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Security chiefs and hackers race to benefit from AI prize

Companies are turning to artificial intelligence, but criminals are not far behind, writes *Hannah Kuchler*

Humans have so far failed to keep up with the scale and sophistication of cyber attacks — so security companies are now starting to put their faith in artificial intelligence to protect networks from hackers.

From Apple to Twitter, tech companies are snapping up artificial intelligence start-ups and using the technology to do everything from predicting customer behaviour to interacting with users via virtual personal assistants.

But the security industry in particular has become excited about the potential of so-called machine learning, where computers learn without being explicitly programmed. For security companies, the growth of more sophisticated artificial intelligence promises the opportunity to catch up with hackers, who experts say have the upper hand.

For example, as the industry struggles to find qualified engineers, many companies are turning to artificial intelligence to supplement their workforces.

Tomer Weingarten, chief executive at security software provider SentinelOne, says cyber security is one of artificial intelligence's most promising applications. "It can look at all the behaviours and interactions that happen on a given machine, the malware [cyber attack software], what happens when someone is attacking you, to learn what 'badness' looks like, how an attacker behaves and what they will do once they try to compromise the device," he says.

Artificial intelligence can perform the role of many lower-level employees and it may increasingly need to do so. Last year in the US 209,000 cyber security jobs remained unfilled, and this could rise to 1m-2m globally by 2019, says a report by Intel Security and the Center for Strategic and International Studies.

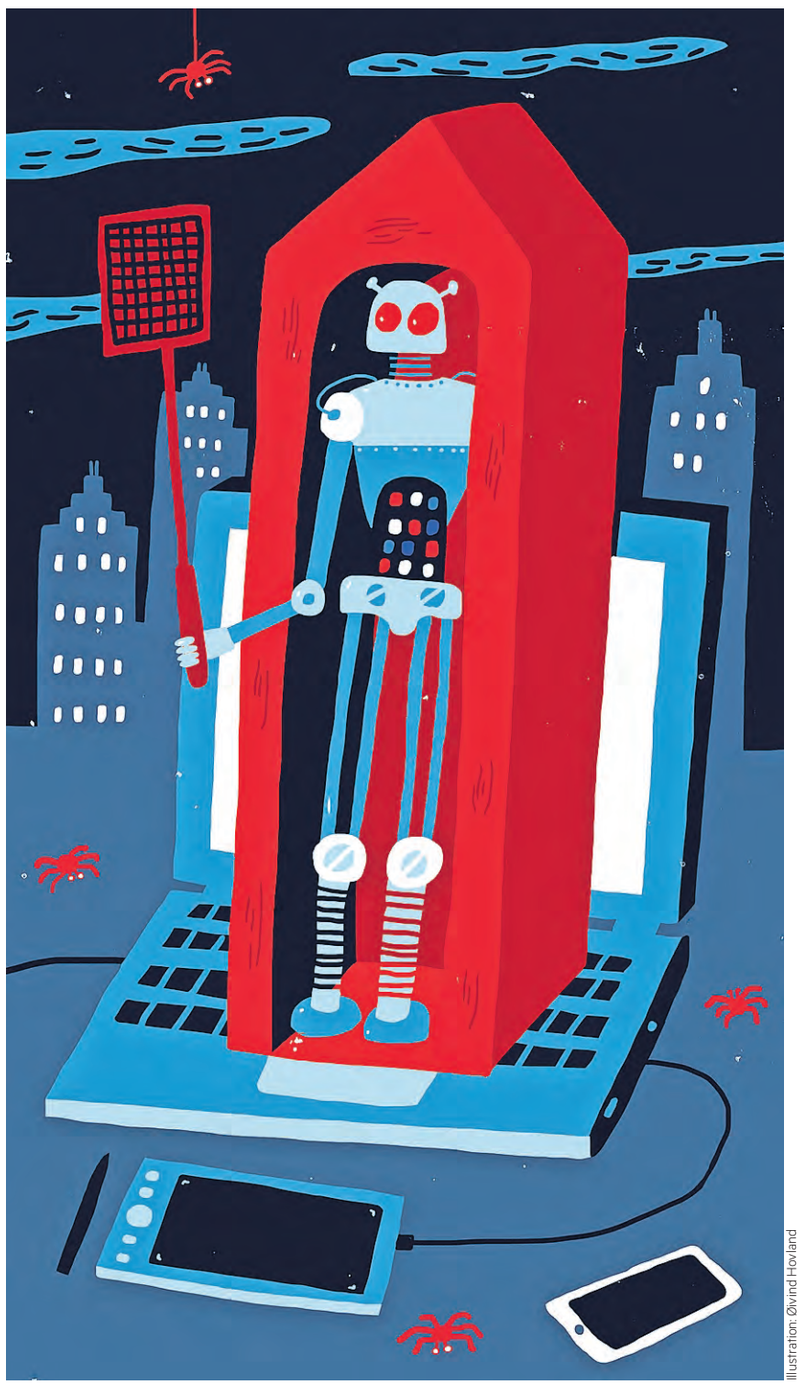

Illustration: Øivind Hovland

The ideal is artificially intelligent computers that can stop themselves from being attacked, such as by hunting for programming weaknesses and fixing them. The first steps towards this goal were taken earlier this year at the annual hacker conference Def Con in Las Vegas, when Darpa, the US Defense Advanced Research Projects Agency, known for supporting self-driving cars and GPS, ran a contest to invent such a machine, with teams building computers to compete against each other.

Seven teams from universities and private companies took part in the Cyber Grand Challenge, which was won by ForAllSecure, a team from Pittsburgh, and its computer Mayhem.

> The ultimate dream is to make artificially intelligent computers that can stop themselves being attacked

Darpa put up a $2m prize in the hope that the competition would change the future of cyber security and encourage others to explore the possibilities of using artificial intelligence to defend computer networks.

Artificial intelligence cannot yet operate completely independently of humans: even in the Darpa challenge, the computers were not good enough to beat humans. But Mr Weingarten says artificial intelligence can supplement his "heavy-duty security researchers", adding to their understanding of how hackers behave by highlighting what is happening deep inside a machine.

"Some things happen at a kernel level [the nucleus of a machine] during execution [of an attack] that a human wouldn't be able to [notice]," he says.

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Inside

Older entrepreneurs pass 'pint of beer' test with investors

Funding

Jane Bird discovers that the number of middle-aged people founding start-ups around the world is rising

Technology entrepreneur Steve Young launched his most recent appeal for venture funds at the age of 63. The part-time professor of information engineering at Cambridge university wanted backing for VocalIQ, a speech-related artificial intelligence company he founded with a then 31-year-old member of his Cambridge research group. The pair raised £750,000 in June 2014 and delivered a rapid return on their backers' investment in October 2015, when the company was sold to Apple.

At a time when people are expected to work longer and it is harder for many to find jobs, entrepreneurship among older people is rising. This is particularly so in less developed economies where there are fewer jobs, says Donna Kelley, professor of entrepreneurship at Babson College, Massachusetts.

The 2015 Global Entrepreneurship Monitor survey, which she co-authored, found that in less-developed countries, 17 per cent of founders were aged 55-64, the same ratio as among 18-24-year-olds. A further 21 per cent were 45-54.

Start-up founders are often older, says Prof Young, because it takes time to gain knowledge in areas such as computer science, mechanical engineering and robotics. However, older digital entrepreneurs need fairly young and energetic partners to help bring projects to completion.

"I don't think the equivalent of a Rolling Stones pitch [where the founders are all over 60] to investors would work. The package we were selling was my several decades of experience combined with my very bright, energetic young colleague, Blaise Thomson."

Prof Kelley says entrepreneurship lets older people "be their own boss, do something they enjoy . . . It gives people not ready to retire a source of income when their job options are slim and achieving former earning levels is hard."

Despite this, age can be an obstacle to raising cash, says Peter Cowley, a business angel in the UK. Entrepreneurs need to be there long enough for an exit to occur and must have energy, agility and drive. He adds: "Potential investors might wonder why they are unable to fund the early stages themselves."

Generation game: backers want Mick Jagger-style energy — Yamil Lage/AFP/Getty Images)

Wise words Start-up tips for the not-so-young

- Have a younger co-founder to show your business has the required energy.
- Be prepared to continue working if your business is acquired.
- Have a succession plan if you are likely to take more than 10 years to achieve an exit from your business.
- Target areas where older people may have knowledge, such as health systems.
- Choose a field where your wide network can help, either as employees, investors or customers.
- Put in your own money, even if it is only a small amount.
- Be open about your mistakes with others and learn from them.
- Recruit slowly — but fire fast if you need to.

But Mr Cowley agrees they do have experience on their side. Even those who have not run a business have been in the workplace a long time and better understand resources implications such as recruitment, Mr Cowley says. "Lots of young people hire fast and fire slowly, whereas they should do the opposite."

Older people can also build on past mistakes, Mr Cowley says: "In the UK, that used to be a problem. But now we've adopted the US view that you can't be trusted to run a new business if you haven't had a failure."

California-based investor Ronjon Nag, who has backed many digital companies in the US and Europe, agrees: "Older entrepreneurs are likely to have made more mistakes and are less likely to repeat them." The average age of founders he has backed is over 38, and several are well into their 50s. The older ones tend to have more connections, he says. "A lot of success in business is knowing the right people and targeting your product in the right place."

Industry contacts have been central to Prof Young's success. Thanks to his long teaching career, he knows people in many large companies that have an interest in speech technology.

He also has a good record. Raising funds for VocalIQ was relatively easy, given the success of his previous ventures: Entropic was sold to Microsoft in 1999 and Google bought Phonetic Arts in 2010. He also invests in his start-ups.

One problem for older entrepreneurs is how long they might want to keep working after the business is sold. "The acquiring company is buying your expertise and will want to lock you in," Prof Young says. He worked for two years at Microsoft after it bought Entropic, and will spend 60 per cent of his time with Apple until he is 67.

Older entrepreneurs have the advantage of being closer in age to most investors. This helps them pass the "pint of beer" test, says Mr Cowley, where the investor takes the entrepreneur for a drink to find out whether the relationship will work at a personal level.

Given demographic trends towards longevity, Mr Nag says older digital entrepreneurs may have more insights into future trends. "They will be better placed to create products for the fast expanding ageing population," he says.

Prof Kelley agrees: "With the population ageing in developed economies, the market for entrepreneurial opportunities targeting older age groups will grow, and entrepreneurial individuals in these age groups will be better placed to notice and understand these opportunities."

Link between tech and productivity is elusive

Investment The internet revolution has yet to raise output. By *Emily Cadman*

Rowan Crozier, chief executive of the 125-year-old UK manufacturing company Brandauer, based in the Midlands, pauses for a moment while describing the company's shift to a new state-of-the-art computer system.

"We switched from a highly flexible, largely paper-based, system to one that was a lot more rigid . . . there was a lot we had to go through," he says.

Brandauer's business is based on technical excellence. Its precision presses make metal components, from dental floss cutters to ethernet connector pins, with such efficiency that it is one of the rare UK companies to export parts to China rather than import them.

But the IT challenges Brandauer has faced reflect a wider struggle among businesses overhauling creaking, but functional, software systems in order to become more productive. Changes have meant that practices that were once second nature must be relearnt, old shortcuts no longer work and executives doubt whether it will all be worth it.

Meanwhile, software has continued to improve. Applications that only a few years ago would have not been out of place in a science fiction movie — such as video calls — are now commonplace.

Yet across the developed world productivity growth has fallen since the financial crisis began in 2007.

The great age of productivity growth was between around 1920 and 1970, an era that saw technological advances from telephones and washing machines to cars and aircraft. There was a second boost in the 1990s, when wider use of workplace computers helped companies produce more goods and services per worker — and ditch whole classes of employees such as secretaries.

> Productivity growth matters because without it companies would struggle to increase wages

The expectation was that the internet revolution of the early 2000s meant another rise in productivity was on its way. But it has not worked out like that.

In the UK, the output of the average worker has not risen for nearly a decade. The Center for American Progress estimates the US will produce $2.8tn less in goods and services than was forecast before the 2008 financial markets crash, slower productivity growth being the main reason for the shortfall.

Productivity growth matters because without it companies will struggle to increase wages. This affects both workers and a nation's tax receipts.

There is no agreement among economists about the reasons for the decline. Professor Robert Gordon, of Northwestern University in the US, believes some inventions, however flashy, are just not as significant as others. His argument is in the ascendance, partly because alternative suggestions on their own — from a lack of business investment to mismeasurement of the digital economy — do not seem sufficient.

Global corporate IT spending had been rising, but research company Gartner forecasts it will be flat in 2016. Despite this, Gartner still estimates that $3.41tn will be spent on IT this year, more than the UK's GDP, up from $2.6tn four years ago.

In terms of economic output generated by each employee, John-David Lovelock, an analyst at Gartner, says the research shows a clear relationship with higher corporate IT spending. But it is not a perfect fit by any means.

On the question of mismeasurement, former deputy governor of the Bank of England Sir Charlie Bean concluded, in a review of the digital economy published this year, that official statistics were not capturing all of the benefits of the digital economy. If these were fully accounted for, the average annual UK growth rate over the past decade would have been between 0.4 and 0.7 percentage points higher, the review said. Though this is significant, productivity growth has nonetheless stalled.

Chad Syverson at the Chicago Booth School of Business has calculated that the unrecorded value of the digital economy to the average US citizen would need to be $8,400 per year — or a fifth of net disposable income — to make up the difference in the productivity gap.

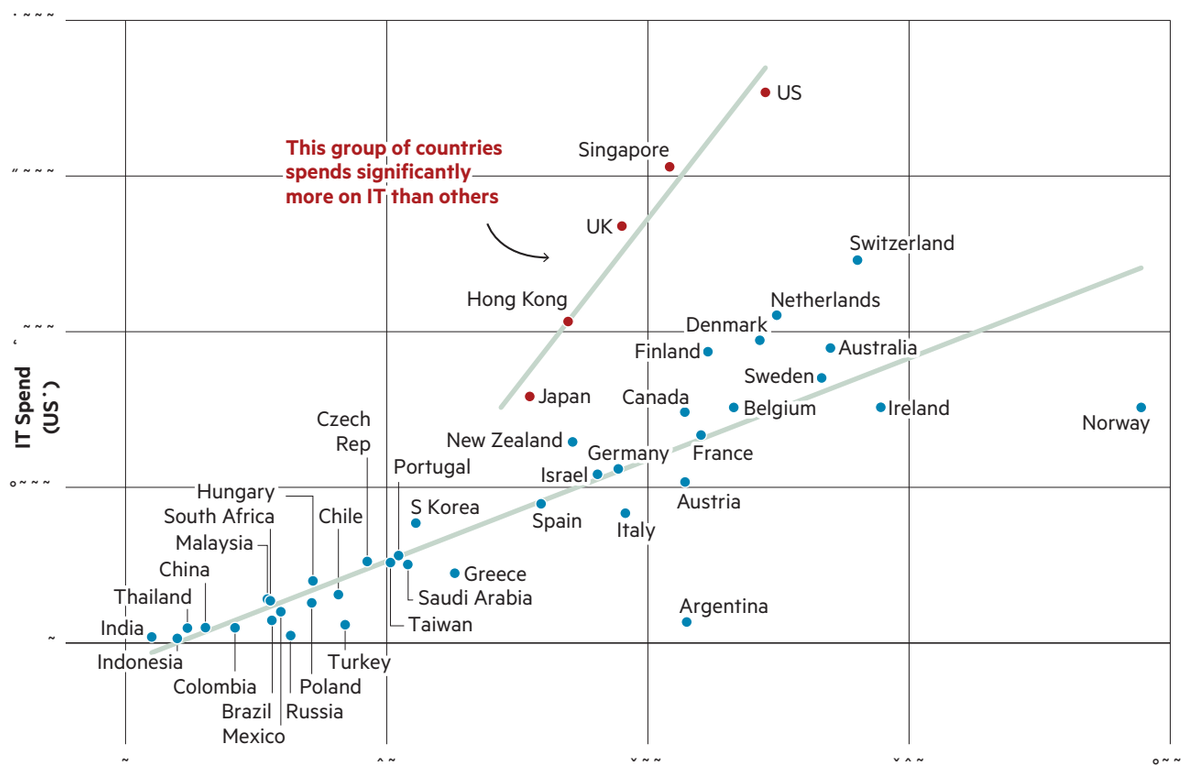
Despite the apparent gloom, there is a more optimistic argument: that we are in a temporary pause before the gains from improved IT begin to show. Professors Erik Brynjolfsson and Andrew McAfee at MIT argue there has always been a delay between the time when technology arrives and when it really begins to make a difference. The gains are on the way, they argue.

Brandauer's Mr Crozier takes this view. His company's £400,000 IT investment was necessary even if it took time to bed in. "We've gone from making decisions based on gut instinct, to judgments based on data," he says. The company is seeing measurable benefits and expects the investment to have paid for itself inside 18 months, he says.

This is just as well. All of our future living standards depend on this small example becoming commonplace.

Tech spending in ˜°¸"

IT spending per employee v GDP per employee



FT graphic Source: Gartner

Chiefs and hackers race to benefit from AI prize

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For example, artificial intelligence might be able to spot when ransomware — malicious software that codes files and demands a payment to unlock them — begins to encrypt documents. It may even be able to stop an attack in its tracks.

Lawrence Pingree, a security specialist at Gartner, the research company, says artificial intelligence is at its most effective when it can reduce the number of "false positives" — events flagged as attacks that turn out not to be — that professionals have to sift through.

"Generally, [artificial intelligence] can identify malware really accurately but it can't explain why it is there or who is behind the attack. The end goal is it could describe the malware in the context of all the interactions on the network today," he says.

Some artificial intelligence-based security software is good at building visualisations of a network to help people explore potential weak points and problems more clearly, Mr Pingree adds.

Shuman Ghosemajumder, chief technology officer for Shape Security, has been working with artificial intelligence since he led Google's efforts to protect the search engine from click fraud — repeatedly clicking on an advertisement to make it seem more popular than it is.

It was essential then to analyse the billions of clicks that happen every day.

At Shape, he uses artificial intelligence to protect web pages and mobile apps against automated cyber attacks from botnets — computers co-ordinated to launch a cyber attack without their owners' knowledge. "We're looking at hundreds of different signals to analyse the ways that real human activity should look in every single transaction."

But criminal gangs have followed the development of artificial intelligence with interest. Many are using similar tools to imitate human behaviour, simulating how someone might log on to a website rather than using crude "stuffing credentials" techniques — the mass use of stolen customer details at one time to gain access to accounts.

Mr Ghosemajumder says: "[Hackers] are generating fake mouse movements, keystrokes, technologies that vary typing speeds to get around tools for detecting [too many of the] same typing speeds, and making it look like they're coming from different browsers."

Despite the industry's high hopes, Mr Pingree warns that some companies use terms such as "artificial intelligence" and "deep learning" just for marketing. "The biggest trap some providers fall into is they say they have machine learning when they really don't," he says.

Fraud protection Voice recognition should not be banks' only defence

In South Korea, the more than 26m customers of BC Card can use the financial service company's mobile payments app to verify transactions by simply speaking into a phone. Catering to consumers fed up with lengthy authentication processes, such as PIN codes and passwords, companies are turning to voice recognition to speed up the safe transfer of money.

Powervoice, a South Korean company, has been researching voice recognition for 14 years and says that its technology now only identifies the wrong person once in 10,000 times. Its services are now used by BC for its mobile payment services. Transactions of Won300,000 (about $270) or less require one biometric verification — fingerprint, iris or voice confirmation. For larger amounts, people must also use a PIN code.

But Hee-suk Jeong, chief executive of Powervoice, thinks voice recognition could be the best option for securing mobile payments, as well as making wearable devices and the so-called internet of things — the connection of previously unlinked items over the internet — safer. It is hard to enter a password when using connected glasses or travelling in a connected car, but easy to talk to them.

Mr Jeong says the company's speaker verification technology adapts to an individual's vocal changes. "For example, if they catch a cold, it has advanced capabilities to distinguish between very subtle differences — even the voices of identical twins — and can differentiate between a recorded and an actual voice."

Around the world, the financial industry is exploring voice technology as a means to access accounts. Vijay Balasubramaniyan, chief executive of US-based Pindrop Security, says many banks have been working on mobile voice recognition apps and some have rolled them out to selected customers.

Pindrop was a pioneer in voice recognition in call centres, monitoring 360m calls to banks, insurers and retailers each year. It is now developing technology to work in voice-activated devices, such as Amazon's Echo and Google Home.

Voice recognition has also long been used by law enforcement agencies to track criminals. Emilio Martinez, chief executive of Spanish voice recognition company Agnitio, says all he needs is a 10-second recording to create a criminal's "voice print".

Voice master: Emilio Martinez

While some banks ask people to repeat a particular phrase, Agnitio has had to develop its technology to identify criminals and terrorists, who are not as easy to record. "It has to be very accurate as a method of authentication: enough to put somebody in jail," Mr Martinez says.

Like Pindrop, Agnitio has also deployed its technology in call centres, focusing on identifying repeat fraudsters. "They are usually in gangs, with no more than 10 or 20 people, repeating calls to do some kind of illegal actions. Once they've done that, however, they won't be able to do it twice," Mr Martinez says.

But there are still risks associated with voice recognition. Callers may be locked out of their account if their voice is not recognised because, for example, they call from a noisy environment. Powervoice says that it has a 96 per cent verification success rate. Additionally, if banks use a set phrase, a customer could be tricked into saying it by a criminal who is recording their voice, says Mr Balasubramaniyan.

"One solution is never 100 per cent foolproof," he says, adding that there should be more than one level of authentication, and many layers of defence, to complete a transaction.

"Everyone comes up with a new technology and forgets what we've learnt in security over the years: defence in depth," he says.

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Security is the new bling in luxury phones

Smartphones Privacy is the latest must-have feature for people with information to protect, says *Daniel Thomas*

High-price security: a basic Solarin phone costs about $16,000

Leonardo DiCaprio and Tom Hardy, fresh from success in the Hollywood western blockbuster movie *The Revenant*, flew to London in May for a different kind of adventure into the unknown: promoting a new smartphone aimed at the super-rich and super-private.

As a Hollywood A-lister often snapped unawares, Mr DiCaprio probably knows the value of privacy. And that value has never been higher, it appears.

The Solarin phone has gone on sale for £9,500 for the basic model ($16,000 in the US) — at least £9,000 more than the average smartphone, which already offers encrypted messaging services such as WhatsApp.

But the Solarin phone promises much more. At the phone's glitzy launch in London, Mr DiCaprio took a front-row seat as its maker, Sirin Labs, extolled the advantages of a device that offers military-grade security.

It boasts high-level cyber security protection using 256-bit encryption, which Sirin claims will stop device, network and application cyber attacks. There are also the usual smartphone functions, including a high-quality camera and toughened Gorilla Glass to protect the screen camera lens.

Perhaps predictably, given the price, the smartphone has been sold only in the stamping grounds of the wealthy: a boutique in London's Mayfair, Harrods, Heathrow's private lounges and a summer pop-up shop in a Cannes hotel.

At a time when most smartphone makers are trying to squeeze in the most advanced hardware and features as cheaply as possible, the Solarin appears to be a deliberate statement about the opportunities at the more expensive end of the market.

Tal Cohen, Sirin's chief executive, says the phone is expensive because of the cost of the technology. "We look at the newest and the most advanced technology and incorporate [it] into a new phone. That costs a lot of money."

Mr Cohen says Solarin owners "will typically be wealthy businesspeople who carry sensitive corporate information, or celebrities valuing their privacy", but who do not want an ostentatious phone.

"You won't see diamonds or a blingy gold phone. It's security and technology. We need to make a profit, so we need to price the product accordingly," he says.

Solarin's price point puts it up against other luxury phones, such as brand leader Vertu, which sells handsets made with precious metals and jewels at high prices.

In recent years, the British brand has been trying to shed a public perception that its prices — thousands, or tens of thousands, of pounds — are the main draw for customers.

Acquired by a group of Chinese investors last year, Vertu has improved its smartphone technology to match much cheaper rival devices with better cameras and audio and an up-to-date operating system.

> Solarin is creating a niche based on the power of its encryption

Vertu's phones still have a handmade luxury finish and offer personal concierge services that allow subscription-paying users to book restaurants, hotels flight and events. These remain its principle attractions.

Analysts say luxury phonemakers, including Vertu, are likely to be affected by the slowdown in the global luxury market, which means that having extra functions and a customer base in the corporate sector, as Solarin is seeking to build, may become more important.

"[Vertu] is the brand synonymous with the category and is the company that put the product category on the map. [But it] has had a turbulent time over the past few years, with ownership changing hands and the luxury market suffering, particularly in China," says Ben Wood, analyst at CCS Insight.

The market for the luxury phone has always been niche, similar to supercars in the automobile sector. Fewer than 1m luxury phones have been sold in the past decade, CCS Insight estimates, compared with the roughly 1.5bn standard smartphones that will be sold this year alone.

But Gordon Watson, chief executive of Vertu, believes the luxury mobile phone sector can sustain sales of at least 500,000 units over the next few years. He says the sector is "small, by comparison with the high street but [will be] well ahead of where the luxury phone segment is today".

Likewise, Mr Cohen describes the potential for "tens of millions" of future buyers of his company's phones. The company has not released any guidance on its initial sales, however.

Solarin is emphasising the power of its encryption, which pits it against other manufacturers that stress the security of their services and devices, such as Silent Circle. This Swiss company's Blackphone 2 also promises enhanced mobile privacy, albeit at a much lower cost of about £500.

Another device aimed at customers seeking privacy is the forthcoming Turing Robotic Industries liquid-metal smartphone, which promises to be tougher than a titanium and steel handset. The Turing phone offers privacy via a security system inspired by British wartime code expert Alan Turing's cryptography. The phones will cost about £550.

Privacy, it appears, is the new must-have feature for the wealthy. However, the good news for more cash-strapped customers, says CCS Insight's Mr Woods, is that security solutions similar to Sirin's and Turing's phones can be easily added to standard Apple and Android devices. These include WhatsApp and Knox software. For those phone buyers who do not possess bottomless pockets but still like privacy, security does not have to cost the earth.

Manufacturers focus on cameras to boost sales

Components

Ever more sophisticated means of taking pictures are being added to our handsets, says *Stephen Pritchard*

Darkened rooms full of smelly chemicals and glass plates have given way to the smartphone and the selfie. This year, we will take 2.5tn photographs, 15 per cent more than in 2015 — 90 per cent of them on smartphones, according to professional services provider Deloitte.

Smartphones have made personal photography ubiquitous. In the 1990s, the number of pictures taken on film stood at about 80bn images a year, notes Paul Lee, a partner in Deloitte's technology, media and telecommunications practice. The number of images taken on digital cameras and smartphones has long since surpassed that figure. The growth is partly driven by rapid improvements in camera phone technology. The quality of smartphone pictures is now considered equal to — and sometimes better than — camera images, at least in terms of the amount of detail they can capture, known as the image resolution.

While only a handful of smartphones boast zoom lenses, and they cannot match the best cameras for performance in poor light, they are more convenient and easier to use. Consumers like being able to share pictures online. So far, few cameras can connect directly to the internet and even expensive models with WiFi can only transfer pictures to a smartphone or tablet.

"Smartphones have become a direct substitute for digital compact cameras; camera sales have declined rapidly in recent years," says Peter Becker-Pennrich, head of Vodafone's handsets range. "Smartphone camera quality improvements have been achieved through better and bigger sensors, high-quality lenses, image stabilisation, fast and sophisticated image processing, and fun features like filters," he says.

Annette Zimmermann at industry research company Gartner says: "The camera is one of the key uses for a smartphone, and vendors put a lot of effort into it to keep people interested [in new phones]. People expect to use their phones to take high-quality pictures."

Ms Zimmermann sees camera manufacturers adding dual-lens cameras, which work better in low light, and even 360-degree cameras at the more expensive end of the market.

Cameras are costly components in smartphones. According to Ian Fogg, analyst at IHS Markit, a camera for a more upmarket handset such as the iPhone or Galaxy S7 costs between $20 and $30; a module for a mid-range smartphone can cost as little as $5-$10.

But the cost is only part of the picture. To take good photos, a phone needs a powerful processor and lots of memory to record the pictures and video. Next-generation phones with multiple cameras need even speedier chips to process several images at once. More expensive still is the know-how and the software needed to make the cameras work. "Software optimisation needs a lot of engineering time," Mr Fogg says. The phone's operating system, for example, might only show the users the best quality pictures they have taken.

Increasingly, the camera is one of the ways in which phonemakers differentiate themselves, he says. Deloitte's Mr Lee says that smartphone makers are turning to camera brands such as Leica and Carl Zeiss for optical technology. This, he believes, widens the appeal to enthusiasts as well as those moving from a camera to smartphone.

Nor is it only stills cameras that are being incorporated into phones. Smartphones from Sony, Apple, and Samsung are among the brands offering 4K, ultra high-definition video — four times the resolution of high-definition TV and more powerful than most cameras used for broadcast television.

Future smartphones could contain 8K video cameras — equal to the resolution used by professional cinematographers. Marvel superheroes movie *Guardians of the Galaxy Vol 2* will be shot using an 8K camera, for instance.

The barriers for phone companies have less to do with camera technology than with phone memory and connection speeds. UltraHD video, let alone 8K, produces very large files. "Phones will capture at least 4K," says David Mercer, analyst at Strategy Analytics. "The question is, what happens next?"

The iPhone 7 Plus already offers two cameras, a wide angle and telephoto lens. Phonemakers could use higher resolutions to create digital "zooms" that can focus on a subject without any loss of quality, or to create 360-degree or virtual-reality images.

Companies such as Samsung have developed virtual reality headsets for phones but, for now, these rely on professionally produced content. Better cameras could allow users to create their own. And smartphone makers are using the high-dynamic range display technology used in professional filmmaking, which is also found in expensive TV sets. HDR displays more colours, cleaner shadows and highlights, and is easier to see in bright light.

Ron Leitch, senior vice-president of corporate development at Teleplan, a specialist electronics manufacturing and servicing company, says that HDR screens could appeal to companies that distribute movies and TV shows, such as Apple and Sony.

He says they improve the smartphone viewing experience and could be at the forefront of advances in entertainment. "HDR might be unnecessary for someone reading their emails, but plug it into VR goggles and it takes on a new lease of life," Mr Leitch says.

Photo finish: a dual camera being inserted into an iPhone 7 Plus

Data analytics is on trend with fashion houses

Retail More clothing outlets are turning to algorithms to boost their sales.
By *Sarah Murray*

Just gotta have it: models at the Anya Hindmarch catwalk show during London Fashion Week last month — Neil Hall/Reuters

Fashion retailers are increasingly turning to data analytics to keep up with the latest trends and client demands.

As well as having to meet the demands of "fast fashion" — customers wanting the latest designs from catwalk in stores the instant they appear — businesses must also price items correctly, know when to reduce them, stock enough of the right styles, colours, fabrics and sizes, and ensure that stores are well supplied and operate efficiently.

Data analytics is not new to the industry, which has long used spreadsheets and analysed sales information. However, new sources of data are now available, such as the information on mobile devices or social media sites. "The biggest change is the growth of unstructured data [data not stored in databases] — the texts, images, audio and YouTube videos," says Keith Mercier, retail industry leader for global cognitive business solutions at IBM.

One method being deployed by retailers to discover more about what customers might want is the use of cognitive computing — programs that simulate human thought process and mimic the functions of the brain.

Cognitive computing relies on techniques such as data mining — the analysis of data from different sources — pattern recognition and natural language processing.

Mr Mercier says these types of applications mean vast new data sets can now be analysed, producing faster insights into fashion trends. "If we can give a retailer a two-week jump on trend prediction, [then] two weeks of selling time in stores is golden in this highly competitive industry," he says.

By tracking how customers behave while shopping, data analytics can also help to improve the design and management of shops and department stores. Despite the growth of online fashion outlets, many consumers still visit stores to touch and try clothing or shoes before buying.

"The need [for companies] to know who is in the store — with [customer] permission — the moment they walk in is greater than it's ever been," says Brent Franson, chief executive of Euclid Analytics, a US-based company that uses location analytics to monitor consumer traffic in shops and malls.

Euclid uses WiFi signals from smartphones to track and analyse everything from the number of people entering a store to the length of time they stay and how often they come back. Customers can opt out of having data collected.

"Knowing your purchase history, and the kinds of things you buy, retailers can create a more personalised experience," says Mr Franson.

Retailers also need to know when new products become available, which colours, styles or brands are selling fastest and when to mark down items.

These kinds of insights are what WGSN, a fashion trend forecaster, provides to clients through its Instock service, which tracks the clicks of online shoppers as they browse and buy items.

"It's all about understanding when people are going into markdown, making sure you're competitive on price and that you have the right balance of items," says Francesca Muston, WGSN's head of retail and product analysis.

Her company conducts catwalk analytics, with teams of experts tagging each outfit — noting its garment type, style, colour fabric and other details — as it is presented on the runway. Analysing this data reveals whether skirts or trousers are dominant in a particular season and, if it is trousers for example, whether they are mostly wide leg, flared-leg or bootleg styles.

Applying analytics to fashion is not easy, particularly as garments may have different names in different territories — trousers are pants in the US — and the lines between garment types are blurring with hybrids such as the "coatigan", a softer or knitted version of a coat.

So while data analysis is a powerful tool, Ms Muston argues that it will never entirely replace human insights. "A lot of it comes down to intuition," she says.

Nevertheless, the use of data is helping some businesses to adopt a more counterintuitive approach by designing algorithms that will choose people's clothes for them. For example, no styles are shown on US-based online retailer Stitch Fix's website. Instead, it sends shoppers a box of five items that have been selected according to the "style profile" users have created by answering questions on everything from their favourite colours and fabrics to their size, budget and lifestyle.

> 'It's about making sure you're competitive on price and have the right items'

The San Francisco-based company employs 75 data scientists who have developed algorithms that aim to ensure that as few items as possible sent to customers will be returned.

After receiving their items, customers decide what to buy and what to return, and provide detailed feedback on the selection or what they would like to receive in future. "Those two sets of data — preference data and feedback data — drive everything," says Eric Colson, Stitch Fix's chief algorithms officer.

Despite such advances, Ms Muston believes many retailers need to do more to apply analytics to their own data.

"A lot of them are playing catch-up," she says. "They need to understand how to better organise their systems so that their products can be classified and analysed and they can get a view on their data. That's a big shift."

Size matters The time is coming when the customer could ask a piece of clothing whether it will fit

Zurich-based Isabelle Ohnemus (*pictured*) was always interested in fashion. As well as working as a broker, she ran a personal shopping service, ordering clothes and selling them from home. She placed orders online but found it hard to know which size was right for her clients. "There are no unified sizes. Designers each have their own way of cutting and sizing," she says. "It is hugely frustrating. Even though I was measuring my clients in every way, I was still having to return things."

She tackled the problem by creating EyeFitU. This app lets users create a profile of their measurements and matches this against sizing charts from thousands of brands, filtering online shopping results down to the items most likely to fit.

Sizing is a significant problem for fashion retailers. Poor fit is one of the main reasons clothes are returned, particularly when it comes to items bought online. Returns cost money. Around $642.6bn worth of clothing and footwear is returned to stores globally each year, according to a study by IHL, a research company. About 10 per cent of this is due to poor fit.

Nick Robertson, former chief executive of Asos, told Reuters in 2013 that a 1 per cent fall in returns would add £10m to the UK fashion retailer's profits.

Retailers have been trying to solve the sizing issue in various ways. A few years ago there was a rash of virtual changing room trials, avatars that could try clothes on for you and automated shopping assistants. Asos, for example, introduced a virtual fitting tool called Virtusize on its site in 2013, which it says reduced sizing-related returns by up to 50 per cent.

However, these tools only went so far. "A majority of them feel a bit clunky, like you are playing a video game that isn't much fun," says Jo Allison, an analyst at Canvas8, a consumer behaviour consultancy. Menswear brands such as Thomas Pink and Hugo Boss have had some success with virtual fitting rooms she says, but "women have more variables".

"Chest size, for example, can hugely affect how clothes fit, and this can be harder to represent."

Women's sizing is also an emotive issue, says Donna North, co-founder of Dressipi, which provides personalisation services for retailers such as Top Shop and John Lewis. "Only about 15 per cent of women are happy to put all those measurements into the virtual avatars. Most of us past 25 don't even want to know what our waist size is, let alone enter it online," she says.

Ms Allison agrees. "People will often put sizes into these avatars that don't reflect them. There is a lot of shame attached to sizing."

Ms North and her Dressipi co-founder Sarah McVittie are trying a different tack. Their personal shopping assistant not only asks for measurements, it learns a shopper's size by asking what brands' tops, trousers and dresses fit best. It further judges size by monitoring what is sold and returned. "It isn't just about sizing — there are also many features and details that can lead to shoppers returning items," says Ms McVittie. Dressipi collects around 30 to 50 pieces of data for every garment in its system, and can recommend items to go with previous purchases.

Ms North says the service has led to a 3 to 5 per cent decrease in returns at the retailers it works with and a 10 to 30 per cent increase in spend among users. There are plans to extend the service to physical stores.

"Personalisation is the big game in retail right now," says Trish Young, UK and Ireland head of retail consulting at Cognizant, a technology consultancy. UK and US shoppers surveyed by the company said they wanted retailers to understand them better.

Personalised fitting could speed up as clothes are wired up to the internet of things — the linking of previously unconnected objects to the internet — says Andy Hobsbawm, chief marketing officer of Evrythng, a technology company that this year signed a deal with US branding and labelling company Avery Dennison. They are working to give 10bn clothing and footwear items a unique profile on a cloud database.

Retailers are testing digital tagging of items to monitor supply chains and reduce theft, and most clothing already has identifying information on care labels. "Each item of clothing could have a data record in the cloud, including where it was made, its materials, size and cut," says Mr Hobsbawm. "You would be able to simply ask the jacket if it is a good fit for you."

Maija Palmer

Risks of state IT projects should be split with providers

Bungled schemes

Jessica Twentyman finds that nations around the world waste billions of dollars

Why do big state-run IT projects run into difficulties? Many fail to be delivered on time, on budget, or even to work properly at all. For instance, almost half of the UK government's 36 important information technology projects currently under way are unachievable or unlikely to be completed successfully, according to a report from the Infrastructure and Project Authority, which helps to manage and deliver British public sector schemes.

Among the projects judged to be at risk were the Ministry of Justice's new electronic tagging system for criminals and the Department for Transport's move to a shared service centre for financial accounting, human resources, payroll and procurement systems. The IPA says both appear unachievable without urgent intervention. A further 15 schemes are thought to have "major risks or issues apparent in a number of key areas", the report says.

The UK is not alone. Governments around the world waste billions on IT schemes that fail to deliver. Such projects make up the vast majority of government IT initiatives, research published in June 2016 by consultants at strategy firm Boston Consulting Group suggests.

The authors estimate that 70-80 per cent of what they call "public-sector core-system modernisations" — the prerequisite for delivering digital government services to citizens — either fail outright or are disappointing. Another 20-30 per cent fall in the "good" range, delivering largely within budget and on time and meeting the general objectives. However, "they are not transformative and they don't realise their full potential", BCG says. Less than 5 per cent of projects meet budget and schedule goals or deliver substantial benefits.

Bungled programmes share certain characteristics, says Kevin Desouza, a professor in the School of Public Affairs at Arizona State University and a fellow at the Brookings Institution, a Washington DC-based think-tank. They are often too big, Mr Desouza says. "One of the primary reasons for failure is the complexity associated with how many things a government or agency is trying to address under the umbrella of one project," he says. "Rather than trying to address an isolated IT issue, an isolated policy issue or administrative change, they try to do all three at once."

Projects can run for many years, putting them at risk of being knocked off course by changes in government or policy, or technological developments.

Fiona Czerniawska, director of Source Global Research, a research and advisory firm that focuses on the global consulting industry, says the problems often go back to the procurement stage. "Public-sector procurement people don't always understand the requirements," she says. "And they're often more motivated to get a short-term discount as opposed to ensuring the long-term success of a project."

She says officials tend to negotiate on price rather than extracting value.

Both Mr Desouza and Ms Czerniawska say establishing new procurement methods would go a long way to tackling IT project failure in the public sector.

Ms Czerniawska says that about a third of private-sector IT contracts in the UK contain a performance-related element, meaning consultants forfeit a portion of their fee if goals are not met. By contrast, she says that only about 10 per cent of public-sector contracts work this way.

Mr Desouza says once a project is under way the risk should be shared by governments and suppliers, rather than be borne by the state alone. He suggests changing the review process for big, multiyear projects. Rather than deciding upfront to commit $20m or $100m to a project, states should see how the first year goes and, assuming goals are achieved for about $3m, decide on further investment later.

BCG's authors agree that an incremental approach to implementation could work better. While conventional wisdom dictates IT projects should be executed on the basis of a detailed design and execution plan, with clear milestones and multiyear funding, they say such an approach "overlooks the fact that new information emerges over time and circumstances [change].

"Rather than involving a big, upfront investment, implementation should be conducted in small, manageable pieces, and high-value, low-risk components should be rolled out first. This not only ensures some early wins but also allows lessons to be gathered and distilled," the report says.

Above all, policymakers and officials should seek expert advice early when considering change. Too much focus is given to policy aspects and not enough to how projects are managed and delivered, says Mr Desouza.

"The technical details get overlooked, because the people who are debating these things frequently lack the knowledge to confidently critique or examine the technology element in any depth."

What went wrong and where Examples of tech project failures from around the world

US

Within hours of the October 1 2013 launch of Healthcare.gov, a site for US citizens to sign up for health insurance plans under the Affordable Care Act, users had problems.

Some could not create accounts, while others who already had accounts could not gain access to them. Healthcare subsidies were miscalculated and the site crashed several times.

A government audit found that state employees responsible for overseeing $600m in contracts to build the site had been inadequately trained, kept poor records and failed to identify delays that contributed to millions in cost overruns.

Australia

The rollout of a new payroll and rostering system for public servants in Queensland was plagued with delays and budget overruns. When it finally launched in 2010, it failed spectacularly, with staff receiving the wrong pay or, in some cases, none at all.

A public inquiry found that much of the fault lay with state employees who failed to manage the project properly or negotiate effectively with contractor IBM. A protracted legal battle between the technology company and the Queensland government over who was to blame resulted in victory for IBM, with the government bearing the technology company's costs.

Netherlands

Between 2012 and 2014, the House of Representatives of the Netherlands conducted an investigation into the failure of a series of central government IT projects. These included werk.nl, a jobs website for the nation's unemployed, and EPD, a digital patient records system.

The resulting report concluded that the Dutch government is wasting between €1bn and €5bn a year on failing IT projects.

"The government often fails to keep control of its IT projects in terms of cost, timing and the end result," said the parliamentary commission leading the investigation.

UK

In 2012, the UK's National Audit Office announced that the Immigration Casework IT system being developed for the Home Office to handle immigration and asylum matters was a year late and had exceeded its original budget by £28m due to "a loss of focus, poor governance structures and optimism bias in planning and reporting". In 2013, the project was abandoned at a cost of £347m. A new system is now under development.

An assessment of this by the Infrastructure and Project Authority deems it to be feasible, but notes it is unlikely to be fully rolled out by its March 2017 completion date.