



Science and Technology Committee

Corrected oral evidence: Delivering a UK science and technology strategy

Tuesday 8 March 2022

11.15 am

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Members present: Baroness Brown of Cambridge (The Chair); Baroness Blackwood of North Oxford; Viscount Hanworth; Lord Holmes of Richmond; Lord Krebs; Baroness Manningham-Buller; Lord Mitchell; Lord Patel (co-opted); Lord Rees of Ludlow; Baroness Rock; Lord Sarfraz; Baroness Sheehan; Baroness Walmsley.

Evidence Session No. 6

Heard in Public

Questions 40 - 46

Witnesses

Nigel Toon, CEO and co-founder, Graphcore; Suranga Chandratillake OBE, Partner, Balderton Capital; Mike Biddle, Programme Director, Industrial Strategy Challenge Fund, Innovate UK.

USE OF THE TRANSCRIPT

This is a corrected transcript of evidence taken in public and webcast on www.parliamentlive.tv.

Examination of witnesses

Nigel Toon, Suranga Chandratillake and Mike Biddle.

The Chair: Good morning to our second panel of witnesses and thank you very much for joining us today. Before we start the questions, I remind you that the session is being broadcast on the internet. You will be sent a transcript of today's session in a few days' time, to which you can make minor corrections. If there is anything you feel you did not get a chance to say or you would like to clarify, or additional information that you think would be useful to us, we would be very pleased to have that in writing after this session.

If that is all clear for our witnesses, we will start. I will look to Lord Mitchell to ask the first question for us.

Q40 **Lord Mitchell:** Good morning and welcome to everybody. Mr Toon, I am afraid I am going to put you on the spot to start with, and it is a subject very dear to my heart. You represent a high-tech company that began as a start-up and has been very successful within the UK system. Could you outline the role of government support in getting your business from the idea to the industrial application, and how that support could have been improved?

Nigel Toon: I am the CEO and co-founder of a company called Graphcore, which is developing a new microprocessor to accelerate artificial intelligence. I also sit on the board of UKRI, and I am a member of the Prime Minister's Business Council for this year.

In short answer to your question, I would say nothing. We developed the technology ourselves. We worked with leading thinkers in AI around the world to understand the requirements and problems that needed to be solved, and we funded the business through commercial venture capital and our own resources.

Lord Mitchell: Did you not think there was an opportunity for government to assist, or did it not go through your mind at any point?

Nigel Toon: We know of opportunities for assistance, particularly in the early stages, but with 15 PowerPoint slides we can raise \$30 million of venture capital, whereas with 200 slides we might be able to get a few hundred thousand from a UK scheme, so it is far more efficient to look to commercial sources.

Lord Mitchell: That is pretty conclusive. Thank you very much.

Can I ask the same question of the other two witnesses? Mr Biddle, how do you feel about that?

Mike Biddle: Good morning. I am from Innovate UK. I am the programme director for the Industrial Strategy Challenge Fund.

Since Innovate UK was founded, we have supported about 12,000 businesses at various stages, many of them start-ups, and we have found that we can build an ecosystem that brings things together. We published our plan for action in autumn of last year, which followed the

Government's innovation strategy. We have examples where, through activities such as our ICUR programme or the Industrial Strategy Challenge Fund, we have been able to connect early-stage ideas all the way through to commercialisation.

As an example, a company called Wootzano, in the north-east, was part of one of our innovation labs for robotics, which was one of the challenges that we started with in 2017. This is robotics for a safer world—how you do those dull, dangerous, dirty jobs that perhaps humans could not or should not do. It was developing an e-skin technology to look at how it could work as part of a consortium to inspect wind turbine blades. It was founded at the beginning of 2018. It went to the Innovation Lab through 2018 and was part of an £800,000 grant-funded project. Now, it has pivoted some of that technology, and that e-skin technology developed for wind turbines is being used for grape picking in manufacturing. It was awarded a £300 million commercial contract, which was the largest award to one of the robotics companies in the UK.

There are examples where we can take companies and work with them on that journey from early-stage idea all the way through to commercialisation. We need to do more of that. How do we turbocharge that across the UK? We have those examples. We have the schemes that can help. We need to think about how we can broaden that out further.

Lord Mitchell: Suranga, can you comment on this as well, please?

Suranga Chandratillake: Absolutely. I am a general partner at a venture capital firm called Balderton Capital based in London, but we invest across Europe in early and late-stage technology companies. Separately, I am also on the Prime Minister's Council for Science and Technology, and on Cambridge University's endowment advisory board, which I mention because the endowment invests in technology companies primarily via technology venture funds, so it is involved in this space.

To summarise my views on this, Nigel's experience is very typical. Very few of the companies that we work with or that we fund have pursued large volumes of capital from government sources. There are some interesting cases where government options have, to his point, become more streamlined. Historically, getting small grants early in a company's development is extremely complicated; it requires a lot of paperwork.

Programmes such as the Future Fund, which were built around the coronavirus response a couple of years ago, were a much more lightweight process. It allowed the Government to supplement existing private investors with additional capital, which was very helpful and worked more rapidly, and was therefore used by more companies. We have seen a mixture of both. We have seen challenges where the government provision is complicated and heavyweight, and other cases where it is more lightweight and more in line with what the companies would expect and what they can get from the private sector.

Overall, I look at it as a holistic picture. My perspective is that we want the companies that are doing good work and that could be valuable to

have access to capital. I am relatively open-minded as to whether that capital is directly from government, from the private sector or from government-convened or government-incentivised private capital. Increasing all three of those would be beneficial, in my view.

Lord Mitchell: I do not want to misquote Mr Toon, but I think he said at the end that approaching government is hard for not very much money, whereas with the private sector for 15 PowerPoint slides you get \$30 million. Does that resonate with you, and is it something we should really be looking at?

Suranga Chandratillake: Yes, overall, it resonates with me. As I said, there are a handful of counter-cases. I point again to the Future Fund, which was structured so that it essentially invested alongside private investors. It followed the diligence process of the private investor. It can be done that way, but, overall, I would agree with Nigel. He is absolutely right that the vast majority of government funding is accessible only through an onerous and painful process when compared with the equivalent process on the private capital side.

Lord Mitchell: That is very important. Thank you very much.

The Chair: Mike Biddle, on the idea that government funds are invested following the due diligence of private investors, is not one of Innovate's benefits that it does a lot of due diligence and that gives confidence to other sorts of private investors to come in after you, in fact?

Mike Biddle: Absolutely, Chair; thank you. How do you work with that private investment landscape to crowd them not just in but forward? How do you help to do that? We have been running programmes such as our investor partnerships, which is working with those private sector investors. That has the benefit for them of getting some of the benefit of the technical due diligence through the assessment process we have.

I take the point that our other panellists have shared, but we have tried to strip back a lot of that. Even through some of the Covid response activity, we stripped our application process right back and we have now embedded some of that into our broader application process. We dealt with a volume of 8,000 applications in the space of a couple of months, and we funded 800 of those companies right at the first peak of the pain of the first lockdown, which has had good benefits for not only the pandemic response but those companies and their onward growth.

Through our innovation strategy and through the plan for action, we have been trying to think about how we bring those investors in earlier. Not only are we then crowding them forward, but what we also offer is a one-stop shop. For a company on the start of your journey, rather than having to traipse around everywhere and understand the various aspects, you can come to one place. We have had investment accelerators through some of our challenge activities in varied things from creative industries and net zero, across the breadth of where the opportunities lie. We are constantly looking at how we make these things easier, and we have examples of where we have been able to do that.

Q41 **Lord Sarfraz:** Suranga, is it true that the UK is the best place in the world to be a founder and launch your start-up?

Suranga Chandratillake: That is a deceptively simple question but it has a very complex answer. I think it is a very good place to launch a start-up. It is a less good place to build that start-up into a large, enduring business. I apologise for not having as pithy an answer as your question was.

If you look particularly at technology-first start-ups, the UK punches above its weight from a scientific research point of view. We are active in all the interesting commercial areas of technological innovation, whether that is computer science, life sciences and so on.

When it comes to start-up metrics, although we perhaps trail the US, Israel and a couple of other places, certainly when compared to the rest of Europe and most of the world we have good financing, both private and public, for the early stages. Where it really falls off is late-stage investing. If you look at funding rounds for companies that are raising £100 million or more, at that point the vast majority of the capital that British companies raise comes from abroad, usually from private investors—primarily US investors but also from places like Asia. The bigger those rounds get, the more of that capital that comes from abroad.

That is a problem from my point of view. If you put yourself in the shoes of that founder, it means that they have to spend time travelling the world looking for that financing. It means they are spending more time in those places, and, ultimately, typically moving their companies to other countries.

So, yes, I think it is a healthy environment to start a company, but I am not sure it is as healthy as it could be to stay and build that company over time.

Lord Sarfraz: The gap is in the late stage in the UK, in your opinion.

Suranga Chandratillake: In my opinion, yes, and the data evidences that. If you look at early-stage funding rounds in the UK, the majority of those are completed by UK-based funds of various sorts, public and private. The later the stage of funding, the more international capital there is. The later-stage companies tend to start spending more time abroad—in some cases relocating abroad—and in the end, in many cases, listing abroad in a public market outside the UK.

Lord Sarfraz: Can you think of an example, Suranga, where one of Balderton's portfolio of companies was going to die—although Balderton companies do not die much—and the Government could have done more to help save it?

Suranga Chandratillake: I do not think I have a specific example of a Balderton company that fits exactly what you describe. It is important to remember that technology, and particularly an early-stage technology venture, is also about failure. Some companies will die, and that is okay. That is part of the Darwinian process of these things.

I have a good example that I am going to pull from what we prepared originally for the Prime Minister's Council for Science and Technology. It is not a Balderton company, but it still answers the question you are seeking to answer. That was to compare two parallel companies. One is Oxbotica, an Oxford-based autonomous-vehicle company, so self-driving cars; the other is Aurora, a similar autonomous-vehicle, self-driving car company based in California.

It is remarkable if you look at the fundraising journey of those two companies, even though they are similar-sized technology companies with similarly impressive technical founders. Just to give you one example, in the first three rounds of financing, Oxbotica was able to raise a total of about £82 million, while in that same period in the US Aurora was able to raise \$693 million. That is £82 million versus \$693 million. With relatively little technical progress and evidence in both cases, the US company was able to raise a lot more capital. If it can do that, it can invest that in further technology, hiring the right people and so on and so forth. It is that late-stage investment delta that the Government could help with.

Lord Sarfraz: Finally, Suranga, Mr Toon mentioned that he would much rather raise money from private sector investors than pitch to the Government, but is it not the case that many of the venture capitalists in the UK to whom he presents 15 slides have received public sector money, so it makes it easier for him because you are the filter between that?

Suranga Chandratillake: You are right that the picture is complex. There is a large number of UK and European investors who have received capital from the UK Government. I do not know Mr Toon's specific case, so I do not know which investors he had at the various stages and to what extent they were exposed to UK public funding, but that is correct. One way in which the UK Government can help, and has helped, the technology ecosystem is by investing in the funds themselves and then those funds investing downstream in the companies.

Lord Sarfraz: Thank you. Mr Biddle, we often hear that the Government is no good at choosing companies. That cannot be the case for the Industrial Strategy Challenge Fund—you are choosing great companies. How are you managing to attract businesses? Do you see enough good-quality companies come to you for funding?

Mike Biddle: What we have done with the Industrial Strategy Challenge Fund and what we do with our innovation programmes in general is to try to look at where those big challenges are that we need to address for everybody's benefit anyway, but, crucially, where the UK can have benefit by doing that. How do we capture some of the value from what we have to overcome anyway? We built our challenges around those opportunities, and from that we can look at how we invest and help them grow.

Picking up the point about the start-up and the scale-up space, I completely agree that scale-up is where we need to do more. If you look at the information, the UK gets ranked third for the start-up space and 13th for the scale-up space. That is what we found when we were putting

together the Innovate UK “Plan for Action”. We are now trying to figure out how to address that. We have examples where we have done that and have crowded that investment forward, as we have talked about. But, for me, it is about framing the right challenge.

Within Innovate UK, we talk about three words—three simple words, but they have a lot of power: “inspire”, “involve” and “invest”. We need to inspire UK companies for where the opportunities are for the future that we all need to address. We then need to involve everybody—those small companies, those scale-up companies, the academics and the research technology organisations, the broader landscape and the investors. Then we need to invest in those best ideas, but that is not just about investing money; it is also about investing time in those connections and building the network.

You asked about things that have not worked and what could come from that. We have found that part of the value that we can add is by being a collaborative partner with those projects and with those companies as they are going through that journey. At the point where they face the “Oh, my life, this isn’t going to work” moment, we can work with them to overcome that.

An example would be, going into the first lockdown two years ago, when we were funding our Audience of the Future: Demonstrators, which were looking at the future of virtual and augmented reality. They had been working really hard for two or three years. They were just about to go out to have these demonstrators. One of the demonstrators was going to be looking for 100,000 people in a Gateshead shopping centre to put on a VR headset. All of a sudden, that was just not possible. Even if you could do it, which the rules did not allow, who is going to want to put on a virtual headset that somebody else has just had? We worked with those companies and gave them the time and space to pivot what they were doing to make those technologies available more through the App Store or Google Play by putting it into handsets in homes. That changed from being something in shopping centres to handsets in homes.

You may have seen it, but “MyRobotMission” and “MyDinoMission”, and “Wallace & Gromit: The Big Fix Up”, were funded through that programme. It is about trying to think about where those great opportunities for the future are, where the challenges that we face are, and how we bring that together. That is where that “inspire, involve, invest” message comes together.

Lord Sarfraz: Mr Toon, the theme seems to be that later-stage funding is an issue. Is that because companies are staying private longer, there are bigger rounds, and public markets are not being used as growth vehicles but as exit mechanisms? What more can be done to help in later-stage rounds? What about ensuring that private companies such as yours and others have liquidity in later-stage rounds as well?

Nigel Toon: If I go back to the start-up phase, 20 years ago—and I started a business about 20 years ago—there was much less early-stage funding available in the UK. By that, I mean informed investors who are going to help with connections, who have business experience and are

able to help entrepreneurs grow their companies. It is completely different today. We now have a rich source of well-informed, capable, earlier-stage investors through what are colloquially termed series A and B, and even to series C, stages, in the UK. Balderton is a great example.

Today, still, when you are scaling the business and you are in that C, D or E stage of a funding cycle where you are looking for much larger cheques, there are far fewer sources in the UK, so you are going abroad to find that money. We raised a \$250 million round at the beginning of last year, led by Ontario Teachers' Pension Plan. Going abroad to find those people, you are obviously competing with other global companies in that race, which in some ways is good because it shows you are world-class, but, equally, it creates an extra barrier because these people are not necessarily local to you.

The benefit with a smaller, local VC is that they are there, they are helping you, and they are supporting you. A US VC is much less likely to engage in that if it does not have an office locally in the UK, for example, because it would want to help and support the company, and want to be there with the company. If you are going to get early-stage funding from that company, it would encourage you to move to the US to be local with it so that it could help and support your business to grow.

The same pressure then applies at the scale-up phases as well, sometimes where there is pressure to think about relocation, or pressure with particularly large sovereign wealth funds that can be the source for this type of funding. There are issues around the scale of cheques that are available from UK private investment and the whole knowledge that exists around that area as well.

Lord Sarfraz: Thank you.

Q42 **Lord Krebs:** I have a few interests to declare. I am an adviser to two plcs, Greggs and Marks & Spencer, including advising them on research needs. I am also the co-founder and chairman of a fintech spin-out from Oxford University that has not had any government investment.

I want to address my question initially to Nigel. Are there regulatory barriers that are preventing start-ups from getting established or scaling up that the Government should seek to address?

Nigel Toon: I do not think there are significant regulatory barriers. The UK is a very good place to start a company. Employment law is good. It is a place where you can quickly build a business. The advisory services are strong. I do not see any major issues. The key thing when you are starting a business is access to talent and access to capital. We have talked a lot about the access to capital piece.

On the access to talent, there are certainly issues that have come up over the last few years in terms of our ability to bring talent to the UK. The visa scheme that has been introduced is very good, but the perception that people have of whether the UK is a welcoming place for those talented individuals to come remains an issue, and there is perhaps more that the Government can do to promote our interest in attracting people

and assure them that they are going to be welcomed long term to help us build the country. That is a big piece around what goes on.

I do not see any major regulatory issues for the start-up community. We have done very well, as all the numbers suggest, in building these start-up companies. The challenge is when you look under the lid of that and you look at many of these companies. Their entrepreneurs have come from perhaps eastern Europe to build their business in London, or they have come from other places to build their business in Manchester. Whether we are going to continue to enable that and encourage that is something that the Government really need to take note of.

Lord Krebs: Thanks very much. Suranga, do you have anything to add on that?

Suranga Chandratillake: Nigel has summarised it pretty well. One interesting thing that I will note is that there are some regulatory challenges around asset owners and pension fund managers in the UK investing both directly in high-growth businesses but probably more likely in venture capital funds. If you look at the analysis of pension fund asset allocation in the UK versus similar-sized economies, we have more in bonds, less in equities, and, in particular, less in private equity. That means that the local late-stage investors of the type that Nigel described earlier that he did not have access to have less firepower and are not able to write the large cheques that a business like his requires. If you compare that with the situation in Australia or the US, more of those large asset owners and asset managers invest more in venture capital, and, in particular, in late-stage venture capital.

There is a regulatory barrier around that, and around the second-order financial challenge, but when it comes to the day-to-day reality of building a business as an entrepreneur, the UK is a great place to build a company.

Lord Krebs: Thank you. Mike, do you have anything to add?

Mike Biddle: Regulation, if done well, can drive innovation. We need to look at it as an opportunity. We have examples where we have done that. The Regulators' Pioneer Fund, which was a programme we helped to deliver with the Department for Business, Energy and Industrial Strategy, looked at how you help regulators enable innovation. One example was an innovation hub that the Civil Aviation Authority put together. Some work was going on anyway, but we found that we could put that together with our Future Flight Challenge, which looks at the electrification of flight and how the airspace might be used with drones and other remotely piloted autonomous systems.

In the pandemic, that was all coming together in the mid-2020 timeframe, and developing that innovation hub enabled the CAA to be able to have the first flights. The second round of activity through the Future Flight Challenge had flights in Scotland and flights between Cornwall and the Isles of Scilly that were remotely piloted—autonomous—and were delivering vaccines. That was the first vaccine flight that was delivered autonomously from Cornwall into the Isles of Scilly. That is an

example of where you can put innovation in the regulation space together with a grant-funded programme, working out where the opportunities are for the UK, bringing it all together, having a safe and responsible place to play, and then to drive that regulation forward.

The other thing I would say on the regulation point is that the standards piece is important as well. You heard that in the first session today. Standards are a very early soft signal—in fact, a fairly hard signal—for where things might go into that regulation space. What we have been looking at there is not just the standards in given sectors but also what should be the standards for responsible innovation. When you are at the cutting edge and doing new technologies, whether that is in biotech or some of the harder technologies, you need to think through some of the opportunities and implications. There is work that we have done with the British Standards Institution, BSI, as a partner, where we have put together a publicly available specification looking at exactly that. I think standards and innovative regulation can drive innovation in the UK.

Lord Krebs: Thank you. Can I ask Mike one brief supplementary? The Public Accounts Committee made a number of recommendations to the Industrial Strategy Challenge Fund. Have you made progress or responded to those recommendations?

Mike Biddle: Yes. When the National Audit Office issued its report, it referred it to UK Research and Innovation, which the challenge fund is delivered through, as being a learning organisation, which was a very good thing. What we have been busy doing over the past year is exactly that.

For example, the PAC report referred to the recruitment time for challenge directors being as long as 37 weeks. We knew that was too long. In the most recent example of that, we did that within 22 weeks, which included a person's 13 weeks-worth of notice period.

We have also been busy improving the speed with which we can put the business cases together, working in partnership with government. It is early stages. We are about to go into the next phase as we come out of the spending review. The last time we had business cases approvals, we did those in as short a period as eight weeks, using the fast-track process with BEIS.

We have more to do. We will continue to be that learning organisation and to do that important work.

Lord Krebs: Thank you very much.

Q43 Baroness Rock: If I may, I have two questions. The first is to all our witnesses about the perception that ideas are born in UK universities but are commercialised elsewhere. As all of you, I suspect, work with universities, can you give us some examples of whether you think that is true or not?

I am very interested in the concerns that have been raised about the scale-up side of things. I sat on the Select Committee on Artificial

Intelligence in 2017, and one of our biggest issues was scale-up. It sounds as though there has been no improvement in looking at funding for scaling up.

Nigel, given that you particularly said that you are looking at raising funds abroad, does this mean that companies are likely to list abroad as well? What could government do to ensure that companies that start in the UK try to list in the UK?

They are two slightly different questions, but perhaps I could start with the universities and you, Suranga.

Suranga Chandratillake: We work a lot with the universities. The first part of your question fits with the second part. Today, companies now thankfully start here in the UK. The science that starts in the university is spun out one way or another. It then embeds in a private company here in the UK, and, as Nigel has detailed, at the early stage there is a very strong ecosystem of investors—some public, some private, some private but publicly funded, or at least partially publicly funded—who all lean in towards that. Innovate UK is a big part of that, and most of the more innovative companies absolutely receive grants from it as well.

Where it goes wrong is in the scale-up stage. It is exactly as you found with the AI initiative. At that point, do we need to have to go abroad to find late-stage capital? That also does indeed seem to lead to more of those companies eventually floating abroad.

The impact of that is very easy to measure. If you look at the FTSE 100's performance versus NASDAQ or the New York Stock Exchange over the last 10 or 15 years, you will see that the US markets and indices have outperformed ours by a factor of up to 10X over a relatively short period of time. If you look at the components behind that, you find that the big difference is a lack of technology. We have a couple of well-known technology companies in our index, but there are many interesting technology companies from around the world that live on those American exchanges. That is obviously where we miss out in the long term.

Baroness Rock: That is very helpful, thank you. Nigel, perhaps I could come to you.

Nigel Toon: I am keen to address your point about science and the scale-up piece. Science is about learning new knowledge. Innovation is about solving a problem. It sounds subtle, but there is quite a fundamental difference between the two. I do not know the exact numbers but we are probably number 2 for discovery science in the world. We are a science superpower in discovery science. We have some of the world's leading academic institutions. China and the Middle East are investing billions to try to build institutions that would rival the institutions that we have here in the UK. We have institutions at the very top of the leader board for basic discovery research.

Where we struggle a bit more is on applied research. This is the piece that fits between discovery research, the search for knowledge, and the search for how you apply it to solve a problem. This is where the

engagement with industry works well and where we can do more. It is also where funding for research perhaps falls down because it is also about timing in those applications. You might have a group who has developed something interesting at a discovery stage and they want to then carry it forward and try to apply it in some particular area. Can they get the follow-on funding? Can they keep that team of researchers together, or do they disappear to the three winds because the funding does not arrive in time?

What sometimes happens is that those groups decide that they will spin out to keep the team together. They spin out too early. There is then a valley of death of funding for those types of businesses, where it takes too long to commercialise those ideas and turn them into businesses. There is a piece that we need to ensure that we fund around turning that basic research into proper applied research.

In the US, people will work towards tenure in an academic institution but then they will be able to leave and go into industry for a period of time. They will be able even to start their own company and then come back to those institutions. We do not have that same culture here in the UK. Most of the institutions would not allow that freedom. You might get a sabbatical for a short period of time, but you would not have that same freedom to go off and try to explore things and then bring back that industrial knowledge to say, "Look, these are the problems that industry needs us to solve. These are the kinds of interesting applied-research areas that we should be looking at".

We need to think about how, in academia, the idea of commercialisation is encouraged. I overheard some of the previous discussion in the last session, where it was said that younger researchers are more entrepreneurial. I definitely think that is true. I definitely see young academics being more entrepreneurial and wanting to build businesses and wanting to apply their research, but they struggle for funding, they are spinning out too early and they are failing because they then cannot convert it into a really applied problem. That is something around which we can do a lot to try to help.

It is also value that is lost for the UK, because you put in a small amount of funding to help those groups move towards that applied research phase, and the leverage of that in the valuation that those businesses might be worth, and the amount that the IP that has been generated is worth, that would feed back into the universities would be much greater. It is a real win-win situation.

Very importantly, it must not be at the expense of that basic discovery research, because the basic discovery research is why the smart people want to come here. It is what creates the underlying talent that exists here. It is the creativity that exists in the UK.

I apologise because I have probably gone on too long, but I am quite passionate about this as a source of issue that we have. There are things that Innovate UK can do through some of its programmes to bridge that gap. There are things that UKRI can do to bridge that gap. There are

definitely things that the Government can do to really bridge that gap and understand just a few key points that need to be switched to drive that.

On scaling, the point I would reiterate is that, yes, there is the whole issue of scaling the company, but there is that valley of death piece that I would go back to. You have this push of a technology—it is fantastic technology—but what problems does it solve? Bridging that gap is very complex, and we need people who are able to focus in on that.

To your point about going public, LSE has improved a lot over the last few years. I know it is working very hard to try to create an environment that is better for tech companies to list in the UK. Unfortunately, it is still unproven that you could list at a few tens of billion and grow to hundreds of billions, or perhaps a trillion. That is not the case in the US. There are many proof points for how that has been achieved. There are now even proof points of how that has been close to being achieved in Asian markets as well. We need to find ways in which we can ensure that companies can go public and they can scale—and they can scale to very large sizes.

Our top FTSE businesses need to be made up of tech businesses as well. We should all aspire to try to work on that. Maybe it will come from this great research that goes through, but it is not a linear process. Often what will happen is that some innovation will happen, and then you will go back and do some basic research and that will allow you to go to the next scale. It is a soup that all works very much together. There are a lot of issues tied up in that, but there are a lot of improvements that we could make.

Baroness Rock: That is very interesting—the journey to success and the challenges that are faced along that timeline. Mike, do you want to add anything to that?

Mike Biddle: Nigel referred to some of the things that we do. One of the activities we have to help with that commercialisation space for some of those early-stage ideas and with some of those early-stage researchers is the ICURe programme. Part of the model for that soup, as Nigel referred to it, is not just about the funding; it is what we call the innovation roundabout. It is looking at whether the idea is too early. Do you need to go back into the lab? Sometimes, spinning out too early is even more dangerous than going a little bit later. Those are some of the things we are trying to do.

Part of that is how you build that wraparound support, so that people can explore their idea, explore where the potential is, explore where their customer base will be, and then we try to connect them with our broader innovation landscape as well through activities such as Innovate UK EDGE and Innovate UK Knowledge Transfer Network, to try to bring all these things together and pull them together to help create that ecosystem.

Baroness Rock: Thank you.

Viscount Hanworth: May I follow up one of the previous questions? Is there a danger that successful high-tech UK start-ups will be quickly

purchased by overseas investors and stripped of their intellectual assets? Maybe Suranga has a comment on that.

Suranga Chandratillake: It is usually less dramatic, but the risk is there. Essentially, what tends to happen is that the later-stage scale-up capital comes from international investors. It is not so much that they purchase those companies as a whole or strip their assets, but the direction of travel for that company starts to be modified towards the international market, and eventually it will raise all its future funding from a different country, and, if it goes public, it will go public there, or be acquired by a company there. It is not to say that the company is a failure. It is not a failure; it succeeds, but the success happens elsewhere. That is the danger of that.

Viscount Hanworth: So in your perception the danger is not as great as I might imagine.

The Chair: We need to move on. Thank you for that answer.

Q44 **Baroness Blackwood of North Oxford:** We heard from the previous panel that UK intellectual property laws are in a very good position, but there are probably some steps that can be taken for international harmonisation and digitisation, and there is quite a challenge with tech giants and IP capture. What views does this panel have on whether the IP laws are fit for purpose and how they benefit our collaborations internationally between industry and academia? Then I would like to come back to some supplementaries on your previous answers. Perhaps, Nigel, you might start.

Nigel Toon: Broadly, the IP regime that we have in the UK is very fit for purpose. I do not see any major issues. The challenge is more around making sure that IP is handled appropriately, particularly as you think about spin-outs. Are we making appropriate value for where that IP has come from? If the Government have funded that research, are they being repaid for that research through the value that has accrued? Are we handling that IP appropriately and not restricting the freedom to operate for those businesses such that they go into a partnership and people worry that somebody else has the right to acquire that IP and we could end up in some litigation issue that might mean those companies cannot go forward? I see fewer issues around the IP itself but more around how, particularly in the innovation cycle and in the university cycle, we handle and treat that IP.

There is a legal distinction, if I am correct, where, in the UK, when you join an organisation, all your IP is owned by the organisation that you work for, whereas in the US that is typically covered by your employment contract. How that relates to universities is very different, where you engage in joint collaborations with universities, putting in place the appropriate IP frameworks that allow you to acquire or share the IP on appropriate terms that give you freedom to use and commercialise that, and there is no risk that other people could acquire that IP or you get acquired by somebody else and then sued. That is something that we need to look at.

The original purpose of IP was to encourage innovation, and its use by large companies to crowd out spaces and to own particular spaces is an issue. But if you are innovative and you are exploring new areas, you can generate very interesting patent portfolios. As an example, Graphcore is a five year-old company. We have so far filed for over 400 patents across the globe, of which 100 or so are in families that represent unique IP. It is definitely possible to do it, but it has been very much part of our strategy as a company to build that IP portfolio, and we have employed experts to build that strategy for the company. I am not sure everybody has access to those skills and that expertise; it is a global thing and not just about the UK.

Baroness Blackwood of North Oxford: When you come out as a researcher, you have to find those who could help you with that expertise and partner, and that is part of the technology transfer office's role, I presume.

Nigel Toon: Yes, it should be, but are they at a global level? We went to Silicon Valley. We hired our chief legal officer from a Silicon Valley company. They were a patent attorney in their background. They have worked in Singapore and Hong Kong. They had a global expertise in this space. We are filing patents in China and in all the major markets such as Korea, the US, Europe and the UK, and looking at how we are building that portfolio. Does that expertise exist in those technology transfer offices? Can they attract people of that calibre into those technology transfer offices to provide the right help?

Baroness Blackwood of North Oxford: The committee is looking for recommendations, so that could be one of them.

Suranga, would you like to answer the question?

Suranga Chandratillake: I do not have a huge deal to add. I agree with Nigel that our regulatory IP structure is relatively fit for purpose today. There are some interesting question marks about what happens over the next 10 years, particularly if you look at areas such as bioengineering. IP needs to be redesigned to fit the reality of some of the innovations in that area. I am not an expert in that area but it is a good example of where, particularly in a post-Brexit reality, the UK can, to a point that was made earlier, use regulation as an advantage. There are interesting opportunities there, but that is really for the future. Certainly, for today, it works really well.

I absolutely echo Nigel's point that, where you hit IP problems, it is not with the IP itself but with the handling and the management and the financing of that IP around it. He made the really good point about how IP is handled when it has been created in the university and is then spun out. That is a highly complex area. For what it is worth, a lot of countries do not do this well. I spent 10 years as an entrepreneur in America. There are many people who complain about what happens in the US, including in places such as Stanford, Harvard and MIT. It is easy to beat ourselves up on this, but no one has really cracked this nut well, and we do a decent job of it.

The other area where I think IP is misunderstood again—and I am sorry to harp on—is on the late-stage investing side. We find with our IP-rich companies in my portfolio that late-stage investors in the UK do not understand how to value intangibles. If you talk to a late-stage investor, particularly a public-market investor in the UK, they will drive most of their valuation process around the core profits and loss and revenues and turnover of the business, and not the intangible value of things like technology. Not understanding intangibles means that we cannot understand the value, or a big chunk of the value, of a business like Nigel's, and that means we miss out on those late-stage investments as well. There is an issue around that. Again, that is not really the IP itself; it is more about the understanding of the IP.

Baroness Blackwood of North Oxford: That is really helpful. I wanted to follow up on the points that you made to Baroness Rock about the challenges with late-stage funding. Nigel, you also made these points. We recognise that there is a shortage in the UK ecosystem. What recommendations do you have to address that? You must have discussed this with the Prime Minister's council and other places. Did you have some specific recommendations in addition to valuing intangibles? Perhaps I can ask Nigel that as well.

Suranga Chandratillake: We wrote a letter on this as part of the Prime Minister's council. You can look at that record separately. Fundamentally, it boils down to two things: it is about people and money.

If I take the money first, there is absolutely an opportunity for some form of government-funded, late-stage investment fund, whether that is a sovereign wealth fund or something similar to what we have seen before with things such as the Future Fund; the exact structure is open to determination. That will be direct public funding in the late-stage area and could be tied particularly to things like the industrial strategy, focused on areas where, as a country, we have decided that we would like to lean in and double down on areas of expertise or speciality.

The other big source of capital—the part B of money—is really around crowding in more private capital. There, the big opportunity, which I mentioned briefly earlier, is pension funds and other asset managers and asset owners. Today, if you look at the pension fund industry across the UK, relative to its peers, it is massively underinvested in equities in general, and especially in innovative or private equity. Some of that is regulatory. It is to do with transparency, fee regulations and so on, and some of it is cultural.

The final piece is people, and I think that is the most important bit. At the end of the day, the biggest challenge we have with late-stage financing is people, and it is a cultural problem. If you talk to the average late-stage investor in the UK, they are typically someone who has no background in technology, science or innovation. They would struggle to understand viscerally what some of these companies are building and what they are about. As a result, they struggle to invest in them directly and to invest in the funds that might invest in them.

If you compare that to other markets, my fund has investors who come from the US, so we spend a lot of time with US investors. Some of those endowments and pension funds have deeply technical investors who absolutely understand technology and its value, and the direction that technology is taking us, and so are very excited to be able to invest in those companies at both early and late stage. A big part of our recommendation to the Prime Minister was how we can improve the education of some of these financial institutions to ensure that they get more exposure to technology so they can start to understand things like the intangible value of technology, place a value on it, and therefore hopefully invest in it going forward.

Baroness Blackwood of North Oxford: Thank you very much. Maybe we do need a few scientists in finance.

Nigel Toon: We definitely do, if I may interject. I want to add that the thing I struggle with is: why is it that pensioners in other countries are going to benefit from the success of Graphcore rather than pensioners here? We have a social care problem that could be fixed by greater returns through pension funds, and other countries are doing that. There is a really significant issue here around how we encourage our pension industry to not invest in property but instead to invest in growth businesses.

Baroness Blackwood of North Oxford: Mike, do you want to add anything?

Mike Biddle: One brief point. I agree with the points made about IP. We should not undersell the importance of know-how. We found that with medicines manufacturing, for example, a lot of the developments are clearly things you would patent, but how do you make gene therapies or small-molecule therapies at scale? Understanding that and getting people worldwide to value that means that you have something sticky that will anchor in the UK. IP has its place, but know-how and valuing that know-how is also important.

Baroness Blackwood of North Oxford: Thank you.

Q45 **Lord Rees of Ludlow:** I would like to expand on the issue of the talent pool and the links with universities. We have heard a lot about this. Can you say a bit more about the extent to which you think universities could be more flexible in allowing experts to go into the commercial sector and then back again, et cetera?

Also, could you say something about attracting talent into the right kinds of businesses—not just talent trained in the UK but, as someone mentioned earlier, ensuring that Britain does not stop being an attractive location for mobile talent from the rest of the world? That, of course, is a more political question, but we are suffering if we are no longer an attractive place in which to do science and to apply science. Do you have any further thoughts in addition to the interesting ones we heard earlier?

Nigel Toon: As I said before, we have a massive talent pool in our basic research and our leading institutions, and we must ensure that we

maintain and build on that. We are under constant global pressure for that talent, and we need to maintain it.

We need to create greater links between those people and industry. I definitely see that happening in our academic institutions. I definitely see the younger research scientists interested in the application of their technology, spinning out companies, et cetera. There is a real opportunity there to create almost a dual class or a dual track for academics, where they can maintain academic tenure but move more towards that applied aspect of research.

You see that a lot in engineering companies or technology companies, where you have a dual track so that people can continue to be engineers rather than having to become managers, and they can continue to pursue their intellectual talent rather than having to feel that they get paid more because they go into management. We have a pay structure that allows people to be great engineers and be paid more than our managers.

The same should be true in academia. People should feel that they can follow an academic path, where they are measured on papers that they are generating, and/or follow a more commercial path, where they are generating outcomes that generate IP that goes off into industry and applies to help us build new companies. There are opportunities around that from a funding perspective and from a structural perspective that we could really benefit from.

Mike Biddle: The opportunity to connect academia with business throughout the UK is one of the things that we absolutely need to address across the country for the country's benefit. Roughly speaking, about 18% of the Innovate UK funding tends to go to academia. From the Industrial Strategy Challenge Fund, it was about 30%, so it was slightly higher. Academia was involved in about 25% of the projects. Connecting industry with academia is important for all our futures. There is a porosity there not just in people but in ideas and how we make that happen.

We need to recognise that great ideas can come from anywhere and anyone. A lot of that is in academia but it is not only in academia. If 25% of the projects involve academia, that means 75% do not. We need to celebrate other opportunities for talent and skills across the country.

It is International Women's Day today. We have a Women in Innovation programme that celebrates those opportunities, not just funding great ideas that women have but trying to build an ecosystem around that and celebrating those successes with purple plaques, not just blue plaques. We are putting purple plaques on the schools that were connected with those women and helped them develop their innovation, to perpetuate, showcase and celebrate that journey for the future.

Lord Rees of Ludlow: What about attracting people from overseas?

Mike Biddle: We need to recognise that it is a global talent pool. The way we do that from a business innovation perspective is to have the environment whereby they can see that we can connect academia with business. We have often heard that they value that connection. If we can

get that right through our ecosystem in this country then that is one of the things they will value.

Lord Rees of Ludlow: Suranga, do you have a last word?

Suranga Chandratillake: You ask a really important question, because all this stuff is about people. Historically and culturally, for a number of reasons, Britain has had a very stovepipe approach to careers, and that really harms us in the long run.

Academics absolutely should have exposure to business and industry, and people who work in business and industry should have exposure to academia. If I can add a third tier to this, finance is really important—having people who have science backgrounds spending time in the world of finance and, dare I say it, even government. There is a need for people to have a sense of what else goes on in other spheres. Without that, we lack the connectivity to really pool all these things together, because the reality is that great companies are built from all these components, not from just one.

As someone who happens to have spent a bit of time in different spheres, I am constantly struck by the misunderstanding, or lack of understanding, across the boundaries. Anything we can do to promote that would really help.

Your point about the attractiveness of the UK to external talent is an absolutely crucial one. If you look across our portfolio today and at the British companies that we have backed, 65% of them have founders who were not born in the UK. Obviously, that is, by nature, a rearward-looking statistic. Historically, we have backed lots of British companies, companies that were based here and generating value here, but founded often by people who were not originally from here. I worry a lot about what that looks like going forward.

To Nigel's point earlier, from a visa point of view, there has been some really great work. But it is not just the visas; it is also about maintaining the image that this is a great place to move to, to bring your family up in and start your company in. Anything we can do to encourage that will benefit all of us.

Lord Rees of Ludlow: Thank you very much.

The Chair: We will finish the session with a quick question from Baroness Walmsley.

Q46 **Baroness Walmsley:** This is the last "Desert Island Discs" question. I will not ask you which piece of music you will save from the waves, but if you were able to advise government on one priority or one action it could take to include in its science and technology strategy, what would it be? It might be something you have mentioned this morning, or it might be something you have not mentioned. I will go in alphabetical order, and start with Mike Biddle.

Mike Biddle: For me, it would be to continue to invest in innovation because it is a long journey. On that science and technology strategy, if

we are going to capture the value in the UK, we need to invest in innovation for the long term. We have shown with the challenge fund that £2.5 billion of public money will way exceed the £2.8 billion of co-investment that we were expecting; it could even be over £5 billion. We know that £5 billion of money invested through Innovate UK has driven £22 billion of value in the UK economy. We have that evidence. Invest in innovation for the future.

Baroness Walmsley: Thank you very much. Suranga Chandratillake.

Suranga Chandratillake: For me, it is all about people. Let us use every carrot and stick we have to convince scientists that seeing their science and basic research come to fruition in the form of profit-making companies is an exciting thing. Equally, let us get financiers into and understanding technologies that they can invest in for the companies that will build the future.

Baroness Walmsley: Thank you. Finally, Nigel Toon.

Nigel Toon: I would like to see more cross-functional activity. The UK is incredibly strong, for example, in bioscience and AI. How do we bring those two together, because the next phase of bioscience, discovery in drugs and so forth will be driven by AI? Can we create an environment where we are able to bring across those boundaries that have traditionally been siloed and create a much more inclusive, diverse research community that is crossing those boundaries and able to solve problems across those different boundaries? That is what I would say we should try to do. Quite how we do it is hard.

Baroness Walmsley: I was going to ask you that.

Nigel Toon: The Alan Turing Institute is a place that could be a basis for some of that. Some of the research centres that we have are trying to drive and encourage research funding that crosses those boundaries. These are all areas that we could look at.

I would return to the point I made before about how we can make sure, once people have done the discovery research, that we support them to turn it into applied research, which, again, is often about crossing boundaries where you take one piece of technology—graphene, for example—and think about how you might apply it to avionics. A lot of that next piece of applied research that we need to build on top has to be associated with those cross-functional activities.

Baroness Walmsley: Thank you very much.

The Chair: Thank you very much to our witnesses. We must end the session there. As I said at the start, if there is anything you would like to clarify, or further information that you would like to provide to us, we would be delighted to receive it. Thank you very much. It has been a very interesting session. Goodbye.