

Disruption & Technology

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When politics and social media collide

Leaders can connect with followers as never before, but boosting engagement is tricky, says *Jim Pickard*

Technology has been as disruptive in politics as in every other sphere of life. For one thing, it provides us with insights into the thinking of the world's politicians in a way that was never before possible.

For example, to see what goes on inside Donald Trump's mind you can study his personal Twitter account (12.5m followers). In August, when NBA player Dwyane Wade spoke about the shooting of his cousin in Chicago – a city the Republican nominee has repeatedly cited as exemplifying America's woes – Mr Trump jumped straight in: "Dwyane Wade's cousin was just shot and killed walking her baby in Chicago," he tweeted. "Just what I have been saying. African-Americans will VOTE TRUMP!"

Critics rushed to their keyboards to

condemn the billionaire for tasteless opportunism. However, unfiltered by press advisers, the Republican presidential candidate continued to tweet with bombastic aggression.

In October, as Republicans deserted Mr Trump following a spate of bad publicity, he declared on Twitter: "It is so nice that the shackles have been taken off."

The interplay between politicians and social media was an important part of Dave Eggers' satirical book, *The Circle*. This is about a fictional Californian tech company emerging as the dominant social media, email and messaging platform. The novel, a warning against the internet's remorseless creep into people's private lives, featured politicians agreeing to allow cameras to film them during their waking hours.

We are not at that point yet, but world



Instant communication: a journalist records US presidential nominee Donald Trump at the first television debate with rival Hillary Clinton in September

Carlos Barria/Reuters

leaders and their wannabe replacements can now have unfiltered communication with online followers.

Democratic candidate Hillary Clinton, who has 9.8m Twitter followers, has used social media to hit back at Mr Trump's criticisms. Meanwhile, incumbent US President Barack Obama has more than 78m followers on Twitter, while India's prime minister Narendra Modi has more than 23m.

Politicians have a choice. Some show their true selves on the internet, with the risk of enraging or offending voters. Others hide behind professional, bland accounts, with the risk that they can be seen as characterless.

Social media is also disrupting the relationship between politicians and older news groups. In days gone by, a politician might simply give an interview or an opinion piece to a television

station or newspaper. But newspaper sales are in decline and media groups rely ever more heavily on websites. To lure eyeballs to online articles they now use social media to attract attention.

At the same time, politicians are trying to find new ways to reach people who are increasingly consuming news through online platforms.

In the UK, online campaigning helps political parties get round the ban on political advertising on television.

They can use a scattergun approach to the internet in a way that they could not with traditional media. "Political parties used to put a huge amount of effort into one thing," says James Morris, partner at Greenberg Quinlan Rosner Research, a consultancy.

"Now they can create 150, and if only three go viral then it has been worth it."

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Politicians need new ways to reach people consuming news via online platforms

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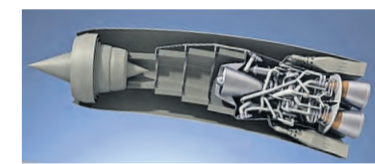
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Disruption & Technology

AI and robots line up for battlefield service

Defence The future of the US arsenal lies in next president's hands, says *Sam Jones*

Artificial intelligences have a long history when it comes to visions of future conflict: from the medieval Golem of Jewish tradition to the robotic Martian handling machines of H G Wells' *The War of the Worlds* and beyond. Even our darkest cold war visions had technology at their heart: the world ends in Stanley Kubrick's *Dr Strangelove* because a machine wills it.

The past few years, however, have seen a flowering of revolutionary technologies that make many of these fantasies a near-achievable reality: robotics and AI are now at the forefront of the military technologists' art.

Military systems used in current conflicts around the world already depend on increasingly automated processes to make them run. US Aegis missile cruisers have automated targeting systems for their anti-aircraft and anti-missile systems. In cyber space, automation is essential to the way sensitive networks defend themselves against a huge onslaught of attacks because humans simply cannot make the decisions about what is friendly and what is threatening quickly enough.

On the drawing board, AI is even a defining feature of many platforms. The prototype Taranis stealth drone, being designed by BAE Systems and expected to be operational by 2030, will mostly run autonomously.

Indeed, across the board of offensive military platforms in development, computer programs that automatically identify and select targets for their human operators are becoming ubiquitous. So far, at least, western militaries have adhered to the principal that a human being must always be kept "in the loop" for any lethal action.

The next US president will face an early decision on just how much America's future arsenal will depend on AI and robotics. President Barack Obama signed a directive on the research, development and use of autonomous weapons systems in 2012. Conscious of the moral questions such action might raise, the president inserted a five-year "sunset clause" into the order, meaning it needs an executive decision if such projects are to continue. What is decided in 2017 could determine how the world's most powerful nation wages its wars over the next few decades.

The prospect of robotics in warfare



Clear-skies thinking: the prototype Taranis stealth drone is being designed by BAE Systems and expected to be in use from 2030 — BAE

has created anxiety, as scientific development often runs ahead of our ethical and moral consciousness. The implications of *Terminator*-style robots on the battlefield, or drones deciding by themselves who to blast from the skies, are still not discussed with great seriousness in public. Groups such as the International Committee for Robot Arms Control, Human Rights Watch and the Campaign to Stop Killer Robots are actively trying to change that. They advocate an outright ban on the development of autonomous weapons systems (AWS).

'The US and all western states are facing a challenge of increasing costs, both of platforms and military personnel'

The US, at least, is unlikely to acquiesce to such a measure. Robotics has already been defined by the Pentagon as the future foundation of US military dominance. It is the key component of what the department of defence's strategists call "the third offset" — each offset being a groundbreaking technology that the US has explored and used to dominate warfare for years before adversaries were able to adapt or catch up with it. The first was nuclear weapons; the second precision and guided munitions.

"The US and all western states are

facing a challenge of increasing costs both of platforms and military personnel," says Elizabeth Quintana, senior research fellow and director of military sciences at the UK's Royal United Services Institute, a think-tank. "This is leading to ever more sophisticated platforms, but in ever decreasing numbers. But mass does have a quality all of its own — the third offset strategy proposes to use robotic platforms in support of larger, traditional platforms to overcome this challenge."

Robot platforms will become

essential, US strategists believe, in helping to protect valuable assets such as aircraft carriers from cheap technologies that adversaries are developing. To counter hypersonic Chinese missiles, or swarms of small explosive boats being developed by the Iranian navy, militaries like the US will have no option but to turn to robotics and AI.

"The necessity of AI is not that it replaces human agency in our military systems, but the opposite," says one senior British naval officer.

"We need robots and AI more and more so that we can keep fielding our highest-value assets, which are human, without putting them in greater and greater danger."

AI is also attractive for large, well-funded militaries precisely because of its expense. That is the essence of the third offset strategy. The technological cost of developing sophisticated AI puts such weapons beyond the reach of challenger countries, whose adoption of asymmetric warfare and cheap technologies such as drones and cyber weapons has begun to level the playing field with even the best-equipped opponents.

While AI technology may still be some years away, the ethical concerns and risks it poses are real. Proponents argue that AI will lead to greater accuracy in conflict and fewer incidents of civilian deaths and war crimes. But opponents point out that nothing goes wrong by design and that fielding robots in war with even partial elements of autonomy may change the nature of conflict.

The effect on local opinion of the US drone campaign to hit al-Qaeda's leadership in the federally administered tribal area of Pakistan since 2004 has, for example, only recently been taken seriously by military chiefs.

Arbitrary justice meted out from the sky without warning, sometimes killing innocents, has undoubtedly had a powerful and deep psychological effect on many that could, in future years, be damaging to US interests.

As Russia's invasion of Ukraine — and the huge information warfare campaign that accompanied it — has shown, the wars of the future will be as much about controlling messages and psychological operations to influence what military technologists call the "human terrain" as they will be about costly technical lethal platforms.

How robotics and AI will fit into that dynamic remains to be seen.

"AI is just a tool," says Ms Quintana. "Humans wage war. As we have seen in Syria, manned platforms can be used in a very precise or considered manner, or to commit war crimes using unguided munitions and barrel bombs. The tool is not the problem. It is how it is trained."

When politics and social media collide

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Younger consumers in particular look to social media for news, says Mr Morris. "I think there is a generational issue. For people over say 35, social media is a distinct thing, it is one among many types of media," he says. "For younger people it is their main source of media, so social media is media for them. A 22-year-old is unlikely to be watching the 10 o'clock news on television."

The old system of media "gatekeepers" has its critics — on both the left and right — who accuse newspapers of slavish adherence to the agendas of their owners.

Jeremy Corbyn, the main opposition Labour party leader, has praised social media as an alternative way to reach big audiences. He wrote on his Facebook page in May: "When in one week, we can get 1m-2m people watching online a message . . . it is a way of reaching past the censorship of the rightwing media in this country that has so constrained political debate for so long."

He may be underestimating the reach of television and newspaper websites, which still command large — albeit ageing — audiences. He may also be neglecting how mainstream media content — often short clips, shorn of context — is often shared repeatedly on social media, magnifying its impact. But Mr Corbyn has amassed an online army of supporters, able to produce much-shared messages at short notice demonising his rivals as "Red Tories" or "Blairites".

Social media tends to favour posts that are funny, surprising or shocking over complex material. The campaign for the UK to leave the EU harnessed social media to spread its basic message about "taking back control", an end to multimillion pound payments each week to Brussels and cutting immigration, without delving into much detail.

Some academics and journalists fear

Westminster MPs turn to encrypted messaging programs for whispering campaigns

First there was the pager. Then came the text message. But is the Mother of Parliaments now marching to the drum of WhatsApp? In a whirlwind political year in the UK that featured the Brexit referendum and leadership elections in the Conservative and Labour parties, there were rumblings the messaging service had found political fans.

The app, with its ability for instantaneous group chats, appears made for political scheming. As centrist Labour MPs tried to organise opposition to Jeremy Corbyn this summer, they reportedly turned to WhatsApp to discuss their plans. During the key moments of the EU referendum — the TV debates and the final count — campaigners had also embraced it. "It is big," says one. "We used it all the time."

It is unclear whether WhatsApp really changed anything: the centrist MPs who used it did not succeed in ousting Mr Corbyn; one of the Labour leader's allies denounced them as "useless".

Nonetheless, for those in government, WhatsApp — and other services such as Skype — have a big advantage over email: messages are more likely to escape the prying eye of the Freedom of Information Act.

This is not a legal point — all relevant personal messages should be disclosed — but a practical one, given that the

service is encrypted and often installed on officials' personal phones. This has not escaped the attention of the tabloid press. During the EU referendum campaign, The Sun proclaimed on its front page that the then prime minister David Cameron's allies were using the app to skirt round the restrictions.

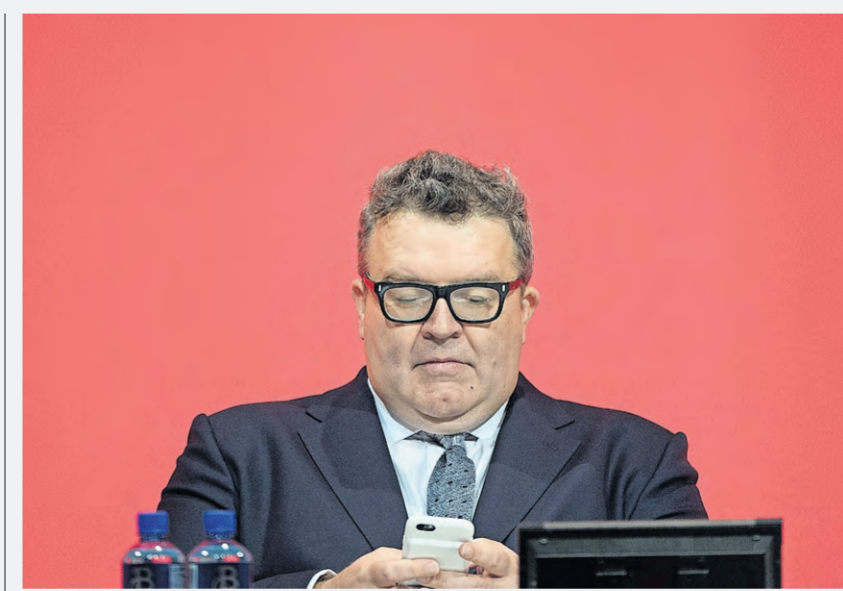
Mr Cameron's director of communications, Craig Oliver, was enraged by the report. "Those of us in the group, which is actually used to make sure we are all up to speed on fast-moving stories when we are out of the office, and late at night to take the piss out of each other, are contemptuous," Mr Oliver says of the story in his memoir *Unleashing Demons*.

"Does anyone involved in the story really understand what [WhatsApp] is or why it is used?"

In any case, WhatsApp's success may be double-edged. Once politicians have noticed a technology, they have a tendency to demand more of it.

Take Twitter. Many MPs are near-addicted to the platform, and as a result, they are well aware of the offensive content that it sometimes contains.

"It is disgraceful that any individual should have to tolerate such appalling levels of anti-semitic abuse in order to use Twitter — a social media platform now regarded as a requirement for any



On message: deputy Labour leader Tom Watson checks his phone — Getty Images

public figure," a committee of MPs concluded last month, before calling for the service to spend more money rooting out abuse.

Until January 2014, WhatsApp and rival service Snapchat had largely escaped political attention — and had never even been mentioned in a parliamentary debate. Recently, however, they have cropped up more often as the government seeks to widen its surveillance powers. MPs have

agreed with security services that the government needs "the same powers in the age of Snapchat and WhatsApp as we had in the age of the telephone".

Opposition politicians, meanwhile, have sought to show superior knowledge. Brian Paddick, a former police officer who is now a Liberal Democrat peer, told the House of Lords in October he had "10 different apps on my mobile phone" used to communicate with other people. These included "my

Facebook app, my WhatsApp and iMessage apps — which are end-to-end encrypted messaging apps — my Facebook Messenger app and my Twitter app," he said. His point was that monitoring when apps were connected to the internet — as the government was proposing — would not be particularly effective.

Yet not everyone is on the action. Those at the top of politics generally have little time for the latest technology. When Tony Blair was prime minister, he never even got the hang of a computer.

And as Conservative MP Oliver Letwin, then a Cabinet Office minister, told the House of Commons in April: "I hesitate to admit . . . that I have never personally used WhatsApp in my life." At which point the speaker said: "That probably makes two of us, then."

One of those to embrace WhatsApp, the former planning minister Nick Boles, was caught red-faced during the Tory leadership contest when a message he had sent to MPs, asking for them to support Michael Gove for tactical reasons, leaked to the press.

But the message was a text, rather than a WhatsApp chat, proving perhaps that the older medium is still king in the corridors of power. Who knows, there may even be the odd surviving pager. **Henry Mance**

that the shattering of the old systems is allowing myths, lies and distortions to spread like wildfire through our interconnected screens. "When the prevailing mood is anti-elite and anti-authority, trust in big institutions, including the media, begins to crumble," wrote Katharine Viner, editor of *The Guardian* earlier this year.

A baseless anecdote about a prime minister inserting his private parts into a dead pig's head? M15 working to undermine Jeremy Corbyn? All sorts of unverified material can go viral swiftly.

Equally, mass bullying can be unleashed to repress opposing views. For example, Labour MPs who in 2015 defied Mr Corbyn to vote in favour of bombing jihadis in Syria were subjected to online abuse from leftwing activists.

Politicians more generally also have

to live with unprecedented online acrimony. "You should see the replies I get on Twitter, just comment after comment, aggressive, poisonous," says a former Labour cabinet minister.

The often wild tendencies of the online world may seem to be the spontaneous actions of a newly liberated public to express their views.

Yet some organised groups, including governments, are taking advantage of such systems. The Kremlin, for example, has hired hundreds of citizens to spread pro-Russian messages on social media in so-called troll farms.

Then there is the problem of the "filter bubble". Sites such as Facebook, which has 1.7bn users, are increasingly tailoring content for consumers to restrict you from seeing posts deemed to be of no interest to you. This makes it

less likely that anyone will encounter material challenging their world view.

It is true that old media also tended to divide readers, typically by educational status or by political leanings: in the UK, not many people read both the *Daily Mail* and *The Guardian*, for example.

But the echo chamber effect of social media can lure activists into thinking they are gaining support when they are reaching only hardcore followers.

Charlie Beckett, professor of media and politics at London School of Economics, says platforms such as Twitter are political bubbles rather than megaphones. "Twitter can't be used to identify swing voters and nudge them to vote for you." He warns that Mr Corbyn's supporters are failing to reach beyond the converted.

"His base is criticising anybody who

The echo chamber effect of social media can lure activists into thinking they are gaining support

doesn't share their hive mind, and that's the opposite to what you need to do to win a general election," he says.

There are no signs social media is softening the global disenchantment that electorates feel about political elites.

Ed Balls, the former UK shadow chancellor who lost his parliamentary seat in 2015, says a well-organised social media "surge" can recruit members and generate excitement faster than ever before. "But social media cannot begin to explain, at root, why politics today is in such turmoil. It is a magnifier of events but it doesn't change the fundamentals."

And Greenberg Quinlan's Mr Morris says our fascination with politics is fickle. "Interest in politics on social media tends to spike at election times or during the referendum campaign, then go down again."

Disruption & Technology



Alimentary discoveries produce a gut reaction among investors

Health Companies aim to exploit one of the 21st century's big advances, reports Clive Cookson

In 2003, when University College Cork (UCC) set up a pioneering research centre to study the interaction between human health and the microbes in our body, the field was in its infancy.

The term "microbiome", which describes the trillions of bacteria resident inside each of us, was not then in common use and UCC came up with the gainfully name of the Alimentary Pharmabiotic Centre for its institute.

The growth of what the Irish university now calls its APC Microbiome Institute illustrates the flowering of a field that arguably represents the greatest advance in scientific understanding of the human body so far this century.

"We were sure 13 years ago that this would become a huge new area of human biology — and so it has proved," says Fergus Shanahan, UCC professor of medicine and APC director. "The number of research papers in the field has grown exponentially since we started."

The APC now has 300 staff and is working with 22 partner companies in the pharmaceutical, biotechnology and food industries on 26 microbiome projects.

A typical adult hosts about 100tn microbes, mainly in the gut but also on

skin, in the mouth, nose, genitals and elsewhere. They account for about 2 per cent of body weight. The vast majority of the hundreds of bacterial species in the human microbiome are benign, and indeed essential for health.

As research has uncovered more evidence about the biological role of the human microbiome, not only in digestion and metabolism but also in less obvious areas including immune response and even behaviour, so companies have piled into the field.

David Cox, healthcare analyst at UK stockbroker Panmure Gordon, notes the commitment of Nestlé, the Swiss food company, to microbiome research. "Products could be approved quickly via the consumer food supplement route in the first instance, before being reformulated as more potent pharmaceutical products," he says. "Nestlé could really help this cause for smaller players through its commercial reach."

UK companies active in the field include 4D Pharma in Leeds and OptiBiotix in York. In the US, Second Genome, based in San Francisco, has raised \$59m from investors for microbiome research. And Seventure Partners, one of France's top venture capital companies, has raised €160m for an investment fund focusing on the microbiome.

Prof Shanahan envisages three broad applications for microbiome products. The first is directly improving the composition of gut bacteria in people with impoverished microbiomes. Probiotic and prebiotic nutritional supplements do this gently by nourishing existing microbes or by adding new ones.

Skin deep: an image that includes bacteria, taken from the model's fingers, in a Petri dish
Samuel Kaye / Wellcome Images

'We were sure that this would become a huge new area of human biology — and so it has proved'

A more drastic option is a faecal transplant: moving stool material from a person with a healthy microbiome into a patient who needs a bacterial boost.

Clinical trials show the procedure can help those suffering from clostridium difficile infection, a bowel infection. But, apart from the "yuck factor", this is not a standard treatment and can be hit-or-miss in its effects. "We're trying to develop an artificial stool to replace faecal transplants," says Prof Shanahan.

Scientists at the Wellcome Trust Sanger Institute in Cambridge, England, have grown and catalogued 130 different bacteria from the human gut. Their aim is "to create a pill containing a rationally selected, defined mix of bacteria, which could be taken by patients and replace faecal transplants".

The second application is to use the microbiome for discovering new drugs, especially much-needed antibiotics. The evolutionary arms race between bacteria leads to production of molecules that one species can unleash to kill another as they compete for resources in a particular ecological niche.

Most antibiotics prescribed today are based on these molecular weapons derived from soil bacteria. But researchers expect our internal microbes to provide a rich new source. In July, for example, a team from Germany's University of Tübingen reported the discovery of a powerful new antibiotic called lugdunin secreted by nasal bacteria. Cork's APC has identified 20 potential new antibiotics from the microbiome.

Third, the composition of the microbiome is a diagnostic indicator for

some diseases. It may change, for example, in the early stages of colorectal cancer and other gastrointestinal disease.

However, Jaqui Hodgkinson, a vice-president at the life sciences division of Elsevier, part of the information and analysis provider RELX, warns that the huge volume of complex data involved in microbiome analysis poses a serious challenge. "With this complexity, comes the possibility of a huge margin of error," she says. "While there is already a lot of published data on microbiomes, some of it may not be useful at all, dependent on the context and organism used in a study. It is already very clear that the microbiomes of humans are incredibly complex and variable."

Regulators too face challenges. "Microbiomes could ultimately show more promise than existing therapeutics that try to target change in human cells," says Dr Hodgkinson. However, learning which changes will have the most chance of therapeutic success will be "essential in making microbiome analysis usable in research and development", she adds.

Steve Arlington, who chairs the Pistoia Alliance, which promotes R&D among life sciences companies, agrees. "Understanding microbiomes could be as big a leap forward in medicine as unravelling the human genome."

He adds that the challenge lies in unravelling massive data streams that currently have no agreed standards. "These are exactly the types of things that the pharma industry will collaborate on, as we need a common language to drive forward innovation."

Commuting Driverless cars pose threat to growth of cycling in cities

The bicycle was a great disrupter of social norms when it first became popular in the 1800s. It was accused of eliminating barriers between social classes and the sexes as it provided young people with a means of escape from their usual stamping grounds and any watching chaperones.

In the 21st century, the bike is seen in many nations as a way of reducing traffic congestion and pollution.

In London, more commuters are taking to bikes, with cyclists making 645,000 journeys a day in 2014, up a third from 2008. The UK capital's Santander hiring scheme enjoyed almost 10m hires last year, up from 7m in 2011. Cycling is also very much on the political agenda. New east-west, north-south and west London routes are in the works, in addition to six existing "cycle super-highways". Additionally, some dangerous trucks that afford drivers limited visibility — which were involved in 78 per cent of cyclist deaths in 2015 — are to be banned from 2020. However, carmaker Ford is



For hire: bicycle rental is growing in popularity

designed as more open, shared spaces, Prof Parkin argues.

However, other challenges remain more problematic. Adrian Lord, associate director at transport consultancy Phil Jones Associates, says. "Once people realise that an autonomous vehicle will stop [automatically], will pedestrians and cyclists deliberately take advantage and step out or cycle in front of them?"

"If that's the case, how long would such a vehicle take to drive down Oxford Street or any other busy urban high street?"

His concerns about the added congestion that driverless cars might cause are shared by Andrew Gilligan, who championed cycling under Boris Johnson, the previous mayor of London.

If the day arrives when people do not need driving licences or have to pay for insurance, and can simply call a driverless car at a moment's notice, the number of vehicles on the road is likely to increase, Mr Gilligan says.

And the eventual arrival of self-driving cars may lead to more arguments about how space is allocated between different road users, Mr Gilligan says. "Even now, taking out one of four [vehicle] lanes on Victoria Embankment [to be turned into a cycle lane] was treated as if the world had fallen in. Nigel Lawson, former chancellor of the exchequer suggested in a speech that this was the most damaging thing to happen to London since the Blitz."

But Mr Gilligan argues that the only way to accommodate both cyclists and cars happily in such a future would be to take space away from vehicles and give it to bikes.

The arrival of autonomous vehicles will require innovative solutions to share the limited road space efficiently and keep the world's commuters moving. **George Greenwood**

The big unknown is how cyclists will cope with robotic vehicles

planning to launch its first commercial driverless models in 2021 and, as automated vehicles take to the city streets, the bike itself may be subjected to technological disruption.

The big unknown is how cyclists will cope with having to share the roads with robotic vehicles. On the one hand, proponents of driverless vehicles argue they would reduce opportunities of human error contributing to accidents.

Google has taught its driverless cars to recognise cyclist hand signals to predict their movements. Vehicles will also be programmed to brake immediately if a cyclist or pedestrian steps out in front of them.

Driverless vehicles may require a different approach to transport planning in metropolitan areas, says John Parkin, professor of transport engineering at the University of the West of England.

He says that, currently, much infrastructure is being added to roads to keep bikes and vehicles apart that might not be needed in future.

When fewer cars are driven by humans, in cities at least, there would be less need to segregate cyclists from traffic. This would allow roads to be

Obstacles block Asimov's vision of accurate prediction

Data analysis

Geof Wheelwright asks if science and social media will ever be able to forecast world-changing events

In the 1940s, science-fiction author Isaac Asimov began writing his *Foundation* series of stories. At the heart of these is an early vision of what we now call data analytics: his invented science of "psychohistory". This is the notion that scientists, using sophisticated mathematics, history and sociology, might accurately predict human events — wars, revolutions, election results — and their outcomes based on the behaviour patterns of large groups of people.

Might the day be dawning when such techniques can be used to fulfil the dream of every marketing guru and political pundit, and accurately predict how large swaths of humanity will behave by analysing social media?

SC2, a Florida-based company, has already worked with IBM, HP Enterprise and Belgium's Luciad to develop software that monitors social media feeds for signs of potential conflict.

Robert Guidry, a former officer in the US joint special operations command and SC2's chief executive, says that he is increasingly seeing conflicts and attacks being forecast on social media by the

people planning them. He adds that some insurgent groups, such as Isis, are even "unashamed to declare what they are going to do" on social media.

SC2 says its clients are governments and large commercial organisations. Military scenarios feature heavily in videos on the company's website that demonstrate how its technology is used.

"We can develop models so that when an idea or concept [based on a calculable set of conditions] reaches a particular threshold of volume, or sentiment, or geographic concentration of an idea or theme, we can send an alert," Mr Guidry claims.

He also says he sees the beginnings of more accurate election predictions about who is going to win in the vast cascade of social media commentary on the 2016 US presidential election. "Polling is dead and just doesn't know it yet," he says. "People provide more guarded responses in polling than they do in social media. In social media, people just spout without thinking."

Not everyone in the data analysis field agrees. Jake Hofman, senior research scientist with Microsoft Research, says his studies suggest that insights derived from social media might not be the best source of information for predicting future human behaviour, and particularly not the results of elections.

"Things are less predictable in social [media] systems than we thought they might be," he says.

Earlier this year, he and three

colleagues published research looking at data gleaned from views expressed on Twitter during the 2012 US presidential election against traditional polling and found the two were not comparable.

"Most existing research counts each of these [social media] engagements independently, ignoring user identity information. If this were a survey, it would be the equivalent of allowing users to respond as many times as they want," they concluded.

PlaceSpeak is an online public consultancy based in Vancouver which operates across Canada and the US. Colleen Hardwick, its chief executive, says the key to harvesting accurate opinions on politics and public policy is to verify the identity and location of the people whose social media views you want to gather.

Without robust authentication tools, she says, people trying to use analysis of such information to make accurate predictions could well see their results influenced by online behaviours that are "designed to skew and distort public opinion". Such activities, she says, include: trolling (people who use threatening behaviour against opponents to deter them expressing conflicting views); "sock puppets" (accounts set

Groups such as Isis are 'unashamed to declare what they are going to do'



Social sharing: online polls may not reflect the majority view

up to hide users' identities); and "astroturfing" (orchestrated political campaigns that appear to be from genuine members of the public). These could be used to create an impression of wide grassroots support for views on social media that might not reflect reality.

Ms Hardwick also cites the instant polls on some news websites that followed the recent US presidential debates as an example of how not to find an accurate reflection of public opinion.

What is essential, she says, are systems that allow citizens to prove their identity while ensuring their private data cannot be revealed, so that no one's privacy is jeopardised by taking part in research.

Paul Russell, director of analytical solutions at information services provider Experian, says turning social media insights into useful actions is no simple task. "Data can help, and is helping, inform our approach to some of society's biggest problems: famine, disease, poverty and ineffective education. And it is providing useful input to the political processes that are focused on solving these problems."

However, he says, the answers to such problems lie in the hands of governments rather than data analysis. "Data solutions to these problems are some way off."

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Disruption & Technology

Rocket engine will need funds to reach lift off

Space race A British project to create a reusable launching mechanism could have the edge over Elon Musk's SpaceX scheme, reports *Peggy Hollinger*

Alan Bond is living proof that persistence pays off. The former Rolls-Royce rocket engineer has spent more than 30 years chasing his dream of space travel, fighting not just bureaucracy but also indifference to a vision many believed was impossible.

Yet the engine concept that the 72-year-old and his two partners have developed, which could eventually take an aircraft from earth to orbit and back again, is on the brink of becoming reality. Reaction Engines, the UK company formed by the three, expects next year to start building the first components for a demonstrator of their engine, named Sabre, with a view to begin testing by 2020.

The technology promises to revolutionise access to space, where launching methods have changed little since the 1960s. Elon Musk's SpaceX venture has spent large sums searching for a faster, cheaper and reusable way to get into orbit. Though SpaceX aims to recycle the first stage of its rocket system, it still uses traditional rocket technology that requires heavy loads of liquid oxygen.

The difference is that Sabre (Synergetic Air-Breathing Rocket Engine) would take a vehicle into orbit in a reusable single-stage vehicle, or cut the cost of a two-stage launch. It would use jet engine technology that effectively "breathes" air to make 20 per cent of the journey to orbit before switching to rocket mode to complete the trip, in the process powering a vehicle to travel at up to 25 times the speed of sound in orbit. There is far less liquid oxygen to reduce speed or dampen thrust – roughly 250 tonnes less – no jettisoning of parts and the aircraft should be able to return to earth and repeat the trip.

"Single stage to orbit is the holy grail," says Carissa Christensen, managing partner of the US-based space consultancy Tauri Group. "It is potentially transformative in terms of the economics and performance of launch into space, particularly if you combine it in a reusable format."

Mark Thomas, Reaction Engines' chief executive, says: "The problems

The Sabre dual-mode rocket engine explained

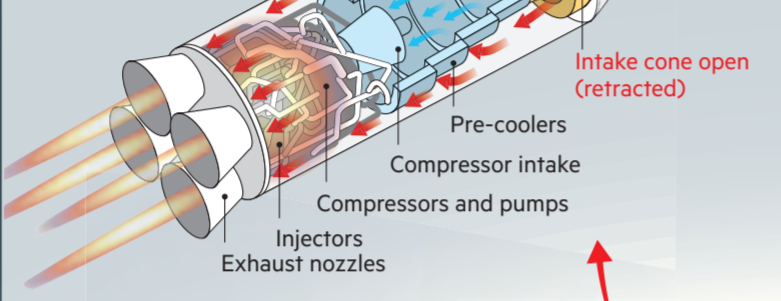
The Synergetic Air-Breathing Rocket Engine (Sabre) is an attempt to create a reusable rocket engine designed to power craft directly into space cost effectively and that can fly at five times the speed of sound in the atmosphere. It aims to eliminate the need for wasteful, multi-stage rockets

How Sabre works

- In a rocket engine, fuel and a source of oxygen, called an oxidiser, are mixed and exploded in a combustion chamber to produce thrust
- Sabre will reduce the weight of the on-board oxidisers such as liquid oxygen, which normally make up over half the weight of the vehicle, by using oxygen from the atmosphere, as a jet engine does
- It will have two rocket modes: an air-breathing mode for take-off and flying fast in the atmosphere, and a conventional rocket mode for launching into space. In both, the thrust is generated using the rocket combustion chamber and nozzles

1 Air-breathing mode

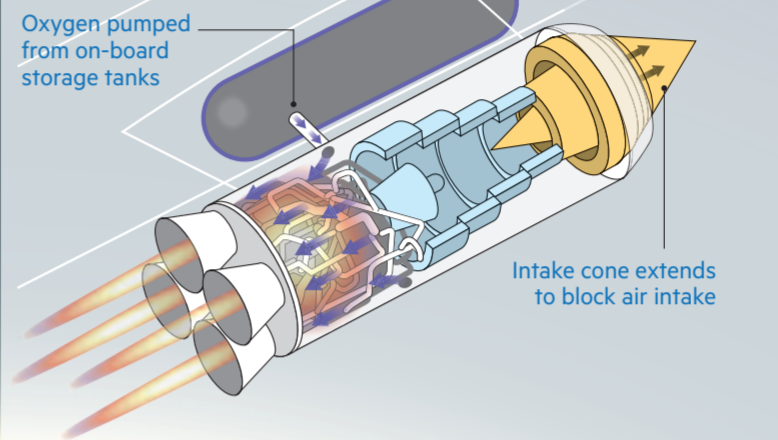
The rocket engine sucks in atmospheric air as a source of oxygen (as in a typical jet engine) to burn with its liquid hydrogen fuel in the rocket combustion chamber



Take-off using air breathing mode

2 Conventional rocket mode

Once above the atmosphere the engine switches to using conventional on-board liquid oxygen



Sources: Nasa, Reaction Engines; FT research
FT graphic: Graham Parrish

'This is not a conventional project. It is not a natural evolution in civil aerospace'

[Mr Bond and his partners] fixed in the early years were unbelievably challenging, ones that other companies and countries had thrown millions of dollars at and not fixed."

James McMicking, chief strategy officer of the UK's Aerospace Technology Institute, estimates the engine could be "10 to 100 times more cost effective than traditional rocket technology". Today a rocket launch, excluding the cost of a satellite, is upwards of \$65m or more, according to Tauri.

Reaction's Sabre concept has drawn interest from the US, which has for decades pursued its own version of

air-breathing engine technology with Nasa's Scramjet. However, many experts believe the UK engine is more advanced.

"Nasa is a long way from making that work in a reliable repeatable way," says Mr McMicking. "The Scramjet will not deliver a vehicle into space. It has to be combined with rocket technology and the Scramjet does not combine technologies as Sabre does."

The real innovation of the Reaction engine lies in its ability to cool the air passing through the jet turbine

and into the rocket quickly, while expelling all moisture to prevent frosting that could block the cooling system. "The heat exchanger was the key," says Mark Ford, head of propulsion engineering at the European Space Agency (ESA). "If that had not worked this technology would have gone nowhere."

It was this innovation, which takes the temperature of the air inside the engine from 1,000C to minus 150C in less than 1/20th of a second, creating the compressed oxygen needed for the rocket stage, that brought ESA onboard in 2008. Subsequently the technology has been validated by the US Air Force

Research Laboratory as being viable.

The UK government, through ESA, has allocated £60m to fund the demonstrator phase, while BAE Systems, the UK defence company, contributed £20m last year in exchange for a 20 per cent stake. But more money will be needed. Mr Ford estimates the total cost of eventually putting Sabre on to the wing of a vehicle at £500m-£1bn.

"We will need investment," says Mr Thomas. "This programme will get larger and the funds required will be exponentially larger." He hopes the technology will interest partners from outside the space sector. Its cooling concept has applications well beyond aerospace, stretching to transport, power systems and aviation. "It can be used anywhere you have thermal management challenges, where you need to transfer heat efficiently," he says.

But significant challenges remain to prove the technology works as promised, not least in developing an aircraft to be powered by the Sabre system, which could require billions of dollars. "The vehicle is just a concept at the moment," says Mr Ford. "It is lagging behind the engine in terms of development." There are also challenges in making components that can be reused and maintained cost effectively.

Much of the work being carried out by Reaction on components, materials and precision manufacturing, for example, will be useful in ways that cannot yet be imagined, says Professor Iain Gray, head of aerospace at Cranfield University. "This is not a conventional project. It is not a natural evolution in civil aerospace. It is a game-changer project."

The key will be to ensure the UK maintains sufficient support to ensure the project is not overtaken. The US, China and Russia are all working on hypersonic concepts.

"If the UK takes too long to develop this, the cat is out of the bag," says Mr Ford. "Like all technologies, it does not take long for second and third adopters to come along." But success is not a given he says. "It is still a very high-risk programme. There is no guarantee."

Human skills are essential in battle against cyber crime

Security

Insight and curiosity are as important as analytics and artificial intelligence, writes *Sarah Murray*

"You're looking for the bad guys, the tracks they leave and their mistakes, and you're also trying to predict where they're headed, so it's thinking like a Columbo – always asking the questions," says Kevin Bocek, strategist at Venafi, a cyber security business.

In the digital world of cyber crime, it might seem odd to refer to a now old-fashioned figure such as Columbo, the bumbling and disheveled TV detective known for his crumpled raincoat and half-finished cigar who was always asking suspects "Just one more thing".

But as security experts battle the increasingly sophisticated methods of today's hackers, experts say that the police lieutenant's human investigative skills and insight are as important as software, data analysis and artificial intelligence in fighting crime.

The technique of cyber hunting, in which technology and human insights are used to identify potential threats, takes a different approach to traditional cyber security. This strategy has focused on detecting intrusions and blocking entry to hackers through such means as firewalls and antivirus and intrusion detection software.

"That's what we call that the 'known bad' model," says Jason Matlof, chief marketing officer of LightCyber, another supplier of digital security services.

"Those systems are trying to keep up with the latest attack threats, but they can never be fully up to date because of the dynamic changes going on in the hacking world," he says.

Rather than designing security measures based on existing or past breaches, threat hunters focus on identifying emerging attacks or signs of a potential compromise to a system's dependability.

Driving demand for this approach is the fact that each advance in technology creates a hacking opportunity – from data storage on remotely hosted servers to devices equipped with processors, software and web-enabled sensors that can capture and transmit data as part of



Threat detection: online attacks are growing in sophistication

the so-called internet of things. "You have growing complexity and the bad guys are getting better and better at hiding their tracks," says Mr Bocek.

Hackers can now even breach encrypted data, which Mr Bocek says now represents more than 50 per cent of internet traffic.

This is problematic for companies since most of the tools used to detect cyber threats cannot inspect encrypted data. But threat hunting enables analysts to detect hackers who might be present on a system for several months while working out which servers, data-

'The human brain can't process the gigabytes of data but it can ask the right questions'

bases and accounts they need to control in order to prosecute their attack, known as "dwell time".

By actively looking for anomalies in IT networks, threat hunters can identify these potential breaches before an attack has been launched.

But this requires companies to know their systems and what constitutes normal activity well, known as "situational awareness".

"That allows you to detect that there's something new going on," says Hardik Modi, vice-president of threat research at Fidelis Cybersecurity, another security service provider.

"Along with that, you need forensic information that allows you to investigate these anomalies," says Mr Modi. "That's the hunting aspect of this."

Mr Modi and others say that, while computers can analyse vast volumes of data, the human element is critical. Experts needed to assess deviations from the norm and investigate whether they are potential breaches.

Mr Bocek agrees. "The human brain can't process the gigabytes of data but it can ask the right questions and it knows what doesn't look right and how the machine can be fooled."

For many companies, however, the resources needed for threat hunting – from software to data scientists and certified security analysts – are too costly and consume too much time.

"A threat hunter needs to have built up a strong sense of intuition and expert judgment about the distinguishing features of attackers," says Eli Jellenc, vice-president of threat intelligence at Stroz Friedberg, a cyber security consultancy. "And there's no replacement for that experience."

With an eye on increasing demand for threat hunting, companies are coming up with new products. LightCyber's behavioural attack detection products, for example, help companies to identify advanced or targeted attacks, insider threats and malware – malicious programs that have infected computers – that may have already circumvented traditional security controls.

Gartner, an industry research company, estimates that half of medium-sized and large organisations will add more advanced inspection features to their network firewalls by 2019. But while much attention is focused on threat hunting, Mr Jellenc stresses it is not the only answer.

"There is no silver bullet that can protect an organisation against 100 per cent of cyber attacks," he says. "Threat hunting should be seen as only one important element in an organisation's overall holistic security strategy."

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