HOUSE OF LORDS

Select Committee on Science and Technology

Corrected oral evidence: Life Sciences and the Industrial Strategy

Tuesday 7 November 2017

10.05 am

Watch the meeting

Members present: Lord Patel (The Chairman); Lord Borwick; Lord Fox; Lord Griffiths of Fforestfach; Lord Hunt of Chesterton; Lord Kakkar; Lord Mair; Lord Maxton; Baroness Morgan of Huyton; Baroness Neville-Jones; Lord Oxburgh; Lord Renfrew of Kaimsthorn, Lord Vallance of Tummel; Baroness Young of Old Scone.

Evidence Session No. 12 Heard in Public Questions 78 – 93

Witnesses

Dr Ruth McKernan CBE, Chief Executive Officer, Innovate UK; Chris Molloy, Chief Executive Officer, Medicines Discovery Catapult; Keith Thompson, Chief Executive Officer, Cell and Gene Therapy Catapult; Professor Graham Hillier, Strategy and Futures Director, Centre for Process Innovation, High Value Manufacturing Catapult.

Examination of witnesses

Dr Ruth McKernan CBE, Chris Molloy, Keith Thompson and Professor Graham Hillier.

Q78 **The Chairman:** Good morning, ladies and gentlemen. First, I have to tell you that we are on live stream on the internet, so any conversation—this applies as much to my colleagues as to you—you have privately will be picked up. If you do not mind, please introduce yourselves, say who you are and which catapult you represent. If you want to make any comments, please feel free to do so. Then we will get on to questioning.

Chris Molloy: Good morning. My name is Chris Molloy. I am the chief executive officer of the Medicines Discovery Catapult formed last year as the national workplace for the medicines discovery sector, bringing together a fragmented sector to perform applied R&D, to enable new technologies, products and services to reach the market, to help the sector perform better and improve its productivity.

Dr McKernan: Good morning. I am Ruth McKernan. I am chief executive of Innovate UK. We are the business-facing part of UK Research and Innovation. Our job is really to drive productivity and economic growth in the UK. Most of the businesses we support are SMEs, and that is largely our focus.

Keith Thompson: My name is Keith Thompson. I am the chief executive of the Cell and Gene Therapy Catapult. I had the pleasure of appearing before you in late 2012 in an inquiry into regenerative medicine. Many of the things that came out of that inquiry have been implemented, and I am pleased to say that the advanced therapy sector is booming. I hope that the industrial strategy will help it boom even more.

Professor Hillier: I am Graham Hillier, and I am the strategy and futures director of the Centre for Process Innovation. I am representing the whole of the High Value Manufacturing Catapult here today. CPI is a centre within that. We, within CPI, are the largest life sciences group. We have a biologics manufacturing centre. Our formulations teams do a lot of work with the pharmaceutical industry. We are just about to start work on building a centre to use light to treat diseases. In addition to that, I was the CTO for the High Value Manufacturing Catapult in its early days.

The Chairman: Thank you very much. I know that you may be keen to tell us about how successful you are. We do not really want to hear that. We want to know about life science strategy, what your role might be in it, what you see as your role in it and how it might be made successful with or without your role in it. I know from past experience that catapults are always keen to tell me how they will be masters of the world. I take that for granted.

I will start with the first question. What do you think your role will be in the implementation of the life sciences strategy?

Dr McKernan: We were heavily involved in the life sciences industrial strategy. Sir John Bell had members of my team on his group, and we

have been working very closely with them. In particular, we will be involved in the industrial strategy challenge fund and implementing those elements, which are very well aligned with the industrial strategy. They are a smaller part, but contained within it. Specifically, our role with the first wave of the industrial strategy challenge fund will be to establish a medicines manufacturing innovation centre, extend the advanced therapy manufacturing centre—Keith can say more about that—create three advanced therapy treatment centres in hospitals, build a vaccines development and manufacturing centre and deliver the digital health technology catalyst programme, which we have already started on.

We will probably have a part in delivering aspects of the accelerated access review, where there are competitions to be run. We are a delivery agent for many health practitioners across the UK. We will continue to fund initiatives in open style competitions for small businesses that are growing and are able to contribute to productivity and economic growth.

We also take a very close account of where our funding goes across the UK. We map it, we trace it and we follow it. If you have been reading the Industrial Strategy Commission [report], we will be trying to ensure, when it comes to productivity and improving growth and job prospects for people, that we do something for everyone, not everything for everyone.

The Chairman: Do you have a business plan with timelines mapped out for this?

Dr McKernan: We do.

The Chairman: Is that for the whole industrial strategy?

Dr McKernan: For the elements that we are involved in delivering, for the challenge fund part that sits within John Bell's industrial strategy, we have timelines mapped out. We have some things that have already started, and some competitions that have already opened that will enable SMEs to work with research and business to deliver elements of it. We have been working hand in hand. The industrial strategy challenge fund is aligned with John Bell's much larger, more forward-thinking, overarching industrial strategy.

The Chairman: Where will the funding come from?

Dr McKernan: We are fortunate that the Government announced additional funding in the Autumn Statement last year for the industrial strategy challenge fund. We are expecting about £2 billion to be made available. An element of that will go to the industrial strategy challenge fund challenges within the life sciences sector.

The Chairman: What are those?

Dr McKernan: The first cluster of investments is to improve advanced therapy manufacturing in the UK. This is a complex area. I come from the pharmaceutical industry and, in the past, if you made a product, it was a single pill, a molecule, that you could take intellectual property on. It was simple to make and you could make it anywhere in the world. In the future, we believe the economic growth will come from much more

complex therapies: things like cell therapy and gene therapy. It is a strategy to ensure that the UK is at the cutting edge of those industries, because it will encourage global businesses to invest here, allow our own companies to grow to be medium-sized and improve employment and productivity.

The Chairman: What do you see as the challenges of being able to deliver the life sciences industrial strategy?

Dr McKernan: In the area of advanced therapy, it is technically difficult. That is a challenge: it is technically difficult.

The Chairman: The strategy depends on delivering in that particular area and nothing else.

Dr McKernan: Strategy depends on delivering many things. For the advanced therapies, it has to deliver some things that are technically very difficult. Our research community and our catapults are good at it, but it is difficult. It will also require good partnership across research, business and elements of the healthcare system. We are trying, as best we can, to put in place the elements that we anticipate will be needed, which is why we are implementing advanced therapy centres, which will be in hospitals.

Q79 **The Chairman:** Okay. Before I let my colleagues in, I am going to give the others a chance to get in.

Dr McKernan: Okay.

Keith Thompson: Shall I move on? Being the longest-established—

The Chairman: No. I want to hear about the question I asked.

Keith Thompson: What are we going to do? We have established a lot of assets for industry to use. We have done that over the last five years, one of which is a large-scale manufacturing centre, which has a unique business model and 150 technically able staff who concentrate on industrialisation challenges. The opportunity for the UK, as it is mapped out in the strategy, is very real in advanced therapies. The industrial strategy recognises the opportunity in advanced therapies, cell therapies and gene therapies, in terms of not only the benefits that they will bring to patients but the chance to industrialise and embed an industry.

The Chairman: How long has your catapult been going?

Keith Thompson: Five years.

The Chairman: So far, how much taxpayer money has been funding you?

Keith Thompson: We have had a lot of capital investment, about £50 million, to build the large manufacturing centre, and another £10 million-plus of capital going into equipping Guy's. The other funding in the first years has totalled about £100 million in various capital revenue and project streams. We have outputted much of that in terms of projects that have assisted companies. The assistance of companies includes solving their technical challenges, such as freezing cells; we did

that with ReNeuron so that it could put its stroke treatment into the brains of patients.

The Chairman: We are going back into treatments again.

Keith Thompson: Sure, but this is important. It is important that the technical challenges are overcome because that is what embeds companies in the long run. We have also helped various other companies.

In terms of the strategy, it is about the technologies used in manufacturing, in the main, and the actual manufacturing facilities. Over the next five years, we intend to continue developing and industrialising those technologies and to provide a place for companies to manufacture their products. One of them is in Stevenage, which is just being brought online. We already have four companies lined up and we hope to at least double that during the period of the next industrial strategy.

The Chairman: In financial terms, have there been any returns so far?

Keith Thompson: Yes, there have been huge returns.

The Chairman: What is the amount?

Keith Thompson: The total industry has raised in excess of £1.3 billion. We identified eight of our collaborators that have, subsequent to working with us on technology programmes, gone out and raised in excess of £355 million to fund their programmes. Those are just a couple of the examples.

Q80 **Lord Fox:** Dr McKernan, you correctly identified that a £2.2 billion pot came with the challenge fund. Clearly, the life sciences game is not the only game in town.

Dr McKernan: That is right.

Lord Fox: You are from pharmaceuticals, where a billion here and a billion there in a research project seems to be the down payment. What percentage of that £2 billion will go into the five projects or challenges that you listed just now? Is that enough or is it just playing around the edges?

Dr McKernan: The money has not all been allocated yet. We have allocated funding in the first wave and, in the first wave, there were three large commitments. One of those was to advanced therapies, and that was £143 million.[1] I will get you the exact figure because I am remembering it off the top of my head.

The Chairman: Please do.

Dr McKernan: There were two other large investments. One was batteries.

Lord Fox: Batteries I am aware of.

[1] Dr McKernan confirmed after the evidence session that the correct amount was £146 million.

Dr McKernan: The other was the Faraday Institute, which you will know was the biggest at £240 million.[2] The third one was to make sure that we had robots to be used in safe environments, so "robots for a safer world", and that was the third large investment. There were some additional pathfinder and smaller investments that went in wave 1. We have been working diligently on the next set of proposals.

Lord Fox: If you are putting £143 million into advanced therapy, would you expect the industry to come like-for-like, two-for-one or three-for-one? What kind of percentage are you expecting?

Dr McKernan: For most of the programmes that Innovate UK runs, it is matched funding.

Lord Fox: It is like-for-like.

Dr McKernan: For anything that we run, it is like-for-like. Not all the elements of that programme will be run in a traditional way by Innovate UK. The exciting thing about the industrial strategy challenge fund is that we are moving to a position within UKRI where we have a more empowered challenge director, who is able to move funding around, stop programmes that are not working and put funding on to programmes that are working better, in a way that the research councils, and probably Innovate UK, did not generally do too frequently. In doing that, we are really trying to make the best use of the funding.

Lord Fox: You do not have time now but, if you could write to us with the details of how that works and how that is governed, I would be really interested to see that.

Dr McKernan: I would be happy to do that.

The Chairman: I have requested you to keep your answers short because we have lots of questions to go through. It will be to your disadvantage, and ours, if we do not get through this.

Professor Hillier: We should not get hung up on the actual matching of the money that is invested. As catapults, we provide a capability that allows companies to develop their products and their manufacturing processes and move them into the market.

Lord Fox: I am hung up on the scale of it. If you match it, you double the size.

Professor Hillier: It is probably not big enough. The larger it is, the more leverage you get.

Lord Fox: Exactly, that is why I am hung up on it.

Professor Hillier: We have a capability. Companies do projects with us. That gives them an answer or an output. They then do something with that output and it becomes an outcome. Once it is an outcome, they have invested, their company exists and it generates value year on year. The more there is to match in the first place, the better off we are as a

[2] Dr McKernan confirmed after the evidence session that the correct amount was £246 million.

nation. Where we, as catapults, are more effective is in helping those companies develop and deliver, working with us creates a significantly greater leverage and reduces risk. I can show you very small projects of thousands of pounds that have created millions of pounds of outcome, which creates jobs and profit year on year. I can also show you some projects where a big company has spent a lot of money, but has stopped a project, because it has decided that it is not going to work. Companies of all sizes can use catapults to get to that point quite effectively. We de-risk their innovation work.

Keith Thompson: Industry, particularly in the life sciences, is really dominated by SMEs, with the final customer being big pharma or big biotech. The dynamics of the money in the various stages of this are quite different. An SME, with either angel investing or venture capital investing, does not like to put its money in bricks and mortar.

The Chairman: We will come to SME questions.

Q81 **Lord Griffiths of Fforestfach:** I would like to ask Dr McKernan a question that has two parts to it. You made a very convincing case that there already is an industrial strategy that is working. If you think there is another phase of that and, in the review that we are doing, we might make some contribution to what that is, what are the elements of an extra phase in the industrial strategy that you would recommend?

Secondly, you mentioned that there would be technical difficulties. You mentioned it three times. Is that a question of money? Is it a question of co-ordination, because there are so many different players in this game? Is it a question of telling some people to wake up?

Dr McKernan: I do not think I will be telling anyone to wake up. Let me take each of those separately. You are asking me what I would recommend in the industrial strategy.

Lord Griffiths of Fforestfach: Yes. What is not there at present?

Dr McKernan: People have said that the strategy is much more about biomedical science and has not really looked at things such as food science or nutrition. Those elements were not included. It might be good to look at them. I would also recommend a real focus on areas that improve job prospects for people and productivity. That comes in both long-term and short-term investment. On short-term investment, I would particularly recommend and support the idea of improving radiology and pathology, which is in the report, because that will improve productivity and earning power for the people who are involved in doing that.

Social care elements, such as how we look after the elderly and people with mental health problems, came up a lot in the discussion. They are fairly light in the final review but there are things we can do there—using technologies to help and support, making our social care services more efficient—while at the same time improving earning power for people in those areas and upskilling them. Those are some of the elements that I would pull out and particularly want to see.

Co-ordination can always be better; there are no two ways about that. The formation of UKRI is a real positive step, so I am very pleased to see that. It is nevertheless, even with OSCHR—the organisation that John Bell chairs—quite a complex world where we have a lot of different groups providing research into data, improving data and getting really good-quality genomics information. There is long-term investment there that will allow us to do better diagnosis and better healthcare management, but it takes 15 years to make a drug. That will not deliver productivity and better growth for people in a five-year timeframe; that will be in the 10 to 20-year timeframe.

The Chairman: How should this strategy be implemented? Who should be responsible? Who will drive it?

Dr McKernan: It needs to be a joint effort. UKRI absolutely has a significant role in driving it. We also have to engage the NHS, NIHR and the other healthcare professionals. You cannot push technology unless people want to adopt it and absorb it.

The Chairman: Who and at what level would be the highest level that drives it?

Dr McKernan: In any strategy, support from the highest level is very helpful.

Q82 **Lord Kakkar:** I want to come back to the manufacturing centre and the business model. Could you briefly explain what that unique business model is?

Keith Thompson: I would be happy to. When we looked at the need for a large-scale manufacturing centre—because there are many small centres across the UK, mainly academic centres—we looked at how we could best drive companies to manufacture. When we started building it, contract manufacturers really were not interested because there was not a market. We heard over and over again from companies that they wanted to manufacture their own products, but each of the venture capitalists did not want to put £25 million into a factory that could become outmoded very quickly. We created this unique modular factory that has the potential for 12 mini-factories inside it. The companies come in and they manufacture with their own staff in that facility, but they are supported in their totality by the catapult, both in improving their technology and with all the background good manufacturing practice. It is unique in the world and companies absolutely love it.

Professor Hillier: CPI's model and Keith's model are extremely similar in that we both provide assets that people cannot get hold of anywhere else. In the biologics space, which is different from the cell and gene therapy space, we offer a very similar service to those companies. Both of our organisations are pretty unique in the world. Well, you cannot be pretty unique, can you? There are only two or three centres like CPI and the Cell & Gene Therapy Catapult in the world. It means that we are in a position where we can pick up ideas, research work and take it through into market. You have to collaborate in that space and that is what we are there for: open access.

Keith Thompson: One of the recommendations of the 2012 inquiry was that a large-scale manufacturing facility should be built, and this is it. When we say "large scale", it is not just that it is a big building; each one of these modules can do a thousand-litre reactor, which is more than enough to do a trial and the initial market supply.

Q83 **Lord Vallance of Tummel:** My question was going to be about finance but we have touched on that quite a bit already. Let me come at it from a slightly different angle. There are some pretty ambitious strategic goals in this plan, one of which is that four UK companies with a market cap of greater than £20 billion should be produced over the next 10 years. Do you think that your current institutions, given the way they operate and their level of funds, are capable of producing that kind of outcome? Is it pie in the sky?

Dr McKernan: They are ambitious goals, but they are exactly the sort of goals that we need to have if we are to create the economic growth that the UK needs. They are ambitious. Our job is to support the small and scaling businesses, but they will need substantive private investment to get to that scale. We have some great companies that we can see scaling and growing very quickly. We probably have our favourites and ones that we think could get to that stage. It is ambitious but potentially doable. We work at the small to medium level, getting them up and running, but they need a lot of private sector investment.

Chris Molloy: One has to recognise that the life sciences companies of the future may not look like the life sciences companies of today. Industrial models are changing rapidly and routinely, and we have to look to tomorrow's companies and how they will be structured. They will potentially be more consortia-based in the life sciences, and in the medical field perhaps more disease-centred than ever before. One must project forward into a slightly new model where a collection of companies, which we help stimulate at the early stage, comes together through biomarkers, diagnostics, therapeutics, informatics and other forms of tech to form coalition companies, rather than the model of 30 or 40 years ago where a single medical asset would lead to a company the size of Genentech. There is a different approach. To translate these early technologies, to nurture an environment where smaller, more interactive coalitions will form, is an important part of what we are going to do.

Lord Vallance of Tummel: Is that just a gleam in the eye or is it something that you are working on as a possibility?

Keith Thompson: It is absolutely real. I am co-hosting an investor conference in advanced therapies in London on Thursday, and I have the pleasure of giving the opening panel there. The reference point for the opening talk will be in these new immunotherapies. For those of you who follow the space, a very early-stage US company called Kite has just been sold to another company called Gilead for $12 billion. It has only been going for a few years. That becomes the attractant: that people can get to this scale.

Historically, the UK has sold out early, because of the way that funds work and the need for return. We are very pleased to now see some longer capital going in though places such as Syncona, Woodford and whatnot.

Yesterday, I was at the opening of the new facility for an Oxford-based company called Adaptimmune, which does immunotherapies. It is at a pretty early stage. It is on the NASDAQ, but its market cap is £600 million which, pre the Brexit crashing of the currency, would have been $1 billion so it would have been one of the unicorns. It is entirely possible that, if that company stays in ownership—I can name several more that have similar characteristics—we will get to the stage where we have £20 billion companies.

Lord Vallance of Tummel: You are telling us that there is no need to change the current structure and that it is okay.

Keith Thompson: Patient capital is important.

Professor Hillier: The business model change that Chris Molloy outlined is important. It will change the model of healthcare in the future.

Lord Vallance of Tummel: Let me come at it in a slightly different way. Let us suppose that there was a shift in the emphasis of UKRI marginally away from research to commercialisation. Suppose that happened and it led to a doubling of your capital. Could you make the same sort of returns out of that shift change? Are there enough things in the queue by way of potential SMEs to meet that?

Professor Hillier: We are losing quite a lot of what we discover, because the imbalance between our research and our innovation is quite significant in the UK; it is something like a nine to one between research and innovation. As a nation we need a greater focus on creating value through innovation.

Chris's point about the business models changing is quite important. The reason we can be successful is that we can create collaborative partnerships between investors, researchers and manufacturers to get new ideas and products into market effectively. Encouraging that to happen more will make a significant difference. The thing that drives it is investing further to make more innovation happen.

Dr McKernan: If there was more funding available, would we be able to spend it on really good things? Yes, in two ways. First, the competitions that we currently run, where funding is matched, so it crowds in funding from businesses, which is what we want, are hugely oversubscribed. The digital catalyst programme had 450 applications for £10 million. That means that, even if 50% of them are of good enough quality to be funded, we will be able to fund less than 10% of those. There is an appetite from SMEs in the UK to apply for Innovate UK funding. That is at the bottom-up end.

At the top-down end, we have consulted widely with industry in the work that we have done on the industrial strategy challenge fund programmes. We went out and did a round of engagement activities in January. We put

together a big longlist of proposals across all UKRI government departments, which we narrowed down to just 11 in the next top wave, against the criteria that were in the Government's announcement, and there are several in the healthcare area. All of them are good. Even with the £2 billion, which is fantastic, we could not fund all those. I have no doubt that there is knowledge, technology, opportunity and appetite in the UK to start and grow those businesses. They will need private sector investment to help them scale, but I am in no doubt that this is something we are really good at.

Chris Molloy: There is an important element of making sure that these SMEs, these people who wish to translate and these translational academics who have assets—and there are plenty of seeds planted in the ground—have the industrial rigour underneath them to make their assets industry-consumable or financeable. Just giving money does not necessarily buy that industrial rigour, and it is a really important part of the translational fund, which is one of the methods of delivering the industrial strategy, which the Medicines Discovery Catapult inputted into and sees as a major plank of delivery.

Q84 **Lord Hunt of Chesterton:** There are so many programmes available to SMEs. Are you worried that it is difficult for them to navigate what is available? What could be done to rectify this and make it easier? As civil servants, it is a delicate business to choose one company relative to another. You have implied that there is lots of money, but how do you make sure that happens? That seems to be the big challenge. You want government involvement and therefore you are in the classic business of civil servants making choices. Could you talk about that?

Dr McKernan: We are public servants; we are not actually civil servants in the partner organisation. In the way that we operate, when we get applications for grants, they are independently reviewed by five experts in the field. Our job is to make sure that we send the applications out to people who are technical experts, and they will say which of them are fundable and not fundable. Then we look through and make sure that we are funding the best. We may have to make some portfolio adjustments so that we do not fund 10 things in one area and nothing in another, but that is the way that we operate.

It is done with the same type of rigour that research applications are funded by. We are never short of applicants for our competitions. Actually, it might look like there are lots of different things, but we are covering many bases. Somebody who applies for a digital catalyst project for a digital medical business will be very different from the cohort of people who apply for advanced therapies.

We also run competitions for other government agencies. For example, we run the small business research initiative competitions for the NHS, which is looking to get early procurement of new ideas that have been developed by small businesses. We have a variety of different opportunities. Some are driven by us and some are in partnership with other agencies, to support them in getting the best applications for the funding they have.

Keith Thompson: We work a heck of a lot with SMEs, with which we jointly apply for collaborative R&D, which goes through this peer process. Not only is the match funding welcome to the firm, but the fact that it has been through the rigorous peer review process helps the firm go out and leverage that money. We have seen people who have one of these prestigious awards go out and, on the back of it, raise multiples more money. It almost has an instant amplifying effect.

Professor Hillier: The SME field looks quite complicated, but what we all do with those SMEs helps them through the process. To get from having an idea to being a company, they need to do some private projects of their own to get their own IP. They then need to work through collaborative research and development projects, and, as catapults, we can help them to get to that point. As they get towards the end of the innovation phase, SMEs need to build their supply chain so, again, we, as catapults help build those collaborative networks with the SMEs. It looks complicated if you are an SME but, if you are working with a catapult centre—one of the effective catapult centres, at least—you can move those things forwards.

Lord Hunt of Chesterton: In the United States, the American trade department spends a lot of its time looking at projects all around the world—including a tiny company of mine—which is remarkable. When the Science Minister was in Japan, he saw some work and he thought, "There is a British company that I could suggest". The civil servant said, "No, you must not choose, Minister". I just wonder about this aspect of it.

Chris Molloy: The catapults are independent companies. We have our own boards of directors, advisers and so on. As catapults, we can take sector-led choices. That is the freedom that we have, with good governance, to make sure that we represent the sector and help it pull these consortia together where they might not otherwise form. Some of the most important consortia to address some of the shared challenges are tough to hold together. Most of the catapults spend time and energy answering or dealing with the "somebody really needs to" challenge. That is a constant thought for us. That is our trigger—somebody really needs to—because that tells you that no one party could, should or probably would solve the problem. That is where we spend a lot of energy, so we can pull people from the UK and around the world to build those consortia.

Professor Hillier: That is "market failure", in the words of this document.

Keith Thompson: We have an advisory panel that has academic and industry representation, not only from the UK but internationally. We present to it what the technology challenges are, we get the feedback and then we make choices about whether we will invest in certain types of technologies to improve gene therapy or other things. I make no apologies for that. I have employed extremely good people to do that. We have managed to keep slightly ahead of where industry needs to be on many of these things because we take that risk for them. They do not all go right but most of them have.

Q85 **Baroness Neville-Jones:** Dr McKernan, you mentioned that you would perhaps finance only 10%. Let us take the hypothesis that there is actually more money. It is an unlikely proposition, I fear, but nevertheless let us take that hypothesis. Is the current system capable of infinite and indefinite expansion or, if there were significantly more funding available, would you start encountering bottlenecks in the system, and, if so, where? If that situation arose, where would you need to expand capacity and capability? I am interested to know what sort of scale we are talking about. Given more money, can it go on producing at the same level of quality?

Dr McKernan: Do you mean operationally?

Baroness Neville-Jones: Yes.

Dr McKernan: In terms of delivering funding to the best businesses in an open way, we now have a digital grant system, which really helps with the operations. We still have to select reviewers for applications, and that requires expertise within our organisation, so we would need to scale a bit to make sure we had the depth of expertise to handle 10 times more applications, for example.

Baroness Neville-Jones: Do you reckon you can do that?

Dr McKernan: We can do it and we will need to do it carefully and thoughtfully if we are just handling more applications. But I do not think that is really the right solution. We need a challenge that people can rally round. It takes time to build the right groups of people, the right businesses and the mindset that this is not a pool of money where you can apply and get something to help your business; this is a challenge that we all want to help solve. The world is facing those types of challenges. We are facing the ageing demographics. We are facing the increase in mental health problems. We are facing the challenging cost to our health service. It takes time and commitment to get people to agree that they can all contribute a part to solving the challenge and use the money very wisely to create economic growth for the UK. That is a much harder cultural thing to deliver than just increasing the number of people who are managing the grant process.

Baroness Neville-Jones: The capacity to scale up seems important to me, all the same.

Keith Thompson: When I was here in 2012, there were only 22 firms in the advanced therapy sector so, quite frankly, there was not the absorptive capacity of industry to grow. There are 64 now, most of which are well-staffed and well-funded, so there is an absorptive capacity to come along and say, "We will work on these challenges". It cannot be forever, obviously, but we believe that the absorptive capacity is there, and there will be continued growth of new spin-outs into this burgeoning sector.

Professor Hillier: The other thing here, though, is that we have systems and processes that we have learned. The CPI is 14 years old and predates the catapult. We have efficient systems and processes to drive

innovation and they are used over and over again with different partners. This makes the growth process easier to manage and control.

Q86 **Lord Kakkar:** I want to turn to your experience of working with the NHS. We heard a moment ago about the importance of driving a cultural change in terms of maximising the benefit of interactions between the catapult, potentially universities, industry, SMEs and so on. Could you each give your view about how the NHS is able to interact with you at the moment and how it will interact more broadly with the life sciences industrial strategy?

Chris Molloy: From the medicines discovery side of the house, clearly the NHS has exceptional capabilities in clinical trials through the CRN and NIHR, and in medical research through the BRCs and the academic health science sector. That can be opaque or difficult to comprehend for many SMEs. It is really important for the NHS, in order to become a really active partner to the SMEs, to work with us to be less opaque. I know there is willingness to do that. It is an important part of the life sciences industrial strategy's success to make sure that those links are established and maintained. Let us remember that the SME community turns over quite quickly so, if a message is given out by government one year, there may be 30% turnover by the next year and the year after that. It needs to be relentless. The catapults can play a role in helping that message be consistent, coherent and channelled.

Keith Thompson: I have interacted with the NHS for my entire professional life and, in fact, I ran a piece of it around the Scottish National Blood Transfusion Service, which was research-active, for eight years. The NHS is a very diverse organisation. You cannot go and knock on the door of the NHS; there are lots and lots of people involved, often with different agendas. But it could and should be a principal national asset, and John Bell was right to recognise it as a differentiator, even though it was, "Why are you looking at it through the lens of the NHS?" It is a differentiator.

The HRA—Health Research Authority—had definitely improved processes. NIHR has definitely improved the ability to get trials done with BRCs, academic health science networks and all that stuff, but there is no doubt that, from a clinical trial and an industry point of view, there is the opportunity to do better and to run more and larger trials. I would like to see the NHS, or the bits of the NHS that make this happen, incentivise. If you are a chief executive in a trust, you are dealing with a thousand things, and the last one is trying to improve research outputs. Working through that is important. The recently announced advanced therapy treatment centres are an opportunity for industry to develop the technologies that will deliver advanced therapy. That is very exciting and it could be transformational.

There are two other really important things. Historically, the NHS has been a late adopter of innovation. Policies need to change and hopefully the AAR—the accelerated access review—will help change that. To get early adoption for things would be important in the early stages of research.

The last thing is being a good buyer of therapies. If we wait for these therapies to be fully developed overseas and then buy them later when we have lost the industry, we may save money in the short run but we lose the industry in the long run. These things are all important. I would like to see a ring-fenced fund for the early adoption of advanced therapies so that the NHS does not have to worry in the short run about how it would rate their budgets. That would have a fantastic stimulating effect.

Professor Hillier: The NHS is a massive opportunity for us but we need to bring it into the partnership. It needs to be part of the collaborative partnership, and that means its behaviour has to change towards wanting to make these things happen.

Lord Kakkar: We are talking about the future interaction with the NHS, but the catapults have been around for some time now. Why has that not happened to date? Is it because there is not the funding or the encouragement for NHS organisations to interact in the way that you are suggesting?

Keith Thompson: If you have that impression, I have obviously misled you. We have been interacting with the NHS and, in fact, working on the regulatory, the R&D process and all that.

The Chairman: Which bit of the NHS are we talking about?

Keith Thompson: This is mainly things like the BRCs and the individual clinics that run some of these innovative trials. We have run several innovative trials. We did this in a way because we wanted to do really difficult trials in the NHS, in order that we could open up the processes for others. The evidence is there that there has been a 190% increase in the number of advanced therapy trials being carried out.

Dr McKernan: Can I add one point there? It is an important one. Innovate UK's role is to help develop the products and services that will make the NHS more efficient and more productive. We are running NHS test beds across the UK in different areas. Diabetes treatment and management is one of them; mental health treatment and management is another. We help small companies, and some larger companies such as Microsoft, develop the technologies that will make the NHS more efficient, absolutely in partnership with the NHS. That has been a flagship programme. It is only a year or 18 months in. But there is an opportunity to do much more of that and get the pull of what the NHS wants, rather than just sell the technology that is being developed.

Lord Kakkar: Finally, coming to the second part of this question about interactions with academic intuitions, are you satisfied that the models you currently have are fit for purpose and that they will carry through into delivery of the industrial strategy for life sciences when it comes to academic institutions?

Dr McKernan: Within UKRI, yes. That is as short as I can be.

Professor Hillier: There is one bit missing. Some time ago, we had an advanced manufacturing supply chain initiative, called AMSCI, which

allowed you to create big supply chain partnerships that could make things change. That bit of the funding mechanism is not there currently and a mechanism needs to be put in to replace AMSCI. At the moment, the catapults tend to go to Horizon 2020 and obviously that may not be available as an option soon. The UK needs a funding stream that allows for those bigger supply chain projects. They are collaborative projects that create significant value for the UK.

The Chairman: That was a good answer.

Q87 **Baroness Morgan of Huyton:** Mr Thompson, you seem to suggest to us that everything is working rather well at the moment, whereas, Mr Molloy, you said—this is my understanding of Sir John Bell's position—that the NHS could and should be a real differentiator for us as a country. What would that take? I am still not clear. It feels to me that these are all warm words at the moment. What would really make the difference? What will shift the dial to make that real?

Chris Molloy: The proof will be in a consistent set of clinical trials being done by UK SMEs and celebrated well. The BIA does an exceptional job of doing this but there are few and we need more. The NIHR and other groups wish to do more. There is a communication issue.

Baroness Morgan of Huyton: It cannot just be communication, can it?

Chris Molloy: No, but it is about making sure the SME community knows those resources are there and helping those resources be well used and celebrated when done so.

The Chairman: You will be surprised to learn that, when we had SMEs here, they felt completely different about it: that their access to the NHS is extremely poor and they do not know where to go.

Keith Thompson: Absolutely.

The Chairman: Are you surprised at that comment?

Chris Molloy: I am not surprised at that comment. There is opaqueness and difficulty, and that is one of the things we are seeking to overcome with companies such as Matoke Holdings.

Keith Thompson: There are different things. Selling to the NHS is one thing, but we are focusing on clinical trials. The reason we keep banging on about this, particularly for advanced therapies, is that people want to do clinical trials here because the quality of the clinical research is exceptional. The gateway to it, or the difficulty, used to be the regulators. That is not the case now. The regulators are very efficient and very good. But, when you get there, the actual mechanism to start a trial up often has to go through duplicative processes, such as local R&D committees. I know they are working on that. Really, we want to see measurements and incentives for people to do clinical trial set-up not necessarily more cheaply, but certainly better and more quickly.

Baroness Morgan of Huyton: Something needs to be put in to make sure that those clinicians have time to do that properly. Without that, it is not good enough.

Professor Hillier: They should be incentivised to drive that rather than to carry on doing what they have always done.

Baroness Morgan of Huyton: With respect, I am not sure it is about just being incentivised but being given the space, time and capacity to do it.

Professor Hillier: Yes. I agree.

Lord Kakkar: Would we be right in concluding that the principal focus, as far as you see it, of NHS interaction is the ability to deliver clinical trials?

Keith Thompson: Yes, at the moment. The next one is adoption and proof of adoption. Trials and adoption are the key things.

Lord Kakkar: Does the industrial strategy lay out the answer to those two questions to your satisfaction?

Keith Thompson: It certainly lays out the challenge. The answer is yet to be revealed, frankly.

Professor Hillier: The reason the NHS is such an opportunity is because it can do the clinical trials, it provides the treatment and we have an integrated structure in the UK that covers the whole picture. There is much more work to do to make it happen. In CPI we work with a thing called the NHSA—the Northern Health Science Alliance—which is a partnership of trusts and universities that bring this activity together. That allows us as catapults to interact more effectively. More of that kind of thing will make the difference.

Q88 **Lord Kakkar:** Do you think that there is the opportunity to learn from other health economies around the world that have been successful at developing life sciences industries in terms of how their healthcare systems deal with the two particular questions: the opportunity for clinical trials and the adoption of innovation? Do you have examples elsewhere that might help us provide the answer to that here?

Keith Thompson: Some of the changes that have occurred in Japan in late spring to mind. By a specific law, they changed the regenerative medicine regulations and essentially got early conditional approval. That conditional approval meant that they could actually get on the market early and gather more data. That has really stimulated a great deal of interest in Japan.

The US is different because there is a socking great market economy where the fundamental belief is that, if you have a good product, you will be able to get reimbursed, and then that drives huge numbers, and we are not that. But having the access to a big system and being able to get in early through all the gatekeepers that measure it out is really important. I would say that NICE has done a better job recently on laying out what it takes to get one of these therapies through. What we really want is not sequential evaluations but parallel evaluations, all to get these things to market.

Q89 **Baroness Young of Old Scone:** I would like to take the point of

adoption one stage further. We have been told by other witnesses that that worry about adoption and the lack of opportunity to get adoption right across the NHS with effective technologies is stopping people putting money into the system. From your close engagement, what are the ideas? The strategy identifies what the problem is but what are the ideas for speeding up NHS adoption? Should we have a mandation of successful technology?

Keith Thompson: Most drugs that go through the system are in the existing paradigms: they are small molecules, there are some biologicals and they get assessment and go in. There is an ecosystem of drugs coming off patent and new ones coming in, and there is the usual negotiation that goes around that. But, for these new therapies, they require different bits of infrastructure. You can hardly take a cell therapy, put it in a blister pack, put it in a pharmacy and expect people to prescribe it. It is a living medicine.

Baroness Young of Old Scone: Does that mean it will get worse rather than better?

Keith Thompson: No, the opportunity comes through exemplifying it in a small number of specialist centres, working out how it can be done and rolling it out to the NHS that way. It is not only about the NHS but, for the firms that make this work, it then becomes potentially an export opportunity, not just for the drugs or medicines themselves, but for all the infrastructure, such as the IT and point of care manufacture that exists around it. It is a terrific industrial opportunity that has health benefits as well.

Q90 **Lord Kakkar:** You mentioned the change in regulation in Japan. Does the life sciences strategy outline or provide the mechanism for that thought about changing the regulatory environment to drive the adoption necessary to deliver this strategy or is that something that has to be added to it?

Keith Thompson: There are schemes already at both European and national level, such as EAMS and PRIME, so it is different but there is opportunity. The accelerated access review is a good start but it is only five products per year. I would like to see a harder foot on the pedal on that, frankly.

Professor Hillier: The hooks are there but there is a lot more work to do to develop the system.

Q91 **The Chairman:** Let me come back to you with a different question, Dr McKernan, about the relationship between UKRI and Innovate UK. How will that operate in terms of driving the life sciences industrial strategy? In terms of funding, the risk that we have heard about is that the money would be sucked out of the science side into the innovation side. At the same time, John Bell's report asked for more science settlement, which means more money for research. How will this relationship work?

Dr McKernan: I am really positive about it, and I was not to start with. After the way I have seen this working in practice, I feel wholly reassured.

The Chairman: They have not been going yet.

Dr McKernan: A lot of work has been done; it is just that people have not been seeing it. The first pillar of Sir Mark Walport's vision is making sure that UK Research and Innovation looks after the best science in the world. Economic growth is the second pillar. The third pillar is around the social and environmental responsibility and learnings. There are three pillars, and the nine councils and Innovate UK contribute differently to each of those. It is really not the case that there is competition for funding. The industrial strategy challenge fund—I chair the programme board—is a multidisciplinary, multicouncil group that looks at how we will deliver that challenge, and pulls in people from EPSRC, MRC, BBSRC and whoever is required.

Already, we have seen a shift towards the opportunity to solve a multidisciplinary problem from how it used to be if you looked at the funding previously. In the last year, if you just say how much money went to the research councils, it is 91%, and to Innovate UK 9%, of the whole budget. That does not really reflect the benefit industry gets, because the EPSRC works with businesses even though the funding goes to the research council. We should be looking at who receives the money, the benefit and the productivity and economic growth that follow, not the council that has the money to start with. UKRI allows that to happen and, in the language and the mindset of the really strong research councils, I have already seen a lot more acknowledgement of the contribution that they can make to economic growth, even in discussions over the last nine months. That is great, because that is what we should be aiming for. Research in the UK has always punched above its weight, as have the research councils, but the diffusion of that science and technology into business has been our problem. UKRI has the opportunity to make that better, to measure it, to understand what works and to make changes as a consequence. I am very enthusiastic.

The Chairman: Is it UKRI that will be responsible, for instance, for infrastructure development?

Dr McKernan: What sort of infrastructure do you mean?

The Chairman: For both research and innovation.

Dr McKernan: At the moment, we are doing an infrastructure map that STFC and Brian Bowsher are leading on, looking at what we have and what we can offer to businesses from the Diamond Light Source all the way through to the catapults. There are over 300 institutes. If you are looking at the infrastructure that UKRI has at its disposal and that it funds, there is something more we can do to share what is available for businesses and make that easier. Are you talking about infrastructure as in trains or water?

The Chairman: No.

Dr McKernan: In terms of our own infrastructure, we are looking at that.

Q92 **Lord Hunt of Chesterton:** We had a witness a few months ago from Siemens and we asked them what they thought about catapults vis-à-vis Fraunhofer institutes. Their comment was that they were quite good. They have people who are young and good people who are old but the catapults are missing people in the middle. Discuss.

Professor Hillier: We have just started a whole programme within our organisation to bring more of our students, scientists and younger people through to pick up innovation capabilities. Training is an important issue.

Lord Hunt of Chesterton: The question was also raised by the previous chief scientist of energy. You have government civil servants and they have their career. The point was made about what happens to the career path of people in catapults. Will it be a lifetime job?

Professor Hillier: Yes.

Keith Thompson: I can speak to this. I have reached the grand old age of 60, and even cell and gene therapy will not make any difference to that, unfortunately.

The Chairman: I would not be so sure about that.

Keith Thompson: For once in my life, I am the oldest person in the catapult, which is fab. We have a lot of new post-docs in there. We have good, solid middle management who are in their 40s. Do you know what? We are about 150 people now and, in our start-up, we have lost about 50 people to industry. It is fantastic. People, particularly the younger ones, coming in, doing a two to four-year stint and then moving on to high-paying industrial jobs is fantastic. It gives me a headache but it is fantastic. I have no problems with careers in catapults.

Professor Hillier: We are filling an important role. We need to do more skills development. Historically, there were organised development processes in large companies. For example, I joined Rolls-Royce first and then I joined ICI, so my career and personal development were managed. As catapults, we can do a lot to develop programmes for innovators. I have been at CPI for 14 years and I have accumulated a lot of knowledge that I can be pass on.

The Chairman: That leads into Lord Mair's question.

Q93 **Lord Mair:** We have heard from all four of you, unsurprisingly, about all the very good things that catapults are doing. The Government have commissioned a review and you mentioned in your written evidence, Dr McKernan, that that would report by the end of September. Has it reported yet?

Dr McKernan: It is complete. We have run our own independent review on the catapults, along the lines of a quinquennial review, to look at whether they are doing the right things or whether they need to correct course a little. We ran that first and made some recommendations on that, which fed into the EY review. I believe the EY review should be published shortly. I have seen it myself and been able to respond to it. In

general, it says that catapults are a very good thing. There are things that we could probably do better, and I take that on board and we will make some changes and modifications. But they have a fantastic position in the landscape for supporting businesses in the UK.

Lord Mair: Does the review specifically talk about the role of catapults vis-à-vis an industrial strategy?

Dr McKernan: I will have to look at it. I do not think it does specifically, because a lot of the evaluation was done and the whole of the industrial strategy has not yet been published. I expect the catapults, with their unique positions, to be able to drive the industrial strategy. In a few years' time, we should be looking back in the next evaluation and asking, "What did the catapults do to deliver economic growth and the Government's industrial strategy?"

The Chairman: What were the key metrics used to evaluate that?

Dr McKernan: When we evaluated the catapults, we specifically asked our independent panels to look at the businesses that had been supported, what kind of impact they had had, the number of engagements they have with businesses; it was really quite a holistic view. There were some questions about the technologies, the techniques, the machines, the equipment—for example in high-value manufacturing—that was available and how much they were used by businesses. It was quite a broad review, and we asked catapults to describe what they would do in their next five-year plan.

Keith Thompson: I have something to add to that, having been on the receiving end of it for most of the summer, which was a delight. The way we have the whole thing worked out is that there was an economic evaluation conducted and there is a logic model, which is very valuable. Once you are a catapult and there are things to change in the environment, you then put into it inputs—I think I said this earlier—in the form of people and expertise, and assets in the form of buildings, equipment and what-have-you. Then you do activities, i.e. projects—either platform projects within the catapults that industry can then adopt or collaborative ones with industry—which creates a series of outputs in terms of patents and technologies that people can absorb. That in itself creates a lot of outcomes for them.

Lastly—you can imagine that this is a long-ish journey—it generates impacts. I know that both HVM, which has been around longest, and we, who were next, have been able to demonstrate clear linkage in all those activities that have a demonstrable value add.

Things change all the time, so you have to be able to adjust to that. At least for the Cell and Gene Therapy Catapult, we have adjusted the portfolio of activities that we do to reflect what is in the industrial strategy, and we influenced a little what would be in there in terms of advanced therapies and manufacturing.

Professor Hillier: I alluded to this before. Measuring impact is quite complex and it is very easy to measure activity. The easy thing for government is to do activity measurement. You have to be patient and

work with us to get to the point of being able to measure what these impacts are because those are the things that create the value for the country. They are the ones where the outcome creates an ongoing value. It is about not how many projects we do, but how successful those projects are and, to be honest, how we stop people wasting money on things that are not going to work. That is almost impossible to measure. Our impact consultants say it is a very valuable thing but it is almost impossible to measure.

The Chairman: Here you are, Dr McKernan. That is an invitation to you.

Dr McKernan: We have had these conversations. We have worked very closely with chief execs and chairs of the catapults.

The Chairman: Should you be that close to them?

Dr McKernan: We independently commissioned the evaluation—we did not do it ourselves—and we independently commissioned an independent group to look at the quality of the catapults. We have taken everything they say and we are changing some things. Many of the things, not surprisingly, that we saw that could be improved, EY also saw. When that report comes out, there will not be anything in there that we would not support. Some catapults have had new chief executives, not in the health and life sciences area, who are really redirecting it and doing a great job. Overall, it is positive.

The Chairman: Thank you very much for your time. We are very grateful to you for coming today. I know it was a challenging session but that is how we like it. Thank you very much indeed.