# THEY'RE GREAT!

Eight technologies which could allow the UK to take a market lead. By **Graham Pitcher.**

Last year, while he was still minister for universities and science, David Willetts wrote a paper for the 'think tank' Policy Exchange in which he argued that the UK was either leading the world – or had the opportunity to lead – in a number of technologies. The paper's title summed it up – 'Eight Great Technologies'.

In his introduction, Willetts asserted that the UK is the best place in the world to do science of all kinds. But, while Willetts drew up the list, it was the Chancellor who gave the concept its first airing. Speaking to the Royal Society in 2012, George Osborne said: "I want to begin a debate about eight future technologies where we believe we can be the best – where we already have an edge, but could be world leading."

The technologies in Willetts' paper are:

- Big Data; where he believes the UK can lead the big data revolution as well as develop energy efficient computing.
- Satellites; not just designing and building them, but also working out ways to exploit the data they collect.
- Robotics; ranging from devices for assisted living to those capable of decommissioning nuclear power stations.
- Life Sciences; including synthetic biology and genetic engineering.
- Regenerative medicine; technologies to repair the human body.
- Agri Science; helping to improve the efficiency of food production.
- Advanced Materials; developing new materials to support sectors such as aerospace and quantum photonics.
- Energy Storage; said by Willetts to be one of the most important applications for advanced materials.

Willetts' position was that considered support from Government will help the UK to make that leap to the forefront of each area.

Since his 2012 speech, the Chancellor has made a number of significant investments in what can be termed basic science. These range from £50million to underpin graphene research through the creation of the National Graphene Institute to £270m over five years to investigate quantum technology. Earlier in 2014, he caught many people's attention when he announced in his Budget speech that he was allocating £42m to set up the Alan Turing Institute to explore big data and algorithm research.

Here's a quick look at what's happening in Big Data, Satellites and Robotics.

## Big Data

Perhaps the topic carrying the greatest momentum at the moment is Big Data. It's an approach tied closely to the Internet of Things and to the broader use of data analysis.

There's an awful lot of data around. Estimates suggest several exabytes of data ($10^{18}$) are generated each day. The thinking is that, by analysing this data at a very high level, greater insights can be gained into particular areas, including technology and business.

But the problem is that traditional computing approaches aren't geared up for the task. You only have to look at weather forecasting to understand that, despite the fact there is a lot of data describing weather systems around the world, analysing what that data means is still problematic.

The Large Hadron Collider at CERN is another example. Even when just 0.001% of the sensor data is collected, the four experiments would amass something like 25Petabytes ($10^{15}$) of data per year. That, by any description, is Big Data.

So how can such volumes be analysed? One of the subsets of the Eight Great Technologies programme is to develop the technologies required – not only software, but also hardware.

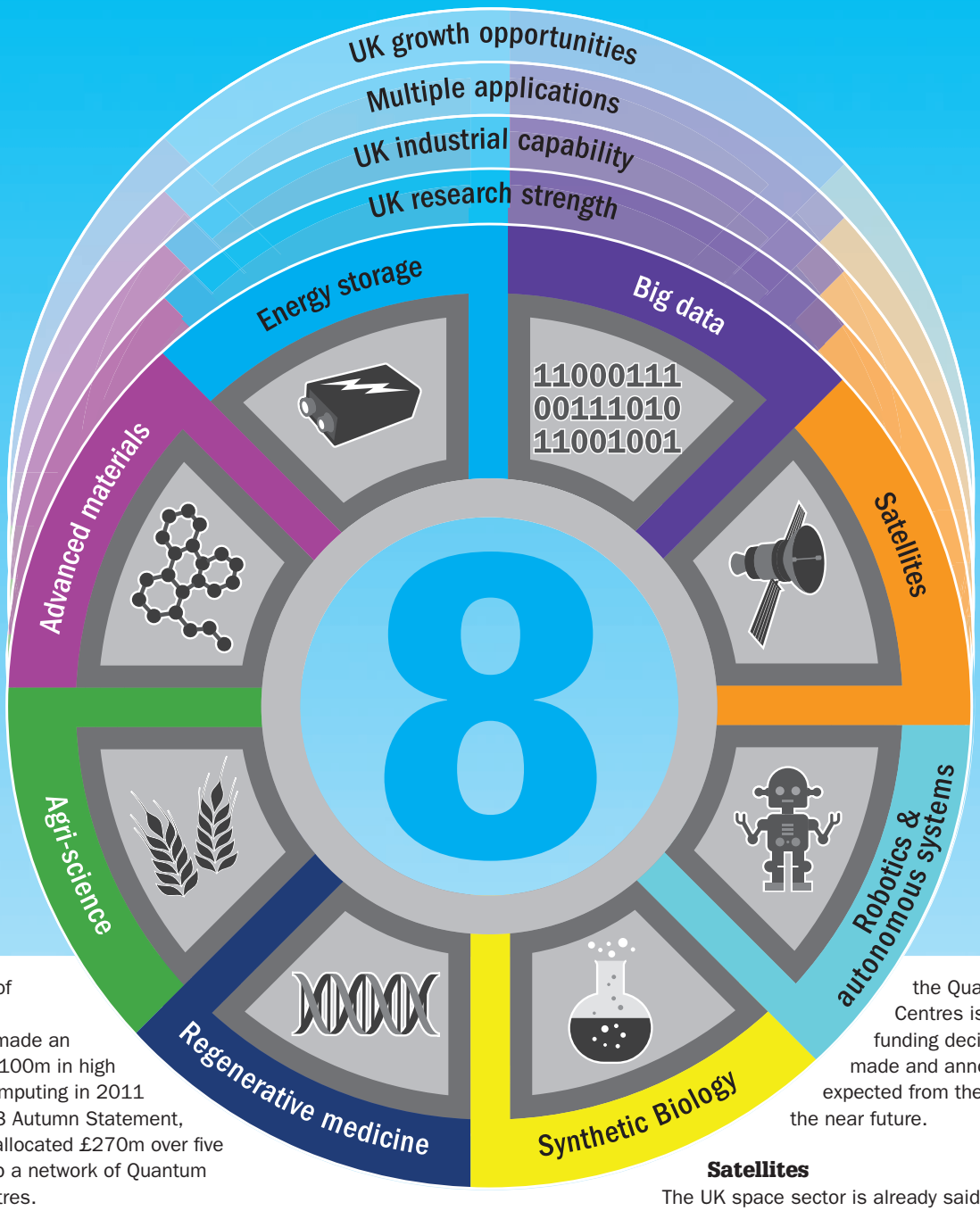
The Chancellor's announcement of funding for the Alan Turing Institute is slowly turning into reality, with the Engineering and Physical Sciences Research Council (EPSRC) taking the lead. It is just closing an invitation for partners to help establish the Institute, which will be a physical entity, rather than a virtual network.

Willetts' successor as minister of state for universities and science, Greg Clarke noted: "It is a fitting tribute to Alan Turing that this Institute will push the boundaries of mathematics and lead the way in research, education and knowledge transfer."

Expanding, EPSRC chief executive Philip Nelson, added: "Big Data plays an increasing role in research across many scientific and engineering fields and therefore it is vital that the UK stays at the leading edge in this area."

In its call, the EPSRC notes: "The work of the Institute is expected to encompass a wide range of scientific disciplines and is similarly expected to be relevant to a wide range of business sectors. The Institute will be centred upon a discrete independent facility which has the potential to be used as a focal point for a wider network of national activity. There will be scope for the co-location of similar national centres where there are clear synergies and there is the potential for the national clustering of economic activity based upon big data exploitation."

Big Data analysis will only be enabled by the development of high performance computing technologies




– another area of interest to the Chancellor. He made an investment of £100m in high performance computing in 2011 and, in his 2013 Autumn Statement, the Chancellor allocated £270m over five years to develop a network of Quantum Technology Centres.

It's another area being handled by EPSRC, which says there will be up to £20m per centre, along with a £75m fund for capital investment. EPRSC says at least five areas will be supported: quantum secure communications; quantum metrology; quantum sensors; quantum simulators; and quantum computation.

Quantum computing is certainly one of today's hot topics. The attraction of quantum computing is that it offers a completely different way of processing information and the potential to solve computing problems that cannot be addressed with conventional technology. Quantum communications, meanwhile, is suggested as offering a way to transmit data in a completely secure manner.

According to EPSRC, the process of examining the expressions of interest for Turing Institute partners and for the Quantum Technology Centres is complete, funding decisions have been made and announcements are expected from the Government in the near future.

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**Philip Nelson**

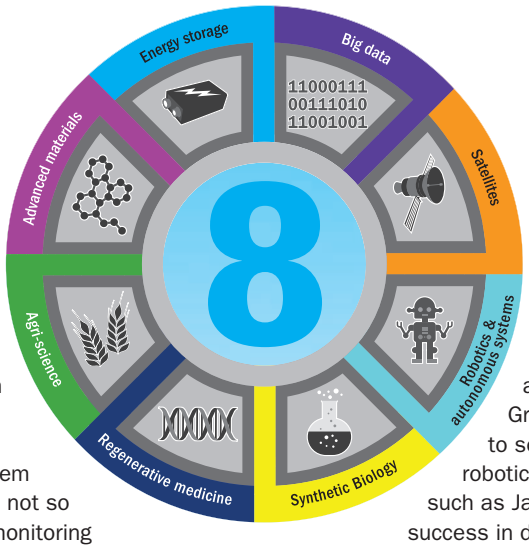
### Satellites

The UK space sector is already said to contribute £9bn a year to the UK's economy and to be growing at something like 8% a year. The Government's ambition is for the industry to be worth £30 billion a year by 2030.

It can be argued that the Space Race of the 1960s resulted in a step change in technology; there were challenges which needed immediate solutions. The technologies developed have since found widespread application, including such materials as Teflon.

But space in the future will offer different benefits – and many of these will revolve around exploiting the data collected by satellites.

Talking to *New Electronics*, Paul Febvre, chief technical officer of the Satellite Applications Catapult, noted: "We need to focus on what satellite data is going to be used for, how it is going to be used in the future and how it is




going to be relevant to society." He believes the value of satellites will be enhanced when they are combined with terrestrial systems.

We're already used to the concept of navigation services provided by the GPS system and with satellite communications. But we're not so familiar with the potential of environmental monitoring systems.

The UK already has the National Centre for Earth Observation, a partnership of more than 100 scientists from UK institutions whose mission is to unlock the full potential of Earth observation data.

Data from Earth observation satellites is being used to monitor global and regional environmental changes and to improve predictions of future environmental conditions.

But there will be many hardware based opportunities – and it's not just a sector for those companies with seemingly bottomless pockets, as demonstrated by companies such as Clyde Space, whose CubeSat UKube-1 was launched into space in July 2014.

### Robotics and autonomous systems

If the EPSRC is to be believed, the UK is 'sitting on a robotics goldmine'. Its Robotics and Autonomous Systems strategy suggests the UK is in a 'prime position' to exploit a market estimated to be worth in excess of $2bn a year by 2025.

Professor David Lane, chair of the Robotics and Autonomous Systems Special Interest Group, said: "The UK is a substantial contributor to some of the world's best research in the field of robotics and autonomous systems, but countries such as Japan, Korea and the USA have had greater success in developing companies to exploit those opportunities. We need to provide a business environment in the UK that is geared towards helping robotic and autonomous technologies out of the lab and into the marketplace.

"The UK has an exceptional heritage in many of the industries where robotics can be most useful and our world leading research base makes us ideally placed to exploit the opportunities arising in these fields, but we need to act quickly if we don't want to be left behind. With the right course of action, we believe the UK could achieve 10% of the global market share by 2025."

Rich Walker, managing director of Shadow Robot, said: "We've been developing robotics technologies for more than a decade. Getting 'joined up' thinking between government, research and industry to position the UK as the best place in the world for robotics and autonomous systems is a fantastic opportunity for technology SMEs and will help us take our technologies into places we could never previously hope to reach."

A recent initiative in the field of robotics is the launching of a fleet of seven robotic vehicles by the National Oceanography Centre (NOC). Each is expected to travel 300miles in 20 days, collecting scientific data about the ocean off the South West of England and its wildlife.

Dr Russell Wynn is scientific coordinator. "Nothing on this scale has been attempted before. The range of vehicles and instruments being deployed at the same time is unique and they will generate vast amounts of valuable scientific data. Robotic vehicles are relatively small and quiet compared to research ships, so they are ideal for making observations of marine life. This new technology is really transforming our ability to measure and monitor the ocean."

### The last word

According to the Chancellor: "In the long run, it is technical change which determines our economic growth – we become more productive not by more back-breaking labour, but by working with more knowledge in our heads and more equipment in our hands. That knowledge and that equipment are achieved through scientific and technological advance."

### 14 US challenges

The UK isn't alone in identifying technology challenges. In 2008, the US National Academy of Engineering highlighted these 14 topics as being critical:

- Making solar energy economical
- Providing energy from fusion
- Developing carbon sequestration methods
- Managing the nitrogen cycle
- Providing access to clean water
- Restoring and improving the urban infrastructure
- Advancing health informatics
- Engineering better medicines
- Reverse engineering the brain
- Preventing nuclear terror
- Securing cyberspace
- Enhancing virtual reality
- Advancing personalised learning, and
- Engineering the tools of scientific discovery

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