



Select Committee on Science and Technology

Corrected oral evidence: Autonomous Vehicles

Tuesday 8 November 2016

10.40 am

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Members present: Earl of Selborne (The Chairman); Lord Borwick; Lord Cameron of Dillington; Lord Fox; Lord Hennessy of Nympsfield; Lord Hunt of Chesterton; Lord Mair; Lord Maxton; Baroness Morgan of Huyton; Baroness Neville-Jones; Lord Oxburgh; Viscount Ridley; Lord Vallance of Tummel; and Baroness Young of Old Scone.

Evidence Session No. 3

Heard in Public

Questions 20 - 30

Witnesses

[I](#): Claire Depré, Head of Sustainable and Intelligent Transport Unit, DG MOVE, European Commission; Dr Hermann Meyer, Chief Executive Officer, ERTICO - ITS Europe (Intelligent Transport Systems); and Mike Hawes, Chief Executive Officer, Society of Motor Manufacturers and Traders (SMMT).

USE OF THE TRANSCRIPT

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

Examination of witnesses

Claire Depré, Dr Hermann Meyer and Mike Hawes.

Q20 The Chairman: Good morning. Could I, on behalf of the Committee, welcome our witnesses today? We are most grateful to you for joining us. We are being broadcast, so I am going to ask you if you would like first formally to introduce yourselves for the record and, if you would like to make any opening statement as you do so, please feel free to do so. Shall we start with Clare Depré?

Claire Depré: Good morning. My name is Claire Depré. I work for the European Commission in the directorate-general which is in charge of mobility and transport, so the explanation I will be giving over the session today will be very focused on the benefits that we can see from these technologies, connectivity and automation, for the transport system.

The Chairman: And Dr Hermann Meyer?

Dr Hermann Meyer: Thank you, Chairman, ladies and gentlemen. I am very honoured to be here on behalf of the ERTICO-ITS Europe Partnership. My name is Hermann Meyer. The ITS Europe Partnership has a mission to bring all the stakeholders together that are important to developing intelligent transport systems in Europe. We focus mainly in our work on interoperability so that the driver, the customer, the traveller has a seamless experience of services in Europe and that there are economies of scale. We also deal with issues concerning a common European regulatory framework so that member states do not have very different political and regulatory frameworks but one common market. We also deal with the co-operation of the necessary stakeholders because, when you look at intelligent transport systems, it is about collecting data, exchanging data and bringing the services to the users, and they are quite complex value chains. We also create within our partnership business models so that the stakeholders can sufficiently, effectively and appropriately provide the services for the customers.

In the context of today's committee meeting, for us, most important is an understanding that connected and automated vehicles can provide their full potential only if they are also seen in the context of other trends which we currently observe, such as, for instance, mobility as a service, which we believe is very important and has to be seen also in this context, and, the electrification of vehicles.

The Chairman: Thank you very much. Mr Hawes?

Mike Hawes: Thank you, my Lord Chairman. I am Mike Hawes, chief executive of the Society of Motor Manufacturers and Traders. We represent the automotive industry in the UK, which is vehicle manufacturers and is also the supply chain and after-market, not just in terms of passenger cars but buses, trucks, taxis, coaches, trailers; the whole gamut. This is an issue which affects all of them to a greater or lesser extent immediately, but certainly we see the opportunities for the industry, and indeed the industry in the UK, as significant, so it is important that we work

with the Government and other stakeholders to grasp that opportunity for the benefit of all.

The Chairman: Thank you very much and thank you for your written evidence, which we read with great interest. There may be some specific questions to you on that which we want to come back to.

First, perhaps I could ask all three: we have the opportunity here to look at this at the European level. Perhaps you would explain how you think your own organisation contributes to the regulation and standardisation and how it can contribute effectively to the clear requirements. What is it that you can deliver which cannot be done at an individual member state level?

Claire Depré: If there is one topic where we should really avoid confrontation between what is happening at the national, local or European level, it is precisely this one. What we do in DG MOVE is try to foster co-operation, and I think the key word in this respect is “co-operation”. Why so? Because, of course, the area we are talking about is also about regulation, but regulation should be when we are able to register all together some shared vision that we will have been able to develop all together.

In my department, we have started working on a co-operative system, which are technologies that enable communication between vehicles and between vehicles and infrastructure where, for a long time, a lot of investment has taken place in the research area, but there was a problem of chicken and egg: who would start with the investment and what would be the benefit? Late in November 2014, we started working extremely hard to try and develop, together with the industry, with local authorities, with member states and between the different Commission departments, a shared vision on this co-operative system. The same is being developed now for automation with our colleagues from DG GROW who are in charge of the industry and the vehicle-type approval for automated vehicles.

What we hope to manage is, first, making sure that the introduction of these new technologies supports benefits for our transport system. We all know how many externalities we have in terms of daily congestion, the road safety aspects and pollution, the emissions, so we are trying to develop a shared vision on a conversion between these two different technologies, the co-operative system and automation, and making sure that, hopefully, in one decade, we do not see these elements as very different from each other, but that altogether they can bring benefit for our transport.

The Chairman: Dr Meyer, would you like to add anything?

Dr Hermann Meyer: First, vehicles and people cross borders and they expect to have a seamless experience in driving their vehicles and in travelling. With respect to automated vehicles, there are technical complexities, organisational complexities and regulations. Our aim is to achieve one market, which means that we establish interoperability of the technologies, which means, for instance, in the context of connectivity, that we have a situation where the technologies on board the vehicles

in Germany, Belgium and the UK are interoperable and can provide the same communication values.

Mike Hawes: From the UK perspective, we must appreciate that the UK automotive industry operates globally, but is totally integrated into a European automotive sector. The issues that arise from this shift to connected and autonomous vehicles are international. The issue of interoperability is valid and significant for a number of reasons, certainly in terms of functionality, as you want the vehicles to be able to operate, and in terms of the consumer and their level of expectation around mobility, that they can take their car and travel anywhere without much hindrance. That is something we need to assure for the future, and the role of the SMMT is to try to ensure that the UK interests would obviously be represented, but there is a national interest here. The role of the SMMT is in trying to promote the UK industry and see it grow. This is a massive opportunity for growth, which I am sure we will come to, and it is important that the UK has, within its gift of a national framework, the ability to see these technologies flourish for the benefit of transport, the industry, the consumer and society. One of the roles we try to play is in bringing together the parties that would be involved, but certainly we have to recognise, given the significant investment that is required to develop these technologies, that it is a European, if not an international, agenda and the UK must play its part in that.

The Chairman: If I could ask you specifically about your links with other parts of the world as well as Europe, it is clearly important in the markets in which you are selling, the rest of the world as well as Europe and, indeed, for people selling into this country, that we have sufficient connectivity with other areas. Are you persuaded that there is indeed the proper amount of liaison and collaboration between European countries and other manufacturers around the world?

Mike Hawes: I think there is because, as I said, the industry is international and American companies operate in Europe and European companies in America, for instance, and yes, there will be the development of national frameworks within those large markets, with the European market as one. Invariably, there are going to be some disrupters coming into this industry, and they may originate in the States, in China or in Japan, so it is certainly beholden on the industry to be cognisant of those developments internationally. Certainly, everyone is conscious of the need to try to make sure that they are alert to those developments because they may be opportunities for collaboration or they may be competitive issues, but certainly you need to be aware of them.

The challenge, I think, for the UK in particular is ensuring that we can facilitate the development of these technologies here in the UK, so it is not just contributing to a global development of them but to what extent we can grasp that opportunity for the UK. Every member state has an ambition to be a testbed for some of these technologies, so the UK would not be alone in that. We have certain advantages, which I am sure other witnesses have alluded to thus far, but again there are challenges and it is about bringing together the wider stakeholders to ensure that we grasp those challenges.

Q21 Lord Hunt of Chesterton: I wonder whether you would like to outline the key benefits of automated vehicles. In doing so, I wonder if you could just clarify, because it is still not clear to me, whether the automation involves vehicles, as it were, electronically talking to other vehicles—the radar, as it were? I am very concerned about being able to tell that a car is coming around a bend in a leafy lane in Devon, where my daughter had a crash, and would that not happen in the future? The other thing is pollution. Will pollution and safety generally be improved by these kinds of automation?

Mike Hawes: You have raised a number of issues. The benefits are myriad, certainly in terms of improving safety. The thing to remember with the development is that it is increasingly autonomous vehicles. It will not be that we go from what we have today and then, in five years' time, it is fully autonomous vehicles; this is a step-by-step development. In terms of the shape of the technology, you are seeing increasing safety measures and equipment put on to vehicles, such as autonomous emergency braking, Lane-Keeping Assist and so forth, which are not autonomous but the vehicle tends to be independent. What you will see is vehicles being connected to other vehicles and to infrastructure facilitating those safety aspects. We are already seeing some trials of platooning of HGVs. We firmly believe that HGVs may be one of the first elements of road transport that will take advantage of some of these technologies because, clearly, if you are a road haulage operator, you are very interested in what your pence per mile rate is. If you can have a benefit in fuel economy by platooning, which also has an environmental benefit, clearly that will come through as well. There are other aspects, such as safety, environment and congestion, to a certain extent, because you can maximise the capacity on the existing road network by having vehicles potentially travelling closer together. One thing we need to look at is that famous two-second rule as an appropriate distance between vehicles. If the vehicles are connected to one another, you can potentially move them closer and get greater capacity within an existing network.

Without a doubt, there are also social benefits to be achieved by much safer vehicles and, potentially, an industrial benefit. We did some work with KPMG last year which put that benefit to the UK economy at £51 billion to GDP per annum. Only about £1 billion to £2 billion of that will naturally accrue to the automotive sector and the other £49 billion is up for grabs, given the potential monetisation of connected vehicles, data and issues such as that.

Lord Borwick: On the interface between fully autonomous vehicles and not the least bit autonomous, there seems to be confusion. Do you know of any simulations that have been done of integrating autonomous vehicles with normal vehicles, and do you think that the market will develop in the same way it has now, where the European market is dominated by the very large companies and the very small producers—the 1,000 to 10,000 vehicles a year—are a pretty small percentage of the total? Do you think that will change in the next 20 years as autonomous vehicles develop?

Dr Hermann Meyer: As an organisation, we have not done the simulation ourselves concerning the situation where you have autonomous vehicles and still

conventional vehicles or only highly automated vehicles. Such simulations exist and it looks like it is possible to have this mixed situation. Nevertheless, for automation, this poses some challenges, more challenges than when you have only automated vehicles. First, we will need the different steps towards fully automated vehicles and, with fully automated vehicles, you will have a game changer, the reason being that you can then bring into the game issues, such as mobility as a service. Because you have a situation where you do not have a driver anymore, with mobility as a service, you will be able to call your vehicle, the vehicle comes and picks you up, there is no driver, and it brings you to your place. We will also then see that the differentiation between individual transport and public transport might even almost disappear. Then, I believe there may be new players coming into the market because we see very important developments from the vehicle industry side. We have in Europe, and you have in the UK, very strong companies which will prepare for this new era of automated vehicles. They have all the technologies necessary and they are further strengthening to develop these technologies, and they are companies which come from the data side, so more from the service-oriented side. What we will see is the two sides merging, and I believe that new companies and new opportunities will come up, so we cannot see the automated vehicle in isolation and we have to see it in a broader context.

Claire Depré: If we are looking at the trends in usage of cars today, these have nothing to do with what at least my parents were experiencing. In terms of market developments, I would be happy to have a crystal ball to know. I think we are all in the same situation where we see that transport is getting completely transformed on an evolutionary path—not a revolution—but at the same time let us not forget that cities, which face congestion today and have problems with emissions, will still look at these new technologies for what they can bring to their own agenda. It means that, if you replace a dirty and unintelligent car with a clean, smarter car, it is still one car. There are a lot of promises that this new technology brings, which need also to be seen in relation to flanking measures where we will be able to continue managing traffic, organise how we want to provide mobility for the end user and how we manage flows of people and goods.

I come back to my first statement: co-operation. If we leave the industry alone, it will probably make the most beautiful product, but it needs to fit into one reality, and the more we are able to discuss, understand and see what the expectations are from both sides, the better we are able to provide something useful in the end in real life.

Mike Hawes: The idea of this mix between fully autonomous and non-autonomous will be there for many years. There is still, as I am pleased to reaffirm, a huge swathe of the population who like driving. Now, that may change in a number of years, but you also have a lot of companies, and the UK has more than most—McLaren, Aston Martin, Morgan, Bentley, Rolls-Royce—whose cars you buy to drive. The idea of an autonomous McLaren might be entertaining as a passenger, but you are not seeing its full functionality, so I think there will always be that degree of mix. Certainly, I think the industry is acutely conscious that there is that potential for disrupters, and the lessons from other industrial sectors are salutary about any

industry that ignores the potential for disrupters coming in and completely changing the game.

Lord Borwick: With that mixed economy, which one should be immediately identifiable, the autonomous vehicle or the non-autonomous vehicle? At the moment, an autonomous vehicle has a lot of things on the top with cameras, but they may well be hidden, rather more like a Tesla is.

Mike Hawes: I do not think we should be seeing them as two distinct sets because there is this evolution and, even with a high-performance sports car, the introduction of more connected technology will add additional safety features and they will be embraced as rapidly in that sort of company as they will in a mainstream volume manufacturer. There are still undoubted social and economic benefits that will accrue, but the challenge for the industry is to manage that shift, recognising that there will always be that mix on the road for many years.

Dr Hermann Meyer: Can I add to this because you are touching on a very important point? There are different approaches that can be taken. First, should you be able to spot already if there is a fully automated vehicle? Yes, it might be necessary because of the interaction between the people who are in the car and the pedestrian where maybe the pedestrian thinks it is a driver. There is today already an exchange: you look at each other and you think you understand each other. If now this is an automated vehicle, I think we need a new approach to this.

Secondly, in the context of mixed traffic, we have to think about the transition period and the strategy for the transition period. What is our road map? How do we introduce automated vehicles? Do we need, at the beginning maybe, a dedicated infrastructure? If we use a dedicated infrastructure, how do we organise it, because we might not want to increase the complexity of traffic? There are many political issues which have to be tackled in this context.

Q22 **Lord Oxburgh:** You emphasised the importance of viewing autonomous vehicles in the broader context. If one leaves the new technology for a moment, what are the implications of autonomous vehicles for road maintenance, for example, which is a very old technology? All parts of the world have holes in the roads and inadequacies of that sort which are not repaired in a timely way. What are the implications here?

Dr Hermann Meyer: First, there is a very positive one because, when we talk about automated vehicles, we talk in general also about connected automated vehicles. When you have a connected automated vehicle, the vehicle itself can spot on the road surface if there is a hole or anything which needs maintenance. In the future, when these connected automated vehicles are also linked to the road infrastructure operator, the road infrastructure operator can immediately be informed about the situation of the road surface and can intervene, so you also have these benefits. Also, when we talk about connected automated vehicles, I would put a lot of emphasis on the need also to link these vehicles with the traffic management centres because then you can improve traffic management as a whole, so there are benefits on both sides here—for the traffic management centre in organising the

traffic and for the individual vehicle because the vehicle can be routed in a more optimised way.

Lord Oxburgh: This is all very well for major routes. I have no idea what the actual number is, but maybe three-quarters of our roads are smaller and not part of this, and maintaining them is quite a challenge.

Dr Hermann Meyer: There is one challenge which also has to be taken into account: when you have automated vehicles, there are also some demands concerning the infrastructure, the lining, et cetera, so that you have a safe situation, and that then incurs some investment which is necessary, which can be especially challenging on some rural roads.

Lord Oxburgh: But there may be roads which autonomous vehicles cannot use.

Dr Hermann Meyer: At the beginning, in the introduction scenario, there will be situations where you have certain roads where you can have automation and certain roads where, at the beginning, it will not be possible.

Baroness Neville-Jones: I am prompted by the statements that you thought there would be a declining difference between public and private transport, which implies—tell me if I am wrong—that you envisage a marked reduction in private ownership of vehicles and that it will become a service where a company will supply you with a vehicle when you want to go from A to B. Is that the case and would the fact that you do not have to own a vehicle to have the convenience of transport be a driver of take-up?

Dr Hermann Meyer: Owning or not owning a vehicle, the people will decide and we do not know yet, but we are certainly moving towards a service-oriented society. When you look at the future of automated vehicles, there will be service providers who own these automated vehicles and then the people can take the service of using these automated vehicles. That might also have an impact on the situation concerning car ownership. I think we have to be realistic with respect to fully automated vehicles. There are different levels which are defined for the automation of vehicles and, when we talk about the last level of automation, level 5, where you do not have a steering wheel anymore, that is far in the future and then we might also have these possibilities concerning these services.

Claire Depré: We have been working quite a lot on these connectivity and co-operation aspects. In the next few weeks, The Commission will be issuing a European strategy for the deployment of these technologies. We are aiming, and not because the Commission is but because the whole community is, at seeing this technology deployed in 2019, which means that vehicle manufacturers are working on that baseline scenario, and I want to link it to the benefit of automation, where this connectivity element is essential. As humans, we are not relying on only one sensor, our eyes, but we have a mouth, ears, and that is the same for a car. If we have only sensors in an automated vehicle, but we are not able to hear what is happening beyond what the eyes can see, that is a perfect recipe for accidents.

To come back to collective transport versus individual transport, if we are not able to include public transport and have public transport benefit from these

technologies, again that is the perfect recipe for disaster. Of course, as I said at the beginning, we are working with local authorities and with the European Association of Public Transport. They need to make use of these technologies. This is how you make priority lanes more efficient in a way and it is how you make sure that you are providing mobility for elderly people. We all know that, when these technologies are introduced, they will be more expensive, so we need to think about getting the benefit for society as a whole.

Mike Hawes: I would add a quick supplementary to that where there is a UK benefit. If you look at London in particular, obviously you have Transport for London, a single authority which oversees the public transport. If you look at, in particular, the bus industry, public buses tend to be UK-developed and UK-built, so they certainly are alert to this. When you have the scale of a city such as London and the opportunity for UK companies—Alexander Dennis, Wrightbus, Optare, whoever—who build their buses in the UK, they will be working with the likes of Transport for London to take advantage of these technologies as they develop.

The Chairman: We are half way through the session and I am afraid we are by no means half way through all the questions we want to ask you. I will ask Lord Fox, Lord Hennessy and Lord Vallance to come in briefly, but then we must get on to Lord Ridley.

- Q23 **Lord Fox:** It seems to me that, if we were in 1903, from what you are describing, we would have to wait for the invention and the introduction of cats' eyes before we could implement any cars at all. In other words, you are trying to build the end infrastructure before these things come in. I understand the point about an open language, which obviously counts for other things as well. It seems to me that pushing the onus back on the manufacturers and saying, "Here is our definition of what is safe operation. You then deliver that safe operation", rather than, in a sense, trying to invent the infrastructure in advance of the population of that with vehicles, might be another way of looking at this regulatory challenge.

Claire Depré: When I look at this co-operative system, again I had a lot of questions in the beginning: is it thinking about regulating and equipping infrastructure every how many miles or kilometres? We have been doing work together and we are trying to progress together in trying to find a solution in terms of how we implement data protection and what the expectation will be in terms of how we can address security and how we enter into interoperability. There will be a lot of different elements. Of course, the driver experience is important.

Lord Fox: I think that is the point I am making. You are trying to second-guess every single possibility of everything before anything can happen.

Claire Depré: No, on the contrary. Indeed, as I mentioned, with the co-operative system, when I started three years ago, there was no light at the end of the tunnel. Eric Sampson has been working with us. We have dedicated a year of I do not know how many meetings to progress on the same path. The same should happen for automation. The point is, and on this I insist, that we need to be able to think about how we want this system to be deployed. If I make the comparison with the co-

operative system, we have tried to understand what kind of services we want out of these technologies. Of course, they can provide a lot of driver comfort, but is it the role of a public authority to look for driver comfort? My role is that we introduce this vehicle and I hope we can make our road safety figures better and our role is that we do not bring in more congestion and that we try to address it, so there is a lot of work in, first, understanding each other, believe me. We are using automation, but do we understand automation in the same way? With services, and I am talking about roadworks, if I talk to an Austrian colleague or a French colleague, the understanding is not the same, so a lot is about understanding the semantics in the first place and then trying to move together towards this shared vision and moving step by step, because it will not happen from one day to another.

Dr Hermann Meyer: What you are saying is, “Do you try to second-guess everything that could happen?” Yes, the industry does because the most important thing is safety, safety, safety when we have automated vehicles. Therefore, in Europe, in the US, in Japan, South Korea and China, there are test-beds. We need these test-beds and to test the systems in all different situations, and we are learning enormously because we have machine-learning capabilities—the vehicles themselves learn in these situations—and we want to ensure safety. Therefore, for instance, the connectivity is important because it gives you additional redundancy concerning the systems if the sensors do not work, but an automated vehicle at the beginning also has to be able to work properly without connectivity because we cannot rely on it, so we are second-guessing everything.

Lord Hennessy of Nympsfield: You referred twice to potential disrupters. What did you have in mind?

Mike Hawes: We would not have full sight of any potential disrupter, but we see other companies looking to develop autonomous vehicles—the likes of Google, Apple and so forth. There may be others that we are not aware of, but equally the industry recognises these challenges and develops the technologies. With the different offerings in mobility, safety, connectivity and autonomous, that whole suite of technological change, which is hugely complicated and, as a consequence, usually expensive, it means that you are seeing a lot of collaboration equally going on across manufacturers.

Q24 Lord Vallance of Tummel: Connectivity will depend in the end on the telecommunications infrastructure one way or another. We understand some of it, the satnav stuff is pretty obvious, but vehicle-to-vehicle and vehicle-to-infrastructure and so on is a different matter. You will need international standards on this to get it off the ground at all. Is there any agreement yet as to what kind of technology will be used, other than the satnav, who is driving it and how will the international standards be achieved?

Dr Hermann Meyer: There is tremendous work on this concerning vehicle-to-vehicle, vehicle-to-infrastructure and communications. There is already one technology, ITS-G5, which is very mature. There was work done in ETSI, CEN and ISO on this technology, which are foreseen to be used in Europe, the US and other

countries. There are also technologies with respect to cellular communication where e.g. LTE-V is now in the last stages of standardisation and they could provide the technology for vehicle-to-vehicle and vehicle-to-infrastructure communication, but some work still has to be done. Then, we are all looking forward to 5G, which is the next step concerning cellular communication. Currently, we have 4G and, with 5G, we will see the latency and the robustness of the communication further improve, security improve and, with the network slicing, we will see that there will also be new opportunities concerning the business models.

For the vehicle industry in the context of network neutrality, it is also important that we have different levels of quality of service. If there is communication in the context of a critical safety item, we need priority for it, so it is also important in the context of the debate on network neutrality that we take the quality of service and the different levels of the quality of service into consideration.

Q25 Viscount Ridley: I want to try to pin one of you down on the timescale of how long it will be before this comes in. I understand that it is evolutionary and not revolutionary, as Ms Depré said, and I understand that there are five different levels of automation. None the less, there will be milestones and I would like you to give me a date for one of these milestones. For example, when will Dr Meyer first step into a car that has no driver to take him on an ordinary road, maybe not on every road, to a destination? Is it 2019?

Claire Depré: 2019 for the co-operative system, which means information that is being provided to the driver, and always the driver, in front of the wheel.

Viscount Ridley: When will it first happen?

Dr Hermann Meyer: There are 120 partners who have different views on this topic, so I will give you my personal view. Highly automated driving already means a lot; it means already that, in certain situations, you do not have to care about your driving, so highly automated driving provides already a big step. Highly automated driving, I think, we will see between 2020 and 2025.

Viscount Ridley: In that period, I will be able to read my emails while on the motorway?

Dr Hermann Meyer: Yes. I cannot speak for all motorways and I do not know the UK motorways, but I am very optimistic that, on a motorway with a “highway chauffeur”, which it is called, you will see it between 2020 and 2025.

Mike Hawes: I would endorse that. For the fully automated, L5, it is looking more like 2030. That is the no steering wheel model.

The Chairman: That is level 5 you are talking about?

Mike Hawes: Yes.

Lord Hunt of Chesterton: German motorways have an autobahnkapelle, a church for road drivers.

Mike Hawes: Certainly, there are three or four major manufacturers which have said that they will be introducing the level 4 technologies in early 2021 and so forth.

These will be very limited numbers to start with, so there is that question. Yes, technically, those cars are available, but they are not necessarily in widespread use.

- Q26 Baroness Young of Old Scone:** This is a question that perhaps should have been raised in the previous one, but it is to Mr Hawes about the report that you commissioned from KPMG on the benefits, talking about the up to 320,000 new jobs being created in the UK. I was rather mystified by that and I could not find any of the background figuring out in the report. If we are talking about this as being an efficiency measure and a productivity measure, one would imagine that there must also be efficiencies and reductions in jobs as a result of automating many of these processes, so I was not quite sure how you could say that there was a net gain in jobs of that scale.

Mike Hawes: We need to distinguish between autonomous vehicles and connected vehicles. The growth opportunity is about the connectivity. I go back to that figure we said in terms of the potential benefits to GDP and the monetisation of that. The largest swathe of that benefit comes from the connected vehicle. The autonomous vehicle is about efficiency and productivity and there are potential benefits to that, but in terms of jobs, with any new technology, invariably there is a shift in the types of jobs and skills that are required. I know that SECAB have produced a report recently on the level of skills that are needed to facilitate this transition, and we have, as you might expect, a big skills gap in that area, but we see this development of the connected vehicle and all the data that it will generate, which is of huge interest to other sectors of the economy, creating jobs in that regard rather than specifically in the automotive sector or the public transport sector.

Baroness Young of Old Scone: So your figures were of gross increases in sectors as a whole?

Mike Hawes: Correct.

Baroness Young of Old Scone: But they did not take account of any of the reductions as a result of the productivity factor?

Mike Hawes: I think to a degree. The question about productivity does not necessarily mean job cuts. Certainly, in terms of increasing productivity, it means you can increase your capacity and, as long as there is a market for whatever you are producing, you can see that develop. That is a much harder thing to forecast. Productivity, in essence, is a good thing because you can do things potentially more cheaply, but that can allow you to do other things with those resources.

Claire Depré: These are important elements because, of course, new opportunities for new jobs mean also, in some cases, the reduction of jobs, so that dialogue with the social partner is crucial also. The truck-driving sector and taxis will be impacted. We should not stop changes, but we should be able to start discussing and understanding how this will indeed impact those sectors.

Lord Cameron of Dillington: I was going to ask you about the appropriate level of the regulatory regime, but, to a large extent, you have answered that previously, so perhaps I could add to my supplementary. At what stage of the development of

these vehicles do you consider that you will need to bring in a regulatory regime either nationally or internationally, because I suspect it will lead from one to the other? Also, in terms of developing a regulatory regime, to what extent are you building up partnerships among each other, nation to nation, legislature to legislature, government to motor manufacturers and, most importantly, bringing in the insurance industry, because I suspect that not so much the development of the programme but certainly the utilisation of automated vehicles will depend upon how the insurance industry approaches the whole issue?

Dr Hermann Meyer: The insurance industry is included within our partnership so they are already part of the debate, and that is related to a situation where in the future an automated vehicle causes an accident because of some mistake, and we certainly have to see how this will be dealt with in the context of the insurance industry. There is legislation in place, the motor insurance directive, and I think that is sufficient. If you ask me about the main challenges on the regulatory front—one issue concerns the homologation of vehicles. At the moment you cannot homologate—type-approve, an automated vehicle.

Lord Hunt of Chesterton: Can you repeat that?

Dr Hermann Meyer: You cannot type-approve, certify, an automated vehicle. The reason is the Vienna Convention and the Geneva Convention, which say there must be a driver in full control of a vehicle. Maybe you can interpret driving a vehicle as in a piloted vehicle, but that is not clear at the moment; the understanding at the moment is that you cannot type-approve an automated vehicle in Europe.

The second major challenge is cyber security, so that in the future systems with this connectivity cannot be hacked. There is a lot of work going on in the context of the different technologies, and we believe this can be dealt with, but that will be an ongoing challenge because it is not that you fix it once and you have fixed it for ever; you have to work on it continuously.

Q27 Lord Vallance of Tummel: On the insurance point, it is conceivable that there are accidents due to failures in the communications network. Have the insurance companies taken that on yet?

Mike Hawes: Here is where we see the real benefit of connected vehicles. Over 90% of accidents at the moment are generally due to human error, and you are absolutely right that the insurance industry is certainly looking at future models, as indeed potentially are the Government. They are consulting at the moment about what insurance should apply to the vehicle, whether to move from driver insurance to a product liability model. Certainly that will account for the instance that you describe. This goes back to the earlier question. These are some of the issues that need to be discussed, and that is why you need all the stakeholders contributing to the development so that you have where you need it a regulatory framework, but where you do not need it, you have the ability to let the technology flourish.

Lord Vallance of Tummel: I am not sure it deals with the issue I am talking about. If there is a telecommunications infrastructure, say, up and down the motorway networks which somebody is running who is neither a manufacturer nor a driver,

and there is a failure in that, presumably whoever is running the communications network has some liability.

Mike Hawes: Yes. That compounds the need for all parties to talk.

Q28 Baroness Neville-Jones: My question follows rather closely on this last exchange, concerning liability when there has been an accident, say. In the EU, at any rate, although we have product liability, we do not have an agreed regime on this kind of liability. What is your view about the state of the law, and how would you go about getting a degree of certainty about who is legally liable in a vehicle that is thinking for itself when there is an accident of some kind, a Tesla type?

Dr Hermann Meyer: First, I think we have a product liability directive and at the moment we are content with it.

Baroness Neville-Jones: Yes, but this is not the situation I am talking about.

Dr Hermann Meyer: The situation is if you are in an automated vehicle and the vehicle makes a mistake, the liability is certainly with the product itself. What you have to know in this context is if at the moment the mistake was made the vehicle was in automated driving mode or if the driver was in control; that you have to know, and the driver has to know if he is in control, because there can also be a situation where the vehicle thinks the driver is over-steering but the driver himself has not noticed this. There can be very complex situations. It has to be clear who was in control at the moment when something went wrong. That is the first part. The second part is that you need some data to prove it. That is an area where some work has to be done so that we have a clear situation concerning liability, but if the vehicle itself has made the mistake, it falls certainly under product liability.

Mike Hawes: Which underscores the need for event recorders in cars.

Lord Hunt of Chesterton: The black box.

Baroness Neville-Jones: Do you think it will be necessary to have some legislation on this subject or is this something that will have to be tested through the courts?

Mike Hawes: You are going to hate me for this answer; I suspect the answer lies somewhere between the two. The Government will obviously set the appropriate regulatory framework but, again, they want to do so such that the technology will flourish, but the limits of that level of responsibility are invariably tested through the courts.

Lord Hunt of Chesterton: To what extent will this black box and other devices mean that cars will all have Big Brother looking after them? For example, in the United States you are driving along and the car in front of you probably has a gun behind the driver. If you have been to Colorado or Arizona, the places I have been to, that is quite the norm. You want to know the contents of people's vehicles. We are now in a very complex security situation in Europe. It seems to me that this may be an advantage, in fact, that in order to have autonomous vehicles, they must be part of a global or a national security system, and therefore obviously police computers will be there monitoring what is going on. Once we start down that road, it has to be

done thoroughly.

Mike Hawes: It is a very important point that you raise, and this comes down to society's attitude towards privacy and so forth, and different societies will be in a different position on data privacy. Clearly, such technology presents an advantage to society, and you need to ensure that the consumer is in control of a large part of the data that will be generated from vehicles. You clearly have to have some sort of protocol or agreement that in the event of an accident that data is available for the responsible authorities to be able to interrogate, and potentially only in the event of those extreme circumstances.

Claire Depré: We need to be firm on this. There is now a strong framework in place in Europe for data protection, and it has to be respected in this field too. I come back to the co-operative system element; we are looking at the conditions under which a broadcast could happen. Should we ask not the owner of the vehicle but the driver each and every time if he wants to broadcast the data, and for what purpose? Is the situation different when it comes to road safety-related services, whether safety is at stake or not? We have talked about event data recorders. That of course does not mean that this general data protection regulation should not be applied. It is true that we are at an early stage in understanding how the two things need to co-exist so that we are not taking rights away from people but allowing them to benefit from technological development.

Dr Hermann Meyer: To qualify this a bit, with an event-data recorder, you would not get into a situation where you have the data for the whole trip. It is only when you have an accident that you have access to what happened in maybe the two or three minutes leading up to the accident. The other data will always be deleted, so there are already precautions taken so Big Brother is not watching you. We also have to look at where the data is stored, whether it is stored in the Cloud or in the vehicle itself in a black box. There are different possibilities on how to organise it but it is clear that the data event recorder only stores the data very close to the accident itself.

Claire Depré: We could make the analogy with the eCall system, the emergency call system.

Lord Hunt of Chesterton: Is it eCall?

Claire Depré: Yes, which will be in vehicles as of March 2018. It is the same system. You only record what you need and it is limited to the time of the accident.

The Chairman: I am sorry. We have to curtail that one because I have three further contributions to try to fit in in five minutes.

- Q29 **Lord Mair:** Public confidence is crucial here, and of course, confidence in the technology is equally crucial. Can I ask you a bit more about testbeds and large-scale testing? Dr Meyer, you mentioned the crucial role of testbeds in regard to safety. Mr Hawes, in your evidence you talked about the need for comprehensive testbeds in the UK certainly, but can I get your views on what more is needed? What do you mean by comprehensive testbeds?

Dr Hermann Meyer: We are currently working together with the European Commission to develop a European testbed. We are currently looking at existing or upcoming testbeds in Europe, and we see that a lot of testbeds already exist and new ones are coming up. You are very strong on this in the UK. They are on motorways and in cities. We would like to create a situation where these testbeds co-operate with each other in the context of the use cases which they deliver and implement, and in the context of the technologies and organisational frameworks which they implement. We would like to avoid fragmentation and silos. Most important for the future of automation are economies of scale; we have to move in the same direction, and that we can do with a European testbed.

Claire Depré: This has already started with the c-roads platform, whereby 13 European countries are already sharing experience, allowing interoperability, doing the tests cross-border. The European Commission has put on the table quite a significant budget to allow for the conversion between this co-operative system and automation with the precise aim of doing the same for automation, so as to be able to understand quicker, avoiding duplication all over Europe without talking, without understanding, without being able to allow interoperability from day one.

Q30 **Baroness Young of Old Scone:** My question is the reverse of that. Mr Hawes, do you think the UK Government are doing enough to develop a vision that allows the United Kingdom to benefit and develop a leadership role in this area?

Mike Hawes: Yes, I think it is. It could always do more but if you look internationally, the framework that we have in place is facilitating the UK as a testbed, and that is part of that journey. We have tests in Greenwich and Milton Keynes. Volvo have announced that they will be testing autonomous vehicles in London next year. That shows that international companies have been looking at the UK as a potential test-bed. There is a framework in place where essentially all you need is the insurance. Going back to what Dr Meyer said earlier, because of a quirk of history, the UK never signed up to the Vienna Convention—I am never quite sure why. It was the late Sixties, early Seventies or something—and as a consequence some of those barriers are not there. The real challenges are making sure that the Government develop a strategy which brings all the sectors together: government, automotive, tech companies, telecoms companies. We talked about the importance of infrastructure; it is hard infrastructure on the roads, the virtual infrastructure of 5G, and so forth, and the coverage around the UK, because, as we said before, it is all very well testing the vehicles on the motorway—nice line, straight roads, everyone is going in the same direction, traffic is segregated—but as soon as you hit the off ramp, the level of complexity increases enormously, and that is where we can do nothing but further testing.

The Chairman: We have run out of time. Lord Oxburgh has kindly indicated to me that he does not wish to pursue his question. I have to say to our three witnesses that we are enormously grateful to them for having joined us today, and I know you have travelled quite a bit to get here. So to Claire Depré, Dr Hermann Meyer and Mike Hawes, very many thanks for your help today. Thank you very much.