HOUSE OF COMMONS

Science and Technology Committee

Oral evidence: The Draft Spaceflight Bill, HC 1070

Wednesday 19 April 2017

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Watch the meeting

Members present: Stephen Metcalfe (Chair); Victoria Borwick; Chris Green; Carol Monaghan; Derek Thomas; Matt Warman.

Questions 66 - 150

Witnesses

I: Stuart Martin, Chief Executive Officer, Satellite Applications Catapult; Stuart McIntyre, Chief Executive Officer, Orbital Access; and Professor Sir Martin Sweeting, Group Executive Chairman, SSTL.

II: Tim Johnson, Policy Director, Civil Aviation Authority; Jeremy Stubbs, Programme Manager, Commercial Space Operations, Civil Aviation Authority; Rebecca Evernden, Director of Policy, UK Space Agency; and Dr Richard Crowther, Chief Engineer, UK Space Agency.

Examination of witnesses

Witnesses: Stuart Martin, Stuart McIntyre and Professor Sir Martin Sweeting.

Q66 **Chair:** Good morning, welcome and thank you for joining us this morning for the continuation of our inquiry into the Spaceflight Bill. Perhaps for the record you would care to introduce yourself and state who you are representing this morning.

Stuart Martin: My name is Stuart Martin. I am the chief executive of the Satellite Applications Catapult.

Stuart McIntyre: I am Stuart McIntyre, the chief executive of Orbital Access Limited.

Professor Sir Martin Sweeting: I am Martin Sweeting, executive chairman of Surrey Satellites.

Q67 **Chair:** Welcome, all of you, and thank you for joining us. It is fairly well established that the UK is a leading developer of small satellites, despite not having its own launch capability. Do you think that establishing a spaceport or the Spaceflight Bill is going to make a real difference to your sector?

Professor Sir Martin Sweeting: Maybe that is something I could pick up on first, as our main business is designing and manufacturing small satellites. Clearly, at the moment there has been quite an explosion, if I may say so, in the market for small satellites. At the latest count, when I looked, there were proposals for a number of very large constellations; something over 150 constellations are being proposed. If all those came to fruition, it would be something in excess of 20,000 small satellites. Not all of them are going to come, of course—the business case will not be proven for all of them—but it is quite clear that there is an expanding market for small satellites. The UK has taken a leading role in that. Most of our business, therefore, is export so there is a real opportunity for us.

The constraint that we have at the moment is primarily on the availability and the cost of launch; so, the proposal for a UK launch capability will certainly enhance the business opportunities. At the same time, it will make us less reliant on procuring, as we are at the moment, from non-sovereign sources. Having a sovereign capability, both for business and for national interest, is a very strong reason to proceed with this.

Stuart McIntyre: I concur with Sir Martin. The recent forecasts for the small satellite launch market globally are for launch values in excess of 35 billion over the next 20 years. So, for the UK to participate in that market, obtain a share of it and, importantly, launch its own satellite products and enable its own satellite applications, having the end-to-end capability to design, build, launch and then draw data and sell data from satellites is a key enabler in capturing that market.

Stuart Martin: It is very clear that the existing launcher industry has always been focused on the much larger traditional satellites, the big telecoms satellites. For the smaller satellites to gain a foothold in that sort of market offering has been very difficult. They have always been secondary payloads, so very much reliant on the timescales and orbital demands of the larger satellites. As Sir Martin was saying about the shift that is happening in the industry now, there is a gap in launcher capability worldwide that is focused on the small satellite sector, and there are some very good reasons, not least the strength of the industry in the UK—the small satellite industry—why the UK would be a great place to establish that new industry.

Q68 **Chair:** Do you think the industry in the UK could thrive on a completely commercial basis or do you think it needs Government support, the awarding of contracts, to try to stimulate it? SpaceX has a $1.6 billion contract with NASA to deliver goods to the International Space Station. Is that something we would need to explore, or do you think it can be done, as I said, completely on a commercial basis?

Stuart McIntyre: We have to understand that what is going on is a significant shift between the large, vertical launch sovereign programmes of the past, of which SpaceX remains a part, through a slightly different commercial vehicle, and the emergent small commercial payload market, for which the new small launch vehicles that are in development create a high cadence drumbeat of launch capability. The high up-front costs of very large vertical sovereign launch capabilities are not really what we are talking about. That said, there are aerospace development activities to develop launches that will require some support, as normal aerospace programmes do, but they pay off over life and become commercially rewarding for the nation.

Professor Sir Martin Sweeting: We have seen a big shift away from institutional funding for many of the space businesses of the future towards much more private sector funding. If you look again at our business, over 98% of it is export. It is not Government based. Consequently, this is an opportunity where Government can take advantage of the investment in the commercial sector to utilise it for some sovereign requirements without having to foot the entire bill.

Stuart Martin: That is the point. Where the Government, with a customer role, are coming in is very different from the Government in the pump-prime funder role that we have perhaps seen in the past. That is very much part of the transition that we are seeing now for the UK Government and overseas.

Stuart McIntyre: The reality is that the market is becoming very commercial. It is all about taking a leadership position. We are, as the UK, not behind the world as we engage with the commercial market. Indeed, all the US horizontal spaceport sites are still essentially sitting idle waiting for the systems and capabilities that we are talking about putting together in the UK.

Q69 **Chair:** By the sound of that, you are fairly welcoming of the Bill. The purpose of this inquiry is for us to gather evidence to feed back to the Government to help inform the process as we move forward. Can you tell us what your first impressions of the Bill were? Is it creating the regulatory framework that will enable the establishment of spaceports, and are there things missing from it that you would like to have seen included?

Stuart Martin: To paraphrase an American friend of mine, the great thing about the Bill is that it is this thick, not that thick, compared with some of the US legislation, although I know it is only the framework and a lot of the implementing regulation will be coming along behind it. As a framework, it is a really good start and it sets out a good trajectory for the regulation that is going to follow.

Professor Sir Martin Sweeting: One of the strong points of the Bill is that it sets its overarching framework, an umbrella, without constraining a lot of the detailed implementation. Technology and the business cases are going to evolve very rapidly over the next decade and we do not want a Bill that is very finely structured and then rapidly becomes out of date because the business cases move on. Having an umbrella that is strong, allowing the implementation then to be developed, is the right way. From my reading of the Bill—I am not an expert on the detail—it does exactly that.

Stuart McIntyre: It builds on several years of experience in other countries in this sector and therefore enters at a level that is much more aware of the realities of today's launch environment. It is not a Bill like legislation in other nations that is based on large sovereign launch capabilities being converted for application; it is designed for purpose. That is an important point in the Bill: it is structured for today's emerging industry, not yesterday's outgoing industry.

Professor Sir Martin Sweeting: The fact that it was developed in six months is a credit to the agency, and the fact that it is only that thick is another credit. Those two things are indicative of its suitability.

Q70 **Chair:** So leave it as it is.

Professor Sir Martin Sweeting: Don't mess.

Q71 **Chair:** You are absolutely right to highlight the fact that it was done very quickly, which, as you say, is impressive, and there is obviously a view to try to get it in place in time to open the first spaceport by 2020. Do you think that is actually realistic? We heard in our evidence sessions in March that it was probably quite ambitious.

Professor Sir Martin Sweeting: It is ambitious—very ambitious. We have to set the expectations right, because it is perfectly practicable to have a spaceport in place and to undertake some test launches of one sort or another, whether sub-orbital or orbital, in that sort of timeframe. To have a fully operational commercial system in that timeframe would

be considered overly ambitious, but to establish something and to carry out preliminary tests is perfectly sensible, providing it starts quickly and the approach is done in a very light-touch manner. Otherwise it would take longer.

Stuart Martin: The key thing is that the market opportunity is evolving quickly as well. I can completely understand the motivation to get the legislation in quickly so that we secure taking advantage of the market opportunity in the UK. We can debate what open means by 2020, but we want to make sure that it is clear by 2020 that that presence is going to exist and that industry can be ready to invest in the UK without the regulatory risk associated with any investment.

Stuart McIntyre: The key point is that the legislation must not be the final piece that comes into the equation. We have to get the legislation in place to allow all the development activity, both launchers and spaceport facilities, to be ready in that sort of timeframe. Of course, as Sir Martin says, the type of operation that is occurring in 2020 may still be late-stage development activity. There are bound to be other types of space-related activity already going at the spaceport by 2020, even if it is not launch. Setting out the ambition and identifying the sites and locations for those investments is critical now.

Q72 **Chris Green:** It is interesting that spaceport 2020 is perhaps not happening, or happening a little after, when we were expecting a general election in 2020, which is not likely to happen either. There has been a lot of urgency surrounding the Bill and the Government are very keen to get things going. Presumably you want the next Parliament to pick up where we leave off now, and I suppose all the parties will be pretty keen in the future, but why do you think there has been so much hurry?

Professor Sir Martin Sweeting: As was mentioned earlier, we have seen tremendous acceleration in the business environment for small satellites, which would then be a market that could be met by the spaceport. If we delay, we will see that wave move through and we will not be able to catch it.

Q73 **Chris Green:** Is it really that Government are responding to the needs or the interests of business, because of the opportunities and developments coming through? Are the Government taking their lead from business?

Stuart McIntyre: The market is burgeoning right now and the UK faces an unprecedented opportunity to occupy that space, not just serving the UK industry but creating a profoundly long-term valuable export capability that will be the foundation for young engineers and the aerospace and space industry for decades to come. The urgency, I think, comes from the degree of opportunity we face and the opportunity for our economy, for our industry and for our technical competence in the UK.

Stuart Martin: The space industry has benefited from a strong partnership with Government over the last 10 years or more, including the innovation and growth strategy, which we have debated and discussed in this Committee in the past. In the first publication of that, in 2010, it was identified that the absence of low-cost access for space, particularly for the small satellite market, was even then a barrier and was going to become more of a barrier. As things have progressed, that has become more apparent, and now is quite clearly the time to try to take advantage of that, not only as a blocker but also as a market opportunity. That is what we are trying to take advantage of now.

Q74 **Chris Green:** Does the UK's location for a potential spaceport mean we can only put satellites into space in the polar orbit as opposed to equatorial orbit? Is there a limitation?

Stuart McIntyre: In terms of geographic location, the UK's latitude makes it well suited to polar launch, but the economic value from the launch capability we have set up is not just in what we can launch from UK soil; it is what we can launch with UK-manufactured technology and systems in global locations. Accessing sites in Australia, the US, the far east or the south of Africa all creates outlets for the UK industry to launch to any orbit at any time. As long as the strong UK bilaterals are there to allow and permit that type of operation, we will find ourselves with an industry that is uniquely strong and leading this new market. That is the ambition that the Government have set out to capture, and the Bill acts as a very dominant first step in stating that intent.

Q75 **Chris Green:** It is not just about launch here—it is global opportunity.

Stuart McIntyre: It is a global market, and we have the opportunity to lead as the UK.

Q76 **Chris Green:** There are limitations on the size of satellites that can be carried on horizontally launched spaceplanes. Why do those limitations arise?

Stuart McIntyre: There are a range of international treaties that control these types of technologies. For horizontal launch systems, you are limited by existing technologies. In the future, with important UK technology such as the SABRE engine from Reaction Engines, we will start to see much higher capacity and payload capability launch vehicles taking off from horizontal spaceports. At the moment, the first systems will be constrained by conventional civil aircraft technology, and that creates a certain payload weight limitation. The important thing is that the very first systems that are developed to operate in 2020-21 are really just the first step in a long-term road map of technical capability for the UK, of which Reaction Engines' SABRE engine, for example, is an absolutely pivotal technology.

Q77 **Chris Green:** Will it hold back the UK's small satellite sector or not?

Stuart McIntyre: It will certainly drive it. The small satellite sector is suited exactly to the sorts of capabilities that are being designed.

Professor Sir Martin Sweeting: I am not sure whether you have a follow-on question as to whether we are going to be solely constrained to horizontal launches. My personal view is that, yes, that is one of the paths that will serve both the small satellite sector and possibly the tourism sector in due course. Until we can develop—probably in a decade or so—large capacity horizontal take-off vehicles, we will also require vertical launch capabilities if we are to meet the demands of the small satellite community in the next decade. There will be two strands, and they are slightly different technologies: one exists and is proven, and the other one is coming along. Those combined will provide us with a much stronger position, both for the near-term small satellite market and the longer-term satellite plus space flight markets.

Q78 **Derek Thomas:** I am a Cornish MP and I have Goonhilly Earth Station in my patch; so I have a particular interest in this. I know Surrey Satellites has a relationship with Goonhilly, so it is good to meet you. I am not sure if I have to declare an interest, but I am very interested.

Last year, we heard that the UK's current regulations had been written on the assumption that satellites were large and were launched one at a time. What do you think needs to change so that UK regulations can accommodate launching multiple small satellites? Are they adequately reflected in the Bill? You may have hinted at that already, but maybe you could unpack it a bit further.

Stuart Martin: That is a really good question. There are three things that the Bill is trying to achieve when it looks at the future of satellite licensing. One is that it is trying to respond to the changing environment that you are referring to, which is the proliferation of constellations of small satellites and what is an appropriate licensing framework for that. The second thing is that, in order to create an environment that is attractive to industry, there needs to be a very clear process. It needs to be well understood, and people need to have good confidence that they know what they need to do in order to get a licence. The third thing it needs to achieve is a balance of the risk between the private sector and the public sector, to make sure that the Government are not taking an unnecessary share of the risk, but at the same time there is an environment that creates the right conditions for industry to invest, because the risk profile is acceptable for them.

That balance is extremely difficult. How do you achieve all those three things? This is a question about indemnity, ultimately, isn't it? How do you create that environment when you are looking at one large satellite versus several small satellites? What is the model for partitioning the risk between the private and the public sector? The Bill itself is quite flexible on that. It is one of the many uses of the word "may"—the regulator "may" choose to do something or other—and that is an example of the flexibility that we all welcome in the Bill. It worries me slightly that that

liability model is quite a blunt instrument when you are trying to manage such a complex mix of objectives, not only in the indemnity but in the balance of risk.

The Space Agency is doing a really good job at the moment of looking at different options, looking at traffic-lighting models for orbital characteristics that will present a low risk to Government, particularly for satellites that will naturally de-orbit in a short period of time, so there is very little risk exposure to Government associated with that. It is looking at the ways for constellations—where you can manage the insurance or manage the indemnity on a constellation basis rather than a per-satellite basis. It will be critical that somehow we maintain that flexibility through the lower level legislation, so that at some level there is discretion to look at options on a case-by-case basis and apply some judgment depending on individual circumstances.

Professor Sir Martin Sweeting: By the way, we are very pleased to be working with colleagues down in Goonhilly.

Derek Thomas: They are fantastic people.

Professor Sir Martin Sweeting: We can also be clear that there are two sets of risks: one is the risk associated with the launch operations, and the other is the ongoing risk of the satellite or the constellation in orbit. They are of varying degrees of risk and complexity. The launch operation is something that is pretty well known. It has been handled for many years, so that is an area where initially Government will probably have to assume a risk that is a bit higher in the early stages of proving, and, as it becomes commercially more routine, the private sector will assume a greater amount of the risk. The second area of risk is the number, the orbit and the characteristics of the satellites once they are in orbit. If we have very large constellations and they are launched from UK sovereign soil, there is a separate risk issue. I know colleagues in the next session are likely to address that.

Stuart McIntyre: We have to stay focused on the fact that we are looking to enable a very strong commercial operation. So, the relationship between risk and liability, the cadence of launch that we are looking to enable and, therefore, the speed with which licences can be processed and given are important aspects that we need to nurture carefully as the Bill goes into more detailed legislation. Ultimately, this is a market where developers are investing in technology and want to get that technology in orbit decisively and quickly, in order to gain the commercial return from that investment. Long delays in licensing—very onerous processes—need to be avoided wherever possible.

Professor Sir Martin Sweeting: Yes.

Q79 **Derek Thomas:** We often hear in this Committee that the jobs that our young people will be doing have not yet been invented, so I want you to predict the future. We have already heard, even in the few minutes we

have been here, that the satellite sector is rapidly evolving. I do not know if you want to have a go at this, but how much technological change are you expecting over the next 10 years across the space and satellite sector, and is the Bill flexible enough to accommodate that? You hinted at that, but it would be interesting to know where you think we will be in 10 years' time, if that is possible to predict.

Stuart Martin: I guess that one is for me. I should start by saying that we too have a partnership with Goonhilly. We have a centre of excellence down there.

Derek Thomas: I apologise for not including you in my preamble.

Stuart Martin: We will have to introduce you to the team down there. Where to start? There is so much that is changing right now when you look at the communications, infrastructures and new satellite communications networks starting up that will be delivering internet to people who have never been able to get that kind of technology before. We are also looking at the constellations of imaging satellites that are going to be imaging the same point on Earth, not only every day but potentially every hour, within a relatively short period of time, which is going to give much shorter intervals between the visibility of data. It means that farmers will be able to get updates regularly on the progress of their crops, which will help them plan their activities much more granularly.

In terms of what jobs it is going to create, the great thing about the space industry is that we have high-tech manufacturing jobs as well. We have several hundred people working in that industry in the UK already, but we also have IT jobs, data analyst jobs and the whole industry of data science, analytics and machine learning and all the industries that go around it. This is something that we are very strong at in the UK and we will be certainly world leaders on it, using satellite data, in the years to come.

Stuart McIntyre: In the aerospace technologies that we will see develop—we mentioned the SABRE engine as a radical new capability—we have to recognise that we have nearly 100 years of aviation and aircraft design capability in the UK economy. We have a fantastic platform to develop the next generation of aerospace and space technologies. Those jobs may be in slightly different sectors—very advanced materials, hypersonic aerodynamics and those types of capabilities. At spaceports in Cornwall, in Scotland, or wherever, we are going to see clusters of those engineering capabilities start to form as we prepare the vehicles, mount the missions, develop and design the vehicles and manufacture the vehicles. We are going to see a whole ecosystem of aerospace and engineering activity form around those sites. We too are looking forward to our relationship with Goonhilly, which is not quite yet established but is on the way.

Derek Thomas: I should get them to write my election address.

Professor Sir Martin Sweeting: My colleagues are focusing on applications and I am a satellite chap; so we are looking at it from the satellite point of view, 10 and perhaps even 20 years ahead. At the moment, we are looking at how we can transfer the assembly and the manufacture of satellites from Earth to orbit. The next step is to build satellites, Lego-like, in orbit, so we have small satellites where we can create bigger ones by Lego—easier said than done, by the way. The next step, beyond that, is that we design the satellites to survive the rigours of the first 20 minutes of launch and then they just float around in orbit. How can we get rid of that by essentially manufacturing—3D printing—the spacecraft in orbit, so that we can launch a bag of sand for the semiconductors and a lump of metal for the structure and then spin them out in orbit? That is the sort of thing we will see in the next 10 to 20 years, and small satellites and small launchers would enable that. This is a real opportunity for the UK to completely change the whole paradigm of space.

Q80 **Derek Thomas:** Cornwall is open for business and we will certainly welcome any new partnership. My son is 10 and very good at Lego, so he may well have a job there as well. Do you know whether the Government are planning to have licences issued for each individual mission, or licences for particular types of activity—an orbital flight licence, for example? If licences will be for individual missions, is that an improvement on where we are today?

Stuart McIntyre: I go back to the point I made earlier. We have to look at the individual missions and the commercial activities that are intended and make sure that the licensing framework is fit to serve those needs. There may be some types of mission for which some sort of blanket permission can be granted, and operators can operate freely within the confines of those. There may be other missions that absolutely require individual licensing because of their particular unique nature. The Bill clearly creates the framework for all those types of approaches to be developed as appropriate. As we have already said, the technology and the industry are developing rapidly, and that flexibility of implementation is critical in taking this to success.

Stuart Martin: There are two classes of mission that we are talking about. There are very standard missions. We can talk about some of the equatorial launches. You could imagine that there would be a template mission as a standard launch trajectory—a standard type of platform with a standard type of payload on that platform. We would like to think that there could be a very quick, easy process to get a standard licence for that sort of mission, but we also want to make it possible to have much more complex, innovative and creative missions, and that will require a level of bespoking and much more dialogue. We need to make sure that the framework can cope with that sort of thing too. They are two extremes.

Q81 **Chair:** Thank you. A trip to Goonhilly might be quite interesting, by the

sound of it. You mentioned, Sir Martin, two things that I had not even considered previously: launching small satellites to build bigger satellites in space and manufacturing in space. Presumably, therefore, there is huge potential to do much more than is even being considered at the moment. In terms of timing, how far away are those visions of sending components up and building something bigger, and manufacturing in space? Are they science fiction or are they verging on science fact that we may see within that 10-year timeframe?

Professor Sir Martin Sweeting: The first demonstration mission of in-orbit assembly of a number of microsatellites to make a larger mini-satellite is planned for about two years' time. The first steps—this is not science fiction, but a path—are well under way. Moving through to complex assemblies in orbit and then eventually manufacturing is further downstream, but is it 10 years or is it 15? One could argue that it is not 50. The key for the UK is that a small launcher really fits that, and it is an opportunity for the UK to drive this ahead. The timing is absolutely right.

Stuart McIntyre: We have to view low-Earth orbit as an emerging industrial workspace. While we conceive of launch around the relatively simple concept of a small payload being launched, going into orbit and delivering a service, the reality is that the mission profiles are endlessly wide, from in-orbit manufacture and servicing in-orbit assets that are already there to clearing up the rubbish in that industrial workspace, and so on and so forth. The technologies and capabilities that the Bill enables are simply the industrial machinery associated with accessing that industrial workspace; so, the spaceports themselves, the launch systems, and their multi-role capability are key, which is why the technology is moving into an entirely new era and why we are at the very front of it.

Chair: Fantastic. Thank you very much.

Q82 **Victoria Borwick:** That takes us on to the next topic, which is insurance—the UK's liability and insurance requirements. We understand, inevitably, from what you have enthusiastically told us again this morning, that you are calling for them to be made less onerous on the industry. Will the Bill do that and what flexibility is there?

Stuart Martin: It certainly creates the conditions for that to happen. It does not explicitly deal with it, but it certainly has the necessary conditions, such as whether you have a blanket liability cap, which at the moment is a blanket insurance requirement for, I think, £60 million. If you have a small satellite that costs only a few hundred thousand pounds to build, and you put a £60 million insurance policy on that, it will cost several times more than the construction and launch costs of the satellite to provide the insurance policy. If you can convince yourself that the risk of operating that satellite does not warrant the £60 million liability, the legislation has to be flexible enough not to force you to impose it. I think the conditions are there for that. It comes down to the detail of the implementing regulations as to how that gets implemented.

Q83 **Victoria Borwick:** Of how you negotiate that—fine. Your objective is presumably to ensure that you are not left with unlimited liability for unrealistic values—

Stuart Martin: Yes.

Victoria Borwick: With the changing technology that you have just explained to us.

Stuart McIntyre: More importantly, it is the right exposure for the correct liabilities. The important thing is that there is no unreasonable or unnecessary burden placed on this opportunity.

Professor Sir Martin Sweeting: Or an unreasonable burden on either side—either on Government or on the private sector. The balance and assessment of risk to make sure that it is reasonable, whether it is a full commercial or whether it is trying to innovate in technology, needs to be assessed on a case-by-case basis, so that the risk does not fall unreasonably either on the private sector or on the public sector.

Q84 **Victoria Borwick:** The Government have told us that the cap on operators' liability is being removed because the risk of claims against the Government from other states is lower where UK launches are concerned. Do you agree with that assessment?

Stuart McIntyre: Clearly the risk in other nations is a function of where the missions are taking place and what is actually happening in other nations' airspace, or what have you. Where operations are confined to UK airspace, it seems entirely reasonable.

Q85 **Victoria Borwick:** Fine. You are happy with that. What if a UK national launched something overseas? Do you think claims against the Government might be less likely in respect of UK launches than for, say, UK companies launching a space object—I use that as the loosest term in view of all the descriptions of satellites—overseas?

Professor Sir Martin Sweeting: Joanne Wheeler, who gave evidence previously, is probably the expert on that, but my understanding is that there are two sectors. One is the physical launch and the potential for damage caused by that launch, which may be over UK sovereign territory. It is home insurance, if you like, versus potential damage to a third party from satellites once they are in orbit having been launched by the UK as the launching state. That is where the £60 million really applies. The damage due to the launch itself is generally insured separately. Irrespective of whether it is a national launch or anything else, once they are in orbit we are looking at the launch state liability rather than the territorial liability. That would be my inexpert understanding.

Q86 **Victoria Borwick:** Fine. Finally on this topic, under clause 31 of the Bill the Government may indemnify operators in respect of liability if it is more than they are required to insure against. If the Government do not

do that, do you think it will put people off? From the way you have spoken this morning, you are talking much more about kit forms and smaller liabilities; so I do not know if you feel, like many things in life, that the overall costs will come down in the longer term. Do you think the current liability rate is right and that, therefore, we need the Government indemnities?

Stuart Martin: No business likes the concept of unlimited liability. That will put people off. I am sure of that. Some level of Government indemnity above whatever cap is decided relevant to a particular mission is very important.

Professor Sir Martin Sweeting: Yes.

Victoria Borwick: Thank you.

Q87 **Carol Monaghan:** I would like to ask a little about the impact of Brexit on the industry. To date, have there been any repercussions as a result of the vote to leave the European Union?

Professor Sir Martin Sweeting: The honest answer from what I have seen in my business area is no. There have been some scufflings, shall we say, around the award of the next Galileo work order 3, which is still going through the process. Brexit has complicated that discussion, but I believe it is now coming out of the pipe and we hope that it will not have been affected. Apart from that, currently, no, with the exception of the uncertainty that it has presented to some of our European staff who are obviously anxious about what the implications of Brexit might be on their residence. Of course, we are also concerned about the ability for us to be able to draw on the expertise of European personnel in the future, but as of today, no, we have not seen any specific impact. But we need to watch those areas for the future.

Q88 **Carol Monaghan:** Are there other opportunities presenting themselves?

Professor Sir Martin Sweeting: I think there are, because in one sense the UK stepping out on its own, if you like, is opening discussions with some of our potential export customers who see an opportunity for more bilateral relations in a less constrained discussion. It has opened some opportunities, but it is early days yet and we need to see how they develop.

Stuart McIntyre: We have to recognise that the space industry is a global industry, and space is a global asset. Certainly from our discussions on possible global launch locations, it is very clear that a resurgent international UK posture strongly supports the view of global service delivery from a UK industrial base, and the ability of the UK to foster the bilateral relationships that launch activities in foreign states will require. That independent UK personality is certainly, from a launch perspective, a significant plus.

Q89 **Carol Monaghan:** The Bill says that licences must be consistent with

international obligations. Is there a risk that the licence terms could change once we leave the European Union, or has the Bill been future-proofed to avoid that?

Stuart McIntyre: The regulations concerned are beyond European. They are global treaties.

Stuart Martin: It is mainly UN treaties.

Stuart McIntyre: So I do not think that applies.

Q90 **Carol Monaghan:** Will we still be subject to, for example, EU aviation regulations?

Stuart McIntyre: That is a matter for the Brexit discussions, I think.

Q91 **Carol Monaghan:** Fine. I will move on. The CAA has indicated that spaceplanes should be classified as experimental and thus excluded from the European Aviation Safety Agency regulations. If we are talking about something that will potentially be commercial, and could have investors or clients interested in it, is "experimental" the correct term to use and the correct category for spaceplanes?

Stuart McIntyre: In response to that, I would say that that language very much mirrors the approach taken in the US in a similar way. Importantly, that language places the UK on a level playing field with similar development activities and certification requirements for similar systems in the US. The classification seems entirely consistent right now. In some future concept, when the spaceplanes of tomorrow are like the airliners of today, I am certain those classifications will be modified and improved accordingly.

Q92 **Carol Monaghan:** Could that experimental tag, or labelling, on spaceplanes deter investors from becoming involved?

Stuart McIntyre: In my view, no, it does not change the market at all. Indeed, all launch vehicles that are operational right now in the world are considered experimental, in that they are all broadly unique and they are all broadly or subtly different in one area of technology or another. Therefore, as a tag, the industry understands that it does not mean unreliable or difficult to operate. It is simply—

Q93 **Carol Monaghan:** You are not concerned by this.

Stuart McIntyre: No, not at all.

Chair: Thank you very much. Just as an aside to that, this Committee has called on a number of occasions for assurances to EU scientists already in the UK that they are welcome. We should be giving early reassurances to them that, despite whatever new framework is put in place, we need access to EU scientists, and actually UK scientists need access to the EU. That needs to continue; so I want to put that on record again.

Carol Monaghan: That is your weekly putting on the record.

Q94 **Chair:** It is my weekly putting on record that I do not see reassuring these people now as undermining our position.

As a final question, you noted earlier in your evidence that much of the detail is not on the face of the Bill; it will be done through statutory instruments and regulation at a later point. Do you think that those draft regulations should be published alongside the Bill so that you can see the direction in which it is heading, or is that not a particular concern of yours?

Stuart Martin: I am not particularly concerned about that. We have talked about speed already and the pace at which the industry is moving, and we need to keep moving forward on the regulatory side at a pace that is commensurate with that; so I would not suggest that we hold this up waiting for it to come in place. It can all take place in separate consultation.

Stuart McIntyre: I agree with that. There are probably one or two areas in the current Bill that we need to make sure are broad enough to allow interpretation in the secondary legislation. A particular one relates to the definition of range, which I think it is important not to take in too confined or literal a manner. Given the way technology is developing, range will be a bespoke definition for a particular launch, not just a set of GPS co-ordinates that are set in stone from the beginning. There are one or two small areas like that that need some clarity, but the legislation can be allowed to develop under the competence of the UK Space Agency quite comfortably.

Q95 **Chair:** On the specific point about areas where you are concerned, this is an opportunity to get them on the record. Or are you putting in your own submission to the consultation on the Bill?

Stuart McIntyre: We will be submitting to the consultation on those small points.

Chair: Fine. Thank you.

Professor Sir Martin Sweeting: To reiterate, keeping forward movement on the Bill is most important. I would hesitate to slow it down by trying to provide some finer detail, but perhaps what could be done, if there is such a mechanism, is to provide with the umbrella of the Bill some additional notes that are not formalised but indicate the direction of travel in some of the areas. That would help business and industry to prepare the way, or to have the opportunity to provide some feedback without its being formally part of the Bill. It would depend on the effort required and the capacity to do that, and I certainly would not want it to slow progress.

Q96 **Chair:** Thank you very much indeed for your answers this morning. As we are ahead of time for a change, which is very unusual, are there any

final points you would like to put on record before I draw the session to a close? If there is anything we have not covered that you think we should have done, this is the opportunity to make those points.

Stuart Martin: There was a question asked at the beginning about the polar orbits and whether that represented a restriction—not being able to access the equatorial orbits. I want to make the point that there are some really attractive characteristics of polar orbits that make them particularly suitable for small satellites, and the fact that there are not good access opportunities to those orbits now is part of the problem that we are trying to solve.

In equatorial orbits, you can do what they call geosynchronous—geostationary satellites where the satellites stay at the same place in the sky—which is great for satellite TV and those sorts of things; but in polar orbits you can have sun-synchronous orbits, which means that your orbit always stays at exactly the same angle with respect to the sun. That is important because it means that you can have the same lighting conditions for a satellite as it passes over the same point on the Earth every day, which makes optical comparison of images on a day-by-day basis very simple. It also means that satellites that require a lot of power, such as radar satellites, can have very simple solar panels, because they always point in the same direction towards the sun. That reduces a lot of complexity in the architecture of the satellite. Being able to do that from the UK is a really attractive proposition.

Professor Sir Martin Sweeting: If you look at the proposals for the various constellations and the numbers of spacecraft that I mentioned earlier, the vast majority are in high inclination orbits—maybe not purely polar but in high inclination orbits—which could be served by the spaceport. That is where the new business is. The traditional business was further down south.

Stuart McIntyre: To put that into numbers, our forecasts predict that somewhere between 75% and 80% of that 35 billion launch market is going to be in polar insertions.

Q97 **Chair:** How much do you think it is reasonable to expect to capture of that market?

Stuart McIntyre: That depends on our capability. If we have a commercially focused and highly energised commercial industry and market to support that, we can capture a very significant market share. There are not very many systems in development. Those that are have their industrial base in the US, in California and other places. All the economic benefits are there. If we establish our own capability and industry in that market, we can aspire to a significant share of it. I hesitate to put a number on it, but it is a very substantial opportunity for the UK economy.

Chair: Fantastic. It sounds like there is a lot to play for, and a lot

potentially riding on the passing of the Bill. Thank you very much indeed for your attendance this morning and for your evidence.

Examination of witnesses

Witnesses: Tim Johnson, Jeremy Stubbs, Rebecca Evernden and Dr Crowther.

Q98 **Chair:** Good morning, welcome. Thank you very much for joining us for what turns out to be the last panel in our inquiry on the Spaceflight Bill. For the record, would you care to state who you are and in what capacity you are before us this morning?

Dr Crowther: I am Richard Crowther, chief engineer at the Space Agency.

Rebecca Evernden: I am Rebecca Evernden, director of policy at the Space Agency.

Tim Johnson: Tim Johnson, director of policy at the Civil Aviation Authority.

Jeremy Stubbs: Jerry Stubbs, programme lead for the development of the regulatory effort in the CAA.

Q99 **Chair:** Welcome, and thank you very much for joining us. You heard the previous panel and you have examined evidence submitted previously to the Committee. It sounds like the Bill is pretty much universally welcomed and will be a useful addition. In light of the fact that the Government have not published their space growth strategy, do you find it odd that they have introduced a Bill without a strategy to justify it?

Rebecca Evernden: The Bill is clearly a very important new opportunity for the UK. As we heard from the previous panel, and as the Government have said many times, we want to act quickly in order to take advantage of this emerging market. There have already been precedents. The Government said in their national space policy what they intend to do, and you, as a Committee, provided a report on satellites and space endorsing the Government's ambition to legislate for launch, and encouraging us to go further, to look at vertical launch, which we did. There is already a good framework within which to fit the ambition to launch. Indeed, the industrial strategy published by the Secretary of State for Business also endorses the need to grow the space sector. While the Bill goes ahead of publication of the strategy, as you said, I think it fits quite nicely into an existing framework.

Q100 **Chair:** Do we know what has happened to the strategy?

Rebecca Evernden: Yes, we do. The strategy is still in development. There is a good partnership and dialogue going on with industry. We know that industry are coming up with their own ideas to put to Ministers for a potential sector deal in line with the framework set out by the industrial strategy, and we are putting into the mix the recommendations

of this Committee. We expect the strategy to develop quite quickly, and we hope to have something later this year, depending on everything that is going to happen in the next few months.

Q101 **Chair:** You said you had had dialogue with industry. Without breaking commercial confidentiality and perhaps giving away too much, what sort of interest is there from industry? Is it UK-based? Can you paint a picture of how energised the industry is by the fact that we are potentially putting in place a Bill to enable spaceports?

Rebecca Evernden: There is a lot of energy in industry. We had an initial launch event back in February where there were 200 representatives, mostly from UK industry but also from abroad. They came to a session where we presented what the satellite launch programme was doing, and at that event we presented the draft Bill, which was published on the same day. There was a lot of energy in the room. We had Ministers from the Department for Transport and the Department for Business there, and we had very good feedback from that event.

We are holding a number of workshop sessions with industry to look at the Bill. We have had one substantial round table and there is another one this week. There is a lot of engagement and ongoing dialogue with the sector; so it is clear that there is interest.

Dr Crowther: There are some very credible systems, from a technical perspective, potentially coming to the UK, which is very promising.

Rebecca Evernden: Yes. I cannot say exactly which operators are interested. As you know, we have a process out at the moment where spaceports and operators have been asked to form partnerships—we mentioned this at our last session—to bid into Government funding to help the formation of those partnerships. There are a large number of spaceports and operators still in the running, with a number of viable partnerships emerging.

Q102 **Chair:** Has the interest been in line with your expectations, or have you been surprised by how much interest there has been?

Rebecca Evernden: We have been not surprised but pleased by the number of expressions of interest we have had and, as Richard said, the number of potentially viable bids into the programme.

Q103 **Chair:** One of the things that have been highlighted is that the United States International Traffic in Arms Regulations prevent US spaceplane manufacturers from exporting technology to the UK. Do you see that as a problem, and would it prohibit US operators from coming to the UK and establishing a UK launch capacity?

Rebecca Evernden: Obviously, we want to encourage US companies to take advantage of the opportunities in the UK, and we are working closely with the US Government to ensure their support. The ITAR

restrictions are something we have to tackle with the US. Those discussions with the US are going quite well at the moment. Obviously it is a new Administration and they are still settling in, and we may have our own issues to deal with here, but certainly those discussions are ongoing at the moment.

Q104 **Chair:** Is that around something like a technology safeguard agreement?

Rebecca Evernden: Yes, exactly.

Q105 **Chair:** How high on the agenda of the new Administration in the US is that, and is it a potential barrier to its being successful in the UK?

Rebecca Evernden: Initial discussions indicate that we are moving into the right place, and there has been no substantial change in the US Administration's position on this. The policy of the US is not to encourage widespread use of this technology, and they are quite careful about where agreements are made, but we have not noticed a substantial change in the position of the Administration.

Dr Crowther: There could be potential for the UK to come into the manufacturing chain to address some of the technology issues. It is clearly a threat, but there is also an opportunity.

Q106 **Chris Green:** In November 2016, the UK Space Agency was trialling a traffic light system to simplify satellite licensing, but there is no mention of that system in the draft Bill. Was the trial unsuccessful? Has it been abandoned?

Dr Crowther: I was the author of the traffic light system. The idea was to give more predictability, hence the traffic light label. I think it has worked. We trialled it on a number of systems. It is supposed to reduce the burden on operators and on the regulator. We have tried to reuse data wherever possible and streamline our processes, and that has borne fruit. We have also tried to be more responsive with the traffic light system. We are trying to characterise risks up front, so where they are well-bounded standard missions, we can do that relatively easily.

There is an issue though, because those technical analyses have raised some important policy questions around insurance. With low-risk CubeSat missions where we could consider waiving insurance, from a technical perspective there are policy issues we need to address. Currently, in the agency, colleagues are looking at those consequences, but we are confident that, hopefully within the next six months, we should be in a position fully to implement the traffic light system. It has been piloted already, but we need to reconcile some of the policy issues that have come out when doing the analysis.

Rebecca Evernden: Clearly, the traffic light system has been trialled in relation to procuring an overseas launch for operating space objects, but at the moment we do not envisage applying it to launch in the UK. We would not rule it out for the future, but when we are setting up the initial

licensing system, it will not necessarily be part of the launch from the UK system, at least not as we envisage it at the moment.

Dr Crowther: The reason is that currently we tend to authorise missions based on the supervision of other launching authorities, but in the case of UK launches we will be supervising rather than just authorising. The balance of activity and response to the analysis is much greater; so the degree of diligence and rigour will be much higher.

Q107 **Chris Green:** We understand that under the Government's plans a licence will be required for each mission and that you will not be using blanket licences for multiple missions. Is that correct?

Dr Crowther: We would always expect to issue a licence for every object launched, simply because when you have, say, 200 satellites, and one fails and is withdrawn from the constellation, you need a way of managing the licensing issues around it. It may well be that we would license a number of satellites against one fee. Rather than require a fee against each licence, in future when we have stable technical solutions to satellites to launches, we could consider in advance that a fleet of well-founded risks, as long as they stay within those margins, could operate under a particular licence, but that is some way ahead.

Rebecca Evernden: That is a very good example of why we are trying not to be overly prescriptive in primary legislation as to exactly how these types of processes would work. As Richard illustrated, the technology will change. This is an emerging market. We are doing this for the first time in the UK. We may want to be able to change and amend the way we do licensing as things become more routine in the UK further down the track.

Tim Johnson: We would endorse that. In the early stages, we imagine quite narrowly drawn licences, but as the track record of the industry to safely manage and deliver launch and space flight develops, we could imagine situations where licences become broader in nature.

Jeremy Stubbs: I fully agree with that. For instance, as sub-orbital spaceplanes become more of an aircraft-type operation, eventually we would want to go with a licence that allows them to operate in many different ways, but we need to get confidence in the industry before we get to that stage.

Q108 **Chris Green:** We heard from the previous panel about future-proofing, and the space industry perhaps being broadly in a very international global context. The Bill states that licences must be consistent with our "international obligations." Is there a risk that licence terms may change once we leave the EU, or is the Bill future-proofed against that?

Dr Crowther: I can answer that from a space orbital perspective. We do not own space. We cannot unilaterally decide what we are going to do; we share it with other nations; so the airspace treaties dictate what we can and cannot do. They are very stable; they have not changed for at

least 25 years and we do not expect them to, but what we see emerging are a number of guidelines for the implementation of new technologies that come along against the framework of treaty and convention obligations. I think it will be relatively stable for us in orbit. As far as the EU is concerned, the CAA may have a view.

Tim Johnson: At the moment, we anticipate that these aircraft and missions will be classified under annex II of the European Aviation Safety Agency basic regulations. That means the regulatory regime will be delegated to the national authority—the UK Government and regulatory agencies—as part of that. As of today, from a European aviation safety perspective, we do not anticipate that that will lead to any significant changes as regards international obligations.

Q109 **Chris Green:** We have had evidence that the definition in the Bill of an operator and who would require an operator licence is confusing. Can you confirm who would need an operator licence?

Rebecca Evernden: Sure. An operator licence would be required by anyone carrying out a spaceflight activity, and that would include both the orbital activity and the sub-orbital activity. The Bill also requires spaceports and a range of control operators to have a licence, but in terms of launch operators there is a catch-all category that includes both orbital and sub-orbital activities.

Q110 **Chair:** You mentioned the traffic light system and said there were some policy issues that need to be worked out. Could you expand on what those policy issues are?

Dr Crowther: It is to deal with situations where we could potentially waive third-party liability requirements. It is just trying to reconcile within Government that that is possible, that we are allowed to do it, and that safeguards are in place.

Q111 **Victoria Borwick:** That is a very neat segue to the next thing. I want to ask the same questions as earlier. I know you were here for the earlier panel on the topic of insurance and indemnities. We would like to make sure we have got this absolutely clear. The Deregulation Act 2015 capped operator liability to indemnify the Government at €60 million, as you are aware. Is that limit now being scrapped? What more information would you like to give us on that?

Rebecca Evernden: The €60 million limit you refer to was an amendment to the Outer Space Act. It was a limit to indemnify the Government for missions launching overseas. What we are talking about in terms of indemnity is under the Spaceflight Bill. We are proposing that initially there will not be a cap on operator liability, but there is a power in the Bill for the Government to introduce a cap if they think it is necessary, perhaps because of issues around market operation.

Q112 **Victoria Borwick:** As we discussed previously.

Rebecca Evernden: Yes. The important point is that other major launching nations, for example the US and France, have a cap for operator liability. It is standard international practice. We need to take that into account. The reason it is included as a possibility, rather than a decision that has been taken at this stage, is the need to understand how the market is going to work in the UK.

Q113 **Victoria Borwick:** Obviously we want to be attractive in that sense.

Rebecca Evernden: Exactly right.

Q114 **Victoria Borwick:** Clause 30 of the Bill focuses on making it easier to sue for harm caused by spaceflight activities. I believe it includes damage to people and property on land and water, but not to other aircraft in the air. Why not also provide UK nationals with a straightforward cause of action for damage in the air? Could you clarify that for us?

Tim Johnson: The Civilian Aviation Act 1982 gives direct responsibility to the carrier to provide passengers on planes who suffer loss with compensation in line with international treaties. We are satisfied that, should a third party be impacted, there is a route for dealing with them. It would then be for the airline operator, if it had cause, to pursue the spaceflight operator for damages in that particular circumstance.

Q115 **Victoria Borwick:** You will be leaving it to the aeroplane that has the accident to pursue that.

Tim Johnson: That is the situation under the current legal construct.

Q116 **Victoria Borwick:** Are spaceflight operators relieved by that decision, or is it additionally onerous on the aviation industry?

Tim Johnson: It leaves them in a position where the spaceflight operator could potentially still be taken to court in certain circumstances by an airline operator, so it does not relieve them of that responsibility. We are aware, particularly in view of the evidence the Committee has received, that this issue has been raised; so, as part of the process we will go away and reflect on that.

Q117 **Victoria Borwick:** Yes, I can see that that is fine for the spaceflight industry but it may not be fine for planes.

Tim Johnson: In managing that risk, the principle of range is very important. Where we anticipate both sub-orbital and orbital flights, we will create a range—a bubble of airspace into which other aircraft will not be allowed for a period of time while the spaceflight is occurring. The principal way of managing that risk is to create segregated airspace between space operations and normal commercial, military or other general aviation uses of airspace.

Q118 **Victoria Borwick:** You will be reprogramming NATS to deal with spaceflights, orbits and satellites as well as planes.

Tim Johnson: We do not anticipate that NATS will provide air traffic control for spaceflights, but we have a well-tried and tested system, particularly for the military, of creating danger areas that provide a piece of segregated airspace that NATS can switch on and off relatively quickly, depending on the demands on that particular piece of airspace.

Q119 **Victoria Borwick:** Presumably, all those arrangements can be taken forward as things progress.

Tim Johnson: Absolutely.

Q120 **Victoria Borwick:** To go back to our insurance point, clause 31 gives the Government an option to indemnify anyone suffering loss if it is more than any limit on a licensee's liability—again a question we talked about with the earlier panel. Why is that not mandatory? Doesn't it risk leaving the public without full compensation for an incident?

Rebecca Evernden: One of the important things we have made sure we do in this Bill is provide for third-party liability insurance, to make sure that there is a clearer course to compensation for anybody who might be affected by loss or damage through whatever incident may be relevant. I think the reason we said "may" at this stage is that we are still considering the issue. We are working with the insurance community to understand exactly what the implications are. When we have received further advice from the insurance community and from industry, we will consider the wording further, but we have taken note of your comments and those of industry on this, and we will consider it further.

Q121 **Matt Warman:** I am sorry I was not here for the beginning of the session. We have heard that terms like "spaceflight activities" and "spacecraft" could be ambiguous, and they are not widely understood, industry standard terms. Why do you think those terms were chosen in the Bill? Was there a discussion with industry first?

Rebecca Evernden: In choosing those definitions, we tried to strike a balance between making them broad enough to ensure that various activities, both now and in the future, can be captured, and making sure that we are as consistent as possible with the various international treaties in existence. There are a number of different parts of the space sector that use those terms in different ways. We have tried to make sure that we are consistent internationally, particularly as this is clearly a global marketplace, and we need to make sure that anybody entering it understands what is in the international treaties.

In the definitions, we have tried to make clear the activities that are applicable to the regulator regulating the activity. While the overarching term "spaceflight" will capture both sub-orbital and orbital, we have tried to make sure that the specific terms refer to what the Space Agency is regulating and what the CAA is regulating. We have taken on board the comments from industry and others, and in the guidance notes we will make sure that we provide a full explanation of what those terms mean.

Q122 **Matt Warman:** Will they seek to provide a definition as well as an explanation?

Rebecca Evernden: Indeed. Yes.

Q123 **Matt Warman:** The CAA has said that by designating spaceplanes as experimental they can be regulated nationally rather than in accordance with EASA guidelines. Do we have anything in writing to say that EASA is happy with that?

Jeremy Stubbs: The answer is no. There is no agreed international definition of what constitutes a sub-orbital spaceplane. Some countries may think they are aircraft; some may think they are rockets, and regulate on that basis. ICAO is in two minds; it says, "If they exhibit some characteristics of aircraft and some characteristics of rockets."

In discussions with DG MOVE at the EU and with EASA, we came to a verbal agreement that, as Europe was not currently in a position to regulate this very new industry, using annex II to the basic regulation method of allowing national authorities to regulate would be the best way while this is a new and emerging industry. It says that it is experimental or used for scientific purposes, and for craft made in very small numbers. We talked some time ago with industry about their opinion of the use of this methodology. As in the previous session, once they understood the reasoning behind it, they were very comfortable with the use of the word "experimental."

Q124 **Matt Warman:** Do you still think that none the less it will be okay not to have anything written down between EASA and the CAA?

Jeremy Stubbs: As it stands, yes. I think the verbal agreement worked. That is fair for the future, although we note the comment and the question.

Q125 **Matt Warman:** Isn't the problem that we find out it doesn't work when we find out it doesn't work, rather than stopping it not working?

Jeremy Stubbs: Yes. We take note of that question and will come back to you.

Q126 **Matt Warman:** There is a suggestion in your 2014 report that spaceplanes will need an EASA-type certificate even for very limited commercial operations. Does that mean that experimental will be an appropriate label for commercial operations as well, or will it need a certificate?

Jeremy Stubbs: That is a very good question. It depends on what you class as commercial operations. If we are talking about the type of spaceplane operation that gets airborne from one location and lands at the same location and it is a spaceflight experience, it is not really what we would class as public transport and we are comfortable with the current plans for that. If you are talking about carrying passengers or cargo from one place to another—the traditional form of public

transport—a much more rigorous type of certificate or examination of the vehicles used will be required. I believe it is EASA's and probably our intention that we look to the future—it will be some time in the future—to have some form of certificate issued, but that is considerably far into the future.

Q127 **Matt Warman:** You are saying that at the moment essentially the difference would be between a pleasure trip, in the manner of the London Eye, that starts and finishes in the same place, and whether it goes from one place to another.

Jeremy Stubbs: That is correct.

Q128 **Matt Warman:** Obviously, we would need to provide the public with some reassurance that there are the same standards of safety, regardless of where you take off and land. Certification is obviously important but it is not the only issue.

Jeremy Stubbs: That is correct.

Tim Johnson: At the moment, we recognise that spaceflight is an inherently risky activity, given the point we are starting from. Therefore, the regime created by the Bill focuses on protected and involved third parties, and some steps where we are putting the onus on operators to have a safety management system to satisfy themselves that the aircraft is safe and fit for purpose. The Bill also says that participants—passengers on space experience flights—will sign an acknowledged consent form to say that they understand that it is a risky activity. That is a completely different set of circumstances. You are alluding to a situation where spaceflight becomes a public transport system, and we are some way from where we would feel comfortable issuing the equivalent of a certificate of airworthiness.

Q129 **Matt Warman:** That was going to be my final question. Is there progress towards the idea of a slightly more routine certificate of airworthiness? You are shaking your head. Presumably, we will have to get to that point, but it is a long way away at the moment.

Jeremy Stubbs: It is quite a way away at the moment. Currently, there is very little activity. There is perhaps one operator working towards that. For instance, in the US there is currently no intention to move towards it. They are prohibited by Congress from doing so until at least 2023. However, that does not stop us and other like-minded nations looking at what is the art of the possible for the future, but we need to work very closely with industry to make sure that any requirements are correct, so that it does not stifle industry, which is key.

Q130 **Matt Warman:** Given that the US will not be doing it before 2023, is that a cap on when we could realistically start to think about it, or is there almost a commercial incentive to try to get in beforehand?

Jeremy Stubbs: I do not think it is a commercial incentive to get in beforehand. If you want my honest opinion, I do not think the industry is ready. It will take some time. We will need a lot of operations to gain safety performance data to bring together the codes we could use for such vehicles in the future. It is some time away.

Q131 **Matt Warman:** We will not hold you to it, but would you care to have a guess at how long some time is?

Jeremy Stubbs: You probably have to ask industry that question.

Q132 **Chair:** From what you say, it sounds as if it will happen; it is just a question of timing. To come back to more immediate issues, I want to examine some of the individual clauses in the Bill. There are some quite wide-ranging powers. Clause 63 gives the Secretary of State a very wide and general power to make regulation in relation to space activities including "associated activities," whatever that might mean. Clause 51 gives a power to make new offences. Why do you think there are those quite broad clauses? Why does the Bill give such wide-ranging powers? Is it because the Government may have missed things in the Bill that they are not aware of, so they are creating a catch-all clause for any future developments?

Rebecca Evernden: The primary reason is that the sector is changing so fast. Technologies continue to evolve and it is likely that we will have to amend regulations at various points in order to reflect those changes; so we are trying to build in flexibility to be able to do that without too much delay, to respond to what is happening in the market. That is the primary reason for having the catch-all power in clause 63.

Q133 **Chair:** Is clause 51—to make new offences—the same sort of thing?

Rebecca Evernden: Again, some of this is dependent on the spaceport that is developed and the nature of the technology that comes to the UK—until we can see what partnerships are on the table between spaceports and operators, and be a bit more specific about some areas, such as offences and environmental requirements. We need to be able to see what we are presented with in terms of infrastructure on the ground.

Q134 **Chair:** Obviously, this is an area that is developing rapidly and it is difficult to know where it will all end. Scrutiny is an important part of any regulatory framework and any new Bill. For example, clause 20 gives unlimited power to make potentially intrusive security regulations with only light parliamentary scrutiny. Do you not think that should perhaps be switched around and that it needs an affirmative parliamentary scrutiny procedure?

Rebecca Evernden: In light of the Committee's comments—I believe we are to receive a memo from the Delegated Powers Committee on this point—we will obviously look at the recommendations around which areas should receive affirmative and negative resolution as we work through

that. We are very happy to take on board your comments and consider them.

Q135 **Chair:** Clause 29 lets the Secretary of State authorise forced entry into property in urgent cases. Why is that? On what grounds do you think that would be necessary?

Rebecca Evernden: I think the primary reason is in cases of urgency where there may be a requirement to see what is happening. As we have referred to all along, clearly this is an inherently risky technology. There are potentially hazardous materials involved, and sensitive technologies; so we are building a framework to allow ourselves, in the interests of national security, if required, the ability to take the necessary action. I turn to my colleagues from the CAA, but I believe that we have tried to mirror what is required in aviation legislation to provide security around spaceports.

Q136 **Chair:** Are you saying that clause 29 is similar to something that would exist in the civil aviation field? The Secretary of State has power to force entry in urgent cases without court scrutiny.

Tim Johnson: I will need to give you a note on that.

Chair: I don't know the answer.

Tim Johnson: I am not aware of a precise parallel, but we will give you a note on it.

Q137 **Chair:** Without setting hares running, can you give us a practical example of why you might need to do that and why there would not be time for court scrutiny when seeking a power to force entry?

Rebecca Evernden: I think it is in the interests of national security. There are very sensitive technologies and hazardous materials involved. The technologies we are using can be used for purposes other than space launch, and we want to make sure that we have the right powers to take the necessary action if there is a potential terrorist incident, or something of that nature, and gain the necessary entry to deal with it as quickly as possible.

Q138 **Chair:** There is a slight contradiction. If that is the case, why does the power remain in place for a month?

Rebecca Evernden: Sorry, could you repeat the question?

Chair: Accepting that there could be a very urgent and immediate need to gain access, and you don't have time for scrutiny, and there is an issue of national security or safety, why does the Bill allow the authorisation for forced urgent entry to exist for a month if there isn't time for any scrutiny?

Rebecca Evernden: We will have to go away and talk to our lawyers about that and provide you with a note, if that is okay.

Chair: That is fine, but perhaps you could do it very rapidly.

Rebecca Evernden: We will. We understand the urgency.

Q139 **Chair:** There is a cut-off looming fairly quickly and we want to get our work done. Thank you for that; it is most appreciated. My final question is for the CAA. Clause 33 provides immunity from liability. Do you believe that is needed?

Tim Johnson: The clause provides for immunity for all the regulatory activity, because this is inherently a new activity and there is not a track record in understanding how the industry performs and where the risks will be, which is very much in contrast to the experience we have in civil aviation. Recognising that, we think the provision is appropriate in these circumstances at this time. That may change as and when the industry becomes more mature and an integrated part of the UK transport and industrial landscape.

Q140 **Derek Thomas:** Every spaceplane that is launched from the UK will need to fly through UK airspace, which is already some of the busiest in the world. Commercial airliners can deviate from their planned route if required. Do you envisage that it will be the same for a launch vehicle? Can you envisage launch vehicles receiving some kind of air traffic control that may be different from what we have now?

Tim Johnson: It will depend on the type of launch vehicle. If it is a horizontally launched vehicle, we imagine that for the first phases of flight the craft will behave very much like a conventional civil aircraft and will be capable of being given air traffic control-like directions, although it will probably be by the range operator rather than the conventional air traffic control system. For rockets, the ability to control them once they have been lit, as it were, is much less clear, and they are much less capable of responding to events. That is why the concept of range—creating an appropriate bubble around the operations, wherever they take place—to provide a safety margin is appropriate. I spoke earlier about some of the well-established processes we have for all types of different aviation operations at the moment and being able to create that safety bubble.

Q141 **Derek Thomas:** I am going to come back to both those things in a minute, so I hope you won't have to repeat yourself. Does anyone else want to comment on my first question?

Jeremy Stubbs: Tim is absolutely right. Initially, certainly all operations will be in segregated airspace away from other conventional aircraft. It is only now that the United States, for instance, is beginning to look at how to bring spaceflight operations, be it sub-orbital or orbital, into the normal global air navigation structure and manage that overall operation. The enabler is how well you can track them and have certainty of where those vehicles are. It is early days yet, but it is getting better.

Dr Crowther: Vertical launch is a very small subset of horizontal launch. You have a static launch site, so clearly you are much more constrained as to what you can do.

Q142 **Derek Thomas:** Let me pick up on range. Tim, you said that the approach set out in the Bill is to establish a range. How feasible is it to establish new segregated airspace corridors in the UK given the pressure on airspace from commercial aviation?

Tim Johnson: It will be one of the key factors that influence the types of spaceports that are authorised. Spaceports with a coastal location and away from some of the busiest parts of UK airspace, particularly in the south-east, will be much more likely candidates. The key concept with segregated airspace is that we have tried and trusted procedures for establishing it on both a permanent and, where required, temporary basis, similar to some of our military ranges. We can switch the range on for a period of time, but, when it is not used, we can close it down and make it available to other airspace users to use in the way they want.

Much will depend on the nature and frequency of the operations, but certainly from a civil aviation perspective we have a duty under the Transport Act 2000 to discharge our duties in the interests of all airspace users. We cannot just give priority to one. We have to take into account the interests of everybody. In discharging the obligations and processes we have in place, obviously we will look to understand where some of these trade-offs and tensions might be and create a process for resolving those and maintaining safety at all times, which remains the overarching priority.

Q143 **Derek Thomas:** I am a Cornish MP. Newquay is certainly in the process of bidding for a spaceport, but it is also a commercial link to London and elsewhere. If it is successful in achieving spaceport status, will that have a negative impact on the commercial side of our aviation in Cornwall? You might not want to answer that, but it is quite important.

Tim Johnson: It is hard to say without looking at the specifics of the type of horizontal operation, the frequency, the nature of the vehicle, how big the segregated airspace would be and, most importantly, the direction of the operation.

Q144 **Derek Thomas:** Presumably that is all being considered as you look at where spaceports might be located; that is all part of the consideration.

Tim Johnson: Yes, and it will be as much a consideration for the spaceports themselves. They will work through the implications for them if they do it. What will be the impact on their existing operations? How would they manage that? Is it possible? Where are the trade-offs? It will be as much about the commercial business case for the spaceport operators.

Q145 **Derek Thomas:** The Bill introduces licensed range controllers to define and establish ranges, but the Civil Aviation Authority will also have to

establish the segregated airspace. Why is that additional layer of complexity necessary? Why can't we just have operators or spaceport operators asking the CAA for ranges directly? Does that make sense? It seems that there is duplication.

Rebecca Evernden: The idea is that the licensed range controller would work with the CAA and others to establish the entire range for the flight. Some of that might be through the airspace that the CAA is responsible for and some of it might be beyond that—for example, if the vehicle is going into orbit. The range controller would make sure that all the preparations for launch are in place, and they would be responsible for tracking the object through launch, limiting the movement of any other parties within the segregated zone, to make sure that the limitations are in place and are understood, and putting safety measures in place. That is why we are licensing a range controller to have that overall co-ordinating role.

Q146 **Derek Thomas:** Who is ultimately responsible? Would it be the Civil Aviation Authority or the range controller? Can one overrule the other? How would that relationship work?

Rebecca Evernden: The range controller provides the co-ordination. That would not affect the CAA's responsibilities for managing the UK's airspace.

Tim Johnson: The range controller is concerned with airspace, land and sea, and there will be co-ordination with the Maritime and Coastguard Agency in that regard. For airspace, we will set the rules of the game and the framework for how the segregated airspace will operate. We will be part of the arrangements, assessing the range and the licensing arrangement, as well as looking at the specifics of the range for a particular launch facility, but it will be the responsibility of the range controller to discharge those responsibilities. We are very clear as a regulator that our role is not to have operational control of the range; our job is to set the rules and the framework by which it is managed by someone else.

Q147 **Derek Thomas:** Given that we have heard today that we want to be the world leader on this, are we not creating a level of bureaucracy that will hamper the commercial sector to grow and develop? I appreciate the need to manage airspace and keep everyone safe, but in this arrangement can you see a particular problem for the operators themselves?

Rebecca Evernden: It is quite usual for regulators to work together in areas of overlap or common interest. That is standard practice. The CAA works with other regulators as a matter of course. What we are trying to do is map to a very fine level of detail where all the responsibilities for individual functions will lie and which regulator and licensing body they will lie with so that we have a complete understanding of how that will work.

Q148 **Chair:** Obviously, there are a lot of unknowns in such an emerging sector. It is developing rapidly. How important are those unknowns at this stage? Are they important enough that it is too early to be putting in a regulatory framework because we do not know enough of the answers, or are these things that you will find the answers to only once you have put the framework in place, started to explore and allowed the sector to develop? Have we got the processes in the right order? Is this the right thing to be doing at the right time?

Dr Crowther: I think it is the latter. If you are too prescriptive in trying to anticipate technologies and techniques, you will rule out some of the new, exotic, innovative solutions that will come along and make it more difficult for them. I think we have the balance right. That is reinforced by our experience in implementing the outer space treaties and how we reflected that in the Outer Space Act. We are not very prescriptive and specific in our approach, and that gives us flexibility to accommodate lots of different missions.

Rebecca Evernden: It is a bit chicken and egg. If we have no regulatory framework we will not have a market; but, by definition, we do not have a market so it is hard to see exactly how the market will play out. We need to bring several factors into play to make this happen, one of which is the regulatory framework; another is the industry side of it—the commercial partnerships between spaceports and operators; and another is international agreement with the US and others to make sure that the technology can come to the UK. We are trying to balance all those areas to try to bring them together into a whole so that they come together at the right point.

Tim Johnson: There is an international space market already. In preparing this Bill and the policy and strategy that sit around it, we have been looking at international experience, in particular countries like America, which has the best developed market in the world. I do not think we started with a blank sheet of paper; we have been looking at what has been going on internationally and trying to learn some lessons from that to create an environment that will be internationally attractive to those willing to export to the UK as well as creating a market that will encourage UK industry to grow and develop.

Jeremy Stubbs: It has been quite interesting listening to the call for grant proposals from the UK Space Agency, as it looks to bring industry, operators and spaceports together. A whole variety of different types has come forward. It is quite comforting that our Bill, as it stands, would be adequate and good for managing all those different types, but we do not know what will come in the future. Something new could be around the corner. That is why flexibility is great and is really needed.

Rebecca Evernden: We know that other European countries are developing their own frameworks and putting their own incentives on the table. They would not be doing that if there was not a very clear market out there.

Q149 **Chair:** Are there any final comments you would like to make—you are the final panel to sit before this Committee—before we deliberate on what we have heard? This is your opportunity to get everything on the record.

Dr Crowther: I would reinforce the point about latitude and launch to polar orbits. A major unique selling point for the UK is its latitude. If we launch from London, we would put satellites directly into a 51-degree inclined orbit. The closer you are from the latitude of your launch site to your polar orbit, the better it is, because the greater the payload you can launch. That is a key USP for the UK.

Q150 **Victoria Borwick:** Why is that more important?

Dr Crowther: The higher the latitude, the closer you are to a polar orbit, so the launcher needs to use less energy to change the inclination of the orbital plane. Therefore, you can launch more mass into orbit—more satellites—so it is more cost-effective.

Tim Johnson: The only thing I would add from a CAA perspective is that clearly we support the development of the sector, and we have taken a leaf from the Government's industrial growth programme. We absolutely recognise that a regulatory regime is necessary for the industry to develop. From our perspective, the focus remains on safety, in particular the safety of uninvolved third parties and the public. Managing that in the best way is essential for public confidence that this is a good industry that well manages its risks. From a regulatory perspective that very much remains our focus, but done in a very proportionate way. We do not want a situation where we are over-regulating or over-constraining. There will be lots of debates about what that actually means, but that is our key priority and focus.

Chair: Thank you all very much indeed. It has been a very interesting inquiry for all of us. Whatever happens on 8 June, I very much hope that whoever is in Government picks up this Bill and runs with it as soon as possible. It sounds like there are huge opportunities for the UK, and this is something at which we could excel. Thank you very much for all the work you have done and for your attendance this morning.