1. This submission focusses on unmanned autonomous air vehicles. I have been involved in research in autonomous air vehicles for over 15 years, and lead the University of Southampton’s Strategic Research Centre in Autonomous Systems.

2. The potential market for unmanned air vehicles (UAVs) is huge, and the UK is potentially in an excellent position to benefit from this new market. However, there are both technological and regulatory issues to overcome.

Potential applications

3. The potential applications for autonomous air vehicles are enormous, and cover a large number of sectors and interests. In trying to map out these potential applications and markets, it is helpful to consider three fundamental things which autonomous air vehicles might be able to do:

- **Observation** – vehicles can be used to carry cameras, sensors and data-collecting devices, both to observe the ground below them and the air around them. Aerial photography is already a growing market, and this will be supplemented by detection using other sensors. Uses could range widely from agriculture to urban planning; mapping changes due to, for example, natural disasters; monitoring coastal erosion; and for leisure uses such as providing TV images of news or sporting events.

- **Transportation** – vehicles which can be used to transport items. An example launched in Rwanda in October 2016 is Zipline, which is transporting blood products and medical supplies to remote locations which cannot quickly or easily be reached by road. Major companies are also interested in using autonomous air vehicles for more regular parcel delivery in urban areas.

- **Interaction** – vehicles which can interact with something in the environment, such as tightening a bolt or attaching a label. There are commercial opportunities in construction, and in maintenance of structures.

Technical challenges

4. Autonomous air vehicles are already in use today. For this market to grow and develop, such vehicles need to become:

- **more useful** (performing tasks previously impossible or improving performance of existing tasks, such as working in a wider range of conditions);
• cheaper, both in terms of the investment needed to deliver a new mission and of the operating cost to perform it, reducing time and personnel required; and
• safer, following routine operating procedures and subject to rigorous evidence-based risk assessments and mitigations.

5. In order to achieve this, there are technical challenges which need to be overcome which researchers at the University of Southampton and elsewhere are tackling. These challenges include:

• greater levels of autonomy;
• higher agility and reduced turnaround time from requirement to mission;
• better scalability - the exploitation of increased numbers and operational tempo of aerial robots;
• more capability - vehicles that can do harder tasks in more difficult conditions; and
• a higher level of safety, where more complex operations can be performed without unacceptable risk.

6. These are significant individual challenges but they also interlinked, and increasingly researchers are addressing them in large, interconnected programmes of research.

Regulatory issues

7. Getting the right regulation is critical to develop both the technology itself and the commercial applications of that technology. Regulations which are too permissive could put people and property at risk, but if too restrictive they will suppress innovation and new developments.

8. In the United States, the Federal Aviation Authority is investing heavily in widespread civilian drone trials at a large number of US universities. This will ensure that future US drone legislation will be evidence based and robust.

9. In the UK, the Civil Aviation Authority is responsible for regulating the use of autonomous air vehicles. So far it has been cautious in allowing such vehicles to fly autonomously beyond the “line of sight” of an operator, and with no distinction made between urban, rural and remote regions of the UK. The Zipline technology which is now operational in Rwanda, for example, could not be used in the UK for regulatory reasons, even though it could have real benefits to remote communities in (for example) Scottish islands.

10. In Europe, the European Aviation Safety Agency (EASA) have recently proposed a Prototype European Commission Regulation on Unmanned Aircraft Operations, which is currently out for consultation. We believe that these draft regulations would have the effect of stifling the market for innovation in this area, by placing burdens on modellers and academics (the groups where much of the innovation comes from) which are completely disproportionate to the associated risks. In part that is because
the EASA risk assessment is based only on the severity of possible events but not the likelihood, and without a comparison to the current environment.

11. The UK will have to make regulatory choices over the next few years which will have a significant impact on the development of autonomous air vehicles and the industries which will use them.

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