Cranfield University – Written evidence (AUV0086)

About Cranfield

1.0 As the UK’s only exclusively postgraduate university, Cranfield’s world-class expertise, large-scale facilities and unrivalled industry partnerships create leaders in technology and management globally.

1.1 Our key areas of expertise and capabilities are grouped under seven main themes: aerospace, defence and security, energy and power, environment and agrifood, manufacturing, transport systems and water, along with our world-renowned School of Management.

1.2 81% of our research is classed as world-leading or internationally excellent by REF (Research Excellence Framework, 2014) and we are ranked in the top five of UK universities for commercial research income.

1.3 Around 2,400 students graduate from Cranfield each year and we award over 5% of the UK’s engineering and technology PhDs every year.

1.4 In its specialist areas, Cranfield is at the heart of postgraduate education. Of those that study in the UK, 47% of aerospace engineering postgraduates, 24% of automotive engineering postgraduates and 16% of production and manufacturing postgraduates choose to study their master’s at Cranfield.

1.5 We are home to many world-class, large-scale facilities which enhance our teaching and research. We are the only university in the world to own and run an airport on campus and to have airline status.

Cranfield’s work with Autonomous Vehicles

2.0 Cranfield has a leading reputation in autonomous systems, established with over 15 years of research in this field. Our expertise covers all types of autonomous vehicles including airborne, ground, marine and space. We work with a number of organisations across various sectors including defence, military, aerospace, transport, research councils and UK/European Government in this area.


2.2 Our facilities include the Autonomous Vehicles Laboratory which is equipped with a netted area for flight tests and a variety of sensors, used for testing in the areas of guidance, navigation, control and surveillance.
2.3 Cranfield University is in the process of building IMEC, a new STEM teaching and learning facility dedicated to the provision of education, training and qualifications for the burgeoning Intelligent Mobility workforce, supported by HEFCE and SEMLEP.

2.4 The Intelligent Mobility Engineering Centre (IMEC) will provide access to further education providers, collaborating universities and industry to deliver sector-relevant education and training in a multi-level environment to provide a skills and qualifications pathway to Cranfield University’s new MSc IM (Intelligent Mobility) offer. IMEC will also offer post qualification leadership, management, executive and entrepreneurial continuing professional development open and bespoke courses. The aim is to provide real-life team-working in the transport systems sector, equipping individuals and partners with the knowledge required for the 21st-century workplace.

2.5 Multi-User Environment for Autonomous Vehicle Innovation (MUEAVI) is a £9m project under development at Cranfield University that will begin to operate as a ‘full scale living lab’ in the spring of 2017. The UK government has invested £3m in the project, through the UK Growth Deal initiative, as an investment in national infrastructure to facilitate research and development for the rapidly developing Intelligent Mobility sector.

2.6 The road, its surroundings, and its day-to-day users, will provide an open research, development, test and demonstration environment for autonomous transport innovation. The MUEAVI facility will integrate research and development, not only in the fields of autonomous technologies, but also in systems engineering, sensing and prognostics, technology diffusion, societal adoption, safety and regulation, complexity science, human factors analysis, risk and policy assessment and ergonomics.

2.7 As well as the technology of autonomous vehicles themselves, research across the University also develops the applications of autonomous vehicles in wider society.

- Academics within the Cranfield Soil and Agrifood Institute are using ‘drones’ for remote sensing imagery to improve crop monitoring.
- Work within the Cranfield Institute for Resilient Futures includes the use of drones for flood extent mapping and damage assessment, robust hydromorphological characterisation and floodplain forest restoration monitoring. Further research activity also includes underwater vehicles for coral reef habitat identification, as well as radio controlled and autonomous boats for freshwater ecosystem monitoring.
- The Centre for Safety & Accident Investigation is developing the use of drones to improve accident investigations.
- As a University, we are also working with a number of SMEs helping to test and prototype Autonomous Vehicles applications and services.
- In the Centre for Logistics and Supply Chain Management, based at Cranfield School of Management, the potential impact of autonomous vehicles on the supply chain is being examined.

**Impacts and benefits**
3.0 The fundamental technology for managing autonomous vehicles and systems is available - but the bigger question is how it can best be used for economic and social benefits.

3.1 This is disruptive technology that could impact on all areas of society, many of which were discussed at a recent conference held at Cranfield University ‘Visions of an Autonomous Future’, featuring leading academics and industry figures from across the UK.

3.2 Some jobs are likely to be replaced; in other areas autonomous technology will be a solution to skills shortages, such as freight lorry drivers; and, more broadly, there will be many more jobs created in technology development, maintenance and management.

3.3 The economic benefits from a world-leading industry around autonomous vehicles (AVs) have already been mapped out: a potential £51 billion for the UK economy each year according to research from KPMG.

3.4 The most obvious benefit of the technology is the movement of people and goods. As transport systems become more crowded and more complex, there is a general need for more autonomous technologies to reduce the increased potential for human error and improve safety.

3.5 The increased sophistication provided by autonomous systems will be an essential underpinning of increased traffic volumes in airspace, on roads and at sea.

3.6 Ninety-three per cent of road accidents are said to be caused by human error; by 2030, the introduction of driverless vehicles is expected to save 2,500 lives and reduce the number of serious accidents by 25,000. In general, roads and central public areas will be safer for pedestrians through anti-collision and speed control technology. Greater traffic management will reduce congestion and lower journey times, reduce CO2 emissions and noise.

3.7 Cranfield is currently working in collaboration with others on CogShift, one of five projects which are part of an £11 million UK Government investment in autonomous vehicle research. CogShift is studying driver attention and cognitive control characteristics. The project will use these to develop an optimal control-authority shifting system which takes driver attention into account.

3.8 As a step on the way to fully self-driving cars, we will see cars that are self-driving part of the time but must still be human-driven at other times. For comfort and safety, it is important that there is a smooth and swift transition between the self-driving and human-driving modes. A particular risk is that human drivers may not be ready to take over safely, as they may be preoccupied with non-driving tasks.

3.8 More use of unmanned aerial vehicles for deliveries and some public services such as security and monitoring will also cut traffic volumes. Driverless vehicles won’t need to be parked in crowded central areas but tidy themselves up and park out of town. There’ll be better access for emergency vehicles due to reduced traffic and their ability to interact and alert other vehicles.
3.9 The technology will also be of particular value in helping governments and societies address issues of transport for the ageing population, allowing for independent and mobility for people into older age. Driverless cars will allow older people to be mobile and independent to any age, without relying on public transport and subsidies.

3.10 They would also offer local authorities a lower-cost option for delivering services like security, environmental monitoring and refuse collection. Fewer accidents and risks in general means lower insurance costs. Investments into the infrastructure for AVs will be repaid from attracting more business and additional residents looking for next generation access and mobility.

3.11 Autonomous ground vehicles can also speed up air travel with less time spent refuelling, removing and loading luggage, and generally improving the efficiency of ground operations. One of the biggest factors in airport delays is ground vehicle collisions – a greater use of autonomous vehicles will help reduce this. Cranfield is currently seeking funding for the Digital Aviation Research and Technology Centre (DARTeC) which will pioneer research in this area.

3.11 Cranfield University research is already demonstrating the benefits autonomous vehicles can have on crop monitoring, flood damage assessment, water pollution monitoring and accident investigation among many others.

Research and development

4.0 Most important of all will be securing public understanding and acceptance to support implementation into towns and cities in stages, the opportunity for lessons to be learnt without the level of opposition that means the transformational benefits are lost.

4.1 At Cranfield we’ll soon be opening an intelligent mobility road running through the campus, allowing for projects to test combinations of road and aerial vehicles in a real-world environment.

4.2 With our own airport, intelligent mobility road and autonomous vehicles research facilities Cranfield’s campus can become a ‘living lab’ to test autonomous vehicles and help strengthen the confidence in how autonomous vehicles can be combined in populous areas.

4.3 Cranfield University is currently involved in AIRSTART (Accelerated Integration of Reliable Small UAV systems Through Applied Research and Testing) funded by the Aerospace Technology Institute (ATI). AIRSTART is a collaborative £3.2 million project led by Airbus Group Innovations. Running until December 2017, it involves a number of stakeholders including SMEs and other research institutions.

4.4 AIRSTART seeks to drive UK leadership in small commercial UAS (lighter than 150kgs) by overcoming major barriers to growth.
4.5 The barriers, that AIRSTART is examining, are mainly the lack of affordable, lightweight, sense and avoid and fast and secure, communications technology required to enable its safe operation ‘Beyond Visual Line of Sight (BVLoS)’, as well as increased endurance. This will be achieved through research and development in new technologies that also have applications in manned aviation and space sectors. We are testing novel hybrid power systems and laser communication systems as part of the AIRSTART project.

Real world operation

5.0 There’s nothing inevitable about the transition to autonomous vehicles given the critical role of public understanding and support of sharing our transport systems with ‘robots’. However, we already do it – around 95 per cent of everyday passenger aeroplane flights are under computer control – but it’s a question of perception.

5.1 There’s a stark difference between autonomous features already available in our cars, the assistive technologies like cruise control, self-parking and collision detection, and the principle of allowing computer-controlled ‘robot’ vehicles onto roads. At the moment, the public tend to trust technology when it’s under human control, based on human decisions, even when all the evidence shows that it’s the human frailties that cause accidents and not the technology.

5.2 The reality is that any accidents or incidents involving AVs in pilot trials on UK roads will be emphasised as evidence of the unreliability of the technology, and for prejudices to be confirmed.

5.3 The development of the technology is moving much faster, driven by the interest of hobbyists and vast potential for useful applications in environmental monitoring, security and logistics, than the regulations governing autonomous vehicles.

5.4 Aerial UAVs create a plethora of regulatory hurdles – how do you regulate the hobbyist and the SME looking to develop an application and the large-scale companies looking to develop their logistics and supply chain operation, all under the same regulations?

5.5 It will be a challenge to regulators to maintain safety and allow innovation to flourish. Too strict regulation and business will be discouraged to take risk, too lax and safety issues will see the public unwilling to embrace technology and provide demand in the marketplace.

Skills requirement

6.0 Building the engineering skills base is essential for the UK to capitalise on the emerging market around autonomous vehicles. The shortage of engineers that the UK faces not only threatens the development of autonomous vehicle technology but also the creation of applications for autonomous vehicles.

6.1 The roll-out of autonomous vehicles will be disruptive and will demand changes in education and skills. In agriculture for example, a farmer may need to know how to
programme an autonomous vehicle and how to interpret the vast amount of data that the vehicle has captured.

Conclusion

7.0 The question around autonomous vehicle technology is when will it be available rather than if it will be available. This raises questions for regulators, industry and the public as a whole, as the technology leaps ahead of regulation and societal acceptance.

7.1 The technology is disruptive – its introduction will change everything from the way we farm, to the way we receive goods, to the way we travel.

7.1 Public attitude will be an important factor in how fast the UK moves in this market, potentially worth £51 billion to the UK economy, will the public be prepared to trust and accept the technology and its applications?

7.2 Cranfield University’s research facilities offers an ideal place for regulators and industry to work through some of the challenges that they face in developing technology, its applications and building public confidence.

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