HOUSE OF COMMONS

Transport Committee

Oral evidence: Motoring of the future, HC 429

Monday 24 November 2014

Ordered by the House of Commons to be published on 24 November 2014

Written evidence from witnesses:

- Thatcham Research
- Engineering the Future
- TRL Ltd
- Professor Oliver Carsten

Listen to the meeting

Members present: Mrs Louise Ellman (Chair); Karen Lumley; Karl McCartney; Mr Adrian Sanders; Chloe Smith; Graham Stringer; Martin Vickers.

Questions 159-240

Witnesses: **Professor Eric Sampson**, Visiting Professor, Newcastle University, **Andrew Miller**, Chief Technical Officer, Thatcham Research, and **Darren Capes**, Transport Systems Manager, City of York Council, **Richard Cuerden**, Technical Director for Vehicle Safety, Engineering and Assurance, Transport Research Laboratory, **Professor Oliver Carsten**, Professor of Transport Safety, University of Leeds, and **Professor Pete Thomas**, Professor of Road and Vehicle Safety, Loughborough University, gave evidence.

Examination of Witnesses

Witnesses: **Professor Eric Sampson**, Visiting Professor, Newcastle University, **Andrew Miller**, Chief Technical Officer, Thatcham Research, and **Darren Capes**, Transport Systems Manager, City of York Council.

Q159 **Chair:** Good afternoon and welcome to the Transport Select Committee. Could you give us your names and organisations, please, starting with Mr Capes?

Darren Capes: I am Darren Capes of City of York council representing Engineering the Future.

Andrew Miller: I am Andrew Miller, chief technical officer at Thatcham Research.

Professor Sampson: I am Eric Sampson, visiting professor at Newcastle university and representing the Intelligent Transport Society.

Q160 **Chair:** Will the introduction of new motoring technology inevitably make our roads safer for everybody who uses them? Who would like to start?

Andrew Miller: I could take a stab at that. I think it is an inevitability. Looking at the future, we are 10 to 15 years away from autonomous vehicles. A number of research projects are being started, and there is quite a lot of activity in the UK in that regard. It is to be expected that autonomised systems will reduce road accidents, on the basis that they are not driven by humans, because the vast majority of accidents are based on human error.

Q161 **Chair:** You think it is inevitable for all road users: car users, lorries, cyclists and pedestrians.

Andrew Miller: I understand the technologies could be cascaded across the entire fleet, from heavy goods vehicles to light commercial vehicles and passenger cars, so in that respect, yes. Other road user groups, such as pedestrians, and other types of transport—cycling and so on—do not fall under the same autonomised capability.

Q162 **Chair:** Does anyone disagree with that, or want to indicate where you think the greatest safety gains can be made?

Darren Capes: I think the greatest safety gains are for car drivers. The move from passive to active safety measures, which we are starting to see now with the move to technologies such as lane guidance and active cruise control—technologies that take the decision away from the driver—will make driving safer for car drivers, but that technology is equally applicable to the relationship between motorised vehicles and pedestrians and cyclists. In the same way as technology can be used to stop cars driving into each other, as part of radar enhancements to cruise control, it can also be used to find cyclists in blind spots and pick out moving pedestrians within a certain area at the front of a vehicle. There are real opportunities with those types of technology to make vehicles more aware of their surroundings and more aware of vulnerable road users within their vicinity.

Q163 **Chair:** Professor Sampson, what is your view? Is all of this inevitable?

Professor Sampson: I have been thinking about the "inevitable" word.

Q164 **Chair:** Would some developments be more effective than others?

Professor Sampson: Yes. I think there are two classes of technology. There is the connected vehicle technology which supplies eyes and ears to the driver and warns that, round the corner where you cannot see it, there is bad ice and a blockage of some sort.

That will inevitably come because automotive companies will provide it. It will be free at the top end and it will drift down.

There is then a big transition to the technology that overrides the driver when the driver does something stupid, cannot react quickly enough or is making the wrong manoeuvre. That technology will have to be mandated in law, and that raises all manner of interesting questions. Is this something the UK can do on its own? Currently, I would say, no; it needs to be done on a whole-European basis, because it is basically changing the technology of the vehicle.

I go halfway with inevitable. There will be significant improvements as drivers are alerted to bad conditions and told, "You're drifting out of the lane and you need to do something," or alerted to the fact they are doing 50 in a 30 limit, but the big gains from the potential safety—vehicle to vehicle collisions—have to be legislated for.

Q165 **Chair:** Do you have any ideas about timetabling? When would we expect to see significant changes?

Professor Sampson: I don't think many people know. The automotive companies are saying, "We will do this by", and I think the earliest figure is about five years away, or 2020. Other companies are saying it is longer than that. Nobody is really clear about the transition, because you are moving from an environment where the driver is monitoring what is going on, and is possibly giving some control to the vehicle, to an environment where the driver has given all control to the vehicle. I do not think there is enough evidence from the trials that have been done for any regulatory body to say it is comfortable with a seven or 11-year timetable, or whatever, for the transition. That is one of the good reasons the DFT driverless vehicles trial is taking place. DFT acknowledges that nobody really knows, so you need to find out.

Q166 **Chair:** What kind of work needs to be done to assess the impact of changes, or which changes they are? Do we need to distinguish more clearly between different types of technological development?

Darren Capes: We need a clearer set of trials. As Eric said, the autonomous vehicle trial is good, but there are lots of competing technologies that need to be trialled in the real world before we can pick what the best of breed is. Certainly, there are competing technologies and different ways in which this could develop. The key at this stage is to do more trials and participate as much as we can in European trials.

Q167 **Chair:** Mr Miller, has enough work been done on trials?

Andrew Miller: No, not yet.

Q168 **Chair:** Are people making assumptions?

Andrew Miller: We definitely need long-term trials on the capabilities of the technology. The Office of Science and Technology has developed a series of definitions for the move to fully autonomous vehicles, which include partially autonomous vehicles that can take some control in certain circumstances—for instance, long-distance driving or traffic queue following—as a starter in that shift. It is very important that we establish clear definitions, and that the DFT, for instance, sets those for us, so that we can make sure that we have the appropriate liability understanding for insurers—the potential for liability and the impact for them. We can trial each different capability to make sure that it is actually delivering the quantified benefit we understand. That then creates the space for potential regulation to realise those benefits as quickly as possible in the marketplace.

On your question about time scales, we estimate that it takes 10 to 15 years for any new technology to cascade right through the new car fleet, and a further 10 to 15 for that fleet to turn over. If we have a partially autonomised vehicle in, say, three to four years' time, it will be 10 to 15 years beyond that to get it into every new car, and another 10 to 15 to get it right across the fleet, unless regulation is brought in. You are talking 20 to 30 years unless there is regulatory imposition, in which case that will accelerate it.

Q169 **Chair:** When you say "partially autonomised", what exactly do you mean? What things would be done under that heading?

Andrew Miller: It might, for instance, be hands-off motorway driving, so the car is automatically accelerating and decelerating in traffic on the motorway, and also self-steering. The vehicle will give control back to the driver, or the driver will ask the vehicle to take back control. Those are partially autonomised capabilities which are just emerging in the new car space, with car makers considering launching them in the years to come.

Q170 **Karl McCartney:** You have talked a lot about motorway driving, but one of the real safety issues is interaction between cyclists and lorries—larger vehicles—on the road. Although lorries can have a radar-type machine on board that will help, is it not a two-way thing? Perhaps cycles need something. Do you think that would actually happen? It would probably put the price of a normal cycle well out of the range of most cyclists. You certainly would not see Boris bikes having equipment that would put the brakes on if a cyclist tried to go down the inside of a double-decker bus or a lorry. Or would you? Do you think that is a way forward?

Andrew Miller: Were you suggesting that the brakes should be applied on the bicycle?

Q171 **Karl McCartney:** There are different types of kit you can put on each vehicle, but if you want to go to full autonomy, are you going to take away control from a cyclist who decides to go down the inside of a lorry or bus as it sets off at traffic lights and turns left?

Andrew Miller: That is one of the biggest questions with an autonomised fleet and other road users. In the particular scenario you outline with large trucks, particularly in places like London, that is a serious issue. I think you need to look at giving capability to the

truck to detect the hazard and make sure either that automatically it will not cross the path of the cyclist or that the driver is warned not to.

Q172 **Karl McCartney:** What I am getting to is: is it not a two-way thing? You can give so much control and technology to the lorry driver, but if some cyclist is determined to go down the left of them as they are turning left—maybe they are in the process of turning left—how will you take away that human interaction?

Andrew Miller: That is very difficult to do.

Darren Capes: There are trials at the moment of transponders fitted to bikes that allow vehicles to know the bike is there, but it is then reliant on the vehicle to take avoiding action. I think that is about as far as it can go. To fit a transponder to a Boris bike that would announce its presence to a vehicle is cheap, and that technology is being trialled with bikes and bus companies at the moment.

Q173 **Karl McCartney:** You mentioned that human error is one of the biggest drivers. I am not saying that cyclists are to blame, but if you want to remove human error from those types of impact—we should not call them accidents these days—how are we going to do that with bicycles, because in certain cities there are a lot of them?

Andrew Miller: I would suggest that because a bicycle is a simple piece of engineering it is difficult to do that. It is fundamentally unstable, and causing automated braking on a bicycle might be quite difficult to do. Maybe we need to look at the road rules as well. We have mixed lane use at the moment. It is very difficult for a truck driver in London to see all the cyclists coming from both sides. Maybe we need to look again at the road rules, but that is not necessarily a matter for us.

Q174 **Karl McCartney:** I have one question on a different subject. Taking it as a generic subject, I personally am very happy about the fact that classic vehicles no longer have to have an MOT, although I think that at the first instance of a fatality on the road involving a classic car that has not been MOT-ed, whether it is roadworthy or not, we will see that legislation revisited. What do you think will happen if you have a fully autonomous car and something drastic goes wrong? Say it does not brake on a motorway and causes quite a large accident.

Professor Sampson: You have drifted into an interesting territory of insurance. It seems to me that, as you go more and more towards the autonomous vehicle, you stop insuring what is being driven by a particular person and you start looking more at how it is being driven. It could be that to get the system started the automotive companies might say, "We're going to bundle insurance in with the product," which has a lot of implications. You lose your statistics almost overnight, but you go to an entirely different world. There has been a lot of speculation that the early accidents will just be sorted out. There will be no admission of liability but, as in many other cases, the companies do not want the litigation too early, particularly in America.

Q175 **Chair:** Regulations have been mentioned. What kind of regulation is required?

Andrew Miller: We would need to regulate the capability of the systems, as we do now with many technologies. Electronic stability control is perhaps one of the most recent ones where regulation has been applied for passenger cars. We have set certain performance parameter requirements for vehicles fitted with the technology, and we would have to do the same.

Professor Sampson: You need to turn the legislation inside-out because, on the whole, UK law tells you what you cannot do, and the regulation for this new class of vehicle might say, "You may operate one of these, provided that" it is fitted with a standard something and it is limited to certain types of road, for example. The DFT regulatory review reports at the end of the year, so that will give us a hint as to the way things are going. The current thinking in various countries in Europe is to have some sort of permissive regulation where, if you fit something, you may do something else. In the whole area, we do not really know. There is a lot of uncertainty in the technology, in the sense that it is based on communications and computer technology. Last week banks were fined for losing those services for a few days; the emergency telephony services were very affected. Vehicles have recalls. The whole area has not yet been rigorously tested, to the point where you can say that, when a vehicle manufactured in country A that is driven in country B comes into proximity to a vehicle built in country C, all of the systems will work 100% of the time every day of the year. We are just not there yet. That will probably mean some form of certification and testing regime, and that goes into the regulation as well, but on the whole we just do not know; there is not enough evidence yet.

Q176 **Chair:** Who should be doing that? Who should be pushing that work forward?

Professor Sampson: The European Commission set up a thing called the co-operative intelligent transport systems platform, which is about 80 organisations all working together to look at these issues. The equivalent body in the States, NITSA, has its eye on a mandate to require all vehicles sold in the States to fit a certain type of device. There is a parallel activity going on in Japan. So far these have not quite come together, but the European Commission is looking at trying to get some sort of world standard. The important thing is that the UK is represented at the table, which so far it has been.

Q177 **Chair:** How would you describe the UK's involvement in this? You say that the UK is represented at the table. Is it doing any more than that?

Professor Sampson: We are leading on some activities. The regulatory review is something that not many countries are doing. The driverless vehicle trial is a good start but it is not large enough. We still have too many pockets of activity. I am not advocating a supremo for autonomous vehicles, but somebody somewhere ought to be joining up the thinking, and I cannot see anybody doing that.

Andrew Miller: I agree with that. I think we need a long-term strategy that builds assessments for each level of technology and looks at what is appropriate in terms of a UK decision regarding realising those benefits, whether it be regulation or allowing the market to implement them. There is a potential big win for the UK in terms of both road safety and economic growth by the reduction of congestion, and also the broader perspective of providing the UK with a high technology base.

Q178 **Chair:** Is this something you think Government should be doing?

Andrew Miller: I think the UK Government should be doing that, and then deciding how it wants to work with European and global regulators in a global technical framework to decide what it wants to push in the international space, but also what opportunity it has to make intelligent decisions for its own territory in terms of realising benefits for the competitiveness of the UK.

Q179 **Mr Sanders:** When we talk about an autonomous vehicle, do we mean one that cannot be overridden by the driver?

Darren Capes: No.

Q180 **Mr Sanders:** So we are talking about a semi-autonomous vehicle.

Darren Capes: Within the time frame we are looking at—the next 30 or 40 years—we will not get away from a mixed ecosystem of old and newer vehicles. As I said a few minutes ago, the time it takes for this technology to filter through the whole vehicle fleet means that we will not have fully autonomous vehicles driving fully autonomously without the ability to be overridden.

Q181 **Mr Sanders:** From a legal perspective, therefore, wouldn't there have to be a form of black box to demonstrate, in the event of something going wrong, whether it was the driver or the system that was at fault?

Darren Capes: That is a very interesting point. The MOT at the moment basically tests the mechanical qualities of the vehicle: the brakes, the suspension and so on. You could imagine a situation where the MOT had to start testing software versions. Have you had the updates? Is the firmware in your vehicle up to standard? You can see a situation where it becomes difficult for a private owner to keep on top of all that. You see a situation where as vehicles become increasingly autonomous you need to lease them and have some kind of ongoing support to run them. That becomes even more complex when those vehicles are working on a network of roads that have less autonomous vehicles on them, and even classic vehicles on them. There will have to continue to be a degree of complexity to allow different types of vehicles to work together harmoniously.

Q182 **Mr Sanders:** Is it possible to have the semi-autonomous vehicles operating without satellite communication?

Darren Capes: At the moment satellite location systems are probably not accurate enough to contribute to vehicle driving. You may well have satnav systems that make a vehicle aware of when it is in particular speed limit areas or when it is approaching particular hazards, but satellite navigation as it is now is not accurate enough to place a vehicle in a particular lane, for instance.

Q183 **Mr Sanders:** The vehicle is going to need to communicate, and presumably that communication will need to be via a phone-mast system, which of itself surely limits the extent to which autonomous vehicles could operate off the main trunk route network.

Darren Capes: This comes back to the point that was made earlier: there are a number of approaches around satellite technology, which will of course improve over the next 30 years. There are approaches around vehicle to vehicle communications, vehicles negotiating with each other and vehicles negotiating with infrastructure so they can use the mobile phone networks. We need to push forward in researching all these possible options, because at the moment it is not clear how this will evolve.

Q184 **Mr Sanders:** What I am getting at is that, if there is a need for the vehicle to communicate externally with a phone system, there is then an issue about the resilience of that system.

Darren Capes: Absolutely.

Q185 **Mr Sanders:** But also the security of that system.

Andrew Miller: We are going to need a lot of technical fail-safes from such a system both at a localised level in the vehicle and also at regional level, whether we are using telephone masts, other types of high frequency transmission systems and/or satellite positioning systems as well. We will probably need a layer of resilience at each level to make sure we have the appropriate level of security in case of either failure or deliberate interference.

Darren Capes: No matter how vehicles develop, they will become far more computerised and they will carry an awful lot of computing power and software. You are right; there will be increasingly complex communication systems. As we know, computer technology is open to hacking and infection by viruses, malicious or otherwise. That problem will grow. A central strand in how this sector develops is the need to ensure security of the systems and that, as far as possible, they are not only hacker-proof but also capable of being very quickly upgraded when new threats arise. A significant threat could disable a large portion of the UK vehicle fleet quite easily.

Q186 **Mr Sanders:** It seems to me you would have to upgrade whatever that computer system was constantly as new models of vehicles came on to the market, and that is where there would be opportunities for malicious activity.

Darren Capes: You are correct. When you turn on your laptop, almost daily you see it applying updates. Vehicles will do that. There is an issue around how vehicles are owned, how owners keep that software up to date and what legislation and mechanisms are in place to ensure that all the technology updates needed, which will be absolutely crucial, are applied properly, and there is some way of certifying that the vehicles on the road have those updates applied. That will be crucial. Without that confidence in the system, the system falls.

Q187 **Karl McCartney:** I am sorry to take you back, but this touches on some of the answers you have just given. It's like a multi-choice question, and all three of you might be able to give me an answer. Do you want to see this new technology enforced through regulation? That is one option. As a good Conservative, I like to see less regulation, but I can see you might want that. Do you think it will be led—probably not, but I do not want to pre-empt your answers—by the automotive industry themselves, because they will have to spend money putting in that technology? Or is there a danger that it will actually be led by the insurance companies, who have a vested interest, and aren't particularly flavour of the month with some of us?

Andrew Miller: I am not sure I completely understand the last part of that question.

Q188 **Karl McCartney:** Is it going to be led by the insurance companies? Is it going to be led by the automotive industry, or do you think it needs to be led by the Government regulating to ensure that fully autonomous vehicles are on the road sooner rather than later?

Andrew Miller: Without any interference, I would have thought the market will gradually introduce these technologies. We will eventually see the capabilities emerging with safe levels of performance. The car makers will take great care over that, obviously from the perspective of their own liabilities, and it will take some time to introduce these technologies, and eventually fully autonomous cars. There may well have to be a great deal of discussion about the legalities and issues around that, which no doubt can take place.

The real question is: do we understand the potential benefits and, therefore, provide policy makers with the tools to make informed decisions about regulation? My view is that we do not really have a long-term joined-up strategy about what the potential benefits are, so that we can understand what good looks like. How do we decide what is appropriate for regulation and what is best left to the market? There are lots of stakeholders. We have talked about a lot of complexity today, both at a technical level and at a societal level. We have talked about liability—about insurers. There is a lot of complexity in there. Each of those things has to be unpicked and developed. This is a brand new technology—the biggest change in the motor car since it was developed—so let's develop a way of getting

the stakeholders together and a good strong strategy. This is a 30-year plus strategy, which the UK deserves so that it can be first in the race.

Q189 **Chair:** Is that where you see the Government having a role in getting that strategy moving?

Andrew Miller: Absolutely. Get our strategy built.

Q190 **Chair:** Professor Sampson, you wanted to say something.

Professor Sampson: You see some of this opt-in already, in the sense of black box insurance, particularly with novice drivers who are quoted hair-raising figures by insurance companies. They can fit the black box that monitors how and where they drive, their speed and the time of day, and they can get affordable insurance. The early stages of autonomous might be just like that. There is an opt-in. In my view there will have to be some sort of designated standard where, if you want to do this, you must fit one of these and there are copious supplies.

The Swedish Government has declared that it is in favour of zero fatalities. Volvo has—

Q191 **Chair:** I think we all want that.

Professor Sampson: To get zero fatalities, if you can ever get there, you have to mandate the fitment. You cannot have vehicles travelling around that are not fitted with the latest technology. That is where I see a very interesting political decision. In the UK you say, "Right. We want zero fatalities. We are going to save about 1,700 lives." You can get a saving of 1,700 lives if you reduce the effects of smoking-related fatalities by 2%. This is going right into political territory.

Q192 **Chair:** Professor Sampson, is there enough evidence about the effectiveness of each of these technologies? You mentioned black box technologies. Is there evidence that that is effective in reducing accidents—evidence rather than assumption?

Professor Sampson: I do not know, because the information, if it exists, is sitting with the insurance companies. Only they know to what extent the adoption of black box insurance has changed accident rates in the particularly sensitive area of very novice drivers. We have said on more than one occasion that there is not much evidence. There has been a big trial in Michigan of 3,000 vehicles, and we are waiting to get the published results from that. There will be publication in the middle of next year of a multinational project in which the UK is involved. The Swedes say they are going to report regularly on a 100-vehicle trial, but it is very early to estimate the costs and benefits and assign them; the information just is not there.

Q193 **Chair:** Does that mean that the proposition that to get zero accidents you would have to make the fitting of certain technologies mandatory would end up being very questionable, unless you could actually show the consequences of doing that?

Professor Sampson: I believe that, if you want literally zero fatalities, you would have to mandate the fitment of something. I do not know exactly what it is, but you would have to be certain that every vehicle on the road had one.

Q194 **Chair:** What else needs to be done apart from developing new technologies? Is there anything different to do with infrastructure, training or retraining? What else needs to happen?

Darren Capes: We need to continue the day job. We need to continue to maintain and improve the road network. We need to spend more money improving the road network. There has been something of a shortfall in funding over the last few decades, and the quality of the road network has deteriorated. That still needs to be addressed; even if we move into new technologies, the basic road network still needs to be maintained. We need to continue to investigate accident reduction by engineering the road network. We have made huge strides over the last 30 years in doing that by better lighting, better signing, better road surfaces and improved junction layouts. That work needs to continue, and we do not need to see technology as a way out of doing it. It still needs to be done. In the next 30 or 40 years vehicles will probably continue to use rubber tyres on tarmac roads. That will continue to be the case, so we do not need to lose focus on that as a complementary strategy to the technology.

Q195 **Chair:** Should industry be supported more, or in a different way, to develop technologies where the knowledge is there?

Andrew Miller: A lot is going on in the UK already with the Technology Strategy Board and the work of the transport Catapult launched recently. A lot is going on and a lot of money is going into it. We can debate that. If we create the right environment, where we have a country that is willing and trying to move quickly into new technologies, we will attract investment in the UK, because this will be seen as one of the largest markets in Europe for new cars, but also a country that is always on the cutting edge of new innovative ideas. It is a great opportunity not just for car makers but for those on the periphery of motoring experience and activity to invest here, because we have created the right environment. We have set out our stall: this is what we are going to do in the next however many decades and this is how we are going to do it. I think that will attract those longer-term investments here.

Q196 **Chair:** Is it going to be a problem having cars using different sorts of technology all operating on the same roads?

Darren Capes: The answer is that it can be, because that is the situation we will face. The technology will have to be designed to deal with that. We will not move overnight from

the current unintelligent transport network to an intelligent one; there will be gradual moves, so the technologies, however they develop, will have to deal with that. There is no choice.

Andrew Miller: If we don't do it somebody else will do it before us in Europe, and we'll be left behind. We will be working to an old standard, and an old way of working and living in the UK. We have a big problem in the UK because of the relatively high population density on the road network. We have talked about infrastructure development over the last decade. We need a longer-term plan. These are very expensive. We all know about our financial position in the UK, so we need to plan it, and we need to stick to the plans and work in each of the sectors.

Q197 **Chair:** Which other countries are more advanced?

Andrew Miller: I understand that the Germans are moving very quickly to understand the capabilities for this, and they are very well organised. That is good for their country and for Europe. We have to decide how we want to realise those benefits for the UK. It is an opportunity.

Q198 **Chair:** Do we know enough to understand which technologies will be most effective in reducing accidents? A lot of different ideas are put forward and there is a lot of knowledge around, but I am not sure that practical research has been done to establish what is most effective. Do we know enough?

Professor Sampson: It is very difficult to research whether—unlike in the medical sector—one particular treatment will be more effective than another. You are relying to a certain extent on retrospective statistical data. That is not to say you cannot do trials—for example, various tests on motorways with controlled lanes, adjusting speed limits and so on. That has been analysed and has shown very positive safety benefits. There needs to be more work. There also needs to be some fairly fundamental work. For a long time we have worried about driver distraction. Is something going on in the cab that distracts the driver? We are now moving towards a completely opposite regime where the driver will not do anything, so will the driver be under-loaded and doze off? How does the vehicle signal to the driver, "I can't cope; you need to take over now"? I do not know of anyone who is researching that.

Q199 **Chair:** How far away are we from that situation?

Professor Sampson: Twenty-five years, plus.

Andrew Miller: I think there is an opportunity to do a more joined-up piece, looking at all the different crash types, or different scenarios, and working out a strategy to build appropriate incentives for the technologies that can deliver value. You may remember that we are promoting autonomous emergency braking at the moment. We have had a lot of dialogue in the public space about that. That is a specific crash type. It is a high-frequency

low-speed crash, which is predominantly the fender bender-type crash most of us know and see on the roads. It is quite an effective technology in mitigating a subset of those crash types. We need to do a piece of work to understand the range of crashes and accidents we are trying to solve, and then we can target those technologies and decide whether the Government have a role in regulating for them.

Darren Capes: We are very well placed to develop these technologies, even if we do not know which technologies at this stage will ultimately bear fruit. We have a very large automotive manufacturing sector in this country, and a huge number of small to medium-size companies backing it up. We also have a huge high-tech sector involving things like motorsport and aerospace, so we are very well placed. We have the technology, skills and understanding in this country to lead this development. What we need is the opportunity to trial it in this country.

Chair: Are there any other questions?

Q200 **Graham Stringer:** I have one question to Mr Capes about a possible resolution by GPS systems. Will the full implementation of Galileo make life a lot easier?

Darren Capes: Yes. It will provide a much tighter resolution, down to individual lanes, but it will always be the case that GPS, Galileo or whatever will just be part of the overall mix. It will be mixed in with vehicles communicating with one another, vehicles able to read and react to road conditions and road signs, and vehicles being able to take information from roadside beacons or mobile phone networks. The ultimate picture will be a mixture of technologies to give the very accurate and immediate control you will need to control vehicles.

Q201 **Graham Stringer:** Can I ask the question in a slightly different way? How important is Galileo to a fully automated system?

Darren Capes: It is difficult to say. You could imagine a road network with far fewer signs and road markings on it because vehicles would be able to pick up a lot of the information we currently get from road markings and road signs from Galileo. The placement of the vehicle on the road would be better, but it would not be the only technology you would use.

Andrew Miller: It would create more strategic resilience for the UK to use the Galileo system. We are dependent on the United States GPS system, or the Russian guidance system.

Professor Sampson: The work being done by the European Commission, given that Galileo is their baby, will be locked into the capabilities of Galileo. In turn, Galileo, GPS, GLONASS and the Chinese one—I have forgotten the name—are all co-operating, so you get a far better service from all of them than any one of them at any one time in any one place.

Q202 **Chair:** Do we need smart roads to go with the new technology?

Andrew Miller: Yes, very likely.

Q203 **Chair:** What would you like to see?

Professor Sampson: At least 4G telephony on any significant road. If you look at where accidents take place, motorways are not much of a problem. They carry a vast amount of traffic with a very low accident rate. It is the rural roads and urban collisions that cause the fatalities. Somehow we have to get smart roads into rural areas, and that has to be through telephony so that vehicles are connected and can see round the corner, get warnings of bad weather—fog or ice—or vehicles coming the other way on the wrong side of the road. That smart infrastructure will be based very much on state of the art telephony.

Q204 **Chair:** Is work being done on producing that?

Professor Sampson: There is an experimental road in Scotland which has been equipped with telephony. When asked what it was going to be used for, the answer was, "We don't know. We just know that it will be wanted some day, and we want to bring that day forward." I do not know what the Highways Agency are doing on that area.

Andrew Miller: I do not think it is part of a joined-up strategy at the moment.

Chair: Thank you very much.

Examination of Witnesses

Witnesses: **Richard Cuerden**, Technical Director for Vehicle Safety, Engineering and Assurance, Transport Research Laboratory, **Professor Oliver Carsten**, Professor of Transport Safety, University of Leeds, and **Professor Pete Thomas**, Professor of Road and Vehicle Safety, Loughborough University.

Q205 **Chair:** Good afternoon, and welcome to the Transport Select Committee? Could I please have your name and organisation, please?

Professor Carsten: I am Oliver Carsten, professor of transport safety at the University of Leeds.

Richard Cuerden: I am Richard Cuerden. I am the technical director for vehicle safety at the Transport Research Laboratory—TRL.

Professor Thomas: I am Pete Thomas from Loughborough university, where I am professor of road and vehicle safety.

Q206 **Chair:** You have heard what our previous witnesses said, and I am going to ask whether, on a few aspects of what they said, you have any differences of view on anything you heard, but I would like to start with your opinion about the assessment of the new technology in what is and is not effective in reducing accidents. Mr Cuerden, I think you have done some work in the Transport Research Laboratory with black boxes in particular. I am interested to know your assessment of the effectiveness of black boxes in reducing accidents.

Richard Cuerden: When we look at fleets that black boxes go into, we see a reduction in the incident rate. We see fewer crashes, at least in the first 12 months, because people know the box is there and they drive differently. What we do not have is good data beyond that, and we do not perhaps know so well how these devices will work with the general public. I can tell you quite a lot about how they work in fleets, in police forces and those sorts of environments, but we are perhaps lacking in knowledge about higher risk groups: young male drivers, young drivers in general or novice drivers on the road.

Q207 **Chair:** You are not convinced there is enough information around to assess the impact of black boxes.

Richard Cuerden: That is really interesting. I am definitely in favour of the notion of having the device there, for a number of reasons, one being that I believe it will act as an incentive for people to drive better. I cannot quantify what that might be too accurately. That is probably where I position myself, but there will be some benefit. The other side of it is that if things do go wrong, we get valuable information on why they went wrong, or at least what the vehicle was doing at the time and what the driver or rider was doing. That is really important.

Q208 **Chair:** Are there any other views about the effectiveness of the new technologies in terms of road safety? Would anybody like to give me any views on how much we know about effectiveness?

Professor Carsten: That was something about which I wrote in my evidence. We know quite a lot. In fact, perhaps Richard is being excessively modest, because he has just done a very large study for the European Commission looking at the safety potential of a whole range of in-vehicle systems. That result is very interesting. Essentially it confirms what I said, which is that we have had some experience from large-scale trials and we know which systems seem to work. Surprisingly, some of the systems in real life do not seem to be as successful as their promoters might have wanted them to be. In the euroFOT trial—a very large trial in which most European motor manufacturers participated—lane departure warning, for example, did not come out with a positive result; it came out in the "We don't know/we can't tell if there's any benefit for road safety" category. The technology that came out most positively was the combination of adaptive cruise control—the intelligent cruise control system—and forward collision warning. That one did not come out as all

that favourable; it came out as somewhat favourable. There was a definite benefit for both trucks and cars on motorways, and beyond that no detectable effect; there was a slight improvement in safety on the safest roads.

On the other hand, intelligent speed adaptation, which is the intelligent speed limiter system on which I have done a lot of work, comes out as extremely positive. It comes out positive both in experience from the UK trials and in the experience of other countries. For example, a recent review in Norway said that it was the most favourable candidate for deployment among all the technologies and would produce the greatest benefit.

Q209 **Chair:** Professor Thomas, do you have any information you can give us about how we assess effectiveness in relation to the safety of the new technologies?

Professor Thomas: It is a tricky field. The reason for that is that when we talk about assessing effectiveness it can mean a number of different things. What we would really like to see for a safety technology is a clear demonstration that without the system you have a certain number of accidents and with it you have a lower number of accidents. That is the ideal. But to achieve that, you have to have examples of a lot of those systems in use in fleets on the roads in normal circumstances, and in the wide variety of road conditions that we all experience. It takes time to get that fleet penetration and numbers of vehicles with the systems driving sufficient distance to allow us to do that comparison.

When we look at some of the experimental types of research that Oliver has just referred to, there are fleets, perhaps small ones of five, 10, 20 or 30 vehicles—that order of magnitude—driven for maybe a few months or up to a year, and it is too difficult to measure any reduction in the number of crashes because there just are not enough of them. Accidents are statistically not that common. Unless you have an extremely effective technology, any changes are likely to be within experimental error, so it is very difficult to measure those.

The types of practical experiment give us an indication, but we have to use substitute measures rather than numbers of accidents. Those have been done for a small number of the technologies. At an earlier stage in development, there is a very wide range of technologies and some may be coming into the vehicle fleet now; maybe the manufacturers are still working on them. People will say that those are likely to be very effective, or not likely to be very effective, but with them we are dealing with projections of safety on the basis of what we think happens in accidents and what we think drivers or road users do. There is a much wider variation in accuracy for those, so it is a more complex situation.

Q210 **Chair:** Do you have access to enough information? It was suggested by the earlier panel that maybe insurance companies have information that they do not disclose. Is that a problem you have come across, or that you suspect is the case?

Professor Thomas: Yes, there are some opportunities to help understand things better with data kept, say, within insurance companies. They have data that is commercial and proprietary for them, so they are sensitive about it. The area we are really lacking—it

comes back to the earlier statements about a clearer strategy—is a monitoring and evaluation framework to give us the whole picture in a systematic way so that we can look at the introduction of a technology on a road and measure the complete set of outcomes, whether it is a safety technology or something to do with convenience, congestion or emissions. We don't have that; it does not exist in this country and it does not really exist across Europe.

Professor Carsten: I do not think there is a hidden gold mine of information in the insurance companies. The Department for Transport is proposing a study of telematics-based insurance. I think it is out for tender at the moment through the frameworks, so we will perhaps get some information about that.

The problem with insurance company data is that they are not controlled trials. The kinds of trials you need to explore system effectiveness have to be very carefully managed. You do not want people to self-select for a particular kind of insurance versus the more risky people going for another kind of insurance and so on, or even opting out of insurance completely. We need some structure to those trials. There have been large trials at European level. They have been very valuable, and potentially they could be done even better. That is no doubt true. They have often involved hundreds of vehicles. We learn a lot from them and we need more of them. The problem is that it is very hard for those trials to keep up with the rate of change in the technologies, because the trials completed just two or three years ago are almost about yesterday's technologies, not tomorrow's. Somehow we need to keep up with things, and promote more tests and encourage manufacturers to bring their systems up for evidence-based research, because it is only through evidence-based research that we will learn about the effectiveness of different systems.

Richard Cuerden: If I may, I would like to jump back a bit. The first question you asked me was about black boxes or event data recorders. As Oliver very kindly mentioned, we are just finishing some work for DG Enterprise where we are evaluating the current general safety regulations and pedestrian safety regulations which apply to all motor vehicles in Europe. The purpose of that work is to see whether there are new technologies or new casualty groups, or other things that can be done potentially to change those regulations so we can reduce casualties. The reason I mention that is that you then go into the literature and scientific evidence and say, "What supports the technologies?", as my colleagues have been explaining. There is a lot of information in the literature about what works. There is still a lot we do not know, but we know a lot about what is working.

I guess I am going to repeat a little bit of what Professor Thomas said. The bit where we struggle is continual monitoring. It is evaluation of a technology. What we do not have is a constant stream over time of understanding when things are introduced how casualties are affected by them. Perhaps the best examples we had were some years ago when the front and side impact regulations were introduced for passenger cars. Cars had to have a frontal impact and a side impact for the secondary safety protection of occupants. Statistically, we can show real benefits in terms of lives saved since 1998, and certainly 2003, which we can attribute to those bits of European regulation. It could be that Euro NCAP added other points to it. You can point to measurable effectiveness in national data. That is really hard to do on some of the other things, which is where I agree with Professor Thomas; if we can bolster and improve our knowledge of why people have these accidents or crashes and

how they are being injured, we can identify the next generation of winners in terms of technologies, legislation or whatever it may be.

Q211 **Chloe Smith:** I am really interested in the area of the inquiry that is the role of Government. There is an awful lot that the market could do and that informed customers could be demanding, and therefore companies would supply. What is your assessment of what the Government need to do? My second question to all of you is: have you any concern that Government, because of its various characteristics, will move too slowly for what you think is needed in this field? Professor Carsten, you referred to something close to that just now.

Professor Carsten: There is a bit of a danger that we wait too long, but in principle Governments have two roles. It is not just the UK Government, because it does not have autonomy here. It is not an autonomous vehicle; it has to work with European and international partners, particularly in the vehicle regulation area.

Q212 **Chloe Smith:** To put words into your mouth, Professor Carsten, if slaving cars is something that is relevant in this debate, is the UK a slave to Europe?

Professor Carsten: No, I don't think the UK is a slave to Europe. The UK has to be in Europe because that is where vehicles are regulated. A lot of regulation is also done in Geneva at UNECE—the Economic Commission for Europe. That is where the international regulation about the basic safety features of a vehicle is set. I do not think we have any choice. If we regulated only for UK vehicles, we would only be regulating for Jaguar, Land Rover and a few other vehicles. Everything else that was imported would not fit our requirements, so I do not think that makes sense. We can do much more in concert with our partners.

What are the roles? One is that what happens in the vehicle market is that safety systems tend—but not always—to be introduced at the top end of the market. That means some executive vehicles—Volvos, BMWs, Mercedes and so on—get equipped. It takes a very long time for those systems to penetrate the market, and Andrew Miller has already talked about some of those issues. What regulation can do is accelerate fitment. Once something has been demonstrated at the top end we can say that everybody should benefit, not just people who can afford very expensive cars.

The other thing it can do is take a strategic view—something that has been mentioned. What are the opportunities for new technologies to deliver that can really better people's lives and improve safety, the environment, traffic flows and so on? Allusion has already been made to vision zero, which the UK signed up to as part of Europe. The vision is to have zero fatalities by 2050. How are we going to achieve that? What crashes do we need to address that cannot be addressed through current technology?

I would posit that, for example, without vehicle to vehicle communication systems we cannot address intersection collisions; for example, the very serious collisions at rural road intersections. We can rebuild every rural intersection in the country, which will cost us billions, or we can have vehicles communicating with each other so that one vehicle does

not pull out dangerously into a gap that does not exist, or we can slow down the vehicle on the main road to allow a vehicle out from a side road, maybe driven by an elderly driver or whatever. Those kinds of communications and co-operation with vehicles have huge potential. That is the area that the US is addressing with the advance notice of proposed rule-making that it has just put out on vehicle to vehicle communication. It is targeted at intersection collisions. Whether or not that technology is right, and I have doubts about that, nevertheless the target is a very estimable one. We need to do something about those very serious accidents. One could use other examples as well.

Richard Cuerden: That is a good question, thank you.

Q213 **Chloe Smith:** My pleasure.

Richard Cuerden: I am an engineer, so I am relatively simple in the way I think about these things. Within Europe in 2013 there were over 28,000 deaths, and an awful lot of cars were made. You have to look at the costs of whatever technology you put into a car versus the potential lives you save or injuries you prevent. If you want to do some cost-benefit ratio analysis, that is probably the best way to justify what it is you propose to change.

I am lucky enough to work in a community where there is a genuine desire and motivation to do things. There is no point in doing things unless it is going to save lives and prevent injuries; in terms of what we are doing, there is certainly no need to regulate. You need good strong evidence. If that evidence is there at a European level, that is the best way for the UK to benefit too. I am sorry; I have forgotten the second part of the question.

Q214 **Chloe Smith:** Do you think that those roles of Government could be executed quickly enough in what is going to be a fairly fast-moving field, and indeed one that is already upon us.

Richard Cuerden: Probably the honest answer is that I do not know. I do not think many people know how quickly these technologies are going to develop, and what they are going to develop into. What I do know is that there are things we could do now that need not restrict that development, but that at least would set some ground rules—in other words, you could get a common baseline.

One of my concerns might be that it is not just a conversation about autonomous or semi-autonomous vehicles. We are possibly going to see a drive for cheaper quadricycle vehicles that are very light and that you can drive under a motorcycle-type licence arrangement; they are electrically powered and very high torque, so they have quite high accelerations, possibly. You can limit the speed and you can drive them at 16. They are not going to be autonomous, and there could be a lot of them quite soon. What happens with that change, or with more cyclists, or an ageing population? Throw obesity into the mix, because potentially we are all going to be bit more vulnerable.

Q215 **Chloe Smith:** For the technical dullards on the Committee, can you explain why those vehicles will not be autonomous?

Richard Cuerden: Simply because of the cost. The way type approval of vehicles works is that, certainly at the moment, nothing has to have any autonomy anywhere, or any driver-assisted systems. It is way outside what is required by any approval-type mechanism. The technologies we are talking about are not cheap, and you want the weight of those vehicles to be as low as possible and the technology to be as simple as possible.

Q216 **Graham Stringer:** I am not sure if this is an intelligent or answerable question, but I will ask it anyway. When new technologies or systems are brought in and are regulated, or they just start, often decisions are made that have consequences for a long time because you exclude certain technologies. One can think of the gauge of railways in the 19th century, how smart meters are being introduced into the electricity system—probably some fundamental errors have been made—or video systems. Are there any big decisions in the basic structure of the technologies we are considering that should be made, and are there decisions that should be avoided at the present time?

Richard Cuerden: You are absolutely right. The way type approval works at the moment—it will have to be even more rigorous in this regard—is that it is not technology specific; it has to be performance specific. If the vehicle has to brake in a certain way, or do a basic manoeuvre in a certain way, that is how the vehicle must perform. It must not say that it has to have this gadget, this gadget and this gadget to do it, or rely on Galileo, or even on vehicle to vehicle communication. The potential for regulating, and then writing those rules, gets very difficult, because you are trying to write rules about performance criteria. At the moment, if you want to make a difference, you try to push manufacturers to a point where those standards would be quite effective.

The autonomous emergency braking systems that are on cars now are designed to stop the car hitting a pedestrian. We have just done a detailed bit of work; if somehow you could turn a switch so that every vehicle on the roads last year had an autonomous emergency braking system, with a camera and radar, and it could observe a pedestrian stepping into the road, or the vehicle doing whatever it was doing that brought about a collision, how many pedestrians would we save? The answer is 6%, or about 31 a year. That is fantastic. Those are people who would be alive now, but we would still have big road safety casualties in this country. That is quite a smart system that can identify a pedestrian and then brake if the driver does not do so to avoid a collision, or at least lessen the severity of it. It is really complicated.

Professor Carsten: The picture becomes very difficult when you move away from autonomous systems to the so-called co-operative systems where vehicles communicate with each other in, say, a platoon, or at an intersection. Perhaps they communicate with cyclists and pedestrians, and potentially communicate with the infrastructure as well. If vehicles are communicating with each other, they have to hear each other and talk the same language. It is as simple as that, so we need standards in that area. That is where the US has moved very rapidly in one particular technology—the one that was trialled in a safety pilot in Ann Arbor, Michigan, and is now being rolled out. They are using a form of ad hoc wi-fi called dedicated short range communication, and there is an 802.11 standard

around that. It provides assured security; it deals with the security, bandwidth and latency issues, but it is very expensive. They have done a back-of-the-envelope cost-benefit calculation on that. Cost-benefit is really important. We are not going to get the benefits of that technology until most vehicles have it, which is probably at least 20 years off, if not longer. People are being asked potentially to pay the cost now of a system that will not deliver in the lifetime—the current ownership—of the vehicle they are purchasing. It is only when everybody else has it that it will really be effective, and that is something we are looking at. Eric Sampson alluded to the co-operative ITS platform, which is the working group the European Commission is consulting on on co-operative systems.

On the other hand, there is a whole host of much cheaper technologies that could work now. For example, we could use smartphones, combined with GPS or whatever, to deliver better information to drivers at very low cost, because people have smartphones. Maybe we cannot do things that are as fancy with that, but we could realise the benefit now, because millions of people are already driving around with the technology in their vehicles. We need to look in a nuanced way at technology deployment paths and make sure that we maximise the benefit-cost ratio, as Richard said, and that we do not impose costs on people for which they will not get any benefit when they buy a vehicle.

Professor Thomas: I agree with what has been said. Additionally, we need to be aware that a lot of the discussion about these technologies is focusing on benefits for vehicle users, car drivers particularly. The systems being developed are those that fit comfortably into a car, truck or bus. The number of people who are killed or seriously injured, at least as occupants of those vehicles, is going down and down, just because we are seeing the benefits of injury mitigation technologies. They have not translated as much as we would like for what we call vulnerable road users: pedestrians, cyclists and motorcyclists. While I would not point to any particular technology, I would point to the potential disadvantage of focusing purely on benefits to car drivers. We have to ask whether this technology is transferable. Will it give similar benefits to other road users, who may be connected only through their phone, for example?

Q217 **Graham Stringer:** With a lot of these technologies, a huge amount of information will become available. What are the benefits and disbenefits? What is the downside of that information? How can the benefits be used?

Richard Cuerden: I am always optimistic, so I do not see many downsides. I spend a long time researching collisions. The benefits are that we can really understand traffic; we can understand how vehicles are moving and people are behaving in a lot more granularity than we do at the moment. Perhaps more importantly, when things go wrong, we can start to understand why they went wrong and why people got injured. We need to understand that if we are to understand the next steps. As these technologies come along it will be an evolution. Which way it goes will depend on where you see the winners will be and which technologies will work in terms of casualty reduction, congestion management or whatever part of the transport system.

Professor Carsten: There are potential privacy issues, ownership of data and so on. We have to explain to the public very carefully what is and is not permissible. We do not want to be finding out where individual A is spending the night or anything like that, which

could be done with a lot of these technologies. In fact, people already reveal that to their mobile phone companies; they may not realise it, but they do. We have to be careful. We have to protect people's rights, but, as Richard said, there is enormous potential in that information.

I am currently involved in another European project called UDRIVE, which is equipping hundreds of vehicles across Europe with camera-based systems both inside and outside the vehicle. We are going to be equipping people's private cars, obviously with their consent, to observe them over a year or two's driving and find out everything they are doing every single second. That is in the interests of learning about safety and about the environmental efficiency of their driving. We can use that data for good purposes, and we want to make sure people are protected against inappropriate use of the data.

Q218 **Chair:** In the case you are talking about, who owns that information?

Professor Carsten: In this case, the project will own the data. The participants will obviously have the right to say whether they want a particular piece of data deleted, but they will be fully informed in advance about how the data are to be used. We have incredibly strong restrictions on the data going outside the project partners where we can control the use of it.

Professor Thomas: The issue of data ownership is quite important. If we are looking at where the data might be derived, where it is available, there is already a lot of it around, owned by the phone companies, for example, but also by public authorities, who gather information about traffic flows in certain areas. We have vehicle counters alongside roads. That contains useful information. If that is public data you can easily argue that it should be used for the benefit of the public, including casualty reduction purposes.

There are other data. We have talked about the insurance black boxes and telematic systems. Presumably, when somebody agrees to have one of those in their car they sign a contract with the insurance provider to enable the data to be used for the insurer's benefit. A lot of data that we will be seeing comes from somewhere in the middle where the ownership is a little bit cloudier. The individual may, and probably will, own a lot of the data themselves, but where it is uncertain, the question is whether it is possible to use it to provide a social benefit, particularly for road safety purposes. How best can we do that? How can we deal with any possible conflicts of ownership where it is uncertain?

Q219 **Chair:** Is enough work being done in thinking through who owns which piece of information? Mr Cuerden, when you did your major research project did you have access to all the information you needed? Were there any problems, and were there any restrictions on how you could use it?

Richard Cuerden: Gosh! Of all of those questions, we did not have enough access. There never is enough information that ties in. There are restrictions on what you can use data for. In terms of strategy and whether people understand how the data are to be used, I think the answer is no. I genuinely do not know, but that is my feeling.

We looked at eCall—an emergency call; once a vehicle has had a collision, it will ring the emergency services for you. Lots of cars have that system already. As of next year or the year after, I think it will be mandatory on new vehicles. That vehicle is driving around knowing where it is, because if it has a collision it has to be able to inform the emergency services because you might not be able to. At European level, quite a bit of work had to go on in terms of whether it was okay to transmit and share that data. The answer is yes, but at the moment to my knowledge it is on a case-by-case basis.

Q220 **Graham Stringer:** Is the Department for Transport on top of all this? You have problems of privacy and large data; you have all this cutting-edge technology—very complicated areas. Do you believe the Department for Transport is on top of all this?

Richard Cuerden: Can I answer in a slightly different way?

Q221 **Chair:** It's all right; you can tell us.

Richard Cuerden: I think, with everything, we can do a lot more. Things have moved so quickly that this is one of those examples where we are not keeping up with the pace. People are being caught on the back foot. We need to speed up our responses so we understand these things, or at least know which questions we should be asking. Referring to the questions you are asking, what happens if we have these vehicles talking to one another? Where does that data go, and who is going to own it?

Q222 **Chair:** All the research you are doing and the questions we are asking lead to more questions, don't they, about what information there is, who owns it, what can be done with it and how it can be applied? Some of you have suggested that some of the information is perhaps not applied for all the best purposes. Professor Thomas, you spoke about knowledge that is there; you said it should not be used just for drivers of cars but for other people as well. Professor Carsten said that not all information that is available is being used in the right way. It is a very big area, isn't? Is it your feeling that it has not been thought through properly, or perhaps it is an emerging field of knowledge?

Professor Thomas: That is the case. We have previously talked about the need for a broader strategy on this, and data handling and data management is one element of that longer-term strategy. There is already so much data flying around. There will be more. I am told that new cars may have five SIM cards in them sending information. What data is that? There are questions about whose data it is. Is it about the vehicle or the driver, or the behaviour of the owner? It is clearly a strategic issue. We want to get the best out of the data opportunities available to us. Data management needs to be one component in the strategic view of how we handle all these technologies to give us the safest road system.

Q223 **Chloe Smith:** Is the legal framework adequate, both civil and criminal? If not, what should Parliament do?

Professor Thomas: I do not know.

Richard Cuerden: I am sorry; I cannot say.

Professor Carsten: It is not really within my purview. I can see that in the future there are big issues. For example, it came as quite a surprise to the American population that accident data recorders had already been installed by vehicle manufacturers almost without regulation. People have to be open about it and tell those buying the car what is on it and what is not on it, so they can make their own decisions. Part of it is just information, and providing them with the information so they can make intelligent choices. There is also clearly a role for regulation, and privacy and data ownership may be one area.

If I can come back to the previous question about whether we have enough foresight from DFT about the big issues, my personal view is that no, we don't. They are very much in the reactive mode and not in the proactive mode. They are not identifying the big issues in advance; they are not mapping out a strategy for exploiting the technologies to meet policy goals, and that is what we really desperately need. We know what the policy goals are: lower emissions, better travel times, fewer crashes, less congestion in the network and all of that. What we need to be doing is taking a long-term view of how best we can take advantage of the technologies, and harness them to achieve those goals. That has been really lacking in the last few years, if we ever had it.

Richard Cuerden: I would argue that we have had it. It has not been perfect in the past, and perhaps it is not as good as it has been. I think there has been a decline, but I have certainly been in working group meetings where the UK has been leading on the evidence, going to a European level with evidence and pushing for things that would be a benefit and would actually reduce UK casualties because they are the really important measures. When I go back to ESC—

Q224 **Chair:** When was that? When were we doing that?

Richard Cuerden: Probably over the last 20 years—certainly in my working time. I suspect it is only in the last few years that we have not been quite so proactive. The really interesting thing for UK plc is that if we are going to the table, be that a European working group, a regulatory body, industry or whatever it may be, it is UK casualties that hopefully will come down, because that is the evidence. Those were the in-depth accident data we were using at the time to argue for changes to vehicles.

Q225 **Chair:** Professor Thomas, what do you think is the most important step that needs to be taken now to use and develop this knowledge?

Professor Thomas: We need to be doing a number of things. One is a systematic monitoring and evaluation framework, which I have already referred to. So much change is happening so quickly with new technologies that it is genuinely difficult to keep up at research level and policy-maker level. We need to find a way to be on top of it, because there are times when real choices have to be made. It is not sufficient to leave it purely to the market. In the market certain types of technologies will be developed—safety

technologies that give some improvements, but they are not necessarily the best improvements in safety we would like to see. For example, we know that the biggest risk factors in road accidents are speed and alcohol. There aren't proposals around from manufacturers to put that sort of equipment routinely into cars. If we want to see big steps, big reductions in casualty numbers, the choices we make as a society might be different from those made purely for marketing purposes. It is a bit hard, but perhaps those are the two ends of the spectrum.

Q226 **Chair:** You do not feel that that distinction is being made at the moment, or that both those paths are being followed.

Professor Thomas: At the moment, in terms of a continuum, the choices being made are largely at the market end.

Q227 **Chair:** Is a target of zero accidents and zero fatalities realistic and achievable?

Professor Carsten: Is it achievable? My view is that we will not know until we get there; and it does not necessarily matter because, if we get close to it, that would be an incredible performance anyway.

Q228 **Chair:** Could you put a year on it?

Professor Carsten: Whether we achieve zero every single year in 30, 40 or 50 years' time is less important than getting it down to a very finite, small number of people.

Q229 **Chair:** You are looking at it in that sort of time scale—30 years plus.

Professor Carsten: Yes. We already know a huge amount about the problems. Pete alluded to some of the problems: speed and alcohol. Seat-belt wearing would be another one. If we can get people complying with all the regulations, we would immediately have more than a 50% reduction in current crashes, which would be an enormous reduction. We know quite a lot about how to take things even further than that. We can add some crash-avoidance technologies and, yes, we will certainly be down to, say, a few hundred fatal crashes and a larger number of serious injuries, but something that is far better than our current performance.

Q230 **Chair:** Professor Thomas, what is your view about achieving a target of zero fatal accidents?

Professor Thomas: It is the difference between a target and a vision. Often, when we talk about zero accidents we refer to it more as a vision and a motivational factor than a true expectation that there will be zero, because random factors always creep in. As a vision, it

is extremely appealing. If we do not get there, we should be able to get very much closer than we are.

The importance of it as a vision is that it makes you think how we get there and what we have to do. What measures do we have to put in place to get to zero or very low numbers of killed or serious injuries? An example was mentioned in the first session about cyclist safety and the interactions between cyclists and trucks. This is an area where we have recently done quite a lot of work. It is very clear that there is no single solution. It is a tricky situation. There are a lot of different factors about conspicuity, behaviour, enforcement and technical issues, such as mirrors, cameras and so on. There is no single solution. If there was, we would put it in place and it would solve the problem, but there is not. A lot of the problems of road safety are like that.

When we say we want to reduce casualties, we are not looking purely for new technologies to come in and take the place of measures that have not really worked in the past. We should be asking how we take opportunities from the new technologies and from the things we know work in road safety—some of the very traditional measures of road engineering, education, enforcement and things like cycle helmets, high visibility jackets and so on—and put them all together to have a road safety strategy that helps us take big steps towards vision zero. We should use the best of what we can already do and take advantage of the new technologies that are going to become available and make sure that those address the big problems, not just the small problems.

Q231 **Chair:** Where does the balance lie? Will the new and developing technologies we have been discussing bring a step change in the number of serious and fatal accidents?

Professor Thomas: Maybe not in the short term; in the long term they could.

Q232 **Chair:** How long is long term? How far ahead is it?

Professor Thomas: It is a guess, but 20 years or something like that. The technologies now coming into the vehicle fleet are largely in the area where drivers make small mistakes. Often, we make a mistake and it does not have the consequences of a crash. Sometimes it does; we go a little bit too fast or we fail to see a pedestrian, or a critical situation like that. Normally, we are able to find our way through and rescue the situation, but sometimes we do not and that is a crash. The technologies we are seeing with stability control or autonomous emergency braking are in that sort of area.

We can imagine a highly automated transport system where the driver becomes a pilot or supervisor. When the technologies are at that level of reliability, maybe we will be able to say, "You can drink as much as you like; it doesn't matter." Maybe we will be able to phone the car and tell it to pick up the kids from school and bring them home, but you need high resilience for those sorts of scenarios. We are a long way away from that.

Richard Cuerden: It is the first time I am going to disagree with anybody this afternoon, but only slightly. We are in a really interesting place. If we were to act now on the technologies that are there, we could see some benefits in the next 10 years. We know that

the front and side impact regulation works; we know ESC works, and we know that brake assist is having benefits. We have seen step changes associated with those technologies and the regulations that came about. I promise I am not banging the table for regulation, but if you can standardise and get the technologies in enough numbers in the next few years, which is not beyond the sorts of things happening anyway with Euro NCAP and other consumer programmes championing these things, I think we could really see some casualty reductions in the next 10 years.

Q233 **Martin Vickers:** We are presupposing, are we not, that people are going to accept all these devices and not overrule them at some point or other? What if they choose to switch off the autopilot, or whatever we choose to call it?

Richard Cuerden: I want to talk about this a little bit, because I am guilty of it. I drive some cars and I find the particular system annoying; I drive other cars and I do not know what the beeper means and I have to work it out. This is one of the problems. Different manufacturers are developing these systems. Manufacturers should be getting a lot of praise for that because some good work is going on, but they are not standardised, and some work much better than others at the human-machine interface.

The other real difficulty with all of this is the idea that I might change my behaviour. There is now good evidence from the United States about advanced lighting, which seems to show that, for systems where you can see the road ahead much more clearly, they have reduced their insurance claims and it looks really good, but if you look at the casualty numbers they are going up. The common or garden crash and lower severity stuff is going away, but people are now driving faster in environments where they could not previously see, so of course we see more casualties. We need to be really careful about unintended consequences when we talk about these technologies, whereas perhaps from my background, which is more engineering based, it is a lot more to do with human behaviour as well as the engineering performance of the systems and how the two go hand in hand.

Professor Carsten: That has been the benefit of some of these large-scale trials. You have an engineering prediction that 50% of the crashes are relevant to the system and the system will work in 50% of those cases, so we should get a 25% overall benefit. Then we look at how people actually drive and how often they switch on the system. One of the problems at the moment is that people do not know they have the technology and they do not even enable it. It is not a question of people overriding it; in many cases they do not know they have it. I was involved in European work where car purchasers were asked about the technologies they had and they said, "Thank you very much for the questionnaire because we didn't know we had it." That was about a lane departure warning system. They may or may not use that properly, which is a separate question, but I agree that we need real-world evidence to find out how people use it in real life. I have a concern about autonomous emergency braking as well. At the moment we simply do not know how people drive with that in real life. Do they perhaps engage more in distracting activities because they think the AEB will step in the moment a situation becomes too risky? That is what we need to be studying. That is the virtue of those large trials and why we need to promote them.

Q234 **Chair:** Is there a need for training? Is that lacking?

Professor Carsten: There is certainly a need for at least a minimum of training, informing people so they know they have it. As to whether people need to be trained in how to use the system, we are in difficult territory. I would hope that most of those systems are pretty much intuitive, and people do not need a 50-page manual to tell them how to programme it and use it. If they do, they are poorly designed in the first place.

Professor Thomas: On the question of training, we have already had one quite significant experience related to that: the introduction of anti-lock braking systems. The operation of the brakes in an emergency condition was very different from what people were used to at the time. Before then, the harder you pressed on the brake pedal, the closer you got to wheel lock-up, and that gave a certain performance. With anti-locks, you can feel the pulsing of the brake pedal as the system bounces in and out of the braking. We know from experiences reported at the time by a lot of people that, when they experienced that, it was something unexpected. They thought the car was going wrong and was not braking properly, and they did not realise it was the normal operation of a new system.

We are looking at other technologies coming in. When we talk about them, we give them a label and imagine they will all be working in the same way. Maybe they will; maybe they won't; there is nothing to control that. It is down to the individual supplier—to the car manufacturers. One automatic braking system might work in one way; another might work slightly differently. It might be that, as some systems do if you are braking automatically, if the driver puts in some steering input or touches the brakes, the car says, "Right, you're in control." Then the system might be operating in an unexpected manner for the driver. Another system might work in a slightly different way. Whether this is going to be important is unknown territory. What level of difference is going to be significant for safety? How does driver behaviour change when they think they know how the system is going to work but they get into another vehicle and maybe it is different? We do not know these things.

Q235 **Chloe Smith:** Do you never worry about dystopia?

Professor Carsten: Could things be worse in the future? I guess that is what you are really asking. I am fairly confident. I do not think I would have been engaged in how new technologies could improve road safety for the time I have been working if I did not think there was a real role. Can we think of scenarios in which individual technologies can cause problems? I think the answer is, absolutely, yes. We have already had allusion to highly automated driving where the driver has the potential to fall asleep, and suddenly the vehicle is expecting the driver to take over. That is a potentially disastrous scenario. We really do not know how to deal with that. Probably the car should carry on driving, or at least smoothly come to a stop somewhere safe, letting the driver finally wake up and so on. When manufacturers say that can happen in the space of two or three seconds, we have to be sceptical of that kind of statement—that a handover will be able to take place in three seconds—because I do not believe it is true for a minute. That might have been unfortunate phrasing.

Q236 **Chloe Smith:** I am a little more concerned about wider-scale malevolence, of which one example would be a cyber-attack, and a broader malfunction while everything is networked is a second example.

Professor Carsten: Cyber-attack is a potential problem that we need to worry about. That is already a big issue. Governments are vulnerable. I would imagine that urban traffic control systems are vulnerable, and so on. There has been work on this in the past. If a GPS system became unavailable tomorrow, that would be very unfortunate, but in the future it might have more disastrous consequences. Yes, we need to guard against those things; we need to think about them and prepare for them, but that does not mean the whole system is a dystopian one. It means that we have to think things through very carefully and have strategies prepared.

Richard Cuerden: Another way to look at this is that there are not many people like us three sitting around saying, "Hey, this is why you should buy a car." The public are out there buying those cars because they want that technology, and the manufacturers are making it because there is a need for it. If there was not, they would not be. If you talk to anybody a little bit younger than us three, there is a good case that the whole driving experience is a bit of a distraction, to be frank. They would rather be on their device. Certainly that is the case with my teenage daughter, if I'm honest—she will hate me saying that. Her view and the way she approaches driving is completely different from mine when my 17th birthday came and I wanted to drive a car. We have to have a certain amount of acceptance that it is going to change.

Professor Thomas: Perhaps I could develop an idea from something Richard said when he talked about the public buying the systems. The public are being offered many of these systems as options on vehicles. Most of the new technologies we see are options. Consumers—car purchasers—can buy them if they choose, but safety options are normally the least successful ones for manufacturers. We often see a situation where what look like really good technologies are available to car purchasers, but if the purchaser does not say, "Okay, I will spend £200 or £500 on this," it will not get into the car. That technology will not be saving any lives if the car is not equipped with it. It is a real issue that we are now seeing likely successful technologies that are only there as options, and fleet penetration is very small. We do not know the numbers because manufacturers do not disclose those, but less than 10% would be typical; less than 5% would be very common. There is a bit of a contradiction between what we are being told and what we might expect. An individual system in principle, if it was fitted to all cars, might give us a really good saving, but in practice if only one in 20, or one in 100, cars is equipped with it, how is that going to have the same level of safety benefit?

Q237 **Graham Stringer:** I am always fascinated by the exponential growth in professors of transport and professors of transport safety and so on. How will your students in the next 20 or 30 years help to make the roads safer?

Professor Thomas: That is a good question. By becoming engineers or by becoming politicians and putting into practice what we preach, probably.

Q238 **Graham Stringer:** By doing your bidding.

Professor Carsten: You are probably aware that, in the current research evaluation framework imposed by HEFCE, impact is a very important part. Having a research impact on real life and real policy decisions is vital to get a high score on the REF. We are being encouraged to do that. We are being encouraged very strongly to engage with public policy and to translate research into practice, and I hope that will continue. It is something I have always advocated. I have thought it really important. I have been rather disparaging about people who say we should just be in an ivory tower publishing results in journals, and that is good enough to be satisfied with in your academic career. I do not think that is good enough.

Q239 **Martin Vickers:** Mr Cuerden, you mentioned a few minutes ago that younger people regard the driving experience as a bit of a distraction, and they would rather be on their iPad, or whatever. Do you envisage a situation where no individual will be legally in charge of the vehicle? In other words, if there is a catastrophic technical failure, presumably a big red light will light up on the dashboard saying "Technical failure", and therefore the human being has to take over. What legislative framework would you envisage?

Richard Cuerden: There are pods or vehicles now where to a certain degree the only control is a stop button, and that is all you need. You get in it and all you have is one red button.

Q240 **Chloe Smith:** It is called slaving for a reason, to use the jargon.

Richard Cuerden: Yes. I can imagine that for certain journeys in urban or rural environments calling a vehicle will change the whole picture of ownership. You are calling taxis effectively, or there is some kind of club or ownership model. These things come and collect you and literally take you from A to B, or whatever. Why not? Arguably, it is not that far away.

Chair: Thank you very much for coming to answer our questions.