



International Relations and Defence Committee

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

Wednesday 26 October 2022

2.05 pm

Watch the meeting

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

Evidence Session No. 21

Heard in Public

Questions 160 - 172

Witnesses

[I:](#) Dr Rob Johnson, Director of SONAC, Ministry of Defence; John Ridge, Director of Defence Innovation, Ministry of Defence; Dr Nicholas Joad, Director of Defence Science and Technology, Ministry of Defence.

Examination of witnesses

Dr Rob Johnson, John Ridge and Dr Nicholas Joad.

Q160 The Chair: Good afternoon. I welcome to this meeting of the House of Lords International Relations and Defence Select Committee Dr Rob Johnson, who is director of the Secretary of State's Office for Net Assessment and Challenge—SONAC, for short—at the Ministry of Defence; John Ridge, who is Director of Defence Innovation at the Ministry of Defence; and Dr Nicholas Joad, who is Director of Defence, Science and Technology at the Ministry of Defence.

I am very relieved to see that the Secretary of State has been reappointed, not least from the selfish point of view of being able to say, in welcoming you today, that he was the one to establish SONAC. I have here his comment that he was making a reform in so doing. It would be interesting to hear from you how that reform is working.

At this stage, as always, I not only thank you for joining us to give evidence to our inquiry—defence concepts and capabilities: from aspiration to reality—but advise committee members and witnesses that the session is recorded, on the record and broadcast. I also remind members that, if they have a relevant interest, they should declare it when they ask their questions.

I am going to start, as ever, with a rather general question, after which I will turn to my colleagues for more focused questions. I anticipate that they may wish to follow those up with more detailed supplementary questions.

Previous witnesses who have appeared before us in our inquiry so far said that the 2021 Integrated Review and the Defence Command Paper essentially placed a bet on quality over quantity—that is, relying on technological innovation and sophisticated science to deliver the military power we need rather than just force size, which has usually caught the headlines in the media. In your view, is such a bet appropriate? Is it the right way to go forward? What are the opportunities and risks it offers? Is it just unfair to characterise the choices we made as a gamble or a throw of the dice?

With three experts before us, I am going to invite you, Dr Johnson—it is wonderful to start with a Dr Johnson—to go first in your response and your colleagues to come in if they wish. There may be occasions when not all three of you respond, but some will. Since we have the advantage of seeing you in person rather than online, I can leave that to your decision. Dr Johnson, each time you can just talk to your colleagues and decide who will come up first.

Dr Rob Johnson: Thank you very much for the gracious welcome and for the opportunity to address committee members today. Let us get started with this question about quality over quantity. While the headlines have focused on this idea of mass—there has been a lot of criticism of the reductions of forces—we should remember that a technological focus,

expanding your science and technology base, could give you more mass. That is the point.

You could generate, for example, waves of drone technology. You can even produce, if you have the right technologies, swarms of drones that have the ability to speak to each other across the airwaves. Technology also gives you the opportunity to achieve speed over mass. The quality then becomes crucially important.

From an industry point of view—I will let my colleagues come in later on this one—if you are focusing on a technologically led process, you could produce much cheaper uncrewed air systems or vessels. There is a virtue to the whole question of quality over quantity.

There are perhaps two parts to the answer. One is about opportunity and the other about risk, which you asked about. The opportunity is pretty obvious: innovation requires investment. It is an unfortunate truism that the UK has underinvested in research and development compared with other developed nations hitherto. The UK is also very fortunate that, right now, it has a new tech private sector. If used well, that could actually save the taxpayer a huge amount of money, in that research and development is being done in that sector, and defence is benefiting from that. That is a complete volte face from history, when research and development in defence was always led by government. There is a value in that.

There is also a value in the fact that all that investment you are making in defence has a secondary benefit to the economy. To give you an example, when 4G was introduced into the United States, it led to an uplift of the American economy, gusting between 8% and 14%, depending on how you measure it. A similar investment in skills and technologies in the UK could produce the same result.

For the UK, there is significant investment going on in defence, as you will know. Ever since the commitment at the Wales summit in 2014, the UK has been living up to that expectation. By 2024 the figures are very significant indeed. Some of the things that should be capturing the imagination, rather than the story of cuts or mass, are the digital foundry and the digital backbone being developed in defence; the innovation that has been brought in and is being led by my colleagues; investment in people and skills development, particularly technology skills; and new partnerships, which I hope I get a chance to talk about later, particularly AUKUS and those with Japan, the Europeans and primarily the Americans. Those areas of advance are going to be very significant indeed over the next 10 years.

There are, of course, some risks. Historically, the UK and its allies have possessed an advantage in wealth and technology that has kept us ahead of the UK's rivals and threat actors. That is now threatened. There is no doubt that there are other international state actors trying to catch up with and, indeed, surpass the West and the UK in its technological advances.

How do we respond? Part of my job is to look into what the solutions might be, but they include greater productivity, being more competitive, being more innovative and investing. The Ministry of Defence is doing all four of those, I am proud to say. We also have to protect that which is vital. That is work in progress. There are lots of things to work on, but I am pleased to say that those are being done.

Let me say one final word on this question of risk. It is clear that Russia and China have invested in mass over technological advance. On our television screens we see pretty much every day the consequence of this idea of mass over quality. There is no doubt that Putin is now losing his illegal, immoral and totally unjustified war. It is a lesson for us to draw that perhaps our advantage remains in technological advancement, focusing not only on the numbers but on the quality of that which we produce.

The Chair: Either of your colleagues may go next. I am not going to dictate this. I had to online; it was very stultifying. Let us have some decision-making from you.

John Ridge: You will be pleased to know that I am not going to disagree with my colleague. It is a false choice, because high tech and mass are not mutually exclusive. By the same token, to use the phraseology, you do not take a knife to a gun-fight. Exactly as Dr Johnson has explained, when our adversaries have made technological advances, there is therefore an onus on us to respond, because we need to either counter or, ideally, outpace the capabilities they have developed. Those are the fundamentals of it.

Ukraine is an interesting example of how this plays out. The way they have combined modern technology, mass and tactics is really interesting. It has made the Ukrainian armed forces extremely competitive against a much larger adversary. The way they have used uncrewed aerial systems is really interesting. The way they have taken dismounted antitank weapons and employed them in all sorts of ways at scale, constantly changing their tactics, is really interesting. The unsung hero of this all is commercial satellite imagery. The way that has played into the intelligence space, again, is really interesting. There is a combination in the commercial satellite space of scale and technology. That is why this is a false choice.

Tech offers some amazing opportunities in stealth, speed and the ability to have modular capabilities, which you can then adapt over time relatively quickly. That is a definite advantage. You can look back through history—Dr Johnson is far better qualified than I—at capabilities that we did not know were going to be game changers until we employed them, such as the tank. There are many other examples through history where technology has delivered a new capability, which has genuinely changed the way wars are fought.

There are risks as well. If you get it wrong and you end up with a very small number of exquisite platforms, it makes it extremely difficult to

absorb losses. For me, that is why we need to make sure this is not seen as a choice; it is combining the powers of both.

Dr Nicholas Joad: Again, I am not going to disagree with my colleagues, you will be pleased to know. It probably also depends on which area you are talking about. Undoubtedly, our adversaries are investing in high technology quite dramatically. To use the analogy of not taking a knife to a gun-fight, there are a certain number of technologies where, if we do not invest, we are probably not in the game. It will not matter whether you have mass at that point; you will just not be able to counter them. There are a certain number of vulnerabilities that we need to look at in our capability. That is why we are focusing on things that are a little further ahead than where we would normally focus.

The advantages to our economy have already been highlighted. It is also worth saying—we will talk about this later in terms of being a great scientific power—that a high-tech ability and the ability to pull that through gives us quite a lot of influence on the world stage. Undoubtedly, when I go around and talk to my colleagues in allied nations, one of the things they value about the UK is our science and technology prowess and what it can contribute to all sorts of alliances.

The Chair: You remind me that the illegal and unjustified invasion of Ukraine by Russia has certainly made it possible for non-experts, such as the general public like me, to learn far more about adaptability and the importance of being able to access technology, knowing how to use it, being ahead of the game and having diversity.

Thank you, Dr Joad, for your final remarks on the way it plays out on the international stage, if the UK maintains not only its presence but its excellence. Two of my colleagues were with me when we went to Bahrain and Qatar on a defence visit just 10 days ago. It was very clear then that the advanced expertise of UK research and our ability to put that into practice was very valued.

Our questions now go into the whole point Dr Johnson raises. We need to keep up with that, but how do we do it? How do we continue to ensure we are the competitors? I am going to turn to Baroness Blackstone to lead us off.

Q161 **Baroness Blackstone:** My first two questions are for you, Dr Johnson. I will come back to the third part after we have considered those. As the head of SONAC—I assume that is how you pronounce it—you are asked to look at and consider what the net assessment of threats to the UK is. Perhaps you could tell the committee, in your opinion, what these threats are and how they ought to be prioritised. In answering, perhaps tell us how well the UK is placed to respond to them.

Dr Rob Johnson: Thank you very much indeed for the question. It is entirely up to you how you pronounce SONAC. Greek scholars pronounce it differently from Latin scholars, apparently. I do not know why.

What we are really trying to do is locate our strategic advantage. That is the litmus test of everything—*quaere oportuna*, in Latin. The idea is to assess a range of threats. The problem is that they are pretty complex, and you have to do that assessment over a longer-term horizon. The risk is that you look at the threats of today and say, "That's the threat". That will project the present into the future, which will do us no good at all.

Some of the threats are quite difficult for people to visualise. The classic example would be climate change. We know it is an approaching threat. My colleagues call it a grey rhino because you can see it coming. The way that it will manifest and the second-order effects of it are much harder to ascertain.

With a nation state such as Russia, we were able to anticipate the nature of that threat very accurately. We know that the primary nature of that threat, of course, is nuclear; it is massed armed forces; there is a very aggressive political purpose behind it as well. We were able to assess those threats. The only thing we all found surprising is that President Putin decided to launch into a war. That is not what he wanted; I think he thought he would just overrun the country. In our assessment of that threat we were accurate, but it came on more quickly and aggressively than we probably had anticipated.

There are some others. We are all very conscious of the way Iran has asserted itself over Syrian and Iraqi politics, and how it intimidates and uses covert measures to threaten its regional neighbours. China, too, has begun to behave in a much more assertive and, I dare say, even aggressive manner. Its track record on its internal politics leaves us all pretty uncomfortable.

When we are assessing these threats, we must not fall into the trap of assessing them only today; we have to look at them across time. We also have to avoid the risk of exaggerating threats. We do that through this idea of a thorough net assessment, by weighing up the relative strengths of the United Kingdom, its allies and partners, and the rest of the world, the United Nations for example, against the actual way the threat manifests itself and will do in the future.

The categories that we assess in SONAC include not just the military ones but ones of political cohesion; relative diplomatic isolation or a combination; the social cohesion of these threat actors; the resilience of both us and them; their economic strength compared with ours; their science and technology base; and their ability to sense, to understand and to generate knowledge, compared with ours. We weigh up all those elements.

Next, we set out to understand the unique contributions we can bring in defence to the national effort. You have heard about a couple of those already: science, technology, innovation and the modernisation of our Armed Forces. Traditionally, we have also been a very versatile, adaptive and expeditionary group of armed forces. We have always been intrinsically working with our allies and partners.

To quote the last two reviews, we are international by design. It is right and proper that we should be. We also have new allies and partners to think about and new relationships we are building. The most significant in the last few months has been the AUKUS deal between the United States, us and the Australians.

In assessing these relative symmetries or asymmetries of threat, SONAC is seeking those opportunities. Where are the advantages? Where are the opportunities that will open up in the future? That is a question of assessing both latent threats and the dynamics of how threats work out internationally. There are also our own vulnerabilities, which we have to address. Those are being prioritised right now.

Where we must not overreact is where our collective western defence, the NATO alliance for example, gives us strength and we can share the burden of defence costs by working very closely with our allies and partners, including, for example, Sweden.

Finally, we must challenge assumptions. We must not be complacent. We must not think, because we think we know what the threat is, we can proceed over the next five years without any further inquiry. We seek out an empirical base to our judgments and we constantly adapt and reassess what we are doing. We have made a commitment to refresh or reassess the Integrated Review and the Command Paper every year. There was a stocktake done in the summer before the announcement of the refresh of the Integrated Review for this year.

I am pleased to report that overall the Integrated Review was seen as a sound document that had accurately assessed the threats we face and the opportunities we possess. The policy lines we have taken have broadly proven to be correct. Those include recognising the threats that Russia poses; the investment decisions we have to make in relation to what we will sunset, as they say, what we will leave out, and what we will invest in that is new; and preparing for the future threats that are over the horizon. Those threats may not be evident today to the public or to our leaders, but SONAC must investigate, unearth and begin to assess them. Then we can provide those observations to the defence planners and to government so they can start preparations in good time and, I hope, avert the crises that we think may threaten us.

Baroness Blackstone: I am interested to know what you mean by "future threats". Would you like to have a go at telling us what your list of three or four might be? Given your role, that is something you do have to think about.

In light of what Dr Johnson said, with a lot of emphasis on Russia, did the 2021 Integrated Review get it all right? Did it get some of it wrong? What was right and what was wrong?

Dr Rob Johnson: Perhaps I will lead off with what the threats are, and then I will hand over to my colleagues to comment. Where do we start with the list of top threats? There are a lot.

There is no doubt that priority number one is always the nuclear threat. We have been struck by the totally irresponsible rhetoric that has been coming out of Moscow in the last few days. There is no nuclear crisis. This is merely rhetorical. We remain unmoved by it and we condemn the rhetoric that has been used.

Nevertheless, we would be foolish to think there is no nuclear threat to the United Kingdom. There is a nuclear threat to the United Kingdom and it has to be our priority. What has caused some interest at the moment is the development of hypersonic missiles. It has caught a lot of the imagination in military literature at the moment. Unfortunately, hypersonics, which come in low over the earth's orbit, represent a far more difficult-to-detect and faster weapon system. You have less warning time when these things are coming towards you, and they can be fitted with nuclear warheads.

That threat is not new. The intercontinental ballistic missile threat remains extant, and there is the phenomenon of fragmented orbital bombardment, or FOBs for short, which is very similar to the idea of a hypersonic and has been around for some time. That has to be number one.

A second area of threat that we are particularly focused on, which is technological, is anti-satellite missile systems and global precision strike capabilities. We should be mindful of those. They are very significant indeed, and therefore we need to work hard to figure out what the countermeasures are and how we defend ourselves.

Thirdly, as correctly identified by the Integrated Review and the Command Paper, Russia is the pacing threat. Despite Russia suffering all sorts of catastrophic failures in the battlefield, its forces remain large. The threat remains extant. It has both the capability and intent to do harm to the United Kingdom, and it will, I suspect, continue to do so over the next 10 years, regardless of the military defeat it is facing in Ukraine. Those would be my top three. I am happy to come back to more if you want more.

John Ridge: Shall I pick up on your question on the Integrated Review? As Dr Johnson said, broadly it remains extant. We are comfortable that the principles that are in there remain the right principles, but some things have changed since then. A more assertive China and what we have seen recently in the news there make the situation slightly different from when the IR was written. Clearly, Russia's illegal invasion of Ukraine is another difference.

Supply chain vulnerabilities have become starker than we have seen before, as has the impact on critical national infrastructure. So there are some things that have come into a sharper focus since the publication of the IR.

From an innovation perspective—I will let Dr Joad speak to the specifics on the S&T side—S&T was a really strong theme in the last Integrated

Review. Our focus is now on taking it from something that has delivered a proof of concept, or an experiment that has been successful, and pulling that through into a core capability. That feels to me like an area we need to focus on as part of our constant refresh. The IR was always a start point; we always recognised that over time we would have to renew it.

Dr Nicholas Joad: If I could pick up on the IR, as my colleagues said, it is broadly in the right space. One of the interesting things about the IR was its emphasis on S&T. One reason we had that emphasis was the changing strategic environment, with much more conflict with nation states than we have seen in the past. There are also a number of technologies that are either transformational for us or quite threatening. Rob has talked about hypersonics, glide weapons and all those sorts of things. It is probably fair to say that the Chinese progress in that type of weapon and technology caught some people slightly by surprise.

There are other things that are slightly more prosaic. We talked about critical national infrastructure and the vulnerability of satellites. We are extremely reliant on GPS systems. GPS satellites are, like any satellite, quite vulnerable; they can be taken out. GPS signals are quite susceptible to electronic warfare. Things that let us reduce our reliance on GPS will be quite critical. It is probably worth bearing in mind on those statements that it is not just about the satnav in your car; basically, all computer networks are critically reliant on precision timing. In much of the modern information-driven world, if you lose that precision timing, you are not in a very good place.

Lastly, AI is quite a big threat. I am sure we will talk later about some of the things we have been doing on AI. Of our adversaries, China has invested very much in AI. It is one of the great things that it thinks are going to revolutionise its technical capability. It is not a question of mass or no mass; if you do not have that sort of capability, you are probably not in the game. They will be able to do things you cannot respond to, and they have a very different ethical framework from ours.

There are a number of things that have made the technical and the threat world a bit more challenging since the IR, but the broad principles are right. The IR was framed on giving us a number of options to respond.

The Chair: As you will appreciate, when we ask questions about the current validity of the IR, we are very mindful that the previous Prime Minister said there would be a review and perhaps new chapters or some rewriting. The rumours now are that this will not appear until next May. We do not know the detail; nobody outside the inner circle will, but, clearly, that is going to be of great concern to us as our clerks draft our draft report and when we consider that before publication at the end of this year.

Q162 **Lord Anderson of Swansea:** Dr Johnson, you were appointed director in May, some five or six months ago. Are you yet fully operational? What sort of staff do you have behind you to meet your many tasks, one of

which is to challenge the existing orthodoxies? Do you suspect that there might be a reluctance of some in the MoD to accept a challenge from someone with a non-military background?

Dr Rob Johnson: That is a great question. I am pleased to report that I do have a former military background. Perhaps that gives me a small advantage in that regard. Yes, dilettante academics may not always be welcome.

Lord Anderson of Swansea: You were in the military.

Dr Rob Johnson: I was, yes, a long time ago.

Lord Anderson of Swansea: We do not have your CV.

Dr Rob Johnson: I am sorry about that. I am on a two-year secondment, for those who are not aware. My appointment as an external shows some maturity on the part of the Ministry Defence, particularly the Secretary of State, who made the decision to do it, that they would take a risk on an outsider coming in to provide that form of challenge, using academic rigour and introducing methodologies to test the way we go about decision-making in defence as a whole.

Constructive challenge as an idea is thoroughly accepted. One of the big surprises for me when I first took up the role was that, literally as I open my defence laptop every morning, it comes up with a reminder that I should be constructively challenging others. In all the meetings I have been to since I started, I find I am invited to challenge during the course of discussions or in some form of summing up at the end. For me, that is evidence of this intrinsic desire to have a more thoughtful way of approaching the problem.

Of course, one might say that in a crisis you do need a form of hierarchy. You cannot have a Chinese Parliament midway through a crisis response. In all the histories of crises, there has still been room for debate and discussion, and then a clear decision that everyone can agree on is what goes out of the door. The value of a good bit of challenge going on in every discussion is grist to the mill. You end up getting rid of groupthink and you come up with, I hope, quite robust decisions.

It might be interesting to the committee to know that the way that we approach this is not to throw stones as critics at individuals or at each other, but to go in for what you might call a critical questions approach. "Why are we doing it this way—if X, then Y? What are the consequences? How confident do you feel in the judgment you are making?" There is no template. It is more of a Socratic, questioning approach, I suppose.

There is a commitment to constant adaptation, enhancement and improvement. No document we are producing in our SONAC team, for example, is a finished product. They are all works in progress, living documents. That Bayesian idea of constant iteration as new evidence comes to you is again evidence of why a slightly more academic or intellectual approach might be helpful.

I am encouraged to speak truth to power, in that ancient Greek idea of parrhesia. It does require knowledge, and I am learning pretty quickly about all sorts of systems inside defence that I did not know about. We are using red teaming; we are carrying out what we call war-gaming, but a better term might be policy simulation, to test out each of the systems we are using. We are commissioning lots of independent studies. We did one on the will to fight and the resilience of nation states and peoples, for example. We are using a combination of quantitative and qualitative academic methods, different hypotheses that we can test out and challenging the assumptions. Everywhere I have been, I have been impressed by how eager people are to embrace that degree of challenge.

Lord Anderson of Swansea: How large a staff do you have to enter into your Socratic dialogues?

Dr Rob Johnson: We have an establishment of 25. We are not there yet and are still growing. It is quite early days, but we are about half way. The way we have mitigated the smallness of the team at the moment is by commissioning external work and engaging small groups of specialists outside defence to make sure we get the yield of expertise and thought.

Lord Anderson of Swansea: Are there other means, in your judgment, to challenge existing orthodoxies, such as by embedding others in the system or parachuting people in? How will you find sufficient groups to challenge the current orthodoxies?

Dr Rob Johnson: We have a very big network already. One of the challenges I set my team, some of whom are behind me, is to find new experts every week. We are trying to build that network as widely as we can. We are very lucky, in a sense. I come from a university background. We have a large number of university sector individuals, think tanks and industry specialists we are connected with. It is a case of maximising those.

We are really keen on making sure that we have a nice throughput of individuals. Perhaps I have set the precedent. We want people to come in, do some work in defence or in government, and then leave and bring that expertise with them.

Lord Anderson of Swansea: Are you fully up to establishment?

Dr Rob Johnson: Not yet, but we will be by the autumn of next year.

Q163 **The Chair:** In the meantime, from now to a year's time, what are you not able to do that you will be able to do with a full complement?

Dr Rob Johnson: That is a difficult question. What will we not be able to do? We are all guns blazing at the moment. The team is working extremely hard. We are borrowing members of staff from different units within defence and across government to help augment what we are doing.

An example would be the way we are constructing war-gaming at the moment. Because we do not have enough people, we are making extensive use of DSTL. We have some other interlocutors from university backgrounds and different national defence establishments. We had an American naval officer, for example, in one of the war-games we ran recently. We have had American academic specialists. We have run a number of war-games through the Foreign, Commonwealth and Development Office. We have a war-game in gestation with the Cabinet Office. We are able to bring in others—that is the short answer—from across government as well as outside.

The Chair: In your opening, you talked about the dynamic development in other countries and the importance of not being left behind. Clearly, it is quite a challenge indeed.

Q164 **Lord Stirrup:** In order to lull you into a false sense of security, let me start by saying that I welcome the formation of SONAC. But I am always cautious when any large enterprise makes an organisational response to a problem. There is always the danger that it can create a sub-empire, as it were, that leads to overlap, duplication, tensions and maybe even competition and protectionism within the enterprise. Of course, the important thing in all of this is that there is an end result in terms of battle-winning capability.

When you mentioned the Socratic approach, I could not help reflecting that Socrates, at least as reported by Plato, was enormously successful at demolishing the propositions of others, but he never came up with any answers to the questions himself.

This is really the first of a series of questions that we will move on to later about the relationships between SONAC and other areas. I want to start off on the departmental relationship; we will move to international and wider UK relationships later. How do you interface with organisations such as the DSTL, the Development, Concepts and Doctrine Centre and rapid capability development hubs? The challenge function is enormously valuable, but how does that eventually feed through into the production of capability, reflecting the input you had? I dare say your colleagues would have a view on that as well.

Dr Rob Johnson: I will lead the charge, and then perhaps you can help me out. We have a very close relationship with each of the entities you describe, DCDC, DSTL and others. It requires a combination of tact and pushiness, I would say. That is what speaking truth to power is about. Socrates was part of his community, even though he was rejected by his community. It was their fault, not his, I would suggest.

Lord Stirrup: When do you expect the hemlock to arrive?

Dr Rob Johnson: I have no doubt it will come one day. I hope I will have gone long before it turns up. That relationship is very important. You mentioned Plato. He set up the academy precisely to build on what had been learned from these things. We are trying to lay the foundations of something that will last. It would be very easy to build up some new

thing, look at what is different this time and then see it all swept away with some new organisational reform later. We are trying to avoid that by making this intrinsic to what we do.

Let me perhaps explain this by means of an example. What we do not allow people to do is to take the product of our work and use it as a rubber stamp for whatever they are working on or whatever new capability it is. We go in at the design stage. We will offer our observations and our critique using a combination of academic methods and other questions. "What are the Chinese doing? How are the Russians doing this? Why is this taking so long? What will this cost? What priorities will you have to make? What will you lose in order to deliver this?"

We do that at the design stage. We allow them to respond to those. We will then perhaps go through several iterations of that. We have done this with the capability teams, for example. At the end of that process, we will stand back and get out of the way. Our job is to make those observations and potentially even recommendations, but we do not try to do their job for them. Otherwise, we would just make a lot of enemies very quickly.

Should we hit an obstacle, we have a hotline straight to the Secretary of State for Defence. We did hit one early on. I will not go into the detail of that, but he gave his authority to me and the SONAC team to go and investigate without obstacles in our way. We did not have to invoke that authority because people were very good and willing. One of the amazing things about working in defence is that people are very helpful and supportive. They want to get it right. That is very impressive, as you will know yourself.

There is always the risk that bureaucracy, because of the necessity of accountability, will want to slow things down and make sure they are done properly. That is all right and proper. We should be accountable, and we should be held to account, which is what this committee is all about. By the same token, we now live in a world that needs to move more quickly. Events over the last few months have indicated that threats can come at you pretty quickly, and you had better be ready.

We have to find mechanisms for speeding up. That is not just focusing on the organisational structure but making whatever that organisation is very agile and responsive so we can get things done quickly and when we need to. I hope that answers your question. I will bring my colleagues in, if I may.

John Ridge: Following up on your question, the other danger is that, because you create an organisation with "challenge" in the title, you think that solves the problem. SONAC on its own is not going to solve the problem of challenge in defence. I did 24 years in the Army before joining the Civil Service. I have seen, certainly over the last four or five years, a really fundamental change in the way challenge is viewed and defence's appetite to be challenged.

A lot of that, frankly, came off the back of the Chilcot inquiry. As Chief of Joint Forces Operations, I remember using the Chilcot checklist as part of our planning process, so we asked the challenging questions that you need to as you go through that sort of process. It does feel that there is a deeper cultural change, and a key part of that now is the establishment of the SONAC, but that is not the only piece there.

Our senior leaders are now much more confident to call out the wrong behaviours, for instance in meetings where they feel that challenge is not being accepted properly. That is called out now in a way that I have not seen it done before. Those are all positive bits about the deeper bit of the challenge culture.

In terms of the relationship between SONAC and the innovation directorate, we work together as a team to deliver what we need to for defence. Part of that, frankly, is my role to challenge defence about how it needs to change in order to become more innovative, whether that is around our commercial processes or the bureaucracy that surrounds the rest of our procurement. Again, it is absolutely a team game. I feel we are completely locked together. Frankly, I would rather have a degree of overlap than have something missed, so I am comfortable with the way it is building out.

Dr Nicholas Joad: There are just a few points that I would add to that. Historically, quite a lot of analysis and analytical work goes on in the MoD. Quite a bit of it is operational analysis through DSTL. There is a large capability there. It is probably worth remembering that SONAC can pull on all of that and it has a very good relationship with the teams in that space. It is not that starting from ground level; there is an established set of things in there.

What Rob has done is to galvanise that and give it a little more structure across the top, because a lot of the analysis was far too tactical and was driven from the bottom up on particular issues. That has been a really good thing. In terms of the science community, I have a science adviser in SONAC, who provides a gateway into the wider S&T community beyond what is already done.

Picking up the point about the MoD's acceptance of challenge, I have something in my organisation called the Defence Science Expert Committee. That is quite a large group of primarily academics who we get to come in and challenge what we are doing. I always laughingly say to them, "The day after you tell me what you think I want to hear, I fire you". They really do take that on board. They have been in and told us some quite hard truths about our understanding of future technology and future ways of doing things, which has had a real impact on some of our major programmes. That has certainly changed since Chilcot, actually. John is right.

Lord Stirrup: Could I just pick up on a point that Dr Johnson started to focus on? That is the issue of agility. A lot of the work you have described has been about forecasting the future. One of the key lessons of history

is that nobody is that good at it. However hard we try, and we should try, we are going to miss something important.

One of the greatest challenges facing the defence enterprise is recognising, when crisis or conflict comes, that plan A is not working or was never going to work, so what do we do now? That requires very rapid, focused and intellectually sound responses. What sort of role do you see SONAC playing in that kind of scenario?

Dr Rob Johnson: You are absolutely right. I remember General HR McMaster saying, "We have a 100% track record at predicting the future. We have been 100% wrong". That is a great one-liner at a dinner party, but it is inaccurate in one way, because there are two features that we can be broadly accurate about. One is demography, which we look at. From demographic profiles in the future, which are broadly slow moving, you can make some pretty accurate predictions about GDP levels, levels of development, employment profiles and so on.

The other thing is climate and climatic change. Although there are lots of scientific arguments about the long future, you can make some fairly clear projections about the way that degradation of the environment is going to affect certain regions of the world much more severely than others. One of the countries that will be most severely affected, which is the least well prepared, is China, a country that, by its own admission, is going to increase emissions until 2040 because it knows the West is going to reduce them. There is cynical politics for you.

You are absolutely right about adaptability and the ability to respond quickly to a crisis. We do a lot of scenario work. Over the last few days, we have constantly been running what we call war-games. These are strategic-level simulations. This builds on the operational research and analysis work that has been done for years, but we look at the different outcomes and we keep changing the variables.

We sometimes rerun the same exercise over and over in order to squeeze out the last possible factors we may have missed, so that, whatever that scenario looks like when it potentially manifests itself, we have all the parameters mapped out and people have become familiar with what may transpire. I am pleased to say that our current Secretary of State is very keen on it indeed. He has set new demands on us, so we are quite busy with that at the moment. Those are a couple of things we are doing.

Like all organisations, there are different things that are in tension: time, your functions, costs and priorities. In the end, these things come down to judgments. If we can prepare our senior leaders and offer them decision support by having mapped all these things out in advance, or at least come as close as we can, the judgments and decisions they make will be the best we can offer them.

Q165 **Lord Alton of Liverpool:** Thank you, gentlemen, for explaining SONAC's work to us so well. I would like to ask you, if I may, a nuts and bolts question about how a net assessment might translate into improved

defence policy. Can you share with the committee whether and how force posture will be adapted, including of course through the procurement of new capabilities, if the analysis you have undertaken reveals an unfavourable balance?

Do you accept that there is a risk that the analysis could be used as a cover for inadequate resourcing, perhaps? That would be an example of the cynical politics you referred to in your answer to the last question, but this time in the context of UK politics. Policymakers could, for example, direct you to assess only contingencies compatible with pre-existing capabilities.

Dr Rob Johnson: That is a great question. I can understand why people might be concerned about that. It is what the military calls situating the appreciation. You do it the wrong way round, come up with the answers you want and then tell people what to say. I am pleased to say that does not happen. We were set up deliberately to be “independent”.

Of course, that does sound like a bit of an oxymoron: if you are inside defence, how can you possibly be independent? That is why I have referred back to this question of having diverse expert opinions brought in from industry, academic studies and think tanks: to make sure we remain true to our salt and are delivering something that is absolutely independent.

We work directly for the office of the Secretary of State, so we do not get interfered with by the units within defence. That is very important. For example, I write a weekly report, which my team support for me. We collectively bring together areas we want to draw to the Secretary of State’s attention, which he may not be hearing about from elsewhere, just as an independent judgment.

I would reiterate the point about early engagement. We make sure that we are in at the very early stages of the formulation of a capability strategy or a capability programme, so that we can push quite hard on the assumptions they are making, for example, or what they think they are doing.

There are lots of issues, some of which are now in the public domain, about things that have gone wrong. Fortunately, they were before my time; I hope they do not happen on my watch. A comprehensive study of the British Army has been done, which SONAC was heavily involved in, with a component part of SONAC called the DOC, the directorate of operational capability. We did our own independent study. That unit also looked at it very hard. We came up with some pretty robust judgments about the state we felt the Army was in. I am pleased to say that all of that has been taken on board. There is an action plan, the Army has met to discuss those findings and is working on that right now.

There was, also in the public domain, quite a lot of concern about the pilot training programme. Once again, the DOC was deeply involved in that and examined it very thoroughly to investigate why that had happened and what lessons might be learned from it. Again, there was

absolutely no interference. There was total co-operation from the RAF and other institutions within the Ministry of Defence to make that happen.

In our net assessments of comparative capabilities and comparative strength, because we are completely independent, we come up with some pretty uncomfortable findings. I am pleased to say that, in the near future, indeed next week, we are having a meeting. The Secretary of State has called it and the service chiefs will be there. I will be leading a pretty robust exposition on what we think is not quite right at the moment within defence. Forgive me; since we are on the record, I will not go into the nature of that in detail. I am very happy to write to you privately to give you further details, should you be interested.

On the positive side, we have just been discussing within capability strategy—we call it cap strat for short, or FinMilCap, the financial military capability team—how we might make better use of what broadly we might call modularisation. This is using existing or new platforms on which you can build much more versatile and adaptive systems that will be relevant perhaps for five years but, because the platform is solid, you can build in new capabilities all the time.

We are heading towards a future with, for example, programmable hardware. One day we will lose software all together, which is quite vulnerable, and move into that space. There will be new communication systems to enjoy. There are all sorts of new possibilities offered by space. For all these things, if we get that versatility right, we will be at a huge advantage over our adversaries.

Finally, one of the things SONAC does is to help people visualise what things might look like, both good and bad. That visualisation—helping people with their imagination, if you like—can be very potent. We ask, “Is this the future you want? Are these the capabilities you think you will really need in 2030 or are you just obeying some sort of legacy sentimentality?” I am pleased to say that the current Secretary of State for Defence is very eager to root out sentimentality, look at things very robustly indeed and say, “We must have the best”.

Lord Alton of Liverpool: Thank you for that. It is encouraging to know that you are able to ask difficult questions within the department, learning from Ajax, for instance, which is an issue the committee has been hearing about during the inquiry.

Beyond the department, we heard about hypersonic weapons, for instance, which Dr Joad mentioned earlier on, and how China has taken us by surprise. We have also heard that 15,000 projects have taken place between academics in the United Kingdom and academics in Russia, Iran and China, nearly 12,000 of which were with China and some of which involved hypersonic weapons and nuclear-powered submarines. I would like to ask you how you operate outside the department in countering that kind of threat.

Connected to that are individuals who have access to technology. I think

of Elon Musk, Ukraine and Starlink. Ukraine has become absolutely dependent on the information it is able to download from Starlink. When an individual says he might remove that and take it away, how do we step into the breach? How do we see that as a danger that we need to combat?

Dr Nicholas Joad: Can I pick up on the bit about academic liaison with China? The research councils have put in place something called trusted research. It is an interesting discussion you have with academia about where you want to put your wall and how high you want to make it. If you build your wall too tight and too high, you stifle progress. If you put it too low, you will develop your technology and at some point, frankly, it is worth stealing.

Basic science is a common across the world, when you look at it. You have to look through science into technology and the actual solutions you get. You have to be quite measured about where you protect it. You can have quite a sensible discussion with academics about trusted research because academics really value their ideas. If you can frame the discussion with them by saying, "This is all about people stealing your ideas and doing things with them", they are much more amenable to other discussions you might have about security. That has worked quite well.

If we move slightly higher up, where things are more mature, you have the various national security and investment Acts. Another mechanism for technology leaking out is the acquisition of companies and the acquisition of personnel. We are being a lot smarter about how we do that. We are also having a lot of discussions with our allies. Basically, this is a community response in the West. It is no good us just protecting our technology; it will go out in other places, if we do not do it. That has been taken quite seriously. It is a long-term gain, because China is in this for the long term. There are a number of things that have been put in place, which we are doing. We just have to hope they work because it is quite hard to close that loop.

Lord Alton of Liverpool: What about Starlink?

Dr Nicholas Joad: That is a very interesting one. I do not want to go into the specifics too much, but there is a variety of ways you can provide that information to Ukraine. We could do it through the national technical means of other countries. At the moment, it is being provided commercially. We probably have more than one option for how we do that.

One of the other opportunities we have is in the space sector in the UK. Space has become quite democratic. The UK can now access a load of space capabilities. We are about to do a launch; we are about to start putting our own satellites up. Previously, that would have been too expensive for us. In that particular area, there are other things we could do in the short term. In the longer term, we have a number of options in that space, if you excuse the pun.

John Ridge: Can I expand a little on the tech industry generally? It is clear that we need a different relationship with industry. That was recognised in the defence and security industrial strategy, which made it really clear that industry is one of our key strategic enablers and key strategic assets, and that we need a different relationship with it.

I went to the launch event of Commercial X last week.¹ It was a mixed event with MoD and industry representatives, a lot of whom were from high-tech industry. They were desperate to do more. They are as patriotic as anyone else and they want to contribute. Part of it is unlocking that potential.

As Dr Johnson has already mentioned, many of the genuine and game-changing innovations will come out of the private sector rather than the public sector, as used to be the case. It is vital that we are able to harness that. It is crucial to have a relationship that allows us to have that continuous adaptation that goes through. It is not a situation where you can buy a capability, use it for five years and come back later; these things need to be constantly adapted. For me, the key about this is a different relationship with industry, which locks us together much more closely and allows a genuine partnership approach, rather than what we have had in the past, which looked quite adversarial from a personal perspective.

Q166 **Lord Boateng:** Dr Johnson, you referred, in answer to my colleague Lord Alton, to helping people with their imagination. Alan Turing said, a little more recently than Socrates, that “those who can imagine anything can create the impossible”. We all owe Alan Turing a great deal in terms of our capacity to counter a previous foe, an enemy of this country, and to do so strategically.

Can you give us your view on how good we are in the UK today at making scientific discoveries and converting them into strategic advantage? Is this still an area where the UK has relative strength over our potential and, now I fear, actual adversaries, or are we on the back foot?

Dr Rob Johnson: I can give a very brief answer, because my colleagues are going to be much better qualified than I am to answer that. I am a huge fan of Alan Turing, I have to say. In fact, one of my external groups that I set up is called the Alan Turing group on new tech in honour of that individual, even though he was a Cambridge man. You cannot hold that against him, but there you are.

There is no doubt that, if you look at the overall development of economics around the world, lots of people want to tell you that China is making pace,² its GDP is growing dramatically and it is going to overtake the United States and the West in certain forms. Perhaps it already has done in manufacturing, which is a problem. But, when you look across

¹ The launch event took place on 24 October 2022.

² Dr Johnson intended to convey that “China is setting the pace”.

the most significant, game-changing—which is the phrase John used—technologies, such as artificial intelligence and new materials, collectively the United Kingdom and its allies dwarf Chinese achievements. They have produced lots of patents. If you look at the raw number of patents, China appears to be on par with the United States. According to their own statistics, which are very untrustworthy, they are ahead. But in the things that really matter, they are not. That is important; we still have this edge.

What has also been really encouraging for me, coming into defence as an outsider, is to see the sheer volume of investment. The figure is £6.6 billion of investment in research development. That is really significant. The UK had perhaps lagged behind other developed nations for many years in terms of its actual investments in research development. It is now going to be surging ahead, and it has this aspiration from the Integrated Review to be a science superpower. That is great.

We are very blessed at the moment, but as we have already been discussing the trick is how we keep ahead. That means you have to take a lot of risk and be bold. John has very kindly spoken about the changes to our relationship with industry. Instead of only delivering the requirement, “Build this many of this particular thing”, now it is a question of getting industry in to help us with defining the problem and the design stage. What we may end up with, in 10 or 20 years from now, may not look like some of the legacy equipment we have today at all. They may find us some much more exciting and valuable solutions.

Dr Nicholas Joad: The UK, for its size, is very strong on science and technology. That is not to say we are the world leaders at everything; that would just be a ridiculous statement to make. In most areas, the UK is at the edge of capability in the world. The reasons for that are very diverse. One of them is that UK science is fantastically networked throughout the world. If you look in all the universities, they have a lot of young researchers from around the world. That is one of the strengths of the UK university sector, that it is so networked, hence some of my comments about how you need to regard S&T as a bit of a global common and to think about where you are going to protect as you develop that technology. Undoubtedly, we have a very strong university sector. We have been quite successful at pulling that through in some areas and less successful in others. We can talk about what we have done to address that.

Our potential adversaries are not going to give up. They have decided that that is the route they want to follow. Even with that advantage we have in S&T, unless we keep pulling it through and turning it into capability, we could very easily fall behind. There are some areas where the UK has not had enough to invest in everything, in my world. If you look at high-speed weapons and hypersonics, we did not invest very much in that in the first decade of this century, and we are not as far ahead as some of our partner nations. In other areas where we have invested, frankly we are right at the edge of where we could go.

The UK is a relatively small market for some of the defence capabilities we may sell. We definitely have to have an eye on what we can export. We have to pay due attention to what the business model of our defence sector is, and whether the people we encourage to come to the defence sector can make a decent living, and provide that capability in a sustainable way. We do have a very strong technological base. In some areas we have done a very good job pulling that through. I mentioned space, which is a really interesting area in the UK, in that we now have a very appreciable fraction of the market for small satellites. That is something you would not have envisaged the UK would be into 10 or 15 years ago, and that is a combination of both military and civil. There is real academic interest in pushing that on.

There are other areas where it has been a bit more difficult to do that, frankly. Because we do not have a very large market or large investment in certain things, we tend to be quite good at pulling things through that do not require enormous amounts of money. If you require a lot of money to pull something through, we have to go about it in a very deliberative and long-term way of thinking about how to do that. We are not like the US, which can pull lots and lots of things through at scale because they have the money to do it and the defence budget. We have to be a little more discerning about what we pull through and how we do that.

John Ridge: I do not think we have an invention problem; we have an exploitation one. We are really good at inventing stuff and getting it to trial stage, where concepts go out, people use them and they say, "This is what we want". It is then really hard to pull them through. We are not unique in that. Innovation is really difficult. The valley of death that takes you from saying, "This is a thing we want" to having it as one of your core capabilities is something that all companies and organisations face.

Part of that is accepting that the valley of death is a Darwinian process. It is where the bad ideas die, and we should accept that. We should not expect to pull through everything that we take to a successful concept. We are better at it when our backs are against the wall. From my experience in Afghanistan, I was an EOD squadron commander out there and I saw how quickly we were able to adapt to the IED threat and bring into the field new detection capabilities. It was really impressive and we can do that.

The challenge is that, when our backs are not against the wall, we tend to fall back on the bureaucratic processes that slow things down. The bumper sticker I am using with my team is that we need to get innovation on a war footing because, exactly as my colleagues have said, we are in a difficult period, looking towards a future that is extremely uncertain and the threats we have spoken about already.

We have the framework in place already. We have an innovation framework that talks about dealing with people, process and the pipeline. People is about the culture change and process is about the various bits of process we need in a department. The crucial bit for me is around the

pipeline, and how you take these good ideas that you have proven and scale them into the field. That is difficult but, if we do not do it, going back to Dr Joad's point, we will have companies, relatively small ones in many cases, that have invested a lot of time and money in developing trials that they are then not able to get fielded at quantity, so their cash flow suffers. There is something about sustaining those ideas through. We are absolutely focused on the role of SMEs in this. It gives us diversity in the supply chain. Many of the best ideas come out of those small or medium-sized enterprises, but they are very vulnerable when they are not scaled quickly. That is the focus that we will have over the next six months or so.

Lord Boateng: I am sure many on this committee would agree with you about the importance of putting innovation on a war footing and see, undoubtedly, the value of SMEs and investing in them to pull things through, as Dr Joad has said.

In one sense, we have ridden into the valley of death in our exit from the EU. I just wonder how our capacity to co-operate with our European allies has been affected by that, and whether, in your experiences, blockages have arisen that did not exist in the past. It would be very helpful if you could be as candid as possible about that.

Dr Nicholas Joad: If I can start from the S&T end, there are a number of things. NATO is obviously an important collaboration mechanism, and I do not think we have seen any change in the approach in NATO and the encouragement to get involved in NATO. There are bilateral relationships, some of which have strengthened over the past five years, and some of which have not.

Lord Boateng: Which have not?

Dr Nicholas Joad: France is probably one,³ except that there are some niche areas with France where the relationship has strengthened, actually. That tends to be where you have a confluence of commercial desire to do something. If you look in the weapons world, there are basically Anglo-French companies operating in that space and that is fine. That carries on. In areas where they have decided to do collaborations with other parties, it has waned.

With countries such as the Netherlands, Sweden and Germany, it has continued to be pretty strong and open. I do not see much change in that space at all. Probably France is the one nation we have seen a difference in; otherwise it has carried on in a pretty healthy trajectory. Is that sufficiently candid?

Lord Boateng: It is as much as I could expect.

³ France is one of the UK's closest partners across a range of defence activity underpinned by the 2010 Lancaster House Treaty. We share a range of capability programmes and collaborate closely in the S&T domain. We are actively engaged to develop the PM and President's ambition for a 2023 UK-France Summit.

John Ridge: If I touch on the international collaboration that is going on, there are two examples that are worth bringing out. One is under the NATO banner and the other is under AUKUS. Under the NATO banner, you will already be aware of the Defence Innovation Accelerator for the North Atlantic—DIANA. The UK will host the European headquarters for that, and will host one of the hubs as well,⁴ working alongside Estonia specifically. That is a good example of a genuine success story and validation of the perceptions of the UK and how people view our ability to lead on this stuff.

On AUKUS, I lead the innovation working group, working with Australian and US colleagues on bringing together capabilities to demonstrate how we can solve problems on a trilateral basis and specifically use innovation to go after some of the existing problems, but with a view that you would develop a framework that you can then expand into various other capability areas. Again, both of those demonstrate the international partnerships and the fact that they are crucial to us and something that we will gain enormous value out of.

Dr Rob Johnson: All I can add to this myself is that I have seen no interruption whatsoever of the UK relationship with NATO, for example, which is absolutely crucial. The JEF—Joint Expeditionary Force—relationship remains strong. There are new relationships being built with Sweden, and alongside that Finland, because of Sweden's application to join NATO, Sweden of course being an EU member state. The UK continues to provide a continuous at-sea nuclear deterrent; it is part of the nuclear umbrella for Europe.

The UK's cyber capabilities are held up as exemplars by European colleagues I speak to, who often ask about how the UK does it. The story of the NLAW, for example, which has become a familiar household name to all of us as a joint Swedish-UK project, is an example of how there has been literally no interruption there at all. It is above my pay grade; it is a policy choice, but all I can report on is what I have observed.

The objective behind the Integrated Review was to say, "Well, we are here. We can't change that fact. Now is the opportunity to build the new relationships that perhaps we wouldn't have otherwise done if we had remained within a political union in the EU". Those are, as has been mentioned, the new relationships with Japan and Singapore, and a closer relationship with Australia. But as you can tell from my voice, I am a little uncomfortable about discussing what is effectively a policy choice as opposed to a defence choice.

The Chair: Indeed, you have helped us by answering what was going to be a question from Lord Anderson on the work of allies. Lord Anderson, if you would excuse me, I am not going to call that, but I will of course be reverting to you for our final question later. Because of timing, we are going to move straight on, which means we stay with Lord Boateng.

⁴ These are the accelerator sites associated with DIANA.

Q167 Lord Boateng: You have made reference on a number of occasions, Dr Johnson—I have noted them—to the Chilcot inquiry. I gave evidence to the Chilcot inquiry, and I must fess up to the mistakes that were made under my watch.

It is for that reason that I would ask you to help us with this. The Treasury is concerned, in my view entirely rightly, to make sure that, in expending its resources, it does so through the departments that can best nurture, absorb and utilise those resources and can make investments in science that will have the greatest impact. That is what the Treasury's job is to do.

I would like to ask you how good you think the MoD now is at that, at procurement and other choices, and at the work that has to be done in creating and supporting a UK scientific base that actually delivers. Do there remain cultural and procedural obstacles to the positive flows of scientific ideas in and out of that department? The public need some reassurance about that, and the Treasury will need to be satisfied if you are to get any more resources. I presume you want more resources, or do you not need them?

Dr Rob Johnson: We definitely need them.

Lord Boateng: Then how do you justify the Treasury giving them to you?

Dr Rob Johnson: I will turn to my scientific adviser first.

Dr Nicholas Joad: There are a number of key technologies that we have been talking about. If I look at quantum, the UK has quite a healthy national quantum technology programme funded out of BEIS into the research councils. The MoD has been quite instrumental in shaping that to make sure that we pick up what is coming out of it and exploit it. Indeed, we will probably be the first adopters of some of that quantum technology because of the platforms we own.

That is quite a good model, because that quantum programme is not aimed just at defence, but at having an economic impact and, in many areas, getting the nation ready to take on quantum technology, make some money out of it, frankly, and get our industrial base in the right place.

There are quite a number of areas where the MoD is not driving the technology, but is making sure that the technology turns up in the right places and at the right time so that we can absorb it and use it. In MoD programme management, we spend quite a lot of time, tears and treasure trying to pull that stuff through. It is happening in the quantum world; it is going to happen in the engineering and biology world. You need to think about that question in terms of the national investment in science, because I do not think the investments we are making outside of defence are just aimed primarily at defence. We need to make sure that the system is such that we can actually harvest it, pull it in and use it.

There are other areas where, frankly, nobody is going to invent the science other than me and my colleagues because it does not really have applicability elsewhere, such as in some of the weapon spaces. The other one where we have that overall investment is in AI. There are national AI strategies; there is an AI centre; there is the Turing Institute and all of those things. The trick there is to make sure that we are expending the right effort in the MoD to harvest that, pull it in, close the loop and influence it because, unlike many other countries, we just cannot afford to have civil and military programmes. We are just not big enough and, frankly, it is a waste of the taxpayer's money to do that.

There is quite a good track record of the MoD reaching out and doing that in various places. We spend quite a bit of time trying to make defence more understandable to the outside community. None of you is smiling at that point; that worries me slightly. If I go into some of the tech sectors or academia, the MoD has a particular set of languages and use cases that it employs. We have done a number of things with the universities to translate that into their world. This is part of how we harvest the technology back into the system. To answer your question about why the Treasury should give us the money, it is because we have made the realisation that this needs to be a national response, and we are playing our part in it to pull it through and shape it in the right ways.

It is interesting that you have both John and me here, because when we put together our programmes they are designed, in quite a rigorous way, to be end-to-end programmes. It is not just about me doing some clever science and technology; quite a lot of thought has gone into how that is actually pulled through.

People have talked about the valley of death. We do not have the luxury of filling the valley of death with taxpayer pounds, frankly. We have to be quite smart about how we do that, which is all about aligning the processes and the incentives. We have, flowing off the back of the IR and the extra investment, launched something called the R&D implementation study. That is looking at how we bring people together to get the end-to-end process all the way through that works right. Because people are incentivised to do different things in that process, you have to bring them together and actually work the process through.

Again, that is an example of a step change in the way the MoD has approached things. It is much less stove-piped; it is much more end to end; it is about trying to exploit the great things my innovation colleagues do in the middle to bring things in on different tracks and that sort of stuff.

In answer to your question, defence is trying to make best use of all the civilian investment. Where it cannot, it has been quite hard-nosed about identifying the stuff it has to invest in and do itself. It is adopting an end-to-end approach, exploiting from wherever we can get it. I think that is the right thing to do, not just from a financial perspective, but because of the pace of change in the technology. If you do not do that, you are

going to end up pulling technology that is 10 years old. In our world, that is probably not going to do you any good.

John Ridge: I will just talk a little bit on metrics. In a private company, it is really hard to make innovation and investment decisions full stop. That is when they have an immediate way of measuring, after a certain time, through their bottom line, whether that was the right decision. We do not have the luxury of having a bottom line by which we can measure whether an investment decision was the right one. The only time it really comes to life is when we end up in a war and are testing these capabilities, which is clearly a situation we do not want to end up in.

There is something really difficult about how you measure success and, therefore, how you use those metrics to make decisions. We are doing some work, though, about understanding how many of our ideas go through the pipeline and end up as capabilities. We are starting to develop some metrics around that.

The other interesting thing, which was touched upon earlier, is how much investment by defence leverages external investment. There are some relatively rough and ready metrics about how much we leverage out of private sector investment, which obviously contributes to national prosperity. There are a series of things that you might want to measure there. I would not pretend that we are wholly mature on that yet, but it is definitely something we are focused on doing better.

Technology might help us in some of this. Dr Johnson mentioned war-gaming, and there may be an opportunity in simulating different investment decisions or different force structures, seeing how they play out and using that as part of your investment choices, which might allow us to have a more sophisticated discussion: "Here are the different ways we could spend the money and here is the impact we think that might have". But that is extremely difficult to plot out. While the technology is there, at the moment there are a lot of humans involved in that process as well.

Dr Rob Johnson: As somebody who has come into defence relatively recently, I have been struck by the need for balance. A very fine politician, William Ewart Gladstone, used to remind his colleagues that all taxpayers' money is a trust from God and should be treated as such. But he was also the first to admit that the first duty of government is to defend the nation.

I was very struck by the arguments that have been played out over decades previous, saying we must cut and be more efficient. Of course, you reach a point where cuts are no longer efficient; they actually become inefficiencies. The amazing thing about the new tech revolution that is going on around us is that it gives us the opportunity of reinvesting money back in the economy in other ways.

For example, data processing at speed may be a useful military utility, but it has a very powerful commercial application for the UK to become

competitive in a much more competitive world. Defeating cybercriminals you might do in a military context, defeating a nefarious state with cyber operations, if you invest in that. But, as a by-product of that, you are now saving the taxpayer millions and millions of pounds every year. Along with that, if you learn how to defeat an adversarial state in the information space or the cyber space, you can apply that to defeating organised crime, which again has a huge financial benefit.

There are all the other things that we normally talk about at these committees, such as the benefit of a multibillion-pound shipbuilding programme bringing jobs into Scotland and the north of England. If we can get it right and we automate our manufacturing base to compete with China in the next 20 years, we will have generated not only thousands of jobs but a much higher GDP for the nation. These things are complementary. There are all sorts of problems. Sometimes technologies go wrong, and they are expensive when they go wrong, but better, I think, to take the big bet risks than not do it at all and become second rate.

Lord Boateng: I have heard that argument before.

Q168 **Lord Stirrup:** My question was going to be about the realities of drawing non-defence research and development into defence capability and, as you have alluded to, vice versa, because it can flow the other way. You have already talked quite a lot about that and given some examples, such as quantum technology. Perhaps I can ask you to say a little more about how you would link with organisations such as ARIA, and what sort of synergies there would be there.

Could I then also ask you to go further? The key challenge for the UK over the years, in both defence and the wider commercial sector, as you have already said this afternoon, has not been developing new science and technology, but translating that into commercial benefit or, in defence terms, capability benefit. That seems to me a question of investment and, to a certain extent, government pump priming, and you have already talked about the risks that SMEs expose themselves to. Are we going to find a solution to that or is everything going to be hung up on those rocks again?

John Ridge: I can kick off with two areas where we are doing quite a lot of this already. One is through DASA—the Defence and Security Accelerator. It has about 100 people and a network of people set out around the country, usually collocated with tech hubs, so they are based in all the regions around the UK. They go out with challenges from defence, present these to industry and say, “Here’s a problem we want you to solve. Have you got any ideas?” They run these relatively frequently. From that, we then draw a number of things in and occasionally a trial comes out of that.

It also does what is called an open call. It will go out and ask, “Is there anything that you’re doing that you think we might be interested in?” It is not against a specific problem. We have seen some interesting ideas

come in from industry, particularly from SMEs, where they say, "We're developing this capability. We're not sure if it's any use". Sometimes that will be brought into defence, but sometimes we can hand it off to other bits of government. Obviously, DASA serves the national security community, not just defence. There are some really useful ways of accelerating those very small companies.

The other bit is the national security strategic investment fund, with which, working alongside other national security colleagues, we can make relatively small investments into dual-use companies. Where there is a company producing, exactly as you describe, a thing that may well have benefit to both national security and the wider private sector, we can make small investments in that, partly to sustain that capability and partly to provide leverage as part of the investment into those companies.

Those are two specific examples of work we are doing now, which goes towards what you are describing in terms of accessing and sustaining that technical base.

Dr Nicholas Joad: There are probably two things I would pull out of what we have done. We have an organisation called Ploughshare within the MoD and its role is to exploit MoD-owned IP. It is reaching out to other investors, PV companies and that sort of thing, as well as our traditional licensing of the technology.

We have had some examples. It is quite interesting, in that we have not felt we had the money to take a particular technology all the way through the development cycle and then buy it back. What they have actually done is license some of that technology out. They have got private sector investment in it and finished off developing the capability, then we have come back and bought it. That is an interesting model. Whether it works for large things or just small things is quite a moot point, but there are certainly some things we can do in that space.

The other thing that people very much value in industry is transparency. There has been a lot of work, certainly in the S&T space, to be really transparent about what we think we want and where we are going, and to try to give them long-term stability. Ultimately, they have to go back to their shareholders and say, "I want to invest your money in this; there's going to be a return at the end of it". The MoD has become much more transparent about that.

It has also become a lot more transparent about what capabilities it offers as well. It has a capability framework that it discusses very regularly with industry. Those are two quite interesting examples where the MoD is trying to bring the supply chain in early, either to exploit stuff that would not otherwise be exploited or to let them take some sensible business decisions about where they want to be involved in that process.

Lord Stirrup: Are you linking with ARIA and its work?

John Ridge: I can touch on that briefly. It is early days. It is still very much in its formative stage. My understanding of the way it will operate is that the board that runs ARIA will take the investment decisions. It will be independent in order for it to seize the opportunities out there. I would be very surprised if there are not areas that ARIA looks at that we are also interested in.

One of my key roles is ensuring that we build a network across the national security sector and more broadly across government, so that we can avoid duplication and find the sort of synergies that there are. I spend a lot of my time talking to national security partners about the shared challenges we have and how we do that. I would be very surprised in time if we do not develop a close relationship with ARIA among all the other UKRI-type organisations.

Dr Nicholas Joad: In the S&T world we have quite a close relationship with DARPA in the US. There are some similarities culturally, I suspect, with ARIA that we are quite used to working with. It is interesting because I would imagine it will be a very entrepreneurial organisation, which will look at a whole set of requirements and then almost take a bit of a bet on what technology it goes after. I am not a proud man so, if it has anything I can exploit, I will be right in there, as they say.

Q169 **Lord Alton of Liverpool:** Earlier on you said to us that we do not have an invention problem; it is more an exploitation problem. I wondered what this means in a defence context. Do innovation and invention amount to the same thing? Are there differences? Could you tease it out for us? Are we predominantly talking about inventing new weapons systems that deliver more combat power for a given level of expenditure or should we understand the term more broadly?

Being very specific, I mentioned Ajax earlier on. Was that an invention problem? Was it an innovation problem? Has it been an exploitation problem? Given what the Public Accounts Committee has said about it having been a disaster from day one, what lessons do we draw?

John Ridge: There is definitely a difference between invention and innovation. Taking it from understanding what your problem is and having an idea about how you will solve that, to inventing a way to solve that problem, those are the early stages of it. You then need to scale it for it to become a genuine innovation. To me, there is a difference and it is in that scaling part. That is the difficult bit where you are pulling these things across the valley of death, as mentioned, so there is a difference there.

We consciously take a very broad view of innovation. We have seen the example of additive printing, out in South Sudan, where an enthusiastic REME tradesman decided to pull together a 3D printer and was printing parts of the guttering, because that was really cheap and avoided having to bring this stuff in. Innovation, to me, is everything from that through to hypersonic weapons, but it is also innovating in the way that you operate. For me, the big prize in this is helping defence achieve the sort

of agility that my colleagues have talked about, which is what is going to give us that competitive edge. That is the end goal of innovation for defence. We take a really broad view on it.

The thing that struck me about the way the Ajax programme played out is the transparency and candour in the report that was written and made public. That is important: we have to be honest about when things have gone wrong, because that is the only way we will learn the lessons from it. The fact that defence published a coruscating report about how the programme had run was very important.

We also have to accept that, if we are going to innovate and try quite new things, whether that is an approach or a technology, occasionally things will go wrong. We need to acknowledge and accept that. Sometimes that will mean that taxpayers' money has bought us a lesson rather than a capability. Sometimes the fact that you have made an investment in something and, at the end of it, you find that it does not deliver what you want it to is itself is a really important piece of work that you have done.

I cannot remember the exact expression that Elon Musk uses but, when his rockets explode, they do not explode; it is a rapid, unplanned disintegration. As part of that they acknowledge that sometimes innovation costs you money to learn lessons. That would be my opening gambit on that.

Dr Nicholas Joad: The MoD has been quite transparent in its report on Ajax: one of the lessons we need to learn is how much of that we knew, but that did not get to the right places. We are doing a bit of a study, which we have called the great scientific department, because we want to do great science, but if we want to be a great scientific department we need to make sure our processes and behaviours are such that, where we know something, we actually act on it. That is one where we probably could have done a better job. It is all about how we provide scientific advice to the decision-makers and how we make sure we get that right.

Lord Alton of Liverpool: Have you got it working now?

Dr Nicholas Joad: It is one of those things: it works when it works, and when it does not work it does not. We want to make sure that we have done that in a very systematic way.

Dr Rob Johnson: Does that not speak to the idea that innovation is as much what you do in the mind as it might be in terms of organisational process or delivery of an item or artefact? Innovations sometimes fail. That is the nature of the beast. If you look at all the great scientific breakthroughs, many of them started with things going wrong or, indeed, serendipity. We discover all sorts of things by not really looking for them in the first place.

One of the things that SONAC is trying to do is to learn from others. What are they doing right and what are they doing wrong? How do we then

apply those? How do we bring those lessons back to ourselves? It has been really striking to learn with humility from the Ukrainians about how they are doing business. There is much that we can learn there. That goes for everything, from how they have made use of commercial drones to how youngsters are getting involved in the defence of their nation, a whole raft of things that we should probably be looking at very carefully. That is what SONAC is for.

Q170 Lord Anderson of Swansea: May I run two questions together, because of the time? First, what are the main obstacles to innovation within the MoD? Are they cultural? Are they risk aversion, scientific or what? How can we improve that readiness?

As was touched on a moment ago in relation to Ukraine and learning from that, actual operations are far more important than war-games and simulation exercises for accelerating innovation. Are we seeing this already in the Ukraine conflict? Are we pooling with our Ukrainian colleagues the lessons that they have learned and that we are applying ourselves, in terms of both organisation and armaments?

John Ridge: Shall I answer the first one? The majority of our problems with innovation are cultural. For example, if you ask a junior civil servant in our procurement system to make a decision where they personally are going to take a lot of risk, at the moment the incentives and, therefore, their behaviours are not aligned. We are trying to ask them to take risks, move more quickly and accept that things might go wrong, but the individual incentives do not line up for that. That creates a culture where people tend to be more risk averse than we need them to be. At its most fundamental, that is the key thing we need to address there.

Usually, their lack of willingness to take risk means they either defer a decision or refer up, and you end up with a lengthy process of bureaucracy before you eventually get to, sometimes, the right decision, but it has just taken too long to get there. Changing cultures is really hard because you cannot deal with them directly. There are a number of ways we intend to get at that. One is around the set-up of SONAC and introducing new pieces to the organisation, which acts as a catalyst for some of that cultural change. We need to look at the way our processes are constructed, particularly those individual incentives. How do we turn round to that relatively junior civil servant and say, "You are not going to be punished if this doesn't go right"?

I am reading a book at the moment about commercial companies rewarding the things that go wrong. They have champagne moments when somebody cuts a programme. That way, you turn it round from being the programmes that fail, where you take those teams to task and they are not promoted. If people make the brave decision to stop stuff at a particular point, because they feel that it is not going to deliver the outcomes they are after, that is a good decision and should be rewarded. There are a whole series of things that we need to do there. I would not pretend it is easy to do, but we are honest in terms of how we are getting at that.

Dr Rob Johnson: In the interests of time, I will give a very brief answer now, but I am very happy to follow this up, because there are some lessons we have been learning from Ukraine that we cannot discuss here in detail as they are rather sensitive. There are certainly things that are important.

One of the most striking things of all is that the UK Armed Forces were part of the training package for the Ukrainians in the first place. Therefore, the way they have gone about fighting in a war, an existential war for them, has been very much the way that we do it. In simple terms, we fight like the Ukrainians do. That is the aspiration: very fluid, devolved command and control, maximum use of new technologies, great manoeuvrability, great lethality at range and so on. Those are the important things there.

There is a broader question about what the obstacles might be within the system. Again, I will quote a classical expression: *gnothi seauton*—know thyself. We have to be realistic and honest about it. Again, one of the reasons SONAC exists is to do that business of speaking honestly to each other, encouraging challenge, showing not telling, and actually demonstrating things that can work and are successful, which is why John's innovation cell is so fascinating and we are working so closely together.

There is also, at the senior leader level, an embrace of what they call the agile methodology, so trying to encourage people to be bold and accept that there may be failures. The Secretary of State himself has put forward some reforms for the way that even the head office is structured, so we can make the maximum use of those changes.

- Q171 **Baroness Rawlings:** Thank you, Dr Johnson, for all your explanations. You started off, right at the beginning, by saying there was no nuclear threat. Then you said, yes, there is a nuclear threat—hypersonic or whatever. I wonder if you could explain and expand on that a little bit.

Dr Rob Johnson: There is a difference to be drawn between the threat and the current rhetoric. The threat exists and has been there since the days of the Cold War. It abated a little, some might argue, in the 1990s when Russia was in difficulty. The nuclear threat is extant and there is no denying that Russia has a significant nuclear arsenal.

What we are objecting to as a nation, because it is in contravention of all the agreements we have had in the permanent five, among the G7 nations and in the non-proliferation treaty, is the use of this rhetoric. There is absolutely no need for it. The solution is very simple: if President Putin decided to withdraw his forces, there would be no need for any crisis at all.

- Q172 **Lord Campbell of Pittenweem:** I understand how you are able to speak honestly within the Ministry of Defence, but we have some projects in which we are engaged with allies, for example the future combat air system. How do you challenge them and speak honestly to the allies if

what they are doing is, in your view, the wrong thing?

Dr Nicholas Joad: The future combat air system is a really interesting programme. Quite a lot of what has been done in that space is to understand what the solutions might be and challenge ourselves in terms of what technology we can access and put in that. In the way that the UK does its concept development, there is a very long tradition of putting together paper and then constantly maturing solutions to understand what you might get in that space. Because of that, we have quite good frameworks where we can talk to our partner nations and say, "If you had an aircraft of that class, it has this amount of technical risk and it would do this".

There are almost two loops in there, so there is quite a tight design loop with our allies, investigating what we might be able to do and what we might get. Then there is a loop going back into SONAC and the wider MoD saying, "Let's just make sure we're positioning that set of solutions in the space of things that we really think are going to have an impact". That has worked quite well, actually.

Lord Campbell of Pittenweem: Does that involve a challenge to another participant country? We have had Eurofighter; that was a multinational effort. What happens if, in your judgment, the ally that is preparing the wings goes in the wrong direction? How do you challenge that, if at all?

Dr Nicholas Joad: It depends at which point. If you are talking about what you want to buy, actually that is both people looking at the solution and asking, "Do I want an aircraft that's this big that can do this?" or whatever it is. That is quite a collaborative space, because people are exploring the answer to that. When you get into the actual performance of the programme, about whether the bits you are building are right or not, that is a different issue. You will get into places to do with workshare, performance of nations and that sort of thing. But the bit up front is actually quite collaborative.

Lord Campbell of Pittenweem: We have not got there yet.

Dr Nicholas Joad: We have not quite got there yet, no.

Dr Rob Johnson: Among friends and allies, if they are genuine friends and allies, you should be able to have an honest conversation and it is a test of your alliance and your friendship, of course, if you can. Our job, I suppose, is to provide the best challenge we can to the assumptions and the reasoning, so that we can send our Ministers to have that dialogue at that level to improve the judgments that are made.

We cannot ourselves say, "You must not invest in that particular aircraft fuselage because we don't think it is very good", but our job might be to say, "The balance is this. If they don't invest in that, it's going to be detrimental to their nation as well as ours, so it's in everyone's interest to make sure that happens". If we can show where the legacies have gone wrong, the lessons that have been learned, the net assessment of the

future and how these things will play out, with a capability strategy that we have been very thorough about, we will have provided the decision support that our Ministers require.

The Chair: Before I formally thank you for your contributions today, I recall that you were kind enough, earlier in the evidence session, to refer to the report you are giving to the Secretary of State next week and you suggested that you might be able to write privately about what may or may not have gone wrong. My colleagues already know, but just for the record, when you write privately, it means that it is not used for evidence. It remains private for the information of the members of this committee only, to give you that reassurance.

You also mentioned just at the end something that, I think, intrigued us all when you said you might be able to give us more information about the lessons learned because of events in Ukraine. That would also be treated as a private matter.

I formally thank you for your contributions, the three of you sitting there, but I also recall that, when asked about the size of your department, Dr Johnson, you said at the moment it has 25 personnel, fewer than there are people in this room. That puts even more gloss on the enthusiasm and determination you have shown today, which I am sure is shared by the other 22 people, but it shows us what a heck of a lot of a job you have. Thank you very much indeed.