Impacts and Benefits

1. What are the potential applications for autonomous vehicles?

The attached CAV Value Chains report, authored by the TSC considers five main ‘scenarios’ or use cases.

Scenario 1: Privately Owned Passenger Vehicles with Advanced Driver Assistance Systems (ADAS) (SAE Levels 1-2);
- Scenario 2: Privately Owned Passenger Vehicles with Connectivity;
- Scenario 3: Highly Automated Privately Owned Passenger Vehicles (SAE Levels 3-5);
- Scenario 4: Highly Automated Heavy Goods Vehicles (SAE Levels 3-5);
- Scenario 5: Low Speed Urban Pods (SAE Levels 4-5).

2. What are the potential user benefits and disadvantages from the deployment of autonomous vehicles?

The CAV Value Chains report goes into these in more detail for each scenario listed above, but can be broadly summarised as:

**Direct market value** - Value from the provision and supply of technology and associated services, which could be exported internationally as well as sold in the UK.

B. **Wider socioeconomic benefits** - Use of the technology and associated services to the benefit of the UK economy, prosperity and quality of life.

The latter type of value could be realised in terms of:

- More productive time available (e.g. for leisure activities / working / resting etc.), time that had previously been spent actively driving;
- Fewer or reduced severity road collisions;
- Easing of traffic congestion;
- Potential reduction in emissions and energy use;
- Increased mobility and accessibility, especially for those that are unable to drive.

SMMT/KPMG report from March 2015

3. How much is known about the potential impact of deploying autonomous vehicles in different sectors?

4. How much is known about public attitudes to autonomous vehicles?

There is already considerable public interest in autonomous vehicles and a number of surveys have been carried out in locations around the world (as well as online) to gauge public attitudes towards the technology. Generally, these surveys have shown that the public are still mainly sceptical about “driverless” cars – with usually something like a 60:40 split between those who would be reluctant to use autonomous vehicles and those who would be keen to. Having said that, the circa 40% favourable figures are widely seen as impressively high for a technology that is not yet available to consumers and whose benefits have not yet been fully demonstrated.

The Transport Systems Catapult’s own Traveller Needs Study, carried out in 2015, considered attitudes to self-driving vehicles within the study’s wider remit of examining attitudes to travel in general, and found that of the 10,000 people surveyed in the UK, 39% would consider using a self-driving vehicle, rising to as high as 62% among young professionals living in cities. See here for more details.

The TSC’s Automated Transport Systems (ATS) team also carried out a survey in January 2016, with the support of YouGov to look at whether familiarity with the technology helped to improve attitudes. Independent polling, carried out on a nationwide basis and also specifically in Milton Keynes, where the TSC has been trialling autonomous pavement-based ‘pod’ vehicles found that 61% of adults in Milton Keynes would be interested in using the pods, compared to a national baseline figure of 38% (which is strikingly similar to the 39% of the Traveller Needs Study). See here for more details.

In terms of current live programmes, further public attitudes surveys are planned as part of the GATEway project in Greenwich, and also within UK Autodrive (for which the TSC is leading on dissemination and communication). The UK Autodrive survey is a comprehensive online questionnaire comprising 48 questions, the first wave of which was launched on 7th October. See here for more details.

5. What is the scale of the market opportunity for autonomous vehicles?

The TSC Technology Strategy states this is currently worth GBP 4.8bn per annum in 2016, rising to over GBP 50bn per annum by 2025. This is a conservative estimate, and the pace of change in this field is advancing and expanding so swiftly that it’s not unreasonable to expect this to grow somewhat faster and larger in the coming years.

6. Is the scale of current and planned demonstration facilities for autonomous vehicles sufficiently broad and ambitious?

Not in the UK if we want to be world leaders. There has been a recent Government consultation on “UK testing ecosystem for connected and autonomous vehicles”
www.gov.uk/government/consultations/driverless-vehicle-testing-facilities-call-for-evidence

which asked a similar question. In response, the TSC and others have called for the “UK Offer” to have an small organisation/function to offer a clearer, more coordinated one-stop shop to access the many world class testing, engineering and academic minds the UK has. To market the UK offer globally meaning the UK can continue to progress and keep clear water between itself and other global competitor countries in the CAV sphere.

7. Is the Government doing enough to fund research and development on autonomous vehicles, and to stimulate others to do so? Should it be doing more to coordinate UK actions?

See the TSC testbed UK response.

8. How effective are Innovate UK and the CCAV in this area?

Both are great, but need more resources if the UK is to compete more effectively on the world stage. The UK currently punches well above its weight in the CAV arena, with much of that due to the good CAV investments of Innovate UK, and through the Government taking a global lead in establishing a cross government departmental policy unit in CCAV. Confidence in the UK’s ability to deliver in the CAV sector has increased faster because of these investments. The UK capability and advantage could be accelerated even faster if more resources were available. But that advantage gap has been closing ever faster, and may well be completely closed soon, as other countries invest more heavily in CAV solutions.

9. Is the environment for small and medium-sized enterprises (SMEs) working in this sector sufficiently enabling?

Some good UK examples exist e.g. Five.AI, Oxbotica, RDM, etc. But more are needed. Also scale-up finance and access to start-up capital is patchy at best, and requires a lot of time, effort and skill to extract funds in the UK. This has started to lessen in the last one or two years, especially as the TSC has become more well-known for its role in championing CAV, through LUTZ Pathfinder and seconding senior staff into the CCAV start-up team. TSC has also convening consortia comprised of SMEs, industry and academia, and for the TSC’s neutrality in its approach to IP management etc.

10. Will successful deployment of autonomous vehicles require changes to digital or physical infrastructure?

The potential impact of CAVs on the physical infrastructure debate will go on for some time. Whether there is V2V, V2I, V2X and/or all three, what is clear is that infrastructure that is being imagines, designed, and built now, needs to have capability for future compatibility and functionality built-in from the get go. Rather than trying to expensively retrofit and/or create new digital architectures to allow the systems and the physical infrastructure to communicate. What is perhaps clearer is that digital capacity, communication certainty, and speed of services will all come under huge strain in the near, medium and longer terms as more and more ‘things’ become connected, which may dilute communication
bandwidths/speeds/certainty levels etc, just when CAVs are needing them most to satisfy safety cases, use cases, consumer needs. Power generation is a stark example of this, as the move towards more electric vehicles and more home and public charging points increases the pressures on the UK power network will continue to be challenged. Add to that the likely high (and separate grid??) power generation needs for HS2, and a series of digital delivery capability and physical infrastructure demands start to become into starker focus.

11. How might a move from current levels of highly automated vehicles to their extensive deployment best be managed? What do you see as the key milestones?

Key milestone is permitting deployment of highly automated vehicles commercially in mixed traffic. For this we need a method for verification and validation of software safety, a large naturalistic driving study in the UK to act as a benchmark and solutions to deal with difficult driving situations, such as traffic management measures, adverse weather etc.

12. Does the Government have an effective approach on data and cybersecurity in this sector?

With increasingly sophisticated mobility systems, complex and interconnected networks across sectors and services, there are unique challenges for security in intelligent mobility.

Eight key drivers of change for intelligent mobility and cyber security:

1. Technology is becoming more integral to mobility experience
2. Technological innovation in cyber security is accelerating
3. Internet connectivity is expected – and everywhere
4. An industry-wide approach to cyber security is shaping up
5. Transport is a critical infrastructure
6. Sector vulnerability and cyber threats are evolving
7. Safety and security are interdependent
8. Privacy will be an ongoing consumer debate

While the UK faces considerable challenges progressing the intelligent mobility market in a secure way, it is well placed to be a global leader.

Five fundamentals of this unique emerging sector:

- Intelligent mobility is a new cyber security proposition that is defined by the convergence of automation, new mobility models and smart ecosystems.

- The rapidly changing security and mobility landscape is likely to mean more cyber-attacks, more often, and potentially with more severe consequences.

- Understanding the nature of the existing issue is still a challenge.

- The UK is well positioned to respond to the challenge as it already has strong capability in cyber security.
• The technology the UK needs is not an issue – secure intelligent mobility requires a robust strategy and cultural focus.

13. Are further revisions needed to insurance, regulation and legislation in the UK to create an enabling environment for autonomous vehicles?

See answer to 11, and TSC response (attached) to the Government’s recent “Advanced driver assistance systems and automated vehicle technologies: supporting their use in the UK” consultation which asked the above.

14. What, if any, ethical issues need to be addressed in the substitution of human judgement in the control of vehicles by algorithms and Artificial Intelligence?

Potentially the emergence of these technologies operating in their fullest and greatest forms may actually negate the need for such discussions of ethical decisions over “which person or persons the vehicle will choose to avoid or save”. Getting to this stage is many many years away, but testing the ethical concept against technological advances and safety and use cases already forms part of the insurance risk cases surrounding CAVs, and will be an interesting area to keep abreast of in coming months and years.

15. What does the proposed Modern Transport Bill need to deliver?

Light touch regulation, with an open and fleet of foot testing and investment environment to encourage continued UK company investment and increasing levels of Foreign Direct Investment into the CAV space in the UK.

16. How effective is the UK’s education system in delivering people with the right skills to support the autonomous vehicles sector?

The soon to be published (2nd November) Intelligent Mobility (IM) Skills Strategy produced by the Transport Systems Catapult concludes that the UK must close the skills gap in the emerging autonomous and connected vehicles market or risk relegating ourselves to the back of the pack for decades in a global transport technology race. If no action is taken across the entire skills pipeline, £50 billion in GDP per annum could be lost. The UK faces a potential skills gap of 742,000 people by 2025 across the diverse IM landscape with around 200,000 of those being in the ‘Disruptive STEM’ high value digital skills arena - the top ten skills needed in automotive are future-oriented skills.

To address the skills shortfall, the report recommends an integrated range of interventions with transport industry experts strongly preferring higher-degree apprenticeships as part of the mix. In addition, new and novel ways of rapidly developing people with digital skills can be adopted in the UK if there is the appetite to challenge our current education system.

17. Is the Government’s strategy and work in this area sufficiently wide-reaching? Does it take into account the opportunities that autonomous vehicles offer in a wide range of areas, not just on the road?
The government’s strategy in this area is very deliberate in focusing on the area of greatest UK advantage (road) as well as understanding proving technologies and services can work in this most competitive and complex of environments will still allow for technology transfer across to other modes/sectors can occur when appropriately mature. That said there could be more focus on aerial vehicles, rail, maritime, hyperloops etc.

18. What are the implications of exit from the European Union for research and development and the autonomous vehicle industry in the UK? Are specific actions from the Government needed to support or protect the autonomous vehicles sector in the short term or after the terms of Brexit have been negotiated?

Access to the single market and freedom of movement of workers are key elements that will need to be reflected in the realities of the post Brexit UK CAV economy. As these, among others, will have implications on the level of skilled workforce, pricing structures, business models and operating models, and therefore overall UK competitiveness in the global export markets, and impact the level of existing and any new Foreign Direct Investment in the UK.

TSC welcomes the Government’s commitment to support UK H2020 and other European funding programmes financial commitments in the short term until Article 50 negotiations are completed. However, anecdotal evidence suggests that despite this some existing consortia agreements have failed to progress due to other member states nervousness about UK involvement, with some other potential consortia not entertaining a UK presence at all. These may be immediate knee-jerk reactions or isolated examples, but they bear noting and keeping a close eye on. These issues were noted more in the wider innovation and Catapult context with the letter from a number of Catapult CEOs and Chairman that was sent to Simon Fiander the House of Commons Science and Technology Clerk on 15th August 2016 (also attached). While this was a broader than just CAVs Brexit response, the main issues and arguments apply just as well to this specific area of focus.

References and Appendices

References

Reference 1 – TSC CAV Value Chain Report – available on request - as we were not allowed to attach standalone documents

Reference 2 – TSC Technology Strategy for Intelligent Mobility – tsctechstrategy.co.uk

Reference 3 – TSC response to the “Advanced driver assistance systems and automated vehicle technologies: supporting their use in the UK” consultation submitted online via textbox – complete text available from DfT

Appendices

Appendix 1 – Joint Catapult CEOs letter to House of Commons Science and Technology Committee [not published]
Appendix 2 – TSC response to the “UK testing ecosystem for connected and autonomous vehicles” consultation [not published]

26 October 2016