



International Relations and Defence Committee

Corrected oral evidence: Defence concepts and capabilities: from aspiration to reality

Wednesday 20 July 2022

10.30 am

Watch the meeting

Members present: Baroness Anelay of St Johns (The Chair); Lord Alton of Liverpool; Lord Anderson of Swansea; Baroness Blackstone; Lord Campbell of Pittenweem; Baroness Fall; Lord Stirrup; Baroness Sugg; Lord Teverson; Lord Wood of Anfield.

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Questions 133 - 145

Witnesses

[I](#): Dr Kenneth Payne, Deputy Head and Director of Research, Defence Studies at King's College London; Dr Simona Soare, Research Fellow for Defence and Military Analysis, International Institute for Strategic Studies (IISS).

Examination of witnesses

Dr Kenneth Payne and Dr Simona Soare.

Q133 The Chair: Good morning. I welcome to this meeting of the International Relations and Defence Committee in the House of Lords Dr Kenneth Payne, deputy head and director of research in defence studies at King's College London, and Dr Simona Soare, research fellow for defence and military analysis at the International Institute for Strategic Studies. Thank you for joining us today as we continue our inquiry, "Defence concepts and capabilities: from aspiration to reality". We started this inquiry just before Easter and shall take evidence until the end of October. We are deep into it. You come at a time when we are looking to go more deeply into some of the areas that we have not previously covered, so thank you for assisting us with that.

At this stage, I always remind members and our witnesses that this session is on the record, transcribed and broadcast. I also remind members that, if they have any relevant interests to declare, they should do so when they ask their questions.

As ever, I shall ask the first question, which will be rather general in scope. I will then turn to my colleagues for more focused questions. I anticipate that my colleagues, having asked their initial question, may wish to follow that up with a supplementary one related to it. If there is time in our 90-minute session, I will turn to my colleagues who may wish to ask more free-ranging questions.

Let us launch into the first introductory question on these matters. Our previous witnesses over the past few months have noted that the Integrated Review and Defence Command Paper has placed a bet on new and emerging disruptive technologies. Such technologies are developing very fast indeed, of course. We are going to see some of them when we visit Portsmouth later this summer. Yet there is still a lot of uncertainty over their full future military potential. A bet on R&D might also imply a trade-off on other matters, such as force size. Against that background, what challenges would you identify? Dr Payne, may I begin with you? I will then turn to Dr Soare. On subsequent questions, I shall leave it to you to determine who answers first.

Dr Kenneth Payne: Good morning. I am very glad that I was not in this room yesterday; it is still fairly toasty today, although hopefully it will not heat up much further. I am really excited to be here to talk to you.

It is definitely a bet. If I had been here before the invasion of Ukraine, I would probably have given you a different answer, which tells you how much of a bet it is and how much uncertainty is involved. I guess that, if the Integrated Review had been written after the invasion of Ukraine, it would look subtly different in a number of regards, particularly when it comes to that bet on technology.

My own research interest is in artificial intelligence and warfare. It is a bet that still has to be taken that involves changing priorities away from

the immediate towards the near-term future and possibly the further-term future. That is where warfare is going, and it is where our principal ally is going. We need to see a shift in priorities towards new and emerging technology.

However, it is certainly a bet. The story of the Ukraine conflict so far has been that plenty of weapons technologies that are rather venerable—NLAWs, Javelin and so on—have proven their utility in conflict, and inventories of those weapons have been drawn down in that conflict and will need replacing. It is all about striking the right balance.

The Chair: You talk about striking the right balance. Are there particular challenges that you would like us to focus on?

Dr Kenneth Payne: Concentrating on AI, which is my area of expertise, one of the biggest challenges is the uncertainty about what the technology will do, given how fast it is changing—and how defence copes with a technology that is changing week by week and month by month in its capabilities—and that large parts of the cutting-edge activity in that field are happening in the civilian sector, not traditional military suppliers. It will call for some fairly radical shifts in approaches to procurement, weapons testing, systems testing and validation, and so on.

Against that, there is a lot of aspiration but not a lot of detail in the Integrated Review, the Command Paper or the defence AI strategy. If I were in a committee such as yours charged with oversight, I would want to drill into some of that detail of what exactly is involved in the MoD.

Dr Simona Soare: Good morning. It is a pleasure to join you today, and an absolute honour to give evidence before the committee. Thank you so much for the question as well.

The Integrated Review and the Defence Command Paper are certainly placing a bet on emerging and disruptive technologies, but that is equally a move out of necessity. Both documents have a good and accurate appraisal of the challenges that we face from our opponents and adversaries, Russia and China. The two papers document very well the erosion of the technological superiority or advantage that the UK and its western allies and partners have enjoyed since the end of the Cold War. That superiority and technological advantage has been eroded by actions and investments in new technologies such as precision-guided munitions, cyber and space technologies, and technologies that relate to developing Russian and Chinese information-driven battle networks. All these have been eroding our ability to defend our interests and project power in the interests of international security. The Integrated Review calls this bet a once-in-a-generation investment in modernising the force. That is necessary; it is a measure of necessity moving forward.

One of the things that strikes me with both papers is that they are informed not just by the changes in the strategic environment but by a broader potential, or aspirational, whole-of-government approach to the transformational impact that all these emerging and disruptive

technologies—artificial intelligence and machine learning, quantum computing, biotechnologies and human enhancement, and additive manufacturing—will have on our societies more broadly. This transformational impact is increasingly putting those technologies at the core of the strategic competition with other great powers, so it is about not just the ability to defend and secure the UK's interests but remaining strategically competitive in the long term.

With regard to challenges, in comparison to where we were four years ago, the Government today are certainly better prepared and better placed to tackle the challenges that come out of emerging and disruptive technologies. They are also better placed to mitigate the risks and seize the opportunities that come with such technological progress, which is incredibly important. Having said that, there is still a lot of work to be done.

Four broad challenges come to my mind with respect to further action. One of the biggest challenges that we face right now is what one would call the organisational and procedural challenge of adapting to the new requirements of developing and adopting emerging and disruptive technologies, in particular for defence. This is more often referred to as a cultural change; I hope we will get into some detail on this later.

The second challenge relates to the organic development of innovation ecosystems across the UK, and ensuring robust and resilient supply chains for all the priority technologies that we are interested in fostering.

The third challenge is closely related to security, and is to do with the protection of innovation. If innovation is giving that competitive edge in defence, and geoeconomically more broadly, it needs to be protected. The Government have a very heavy burden on their shoulders in figuring out how to better protect that innovation.

The last, but no less important than the others, is the challenge of ensuring sufficient, sustainable, diversified and flexible funding to support that innovation.

Q134 Lord Stirrup: Good morning. Part of the title of this inquiry is "from aspiration to reality" so it is only partly about what the Integrated Review and the Defence Command Paper say. It is much more about the "so whats", which we have already started to touch on.

One of the key areas of transition from one state to the other will be in leveraging rapidly usable research and innovation into military capability. The previous Chief of the Defence Staff, General Sir Nick Carter, said that the UK is probably better placed than most other nations to do this. Dr Soare, you sort of said the same thing—yet, a few seconds later, you listed a whole raft of reasons why we are probably not better placed than many other nations. We have had other witnesses who have expressed scepticism about this, by the way.

It certainly seems that the statement should be, "We could be better placed than other nations to do this", but it is not at all clear to me at the

moment that we are. Could you go into a bit more detail about the structural and organisational issues within government and the Ministry of Defence? For example, do DSTL, Defence Equipment and Support and UK science and technology make it organisationally difficult to take innovative and sometimes apparently wacky ideas, pull them through the process of assessment development and into production capabilities so that they actually end up as real military power on the ground, on the sea or in the air?

Dr Simona Soare: Let me start by saying that what I have done in my own research is look at all the countries across the transatlantic area, big and small. My analysis, and my testimony to the committee today, is informed by that comparative analysis. It is my belief, at least from the data I have looked at, that the UK is potentially better placed than other countries on the European continent to rapidly leverage innovation and technological progress in the private sector for defence purposes. All of the moves, actions and structures that have been newly created by the Government to support that via the DSTL—be it the upcoming structures for supporting investment in and the adoption of AI, or others, such as ARIA—are contributing to consolidating the innovation ecosystems on which our ability to develop cutting-edge technologies will fundamentally depend.

Because emerging and disruptive technologies are now more rapidly and comprehensively developed by the private sector, the Government have less control over how fast they are progressing and developing. That control and challenge of adoption are amplified even more by the fact that we have structures and procedures. I am referring here to the procedures to progress R&D projects down the pipeline, for instance, or transition them across the so-called “valley of death” between R&D and procurement. All these procedures were developed for a time when Governments had much more control over the development of those technologies. We are at a point where we need to adjust that.

I believe that the UK has started to make those adjustments but I also believe that it is fairly early to say whether they are fully effective for the task at hand. This is where the aspirational part comes into it. I do not think that there is anything wrong with being ambitious—the times we are living through right now call for higher ambition because the stakes are so high—but that does not mean that our approach cannot be flexible. The challenge before us, with the adoption of emerging and disruptive technologies in defence, calls for an ambitious plan and a long-term vision. However, it also calls for frequent and detailed adjustments to that strategy over time to make sure that we stay within purpose and keep an eye on the ball, as it were, on the most important goals.

I shall comment briefly on some of the challenges of the current ecosystem. You mentioned the DSTL earlier. One of the key points in establishing the DSTL was that it could give the MoD an alternative. The MoD can develop the requirements but you then have access to a broader range of stakeholders from industry and academia, all of which can contribute and compete for excellence in achieving a solution. One of the

challenges that I still see with how the DSTL is working right now is that requirements sometimes come with the expectation of what the solution should look like. If we are developing a solution because we are trying to consolidate our land forces, we would expect the solution to look like a tank. If it is for the Air Force, we would expect it to look like a fighter plane, and so on. There are so many examples that could be brought into this category.

However, DSTL can function in an open innovation ecosystem by allowing more disruptive innovation to come to the fore and challenge some of the expectations. I am not talking about changing the requirements themselves, which of course need to be strict from the military point of view, but about keeping more of a flexible approach to what the solutions should look like. That is the added value in having institutions such as DSTL, UKRI and others down the line.

Dr Kenneth Payne: In respect of competition, or pegging ourselves against rivals and allies, it is hard to know where either of those two groups are. That is particularly true in the sense of competitors.

Recent events in Ukraine have shown that we have overestimated the amount of military modernisation that has been effectively achieved in Russia. Putin has this famous quote that everyone bandies about, “whoever masters AI will rule the world”. It looks abundantly clear that it will not be him. You see extraordinary footage of Russian fighter aircraft with cheap Garmin navigation aids—bought off Amazon, presumably—of the sort that I use on my racing bicycle. It is the stark limitation of the shallowness of some of Russia's modernisation efforts.

China is a different challenge. What is interesting from the Chinese perspective is that a lot of the discussions that I suspect you are having here and I am certainly having day to day, about the challenges facing the British military in modernisation and developing new technologies, are happening in China as well. If you look at the internal Chinese discussions that have been translated and analysed—a lot of good work is being done at Georgetown University on that—they are having interesting debates about the limits of their ability to develop and innovate new technologies, including AI, and then to instrumentalise that in the military domain too.

The Chinese point to some fairly big bottlenecks in terms of hardware, such as semiconductors, and in terms of talent. In the West we have done a sterling job of educating a generation of Chinese scientists over an extended period, but they still feel that they are experiencing talent bottlenecks. It is not clear that their overall ecosystem is as good at generating innovation with basic scientific research, still less translating that into effective military technologies, as America certainly is and perhaps as the United Kingdom is as well. We need to be careful about projecting our fears on to potential adversaries too much.

When it comes to our allies, America is obviously an outlier. We are often drawn to comparing ourselves with America and aspire to have a full-

spectrum military capable of doing some of the things that America does and takes for granted, albeit it on a smaller scale. However, if you look at the amount that America spends on research and development, its latest defence budget is extraordinary—the one that is currently wending its way through Congress, where I suspect the military was surprised to receive substantially more than it had asked for. Would that the British military was in a similar position. It is hard to get a sense of where we stand in the middle of that.

On the UK and its issues, you asked specifically about DSTL. One of the challenges there is to know exactly as an outsider what is going on at DSTL and how effective its research is. There are a large number of scientists, a fairly big budget and lots of it is classified. How do you go about discovering what is being done and how effective it is at translating basic research into applied functions?

However, I would say that it is easier for me as an outsider to get a handle on the broader defence cultural issues when it comes to innovation. The pattern there is one that I am sure you are all familiar with. We have a model that is predicated on developing exquisite technologies and a drive to be at the absolute cutting edge, which means incredibly low volumes, cost overruns, long lead times, a handful of suppliers specialising in making this kit and the challenge of keeping pace over extended procurement cycles with changing requirements so that you are designing and building the F35 at the same time.

That model, to me, is a world away from what I see when I look at DeepMind in Google and OpenAI and the very rapid innovation cycles that are going on there. That is the essential challenge for the MoD: how far does it, should it, and could it switch to a more disposable procurement cycle where it recognises the advantages of AI, for example, lie in scale and in mass, potentially disposable platforms with incredibly short shelf lives? How do you switch from a model where it takes you 30 to 40 years to develop an air superiority fighter? That is the challenge.

Q135 Lord Stirrup: If you are to leverage this sort of innovative approach to research, experimentation and so on, failure and the acceptance of failure has to be a key element within that. How does that fit within an organisation that has accounting officers responsible to Parliament and Ministers who have to answer aggressive questions from across the aisle about expenditure?

Dr Kenneth Payne: It is challenging. There is abundant failure on a large scale and money squandered; you see that year on year. It is not easy. I do not mean to malign the efforts of people in the MoD and procurement and development to do an honest job, but you will be well aware of the various big-ticket items that are over budget and underperforming. You could say, where is the accountability for that? Who was the last person to lose their job over this—beyond a telling off in a committee such as yours?

Again, it is the question of balance. I was very much taken by the recent and rapid cancellation of the RAF's Mosquito uncrewed Loyal Wingman project. It had not been kicking over for a long time and was abruptly halted. I take that as an encouraging sign, rather than a depressing one. I had my doubts about the whole Loyal Wingman concept anyway, but that is a separate issue. What I liked was that a line was drawn under it fairly rapidly. That is where you need to be: more like the aviation industry, whose enviable safety record relies on striking the right balance between owning up to your mistakes and being responsible for them, and not necessarily being publicly flogged for them. I think that is the trick.

Q136 Baroness Blackstone: So far, you are giving the MoD a relatively clean bill of health and certainly suggesting that in comparison with our European allies we have a better record in terms of innovation and meeting the challenges of new technology, AI and other changes.

However, there is a lot of criticism of the Ministry of Defence in terms of the need for cultural change. You have touched on this, but could you say a bit more about it, giving some illustrations of where you feel these comments are unfair or there is some merit in these criticisms? If there is merit, what would you like to see the Government doing, not necessarily just at the MoD but across departments, in working more effectively, particularly with the private sector and businesses, but also with academia and other stakeholders?

Dr Kenneth Payne: I do not think I would give the MoD anywhere near a clean bill of health, but I certainly acknowledge the difficulty of the challenge. I would go so far as to say that the procurement process is hugely and extravagantly wasteful on many projects, and in doubling down on investing in sunk costs and chasing projects that are perhaps less relevant. I could name projects, such as Watchkeeper or the cost overruns on Astute. The F35 programme itself is a success now, but it massively overran and was over budget. There was also the the cancellation of the Warrior infantry fighting vehicle.

That is not good, but what is the alternative? We have a wasteful process where we feed a lot of sausage meat into the sausage plant, and out the other end, after plenty of waste, emerges some useful military capabilities, some of which we are seeing being used in Ukraine now.

I do not think I would compare any of our European rivals favourably with the situation here; it is always a slight finger in the air exercise to gauge military power, but I think we compare favourably with most of our European rivals when it comes to the procurement and weapons development process.

For me, the challenges and the way that you improve it are in how you tackle those cultural issues in an organisation where people belong to a particular service stovepipe. They grow up through the ranks; there is no lateral entry and little outside influence. How do you tackle those cultural issues? That is the real challenge, and I do not think there is an easy solution; otherwise, it would have been reached many years ago. These

are issues that this committee would have been talking about decades ago and will be talking about decades hence.

The challenge is to open the organisation up to the outside. That is why, in respect of AI, I am moderately encouraged by the MoD's efforts to do so by engaging with academia and through things such as its partnership with the Alan Turing Institute and its engagement with UKRI. So there is no easy answer. You are right: I would probably give the MoD a soft pass.

Dr Simona Soare: I agree. I would not necessarily give the MoD a clean bill of health on the measures that it is implementing right now, but that does not mean one cannot recognise the steps that it has been implementing over the past years. When I said earlier that it is certainly better prepared to tackle some of the challenges and seize some of the opportunities that arise emerging and disruptive technologies, that only gets us so far towards the goal of leveraging that technological progress and putting it into our military capabilities.

There are many aspects that come into play when we talk about cultural change. One of them is the ability to evolve our approach to taking risk. Some risk is merited, especially when it comes to flexible and smart investment in emerging and disruptive technologies and proofs of concept early on. Others, on the more procedural side, are turning into obstacles to our ability to rapidly make use of these technologies and adopt them in defence. As Kenneth was saying earlier, with some specific technologies on the digital side in particular, that gap in procurement cannot be this long because we are going to end up with capabilities that are obsolescent or obsolete by the time they actually go into service. The reason why that is important, in my view, is that the technological development stage that we are at now allows technical performance in UK Armed Forces military equipment to be roughly at a scale that is met by our adversaries.

Like Kenneth, I think that one thing the MoD got right was threat assessment. It is very clear: we know who the opponents are and the UK understands better how those opponents are fighting and preparing to fight, both on the battlefield and below the threshold of armed conflict. It is attempting to channel its policies towards closing that vulnerability.

Russia is never as weak or as strong as it seems. The lesson that I take from the Ukraine war is that we need to get better at understanding the Russian challenge and Russia's defence innovation pipeline, because we are now swinging from overestimating its modernisation towards underestimating the steps forward. That is a very challenging and dangerous swing.

There is another part of the cultural change that I see. You mentioned broadening our relations with the private sector and academia. That is probably one of the most challenging aspects of changing how we tackle emerging and disruptive technologies. It is about establishing new types of partnerships and new types of engagement with industry and

academia, especially those that have not been active in the defence sector before and might have some apprehension about engaging with the MoD.

Key to that, in my analysis, is trying to lessen the bureaucratic burden for entry to MoD projects for all the start-ups and academic actors. Granted, that is happening to some degree. DSTL and DASA in particular are trying to do this—they are trying to shorten award times and to shorten the application forms—but, by comparison, our closest ally, the US, has award times that are measured in weeks and its application forms are five to seven pages long. The UK's are not. That is a really hard burden for a start-up which might develop a really exciting application for artificial intelligence, quantum or space debris clearing but has only five employees. It takes a long time to put together an application. That is definitely one of the challenges that I see. Procurement has already been well covered, and I acknowledge that that is also a big challenge.

Another challenge here is the fact that the MoD is still searching, and still on a learning curve, with respect to how to materialise that co-operation with the private sector and academia. Efforts are ongoing within the MoD more broadly to revamp the approach to R&D, shorten initial project cycles to 12 or 18 months, and foster more competition at these early stages. There are ongoing efforts to rethink contracting. For instance, the defence AI strategy mentions co-development, which is a big step. It lacks detail but it is definitely something worth pursuing.

A really big challenge in engaging with the private sector is being able to accurately communicate, and do so early, about what your goals and requirements are. That has been one of the big handicaps in how we were trying to engage with industry before. I see some encouraging signs with the newly launched defence capability frameworks. At least we have the promise of that early engagement and better communication, and we will see how that plays out in implementation.

Q137 Baroness Blackstone: You have cited a number of areas where you think there could be improvement. If you were appointed as a consultant to provide some of the solutions—this question is for both of you—what would you come up with? You have identified problems such as overlong application forms, too much bureaucracy, very long timescales before contracts can be signed and not terribly accurate communication with the private sector. What needs to be done to make the department better at all this? Is it something about the skills of the people doing the job, something about their training or the fact that the department is too closed and there are not enough secondments in and out of it? Could you tell us a bit more about what we should be recommending in order to solve the problems that you have cited?

Dr Kenneth Payne: The things you have mentioned there are entirely apposite. There is a skills challenge, particularly when it comes to AI, which is a fast-moving technology. The military is, broadly speaking, a generalist organisation, where officers rotate from post to post on a two-year basis, and those things work against the development of deep

subject matter expertise and staying current in busy, high-tempo jobs with fast-moving technology. So there are real challenges, many of which are not easy to solve.

I would point to one good thing, the jHub, a unit within Strategic Command, as an example of a reasonably small-scale attempt to “Dragon’s Den”-ify engagement with technology actors for reasonably small projects, positioning yourself slightly at arm’s length from the mainstream military to allow yourself to do that. That is a good example of what the MoD is doing.

To mention one challenge, I was particularly struck by the contrast between Britain and the United States when it came to the latest DARPA dogfighting challenge. This was a sensational breakthrough in simulators, in a competition between, first, automated pilots and eventually a human pilot. The winner, Heron Systems, was not a prime contractor but somebody no one had heard of, yet it saw off Lockheed Martin in the earlier rounds of the competition. When I saw that, I thought, “Could I see the MoD doing that? I’d really like to see it doing that.” My question for the PUS or whoever, if they were sat here, would be, “Where is your dogfighting challenge? Why isn’t it open to anybody to enter?”

Dr Simona Soare: I fully recognise the challenges you listed. I would start with the organisational challenge. While some analysts would say that innovation needs to be deregulated, that you cannot organise and plan for innovation, and that you certainly should not increase the organisational burden on innovation, successful examples of structures in the UK and abroad suggest that some level of planning and organisation is required. So we need to have the right processes in place to know how quickly we can transition and how we can fast-track innovative solutions when they prove to be of significant added value, especially on the defence side, or when they can provide that immediate disruptive added value for defence. That is to do with procurement. That reform is slow in coming and that is one of the really tough nuts to crack.

The way I see it, the other solution is that we need to get better at communicating the effects we want to achieve and our requirements for any kind of military capabilities that we are developing. That can be done through a number of platforms, both existing ones—DSTL, DASA and others—but also through new forms of engagement with start-up associations and putting out more frequent challenges that can help the MoD to have broader access and increase its tech-scouting capabilities more broadly.

The skills challenge is very relevant and important. It is not one that the UK alone is confronted with; this is a general challenge, and not just for defence. It has some specificity to it. The MoD seems to be aware of it. There are some plans, for instance, to implement tech-specific skills frameworks. The defence AI strategy at least goes into some detail about that and about how those skill sets would need to be adjusted based on the roles that different people in the organisation play; one would not

expect the same skill sets of an operator of military equipment and someone contracting in procurement.

There are also some potential challenges with that approach, because we are not seeing the more fundamental changes that are required. For example, the MoD and the Armed Forces rotate personnel depending on need; that is the *modus operandi*. To better leverage the skill set that exists now with immediate effect, but also for the long term, with respect to bringing in new human talent and experts, that would need to be changed and adjusted so that specific skill sets were more prominently taken into consideration.

Dr Kenneth Payne: I shall add a concrete example of that skills challenge. The ministry recently advertised an ethics and AI job. This is a key job—perhaps the key job—in the Defence AI Centre, given public unease about the way lethal autonomous weapons will be used or, more broadly, the way society engages with artificial intelligence, surveillance and so on.

This job, which to me is extremely important, attracted a salary of £40,000. I am fully aware that you are not going to get rich working for the Government, but the challenge is how to compete for people in an industry where salaries are extravagantly high. The number of people who could credibly apply for that job is reasonably small, and that is a real bottleneck.

The Chair: Thank you for that added information. It puts it all into context.

Q138 **Baroness Fall:** I am going to stick with the same area and look in more detail at the relationships in R&D for civilian versus defence purposes. With the Covid vaccinations, we saw the private sector come up trumps and then this became something owned by Governments. With the defence version of that, could we be more innovative? How do we share between the two? What are the drawbacks, especially in relation to IP theft?

Dr Kenneth Payne: The vaccines were a tremendous private sector triumph, as you say, but it is hard to disentangle that entirely from public sector funding, because a lot of those researchers will have been funded by UKRI during their career, including in work that is salient to developing those vaccines. Disentangling the two is a challenge.

In AI, you have an added problem. There is a loose analogy with the Pugwash conference of the 1950s. A lot of cutting-edge AI researchers are extremely uneasy about seeing their work used in a national security context. In fact, a lot of the leading private sector research corporations are explicit about their reluctance to do work that might contribute to national security issues, whether on facial recognition systems or, more broadly, any sort of decision-making technology.

So there is a real challenge about how the public sector in the modern age leverages the undoubted skills of the private and university sectors.

It is a sea-change for AI. For most of AI's history, the Governments here and in the US have played an outsized role in shaping the field, in large part with national security in mind.

The arrival of the big information companies—Amazon, Facebook, Google and so on—has changed that landscape. It is unavoidable that most of the bleeding-edge research will be done by corporations, DeepMind especially, that have hoovered up a large part of the talent in the field, including from the university sector. So that gap is unavoidable. There are still very capable researchers working elsewhere and there are still plenty of companies that are happy to work in the defence sector. But it may be that the gap between basic research and applied research is wider in the AI field than it is in other technology fields.

Dr Simona Soare: I recognise that the relationship between civil and defence R&D is changing. While civilian R&D continues to be a much larger part of our spending, we as Governments are increasingly outspent exponentially by the private sector. I agree with Dr Payne that better leveraging private sector R&D is very important moving forward. That is one of the challenges that we are currently seeing with adopting emerging and disruptive technologies in defence.

I will give you an example of the scale that we are at now. This is not from the UK—unfortunately, we do not have that data yet for the UK—but the US has established a Defense Innovation Unit, which has offices attached to all the major innovation hubs across the country. For every \$1 billion that it contracts, that it awards contracts to the private sector for, it leverages on average \$20 billion in private sector R&D.

I think someone mentioned the best practices of the private sector. The example of the Covid-19 vaccines is something that we also need to take into consideration. The fact that the vaccines could be developed and deployed so quickly is testimony to the quality of our research and development, but also to decades of R&D that were put to good use.

When one talks about leveraging R&D in the private sector, it is common that one would say, "We need to move as fast as private industry does". That is not often associated with a detailed understanding of just how long it takes to pull through a technological breakthrough in the private sector too. Most of us carry phones in our pockets today and we get new software packages pushed through once or twice a year. That is the rate of technological modernisation and change, but it probably took the company a decade to develop the product initially.

There is an issue with leveraging civilian and private R&D better. There is also an issue of putting things in context more accurately—that innovation takes a long time to put through. We need to carefully manage expectations in investment in particular, about when solutions can actually become available.

DARPA is one of the successful examples that is usually referenced in the case of our American allies, but the return on investment for innovation

in DARPA is nearly 15 years. That is a long-term approach. Yes, it is incredibly important when it comes through, but understanding that dimension and that challenge are also important.

Dr Kenneth Payne: You asked about espionage as well.

Q139 **Baroness Fall:** Yes, and that can be my follow-up. Obviously there is more scrutiny around inward investment with the NS&I Bill and its very broad non-definition of national security—let us put it that way. To what extent do you think there is enough safeguarding around IP between defence and non-defence, where they share the same IP?

Dr Kenneth Payne: It is a real challenge. Again, there is nothing new here. If you look at weapon systems fielded by our main competitors—China and Russia—they often bear an uncanny resemblance to technologies that were developed five years ago in the West. This is a long-standing issue, and, if anything, it is exacerbated by the extent to which AI especially is code—it is very pinchable. Also, the people who develop the basic research oftentimes have an interest in getting it out into the world. Their interest is not necessarily the same as the Government's in safeguarding key technologies.

None the less, I am still reasonably confident, because my view is that the bleeding edge in AI technology—I spoke about the shift that is needed in procurement to a more disposable, rapid cycling and fielding of technologies—conveys a disproportionate advantage when it comes to AI. You do not get to the forefront of automated military technology by emulating; you have to innovate. It is not clear that the innovation ecosystems of our adversaries—particularly the Chinese model, where there are high levels of corruption and of centralised control, and with its very top-down, directed approach to R&D, as in other economic areas—are a better model. That is certainly not a better model than the very rich, multifaceted ecosystem that the Americans have developed.

Dr Simona Soare: I have a quick follow up to what Dr Payne said. The challenge with tackling or mitigating the risks from espionage and IPR theft are double. One is that this sort of espionage, given the war in Ukraine and the comprehensive sanctions package against Russia, will likely intensify over the short and medium term. We have seen some signals from the US Administration that that might be the case. We know that Russia is actively looking for ways to bypass sanctions and continue to maintain access to foreign technology, particularly western technology.

This was one of the challenges that I flagged up at the beginning: protecting our technological innovation is increasingly important. Not everything will need to be protected. I see this coming through in the Government's approach to S&T. I see it somehow resonated into the mechanisms for FDI monitoring. But there are some gaps that need filling.

I will start with foreign direct investment. In my own research, I have looked at what the capital markets are investing in, both in the UK and on

the European continent. The UK is fortunate to have a robust capital market to invest in new technologies here. It is one of the biggest investors on the European continent. However, we also have to recognise that we have foreign funds residing in the Indo-Pacific, and Russian venture capital funds that are still active on our markets right now, that are investing in critical technologies that have important security and defence applications.

I have looked recently, and one of the top 10 investors across Europe, including in the UK, is the Skolkovo Foundation. The Skolkovo initiative in Russia is recognised for not producing much in terms of innovation internally in Russia, but it is one of the top 10 investors by number of agreements and by the amount associated with those agreements, in key clusters of emerging and disruptive technologies that we are talking about. Other examples can also be brought to the fore. That is a very important pipeline that our adversaries have to access our science and technology and our technological base. The challenge with that is that investments often come in pre-seed and seed sessions, which are well below our FDI monitoring ceilings. Presumably an adversary, for £15,000, can get access to the cutting-edge orbital debris clearing technology, which one would argue is something that we need to protect.

Efforts are being made by the Government to close that gap, and I think the National Security and Investment Act will help with that, but ultimately one needs to expect an increase in espionage and trying to illegitimately and illegally get access to our technology. One would also expect us to better protect and monitor our own supply chains, especially the ones that are global in nature, to ensure that critical components, such as chips and semiconductors more broadly, do not end up in the wrong hands, because they have contributed significantly to increasing the military capability and efficiency of our opponents.

The Chair: Thank you for the cautionary note as part of your answer to that supplementary question. Clearly, at this stage, the enemy is time, let alone those outwith this country. So in the interests of time I invite Lord Anderson and Lord Teverson to ask their questions together for our witnesses to reply to, because they relate specifically to R&D spending and I am aware that we have covered some of that issue already; there has already been some contribution on that, particularly in Lord Teverson's question, so it might be possible not only for the noble Lords to ask them together but for the answer to be cohesive.

Q140 Lord Anderson of Swansea: As our Chair has said, R&D spending will invite a variation on several of the themes we have already touched on. You will be aware, of course, that in the Defence Command Paper the Government committed £6.6 billion to research and development experimentation over the next four years. I quote from that document: "This aims to implement a set of R&D pipelines which will address critical and enduring military capability challenges to deliver a decisive strategic edge". Can you say how effective and efficient the UK currently is in terms of defence and R&D expenditure? Is that £6.6 billion investment

adequate to meet the goals?

If I may add to that, given the fear that much of the increased European defence expenditure will go to the US—the example cited is Germany, whose first major expenditure, of €100 billion, was on F35s—do you think that there is a danger of much of this R&D expenditure going outside of the UK, on collaboration, partnerships and so on?

Q141 Lord Teverson: My question is primarily about risk appetite, as they call it in the City. You have largely answered it in many ways but any extra comments would be useful.

I am aware that the Defence Command Paper talked about things called innovation hubs, which we do not have much information on. I would be interested to hear about them. I just want to put a bit of balance in there. One of the papers that was circulated was the amazing House of Commons Select Committee report on the Ajax vehicle. We are told in it that it is a multi-platform, digitised, multi-domain vehicle that is extremely innovative, but the interesting thing to me is something that was not said. There was no criticism of all the clever stuff. The fact was that they could not drive it because it made too much noise and vibrated too much—something that, in the old days, even British Leyland would have got right. In its solutions, the one thing it did not mention was WD-40, which is what I would have used and would have thought would solve it. We are useless. Did we get all that difficult stuff right but forget about the easy bit?

Dr Simona Soare: Thank you for all the questions. They are incredibly relevant to our conversation. I will start with R&D spending effectiveness. I welcome the fact that the Government have decided to increase spending on defence R&D; £6.6 billion is not to be discounted, and it is definitely the largest spending on the European continent right now. It puts the UK in a position to better use research and development and better leverage technological progress for its military capabilities for a country of its size.

However, I would also argue that £6.6 billion will ultimately not be sufficient to meet the Government's ambitions when it comes to the next generation and the generation after next's capabilities. I would also argue that this R&D pot potentially should take into consideration retrofitting legacy capabilities. One cannot wait until 2038 to tackle urgent defence threats.

Perhaps one of the ways to increase capacity and capabilities in the short term is to deploy emerging and disruptive technologies to military equipment that we already have and we know works—with some exceptions, of course. That would be a good interim solution. However, to tackle all those threats, £6.6 billion will probably not be sufficient, which is why it is so much more important that the Government are better at leveraging private R&D and the financially superior investments that our private sector makes.

Why not also leverage the technological strengths of investments that our close allies and partners are making? Keep in mind the fact that technological sovereignty is important. Close co-operation with allies and partners is important too, but there are certain technologies and use cases that one would strive to own and control on a sovereign basis. Perhaps the prioritisation within that pot of £6.6 billion is very clear; the need for prioritisation, along the lines of what we would need to ensure technological sovereignty with great priority, is important.

When it comes to risk appetite, we have probably missed the opportunity over the past four to six years to build up internally—within the Government—the narrative about increasing our tolerance to risk, especially when it comes to adopting emerging and disruptive technologies. There are great challenges with respect to artificial intelligence; Dr Payne alluded to them. In many ways, they are unprecedented. However, that does not mean that we should not at least make an effort to better understand what potential use cases these technologies can be deployed for. We are still at a level where we have not yet decided.

If I look at the evolution of strategic papers, from the Integrated Review, the Defence Command Paper and the defence, technology and industry strategy to the defence, science and technology strategy and the defence AI strategy, I see the same language with respect to emerging and disruptive technologies, in particular AI: that it poses both risks and opportunities. That is a generic way of framing things, but it also suggests that perhaps we are not as advanced as we should be in understanding what particular use cases these technologies have. This will be a significant limitation on our ability to scale successful models of artificial intelligence or other types of technologies rapidly. That is why, for instance, we currently have at the service level—this should be recognised—excellent pockets of innovation that none the less face significant challenges in scaling up rapidly. That is important to mention.

The defence AI strategy in particular acknowledges this. We will see how it goes with implementation, but it says that we need to educate leadership at different levels within the MoD and the services to take risk and understand what the technology can do for them. That is a really good step in the right direction; it should be reinforced really boldly in implementation.

With respect to innovation hubs, my understanding of open innovation systems is that innovation hubs happen organically as the ecosystem develops and matures. That is not to say that the Government do not have a role to play in them. Especially on the S&T approach, the Government have taken it upon themselves to intervene and support the development of these hubs.

We have examples. For instance, DASA has a hub with Imperial College here in London where it fosters engagement with the private sector and offers spaces for the private sector to come and work together on specific applications. There are many other examples at the service level which

have put forward battle labs or accelerators in the context of specific innovation hubs. At least we see some encouraging movement

Dr Kenneth Payne: On the hubs, an example might be one that DSTL is standing up via the Alan Turing Institute in September, which was announced this month. My understanding is that it will be relatively small scale; we are talking about eight to 10 permanent members of staff. If that is the scale of the ambition or representative of it, that would seem to be quite small beer.

On the R&D budget, I cannot get my head around the mismatch between the scale of our ambition and the way in which we unreflectively see ourselves bestriding the globe as a world-leading military, and the fact that, on the other hand, we have the smallest Army in a very long period of time and an armoured fighting vehicle that shakes and rattles a lot. There is a real mismatch. If you look at the amount that the Americans are spending on their defence budget on R&D, it is \$130 billion, which has gone up 9.5% in a year.

Unreflectively and in our heads, we anchor ourselves to that. There is a moment where I catch myself and think, "Get real, what do we think we are doing?" What are the limits to what we can achieve as a military power that is still a large economy but one that faces some troubling headwinds more broadly and outside the world of national defence and security?

There needs to be a certain stocktaking moment where we need to think. "Can we really be at the cutting edge of hypersonics, quantum computing, AI and so forth?" Rather than a full-spectrum military—for various political reasons we find it hard to turn our heads to our European allies at the moment—we might like to think more cannily about how we combine usefully with our allies to offset and complement one another's strengths and weaknesses.

Lord Teverson: Without trying to sound naive, one of the most successful civil R&D programmes is Horizon, which we are still trying to be a part of. Could there be an equivalent on the defence side, or is it just too dangerous in terms of secrecy? Why could we not combine that budget and do a heck of a lot better?

Dr Kenneth Payne: Members here will have much more experience than me, but the knitting together of the various national elements in European defence and security has a long track record of being problematic.

I jotted down that there are currently three sixth-generation fighter programmes around the world, but there is only one viable 5th generation fighter programme—the F35. So, somewhere between here and the next generation some head scratching is going to have to be done.

Dr Simona Soare: The European Union, if we are talking about Horizon, has an R&D budget for defence through the European Defence Fund. I think the committee knows much better some of the challenges with the UK having access to that—really with the willingness to have access to that. The European Union has a budget in place to support R&D for defence and it has really been one of the leading measures that the EU adopted starting in 2016 on revamping European defence.

Lord Teverson: Has it worked?

Dr Simona Soare: There are a number of projects in the pipeline that at least look interesting. There are some significant challenges and problems in the way it is being implemented. It is a multinational instrument that depends on the will of the member states, so how fast it can run and what it can deliver are entirely up to the member states.

The Chair: That is a very diplomatic answer.

Q142 **Lord Alton of Liverpool:** Dr Payne, you said that when it comes to artificial intelligence there is a lot of aspiration but not a lot of detail, a point reiterated by Dr Soare. In inviting us to drill deeper, you said that we need a radical shift and to take a bet, because this is the way our allies and warfare are going. Last month, the MoD, as you reminded us, published the *Defence Artificial Intelligence Strategy*, setting out how it will “adopt and exploit AI at pace and scale, transforming Defence into an ‘AI ready’ organisation and delivering cutting-edge capability”.

Without giving either a public flogging or a soft pass, based on its track record how realistic is the strategy and its implementation? There is a Procurement Bill before Parliament at the moment that was described by Professor Louth in evidence to us last week as being long on rhetoric, legalese and detail, but almost incomprehensible even to academics. What difference will that make to our procurement policies, not least in the area of AI?

Dr Kenneth Payne: That is a very difficult question to answer, because I have as much detail as was in the defence AI strategy and in conversations on the bazaars. You always want to be led into the secret rooms where the plans set out in minute detail how the structures and processes are going to change.

There is a lot of ongoing experimentation work. The RAF has a swarming drones squadron. In Salisbury, the Army Futures directorate is experimenting with robotic warfare systems, and a lot of thought is going into the sort of concepts that might be applied to knit those bits of kit together. It is a bit like heavier-than-air aviation before the Great War. It is a bit “Wacky Races” at the moment, and it feels very much—again this is slightly finger in the air—as if it is a bolt-on to day-to-day business.

For me, the defence AI strategy is a clear signal of intent. When the chiefs were all in the running for the top job last year, every one of them gave a speech where AI was “the one ring to rule them all”—that is the one I remember from Patrick Sanders. Clearly there is a top-down

aspiration, and the defence AI strategy is a statement of that. Now it encounters culture, “business as usual”, and what that actually means. How do you go from 20 drones operating together in a small DSTL project to fielded systems at large scale? The answer is that there is still not a lot of detail about that.

In my evidence to the Integrated Review, I called for the creation of an AI stream operating between and betwixt the services as a specialist branch, in the same way that space and cyber might be developing their own domain expertise. That is touched on in the defence AI strategy, but what does it mean concretely? There is still no definitive answer to that.

Lord Alton of Liverpool: And what difference will the Procurement Bill, which is now before the House of Lords, make to procurement and to AI in particular?

Dr Kenneth Payne: I am afraid I do not know. I would have to come back to you with a written answer, as I have not considered the Bill.

Dr Simona Soare: The AI strategy, at least in my analysis, strikes some good notes. It talks about the need to build public and internal trust in this new stack of technologies and specific applications. It recognises really big problems with human talent in the organisation and the importance of organising for these kinds of technological adoption challenges.

Where the strategy requires perhaps some careful management is expectations. The strategy talks very much in terms of ambition; it places the UK as the leading AI power in its size group. However, in the short term, if we read the strategy, what it expects to deliver are the fairly low-hanging AI fruit. This is the back office uses, or what one would call the completion of digitalisation or the digital transformation—the deployment of AI in back-office uses—and some limited uses when it comes to logistics and maintenance, for instance. It will not necessarily be in operational roles, deployed at the edge or deployed on the battlefield directly.

There is an implicit recognition, at least in the way I read the strategy, that that is a much higher challenge and will require more investment, experimentation and investing in verification, validation and certification capacity. It is really important to recognise that about the strategy and to manage expectations about what it can do. I am expecting more detail to come through the implementation plan. This is a strategic document, of course, so one would not expect every detail to be included in it or else we would end up with a 400-page document. That is not unprecedented but perhaps not necessarily conducive to the process. I hope the implementation plan will give that greater level of detail.

Another challenge with the implementation of the strategy is that there are no clear metrics for measuring progress that I can see. I am deliberately not saying “success” here, in the light of the conversation we just had about failure and accepting greater risk of failure in R&D. My

hope is that the implementation plan maps out some milestones and indicators that committees such as yours can use to measure progress, and to track progress in the adoption of those strategies. I hope that will be something that we can look forward to.

- Q143 **Baroness Sugg:** I want to ask about ARIA, which has come up in your earlier evidence, and how it compares to DARPA. Obviously the aim is to go after this high-risk, high-reward R&D, but we have seen a delay in its implementation until the end of the year, although I think it appointed its first chair and CEO yesterday. Its funding commitment is only £800 million and it is a little unclear how its relationship with defence will work. Do you think ARIA is best able to replicate DARPA's successes, given those constraints? How can it work alongside the current R&D environment to make sure it complements rather than competes with existing defence R&D?

Dr Simona Soare: There is always a challenge in looking at foreign examples of success in innovation. The challenge, if we want to internalise that successful model, is that it comes with a really high burden of adapting it to the UK's innovation ecosystem. ARIA would not be the only body investing in high-risk, high-impact and high-reward innovation, one would assume, so I would expect some sort of synergy and collaboration, and more detail to develop on how it integrates with the rest of the ecosystem.

As always when developing a new structure for research and development, not just with ARIA, in my own research I am interested in looking at how and where it is embedded in the ecosystem. Although this is not necessarily the case with ARIA, because it will not be defence focused, the tendency with defence innovation ecosystems in particular is to bring them out of the MoD because that will lower the organisational and bureaucratic burden on them within the MoD and set free the creative geniuses of innovation. At the same time, it has to be recognised that there is also then a really big challenge to bring any innovation products from these structures back into the MoD. That deepens rather than bridges the valley of death.

DARPA is making a success out of its activity by being outside the DoD's immediate scope but being embedded at the high level of decision-making, which has the authority to rapidly transition innovation solutions that are feasible and disruptive and which can give a competitive edge rapidly in the hands of the end-user. My concern with this is with respect to the entire defence innovation ecosystem in the UK. ARIA will plug and play and find its place in this ecosystem. It might be more challenging than meets the eye at the beginning, but if there is no direct pipeline and channel in planning for how to transition its exciting innovation solutions towards the defence end-user, that will be a major limitation and it will impact whatever added value it has.

I have one final note on ARIA. You mentioned the budget. Part of the reason why DARPA is so successful is the methodology that it uses to implement projects, and its ability to take risks without being

immediately held accountable for those decisions. DARPA has a budget of \$3.7 billion; ARIA, to cover "innovation" writ large, will have a budget of £800 million. There has to be some deep consideration about that being a fundamental challenge to its success.

- Q144 **Lord Teverson:** I want to come back to AI and machine learning. One of the few things I understand about machine learning is that you need to have lots of examples to see what goes on. That seems to be difficult for defence. I do not know whether it is possible to explain that to me.

The other think about AI comes back to the garbage in, garbage out thing from my university days on computers: you have to be very careful about biases and the way the information goes in. Although that might not be lethal in some of the civil AI applications that we talk about, it could be militarily. How do we guard against the real flaws we see elsewhere in that system?

Dr Kenneth Payne: Those are huge questions, but I will try to keep my answer brief. Unsupervised learning is a real growth area in AI research, where the machine, rather than looking at a bazillion pictures of a cat to learn how to identify a cat, can pick up salient aspects in its own environment and learn from those, as well as from small datasets. That is a growth area where there has been rapid progress in the last two to three years. But you are right: for a lot of problems in international relations, everything is particular unto the problem rather than being generalisable across them. That may be more relevant when you think about the use of AI in decision support at the more strategic level than when using AI to fly unmanned aircraft, for example, where presumably you can train it.

Biases are a subset of the bigger area of explainable and safe AI, and massively important. AI tends to do things from time to time that are wholly unexpected and not always advantageous. You certainly do not want to experience that in defence. So, again, it is a hugely important growth area which the MoD is actively interested in and I hope the committee engages with.

- Q145 **Lord Campbell of Pittenweem:** You made my day, Dr Payne, when you said, "Get real". I have quite a long question, which I might send to you in writing. It seems to me that what you are both saying with great eloquence is that the strategy is inefficient, that in no way is it as far-reaching as it ought to be, and that the money that is ascribed to it will not be sufficient. My question, then, is: can we do all this out of 2% of GDP spending on defence?

Dr Kenneth Payne: There is a bidding war in the leadership contest for the Conservative Party at the moment, is there not, to see where we end up on that 2% figure? The answer is, no, I do not believe that we can. I believe that this strategy is all about choices. You can do some things to offset that hard physical reality and the economic storm that is headed our way by working closely with friends, so, as I alluded to with regard to the sixth-generation fighter programme, I would expect that to boil down to a smaller number of programmes.

Ultimately, you have to make those choices, and they are hard ones. Can you be good at everything? I do not mean to be declinist about it, but we have been telling ourselves for the past 70 years that we can be good at everything across the military spectrum, and I am not entirely sure that that is the case.

Dr Simona Soare: I have one quick follow-up to what Dr Payne said earlier. A function of how much we spend on defence is also how much we fear the threats and risks that are before us. That is as much the case with technology adoption as it is with preparedness for whatever threats we need to face. Necessity is a very good teacher.

We have spent today talking about innovation and emerging and disruptive technologies, but I would not want to leave the committee with the impression that technology is the solution to everything. It is important to recognise that the UK has come out of two decades of operations in the Middle East where the challenge has not been to adapt to a foe who was technologically superior; the challenge was a foe who was very good at using mature technologies, and fairly unsophisticated ones, extremely disruptively to the way the British Armed Forces operate.

Moving forward, Russia and China are investing a lot of money and are aiming to be competitive technologically as well as militarily, but they, especially Russia, are looking for asymmetric advantage. In my reading, that is what the UK also wants to achieve. My understanding of the strategy is that the MoD does not pretend that it will invest in anything and everything. Rather, it will try to capitalise on innovation that will deliver an asymmetric advantage against these opponents rather than meeting them head on, which might be impossible given the size of the force that we have now.

Lord Campbell of Pittenweem: That depends on clear foreign policy objectives, none of which we have talked about this morning.

The Chair: That may be for another inquiry. On this occasion, thank you both for taking us very deeply into the crucial areas of R&D, and, at the end, putting it into context; that when people say that they are bidding to become leader of—it happens to be my party, but it could be leader of any party—they would say that their prime objective is to defend the country.

The question is defending against what, and you have been very clear about the challenges involved in defence. It is a question of the way in which threats develop—in the past, they developed over long periods of time, but now it seems they develop over very short periods of time—and being able to co-operate internationally where possible, particularly in non-military ways, and the risks in that. Thank you very much for making it clear throughout what those risks are, how they should be analysed and how we need to check the balances on that as against losing and winning the defence of the country in the future.