The Foundation for Science and Technology
Debate Record Note

The Industrial Use of Drones

Date and Location: 20th November 2019 at The Royal Society

Chair: The Rt. Hon, the Lord Willetts FRS
Chair, The Foundation for Science and Technology

Speakers: Elaine Whyte
UK Drones Lead, PwC
Professor Tom Scott RAEng
Professor of Materials, University of Bristol and Director, South West Nuclear Hub
Pae Natwilai
Chief Executive and Founder, Trik

Report Author: Dr Lorna Christie
Foundation Future Leader, Parliamentary Office of Science and Technology (POST)

Sponsors: The Royal Society of Edinburgh

Audio/Video Files: www.foundation.org.uk

Hash tag: #fstdrones . Twitter Handle: @FoundSciTech .

ELAINE WHYTE, UK Drones Lead at PwC began her talk by highlighting that drones are simply a different way to collect data, and collecting aerial data is disrupting the way people are doing business. PwC's May 2018 economic study found that drone technology has the potential to increase UK GDP by £42 billion (or 2%) by 2030. However, in order to do this there are three key areas the UK needs to focus on: advancing drone technology, expanding drone regulations and encouraging societal acceptance of drones. Elaine highlighted that public acceptance often gets overlooked but is an important factor in this debate.

Elaine highlighted that one of the most mature applications of drones is in the film industry. A prime example of this is the TV series 'Blue Planet', in which the film crew used drones to capture footage of the environment, offering an insight that humans had not seen before. Drones are increasingly being used in inspection and surveying, where they are often quicker, cheaper and more accurate than traditional methods. What might be closer to home is the idea of using drones for home delivery, which some stakeholders have said may be possible within 5 years.

PwC undertook a trust survey to investigate public opinion of drones. The study found that when it comes to 'risk to life' scenarios, over 80% of respondents wanted to see drone technology being used. This is reflected by the increased drone uptake in police forces, for applications including search and rescue. On the flip side, society is not so ready to accept drones for package delivery. However, there may be benefits in combining these use cases, for example, using drones to deliver medicines.

More drone trials are now taking place in the transport sector. For example, Manchester Airport has trailed several drone use cases, one of which was transporting aircraft parts from one part of the airfield to another. Network rail have also used drones to identify faults on railway lines. Elaine commented that she could definitely see a future where drones are used to collect information on faults in the transport system to prevent transport delays.

Elaine commented that drone regulations need expanding in order to reach the £42 billion potential GDP growth by 2030. At the moment, drones can only be flown when the operator is able to see the drone (within visual line of sight). Flying beyond visual line of sight (BVLOS) requires special permission which may only be granted in certain cases. It's likely that some sort of traffic management system in the lower airspace will be needed for drones to operate in.

PROFESSOR TOM SCOTT, University of Bristol, started by echoing Elaine's comments about drones representing a big financial opportunity in the UK and globally. Drones can offer enormous cost savings, particularly in areas such as inspection and surveying.

Professor Scott's work involves using drones to capture information about radioactive hazards on nuclear sites to assess whether it's safe for humans to go into certain locations. Drones are a great way to collect data from places that matter - for example, dangerous locations. A good example of this is the Sellafield nuclear site, which has a lot of high-risk infrastructure on a small area of land. One of the key costs associated with running this site is ensuring safety measures. Tom's team were the first people to fly a drone at a UK nuclear site as part of a demonstration using a drone to record radioactivity data. The data collected by the drone was able to give an indication of what materials were contained within different buildings across the Sellafield site.

In the nuclear sector drones can contribute towards some of the cost saving goals that the industry has signed up to. Drones can contribute to these goals because they are repeatable, offer increased efficiency, and can remove the cost of having a person in a dangerous environment. An example of a use case in the nuclear sector is using drones for routine inspections. Drones can be used to carry out quick inspections that take around 20 minutes. This is a huge time saving compared to a human doing it, which would typically involve additional processes such as putting up scaffolding and hiring specifically trained staff to work at heights.

Drones can also be rapidly deployed in emergency response context. For example, it may be as little as a minute between parking an emergency vehicle and having a drone in the air. The 'plug and play' nature of drones means you can choose what type of sensor to fit on to the drone depending on what you want to measure or detect. Furthermore, drones can transfer data back to the operators in real-time, meaning personnel on the ground have a really good situational awareness. In emergency response, the ability for drones to cover large areas very quickly is also very significant.

Tom highlighted that the industry has made big strides in drone technology. When he first started working with drones, they were unreliable, and people wouldn't trust drones to fly autonomously or land effectively. However, they now have excellent repeatability, reliability and robustness and there is a much lower risk of them going down or failing.

For radiological inspection, repeatability is very important, and drones are now able to carry out repeat inspections with a higher degree of positional accuracy than a human being. This means that survey data can be compared more reliably. The same argument about removing humans from certain roles applies to radiation detection: Humans have the potential to block radiation when carrying out survey measurements, meaning that the radiation level readings may come up lower than the true level. A drone is very poor at blocking radiation, meaning it gives better sensitivity of readings and removes human error.

Tom highlighted his work in the Red Forest (a forest area surrounding the site of the Chernobyl nuclear power plant). When the Chernobyl disaster happened in 1986, people did not have drones or method to do real -time radiation level monitoring. Instead they used helicopters to make point samples of radiation levels. Today, with drone technology, this can be done very differently. As part of a research project, Professor Scott and co-workers used a combination of fixed wing and multi rotor drones to map the extent of radioactivity in areas of the Red Forest. This project demonstrated that in a nuclear emergency either in the UK or elsewhere, we would be able to use this technology to very quickly map the extent of the radioactivity. It is necessary to use a combination of fixed wing and multi rotor drones for this work because these different types of drone have different capabilities. Fixed wing drones are good for flying across large areas as they have a bigger range. Multi rotor drones cannot fly as fast, or for as long, but can get much lower to the ground and offer a better special resolution.

Professor Scott finished by saying that there needs to be a convergence between the technology, societal acceptance and evolution of the regulation, with one of the biggest issues being that drones cannot currently fly beyond visual line of sight. Some of the things that could enable drones to beyond visual line of sight in the future include: having a proven detect and avoid system, using a transponder fitted to drones to ensure

they are visible to other systems at all times, and utilising new telecommunications networks such as 5G.

PAE NATWILAI, CEO of Trik started by saying that about 5 years ago she realised that drones could be used to make it easier to capture data, particularly in inspection and maintenance applications. However, at this time, people were still sceptical about drones. Pae realised that the most important consideration was to think about what technology people are willing to adopt and use

Pae started the company Trik, which has developed a 3D analytical software for structure inspection. Trik focuses on how to utilise the data that drones capture for surveying and inspection. Nowadays, cloud computing means that it is possible to upload a lot of data to the cloud, process it very fast, and stream it back down again to look at the results. It's now possible to do things like monitoring, 3D modelling and analytics in real time. One of the key challenges is how you visualise the data and results when there is such a large amount of it. It almost becomes impractical to visually get access to all of it

Trik is a cloud platform that turns drone data feeds into an interactive 3D model, which can be measured and annotated. It pulls together multiple different types of data and makes it possible to view it online, on any device. This makes it possible to have a 'digital twin' of a piece of infrastructure. Pae commented that in the future she expects that we will be able to do real-time mapping so that when a drone flies around a structure, it can gradually generate a 3D model. This could be crucial to enable beyond visual line of sight drone flight, as the drone will be able to livestream data and map its surroundings.

Pae noted that while it's possible to use a drone to map a building or even a whole town, this requires the collecting and analysis of a vast amount of data which is difficult for a standard computer or tablet to open. One of the features of Trik's 3D mapping software is that it's possible to choose to look at different resolutions as you zoom in to different areas. This means that hardware is not a limitation to seeing the information.

Pae has worked with Innovate UK and the Department for Transport to develop a system where a user can have 3D modelling data live streamed to a VR headset. Typically, when using a VR headset, it's necessary to download the data that will be displayed in the VR environment. However, this project demonstrated that it was possible to have real-time live streaming of this information directly to a VR headset.

Pae finished by highlighting that there is increasing interest in applying modelling techniques to new digital infrastructure, particularly with 5G on the horizon. For example, there has been increased interest in digitally mapping telecoms assets so that operators can figure out how much equipment they can add to masts.

Debate

In the debate that followed, the issue of public perception of drones was a major concern. The panel highlighted that the Gatwick incident of 2018 may have influenced public opinion of drone technology, but this has not been measured. On the flip side, the panel noted agreed that we are now seeing more positive news stories about drones and how they have been used to benefit society. The panel also highlighted that local authorities are becoming more open minded and accepting of drone technology, which represents a change in attitude and more enthusiasm around them. Furthermore, sales of recreational drones have increased in recent years, which may also be an indication of an increasingly positive public opinion of the technology.

There was also a discussion around bad actors using drone technology and the use of drone countermeasures. A commonly cited example is bad actors using drones to deliver drugs into prisons. The panel acknowledged that this is an issue and highlighted other potential dangers such as the use of drones to deliver explosives. The panel agreed that when a new technology emerges, there will always be bad actors attempting to use it in a negative way. One panel member highlighted that the first step to preventing a potential incident is to ensure drones can be tracked in the first place. This can be done using radio waves, radar or thermal imaging.

It was highlighted that counter drone technology has received funding in the last year. One of the most promising counter drone technologies is a type of tight-band radio signal which disrupts the radio signal controlling the drone. However, this can only be used for radio-controlled drones. In addition, the panel noted that organisations should have risk assessments in place for drone incidents.

There was also discussion on what more needs to be done to move drone technology forward in the UK. The panel reiterated that a change in regulation to allow drones to fly beyond visual line of sight would be a key step forward. It was also noted that advances in other technologies are also needed. For example, advances in

battery technology are required so that drones can fly for longer, and advances in sensor technology would make drones weigh less. Another point raised was that drones are currently not very resilient to adverse weather conditions, which restricts their use in certain scenarios.

Dr Lorna Christie