 **Chair:** You raised some important points, which we will explore in future questions. I just wanted to knuckle down on the numbers, if I may, before Martin comes in on the strategic purpose. There is something called force elements at readiness, which is the number of actual aircraft that you need to make sure that you have a compliment on board at any time. The numbers that are being thrown around at the moment are a target of 138, with 48 on the cards and 18 now. How many aircraft in total do you need to make sure that we can deploy, at any time, 18 aircraft on board a single carrier?

Nick Childs: The ambition in terms of the core of a carrier strike capability is a figure of 24 aircraft. That has become, in terms of being able to deliver an overall carrier strike capability, the tasking that is required to provide all the different elements of capability that you want to deploy.

That is similar, for example, to what the French navy is able to deploy with the Charles de Gaulle with its Rafale aircraft. In terms of overall capability, that is less than an American nuclear-powered carrier, but we can talk about what a UK carrier could bring to a multinational taskforce over and above just the numbers. To deliver that sort of level, a continuous carrier strike capability also includes being able to generate for the training and for all the other—

Q6 **Chair:** That is the number I am trying to explore. If you have 24 on board—this force elements at readiness—how many more do you need to train pilots and, when things go wrong, to repair them and so on? You need that back-up. There is another number, a higher number, which is normally calculated to make that. I wonder whether we have assessed what that is for F-35 on the carrier.

Nick Childs: If you are doing that for a carrier, but also in terms of being able to sustain it over a period as far as rotating carriers through to provide that continuous carrier strike capability at that level, it is a number significantly higher than 48. I have heard numbers in the region of

60 to 70 overall to provide the kind of capability that would allow you to sustain that level, but also the flexibility within that, if required, to deliver a surge capability if you wanted, in an emergency, to provide a second carrier strike capability of some description as well.

Q7 **Chair:** I want to move on, but do you want to come in quickly, Dan?

Captain Stembridge: Yes. It is in the order of 70 to 80—depending on the speed at which you buy those aeroplanes, around about 70 to 80. If you buy them too slowly, you have worn aeroplanes out by the time the later ones arrive, so you do not have the forward available fleet. What you would require to deliver that sustainably would be four squadrons of 12, which allows you that continuous very high readiness at 24, able to surge to 36. Just like an Army regiment or anything else cannot be at very high readiness forever, you need to cycle some of those through, and that is why you need four squadrons of 12 to deliver you 24 routinely on ship.

Chair: That's very, very high. Kevan Jones has just said that, as a rule of thumb almost, it is one for four as well.

Justin Bronk: May I just add that it is worth looking at the numbers that we have for definite in terms of where we have a force element of readiness, or a new term, as you say—maybe an updated one? For Typhoon, which is a more mature, well-understood platform with a much larger fleet, your ratios would be expected to be better than a smaller fleet's. With 145 Typhoon having got rid of the 15 or so older Tranche 1s—mostly twin-seaters that were not combat-capable—that gives us a force element of readiness of roughly 40 on a sustainable basis. If you wanted to throw everything and the kitchen sink in in a Russia world war 3 scenario, you might get up to about 70 or 80, and that is breaking the entire system. That is from a fleet of about 140. There are a few test and evaluation aircraft in that 145.

If you assume that that ratio goes down for a smaller fleet operating more complex aircraft, with a floating base in addition to the one main operating base, as opposed to two well-established main operating bases on land with contractor support there 24/7, I would suggest you are looking at at least 60, as Dan said, to give you an 18 to 24 surge, probably more like 12 to 18 on a sustainable basis with no other demands. So that is 60 if all you want your F-35s to do is provide you constant 12 to 18 on the carrier, and that really means 70 because through the 2030s you will have to buy additional aircraft as you lose some to attrition and worn-out airframes.

Essentially, the debate around 70, 60 or higher numbers is whether the F-35 force is exclusively for generating capability on carriers on a long-term basis, or do you want it to do other things, too? If you want it to do other things, too, you have to go significantly above 70 over the life of the programme.

Chair: Okay. These are all great questions. I am sure the integrated review is mulling over it as we speak. That segues us nicely to what we are going to use these things for. What is the strategic purpose? Martin,

do you want to take us forward?

Q8 **Martin Docherty-Hughes:** Justin's last answer was an eye-opener in terms of both numbers and the possible long-term cost. I want to ask the witnesses what should be the strategic purpose of the F-35 Carrier Strike capabilities? From your position, has the Government made clear its thinking on this? Justin, can we come back to you?

Justin Bronk: The Government has consistently stuck to its 138 target, but of course we all know that that is an aspiration that is unlikely to be funded at this stage. On the key trade-off on the strategic purpose for Carrier Strike, it is a global carrier power projection capability, which only a few countries operate and is a mark of prestige as well as strategic flexibility. It certainly enables you to do things like contribute armed sorties into an intervention operation or a near-peer competition alongside allies, without having to draw on permissions from partners to fly those armed sorties from their territory, even if you might have to, for example, depend on land-based tankers that can fly from much further away and are a lot less diplomatically difficult in terms of overflight and basing.

The ambition is relatively well understood on Carrier Strike. The problem with F-35 is that the programme has been pushed to the right for so long that now the core question the Government needs to grapple with is: is the F-35 programme going to be sized to deliver what the RAF requirement and the broader joint force penetrating ISTAR strike and SEAD requirement is over the 2020s and 2030s, in which case your number is going to have to be significantly north of 100, and you will have to cut significant other ambitions and capabilities to pay for that or increase the defence budget quite a bit. Or do you want to put a lot of resource into a full-scale fighter-style Tempest programme to replace Typhoon in the 2040s with an IOC target of 2035, because you currently cannot do both? In fact, you will have to make cuts to do either on any meaningful scale.

So the question basically is: are you stimulating your defence aerospace industry base because it brings a decent return on investment and it helps keep jobs and stimulate the post-covid economy and all the rest of it—there are lots of good reasons for doing that—but accepting that you are then going to have to take a massive cut to the ability to operate and defend an airspace that your armed forces have, and there is a huge dependency there for the next 20 years in the hope that you get something post-2040 that is good to replace Typhoon, or do you take the opposite approach and say, "We need this capability for 15 to 20 years. Sorry, but we just can't afford a full-scale, fighter-style, all the bells and whistles, Typhoon replacement. We will have to do something more limited with Tempest"?

Q9 **Martin Docherty-Hughes:** Dan or Nick, do you want to come in on that? Dan first.

Captain Stembridge: In terms of what the Carrier Strike capability is there to do, clearly it is a political tool as well as a military tool, and it

would be unwise of me to comment, particularly in this environment, but in terms of what it allows you to be able to do, it does deliver political choice and it allows you to operate at a time and place of your choosing. Whether you are delivering humanitarian aid or doing high-end warfighting, it gives you the ability to do that without having to seek access basing and overflight from a third party. So it gives you that power projection capability arguably required within global Britain.

Q10 **Martin Docherty-Hughes:** Let me ask Dan. Do you think the Government have been clear on that type of thinking on the Carrier Strike Group?

Captain Stembridge: I think they have been clear from my perspective. They have been clear on what it is able to do and what they might wish it to be able to do. Where they have been less clear is over the attribution of the units within it to that task, and whether it is for that task or whether it is for a number of tasks, because that adds tension.

Nick Childs: I endorse what the previous two witnesses have said in terms of the clarity about the genus of this Carrier Strike programme to deliver a maritime-centred expeditionary capability—a power projection capability, as has been described—and a conscious decision with these carriers to step back up the strategic ladder compared to the last generation of Invincible class carriers in terms of being able to deliver a genuine and strategic capability at a higher level as regards sovereign and independent power projection capability, and to do that independent of foreign basing rights, to provide, as Dan said, the choices, the options, in terms of expeditionary capability that had not existed before without this level of capability. On that level, it is down to what the level of political ambition is in order to deliver on that. There is a degree of clarity in that respect.

One thing I would add in terms of where I think there is slightly less clarity is that when the Carrier Strike programme came into existence, we were in a very different world. It was not a world of great power competition and the return, for example, of requirements for potentially article 5 NATO operations. In terms of the clarity of the capability of a Carrier Strike force set of options in that context, which in many ways is at least equal in terms of strategic requirement—the defence and security requirement—I think there is a clear case for the role of the Carrier Strike capability in that context, and perhaps there should be more clarity on the ability of that programme to deliver in that context as well.

Q11 **Martin Docherty-Hughes:** Thank you for that, Nick. Do F-35 and Carrier Strike illustrate that the MoD and armed forces are opting for a big ticket, without focusing at an early stage on what a capability would actually be used for? I think it was you, Dan, who was mentioning the opportunities for the Carrier Strike force with the F-35, but shouldn't that have been the starting point as to what capability was required? That should have been at the beginning, rather than us having to find out what the Government had plans for.

Captain Stembridge: I think in this case successive Governments—it's a number of Governments since the mid-1990s—have actually been fairly clear on what they believe they are doing in developing a Carrier Strike capability and the political choice and options that it gives you. I can use the really simple example from my own experience of our leaving the Persian Gulf in 2000, having been conducting missions in support of Operation Southern Watch, over southern Iraq, and then, on our way home, being diverted to Sierra Leone. In terms of the ability to project that power—we never wrote in a scenario that this was what we would do—it gave us was the political flexibility to be able to change our minds and turn left as we came out of the Mediterranean and go to Sierra Leone and, arguably, to prevent a significant genocide there. I think that there is something about carriers that gives you those political options, and that successive Governments have understood that fairly clearly.

Q12 **Martin Docherty-Hughes:** I will ask one final supplementary question if I may, Chair. This is based on some of the statements made by the previous Secretary of State, in the last Parliament, to the Committee. What would be the utility of Carrier Strike in, for example, the north Atlantic? How would it protect, for example, sea lanes and communication or help to fill the gaps in anti-submarine warfare capability? I ask because the previous Secretary of State did say that there was a possibility of Carrier Strike being in the north Atlantic.

Nick Childs: Yes, and I raised that possibility as well. Because of the flexibility of the Carrier capability, you can see it in a number of scenarios, but in terms of providing a survivable base for fifth-generation capabilities, in the context, for example, of a multi-carrier taskforce that included perhaps the Americans, that platform in and of itself, at the level of providing fixed-wing Carrier Strike capability, is certainly manoeuvrable and therefore, although there has been a lot of talk about potential vulnerability of aircraft carriers in the context of high-end near-peer operations, the virtue that they bring of manoeuvrability and being able, at the same time, also to deliver a strike against high-end integrated air defence systems, including from the carrier, is a significant one. As far as the questions of the platform as a platform for other capabilities, including anti-submarine warfare, are concerned, yes, they could, with the Merlins on board that they would likely operate with in terms of anti-submarine warfare, have a significant role to play in that context also.

Martin Docherty-Hughes: Does anyone else want to come in on that final question from me?

Justin Bronk: I have a brief point. In terms of a great power competition, that, as was pointed out, was never part of the operating assumption when the carriers were conceived and ordered—nor could it really have been. It is also worth remembering that Carrier doesn't necessarily have to go toe to toe with the Russians or the Chinese in order to be very valuable to a broader NATO coalition in a clash such as that, which would, generally speaking, be, in most scenarios, a flashpoint, rather than a global conflict from the get-go. The easy example is that, if there was a serious flashpoint in the Pacific, and the US had to start shuttling as many

carriers and as much capability as it could to the Pacific, probably the most useful thing the carrier could be doing at that point is providing buy-out for an American CVN in the Gulf, so that they could mount USMC jets as well as our own in order to allow an American carrier battlegroup to go and do things in a much more contested environment.

It is worth noting, though, that there are serious arguments in the US about how survivable their carriers are in a serious peer conflict against either Russia or China, remembering in particular that Russia's new generation of submarines are really exceptionally quiet and very lethal as well. They can put an extraordinary battlegroup around theirs, both surface and sub-surface, so it is perhaps worth being realistic about how survivable we could make the carrier and what that would cost in a direct peer competition scenario, rather than looking at how we can use it to be helpful to the Americans in buying out capability for them to go and do some very high-end stuff, much as the Charles de Gaulle has done for a number of years.

Q13 **Martin Docherty-Hughes:** Dan, have you got any final points on that?

Captain Stembridge: I would just say that, outside of the classification of this—clearly, I am not inside anymore—you would, I'm sure, be able to gain access to classified operational assessments, which would look at the vulnerability assessments that we are talking about. It can be rather unproductive, perhaps, to talk about it in these scenarios, because it becomes extremely complex, regardless of whether you are talking about the vulnerability of land-based air power or indeed carrier-based air power.

Chair: Sarah, you indicated that you would like to ask a question.

Q14 **Sarah Atherton:** I would like to play devil's advocate, if I may. Is it not the problem that the Navy and the MoD have built two very expensive aircraft carriers that we cannot afford to operate, support and provide with enough F-35s, and that we do not have the frigates or destroyers to support that? If I said that to you, what would be your answers?

Mr Jones: Don't cut the budget like you did.

Chair: A view from the devil's advocate.

Captain Stembridge: I would clearly be someone who you would expect to be an advocate of Carrier Strike and carrier air power. I believe that, despite some of the poor decisions that, in hindsight, we may have made, which I believe have come about in many respects due to the uncertainty over attribution that I talked about before—whether it is a combat air platform that is able to go to sea, or whether it is a Carrier Strike platform that can contribute to combat air—what it gives you is that flexibility. I have seen that at first hand, both in the UK and when I have flown with the United States Navy and Marine Corps. It gives you that flexibility, which is very hard to get anywhere else. So, no, I wouldn't say that.

Nick Childs: Forgive me, Chair, I just want to pitch in on the question of the balance in the fleet on the basis of the carrier capability. I would absolutely endorse what Dan was saying about the options that a carrier capability gives you. As I mentioned, it is not so much the admirals who are fixated with aircraft carriers. This is a programme of long gestation, which has admittedly taken a few tortuous turns but has been ultimately endorsed by successive Governments of different hues. Therefore, if it is ultimately the political ambition to deliver that kind of capability effectively, choices should be made at the political level about what that entails in terms of being able to provide and support a balance of other capabilities that are needed both to sustain the Carrier Strike capability and to do all those other things that you are tasking the fleet to do in the context of what other frigates, destroyers and force elements you need to do that.

Chair: We will come back a little bit to this with Emma, but I want to make some progress, if I may. The fourth strand of the Combat Air strategy is to maintain a globally competitive domestic Combat Air industry. Kevan, do you want to take us forward on this area?

Q15 **Mr Jones:** I would just say to Sarah that if the Government hadn't cut the defence budget by 16% for the last 10 years we might be in a better position than we are now. Moving on, can I ask, in terms of the effects of not procuring the 138—or a lower number—what effect that will have on UK industry, both aerospace and maritime? Being a tier 1 partner in the programme, if we were to only procure, for example, the 48 we have already got, would that affect our status as a tier 1 partner?

Justin Bronk: One thing I would say, for a start, on tier 1: the tier 1 or level 1 status was a status we got for the £2 billion buy-in that we had at the beginning of the programme, and was partly a consequence of that buy-in, but also the 138 we agreed to order; but that was for the research and development and then the initial manufacturing stage. That is now no longer really a factor. That was a status that was relevant to previous stages of the programme.

In terms of the numbers bought, certainly if we were to go explicitly from a 138 target, or somewhere between, say, 90 and 138, depending on affordability, down to between 48 and 60, we would inevitably go from being at this point the second-highest ordering export customer, after Japan, to being somewhere really pretty far down, with some of what we would term the small to medium air forces: the F-16 nations, for example—Holland, Denmark—looking at between 48 and 60 in some cases, optimistically perhaps, but that's where they are. We would be well below the Australians and Japanese. You can draw your own conclusions about how much influence that would give us on the programme in terms of follow-on weapons integration, sensor integration, UK-specific requirements and things like ability to edit our own mission data files, play with software, if we wish to buy into options like that as the Israelis have. They have a different relationship, but up to this point we have had a pretty preferential position within the programme by dint of that order

number, accepting that if it goes lower we will inevitably come into consequences.

It is worth noting that last year, when I went round the Fort Worth factory to see the assembly line, with more than 200 F-35s at various stages of construction, there was one UK aircraft on the line. With all the different flags everywhere it was quite notable that perhaps we still think of ourselves as a bigger player in the overall programme than we are. So there will be consequences to going down. Of course, the other consequence will be that if you buy fewer F-35s you will put a much greater strain on the remaining Typhoon tranche 2s and 3s, and there will be a corresponding increase in requirement to, for example, roll out the ECRS to the new E-scan radar with a lot of the enhanced defensive aids capabilities, and electronic warfare capabilities, for not just the 40 tranche 3s but also the 67 tranche 2s, because you will have that many fewer penetrating ISTAR SEAD-optimised platforms in the combat air side of things that you can play with, and you will still have a joint force which is extremely dependent on air-delivered firepower, so you will have to find a way to deal with that, either way.

Q16 **Chair:** Dan, do you want to come in?

Captain Stembridge: I echo what Justin said about the system design and development stage—the level 1 partner status that we had, which allowed us to play a part and influence the initial design and development of that air system—but that is done now. We are buying aeroplanes like everybody else. The 15%, of course, is not based on our buy of aeroplanes; it is based on the total buy, but there is no doubt, I think, that it could have an influence in terms of future decisions that Lockheed may make—in terms of other decisions that they may make—which could potentially affect UK industry and jobs. It is clear that whatever decisions we make as a Government, we should make sure that we are thinking of UK industry and UK jobs in how we develop future capabilities. That leads into things like Tempest as an aircraft, but also into unmanned systems. That really does need to be the way that we start looking at future capabilities, both maritime and land-based. We must make sure, while we have two aircraft carriers that are built specifically for this platform, not just to operate it in a war footing, but to maintain and support it. They are well-found bases. These are not like aircraft carriers that you just plump these aircraft on and they are going to sit there rotting in the hangar; they are specifically designed to do this. Therefore, decisions that we make for future air systems must take into account the fact that for the next 45, 50 years, we have got two 65,000 tonne aircraft carriers. We need to make sure that those decisions are made early, to ensure that any future unmanned air systems are able to operate from both the carriers and land. By exception, they might just be land, based on what they are, but we need to be looking that way every time we start to develop something new.

Q17 **Mr Jones:** Nick?

Nick Childs: I endorse pretty much what the other two witnesses have said, particularly Dan—that whatever the ultimate trajectory of the F-35 programme in terms of the maritime capabilities, you have two very significant aircraft carriers there. For all the arguments around their size and whether or not they represent legacy thinking and a legacy purchase, the whole point about an aircraft carrier that size is that the size gives you flexibility.

These are extraordinary platforms that will, over time, be able to adapt to a whole range of new capabilities coming in, particularly in the uninhabited realm. Initially, I would envisage those would be to support and enhance the capabilities that the F-35 brings within the context of that platform, but further into the future, towards the end of their career, these carriers could take on more roles. If that is the package of capabilities that you were talking about in terms of the rest of the maritime force structure, you need to be able to continue to deliver on those supporting capabilities as well, including for example the trajectory and the future of the fleet solid support shipping, which needs to come forward via the completion of the support package in that context as well.

Chair: Okay. Let's turn back towards the integrated review and focus a little bit on the maritime task group itself.

Q18 **Mrs Lewell-Buck:** What would you like to see from the integrated review, and what are your main worries in relation to these programmes? May we start with you, Dan?

Captain Stembridge: I think, without tempting fate, any discussion that would look at whether we would keep one or two carriers or would mothball would certainly be extremely unhelpful. It is very clear to me that if you want to keep very high readiness capability, and you want to be able to use it at a time and place of your choosing, then you need a minimum of two platforms to be able to deliver that, because they obviously have to go in for refits, into dry dock and so on, on a regular basis.

From an air system perspective, it would be any further slowing down and any question marks over whether we would increase the forward available fleet of F-35 to allow a credible and sustainable force. Then, from the supporting elements of the task group, anything that further reduced surface fleet numbers and therefore your ability to surge that, should you need it, to be able to conduct your carrier strike deployments.

Q19 **Mrs Lewell-Buck:** Justin?

Justin Bronk: The thing that I would dearly love to see from the integrated review, but I will be pleasantly surprised if I do, is clear political direction from the political side, not from the MoD, because it is not a question that the MoD can or should answer, about what is the main point of the armed forces. Are they supposed to do a bit of everything, America at 10%—in other words, the full stretch spectrum force for everything from counter-insurgency through to high-end NATO warfighting? At which point you need 3% of GDP minimum. There is just no way you can do that

on anything approaching 2. We have been kidding ourselves for at least five years on that. If there is direction about whether this is a global Britain, light-foot expeditionary-focused force around the carrier groups—light infantry, train and assist forces, global mobility and that sort of thing—the MoD can give you plenty of very sensible answers about how you might optimise such a force design for those policy objectives within the budget. Equally, that entails telling NATO that we are not meeting our deliverables, and high-intensity war fighting against the Russians is just too expensive. Then it does become a problem because if we, as the second-ish most capable NATO player in the military sphere, cannot do it, who can? The French have their own very specific strategic focus, but it is quite interesting that they contribute more meaningful NATO forces in a heavy context than we do in most categories with a slightly lower defence budget, because they know what their armed forces are for.

Equally, if you decide that Britain, having burnt a lot of its other soft power bridges, wants to specialise in being that hard power framework nation within NATO that it has done across most of the Cold War and up until about 2010, that is fine; the armed forces can give you a perfectly sensible set of force designs for that policy ask. But the idea that they can just somehow give you an answer that fudges both, that won't be a bunch of jargon-y gobbledegook that talks about AI this and responsiveness that and miracle technologies of this, that and the other, is just meaningless. The MoD cannot give answers to a question that is not phrased right. So I desperately would love to see a political answer to the question of what the armed forces are primarily for, and then you will get a very satisfactory set of outcomes, even if there are painful choices to be made.

Q20 **Mrs Lewell-Buck:** Thanks. Nick?

Nick Childs: I think I would start from the perspective that Dan raised of the issues around continuing with the carrier programme and whether there is an option to go with just one aircraft carrier or two. There are two elements. A one-carrier fleet inevitably raises the concern that it will not be available at the times you require it because of the refit and recycling issues. This is a problem that the French have had to grapple with over the years with the Charles de Gaulle. There is also the fact that the two-carrier model provides you with the flexibility to respond in different ways to different scenarios, potentially simultaneously. In order to be able to do that, also, there is the issue of what will happen to the supporting fleet in terms of the integrated review. As for the core, in terms of providing a contested Carrier Strike task group at a high level, there is enough to sustain a task group as well as to provide the requirements for other tasking. It gives you, at least at this level at the moment, some flexibility to provide a second grouping at another level of scenario, potentially, for the other carrier. That gives you a bit of extra flexibility as far as that is concerned. The concern would be about any further depletion in that as far as flexibility of the maritime component is concerned. It is worth remembering, again, when this was first brought into the programme in 1998, it was as a package. There were two carriers and 35, reduced to 32, destroyers and frigates, and 10 SSNs and an amphibious group. So that

was the overall force package envisaged at the time, where a country might run away from that now. And as for being able to deliver on the flexibility that the two-carrier model can provide, there needs to be a sustainment overall in terms of the fleet balance.

Q21 **Mrs Lewell-Buck:** Moving on to the SDSR 2015, it envisaged that by 2025 the UK would have a highly capable expeditionary force of approximately 50,000, which would include a maritime task group centred on a Queen Elizabeth aircraft carrier with F-35 Lightning combat aircraft. How confident are you that the review will maintain that, and if it does not do so, what are the consequences for us? Again, can we just go in order of Dan, Justin and Nick, please?

Captain Stembridge: Is the question whether I think the integrated review that is under way at the moment will maintain that trajectory?

Mrs Lewell-Buck: Yes.

Captain Stembridge: I think there are some decisions that have already been taken with regard to profile of aircraft buy in the meantime, and some of the developmental testing to enhance the F-35 embarked capability, in terms of the developmental test of rolling vertical landings, which have already had some degree of impact on that.

I think it depends on whether you think that by 2025 you have got sustainable capability to be able to operate 24 jets, or whether you think you have got a sustainable capability to deliver 12 routinely, which is what I think we will have.

The devil is in the detail but the language is up to 24, and depending on your view, that can be up to 24 or that can be routinely 24. For me, I think that we will be in a position by 2025 to be able routinely to deploy sustainably 12 F-35s embarked. To put that in perspective, that is what I did when I flew Harriers off Ark Royal. So, that is pretty much what we will get sustainably.

If you want to be able to sustain more than that, you need more aeroplanes and they need to be attributed to that task.

Justin Bronk: I would agree pretty much with what Dan said. I guess that I would just also bring in at this point that it is worth remembering that from a position of the US Marine Corps being somewhat reluctantly induced to provide deployments of up to 36 of their F-35Bs on to the carrier several years ago—there was a reluctance to break up the Marine expeditionary unit construct at the time—given where the planning of the Marine Corps has gone and the recent absolutely disastrous fire on the Bonhomme Richard, leaving them very short of amphibious flat-tops for the next two to four-year cycles, the UK's ability to generate more than, say, 12 sustainable F-35Bs for an amphibious task group in 2025 around the QEs, it may not matter so much to the Americans whether it is 12 or 24, in the sense that the USMC is probably in a position now where, by that stage, we will be giving them something very valuable—to have a

task group to project their fast airpower off—whereas at certain other points it might have been seen to be a favour to the other side.

So, there is a value added, even if the number of sustainable UK jets is "only" 12, and they are very capable jets. But the USMC will be bringing a lot of combat power and that is now more valuable than ever after the Bonhomme Richard fire.

Nick Childs: I think I would more or less endorse the other two, particularly in terms of the ability to provide at the top end of the aspirations. I think that is a profiling and timing question as much as a desire to change and to shift the goalposts.

I would endorse what Justin just said, in terms of this interoperability question, and the fact that as far as the US is concerned, particularly the US Marine Corps, there are significant opportunities for interoperability. That will be to the benefit of both sides, as far as the F-35B programme is concerned, and for the UK certainly, as it builds up a capability to have the extra mass that the US Marine Corps can bring on board. We should be seeing that demonstrated in the near future.

But also, in the context of global interoperability and potential integration of planning in the future, people talk about the number of US aircraft carriers that there are in the total fleet, but the actual readiness levels against their fleet requirements are such that they are very thinly stretched. Even if you add the amphibious ships of the US Navy that would carry the US Marine Corps F-35s, as was suggested, there are limits to those. So this is where a key interoperability question is concerned: the addition of two platforms that could be available as required, when required, in the context of alliance and overall requirements around the globe—the Queen Elizabeth class, both of them—would represent significant, critical strategic assets as well.

Captain Stembridge: Could I just come back with one slight caution on that? I agree with everything talked about there—the flexibility, the co-ordination, and the incredible amount of work that both the US Navy and the US Marine Corps have done in working so closely with us following the SDSR 2010 review on carrier co-operation. In a fairly recent job as the chief of staff in carrier-enabled power projection, I co-chaired the policy working group on behalf of the statement of intent between the UK and the US.

The thing I would say is that although we do work very closely—you can clearly see that from the fact that a squadron of US Marine Corps F-35s are in the UK at the moment—we do need to be very careful of counting routinely on the United States Marine Corps backfilling our aircraft carriers, because it is not in their plan. We do need to check before we start talking about how great this will be for everybody; I would just caution too much enthusiasm over that, because they do have an awful lot of tasks. While they have had that very serious fire in San Diego, they still have a lot of platforms and a lot of land basing options they are looking at, so it is not really our place to be tasking the United States Marine Corps.

Nick Childs: If I can clarify my points, in terms of the actual interoperability and cross-decking, I absolutely take that point. In the context I was talking about, as we build up our own fleet, that is the case. In the context of what UK platforms with UK aircraft on board could bring more broadly in a more global context, when platforms are generally in short supply as far as the alliance is concerned, that is also a key, but slightly distinct, capability.

Mrs Lewell-Buck: Thanks very much. I am happy to move on, Chair.

Chair: Thank you; that is very helpful indeed. It is interesting to place into context where the F-35 sits. I would now like to focus a little bit on that wider picture, compared with the rest of our air combat capability. Derek Twigg, do you want to take us forward on this?

Q22 **Derek Twigg:** Thanks, Chair; it is maybe a question for Justin and Dan. What do you think is the correct mix of F-35s, Typhoons, Tempests and UAVs? We have talked about a number of figures today, but what do you believe is the correct mix?

Captain Stembridge: Ultimately, although you might want to have a crossover period, you need to be very careful about having multiple aircraft types, because of the cost and complexity across all the lines of development that that will deliver. Therefore, whatever that mix is, you need to make sure you are not increasing and further increasing your aircraft types; you would want enough F-35s to be able to routinely deliver you 24 embarked and 36. If you can press that even further—because, of course, any carrier-based aeroplane can operate from land, but it doesn't go the other way—I would see that as a positive. We also need to consider what we are going to do in the future and how we are going to make sure we protect not only jobs in the UK but intellectual property and our ability to deliver a sustainable aircraft industry, which of course brings so many jobs into our country.

On the mix, as you start to run down Typhoon, I would stick with an F-35B fleet, and I would increase that buy. As Typhoon starts to go out of service, I would look at bringing in a UK capability. Time will tell whether it is Tempest, unmanned air systems or a combination of both, but we need to put that money and work into UK industry initially. I would then look to have a complementary force mix of F-35Bs and, as Typhoon goes out, something like Tempest.

Q23 **Derek Twigg:** On the F-35Bs—going back to your earlier comment—you talked about 12. We are not sure yet—or we have not been told yet—what the review will recommend. What should we be looking at to have a sustainable force of F-35Bs to give us the best possible combat air capability?

Captain Stembridge: As a minimum, you would want to be able to routinely deploy 24 and surge it to 36. Actually, what I think would give us the most capability is to routinely deploy 36 combat jets, and therefore you are going to need, in excess, getting up to 100 F-35Bs.

Derek Twigg: To be able to put out that number.

Captain Stembridge: To be able to put out that number routinely and sustain it. To sustain 24 routinely and surge up to 36 will require four frontline squadrons of 12 aircraft, plus an OCU. That equals about 70 to 80 aircraft.

Justin Bronk: I would say that that slightly depends on whether you want a national suppression and destruction of enemy air defences capability at any meaningful scale between now and 2040. If you do, this is not knocking out a few SO2s, 3s and 5s in Libya; you would be looking to attrit and keep suppressed a mobile, fairly resilient, layered network of strategic, long-range, medium-range and short-range systems. Currently, NATO's dependency is almost 100% on the Americans for that. If you believe that that is not necessarily sustainable in the context of wanting a sovereign ability to intervene elsewhere, I would say that you need at least 36 sustainable F-35 frontline numbers, whether they are land-based or carrier-based—as Dan says, carrier aircraft can fly from land, but it does not necessarily work the other way.

The Typhoon fleet is going to be increasingly required to back up a mix of stand-off munitions, offensive and defensive counter-air, and then the more traditional peacetime—or shall we say grey zone-suited—QRA and air policing tasks. Interesting, the QRA and air policing tasks will be one of the last to be suitable in any way for a highly automated, uninhabited system. I predict that you will still have to do those with a piloted platform for things like being able to look into the cockpit of the non-responsive airliner, let's say. Is the pilot slumped over the controls? Is there someone else in there with them? What is the body language? Are they responding normally? You would need contextual awareness in, for example, an air policing encounter, Baltic states-style, of the geopolitical context to be able to accurately interpret what could be aggressive manoeuvres—flares, showing off weapons, unsafe passes and that kind of thing.

Those sort of grey zone activities will continue to require a piloted aircraft of some sort up to 2040 and beyond, I would suggest. What that means is, how are you going to do your three main things? You have Carrier Strike, your QRA, OCA, DCA stuff—air policing—and your penetrating SEAD/DEAD strike in defended airspace. The third and the first ones are all F-35s, and we rely on them mostly on that for the foreseeable. So how long is a piece of string? Probably 36 minimum, and for anything satisfactory you would want as much as you can.

When you come to Tempest, what do you want to replace? Are you doing something that is survivable and lethal enough against the sensors and shooters that you have been looking at, 20 or 40-plus for a 30-year service life? In that case it will have to be very specialised to be remotely affordable. I suggest that that means a UCAV—unmanned combat aerial vehicle. That is the only way that it is conceivably affordable for the defence programme, if it is the UK and Italy, plus maybe a bit of Sweden, unless you join with a much larger programme.

Alternatively, do you want to replace that QRA air policing role in a much more limited spiritual Typhoon successor but without an ability to penetrate into defended air space in any meaningful sense? At that point, sure, you can probably afford to do a fighter-style Tempest. But you will have to make a choice of one or the other.

Adjusted for today's money, the Typhoon research and development and acquisition cost—not operating or anything else—is about £34 billion for the UK. That was as a member of a consortium of four nations. If you believe that BAE Systems, plus Italy and maybe one or two other big partners, can deliver you something more capable, complex, survivable and multi-role, with a system of systems approach, for no more than that in real terms, you are still looking at something that is absurdly unaffordable within the current equipment plan, so you will have to pick.

Q24 **Derek Twigg:** This is a question for Justin or Dan. We talk a lot about aeroplanes and ships, but what about people? What about sustaining the number of pilots and technical back-up service personnel in any programme that we decide to go forward with? What are the challenges currently about this real uncertainty about the number of aircraft?

Captain Stembridge: It is worth bearing in mind that any of these capabilities, even if it is an uninhabited system, still require an awful lot of people to operate. But those UAVs or remotely piloted air systems—depending on which you go for and which epoch you are talking about, and whether they are utilising more machine learning and AI or whether you are talking about a remotely piloted one—still require a significant human base.

That is even more the case, I would suggest, in terms of carrier operations, not in terms of how you might fly them but how you interact with the ship itself. Therefore, the hardest training burden for carrier strike, if you look at it in a training sense, is not on the pilots, for whom it is relatively easy. I am testament enough that you can teach pretty much any idiot to fly an aeroplane. The fact is that it is about the complexity of operating aircraft carriers on four and a half acres rather than the 400 acres that you get with an airfield.

On an aircraft carrier you have lots of aircraft in very close proximity and you need to make sure that that ship, that entire weapons system and that entire task group is able to operate. Yes, all of the services are trying to reduce the numbers of people. But it is not just about the pilots; it is about the maintainers, the support and everything else, because that has a cost. Everyone is trying to reduce the cost, and to reduce the risk to life that you are putting on our people. I am not sure if that quite answers your question.

Derek Twigg: Nick, do you want to add anything?

Nick Childs: No, thank you.

Justin Bronk: I am terribly sorry, but I will have to go at 2.30 pm. I did flag this to the staff. I would be happy to respond in writing to any further questions that I could be of help with.

Q25 **Chair:** We were very conscious of that and that is why we moved the session earlier. We are very appreciative of your contribution. Best of luck with the Battle of Britain commemorations. We are grateful to you for coming to our Committee today. Thank you.

We will now continue. I will turn to some of the attributes that support the carrier strike capability in a second. Following on from some of those questions about this era of great power competition, we planned for state-on-state combat, but the chances of that happening are remote—though we must be prepared for it. We are likely to see those carriers utilised in very many different scenarios that are more to do with that great power competition: policing, status and perhaps humanitarian contributions, too. Therefore, my question is: are we not versatile enough with this floating platform in what we could do with it? Historically, it seems that you get retired fast-jet pilots doing the procurement, wanting to purchase fast jets, and that is what we have.

The actual combat air strategy has four pillars, which I touched on before. No. 1 is to continue Typhoon until 2040; No. 2 is to complete the F-35 introduction; No. 3 is to then advance Tempest and get that on board; and No. 4, which I mentioned before, is to make sure that we remain globally competitive in the combat air industry space. Yet, we see the Americans utilising turboprop aircraft to deliver weapons systems. We have focused on this platform and then the F-35, but the F-35 is itself a platform that delivers weapons systems.

To give an example, when the Storm Shadow was last used in aggression, in a kinetic way, against Syria, I think—correct me if I am wrong—those weapons systems were fired from the other side of Cyprus, across the Mediterranean. They could have been fired from a Tucano turboprop aircraft, rather than from an F-35.

This has been a long-winded way of asking it, but my question is: are we not being clever enough with how we collect ISTAR and show presence, and in benign situations, are there not cheaper ways for us to dominate the skies using high-tech capabilities and high weapons systems, which can, equally, avoid the S-400, or indeed the HQ-9? Nick, would you like to respond to that?

Nick Childs: You are right to point out the capability options in terms of the gradation of scenarios and the different roles that the aircraft carrier can play in different ways. That is clearly one of its virtues: its ability to adapt and take on different roles. In terms of the ultimate question of what that capability was bought for, it may well be that a high-end scenario is low probability but has a very high-risk element, but the key element of that low probability is the deterrent role that those systems play. If that is one of your key conventional deterrent capabilities, you do need to invest in that at the top level, and then everything else flows from that.

On the way to adapt to the contested environment about which you are talking, I think Dan is probably much better qualified on the different ranges of scenarios in order to be able to respond to that. In the end, it is a balance of risk and ability to deliver the actual effect that you are looking at. Like bubbles that are painted on maps and look more and more like no-go areas, I think there is a question about whether that is the right approach. Actually, in terms of being able to manoeuvre, you have to have a range of capabilities, including high-end and fifth generation capabilities that the F-35 brings, allowing you the option and adaptability to be able to use your [*Inaudible*] and provide those effects that you want in different ways. To go down one route of a particular approach narrows those options and makes it easier for the opposition to make its own calculations as to how it postures itself.

Captain Stembridge: I would say that an aircraft carrier or a carrier strike group is looked upon in a couple of different ways. The first would be as a military instrument of war and, in some circumstances to which you have alluded to, you could see where that could be deemed overkill for what might be required.

It is also there as a political statement. These are political tools that will be deployed not only to be a military instrument of war but to make political statements, whether to posture or threaten, to ensure freedom of the seas around the world, or to reassure somebody. The benefit you have with an aircraft carrier is that you can do both of those things at the same time to different audiences.

In terms of the aircraft itself, it can be unhelpful, particularly when it is looked at through the Combat Air lens rather than the Carrier Strike lens, for it to be seen as a bespoke piece of equipment that needs to be polished, put into a hanger and only used for these really hard missions against HQ-9s, S-400s and so on. It carries its weapons internally to be able to do that and reduce its radar cross-section, but it is actually a bomb truck as well: there are 11 hardpoints on those aeroplanes, if you include the gun, and you can strap an awful lot of ordinance on to the outside of it and use it as a bomb truck. I would recommend that, if you do get the opportunity when the United States Marine Corps are over here—as they are now—and you get on board the aircraft carrier, you talk to them about how they use it, because they see this not as something bespoke but as a utility warfighting platform that has the ability to go to high-end but is also able to deliver plenty of other missions in lots of different environments.

So I think it depends on how you look at the platform. There is no doubt that there are stand-off munitions that allow you to do some of these things, but you really do need to be able to survive in those environments to be able to employ them—not the scenario you are talking about, but there are plenty of others.

Chair: I understand that, with Britain wanting to project our influence across the world, when it comes to the Air Force and Carrier Strike, we are looking at high-end, high-tech stealth capabilities. That is good; I do not doubt that. But in Afghanistan, an A-10 or a Tucano aircraft could have

done exactly the same job as the Typhoon, which costs £50,000 an hour to put up in the skies. The ground forces have that versatility, with their nice spectrum of capabilities from the foot soldier to land warfare capabilities, but you have not got that suite of capabilities when it comes to Combat Air or Carrier Strike. It is heavy-duty, high-end, and high-spec, and that is great, but, as you said, the majority of the time it will be different kinds of risk more frequently connected with stabilisation, climate change and other such things.

Q26 **Richard Drax:** A brief question for you, Dan. You might call me slightly old-fashioned, but as an ex-serviceman, the "mark 1 eyeball" was almost unbeatable, and maybe still is. Is there not an over-reliance and huge cost to unmanned aircraft operating out of an aircraft carrier? As the Chair was hinting, things could be launched via propped aircraft from the land, rather than from an expensive aircraft carrier that is vulnerable at sea. If that reliance on unmanned, very expensive aircraft like the Tempest continues, won't the target—the aircraft carrier—become even more of a target, because if you sink that, you have a multimillion-pound unmanned aircraft flying around with no one at its controls? Is there a balance? Dan, as a pilot, will there always be a need in some cases for a pilot in the aircraft seat?

Captain Stembridge: On the intent, with all military arms—and indeed into the civilian sector—we find it very difficult. There are an awful lot of rules and regulations that hinder the art of the possible with unmanned systems, whether they be on the sea, in the air, under the sea, on the road or just delivering your parcels to your backdoor.

All of these provide us with challenges, because there is an awful lot of technology that allows us to do things; we just have humans in the way, as it were, and therefore we have to make sure that we are not putting people's lives at risk. I think that we will move towards that. We need to be careful about betting the farm on being able to deliver something when it is not yet there. I do not mean in terms of the technical ability; I mean in terms of whether we can regulate and actually deliver that safely.

I would like to touch on the point of vulnerability at sea, particularly considering we are pretty much to the day eight years after the attack on Bastion, where some United States Marine Corps people, one of whom I knew, were sadly killed and a number of aircraft were destroyed or damaged by a Taliban attack. There is an awful lot of talk about the vulnerability of carriers at sea, and I don't personally share that. That is primarily because of the arc of horizon that you have—in other words, it is flat sea—which makes it far easier to detect threats that are coming in. Our Navy, as many other navies are doing, is continually progressing its ability to counter that, whether it be sub-surface, surface or indeed coming from the air—whether that be hypersonics or not. The fact is that airfields don't move.

On attacking an aircraft carrier, we talked about its being a political instrument of war, not just a military instrument of war. That means that you are making a very big decision. Only a very few nations have the

ability to do that kind of attack successfully, potentially, on to an aircraft carrier. That becomes a significant act of war. If that is the case, all our airfields are vulnerable as well, because they are all mensurated co-ordinates that are available to everybody on any given day, so I don't quite share that view of vulnerability at sea.

In terms of the mark 1 eyeball, there are certainly scenarios where you could paint it to be far better to have unmanned systems and far better to have a manned system. I think that where we are at the moment is developing, that so that we will end up with a complementary mixed fleet of that for some time. I cannot see in the next three or four decades—or certainly two or three decades—that we would not be in a position where we had some unmanned aircraft.

Chair: Interesting comments. The fact that you are here today shows that your mark 1 eyeball has a lot of experience, and we are the beneficiary of that. I think the concern that is shared is that you will lose that. Junior lieutenants flying become leaders later, and they can apply that experience, having flown. You cannot do the same, because it will be different characters operating the UAVs. You spoke about the vulnerability of land versus sea. Obviously, if it is stuck out at sea, if it is a carrier, it needs to protect itself, which takes us nicely to how carriers defend themselves.

Q27 **Mr Jones:** We have already touched on this in terms of the importance of protection for a carrier or a carrier-strike group. You will be aware of the delays in terms of the Crowsnest system, which may now not be operational until 2023. Would you like to comment on the vulnerability that that gives to the carrier group until it is actually operational? Nick, do you want to go first?

Nick Childs: I think it is absolutely a key capability. It goes back to the experiences of the Falklands, particularly in terms of delivering on that ability to operate and project power in a sovereign context independently, at range. It is a key capability, so it is key to bring that in. The ambition to get that in place as soon as possible clearly has to be a high priority.

Obviously, there have been technical difficulties that have put that back, but that must be an absolute element of the overall package. It forms a different part of the mix now than in the past, not least because of some of the other elements, including the F-35 itself, which provides a significant intelligence surveillance reconnaissance capability with its own sensors that can be brought into play. It is part of that package.

In the longer term, that is potentially one area of possible development, as far as those uninhabited systems are concerned. Some kind of system like that, to provide the radar sensor capability, may also be key in the longer term.

Captain Stembridge: I agree pretty much with all that. The other part is the command and control aspect, which comes back to that human being. You have human beings in the loop who are sharing that jeopardy with

other people and are providing that service. It is not just about the sensor. There is no doubt that an area to look to in the future to provide that coverage would be better delivered by an unmanned system. You are talking about persistence and the ability to be able to do that without having to rotate all the crews around, with all the limitations that you have.

We stand at a key moment with unmanned air systems, if we really want to commit to having them in our armed forces. There are many reasons why we would or would not do that, not least of which is the moral argument, particularly if you are delivering violence to the enemy, as to whether you do that remotely, sitting in a container in Lincolnshire, or you share the jeopardy by being over enemy territory while you are doing it.

You have got to put significant investment into unmanned air systems to be able to get to a position where you can start drawing down your manned systems. Just betting on, "Don't worry, it will all come, so let's not bother with that; we will just develop it," rarely works out. A worry for me during the integrated review would be that we will make decisions to replace manned systems with unmanned systems, but projects, whether they are building an air system or getting an extension built on your house, rarely run on time.

Q28 **Mr Jones:** What will the capability gap be in practice?

Nick Childs: As far as Crowsnest is concerned, it will have some element of capability. Amongst other things, there is a desire for it deploy in an operational context with the first deployment, but it will not be at the level that was originally hoped for. To be honest, from a technical point of view, I am not entirely clear on what the level of capability will be. I don't know if Dan has a better understanding on the Crowsnest front.

Captain Stembridge: All systems are flexible. Its predecessor, the Sea King airborne surveillance and control, spent a significant number of years in Afghanistan. It was never designed to do that, but it provided incredible support to ground forces there, using its radar and command control capabilities in ways for which it was not necessarily designed.

Crowsnest allows you to move out further from the fleet and to provide a co-ordination function at altitude, with strike options, if you are sending aircraft that way. It also allows you to look down threat. Rather than having to put expensive jets up and provide Combat Air patrols, you can put them further ahead of the fleet as a picket defence, use their altitude and persistence and the range of their radar to be able to see incoming threats, and allow the task group to be able to manoeuvre accordingly.

Q29 **Chair:** A really interesting discussion. I remember having a discussion with a former procurement Minister; I shall not say who it was. I had to get him to see the film "Captain Phillips", which features Tom Hanks and involves a tanker getting hijacked, in order for him to be aware of the capabilities that the US Navy were using from a drone. I think it was a Fire Scout that was deployed. I said, "Why haven't we got this on the

Type 26 that is coming in?"

My question is around the fact that we have a growth in understanding the capabilities of UAVs. We have the biggest aircraft carriers that we have ever procured, yet it is puzzling not to see a marrying up of these two capabilities. We are still not flying anything large enough to be able to take off and recapture in the way that the Americans are already flying quite significant UAVs in their forces. Am I missing something? Is there something in the pipeline that we could encourage or be inspired to see?

Captain Stembridge: There is definitely an emphasis towards unmanned systems from a Navy perspective, an air perspective and indeed a land perspective, in terms of tactical air systems. In my role as deputy chair of the Air Power Group, we need to make sure that we do not just concentrate on exactly what you talked about earlier: high-end, fifth gen, expensive, exquisite capability. We need to think from micro UAVs to mini UAVs, and to class 2 and class 3 embarked in our aircraft carriers. There is that disjoint again, in terms of whether you are developing things from the perspective of Carrier Strike or whether you are doing it from a purely land-based perspective.

In the past, we have made decisions early. For a programme such as LANCA, we are not currently looking at that to be a maritime platform. It is an unmanned system and an additional wingman to the F-35, and we are not currently looking at that in a maritime sense, but we should be doing so right from the start. On the other unmanned systems, the first thing is the early investment to get you over the hump and to make sure that you are able to deliver it and still keep your current capabilities until you have taken it over. The other one is how quickly we can get through the manned/unmanned teaming and the regulatory complexity that we tie ourselves up in knots with.

Q30 **Chair:** I suppose my frustration is that I am aware—I stand to be corrected if this has changed—that our aircraft carrier is doing exactly the same from a capability perspective as the new Italian aircraft carrier. The Italians have built their aircraft carrier—it is one third of the size of the UK's. Ours are just enormous. There is a lot of space on board where you can add additional capability without losing the high-end capability that we have spoken about and that we clearly do not want to use, because it is in itself a deterrent in its own way. We could wander down that way; we won't for the moment. Let's talk about numbers of carriers and so forth, and how they all work together.

Richard Drax: I think you have answered this question, but I will ask it again for clarity. How many F-35s are required to justify two operational carriers?

Chair: I think we looked at one. I am not sure that we looked at two.

Q31 **Richard Drax:** Dan, do you want to start the ball rolling?

Captain Stembridge: It depends, politically, on what you wish to do with your aircraft carriers. We have two aircraft carriers and a guarantee that we always have one available at very high readiness. We are not building

two carrier task groups, in terms of escorts and supports. It does not mean that you cannot have two aircraft carriers at sea at any one time; of course you can. But the fact is that we are not, and neither were we in SDSR 15, building and bringing into service two aircraft carriers to deliver two distinct Carrier Strike Groups.

We are doing this to make sure that you always have one available. When both are available, one will be used while the other one is deployed, to make sure that you keep up that very high readiness of the platforms. Remember, it is not just the F-35—it is all the helicopters that will be going on there, and it is also the training that is involved in terms of the support vessels and everything that goes in around the delivery of that Carrier Strike Group. The number is the same. It depends what you want—it is designed for 36—but if you want to operate it routinely with 24 and be the same as the French, then that is going to be four frontline squadrons of 12 aircraft attributed to the maritime.

Q32 **Richard Drax:** Shall we go on to the next question? I think we have answered that question. Or do you want to add something to Dan's comment, Nick?

Nick Childs: Yes. It is the continuous readiness issue at that sort of level, but I think it is also the additional flexibility in the surge capability that, potentially, you could operate at different levels or in different scenarios. If you needed to operate both those carriers with some form of fixed-wing capability within that surge for a particular scenario, then the number is probably the same, but you would distribute the force slightly differently, as far as the overall number of 36 is concerned.

Q33 **Richard Drax:** I think we have touched on this next question—the Chairman touched on it too. What alternatives exist? For example, could the second carrier have a mainly unmanned or rotary wing-based capability? You have already said that it was never planned to have two operational, only one. Picking up on the Chairman's point that there is plenty of room for other bits and bobs in the one operational aircraft carrier, what alternatives exist?

Captain Stembridge: Bits and bobs tend to cost a lot of money, so you would need to ask yourself whether the aircraft carrier is necessarily the best place to be able to deliver those bits and bobs.

If what we are talking about is unmanned systems, for example, noting that we don't have cats and traps, what you are talking about are ones that may be able to launch down the ramp but certainly aren't going to be necessarily able to recover, unless we start fitting wires and so on into the ship. So what we are talking about there is mainly rotary wing or at least a platform that can recover in that sense, whatever that might look like—in which case, we would want that to be versatile enough to be able to operate amongst the fleet.

I guess what I am saying is that the carrier is always the centre of a Carrier Strike Group and it is always the place that people look to first.

Yes, it is big, but the fact is that it might not be the best place to be able to deliver those other areas of capability that you allude to there.

Nick Childs: I would slightly push back on the idea that there would be no scenarios in which you might want to operate the two carriers together with some fixed-wing capability. It is very unlikely that you would necessarily have essentially two high-end scenarios going on at the same time. There is the famed 24 number, but there is also the surge 36 number, in terms of aircraft, and it is possible that you might wish to deploy those in different ways on the two platforms, in order to distribute your capability a bit more, if you are dealing with different scenarios, potentially. It just adds that element of flexibility.

In broader terms, I think there is an ambition, actually, and a plan to look at using one of the carriers at least as a test bed to start to explore some of the potential for the uninhabited systems that we have been talking about—to deliver, as I suggested earlier, some of those enabling capabilities that would be able to force multiply the F-35 elements that you have. By that I mean the support systems—the intelligence, surveillance, reconnaissance and even, dare one say it, an in-flight refuelling capability to extend your range and therefore the manoeuvring space of your carrier air wing with F-35s even further. There are ambitions to look to that in order to be able to exploit both in a more flexible way.

I take the point that the Chair made earlier that navies in general, and perhaps the Royal Navy as well, have been behind the curve, more so than others, particularly the air forces, in exploiting uninhabited systems. But it is getting the right level of capability that you are looking for, at the right price, that actually multiplies the capability overall and does not occupy space on a very large flight deck—which gives you enormous potential at the very high end—in a way that means you are not exploiting the full potential of that platform, just for the sake of having some uninhabited systems on board. It could be a mix of different systems from the lower end to more capable systems, but a key element to it must be the affordability in order to make the most of what—

Q34 **Richard Drax:** That's fine, thank you very much. Finally—again we have touched on this—the reports are that we will have more US F-35s than UK F-35s on the aircraft carrier. What will the impact of that be? Dan, will you start off? I think you have said that we should not be relying on the US anyway, so presumably you agree that the implications of this are that we need more aircraft.

Captain Stembridge: Yes.

Richard Drax: That is a good answer. Nick?

Nick Childs: Yes, I think that the importance of the current deployment—I don't know if it will end up with more US Marine Corps F-35s than UK ones on the carrier for this training process—is that we are in the build-up process for the UK F-35 programme.

Q35 **Richard Drax:** So we need more, yes?

Nick Childs: Yes. The Marine Corps are clearly ahead of us. In that build-up, it is good to have them aboard, but the key, ultimately, must be to have an independently deployable sovereign capability.

Q36 **Chair:** Nick and I should have declared an interest here. I wrote a publication, supported through RUSI, that I think helped to persuade the Prime Minister at the time, David Cameron, to commit to that second air carrier. There was a worry that it might be flogged off and sold. Thank you for your help then. You have also written a book on carriers, which was very helpful and which I recommend to anyone who wants to learn more about this subject.

A question came out of that, on in-flight refuelling. Nick or Dan, will you quickly confirm there is no ability to take another aircraft—a Growler or a C-2—to loiter to allow F-35s to refuel without landing? We do not have that indigenous capability on board the carrier. The other question I had was, are our Voyager aircraft able to refuel F-35s, or do F-35s operate a different system from the Typhoons that the Voyager can refuel? Dan, you might be closer to this. Shall we start with you?

Captain Stembridge: In terms of air-to-air refuelling systems, if you are operating CV aeroplanes—the cats and traps aeroplane—there is a requirement for air-to-air refuelling on safety grounds, because you need to make sure, if the runway where you are landing the aircraft is out of action, that you can refuel your aeroplanes until it is cleared. That is not the case with STOVL aeroplanes, so you do not need one for the recovery phase. You might choose to have one to enhance your range and therefore your operational capability. Currently on the aircraft carriers, we do not have any capability to do that organically within the UK, but we do with the United States, if we are operating with the United States Navy, because they carry organic tankers within their carrier air wing. Could we do it? Yes, we could with something like the V-22 Osprey. We could do that with air, but you are into another fleet of aircraft that you are now operating from the carrier. Yes, that would give you some degree of enhanced capability. Can we refuel from the Voyager tankers? Yes, we can, because it is probe and drogue, so we have a probe at the front of the aeroplane that goes into a basket that hangs out the back of the airliner, in effect. That is a British design, actually, but it is the same as what the United States Navy, the United States Marine Corps and the Royal Air Force use, although it is not the same as the United States Air Force. That is another reason, which we thankfully haven't gone into today, why we wouldn't wish to buy the A.

Chair: I recall there being a difference in the nozzle systems, and you have clarified that. On the V-22, I am having flashbacks of the same procurement Minister I tried to get to purchase the Osprey, which I think is a great bit of kit, and I was told where to go on that front as well. Speaking of the US Navy and our allies, we have got to speak about the wider context of this. Stuart Anderson, do you want to take us forward on this one?

Q37 **Stuart Anderson:** Dan, you spoke about the SDSR 2015. That review

emphasised the strengthening of interoperability between the UK and US armed forces. It specifically stated: "Collaboration on our aircraft carrier programmes and the F35 Lightning, including the US decision to base aircraft in the UK, will enable us to fly aircraft from each other's ships". That is a good step forward, but how would the US and other allies react to a decision to reduce the numbers of F-35s, or reduce the carrier force?

Captain Stembridge: The first thing is that you would need to go back and check the exact punctuation in that statement from SDSR 15, because we are conflating two slightly different issues. When we are talking about the United States basing F-35s in the UK, those are the A variant—the conventional take-off-and-land variant—which are going into Lakenheath. Those are not able to operate from our carriers and never will be. That is conflating two issues. Yes, from SDSR 15, and indeed post-SDSR 10, there has been significant collaboration between the United States Navy and Marine Corps, and the Royal Navy and Royal Air Force, in terms of operating and collaborating together. I personally think it is slightly disingenuous to bring up the point about basing land-based aeroplanes and then say that this will help us, in terms of operating together, with embarked operations.

To come to your second point, which was about whether it was right for us to say that, I think that definitely sits in the political space. Are we able to operate together? Given the fact that VMFA-211 are over here at the moment and are about to embark in our aircraft carrier, absolutely yes. The United States Navy and Marine Corps have been nothing but hugely supportive. As to whether we should be relying on that, I personally don't think so. It is not my place to say politically, but I am sure there would be a view from politicians about whether that is something we should be reliant on. That is probably about as far as I would go on that one.

Q38 **Stuart Anderson:** Thank you for clarifying the two points there. Can I push you a little more on what you think the reaction of our allies would be to a reduction in the number of F-35s?

Captain Stembridge: Indeed. I think that—for the very reason I am sure you asked—those are very much tied together. Therefore, if there were a decision that effectively looked as if we were buying fewer aeroplanes so that we could rely on somebody else to pay for them and put them on to our aircraft carrier, I don't think that is a place that we would necessarily wish to be. No, I don't think that is a good idea.

How would it be seen by the allies? We are specifically talking about the people who operate the F-35B—the United States Marine Corps, Japan and, of course, the Italians. Those are the only nations that we are talking about. So without being a bit of a cop-out, I would say you probably need to ask them, but they would not necessarily wish to be contributing to our defence budget.

Nick Childs: I would endorse that. It is a good thing that you have the potential to do this interoperability with the aircraft across platforms. Dan also hinted that, in terms of the B and the F-35 at sea, there is now a bit

of a network of capabilities developing with not just the US Marine Corps but the Italian Navy, and Japan's two current helicopter carriers are being converted. South Korea is also looking at going down the F-35B route at sea.

But my sense is that the value as an alliance partner as far as the US and others are concerned is about what the UK can deliver as a sovereign capability. Clearly, as far as the Americans are concerned, they have quite a particular view of what an aircraft carrier is and what it can deliver. Clearly, the UK carriers are not on the scale of the US Navy carriers and do not deliver the full capability, but they are potentially closer—particularly with a full complement on board—than anyone else would be in terms of capability. So, as a strategic asset in an alliance context, being able to deliver a full-complement aircraft carrier capability is what is key for the Americans in terms of things like the substitution question of co-ordinated deployments in order, for example, to relieve US strains in deployments for co-ordinated interests, perhaps in and around the Gulf and the middle east. It is delivering at that level that counts as far as the allies are concerned.

Q39 **Stuart Anderson:** If, as you put it, there was a reduction in that and we did not have the full complement, would that impact on allies' willingness to enter into similar joint projects with us? Dan mentioned the great collaboration we have had. Would this concern allies from a military and industry point of view?

Captain Stembridge: I think, from a military perspective, militaries tend to get on with militaries, and they just want to make it happen. I think it is more in the industrial and political space. The fact is, there is no doubt that one of the reasons we are a benefit to the F-35 programme is because of what we bring, not just in terms of operators, but industrially. We are an intelligent customer, because we build our own aeroplanes and weapon systems. All of these things make you a better partner and customer from a political perspective, a military perspective and an industrial perspective.

Stuart Anderson: Nick, would you like to add on that?

Nick Childs: Only to say that, clearly, the US has been supportive in helping to regenerate that carrier capability that has been gapped for a lower level of capability, perhaps since 2010, or much longer—it depends how you count it. There must have been some assumptions in terms of the resources that the United States has clearly put into that and what they are helping to support. Any variance from that might lead them to look at the level of investment they have provided and the return they get from an allied point of view in terms of the ultimate UK capability.

Chair: We will finally turn to the people who make these things fly. Nick Smith, would you like to take us forward on this.

Q40 **Nick Smith:** The Public Accounts Committee is going to be looking at this topic in the last week of September. Most of my questions have been

answered—thanks to the Committee and the witnesses for helping inform Gareth and me in advance of that Public Accounts Committee session. Right at the top of this session, a couple of our witnesses said that some of the elements of concern included a delay in the supply ships. It was mentioned then, but not since, so I wondered what the witnesses had to say about that difficulty. Could they talk further about it? Thanks.

Nick Childs: That is a critical area. The fleet solid support ships are an intrinsic part of the carrier-enabled power projection capability. From here, it does not look as if they are going to be able to be delivered in the timeframe allowed. That leaves what looks at the moment like a single point of failure, in that only one fleet solid support ship is currently available—Fort Victoria, which has been a fantastic asset in all sorts of different ways, but it is only due to run until 2028, I think.

It is a significant element, not least because—as I mentioned before—one of the assumptions behind the original decision to go with Carrier Strike capability at the level we are talking about, particularly in terms of the ships but also in terms of numbers of aircraft, is delivering at a higher level. That includes being able to sustain it as far as logistics are concerned when at sea, and therefore having these capabilities and these platforms in order to sustain those capabilities at sea is clearly a key, critical element of providing the overall package. Yes, it is a concern.

Nick Smith: Dan, do you have anything to add on that?

Captain Stembridge: They are critical, but they also provide support capabilities 365 days a year, just like our Royal Fleet Auxiliaries do now. Whether that is doing disaster relief in the Caribbean, supporting operations in support of our nuclear deterrence in the north Atlantic, or conducting missions out in the Gulf, they are incredibly valuable, and not just from a Carrier Strike perspective. They are vital.

Nick Smith: Thanks for that. Chair, it seems to me that we are probably going to need one of your important interventions on a defence procurement Minister in the months ahead.

Chair: I have obviously not had much luck in the past, so I am not sure I am going to be any more successful.

We are coming close to an end; we have gone over our time already. Can I say thank you very much indeed to our witnesses today? You have been very helpful, and have given us a huge insight. As you heard, the Public Accounts Committee is doing a concurrent study into this, obviously looking at the finances, but this has been hugely helpful to understanding where this important project is going given its timeline, and also its importance to national security as these things are considered in the wider context of the integrated review.

Justin Bronk has had to sidle away, but we are very grateful to him. Nick Childs, it is good to see you again; thank you so much for your help today. Dan Stembridge, thank you also. That brings to a conclusion today's study on the F-35 from the Defence Select Committee.

HOUSE OF COMMONS