HOUSE OF LORDS

# Select Committee on Science and Technology

## Corrected oral evidence: Contribution of innovation Catapults to delivering the R&D road map

Tuesday 15 December 2020

10.15 am

Watch the meeting

Members present: Lord Patel (The Chair); Lord Borwick; Lord Browne of Ladyton; Baroness Hilton of Eggardon; Lord Hollick; Lord Kakkar; Lord Mair; Viscount Ridley; Baroness Rock; Baroness Sheehan; Baroness Walmsley; Baroness Young of Old Scone.

Evidence Session No. 3 Virtual Proceeding Questions 28 - 32

### Witnesses

Dick Elsy CBE, CEO, High Value Manufacturing Catapult; Martin McHugh, Acting CEO and Chief Technology Officer, Compound Semiconductor Applications Catapult; Nicola Yates OBE, CEO, Connected Places Catapult.

# Examination of witnesses

Dick Elsy, Martin McHugh and Nicola Yates

**The Chair:** Good morning. I remind all the Members and our guests that we are on broadcast, so you are being listened to by millions of people all over the world. The time is pretty limited today, so I will ask my colleagues to keep the questions brief. Can I ask our witnesses also to be brief and not to repeat what their colleagues might have already said? I am going to go straight into the session. Can I ask our witnesses to introduce themselves the first time they speak?

Q28 **Baroness Rock:** What new, emerging developments in science and technology hold the most promise in terms of their ability to be commercialised and to deliver significant private sector investment?

***Dick Elsy:*** Good morning, everybody. I am responsible for the High Value Manufacturing Catapult. We help industrial partners scale up new manufacturing processes. It is probably no surprise, in terms of technology, that the digital agenda features very widely in what we do. Artificial intelligence and machine learning can enable processes to be advanced. Artificial intelligence is also used for vision systems, such as cameras, to look at the production process and make judgments about how to improve it.

On advanced robotics, we are not robotics manufacturers in the UK, but we are very good at systems integration, integrating the use of robotics into the manufacturing process. There is a lot of value there and, in particular, in augmented and virtual reality. This is basically putting the human into the digital process through the use of goggles and headsets. We used that to very good effect in the recent ventilator challenge, where we trained 3,000 people remotely using systems such as that.

There is a lot of promise in the area of recyclable materials and, in particular, bioderived materials. We have a chance of having something that is genuinely zero carbon. We are not taking fossil fuels out of the ground; we are creating bioderived feedstocks.

Another area where the UK has great academic strength is in battery chemistry. We all know we are heading towards a highly electrified future, so we have a great capability in things such as sodium-ion and high-nickel batteries, but also in electric motors, with motors without magnets. We have great research. We do not have the manufacturing capability yet, but I am sure, as you will all understand, this is a tremendous opportunity for the UK to build new supply chains for these technologies.

***Martin McHugh:*** I am the chief executive officer of the Compound Semiconductor Applications Catapult. I am also on the advisory board for Cardiff University. I sit on the innovation expert panel board as well for BEIS. For our particular Catapult, the emerging developments focus on the electrification of transportation and high-speed communication. Compound semiconductors or advanced semiconductors have a great

part to play in, typically, extending the range of electric vehicles, giving us high-bandwidth communications and enabling 5G.

***Nicola Yates:*** I am the chief executive of the Connected Places Catapult. In the interests of following the Chair's advice, I am going to keep this brief and not repeat all the above. In essence, the Connected Places Catapult is less interested in the vertical of the emerging technologies. We are much more at the engineering solution end of the spectrum that you are going to hear about from my colleagues this morning. We are very much at the 'how do we actually put those new emerging technologies into the real world?' It is less about breakthrough science and more about ensuring that industrial and economic benefit derives from it.

We are very much at the deployment end, trying to help understand why those fantastic emerging technologies are sometimes slow to get to market, especially when we have buyers with considerable buying power. We have a reluctance to procure innovative solutions and a tendency to go to the same old suppliers delivering the same old technologies. In our written submission, we have indicated some of the emerging technologies that we particularly focus on.

**The Chair:** Noble Lords and Baronesses, if you have not declared your interest, if it is relevant, please do so when you ask your question.

Q29 **Baroness Young of Old Scone:** Innovate UK has a big impact on your likelihood of success in helping us towards the 2.4% target and the R&D road map ambitions. What do you think it should do? What should its biggest priority be to enable you to do that most effectively?

***Dick Elsy:*** We need recognition of our strategic national role. We have a fantastic translation mechanism to take research through to industrialisation. The Catapult programme has developed over the last nearly 10 years now and it is a very well-oiled machine. We would like greater recognition of our role in the UKRI family. The new mission of UKRI is to bring more science through for societal and economic benefit. It is a systematic approach. It is about matching up the research with industrial need. We have a tremendous network within the Catapult programme to enable us to do that.

One challenge that Innovate UK has had in recent years is the amount of discretionary funding it has had to apply to collaborative research and development programmes. About half of its budget at the moment is taken up by the Catapult programme and it has little discretion in terms of stimulus for collaborative R&D with the balance of its budget. Two-thirds of all R&D investment in the UK is in manufacturing, so it would make a lot of sense to place some bets in that direction. I would ask that Innovate UK has more discretion over its collaborative R&D, in other words more funding to be able to stimulate competitions to allow our industrial clients to bid, to win competition funding and to help collaborate.

We operate on a thirds model. A third of our income comes from government by way of the direct grant. That helps us invest in

technologies and process capability that industry would not normally be able to afford to invest in. We get a third of our income from industry for using the equipment and services we offer. The final third comes from this source of collaborative R&D. It is a crucial element because, in order to win it, it has to be collaborative, competitive and innovative. Those elements make it a really important part. Innovate UK is one of our sources of that competitive funding. One of the things we would seek is that Innovate UK is properly resourced in that respect.

**Baroness Young of Old Scone:** Mr McHugh, can you answer that question as well and comment on whether there are any barriers at the moment? We heard that the collaborative funding pot was a tricky one to access because of various funders' rules, but also that your KPIs probably got in the way and that you were driven by volume rather than excitement, if I can use that word.

***Martin McHugh:*** I echo a lot of Dick Elsy's sentiment and comment. My personal experience has been that the question is probably not about Innovate UK's ability to excite us further. It is about getting the balance right between the research budget and the development budget. At the moment, we feel that Catapults are the key link between the universities and industry. I agree with you that the KPIs are set up to measure volume of activity and in our case probably not the quality of activity.

**Baroness Young of Old Scone:** Nicola Yates, would you like to comment on both those aspects and anything else that gets in the way?

***Nicola Yates:*** It is linked to some supplementaries about ambition. We need to remember that all this is about trying to create an environment of investor confidence. That is about bigger, longer-term bets, in order to give that investor confidence. So the larger programmes—Mr Elsy might want to come back and say more about his own success with the Faraday challenge—that is where we see some of the biggest success to drive larger emerging technology for the benefit of the UK.

For me, it is about funding ambition. Are we going to identify and put in larger sums of money? The sums of money we are currently putting into most of the programmes would not compare favourably with other nations. They ought to be of the order of £200 million to £250 million-plus. While that sounds like a lot of money, it is the sort of investment that the industry and business are looking for to create an environment where they themselves will then match-fund. They know it is going to be for multiple years and not just a single year's funding. They know it is about the challenge rather than the individual solutions or technologies. That allows them to create an environment for innovation.

**The Chair:** Do you want to come back about the Faraday challenge?

***Dick Elsy:*** Yes, the Faraday Battery Challenge was in 2017. It was just at the start, when government was planning a big stimulus package to the Industrial Strategy Challenge Fund. Other than working in the Catapult, I sit on the Automotive Council Technology Group. Back in late 2016, the industry had decided to self-disrupt towards much greater intensity of electrification. We set a mantra within the Automotive Council: "what

would it take for 50% of car production to be all-electric by 2030?" Bearing in mind this was in late 2016, that felt like a huge challenge of self-disruption. It does not seem quite so challenging now, when it is enshrined in law that we shall be zero carbon by 2050 and have mass electrification by 2030, but at the time it was.

That led industry to identify really clearly what was needed industrially to get to that target level. It also identified very clearly a number of research challenges that were required to give us the necessary battery technology, so power, range and ability to recharge—all those factors. It ended up with a very clearly defined set of targets. Those were translated down into our best research capability in the UK, which formed the Faraday battery institute, with the best academic minds working on this. We had a fantastic match between industrial requirements with very defined economic outcomes and a set of research requirements back into our academic base.

When we put the challenge together—it was before the ISCF was fully formed—we got £246 million committed, all on a match-funded model. About £60 million of that went directly into research. It was new money to bring new science through for industrial and economic outcome. It moved at an incredible pace, interestingly, because there was not a big governance structure around it. We just used the existing governance arrangements. It has been hugely successful in stimulating the industry in the UK. I would highly commend it as a benchmark model for how to get more science to stick.

**Baroness Young of Old Scone:** Where did the driving force for that come from originally?

***Dick Elsy:*** It came from the Automotive Council. It came from the automotive industry itself, with this desire to self-disrupt. Rather than be instructed to make more electric cars, it had seen the writing on the wall and the demise of diesel, and decided, "We need to press hard now to electrify". That is how it came about. Then, with a sympathetic government ear, there was a stimulus package to help with that transition. That is what the Faraday Battery Challenge was. It was a very clear set of instructions for industry and academia.

In the translational space, which is about bringing that science through to reality, it was a very important thing for us to be involved in. My centre at Warwick Manufacturing Group, as part of the High Value Manufacturing Catapult, is central to the scale-up of battery technology in the UK. Our mission is to secure a long-term future for battery technology, so-called gigafactories. The anchor for that in the UK is about not just a demand for batteries but access to some of the best research. That is a very important lure for overseas investment in battery technology for the UK: our technical prowess and ability to convert that into commercial value added.

Q30 **Baroness Walmsley:** Mr McHugh, do the Catapults receive the right amount of public sector investment to leverage the private sector investment required to contribute to the 2.4% national target? Do you

think the three-thirds model works in practice?

***Martin McHugh:*** I will answer the last part of the question first. Between the three Catapults you have here, there is a good range of maturity and position in life cycle. I believe the thirds model is appropriate for the Catapult. It is probably not appropriate for the compound semiconductor Catapult at its early stage in life, as we are currently in our third year. The thirds model works quite well in making sure that government funding for the speculative research is there. The collaborative research is probably where the most gearing effect comes from, from the 2.4%. The commercial revenue then shows that the Catapult has relevance in the market it is working in.

The Catapults need good access to collaborative funding to be able to crowd industry in to get to that 2.4%. If that collaborative funding is not there, effectively it will be difficult to get to the 2.4%.

**Baroness Walmsley:** Perhaps we can come to Ms Yates next. Yours is a very different Catapult.

***Nicola Yates:*** Yes. What the thirds model is trying to achieve is an important sub-question to all this. If the KPI is used to provide a proxy for how relevant your Catapult is in the industry and sector you work in, I do not think most of the Catapults would have an issue with the principle that we need to show our relevance to industry and academia alike to be able to operate effectively in the environment and technologies we are working in.

As our particular Catapult does an awful lot of convening and are purposefully trying to provide those serendipitous conversations with people in the right environment to create the right ecosystem, for us, it is not necessarily about the large-scale CR&D. For example, if you take our recent success on the future of flight, which was a big initiative that Innovate UK has run, we are involved in six of the seven successful consortia. Our role in that is largely to find the consortia and put them together. We are not the deep-technology specialists. We do not have the engineering prowess that Mr McHugh and Mr Elsy have in their Catapults.

Our share of the successful £11 million that was distributed is only 1/10$^{th}$ of that, yet our role is pivotal to every one of the six consortia we are in. In that instance, using the income and the thirds model as a way of judging how successful we are is more problematic for us than the principle that of course we have to be relevant in both the science and the engineering worlds in which we operate.

**Baroness Walmsley:** Mr Elsy, do you get the right amount of public investment in order to leverage the private sector?

***Dick Elsy:*** I have previously described the thirds model. It is a lot easier for the asset-based Catapults. All Catapults are not the same. We have asset-based ones and service-based ones. I run the biggest asset-based one. We have £800 million-worth of machinery, kit and equipment to help with these big industrial challenges that we support industry through. Typically, we will get about £130 million from government by way of core

grant, but we will win a similar amount of direct industry funding and a similar amount of collaborative R&D.

We have grown since inception. Over the last eight years, we have grown over 20% per annum. The interesting thing is that the collaborative R&D pot has been unable to grow. The fishing pond that we compete in has not grown at the same scale. To compensate for that, we have created new opportunities for the UK. I described the Faraday Battery Challenge. We held the pen on that, did all the groundwork and created a new pool of £246 million in the battery space. We did something very similar with the construction industry. Lord Mair will know that we contributed very strongly to the construction sector's deal. Out of that, we are able to compete into a new pot of about £170 million that was created.

We generated the Construction Innovation Hub in consortium with the Centre for Digital Built Britain and the Building Research Establishment. New collaborative R&D value was created through us helping industry collaborate, get a sense of purpose, get the technology route maps and secure some matched funding. To compensate for the lack of growth of the collaborative R&D pool in general, we have done the homework to create new. An important element is keeping that growth of the collaborative R&D parts, however they come to fruition, whether it is industrial strategy, these sector deals or direct funding through Innovate UK having discretion over that. That is a very important element because it stimulates the competition. It brings the best ideas forward and gets the industry matched funding.

**Baroness Walmsley:** Do you think you are the best people to identify where those new funds should be focused?

***Dick Elsy:*** Yes, we have very good insight. We work with over 4,000 industrial clients a year. For us to be of any use to them, we have to understand their future technologies and all their requirements. When you aggregate that across 4,000 clients, it gives you almost unique insight into the future technology trends, where there are gaps and where we need to get ahead of the market. This foresighting capability is a source of that. The Catapult programme in general is a very powerful thing. That is why I talked in my introductory words about making more use of it, because it has this incredible foresight.

Q31 **Baroness Sheehan:** What size of business do you tend to work with and does your Catapult need to increase its engagement with other sizes of business to help contribute to the 2.4% target?

***Martin McHugh:*** In the types of business we work with, we have a reasonably good balance between SMEs and large enterprises. As a good example for our particular Catapult, we have been convening supply chains to support the electrification of transport. We have been able to convene companies that typically would not work together before. This has allowed us to be involved in over £100 million-worth of projects related to the electrification of the transport sector. That means that approximately £50 million of industry contribution has been made to that.

There was a question in the written material as to our particular Catapult. Because we are fairly new and still growing, we have had to be very careful about the way we have utilised our resources. We have made a point of trying to build balanced consortiums, so we are linking the OEMs, the end users and the manufacturers of equipment, right the way down through the supply chain. By doing that, we are able to successfully link large enterprises, medium-sized companies, smaller companies and universities. We have two successful projects on the go in the electrification of transport that are good examples of that. We are lucky in that we can work across a range of companies, introduce large enterprises to innovative SMEs and introduce innovative SMEs back to those large enterprises, such as BMW and McLaren.

**Baroness Sheehan:** Are the Catapults' KPIs helpful in incentivising engagement with the sizes and types of business that you think are most valuable?

***Martin McHugh:*** I am trying to get the framework of the question and the response correct.

**Baroness Sheehan:** In your evidence, you told us that, as the Catapult is resource constrained, it selects consortia that it believes will deliver the greatest impact in meeting its KPIs. I wondered to what extent the KPIs are the drivers.

***Martin McHugh:*** The KPIs get us to measure the amount of collaborative research funding we have applied for. They get us to measure the amount we have secured. They are very mechanical KPIs. At the front end of the answer, I was trying to explain that, as we are still a growing Catapult, we are trying to make sure that our resources are well utilised to meet our KPIs. The KPIs are there for a good measure. We are in a process of suggesting some new KPIs that are more relevant and measure, for example, the transition into industry of the research we have done in house. In our written evidence, we were trying to say that, because we are new and still growing, we are being really careful about how we use our resources to get the best effect.

***Dick Elsy:*** I am very encouraged to say that half of our client base is SMEs. It did not start out that way. When the Catapult was first formed, we were supported by bigger industry. At the time, if it had not been for that support, perhaps the programme would not have been successful at getting out of the starting blocks as it did. We had made a conscious effort to reach out to manufacturing SMEs in the UK, so half of our client base is SMEs and half of our projects last year were with them—there were 2,200 projects with SMEs. That is through a very conscious effort, through my seven centres, of encouraging SME engagement.

Although SMEs are half of our client base, they represent only about 10% of our income. Over a number of years, we have invested in creating the bandwidth, as in the people and time, to get to and support SMEs. It takes almost as much effort to get into and support an SME. They might be slightly sceptical about the process. We invest time and effort to bring them alongside us, let them understand what we can do to help them, go and have a look round their factory, walk the process, see where we can

help them with improvements. That all takes time. We have invested over the years, principally in bandwidth. I have used my core funding, which I receive from Innovate UK, to create that bandwidth, resources and capability to get to those SMEs.

We measure the number of SMEs we support through our key performance indicators. I would not say that those necessarily drove us. Because we are all industrialists who run the High Value Manufacturing Catapult, we are driven by a sense of the national importance of supporting the SME community. There is no doubt we have seen and felt the loss of an instrument called the Manufacturing Advisory Service, which used to provide at-elbow support for SMEs. That disappeared in some Budget cuts some years ago. In many respects, we have had to step in. I am not saying we are a complete proxy for that, but that at-elbow support for SMEs, to help them with process improvement and bringing innovative products to market, is a really important part of our mission.

The effect of working with SMEs is hugely powerful. Of the SMEs that we work with, 61% said that they have brought new processes and improvements through as a result of working with us. The most encouraging part of that independent survey was that 70% indicated that the product and service that we helped them deliver would be completely new to market. The Catapult model really works for SMEs, but it requires quite a lot of effort and bandwidth.

**Baroness Sheehan:** That is very helpful.

***Nicola Yates:*** I would echo what Mr Elsy said. I will give you a number of examples about how we work with SMEs and large businesses together—we are always doing that. It is always an ecosystem. For example, we work extensively with Network Rail. We are trying to help it go beyond its tier 1 suppliers and look at what innovation is out there, not by not working with the tier 1 suppliers but by giving those tier 1 suppliers the confidence to bring through SMEs in their innovation ecosystem.

It is really important that we do that in a way that is safe—this is a national railway system—but where, when we are working with SMEs, there is a commercial opportunity at the end of the involvement we have with them. Too many SMEs go on accelerators to learn new skills but there is no material advantage at the end by way of a commercial contract. We pull through that innovation into that potential tier 1 supplier as a solution for Network Rail.

All our programmes have that commercial contract at the end of it. While we look at things such as how much investment those SMEs have attracted during the time we have worked with them, we know they go on to attract more investment afterwards, which is not part of what the KPIs measure. We also know, and have put in our written evidence, the number of commercial contracts that are won through the process we run with our SMEs. We have more success and more commercial contracts than we have had numbers of companies that have gone through the

programmes we run. It is very difficult to get that information out of an SME and therefore it does not materialise in our KPIs.

I will conclude with one other example, which was a very big success for us when we were working with the Belfast city region. We worked with that region, the local authorities, the educational establishments, industry and the universities to help them put in an appropriate city deal that has attracted more than half a billion pounds combined, from the UK Government and private sector investment. That includes £350 million from the Government and at the current rates, over £150 million of private sector investment. It generated an estimated £2 billion GVA.

Not a single thing that we did in working with that city region forms any part of our KPIs. As Mr Elsy said, it is the right thing to do because it is in the national interest. As national assets, that is what we as Catapults are charged to do. I would echo my colleagues' pleas: invest in us. We are a tool. We are here to help the deployment of all the great science and link it to all the great engineering we have in this country. That is just one example of how my particular Connected Places Catapult would do that.

Q32 **Viscount Ridley:** Nicola Yates, how can the Government better incentivise universities to collaborate with industry and bring innovations to the market?

***Nicola Yates:*** That is an excellent question. As you will have seen from our submission, we do an awful lot in trying to bridge that gap and help universities understand the power of working with us to get their research out into the market. The single biggest barrier to that is the research excellence framework and the way in which the league tables work and the money to universities flows. It rewards the science end as opposed to the engineering end of innovation. I am not suggesting for a moment that we should not invest in the great science this country has. There is a magnificent variety of institutions and world-renowned academics.

This is about us investing in the development and engineering end of innovation, to complement and to ensure that the success we see in that science agenda gets to the market. For me, that would be the single biggest thing. We have been doing quite a lot of different things with universities. As you will have seen from our submission, we have deep academic alliances. We have more than 350 individual academics that we work with on a regular basis. We have embedded what we call business fellows in those universities to help us get that really deep science out into the ecosystem.

We are currently undertaking a new academic mapping exercise to unearth all the science and not just rely on what the universities are saying to us about where their specialisms are. We are using all the latest technology, all the AI and data mining we can muster, including 1.4 million research papers, to work out where the best research that is ripe for translational deployment into the ecosystem is. We take this really seriously as part of our contribution to the whole ecosystem. I know that universities want to be those anchor institutions in places; I know there

has been lots of research. There is a group of universities now dedicated to that mission, but they can do only so much while they are judged on the pure science of what they produce.

**Viscount Ridley:** To follow on from what Nicola Yates said, Mr McHugh, what specifically could the role of the research excellence framework or knowledge exchange framework be?

***Martin McHugh:*** Let me answer the question in a slightly different way. The universities are slightly disincentivised from collaborating. The particular example we have is the cap on the RTOs. In our Catapult, we rely heavily on CRD funding to collaborate with universities and industry. For instance, over 68% of our projects have university collaboration. In our written evidence, we gave an example where, because of the 30% cap on CRD funding, the project has to be of large scale to allow a Catapult and a university to have reasonable traction.

It is not so much about the research framework. The research framework is what they have. If we could have a better funding mechanism, where the Catapults and universities were incentivised to work better together in a CRD programme, that would be a better solution. That is a roundabout way of answering the question.

**Viscount Ridley:** No, that is helpful. Finally, Mr Elsy, you said in your written evidence that Innovate UK should simplify and standardise rules for Innovate UK projects to help deliver more effective collaboration. Which rules should be simplified and standardised? What effect would this have?

***Dick Elsy:*** Mr McHugh has already mentioned one of them, the 30% limitation, which is a disincentive. We have had to turn a number of projects down because they are not commercially viable for us to do. It seems rather odd that a stimulus programme is capped by that.

The other thing is that we are unable to compete into research council grants. We are part of the UKRI family, yet we are prohibited from bidding into research council grant funding. There is a strange asymmetry to the process. We could do something different, particularly with REF. Our Catapults have four key performance indicators, which look at the way we interface with universities. There are no reciprocal arrangements on the side of the research councils or universities. A set of symmetrical objectives would be quite powerful.

**Viscount Ridley:** That is, to coin a phrase, a level playing field.

***Dick Elsy:*** Yes, a level stimulus field, actually. A percentage of REF impact cases that had Catapults involved would be a great objective. I have objectives: how many universities do you have involved in your projects and how many international universities are you working with? We need symmetrical objectives on the other side. There is no lack of appetite to do that. Tomorrow, we have the UK Manufacturing Forum, where we bring together all the leading academics in manufacturing research with the research councils, such as the EPSRC, to discuss the future of manufacturing in the UK. We share our industrial knowledge with the researchers to help guide and inform how they work.

It is a very powerful community, but it has been created as a sort of patch piece because the system does not allow for it. I know that Dame Ottoline is a systems thinker. I am hoping that, through this stimulus, we can create reciprocal objectives and get this machinery working, which brings great science through into commercial reality. These reciprocal objectives would be very powerful in doing that.

**The Chair:** Can I thank all three of you for this session? It has been very useful and just about brilliant in timekeeping and the answers. Thank you very much indeed and happy holidays to you.