HOUSE OF LORDS

Select Committee on Risk Assessment and Risk Planning

Corrected oral evidence: Risk assessment and risk planning

Wednesday 17 March 2021

11.15 am

Watch the meeting

Members present: Lord Arbuthnot of Edrom (The Chair); Lord Browne of Ladyton; Lord Clement-Jones; Lord Mair; Baroness McGregor-Smith; Lord O'Shaughnessy; Lord Rees of Ludlow; Lord Robertson of Port Ellen; Baroness Symons of Vernham; Viscount Thurso; Lord Triesman.

Evidence Session No. 15 Virtual Proceeding Questions 155 - 162

Witnesses

I: Elisabeth Braw, Visiting Fellow, American Enterprise Institute; Professor Jim Hall, Professor of Climate and Environmental Risks, University of Oxford; Professor Tim Watson, Director of the Cyber Security Centre, Warwick Manufacturing Group, University of Warwick.

Examination of witnesses

Elisabeth Braw, Professor Jim Hall and Professor Tim Watson.

Q155 **The Chair:** Welcome to the Lords Select Committee on Risk Assessment and Risk Planning. For our second panel this morning, we have a panel of experts on resilience. We have Elisabeth Braw, a visiting fellow at the American Enterprise Institute, Professor Jim Hall, professor of climate and environmental risks at the University of Oxford, and Professor Tim Watson, director of the Cyber Security Centre within Warwick Manufacturing Group at the University of Warwick. Welcome to all three of you.

Let us begin with a general question. What is resilience? How do you build resilience? You each have different interests—climate change, cybersecurity and international issues of resilience.

Professor Tim Watson: Resilience is the capacity to absorb disturbance, shocks and stresses and carry on much as before. It does not mean, by the capacity to absorb, that it is all technical; it is as much about human beings and their ability to improvise in a crisis. When we talk about shocks and stresses, we do not just mean immediate bad things that suddenly happen, but stresses that can build up imperceptibly over time. In carrying on much as before, we might see that systems that we describe as resilient change significantly. However, they maintain some form of identity, so they carry on doing what we would like them to do, though they might not be doing it in quite the same way.

Professor Jim Hall: To add to that definition of resilience, more broadly we think of it, as well as the capacity to absorb, as the capacity to resist disturbance, cope with and recover from disturbance and, indeed, learn from failure or, as the current terminology has it, build back better. If we look, for example, at the field that I work in most, at climate risk to infrastructure systems, we can add to resilience by strengthening those systems. That enhances their resistance. We can also add to resilience by enhancing coping capacity. By that I mean, in particular, looking at flexibility, redundancy and additional connectivity, which we heard quite a lot about in the previous session, and by enhancing capacity for warning, emergency response, coping and recovery during disturbances.

Elisabeth Braw: Thank you to the committee for the invitation. It is a really important subject you are addressing in this inquiry. To add to what my colleagues have said, resilience is also the capacity of individuals to be part of the absorption of whatever the shock is and to bounce back.

The challenge that we have is that we do not have a definition of what constitutes resilience and what percentage of operations, daily life, or whatever it is you are measuring, we need to have to call ourselves resilient. Is it half the ordinary daily operations before whatever the crisis is? Is it 75%? We do not know. That may be of less importance to the definition, but it is of importance when we start measuring, for example, what companies are expected to do in a crisis and, indeed, what

Governments are expected to do. What is the benchmark that we are aiming for to call ourselves resilient?

The Chair: Professor Watson, I have heard you speak in the past about the risks of considering yourself resilient against particular shocks. Could you expand on that, please?

Professor Tim Watson: Yes, certainly. We are very good, in cybersecurity and engineering disciplines, at listing all the bad things that might happen and then trying to do something about them. We have risk registers, including a national risk register, but we can get surprised rather frequently.

One of the things that ecologists have discussed for quite a while is that there are two different types of resilience. One is specific resilience, which is listing all the bad things, but the other is general resilience. General resilience says, "I do not really know what I am about to face, but what I do know, having seen a number of different habitats and systems, is that the ones that are generally more resistant and resilient have things in common". They have characteristics that span resilient systems. These are things such as diversity, reserves, making sure that the system is open and you can bring different bits in and pull bits out, and that it is not so locked together that you have to have one precise thing, and only that thing, to make your system work. You need a variety of different types of capital as well—human capital, social capital and trust.

Above all, you need to be able to improvise in a crisis. This is a very operational thing. It also has qualitative differences depending upon whether we are talking about cyber risks or the hazards that we get from natural phenomena. To give you an example, a flood is a risk, but if I have to deal with it, I do not have to outwit it. A malicious attacker attacking me with a cyberattack has the ability to choreograph my bad luck. They can use creative deviousness to throw all of my statistical analyses of how likely things are to happen together out of the window. The way in which you want to deal with those is quite different.

Specified resilience, listing the bad things, is a really good thing to do, but it is not the only thing you should do; you should also focus on general resilience. Often, when we focus on optimising for those specified bad things, we damage general resilience.

Professor Jim Hall: You have been probing us on the definition of resilience and we have given you a number of attributes of that. There is a tendency for the definition of resilience to be broadened so far that it becomes practically meaningless and it becomes a general good thing to have, so I would encourage you in this to seek to come up with quite a tight definition and also, in a sense, to move on to the questions of what we do about it.

Elisabeth Braw: The juncture that we are at with regard to resilience is that we have the traditional forms that we have long needed to protect ourselves against, especially extreme weather events, which are

increasing, but then we have the increasing use of grey-zone aggression by our adversaries. That is what Professor Watson alluded to earlier.

With resilience in that area, it is not just what you do when the contingency happens—it is what you signal beforehand to make that aggression less likely. It is in everybody's interests to signal, "If you try whatever it is you are hoping to try, it will not have any effect, so do not even try it in the first place". That is where resilience is so important to liberal democracies and advanced economies such as the UK: to put out that united front and tell our adversaries, "You may have the capability and you may even have the intent to try your tricks on us, but we will absorb it and recover, so it will not be worth your while".

Q156 **Lord O'Shaughnessy:** They have been very interesting responses so far. I wanted to really push on the societal and individual behaviours that would strengthen national resilience against risk. Ms Braw, you have already talked about the role of incentivising individuals and institutions. Professor Watson talked about the characteristics of resilient systems. I am really interested to know how you think the Government or perhaps wider society should incentivise these kinds of behaviours. What specifically should we be doing in order to provide that precise and general resilience that you have talked about this morning?

Professor Tim Watson: The effective response to shocks is often one of determined improvisation. You might have put things in place, so you have done lots of planning, but often it is not the plan that you enact. What you do is that you take advantage of the thinking that you have done in slow time—but the thing that makes you effective at being resilient is often the quality of the teams that you have put together and the ability they have had beforehand to practise the skills that they need in times of crisis.

What could be specifically done would be to give permission to local communities and groups to use their initiative to experiment and improvise. Local autonomy is useful. Often, we see in resilience thinking people talking about agency; that is a subtly different thing, because you are acting on behalf of somebody else. You were very careful to ask a question about what Governments or society more broadly can do. This is something that we can do more broadly to encourage groups to come together to practise being resilient. We might end up with a more coherent society as a result, as a useful by-product.

Lord O'Shaughnessy: It calls to mind the Eisenhower quote about plans being useless but planning being indispensable. Is that a neat summary of what you are saying?

Professor Tim Watson: Mike Tyson said that everyone has a plan until they are punched in the mouth.

Lord O'Shaughnessy: That is perhaps a better one.

Professor Jim Hall: I will come in directly on where I think you were heading with the question, about the extent to which we can incentivise

individuals and communities to adopt more resilient behaviours. On the one hand, I would be quite cautious about that, in the sense that we are in a society that is 'always on' and always digitally and electronically connected. Expectations with respect to connectivity have, if anything, increased. On the other hand, the pandemic has illustrated that people are adaptable and will change their behaviours in significant ways. For a lot of that, we should be looking to institutions in the broader sense, to rules, norms and powers, rather than necessarily assuming that individuals themselves can handle all of this.

As this committee is clearly investigating, the Government have a responsibility to look at these longer-term, more extreme and unexpected threats, which people sometimes cannot be expected to think about, and approach that very systematically. Government has to look at how systems function, what the vulnerabilities are within those systems and what the threats are to which they might be exposed, what the proportionate actions are to manage those threats and what the monitoring systems are to feed back and tell us how we are doing.

Lord O'Shaughnessy: The point I am getting at is about what a distributed set of capacities might look like. You are quite right that it is not just about individuals acting—it is at every stage and level of society, from individuals through to nation states and beyond. What does a good distributed set of capacities look like that would make us more resilient? What are some of the things that the UK is currently lacking that we might want to build in order to deliver that?

Elisabeth Braw: We are lacking any skill among the wider population. We have a Government that know what to do. We have the gold/silver/bronze system within crisis management and first-responders, but the whole population is essentially a lost opportunity, because nobody, apart from the people who have skills as part of their professional career, really knows what to do.

We saw it with the NHS army, where 750,000 signed up almost immediately to be part of this NHS army, because the Government needed them at that moment, but it was an improvised measure. The Government then took the few thousand needed and the rest were lost. There was the will to be part of this solution, but there was no previous training programme in place. It was an improvised measure.

It does not have to be an NHS army—it can be a societal response core or whatever you want to call it, but that sort of training being provided before a crisis would tap into people's willingness to be part of the solution. It is not just because it is a good thing to do for society; it is a good thing to do for oneself as well, so that one does not get stuck not knowing what to do in a crisis. We see it in earthquake zones, where authorities train the population quite well in what to do.

There is a general willingness to be part of something, but the training has to happen and the command-and-control system has to be in place

before a crisis; otherwise, it will just be an improvised measure when the crisis happens.

Q157 **Lord Robertson of Port Ellen:** Reading the integrated review, as I did very late last night, it would appear that they have swallowed the Elisabeth Braw book almost totally, because a lot of the questions that I was going to ask have been answered in that review. If we are to take that as an action plan, it covers a lot of areas that were critical. What are the issues with the existing ways in which we measure resilience? Apart from what is already suggested in the integrated review, what should we be doing to rectify these gaps? Could the two professors answer that one, and then I will go on to Elisabeth Braw to ask whether other countries do it better and which ones do it best.

Professor Jim Hall: I can recount some of my observations in relation to infrastructure systems in this country. You have just been talking to the infrastructure regulators, and in the Adaptation Committee of the Committee on Climate Change, which I sat on for a number of years, we looked very carefully at infrastructure's resilience to climate-related threats. We found that the sectors that had tighter regulations and more reporting requirements were making more progress with respect to their adaptation around climate-related risks. There were gaps in other areas, such as the port sector, which you will recognise as being less regulated relative to the power sector, for example, in this country. It was much more difficult to find out how resilient they were to climate-related threats.

Another point I would make about what could or should be done is around the role of stress tests and exercises. We have been looking back wistfully at Exercise Cygnus during this epidemic. Much more broadly, stress tests are widely accepted within the finance sector and the insurance sector, but we should be doing more in terms of systematic stress testing and exercises.

I take Tim Watson's point that there are always unexpected threats, so we should not get too hung up on specific stress tests because then something else unexpected is going to happen, but the process of doing stress tests and going through exercises means we learn more about our systems. We also learn a bit about the unexpected and how those systems might respond.

Professor Tim Watson: Jim has made a series of really critical points there. Stress testing is vital. I will give you the concrete example of Netflix, which everybody seems to have; even I have it now. Netflix has a wonderful system called Chaos Monkey. That roams through their systems randomly trampling on servers and killing them off. They have deliberately created this system that will, in production, stress-test their ability to deliver content to customers. It is a great example of the sorts of things you can do, with the right imagination, to build resilience.

There are a number of things that we can do. I am part of a project funded by UKRI, called RIoTE, which is looking at cyber resilience for

critical infrastructure. We have looked across at a wide variety of different ways of providing resilience. There are general characteristics that are coming out. We need fewer silos. We often try to get the cyber right, get the physical aspect right and then get the people right—and these are all linked. We need to understand that, if you focus on a particular system at a particular scale, there is probably a wider government above it and there are smaller-scale systems below it, and we need to understand the interplay between those to be able to get the resilience right.

There are different domains. You have economic, social, technical and biological systems; again, they are all interacting. One of the things that you might see is that you want your fish stock in a sea to be resilient, but if the economics mean that you have to pay a lot for your boat each year, you are going to concentrate on getting the catch you need to pay off your lender, because that takes care of the immediate problem. The longer problem gets put to one side. There are economic factors that are often playing—the classic one is efficiency.

There are things that we can do. There are cheap, frictionless ways of improving resilience. To give an example, airline pilots can eat different meals; if there is a problem with one meal, they do not both suffer from food poisoning. However, you have two pilots in the cockpit; you could have one. Some of the decisions that you take are expensive. You are incurring an extra cost for that resilience. Others are cheap and almost cost-free; we definitely ought to be doing those.

Lord Robertson of Port Ellen: Elisabeth, this is your specialist subject. As I say, a lot of what you have written about is now in the integrated review. Do you spot any weaknesses in the system that should have been addressed?

Elisabeth Braw: First of all, I am delighted that this whole-of-society approach made it into the integrated review. It was quite a step for the UK to go from the fusion doctrine, which was really about the Government only, to now including the whole of society. What is less clear in the integrated review so far is how it is going to be organised. It is fantastic to say, "We will have a whole-of-society approach", but how exactly will it work?

Something that would work really well, which would not be expensive, is to train teenagers. In past generations, every country had national service. We do not really need that anymore, but we need to train the population for general contingencies and also awareness about disinformation. That would be something that would be easy to do and relatively inexpensive. We have, in our teenagers, a fantastic resource. They are not asked to do anything for society, unlike previous generations of teenagers and, indeed, people of all ages. This is an opportunity.

It is clear that people feel apprehensive reading about the UK increasing the number of nuclear warheads. Further down, the Government can

offer an opportunity for people to be involved in their local communities by training them in contingencies that are significantly more minor than nuclear conflicts. The point is that in our society, indeed in any western society, there is not a lot that unites us anymore, which is why we have these crazy situations of really quite toxic conflict between the constituent parts. My perspective is that national security now unites us. This is something where we can all agree that, if we get involved and try to keep our country safe, it is good for everybody. We do not need to agree on much else, but we can agree on that.

Training teenagers, even just for a few weeks, would give us this core of skilled citizens who would be able to help. We would not have to improvise an NHS army the next time there is a major pandemic, because we would have these people who have rudimentary, basic or quite specific skills in whatever it is you want to train them in. You can start with that and go all the way up to more specific training.

You could, for example, also train or have regular consultations with business leaders, so that they would better understand the national security situation in which their companies operate. They see it from their company's perspective—they are on the front line—but they cannot be expected to have the whole picture of what is happening. It is fertile ground for lots of government initiatives that would be quite inexpensive compared to traditional military security.

Lord Robertson of Port Ellen: Do other countries do this? Is there a model that you can point to that suggests it can be done?

Elisabeth Braw: One good model is what Finland does with its national defence course. Some of you may be familiar with it but, just to recap, it is a course for which rising leaders get nominated by their organisations. That can be anything from political parties to NGOs to businesses and the Armed Forces, even though it is about 88% civilian participation. You get selected for this course. It is for three and a half weeks and residential, and you learn the basics of the national security doctrine of Finland. You have a group of leaders who then rise through the ranks, to the highest ranks in many cases, and they all have a basic understanding of national security. On top of that, they have the connection between themselves, so that they know who to contact in a crisis. It is just a fantastic way of building cohesion within the leadership of any country. That is something that works well.

Going back to the Cold War, which had the best thinking on what was called total defence, the best example is Sweden. That is not just because I am a citizen of Sweden, but because it had this fantastic model where lots of auxiliary organisations offered the opportunity for people to get involved in national security, not in a military way but, for example, by training dogs for the Armed Forces or by specialising in satellite communications. It involved any number of civilian skills, and you could get involved simply because you wanted to do something for the country and you were either too old to be part of the Armed Forces or because you felt uneasy about carrying weapons.

Something like that is possible today. Again, that would not be with the same set-up, but with the same mentality that there is a role for everybody in helping keep the country safe. The difference between the Cold War and today is that it is so obvious to everybody that our countries are at risk. While during the Cold War it felt a bit distant in terms of how likely it was that we would be invaded here in western Europe, today it is much more obvious that there are threats to our societies. As a result, it is in everybody's interest to be part of the solution.

Lord Robertson of Port Ellen: If it had not been for the pandemic, we might, as a committee, have wanted to go and look at Finland or Sweden, but we are constrained in what we can do. Thank you very much.

The Chair: We are grateful to you, Elisabeth Braw, for educating the defence establishment about all these things.

Q158 **Baroness Symons of Vernham Dean:** You have been very clear about responsibilities for building up resilience in society as a whole at home. A lot of what we are facing are international problems. Covid is a very obvious one. Climate change is another very obvious one. We could be very safe at home in what training we are giving. What responsibilities do we have to try to train poorer countries, or to give resilience to poorer countries? Arguably, if we do not, we do not solve the problem because we still have climate change and we still have Covid on the face of the planet.

Elisabeth Braw: If we train citizens at home, in the UK, in the particular skills that we decide, we could, although not necessarily, turn it into an expeditionary core of civilian first-responders that we could send out to whatever the crisis was in the world.

We are talking about global Britain, which is a fantastic concept. What if, instead of sending Armed Forces personnel when other countries have crises—they are obviously needed sometimes, because there are things that soldiers can do that others cannot do—we had graduates of the citizen training I talked about, who would be part of a national database of volunteers who would be willing and have the skills to deploy to countries needing help? In many cases, what we do today is scramble to ask an NGO to send people. It would be good not just for those countries but, as a secondary benefit, for Britain to be able to show that it helps countries in crisis, whatever the crisis may be.

Professor Jim Hall: I will come in specifically in relation to climate-related risks around the world. This is an area where, including in my own work, with support from FCDO and UKRI, there is extensive work in terms of building capacity and understanding resilience of networks, economies and systems worldwide. There are incredible opportunities at the moment because of the rapidly increasing availability of data about infrastructure, people, the built environment and the natural environment, which means that we are in a much better position to build

capacity and build best practices in other parts of the world. As the question hinted, there is an element of self-interest and a recognition that these are global problems that can be dealt with only collectively.

Q159 **Lord Mair:** Professor Hall, you have written extensively about the need to take a systems approach and you have done a lot of work for the National Infrastructure Commission on interdependent network vulnerabilities. Can you say a bit more about that and how that kind of research can be used to build resilience?

Professor Jim Hall: Broadly speaking, the approach that we have been working on, including with the National Infrastructure Commission and, as I said in response to the previous question, also in several counties around the world, is to model systems on computer models. We do that by collecting data, mapping out the different assets and entities within those systems, such as power networks, transport networks, digital communications network and water networks, and modelling the flows on those networks and also how those things interconnect with one another.

We recognise that all these networks these days are dependent on electricity and some communications systems. By systematically testing them, we can identify where the weak points in the system are that can lead to the greatest possible impact. We can also simulate extreme events and look at how the system might respond in extreme events.

With the work with the National Infrastructure Commission, we found some very interesting things. If you stress the electricity system, 40% of the failures we tested lead to failures of other infrastructures that are dependent on electricity. In some analysis we did for the Environment Agency, while 15% of the homes in this country are at risk from flooding, 60% of homes are dependent upon infrastructure that is itself at risk from flooding. These interdependencies mean that the impacts from extreme events can be much greater than one might otherwise have thought.

These models are not perfect, but they are a way of learning about systems and engaging multiple people, including from different sectors. We have heard already how communication, for example, across utilities sectors is a challenge. A model provides something that one can congregate around, use to learn about the systems that one is dependent upon and test some of these very difficult questions around how much we should be allocating to resilience, how close to the optimum our system is running at the moment and how much more capacity we might need to provide to become more resilient.

Lord Mair: That leads me to ask another question. You have been talking about computer modelling. My question for you and, indeed, for the other two panellists is related to digital twins. The integrated review that we have already heard about talks about how it will develop a national capability in digital twinning. My question to you first, Professor Hall, but also to the other panellists, is about what you think digital twins can do to assist this question of assessing resilience. Do you see a real future in

digital twins? How should they be used?

Professor Jim Hall: Digital twins are a special type of simulation model. They are assimilating real-time observation data—so data from sensors all the time—and are updating, so that they are very similar representations of the real world. That is a powerful thing to have. Its benefits, in particular, have been found in the aviation sector, where there are digital-twinning aircraft engines.

It is quite a big step to go from those specific instances of digital twins to a national infrastructure digital twin. It is a great journey to be on, but we need to be realistic about how big a challenge that might be. One of the things we always have to recognise with modelling is that it is a horses-for-courses problem. You probably do not need a digital twin to learn something about the sorts of questions we are talking about in this committee.

There are models of a range of different complexities. You can learn things from simple models as well as from extraordinary complex models, like digital twins. In fact, extraordinarily complex models bring their own problems, because they are in danger of becoming black boxes and you do not really understand what is going on. There is a fantastic opportunity that is being opened by this combination of sensing data and computation, but we should not put all of our eggs in the digital-twin basket.

Lord Mair: Elisabeth, would you like to comment on digital twinning and the fact it has been mentioned in the integrated review?

Elisabeth Braw: I have a related point, since Professor Hall provided a very comprehensive overview there. Something that the Bank of England organises, which would be applicable and indeed beneficial to other sectors, is the buddy bank system, where retail banks are paired up, so that, if one bank goes down, the other bank can keep operating on its behalf. You need a lot of trust between competitors to encourage them to, essentially, take over the other side's operations, but it is in everybody's interest to keep operations going in case of some sort of disruption.

I do not have a clear answer to this, but it seems to me that there would be an opportunity for other parts of the Government and other regulators to build similar schemes across the private sector, not by forcing major companies in each sector to do it, but by incentivising them and by providing a forum where the confidentiality is guaranteed. It seems unlikely that competitors would team up just on their own, but if the Government are there as the honest broker providing the framework, it is a model that could work in other sectors as well.

Lord Mair: Professor Watson, what is your view about digital twinning and the potential for that in building resilience?

Professor Tim Watson: There is a lot of potential and there are some pitfalls. As Professor Hall mentioned, all models are wrong but some are useful. We need these models to be sufficiently accurate in the right places, because we are probably going to use them for decision-making. The gap between the behaviour and characteristics of our digital twin and the real system can sometimes be deceptive. We just need to watch out for that.

The issue that we need to understand is that any digital twin needs to capture the full four-dimensional aspect of a system, not just a snapshot. In that way, we need a high-quality four-dimensional model. It is very useful to have it in real time, because you can use it to augment the reality of the physical system to get extra insights. If you can run your digital twin faster than real time, you can do a variety of very useful cheap predictions, which, in terms of the manufacturing potential of the UK, would give us a distinct advantage in world markets. There is great potential, but we just have to approach with caution.

Lord Mair: What do you think was meant by the statement in the integrated review that they will improve the ability to anticipate and respond to crises by developing a national capability in digital twinning?

Professor Tim Watson: I am aware of the work. I am involved with the national digital twin programme and various initiatives and workshops around it. I have seen some very effective digital twins that are used within government to give us insights into critical infrastructure. I believe that there are some systems already available that point towards the potential of these systems, and I think that is what is meant.

Q160 **Viscount Thurso:** From the evidence that we have received so far in the course of this inquiry, I have been very struck by how much expertise and knowledge there is in the United Kingdom, but also by how much of it is in silos and, therefore, perhaps not brought to the attention of decision-makers in the Government or, indeed, to the wider knowledge of the public. You are all scholars of risk, resilience and security. How well is academic and industry experience used in the creation of UK policy on risk and resilience?

Professor Tim Watson: It is a difficult thing to judge. Certainly, I am called upon quite regularly to input into the development of policy and the thinking of Government, so, from my personal perspective, I think that the expertise within the country is well used.

What tends to happen often is that it is felt that a subject matter expert is needed to inject into some group that is developing some policy. Perhaps sometimes the country would be better served by creating more persistent teams that combine government, academia and also the private sector in a team that persists, gets to know each other and then can apply its diverse talents across a range of policy development tasks.

Viscount Thurso: In a way, you have just confessed to being a member of the usual suspects, if I can put it like that. How do you inject

contrarian thinking into that mix to ensure that there is sufficient challenge?

Professor Tim Watson: I am naturally offensive. Contrarianism comes naturally, but you have to ration it. It is a human game played by human participants. If you get on with people, you tend to agree with them. You are allowed to disagree, but if you disagree too frequently, you then become a different type of person and there is an antagonism there. One of the dangers that we have in inviting the usual suspects is that there is a danger of groupthink. It can feel as though we have people who have strange contrarian views but it might be kept to a healthy level, and that might not be healthy for the debate.

Professor Jim Hall: In terms of making the most of the expertise within the country, the mechanisms are quite good. Maybe I am a usual suspect as well. I have participated in SAGE during flood disasters. The other things that the Government have at their disposal are the chief scientific advisers' network and the process of constructing the national risk register, which we have also discussed.

I am inclined to agree with Professor Watson that the trickier part of this is the more dogged, day-to-day stuff of accumulating evidence about how we are doing, spotting the gaps and responding to those. We do pretty well in terms of making the most of expertise.

Viscount Thurso: Can I come to you, Elisabeth Braw? You mentioned one of the dangers of groupthink earlier. Do you agree with your other panellists, or do you think there is another take?

Elisabeth Braw: If I may point to the Catholic Church, they have this fantastic concept of the devil's advocate, which they put in place precisely to avoid groupthink. It is the advocate of the devil. His role is to point out why somebody should not be declared a saint. The formal title has been done away with now, quite recently. Somebody like that is quite useful in any organisation. As Professor Watson said, if we like the people we engage with, we try to agree and not point out fallacies in their argumentation or, indeed, in their action.

One group of people that is not utilised to the same extent as academics and think-tankers in feeding into the Government is the private sector. There is a good reason for that: the Government do not want to be seen as establishing a military-industrial complex, but today the business leaders that the Government would engage with are not just executives at defence primes—it is executives across the board. They have insights that the likes of us here on the committee do not have, because they are on the front line of globalisation, seeing the good and bad every single day. They have the perspective of their companies. As I said earlier, they cannot have the whole perspective, but they have crucial insights that you cannot possibly have if you do not run a company that operates globally or even regionally. That group would be very useful for the Government to consult, not on a commercial basis but just on the basis of exchanging information.

Viscount Thurso: I will ask one short follow-up. If there are good systems, we put together good plans and we assess the risks well, but it goes up into the national register and at that point the decision-makers, who are usually Ministers on a one or two-year job, are then not sighted on all that expertise behind it and therefore do not understand the priorities that need to go with it. Is there a weakness there?

Professor Jim Hall: One thing I overlooked, which follows up on Elisabeth Braw's comment, is the role of the national academies in terms of, in particular, making a connection not only into academia, but, for example, through the Royal Academy of Engineering into industry, business and the professional engineering institutions in the way that has been suggested.

I agree with your suggestion, Viscount Thurso, that the gap is in terms of the follow-up. Resilience is an issue that never goes away, but it is easy to forget about when you are not in the middle of an emergency. That is where the Civil Service and, in fact, your Lordships, who perhaps have a longer horizon than elected politicians, really come in to keep an eye on these persistent issues.

Q161 **Lord Triesman:** I entirely get Elisabeth's point about a wider civilian army, but I am also interested in how we could broaden the group of usual suspects. If you each had to advocate, say, a master's course in a university dealing with this set of skills that you have, which university would you advise me to go to?

Elisabeth Braw: Do you mean an existing university or existing course, or something that should be set up?

Lord Triesman: I mean an existing course in an existing university. Where would we go?

Elisabeth Braw: We would need to set that course up.

The Chair: Professor Watson, you are going to recommend your own course.

Professor Tim Watson: No. I am going to agree with Elisabeth. Let us set that course up.

Professor Jim Hall: I am going to challenge, perhaps, the premise of this. Maybe there is a place for specialist training, but there is a broader institutional issue here as to how we embed what we are talking about across government and society. I would not necessarily prioritise a master's course as being the first step.

Q162 **Lord Robertson of Port Ellen:** I have the final question, which is a quick one requiring snappy answers. If you have seen any of our previous proceedings, you will know what it is. If you could suggest one recommendation that this committee would make at the end of its deliberations, what would it be?

Professor Jim Hall: Stress tests and exercises.

Lord Robertson of Port Ellen: That is music to my ears.

Professor Tim Watson: Facilitate the capacity for improvisation at all scales.

Lord Robertson of Port Ellen: Elisabeth Braw, do you have anything that is not already in the integrated review?

Elisabeth Braw: A national security course for rising leaders taught at the Royal College of Defence Studies, but for people from all walks of society identified as prospective leaders by their respective organisations.

The Chair: That follows the Finnish model. Professor Watson, I have one final question for you. The thought of introducing the Chaos Monkey that Netflix has into the NHS is rather alarming, but could it strengthen the resilience of the NHS, if it was done in a way that could be found not to cost lives?

Professor Tim Watson: It would certainly do that. As you say, it is about how you introduce it, because the more you make it safe, the more you make it ineffective. We would need to find the right balance, but there is a danger to it and that is what gives it its strength.

The Chair: What a wonderful idea. On that note, witnesses, thank you very much indeed. To the committee and our staff, as ever, thank you very much as well.