

HCL

Open Innovation 2030

Future-proofing a
decade of change

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Open Innovation 2030

From covid-19 to climate change, economic recessions to technological disruption, 2020 has served as a reality check that global crises are only going to become more common in today's increasingly-complex and connected world. 'Open Innovation 2030: Future-proofing a decade of change', a thought leadership program commissioned by HCL in partnership with The Economist Intelligence Unit, explores how companies can seize opportunity in complexity to not only survive, but thrive, now and in the coming decade. To rise to the occasion, business leaders must align on an enduring vision to build a better future; one underpinned by equality, sustainability and global cooperation.

Enterprise risk management typically focuses on ‘known risks,’ amplifying them to model the maximum impact so that the worst case scenario can be planned for. At the other end of the scale, ‘unknown risks’ are considered outlying cases, like the asteroids that sometimes fly by Earth—we know they exist and have plans that can be attempted as a possible first response, but they largely remain on the edges of our planning blueprints.

Even with a canvas that wide, nearly all of us were caught off-guard when covid-19 struck earlier this year. Few had imagined the scale of change this pandemic has brought into our professional and personal lives. And yet when we look back at the past six months, admiration has overtaken our initial dismay; admiration at the way individuals, communities, companies and countries have risen to this challenge and admiration at the way human innovation, ingenuity and resilience has prevailed.

The takeaway across the board, therefore, has been unilateral—although we cannot fully anticipate and control all the challenges that may strike, the way we respond may define us forever.

Looking at this through the lens of the technology sector, the response of organizations to the pandemic has had an immense short-term impact and will profoundly shape the future. Most business leaders have embraced technology, accelerating their transformation journeys as they adjust to the new normal.

The best among them are those that are open to change. We call this ‘open innovation.’ Open means many things, as this book explains, but mostly it means being open to rapid change and evolution, crossing boundaries and ignoring norms to assemble the best possible ecosystem to collaborate and create the best strategies.

I see five key manifestations of openness:

Open to re-invention. The dust has not yet settled on covid-19, but it is already clear that businesses in countries that are further ahead have been permanently altered in ways that may prove advantageous—whether it be implementing distributed work arrangements, making long-overdue investments in digital ca-



pabilities and offerings or upskilling staff. Transformations in three sectors—healthcare, real estate and retail—foreshadow changes in the future of work that will affect millions of people.

Open to disruption. Companies must anticipate disruptive change and seize the opportunities it creates. Those with a head start in leveraging key technologies are reaping the rewards. New technologies such as quantum computing, edge, digital, big data and artificial intelligence, among others, must be understood in the context of each business.

Open to secure collaboration from anywhere. Companies must constantly collaborate through ‘open innovation,’ which in practice means partnerships within an ecosystem of businesses in other industries and geographies—or even with rivals. Inside the organization, all perspectives must be included, rejecting ethnic, gender-related or cultural barriers to create value. Cybersecurity must be inherent in this collaboration, especially in work-from-home environments.

Open to adaptation. Collaboration and technology disruption requires companies and their employees to become masters of change management. Agile organizational models break out of the straightjackets we often put on by blind acceptance of rigid

structures. Infrastructural and cultural changes are needed because the most talented people increasingly seek a new style of working, one infused with detailed awareness of global impact, dedicated to sustainability, engaged in life-long education, dripping with technology and constantly adapting.

Open to sustainable consumption. Disruptive technology provides new opportunities to benefit society and increase profitability. Growing scrutiny of the impact of companies on the environment means executives must become leaders in tackling challenges such as climate change and sustainability. In an increasingly interconnected world, firms must consider the needs of all stakeholders—employees, suppliers, consumers, inhabitants of the planet—as well as shareholders.

The challenges are daunting, but this book, published jointly by HCL Technologies and The Economist Intelligence Unit, offers new ways to think about these challenges and help you map out your bets for the future. It includes perspectives from leading business thinkers, chief experience officers, other senior executives and HCL leaders. It offers articles gleaned from The Economist magazine and designed to pique your thinking on related topics. The content is intended to help us all, companies and individuals alike, to be more effective, more successful, more humane, more socially responsible and more able to safely navigate the covid-19 pandemic to a brighter future.

A handwritten signature in black ink that reads "Chijakumar".

C. Vijayakumar,
President & CEO, HCL Technologies

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OPEN TO

RE-INVENTION

Transforming the
world beyond covid-19

Transforming the world beyond covid-19

Crisis has a way of altering societies, often for the better. The four big economic “levellers” to reduce inequality, for instance, have not been election manifestos, books and debates in legislatures but war, revolution, state collapse and plague.

The dust has not yet settled on covid-19. It is already clear, though, that businesses in countries that are further ahead in the arc have been permanently altered in ways that may prove to the better — whether it be implementing distributed work arrangements that had stalled, making long-overdue investments in their digital capabilities and offerings or upskilling their staff.

This article explores how the post-covid-19 world is taking shape in three sectors that have been heavily affected by the crisis and are employment sources for millions of people worldwide: healthcare, real estate and retail.

Healthcare finally gets digital

Pharmaceutical companies and academic research institutes dominate the healthcare headlines as the search for a vaccine and treatments heats up. The tiniest crumbs of positive clinical data are enough to send global stock markets soaring.

But there is a deeper healthcare story than the quest for a cure. The entire sector, both public agencies and companies, is adapting in ways that will be long lasting — and to the good. Telemedicine consultations are becoming possible at scale as governments pass necessary legislation to reimburse it in countries including the US and Australia. This could greatly improve access to healthcare for

those who struggle to attend clinics either due to living in rural and remote areas or because they have mobility difficulties. It will also allow health systems to allocate resources far more efficiently and effectively.

Out of the administrative confusion of the last four months, experts are tabling more innovative and flexible ways of managing public health resources such as “braiding and blending” government funds, creating intermediary bodies to encourage inter-agency collaboration and introducing waivers to reduce red tape in future emergencies. Health systems “should not go back to bureaucratic normal after the pandemic is over”, says one article in JAMA, a leading medical journal.

Upskilling staff to cope with covid-19 has fundamentally challenged methods of in-person training. Armies of volunteers, students and retired medical workers have joined the workforce. In the state of New York, 40,000 people, including retirees and students, volunteered. In the UK, the figure is half a million, and over 10,000 retired medical staffers were brought back into the National Health Service (NHS), along with final-year medical and nursing students.

Many have little to no experience of the technologies or processes involved in acute respiratory disease, though. “The majority of healthcare staff wouldn’t know how to put on aerosolising head masks,” says Alex Young, NHS surgeon and founder of Virti, an extended reality training company. Similarly, staff might be placed in an intensive care unit with no experience of using a ventilator.

Virti, which uses virtual and augmented reality combined with AI, has

provided “just-in-time” instruction, reportedly training over 15,000 health workers in the NHS and 14,000 in the US. This could radically improve healthcare workforce planning in the long run by allowing more staff to be equipped with a richer repertoire of skills.

There are also encouraging shifts for the commercial health sector that could outlast covid-19. For one, it has been a boon for the wellness industry. Some analysts even believe life expectancy may increase as people take more active measures to address health conditions like obesity, with demand for health trackers, smoking cessation aids and vitamins all reportedly increasing. The fact that covid-19’s impact is so much worse for people with conditions like obesity and diabetes — which are amenable to self-monitoring and self-management digital aids—has put companies in this sector, ranging from consumer app start-ups to Apple, on firm footing for the future.

The end of the office?

Real estate, especially for enterprises, is a second sector that will look quite different in a post-covid-19 context. Companies have been forced into remote work by social distancing regulations and, in some cases, the change may be permanent. Facebook’s CEO Mark Zuckerberg recently said 75% of his employees have expressed some degree of interest in leaving the Bay Area, where costs of living have spiralled. Twitter has announced that any workers who wish to work from home permanently will be able to. Jeff Staley, group chief executive of Barclays, said, “The notion of putting 7,000 people in a

building may be a thing of the past.” Real estate platforms are reporting spikes in home searches in smaller cities.

While it is too soon to know whether companies will shift en masse to distributed work — many people are beginning to appreciate the camaraderie and social bonds of office life — experts see the pandemic accelerating the shift towards more flexible work. “I believe the [flexible office] will come back as part of the trade-off of working from home,” says Christian Ulbrich, CEO of Jones Lang LaSalle, a real estate services company. “If employees want to do that, they will need to accept that the company only provides a flexible desk.”

Flexible leasing arrangements are also more in favour as decision-makers fear long-term commitments with so much uncertainty. “Companies are forced to sign up for a certain amount of space for ten years even if they don’t have a clue what they need,” says Mr Ulbrich. “This is the only industry where you force people to make such long-term decisions. We will see the importance of flexibility accelerate.”

The real estate industry itself has suffered through the crisis as transactions dwindle. Yet past investments in technology and data have allowed the more progressive among them to find new ways of adding value to their clients. Companies have, for instance, shifted to offering virtual viewings of properties and digital mortgage applications. “Proptech” start-ups were already a thriving segment. In 2018 alone nearly US\$20bn was invested into companies offering everything from blockchain-based investment platforms to workspace optimisation. Now, their services are particularly useful.

JLL is reaping the benefits of its own venture investing arm, JLL Spark, says Mr Ulbrich. It has, for instance, brought together two of its portfolio

companies — one specialising in virtual sensors to track the use of office space, the other a worker call-out system — to enable companies to automatically notify a cleaner to disinfect a desk when a worker has left. Another JLL portfolio company, which has developed a ventilation technology, is also well positioned as companies improve air filtration turnover to maintain hygienic office conditions.

Retailers: Final curtain or the next act?

For retailers, the pandemic looked dire on the surface. They have seen their profits steadily erode in recent years as consumers flock to the convenience and speed of home purchasing. Look deeper, though, and the pandemic might reward the innovators.

Walmart’s recent deal with Shopify has opened the marketplace of the former to Shopify’s roughly 1m businesses. More broadly, the industry is finally investing in its digital capabilities.

“Retailers have adapted to the pandemic at incredible speed,” says Kyle Monk, head of retail insights and analytics at the British Retail Consortium (BRC). The switch to digital has been unprecedented with non-food online purchases up 60% in May, according to the BRC. “They have made considerable investments in e-commerce, online deliveries and click-and-collect operations, which have allowed the public to continue accessing the goods they need.”

S&P Global Market Intelligence reckons the pandemic will be a catalyst for millions of dollars of investment by retailers in automation and robotics to streamline aspects such as order-picking, inventory-tracking and delivery while also giving companies more control over supply chain bottlenecks.

Even the most technology averse consumers have had to embrace

online transactions as a result of covid-19, and these behavioural shifts look set to be permanent. This transition will support innovators in the retail space and punish any laggards. “With many people trying online shopping for the first time, it is unlikely they will revert back to in-store for some time, if at all,” says Mr Monk. “Many retailers have invested in and expanded their online operations to help meet this demand. While this ongoing transformation may mean fewer stores in the future, diversification of the retail experience will rise.”

The retail sector is also undergoing an overhaul of supply chains. Simone Cipriani, founder of the Ethical Fashion Initiative of the International Trade Centre, a joint agency of the UN and the WTO, thinks that one long-term shift could be greater regionalisation in the fashion sector. This could enable parts of Africa and the Mediterranean to meet demand in European markets.

But this change, while economically welcome, requires companies to take a longer-term view given the potential difficulties in setting up these new outposts. “Asia has become a manufacturing centre — in fashion — not just because of the productivity of labour but also the productivity or efficiency of the overall systems — logistics, banking and the rest, says Mr Cipriani. “These new regions may not be so efficient in areas like shipping, customs, financial services and governance. There may also be challenges around labour practices.”

Mr Cipriani encourages the fashion sector to make a long-term commitment to improving both environmental and labour standards in the industry. Investment opportunities in productivity as new geographies are brought into the sector’s lucrative supply chains now offer the potential for positive, long-lasting change. ■

Re-imagining healthcare in a post-covid-19 world



Shrikant Shetty,
Executive Vice President and North America Head - Life Sciences and Healthcare, HCL Technologies

Covid-19 has played the unlikely role of a chief transformation officer for the healthcare industry. Healthcare enterprises that have typically lagged in digital adoption are, in the blink of an eye, transforming. To those of us working at the confluence of technology and healthcare, the most visible changes are with adoption of telehealth, remote patient monitoring, remote clinical trials and data-led pandemic management. While in the short term these radical changes are a business necessity, there are emphatic signs that the lessons learned, benefits

gained and behaviors adopted during these times will reshape healthcare in the long run. The future portends an accelerated and innovative adoption of digital technologies by healthcare enterprises.

The top three areas of focus for healthcare enterprises to reorient themselves and be future ready are:

- **Patient and physician experience:** The convenience of telehealth consultations, enabled by legislations and amendments, will be very hard to undo. This experience alone is increasingly pushing healthcare enterprises towards consumer-driven, decentralised care delivery models. Digital front doors and virtual care corridors are fast becoming cornerstones of this transformation by leveraging app-based diagnostics, artificial-intelligence, and machine-learning-driven point-of-care solutions. Enterprises that embrace this transformation with speed and agility will flourish, and those that don't will meet the fate of brick and mortar shops who didn't establish web presence in time. Improved care access to underserved communities and cost efficiencies are two major added benefits of this digital care delivery.

- **Unlocking health data:** The publicly visible use of real time data analytics to monitor and predict the progress of covid-19 is unprecedented. The power of data and insights that can be eked out of it are more evident in healthcare now than ever before. Command centres

established by healthcare and pharmaceutical companies are leveraging data analytics extensively to ensure availability and equitable distribution of scarce lifesaving medical supplies and drugs. Equipped with artificial intelligence / machine learning and advanced visualisations, advanced analytics offers viable solutions for pre-emptive and predictive management of global health.

- **IT modernisation:** IT workloads created by the surge of covid-19 patients and remote working enablement for employees are tackled by deploying stop gap solutions. Digital healthcare of the future needs a modern IT foundation that is scalable, resilient and secure; enterprises need to modernise their legacy IT systems to support a broader spectrum of scenarios. The case for large scale adoption of cloud and related technologies in healthcare, and with speed, just became stronger.

An Inevitable Future

The world stands at crossroads once again. The covid-19 pandemic has ravaged societies, halted most economic activity and exposed a number of vulnerabilities. But it has also presented us with an opportunity to reshape the world for the better. With digital innovation, we know that the future is not far when billions of people can easily access a higher quality of healthcare at far more affordable costs. This is a future worth investing in, and the time to do so is now. ■

How to feed the planet

The global food supply chain is passing a severe test



Keeping the world fed

If you live in the rich world and want an example of trade and global co-operation, look no further than your dinner plate. As the lockdowns began in the West two months ago, many feared that bread, butter and beans would run short, causing a wave of stocking-up. Today, thanks to fleets of delivery lorries filling supermarket shelves, you can binge-eat as you binge-watch.

This capitalist miracle reflects not a monolithic plan, but an \$8trn global supply chain adapting to a new reality, with millions of firms making spontaneous decisions, from switching rice suppliers in Asia to refitting freezers. The system is far from perfect: as incomes collapse, more people are going hungry. There are risks, from labour shortages to bad harvests. And there is an irony in seeing the industry grapple with a crisis that probably began with the sale of pangolin meat in a market in Wuhan. But the food network is so far passing a severe test. It is crucial

that, during and after the pandemic, governments do not lurch into a misguided campaign for self-reliance.

The supply chains behind an iPhone, or a car component that criss-crosses the Rio Grande, are wonders of co-ordination. But the unsung star of 21st-century logistics is the global food system. From field to fork, it accounts for 10% of world gdp and employs perhaps 1.5bn people. The global supply of food has nearly tripled since 1970, as the population has doubled to 7.7bn. At the same time, the number of people who have too little to eat has fallen from 36% of the population to 11%, and a bushel of maize or cut of beef costs less today than 50 years ago in real terms. Food exports have grown sixfold over the past 30 years; four-fifths of people live in part on calories produced in another country.

This happens in spite of governments, not because of them. Although their role has declined, they still sometimes fix prices and control distribution. The European

Union's farm tariffs are four times those on its non-farm imports. A dozen or so big exporters, including America, India, Russia and Vietnam, dominate staples such as wheat and rice. Half a dozen trading firms, such as Cargill from Minnesota and cofco from Beijing, shift food around the world.

Concentration and government intervention, along with the vagaries of the climate and commodity markets, mean that the system is finely tuned and can misfire, with devastating consequences. In 2007-08 bad harvests and higher energy costs pushed up food prices. This led governments to panic about shortages and ban exports, causing more anxiety and even loftier prices. The result was a wave of riots and distress in the emerging world. It was the worst food crisis since the 1970s, when high fertiliser prices and bad weather in America, Canada and Russia caused food production to drop.

Despite the severity of today's shock, each layer of the system has adapted. The

supply of cereals has been maintained, helped by recent harvests and very high stocks. Shipping firms and ports continue to move around food in bulk. The shift from eating out has had dramatic consequences for some companies. McDonald's sales have dropped by about 70% in Europe. The big retailers have cut their ranges and rewired their distribution. Amazon's grocery e-commerce capacity has risen by 60%; Walmart has hired 150,000 people. Crucially, most governments have learned the lesson of 2007-08 and avoided protectionism. In terms of calories, only 5% of food exports face restrictions, as against 19% back then. So far this year prices have dropped.

But the test is not over yet. As the industry has globalised, it has grown more concentrated, creating bottlenecks. Covid-19 outbreaks at several American slaughterhouses have cut pork supplies by a quarter—and boosted wild-turkey hunting licences in Indiana by 28%. America and Europe will need over 1m migrant workers from Mexico, north Africa and eastern Europe to bring in the harvest. And as the economy shrinks and incomes collapse, the number of people facing acute food shortages could rise—from 1.7% of

the world's population to 3.4%, the UN reckons, including in some rich countries. This reflects a shortage of money, not food, but if people go hungry governments will, understandably, take extraordinary measures. The ever-present risk is that rising poverty or production glitches will lead panicky politicians to stockpile food and limit exports. As in 2007-08, this could cause a tit-for-tat response that makes things worse.

Governments need to hold their nerve and keep the world's food system open for business. That means letting produce cross borders, offering visas and health checks to migrant workers, and helping the poor by giving them cash, not stockpiling. It also means guarding against further industry concentration which could grow, if weaker food firms go bust or are bought by bigger ones. And it means making the system more transparent, traceable and accountable—with, for example, certification and quality standards—so that diseases are less likely to jump undetected from animal to human.

To understand food as a national-security issue is wise; to bend that understanding to self-sufficiency drives and blunt intervention is not. Already, before this-

year, food had become part of a trade war. America has sought to manage its soya-bean exports and put tariffs on cheese. President Donald Trump has designated abattoirs part of America's critical infrastructure. President Emmanuel Macron has called for Europe to build up its "strategic autonomy" in agriculture. Yet food autarky is a delusion. Interdependence and diversity make you more secure.

Cooking up a new recipe

The work of the food-supply system is not yet done. In the next 30 years supply needs to rise by about 50% to meet the needs of a wealthier, growing population, even as the system's carbon footprint needs at least to halve. A new productivity revolution is required, involving everything from high-tech greenhouses near cities to fruit-picking robots. That is going to require all the agility and ingenuity that markets can muster, and huge sums of private capital. This evening, when you pick up your chopsticks or your knife and fork, remember both those who are hungry and also the system feeding the world. It should be left free to work its magic not just during the pandemic, but after it, too. ■

The sum of all lives

The way people live their lives can be mined, too

But there will be setbacks and privacy problems along the way



Threadworms are trending, according to the app on Johannes Schildt's phone. The app was created by Kry, the Swedish digital health-care firm Mr Schildt runs. It offers information on the sicknesses for which people are currently booking doctor's appointments, as well as on things specifically important to its user—it keeps Mr Schildt, who suffers from hay fever, up to date with the pollen count. It lets him book an appointment with a family doctor or a specialist, and indeed to have such an appointment by phone. None of this sounds particularly radical. But in health care, it counts as radical.

According to the Organisation for Economic Co-operation and Development (OECD), a club of richer nations, the world creates 2.5 exabytes of data a day—thousands of times what even the grandest sequencing centre can produce in a month. Of those which get stored, 30% pertain to health. The trove contains insights into the health of populations and of individuals, the efficacy of drugs and the efficiency of health-care systems, the failings of doctors and the financial health of insurers. But OECD countries typically spend less than 5% of their health budgets managing these data, much less than is

the norm in other areas. By failing to make the most of their potential, these countries are wasting \$600bn a year—roughly the gdp of Sweden.

This underutilised resource has attracted the attention of a panoply of private companies, from minnows like Kry to giants like Amazon, Apple, Facebook and Google. Governments, hospitals and insurers, they think, will pay for what they glean from it. So will individuals—who will often pay for the privilege of supplying yet more data off their own bat. Mobile phones log their users' physical activity, creating records used by many of the billions of health-related smartphone apps downloaded globally every year (1.7bn in 2013, 3.7bn in 2017). Make sense of all this data for them, the argument goes, and you can make money helping people stay healthy and warning them of disease.

As with the genome twenty years ago, some scepticism is warranted. But in time a picture of a life built up from the genome's underlying recipe, from medical histories and tests that profile specific bodily functions, and from the monitoring of every step and heartbeat, will allow personalised, preventive medicine to be rolled out across entire populations. "All these layers define the medical essence of

a human being," says Eric Topol, head of the Scripps Research Translational Institute in La Jolla, California.

Adding real-world data to genome-based profiles would undoubtedly be useful. Michael Joyner of the Mayo Clinic in Rochester, Minnesota, and Nigel Paneth at Michigan State University argue that characteristics such as family history, neighbourhood, socioeconomic circumstances, height and girth still outperform genetic profiling as predictors for all sorts of health outcomes. This does not mean genetic information is without value; it means it needs context.

Various new frontiers in diagnosis are being explored. Firms across the world are competing to develop "liquid biopsies" that can detect and characterise cancers by means of fragments of DNA in the blood; other molecular markers could reveal other diseases. But so could the digital footprints people leave when they decide whether to leave the house, what to buy, what to search for or what to stream.

Not-yet-dead men walking

Sometimes the footprints may be just that. Dan Vahdat, who runs Medopad, a health-technology firm in London, says conditions as varied as Parkinson's dis-

ease, depression and breast cancer can all have a distinctive effect on a patient's gait. He speculates that with enough data covering different behaviours it will be possible to identify "digital biomarkers" capable of predicting the risk of Alzheimer's or a heart attack. Work by Dr Topol has already shown that spikes in resting heart rate—more common when people have an infection—allow someone with access to lots of fitbits to see when flu is breaking out in the population.

The recognition of such patterns is clearly a job for the machine-learning techniques driving the current expansion of ai. These techniques are already being used to interpret diagnostic tests, sometimes with real success. An ai system for prostate cancer diagnosis developed by the Karolinska Institute in Stockholm has held its own against a panel of 23 international experts; a nine-country trial is now assessing how much it can reduce the workload of doctors. But recent research published in *The Lancet Digital Health*, a journal, suggests some caution is advisable. Looking at around 20,000 studies of medical ai systems that claimed to show that they could diagnose things as well

as health-care professionals, it found that most had methodological flaws.

One particular worry with machine learning in general is that bias in the "training sets" from which the computers learn their stuff can mean that the algorithms do not work equally well for all members of the population. Medical research has a poor historical record on such matters, for example when it does not match clinical-trial populations to the population at large, or excludes women of child-bearing age from trials. Machine learning could bake in such biases, and make them invisible.

Excessive optimism that edges into barefaced hype is just one cause for concern about datomics. Privacy is, as always, an issue. The amount of data that parts of the nhs have shared with Google has worried some Britons. Conversely, some researchers feel hampered by constraints such as those of Europe's General Data Protection Regulation, says Claire Gayrel of the eu's data protection authority. They see it as an obstacle to innovation. Ms Gayrel treats that with equanimity: "I don't think it is a bad thing to think slower, especially in health."

As well as worries over

The world creates 2.5 exabytes of data a day — thousands of times what even the grandest sequencing centre can produce in a month.

what researchers or companies might do with personal data, there are reasonable concerns over how safe they can keep it. A cyberattack on Premier Blue Cross, an American insurer, may have exposed the medical data of 11m customers in 2015.

There is also the challenge of cost. Whatever claims are made early on and whatever benefits they may demonstrate, new technologies have a marked, persistent tendency to drive up spending on health in rich countries. There is no obvious reason to think that, just because sequencing, data processing and some forms of machine learning are getting cheaper, their ever greater application to health care will drive down costs.

One reason is that, although knowledge may be power, it may also be a needless worry. A DNA test that seems to tell you some of your future, or a watch that can pick up atrial fibrillation, may seem great to users; they are less enticing to health systems that have to deal with diagnoses which are not, in themselves, clinically relevant. Last year the *New York Times* reported that a period-tracking app which also evaluated women's risk of polycystic-ovary syn-

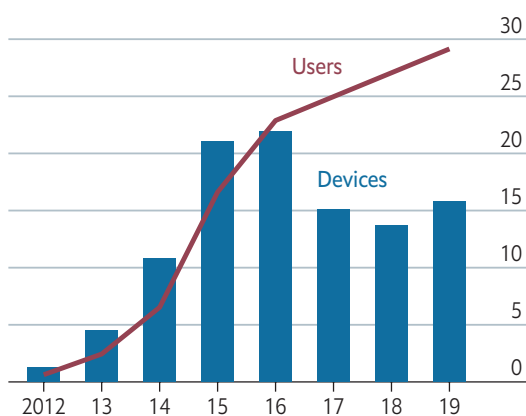
drome, a hormonal problem, was recommending that an improbably large number of its users see their doctors.

Trustable intermediaries—such as government health-care systems, regulators and reputable insurers—will help consumers to know what works best. They should also be able to help each other. Not everyone is motivated to improve their health, and even avid consumers of health data will rarely have the same sense of common cause as people with congenital diseases and their families. But health concerns bring people together, and through supporting each other they may develop new mechanisms for change.

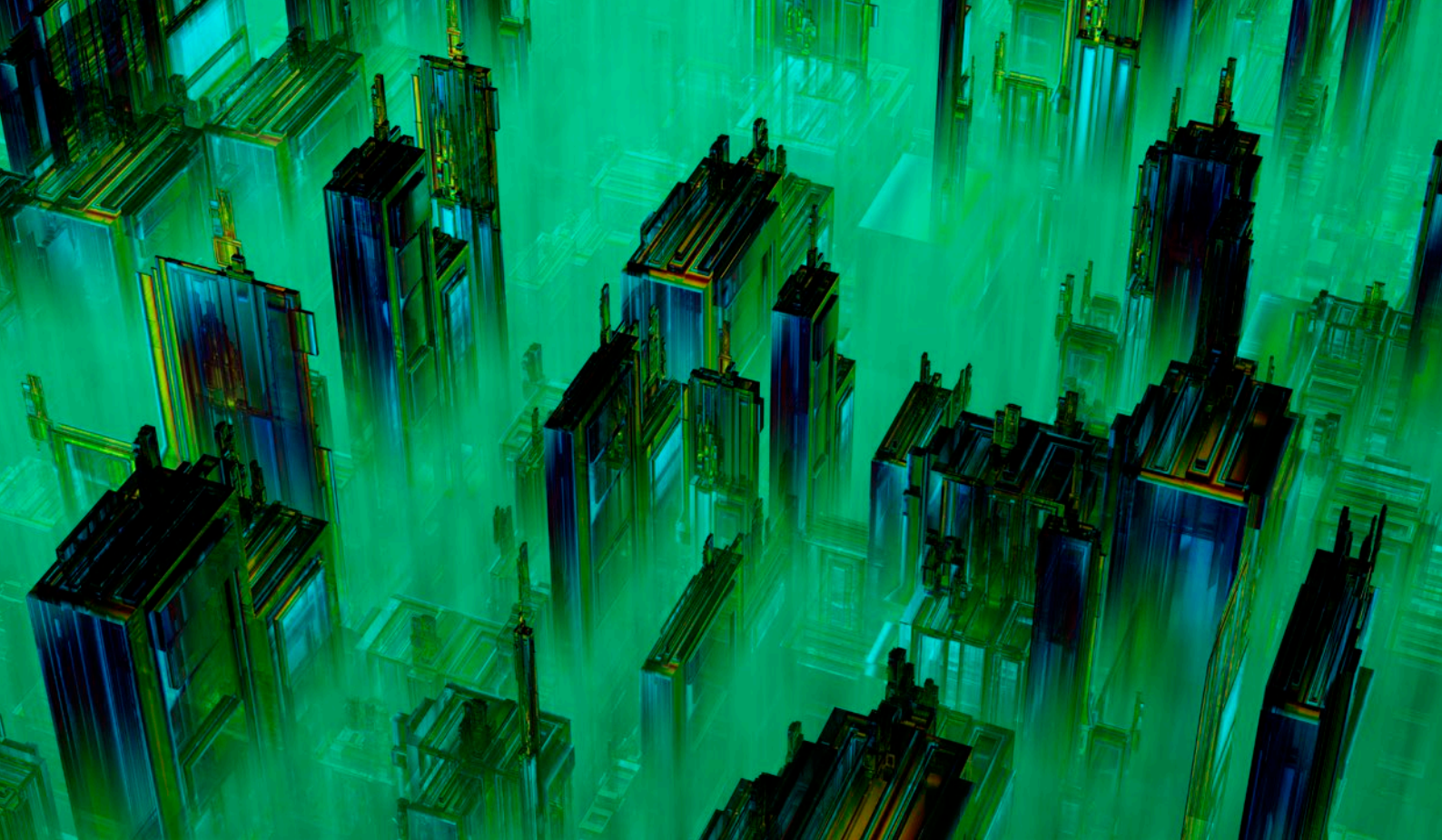
Because health systems look to the needs of the many, personalised medicine will hit its stride only when it can show that its approaches work in the round. But as people get more used to customising their lives through online services that know what they want, health care will get pulled along. There will be many false correlations, privacy violations, and errors along the way. But in the end, people of all sorts will benefit from being understood as unique ■

Mapping behaviour

Fitbit, number of active users and devices sold, m



Source: Fitbit



OPEN TO

DISRUPTION

A lesson in digital
transformation from fintech

A lesson in digital transformation from fintech

Digital technologies are disrupting the landscape of even the most traditional sectors. The financial services sector is a case in point. The power of disintermediation — cutting out the middleman — and the decentralisation of power aided by these new tools is allowing start-ups to reshape every aspect of how we receive, save and spend money.

Underlying this changing landscape are technologies that are optimising or automating processes, yielding unprecedented efficiencies in performing complex operations. Smartphones and other mobile devices, meanwhile, have changed how services can be consumed, enabling instant and convenient transactions. Accordingly, the need to enhance the user experience is a force driving further developments. Husayn Kassai, CEO and co-founder of Onfido, a digital identity verification and authentication provider, notes that, especially for digital generations, “services and user interface have to be fast, intuitive and convenient. User convenience is the new norm and is expected. Traditional and legacy services, such as going in-branch, or showing paper-based utility bills are alien to them.”

While current technology already provides substantial room to improve user experience, advances in areas like global connectivity, autonomous artificial intelligence (AI) and computing power combined with the proliferation of digital networks and the multiple uses of blockchain mean that continuous disruption will be the norm in the lead-up to 2030.

Such technology-driven change will be wide and deep. It will also

bleed across sectors. Innovations that enhance capabilities in one field can quickly do the same elsewhere, revolutionising existing industries and creating new ones along the way. Recall how better data storage and faster transfer speeds for computing quickly upended traditional music and video distribution years ago. This scenario will be repeated frequently in the form of many different advances right across the economy.

Financial services in the eye of the storm

The financial services industry is a prime example of a sector that is experiencing the early stages of revolutionary disruption. This traditionally staid market has witnessed the arrival of numerous so-called fintechs, which McKinsey & Co defines as “start-ups and other companies that use technology to conduct the fundamental functions provided by financial services, impacting how consumers store, save, borrow, invest, move, pay and protect money”. These new entrants, staffed by digital natives ready to innovate, have appeared across the whole landscape of financial services, including investment management, lending, payments, insurance and capital markets.

Finally, the covid-19 pandemic has dispelled the conventional wisdom that long-term prosperity in the financial services industry depends on size or historical pedigree. Expertise in disruptive innovation is now more critical. Mr Kassai notes that in major developed countries neobanks, payment facilitators, insurers and other fintechs have handled the lockdown well. Their capacity for digital interaction with clients has allowed

increased income in many areas. At the same time, many start-ups have easily adjusted to working arrangements imposed by health requirements. “Start-ups and scale-ups tend to be more agile so suddenly working remotely is not much of a fundamental shift,” Mr Kassai explains, “but for large corporations suddenly working from home is not always easy.”

The nature of the new competitive environment

Ongoing barriers to market entry make it difficult to start up as a full-service bank or investment house. Accordingly, existing players do not face big disruptors. Instead, they confront an army of smaller threats: would-be unbundlers attacking profitable pieces of the financial services value chain. These new players are carving out distinct niches in areas as diverse as payments, e-invoicing, peer-to-peer lending, automation, asset management, risk assessment, fraud detection, security and business financing.

For incumbents, though, it is not simply a matter of fending off challengers; the new environment also includes potential allies. Mr Kassai explains that many major banks use his firm to reduce the expense of compliance with know-your-customer and anti-money-laundering legislation. Yet this same lowering of cost also means that new players, which once could not have afforded to meet such compliance requirements, can now become competitors to existing financial services firms.

Fintech, then, is not simply allowing new companies to enter financial services. It is reshaping the entire competitive landscape, making new

strategies both possible and essential.

New business models

PayPal, for instance, was founded as a way for consumers to pay for small online purchases in the early days of e-shopping. Through expansion and acquisition, the company is reaching a level of consumer acceptance that no organisation receiving retail payments can afford to ignore.

In terms of business models, PayPal is well along the way to the coveted status of a platform. "There is a network effect going on," said PayPal CEO Dan Schulman to analysts in October 2019. "We have almost 300m active accounts now. Merchants understand the scale we have. They want to be a part of that. We do start to see right now the beginnings of our capabilities of selling as a platform provider and not just a product."

The intersection of social media and asset management suggests another business model. For example, eToro, founded in 2007, has created a social trading and investment platform, according to CEO Yoni Assia. Among other innovations, it has introduced "copy trading" which allows users to follow the investment strategies of top-rated investors.

Unlike in the past, Mr Assia explains, "gradually, with widespread acceptance of social networks, it has become clear that you can discuss and share your investments online. It's called social investing. People increasingly want to invest in companies that they believe in — brands that they know and love. When they invest in companies they believe in, they are proud to show others what they are investing in".

Regardless of the business model, success requires a compelling user experience. Mr Assia draws attention to the "consumerisation" or "productisation" of the industry where new products consist of user experiences. He further notes that consumers will

expect global solutions, such as "global investment platforms, enabling users to invest overseas, communicate and collaborate across countries".

With the ongoing diversification and unbundling of services, some analysts suggest that financial services will increasingly be provided as part of ecosystems. China's Ant Financial is an example. Originally a payments platform, it now offers a growing range of fintech-based services to about 1bn users. Mr Assia describes a trend of "re-bundling" as fintech players look to aggregate services for the user in order to provide a better experience. Saurabh Narain, president and CEO of NCIF believes that in the future there will be "a marketplace for basic services". In his view, "banks as we know them today will not exist, but banking as a service will".

Finally, technology will break down barriers between industries. Mr Kassai notes that about three-quarters of his company's clients are financial services firms. Other sectors, however, also face strong regulatory requirements to be able to identify customers. Much of Onfido's client base outside financial services, for example, consists of online health-care providers—a growing sector that must be certain of patients' identities. Ultimately, he adds, many companies engaged in ecommerce will be interested in more robust ways to reduce fraudulent transactions and provide a convenient user experience through better identity verification. Onfido will not be the only company looking for wider opportunities, taking fintech's disruption further afield. Amazon Pay, for example, has issued more than US\$3bn in cash advances to merchants in recent years.

How do companies prepare for disruption?

Traditional firms will need to become more agile and adaptable. Mr Narain

maintains that financial services institutions should adopt technology in a strategic manner that leverages their customer data and relationships, analytical tools and computing power. "We can grow in a symbiotic manner with technology companies; it will be a win-win for the financial services sector, the technology companies and the customer."

Indeed, many established firms have started to catch up by improving their digital offerings. As early as 2014, Citi CEO Michael Corbat claimed that "we see ourselves as a technology company with a banking licence". Established firms in the industry need to continue paying attention to areas where customer dissatisfaction may prevail. A study by PwC suggests that insurance (small and medium-sized enterprise, personal and commercial) is a sector that may be ready for disruption, noting increased customer dissatisfaction. Companies should also take advantage of progress in AI, machine learning and computing overall, which can help in cost optimisation in saturated markets with low margins.

The current pandemic may have provided the push needed to accelerate the transformation of older financial services firms into enterprises fit for the new environment. Mr Kassai reports that many major businesses have accelerated their digitisation programmes during the lockdown. Decreasing footfall in bank branches and greater use of digital channels combined with the need for more employees to work from home has left them with little choice.

Looking ahead, the rate of change is unlikely to diminish. For Mr Assia of eToro, the key to navigating disruption is non-stop innovation. He explains how eToro constantly adapts its offerings based on customer feedback. According to Mr Assia, "fintech is still relatively nascent; the next ten years are going to be ten times bigger". ■

Democratising financial data through open banking



Rahul Singh,
President and Global Head
Financial Services,
HCL Technologies

The covid-19 pandemic has accelerated data-driven forces that were already causing sweeping changes in the financial industry. At the same time it has compelled banks to become both more open and more secure.

Open Banking, or Payment Services Directive 2.0, has been in force in the EU for some time, placing the power of data in the hands of banks. There is so great a divergence in the abilities of different banks to make use of this data, however, that analysts suggest that 80% of today's financial firms will not survive in the face of competition from new data-driven, omnichannel financial players over the next 12 years.

The victors will be a new breed of banks that use data to improve customer experience. Before covid-19, the mandate for change was to create multi-channel offerings that enabled banks to become agile while preserving their traditional branch networks.

The pandemic shifted the balance of that vision. The share of financial services served solely through online experiences will certainly be much larger. The scope of online user expe-

periences must, therefore, widen to facilitate the full range of services.

Such expansion brings challenges. The door stands open to aggregators like Amazon. They are skilled at building customer loyalty and own the customer at a deeper level than banks do. With more activity online, security, compliance and data protection must be improved and made more usable. The ease of transactions in combination with the assurance of complete security will become important points of differentiation.

What will the banks of the future look like? Tomorrow's prospective homeowner will expect a bank to provide everything from the ability to examine properties online to completing legal paperwork, paying for the property, renting furniture and applying for loans and insurance. The focus will be on end-to-end solutions, backed by expanded intelligent automation, that make banking itself invisible. The key will be open banking that fashions dormant customer data into compelling commerce. The winners will be those who provide the best synthesis of remote services within a demonstrably secure user experience. ■

How executives use AI

Welcome to the machine

High-growth companies are big believers in artificial intelligence

All workers must have days when they wonder whether their managers possess any intelligence at all. But next time you are puzzled by a boss's decision, consider this possibility: the manager relied on artificial intelligence (AI) when considering their options. A survey by Microsoft of 800 business leaders drawn equally from eight countries (France, Germany, Italy, the Netherlands, Russia, Switzerland, the UK and the US) found they are increasingly keen on the idea of AI.

The survey found that 41% of high-growth companies were already implementing AI, as against only 19% of those defined as low growth. There is no proof of causation, of course; the high-growth companies have not necessarily prospered because they have used AI. The explanation could simply be that high-growth companies have more money to spend on technology and AI is the latest fashion.



Clearly, their experience so far has not discouraged them. Almost all the high-growth companies (93%) intend to invest in AI in the next 1-3 years, and more than half of them expect to use AI to improve their decision-making over the coming year.

So what are the ways in which managers hope to benefit from AI? Microsoft's David Carmona points to four areas. The first is based around customers; identifying for example, which customers are likely to "churn", allowing the company to find ways to keep them on board. A second approach is to use AI to optimise business processes. Third, AI can be used to make hiring decisions. Fourth, managers can use AI to identify new products or areas of expansion. Companies have been using AI already for issues such as quality assurance, predictive maintenance and adding digital assistants to consumer

products like cars. Others use "HR bots" to help employees who have questions about their work.

More detailed questions reveal that "motivating and inspiring employees" is the area that managers think might be the single most useful way to invest in AI. So next time your boss pays you a compliment, remember: an algorithm may have made them do it. ■

The explanation could simply be that high-growth companies have more money to spend on technology and AI is the latest fashion.

To have and to hold

Supplying clean power is easier than storing it

Cutting emissions relies on energy-storage technology coming of age



It sounds simple: lift heavy blocks with a crane, then capture the power generated from dropping them. This is not an experiment designed by a ten-year-old, but the premise of Energy Vault, which has raised \$110m from SoftBank, a big Japanese tech investor. The idea has competition. A cluster of billionaires including Bill Gates, Jack Ma, Ray Dalio and SoftBank's Masayoshi Son are backing other schemes to capture power. A firm incubated at Alphabet, Google's parent company, wants to store electricity in molten salt. Such plans hint at one of the power business's hardest tasks. Generating clean power is now relatively straightforward. Storing it is far trickier.

Solar and wind last year produced 7% of the world's electricity. By 2040, that share could grow by over five times, according to the International Energy Agency, an intergovernmental forecaster. The trouble is, a lull in the wind leaves a turbine listless. Clouds have a habit of

blocking the sun. That means that solar and wind cannot, on their own, replace coal and gas plants, which produce continual power reliably.

One answer is to store power in batteries, which promise to gather clean electricity when the sun and wind produce more than is required and dispatch it later, as it is needed. In 2018 some 3.5 gigawatts of storage was installed, about twice the amount in 2017, according to BloombergNEF, an energy data firm. Total investment in storage this year may reach \$5.3bn, it estimates. As this grows it could drive an extraordinary expansion (see chart). However at present only about 1% of renewable energy is complemented by storage, reckons Morgan Stanley, a bank. There are still plenty of hurdles to clear.

The most common method of storage so far has been to pump water into an elevated reservoir at times of plenty and release it when electricity is needed. This

type of hydropower is not the answer to providing lots more storage. Building a new reservoir requires unusual topography and it can wreak environmental havoc.

Batteries offer an alternative and availability should improve as electric cars become ever more popular. "The whole production supply chain for lithium-ion batteries for electric vehicles is gearing up," says Andrés Gluski of AES, an electricity company, "so we're going to piggyback on that." As greater demand led to greater manufacturing scale, the cost of batteries dropped by 85% from 2010 to 2018, according to BloombergNEF. That makes batteries cheap enough not only to propel mass-market electric cars but for use in the power system, too.

And as electric cars become more widespread their batteries could serve as a source of mobile storage, feeding power back into the grid, if required, when the vehicles are parked and plugged in.

With the right infrastructure in place, fleets of electric cars could substitute for new dedicated storage capacity.

Batteries do a variety of things. A firm called Sunrun sells residential solar panels paired with batteries, a particularly appealing proposition for Californian homeowners desperate for an alternative to fire-induced blackouts. Within the broader grid, batteries can act as a shock absorber to deal with variations in supply from one minute to the next. Other uses include shifting electricity supply from the day, when solar panels often produce a surfeit of power, to the evening, when demand rises.

The growth of storage is becoming a headache for old-fashioned power generators that rely on gas or coal. NextEra Energy Resources, which builds clean-power installations, is increasingly pairing large solar farms with batteries. AES, which has battery-storage facilities in 21 countries and territories, runs a scheme in Hawaii that

combines solar with storage to meet peaks in demand. The Rocky Mountain Institute, a clean-energy research group, warns that solar and battery projects, combined with measures such as smarter appliances to control demand, may turn gas-powered plants into stranded assets.

Nevertheless, the battery industry faces several barriers to broader deployment. To start with, if a battery overheats it can catch fire, producing gases that might explode. In the past year installations in South Korea have caught fire. A fire and explosion in April damaged a storage site in Arizona run by Fluence, a joint venture between AES and Siemens, a German engineering giant. The causes are still under investigation. As the industry matures, safety measures are likely to become more rigorous.

In the meantime, the industry will have to cope with a patchwork of other rules and regulations. South Korea has offered incentives for storage, in part to create a market for

“The whole production supply chain for lithium-ion batteries for electric vehicles is gearing up, so we’re going to piggyback on that,” says Andrés Gluski of AES, an electricity company.

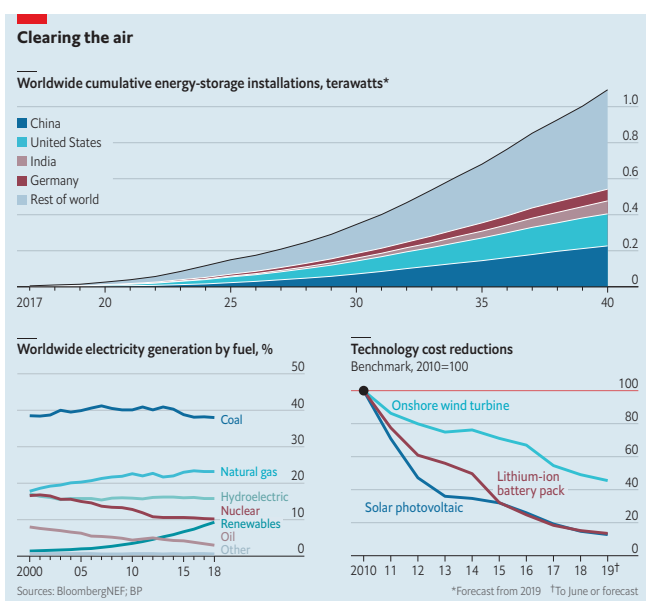
its domestic battery-makers, which are among the world’s leaders. Some states in America, such as New York and New Jersey, have mandated storage to help reduce emissions. In others, America’s federal electricity regulator is trying to open markets to storage, but the details of how that will work in practice are unclear. In Britain, batteries are deemed “generation assets”, which exposes storage developers to extra fees and costs, says Michael Folsom of Watson Farley & Williams, a law firm.

Even if electricity regulations were smoothed, lithium-ion batteries would eventually reach their limits. Breakthrough Energy Ventures (BEV) is a fund backed by Messrs Gates, Ma, Dalio and other billionaires to invest in transformational technologies. The cost of lithium-ion batteries is falling quickly, but to store power for days let alone weeks “lithium-ion is never going to get cheap enough”, says Eric Toone, BEV’s head of science.

Alternatives include flow batteries, that use electrolytes

in tanks of chemical solution, as well as mechanical means such as Energy Vault’s falling blocks. Hydrogen can also be made using clean power and turned back into electricity in gas-fired power plants or fuel cells. In the future liquefied gases might provide a solution. Unlike solar panels, which have become standardised, different batteries are likely to serve different purposes on a grid. “All batteries are like humans, equally flawed in some specific way,” says Mateo Jaramillo, who led storage development at Tesla, an electric carmaker.

Mr Jaramillo now leads Form Energy, a firm that is developing an electrochemical alternative to lithium-ion batteries. Investors include BEV and Eni, a large Italian oil and gas firm. Mr Jaramillo declines to predict when his work will be commercialised. But the goal is clear. “If you can develop a long-term storage solution,” he says, “that’s how you retire coal and that’s how you retire natural gas.” ■





OPEN TO

COLLABORATION

Building a synergistic
multi-stakeholder ecosystem
in the digital era

Building a synergistic multi-stakeholder ecosystem in the digital era

Over the next decade, companies will operate in an increasingly complex world. An ageing, urbanising and growing global population will drive shifts in centres of economic power. Responding to the more demanding tastes of a growing middle class, technologies — ranging from machine learning to 3D printing — will revolutionise services and manufacturing. Global challenges like climate change and cybersecurity will require urgent action. Unexpected events, meanwhile, will increase complexity in unpredictable ways. For example, how many businesses can say that they were prepared for the dislocation caused by the covid-19 pandemic.

Román Arjona, chief economist at the EU's Directorate-General for Research and Innovation, argues that if companies are to survive in a complex world, rapid innovation cycles and adaptability will be paramount. This will require increased collaboration and openness. "Innovations are increasingly open in nature," he explains. "They are no longer based on linear or bilateral transactions and co-operation. They are built on dynamic, networked and multi-colaborative innovation ecosystems. They emerge at the interaction between the physical, digital and biological worlds and at the crossroads of various technologies and scientific disciplines."

The landscape of collaboration

Globally, companies large and small are embracing collaborative innova-

tion models to understand consumer needs, leverage knowledge within their networks and improve their agility.

- Open innovation is already an established practice across industries, utilised by companies such as Procter & Gamble, Samsung and Unilever. This approach allows ideas to flow easily into and out of an organisation in a decentralised way, bringing together companies, start-ups, academia and government in different permutations and for different purposes.

- Collective intelligence involves stakeholders co-operating to tackle complex issues, often assisted by powerful digital networks that can be further boosted with artificial intelligence (AI). Citi has used this approach for strategy formulation, and MIT's Centre for Collective Intelligence creates platforms to examine global issues like climate change.

- Design thinking seeks to devise solutions that improve the experience of users (including not only customers but also employees, investors, regulators and suppliers). It encourages multidisciplinary collaboration among creatives, technologists and managers, with GE a leading adopter of this way of working. Mastercard offers a design-thinking service to its customers. Its chair, Rick Haythornthwaite, says this approach "builds tremendous closeness with customers and puts us at the heart of their innovation agenda, not just ours. We can't think in silos anymore. We have to collaborate and co-create".

Collaboration in practice

Collaboration typically includes transactions, but it runs far deeper than a typical buyer-seller relationship. In the era of the platform economy, collaboration requires much upfront work to set standards for integration and infrastructure.

For instance, Mastercard is partnering with retailers and consumer brands to digitise the payroll of developing-country garment workers as part of a broader effort to develop an "on ramp" to the digital economy. Says Mr Haythornthwaite explains: "You can't just say, 'I'm going to work with you, Marks & Spencer', because in fact you're working with an entire group of stakeholders — Marks & Spencer, its supply chain, governments — to bring interoperability standards within the payments and banking systems. You can't do this in a unilateral way. Putting the standards in place requires an extremely broad partnership."

And collaboration leads to business opportunities. For Antonio Pietri, CEO of Aspen Technology, "in today's technology landscape partnership and collaboration are essential to sustain and maintain competitive advantage". The company has a rich history of collaboration, going back to its origins in MIT research for a project funded by the US Department of Energy.

Collaborating with start-ups offers an additional advantage. "It gives us the opportunity to work with companies that we think are most aligned to our future," says Mr Haythornthwaite. "In a world where we see eve-

rything through the digital lens, we can influence how those technologies come together and the shape of the ecosystem itself. That's invaluable in meeting the needs of our customers."

At Aspen Technology, collaboration has also been essential internally. In order to innovate and develop a new generation of products, the company has enabled collaboration between two areas of expertise: the core capabilities in chemical engineering, and a newer area—working in technologies like AI, the Internet of Things, and cloud and high-performance computing. The purpose is to "improve accuracy of modelling, to automate knowledge and use cognitive abilities in products".

Collaboration in a time of pandemic

Addressing the challenges of covid-19 rapidly requires extensive collaboration between organisations and across sectors. One crucial tool in fighting the disease is the collection of accurate public health information on its extent, spread and retreat. Collaboration is just as fundamental to success here as it is in drug discovery.

One example is the recent joint endeavours of Javara, a specialist clinical research company, Wake Forest Baptist Health, a North Carolina healthcare provider, and Oracle, a global technology firm. The three organisations have launched a large, community-based research project to provide near-real-time data on the state of symptomology and seroprevalence of covid-19 in North Carolina. Initially, individuals are invited to participate in the study via Wake Forest's electronic health record patient portal. Invitees are sent daily, standardised questions about symptoms. Wake Forest also provides a cohort of participants with home antibody-testing kits.

The responses to the texted questions are collated using Oracle's

purpose-built Patient Monitoring System. Health system and government public health officials can then use the aggregated data, presented on a secure, web-based system dashboard, to inform decision-making. The antibody tests are collected and analysed by researchers at Wake Forest and, in some cases, a third party testing company. Since the project's initial launch in April, other health systems in North Carolina have also joined.

Within two and a half weeks of the original partners discussing the idea in late March, the project went live, recounts Jennifer Byrne, Javara's CEO. By mid-June some 18,000 participants from Wake Forest's health system were answering the daily questions, as well as thousands of participants, Ms Byrne estimates, from other systems state-wide. Already, the US Department of Health and Human Services is using the data to track trends in prevalence, and Oracle intends to roll the model out across the whole country. "I don't know of another clinical research project of this scale that has been launched as quickly," Ms Byrne says.

This collaboration provides a practical illustration of several of the points raised in this article:

- **Collaboration depends on a relationship rather than being purely transactional.** Ms Byrne says: "Trust is extraordinarily important. The pandemic required an immediate response and we did not have time to vet each other." Organisations that seek the benefits of collaborative innovation should invest in developing trusted relationships, she adds. "In a collaboration, you are representing each other's reputation and brand identity."

- **Collaboration requires letting each actor do what they do best rather than doing everything jointly.** Ms Byrne notes that success has been built on understanding what each partner has to offer, and

then getting out of the way. In the present project, the three initial collaborators brought distinct assets and expertise: Wake Forest in science and data collection, Javara in research best practice and strategies for researcher-patient interaction, and Oracle in information technology. Each "had a defined contribution", Ms Byrne explains. "We did not try to get into each other's swim lanes. We are not competing to be all things to each other."

- **Collaboration happens in an ecosystem.** Those involved in a joint endeavour need to bear in mind constraints on all the partners and the requirements of other potential stakeholders. For example, medical research of any kind is highly regulated, yet outside the present project each collaborator might have a different experience of how these rules affect their own activities. Therefore, Ms Byrne explains, "we were not acting from a scientific standpoint in isolation and hoping it would work with regulators." A multidisciplinary legal team, as one example, with members from all three collaborators was thus involved from the start. Similarly, there is little point in gathering data that interests no one. Accordingly, those involved in the project consulted with the Department of Health and Human Services on what patient information would be most useful to health officials.

Openness to collaboration allows long-term progress towards addressing complex challenges where no single actor can do enough on their own. Ms Byrne notes that the present partnership, which initially included a single health provider, has now become a state-wide coalition of systems that will grow across the country. "Beyond the pandemic, there will be so much more room for us to work together." ■

Securing the new perimeter: your living room



Maninder Singh,
Corporate Vice President and
Global Head, CyberSecurity
& GRC Business,
HCL Technologies

As covid-19 forced millions of workers home, the front line of the cybersecurity battle went with them. Organisations were forced to secure a fully remote landscape — a reality for which few had prepared. What had been a long-term consideration became an immediate need for tactical responses that could also underpin a resilient long-term strategy.

Internal security challenges, barely managed within controlled on-premises workflows, became major vulnerabilities when the workforce was dispersed. As reported in *The Economist*: “millions of professionals are at home and online, adjusting to new routines and anxious about their jobs. That makes them perfect marks.”

How did we become so vulnerable? As companies have undergone digital transformation, the highest priorities have naturally been profitability, user experience and efficiency. Security, if not secondary, has been left in the trusted hands of a very limited number of IT professionals.

According to CISA director Chris Krebs, the solution to this problem starts with focusing on “the people who make the decisions that enable the actions of the IT security community: and that’s the

C Suite.” They need to “understand the business risk to get those investments in place,” he explains.

A top priority for the near term is widespread, effective training to enable business staff to manage aspects of cybersecurity through self-service. Cross-departmental collaboration and individual responsibility for security extends and hardens an organisation’s defences, addressing the shortage of cybersecurity staff with practices, policies and new technologies that increase the efficiency and effectiveness of security efforts.

In the longer term, there is a need for more cybersecurity professionals and expanded collaboration across industries. Organisations and security experts must also learn from one another to strengthen infrastructure while making it possible to provide secure remote access and combat shifting cybersecurity threats. Companies must fully report on breaches, study them and share best practices.

By raising the visibility of cybersecurity, the pandemic has created an opportunity to increase investment and encourage working in a collaborative, convergent manner. In this way, our collective defence can grow stronger and our preparedness can increase. ■

Cybersecurity

A connected world will be a playground for hackers

Few companies making connected gadgets have much experience with cyber security

As ways to break into casinos go, a fish tank is an unusual route. Yet that is what was used in an unnamed American gambling house in 2017. It had invested in a fancy internet-connected tank in which the temperature and salinity of the water were remotely controlled. Its owners were not naive: when they installed it, they isolated its controls on their own specific part of their company network, away from all their sensitive systems.

It made no difference. According to Darktrace, a computer-security firm, attackers from Finland managed to break into the tank's systems, then used it as a stepping stone for the rest of the casino's networks. They made off with around 10GB of data.

Computer security is already hard. Everyone from the central bank of Bangladesh to America's National Security Agency has suffered hacks or data breaches. The IoT will make things worse. A world in which more objects are computers is a world with more targets for miscreants.

David Palmer, Darktrace's director of technology, reels off a list of examples. "We've seen corporate espionage between suppliers inside a power station," he says. "One supplier was using [their] access within the network to look at the performance characteristics of another suppli-



er's equipment." His firm also discovered an attack on fingerprint readers that controlled access to a luxury-goods factory, and malware which spread through a hospital department after infecting a connected fax machine.

Other incidents have been spectacular enough to make the news. In 2016 millions of people in America found themselves struggling to reach many websites, including those of Twitter, Amazon, Netflix and Reddit. The culprit was a piece of IoT-focused malware called Mirai. By exploiting a list of default usernames and passwords, which most users never change, Mirai had infected hundreds of thousands of connected devices, from smart energy meters to home CCTV cameras and connected baby monitors.

Each infected gadget became part of a "botnet", a group of computers in thrall to the malware. The botnet then performed a "distributed denial-of-service attack" against Dyn, a company that helps maintain the routing information that allows browsers to reach websites. By deluging Dyn's servers with junk messages generated by the subverted devices, the botnet prevented them from responding to legitimate requests.

But the IoT will do more than simply give hackers new targets. As computers

spread into objects that can interact with the physical world, it will enable attacks that endanger life and property.

In 2015 a pair of security researchers from Twitter, a social network, and IOactive, a cyber-security firm, staged a demonstration for Wired, a technology magazine, in which they remotely took control of a car while it was being driven. They were able to turn on the stereo and the windscreen wipers, cut the engine, apply the brakes and even, in some circumstances, control the steering wheel. As a result Fiat Chrysler, the car's manufacturer, announced it would recall 1.4m vehicles. Security researchers have demonstrated an ability to hack into medical devices, including pacemakers and insulin pumps.

Hacking an insulin pump would be a convoluted way to kill someone. But less drastic sorts of crime will be possible, too. Ransomware, which prevents use of a computer until cash is paid, is a natural fit for a world where everything is connected. Ransomware for cars or home-lighting systems is a popular near-future prediction at computer-security conferences. Some accidental infections have already happened. In 2018, 55 speed cameras in Victoria, Australia, were infected by a piece of ransomware that was designed to attack desktop computers. In June Avast

Software, a Czech cyber-security firm, demonstrated how to install ransomware on a networked coffee machine, making it gush boiling water and constantly spin its grinder until the victim pays up.

Dangers of connection

Companies are aware of the danger. A survey of managers by Bain & Company, a consulting firm, found that worries about security were the single biggest barrier for companies thinking of adopting IoT technologies. Consumers are worried, too. A survey of 2,500 of them by Ernst & Young, a management consultancy, found that 71% were concerned about hackers getting access to smart gadgets.

Patching up the holes will not be easy. One reason is that computers, and computer software, are complicated. Ford's best-selling F150 pickup truck, for instance, is reckoned to have around 150m lines of code. A general rule is that good programmers working under careful supervision average about one bug per 2,000 lines of code. That means that

almost any computerised gadget will be riddled with bugs.

Another problem is that few of the companies making connected gadgets have much experience with cyber security – or the incentives to take it seriously. Good security costs money, and the better it is, the less its benefits are visible to the end-user. Attacks like Mirai, in which the costs fall not on the gadget-makers or their owners but on unrelated third parties, muddy things even more. The upshot is that basic precautions are routinely ignored. A paper published in June by Stanford University analysed telemetry from 83m connected devices and found that millions used old, insecure communication protocols or weak passwords.

One option is to learn from others. In February the Industrial Internet Consortium, a trade body focused on industrial deployments of the IoT, published a guide to security written by experts from veteran firms such as Fujitsu, Kaspersky Labs and Microsoft. Another is to outsource the

problem to those better suited to dealing with it. Arm has fortified its chip designs with built-in security features, as has Intel, the world's biggest chipmaker.

Big computing firms are trying to turn security into a selling point. Microsoft sees the IoT as an important market for its cloud-computing business. Under the Azure Sphere brand it has developed a security-focused, low-power microcontroller designed to be the brains of a wide range of IoT devices (these are smaller, cheaper and less capable than a microprocessor). Those micro-controllers run a security-focused version of the Linux operating system and communicate through Azure's cloud servers, which have extra security features of their own. Mark Russinovich, Azure's chief technology officer, says many of the security features were inspired by lessons from the firm's Xbox video-gaming division, which has plenty of experience designing hack-resistant computers. Starbucks, a coffee chain whose connected coffee machines can download new recipes, is one early customer.

Governments are getting involved, too. In 2017 America's Food and Drug Administration issued its first cyber-security-related product recall, having found that some wireless pacemakers were vulnerable to hacking. The following year California became the first American state to mandate minimum security standards for IoT products, including a ban on the use of default passwords. Britain's government is mooting similar laws to require manufacturers to provide contact details for bug-hunters and to spell out how long products can expect to receive security updates.

But whereas widget-makers can learn much from the computing giants, some lessons will have to flow in the other direction, too. The computing industry moves at high speed. Smartphones, for instance, rarely receive security updates

for more than five years. That sort of institutional neophilia is not going to work with products like cars or factory robots, which can have much longer lifespans, says Mr Palmer. Employing the programmers necessary to provide support for dozens of models for decades, he says, will be an expensive proposition.

Code and the law

Looming over everything, says Angela Walch, an American lawyer who specialises in tech, is the question of legal liability. The software industry uses licensing agreements to try to exempt itself from the sort of liability that attaches to firms that ship shoddy goods. Such an exemption, she says, amounts to an enormous de facto subsidy.

So far courts (at least in America) have been broadly happy to enforce such disclaimers. Ms Walch says any attempt to change that would be fought by the software industry, which has long argued that holding it liable for mishaps would stifle innovation. But that line will become harder to defend as software spreads into the sorts of physical goods that, historically, have not been granted such legal exemptions. "What are we saying?" she asks. "That if buggy software or compromised software kills someone, you won't be able to claim?"

Bruce Schneier, an American security expert, thinks that, in the long run, the consequences of poor security could mean that businesses and consumers reach "peak connectivity" and begin to question the wisdom of connecting everyday objects. He draws an analogy with nuclear energy, which enthusiasts once saw powering everything from cars to catflaps. These days "we still have nuclear power," he writes, "but there's more consideration about when to build nuclear plants and when to go with some alternative form of energy. One day, computerisation is going to be like that, too." ■

The IoT will make things worse. A world in which more objects are computers is a world with more targets for miscreants.

Digitisation

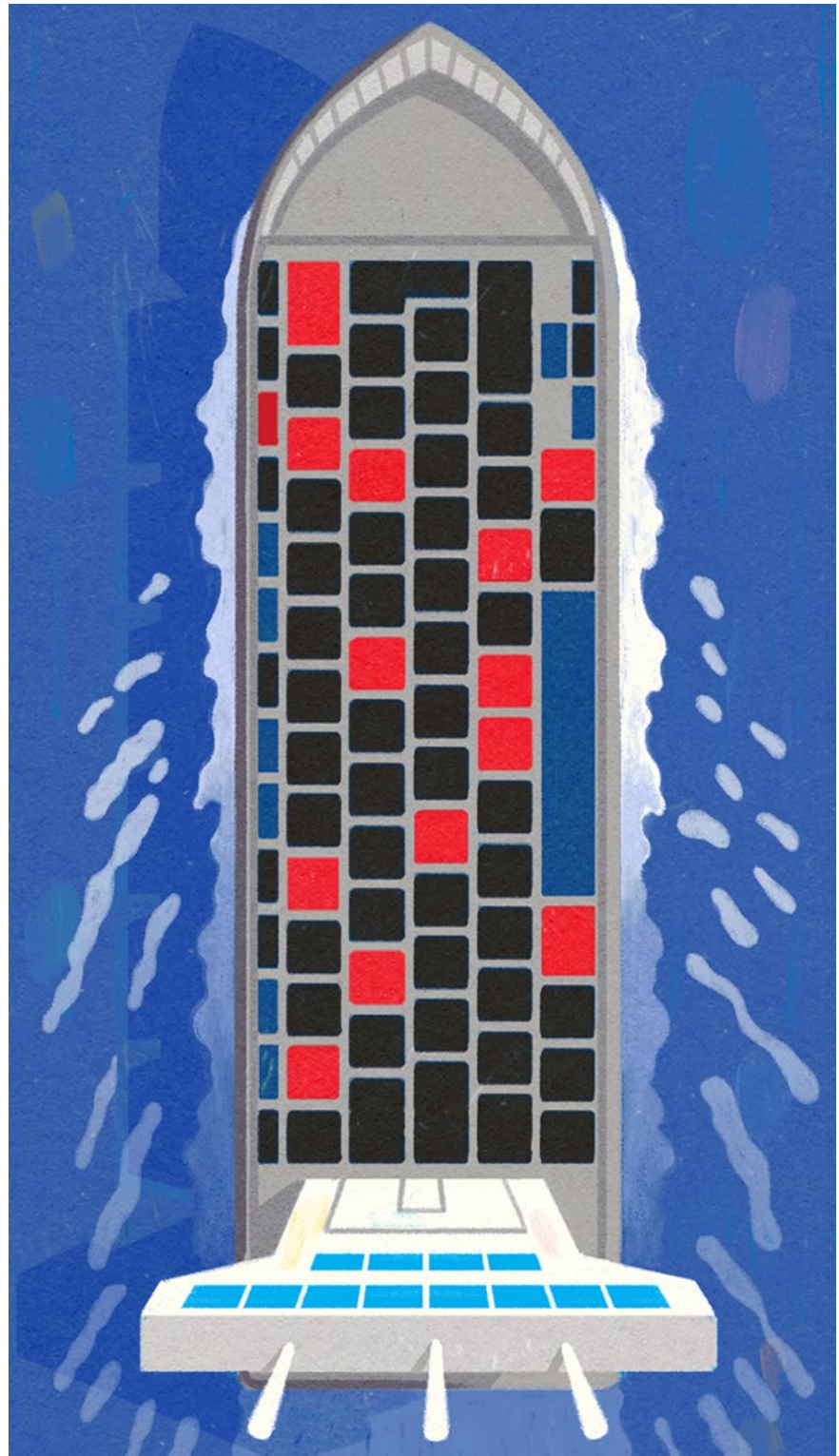
Digitisation is helping to deliver goods faster

Machines are replacing humans in prediction and planning

“Digitisation will have the impact on supply chains that steam and electricity had on manufacturing,” declares Joe Terino of Bain. His claim seems hyperbolic, but it may yet prove prescient. Nearly 30 years after the internet first emerged as a tool for business, the management of supply chains at most multinational corporations (MNCs), which do not operate in the rarefied air of Amazon and Alibaba, remains a surprisingly backward-looking, sluggish affair.

The good news is that companies in many industries are experimenting with a variety of new technologies and methods that promise to improve how they plan, source, make and deliver. These innovations are making supply chains smarter by increasing their predictability, transparency and speed of delivery.

First, to predictability. Firms have long used historical sales data to come up with demand forecasts, then manu-



factured and distributed according to the plan. This antiquated approach cannot keep pace with today's on-demand economy. So firms are experimenting with AI to assess everything from social-media trends and shifts in demand to inventory turnover and vendor behaviour. Their goal is to fine-tune supply chains in real time.

An annual survey by KPMG, a consultancy, and JDA, a supply-chain software firm, released in May, asked executives which technologies had the highest potential impact on supply chains and were most likely to be adopted. Cognitive analytics and AI came out on top, shooting up from their rankings the previous year. Blockchain and drones were down year-on-year.

JDA uses deep-learning algorithms developed by Blue Yonder, a German startup it acquired that originally created the software for particle-physics experiments at the CERN laboratory in Geneva. Morrisons, a British grocery chain, reduced the incidence of out-of-stock items on its

shelves by 30% and cut its inventory needs by several days by replacing manual stock planning with JDA's AI system for demand forecasting and replenishment.

ORSAY, a German fashion retailer, last year used JDA's self-learning algorithm to make 112,000 autonomous pricing decisions. This enabled the firm to reduce the volume of stock that needed discounts of over 30% to sell.

Intel, a big manufacturer of computer chips, estimates that it has already saved \$58m through better forecast modelling. The firm uses so many bots (software that runs automated tasks) that it has created new bots to manage the worker-bots. One executive says that lawyers have been called in to decide whether management is liable for bad decisions made by boss-bots.

McKinsey estimates that 40% of all procurement tasks (vendor management, order placement and invoice processing) can be automated today, and 80% soon; this could produce annual cost savings of 3-10%. All told, it reckons

application of AI to supply-chain management and manufacturing could create \$2trn of value.

Out for delivery

As for transparency, Adam Mussomeli of Deloitte, a consultancy, says that an age-old question still bedevils supply-chain managers: "Where's my stuff?" This may seem surprising in an age of personal connectivity, smartphones and GPS, but it is still true.

Pawan Joshi of E2Open, a supply-chain-software firm, explains why. Because of widespread outsourcing, typical MNCs do not make products (contract manufacturers do); they do not ship them (third-party logistics providers do); they do not store them (warehousing firms do) and they do not sell them (resellers and retailers do). So, he says, "the data needed to make real-time decisions are not inside the ecosystem of the manufacturer." Data inside firms are also compartmentalised into specialised software used by different divisions. E2Open connects and makes sense of all these data.

In November 2017 a strike by German cargo-handlers stranded a shipment of IBM mainframe computers at Frankfurt airport. Unable to track its precise location, the firm assumed the pricey cargo was safe inside an airport warehouse. In fact, it sat on an icy tarmac for nearly a month, exposed to blizzards. When it was eventually located, the kit – portedly sitting in four inches of water – was a total write-off.

The rise of the internet of things (IoT) will help. Sensors are coming onto the market that track not only the location of goods, but also the orientation of crates and factors such as temperature and humidity. In February IBM

launched a "track and trace" service in partnership with Sigfox, an IoT service provider. Initially it will track only containers travelling from suppliers to factories run by Groupe PSA, a big French car manufacturer, but the service is to expand across Europe this year.

Digital innovations from the top down and bottom up are making shipping smarter too. Singapore is building a massive new port that will expand its use of automated cranes and driverless vehicles. It has also launched an international effort to digitise trade. Tan Chong Meng, head of Singapore's PSA, a giant port operator, explains that "like the swift codes used in banking, we need common digital standards."

IBM and Maersk are using blockchain to try to make shipping paperless and transparent. Their TradeLens initiative got a big boost in May when CMA CGM and MSC, two big European shipping firms, joined. The consortium accounts for almost half the world's cargo-container shipments. Every participant in the process, from shipper to customs agent to auditor, will be able to track shipments from start to finish by inspecting the relevant parts of the blockchain rather than ploughing through lots of paperwork.

Standing at Flex's Pulse command centre near Silicon Valley, Tom Linton looks every inch a commander-in-chief. The system gives him access to 92 variables from his supply chain in real time. Rather than hoard this intelligence, he shares it with employees, suppliers and clients on computers and mobile phones.

His "data democracy" has decentralised a lot of decision-making and speeded up the flow of parts. In the first

Digitisation will have the impact on supply chains that steam and electricity had on manufacturing.

two years of using Pulse, Flex reduced inventory by 11 days and released \$580m of cash. “The theory of everything is speed, and you need visibility to get velocity,” says Mr Linton.

To deliver that speed, product design is undergoing a transformation. Spencer Fung is chief executive of Li & Fung, an Asian supply-chain firm that has helped Western MNCs with sourcing for over a century. Getting a new fashion item from paper sketch to the high street used to take 40 weeks, he recalls. Now it can take half that.

Ford’s Hau Thai-Tang says the use of 3D prototyping and digital design shortened the development of the new Mustang GT500, a sports car, by 18 months. Carbon, a Californian 3D-printing unicorn rumoured to be considering a public flotation, is now printing parts used on production lines that produce hundreds of thousands of Ford vehicles and Adidas running shoes a year.

Logistics innovators are harnessing platform technologies like those pioneered by Uber and Airbnb. Warehouse Exchange, a startup, matches owners offering slivers of warehouses on short-term contracts to firms with uncertain or highly fluctuating storage needs. UPS, a big American courier, last year launched Ware2Go, a platform that connects firms with warehouse space, inventory management and other logistics services.

Fast Radius, a Chicago-based unicorn, has an advanced manufacturing facility located at a big shipping hub in Kentucky run by UPS, one of its investors. Its secret weapon is a collection of 3D printers from top manufacturers. An aerospace firm urgently needed a tool to restart production. Making and shipping it using normal manufacturing methods would have taken 45 days. Lou Rassey, Fast Radius’s boss, says his firm got the digital file, printed the tool and delivered it via UPS, all within two days.

At a busy warehouse in Yantian, a port district in the southern Chinese city of Shenzhen, Flexport, a Californian firm, is digitising the freight-forwarding business. As lorries arrive at the loading bay, cargoes are measured digitally, with no manual entries or paper forms, to capture dimensions straight to handheld devices and the cloud. Every pallet is barcoded and weighed on a digital scale. Computer vision turns analogue forms into digitally searchable ones, and machine learning (ML) optimises loading. Flexport reached a valuation of \$3.2bn after a \$1bn investment by Japan’s SoftBank in February. Ryan Petersen, its boss, argues that the old model of shipping 40ft-container-loads of a single product from China to a handful of big distribution centres in America or Europe cannot meet today’s demands for endless variety and speedy delivery.

Rivals send containers across the Pacific to America that are only 65% full. Because his firm digitises packing lists using ML and can run real-time analytics, it is often able to fill the empty third of the container quickly with smaller loads also waiting to ship. To match supply and demand in smaller and varied shipments, says Mr Petersen, “brains, spreadsheets and phone calls aren’t enough. You need technology and data to make decisions right.”

Dave Clark, a senior operations executive at Amazon, agrees. Supply-chain management has gone from a negotiation and procurement job to a technology and science function, he says. Two decades at the trailblazing firm have convinced him that managers introduce huge variability by relying on gut instincts. Rather than machines eliminating human labour downstream in the warehouse, as technopessimists fear, he sees a future in which ML replaces human judgment upstream in prediction and planning. He sums up Amazon’s thinking neatly: “We are a supply-chain technology company.” ■



OPEN TO

ADAPTATION

Navigating the new world
(dis)order by embracing change

Navigating the new world (dis)order by embracing change

At the turn of this year, the business landscape was already characterised by complexity. The boundaries between sectors were blurring as technology companies challenged legacy businesses in everything from manufacturing to financial services. Regulators were imposing new frameworks to grapple with the digital era in areas like data privacy and cybersecurity, and this was motivating companies to overhaul many aspects of their business. Social media judged companies that fell short of expectations in terms of workplace culture, diversity and sustainability.

In light of how the covid-19 pandemic has upended the global economy and healthcare systems, such challenges now pale in comparison with those the world currently faces. With this in mind, however, the very principles and attitudes that corporate leaders adopted to navigate disruption and complexity before the virus struck – agility, flexibility, distributed decision-making and digital transformation – have put them in a good position not only to survive but to thrive in the wake of covid-19 and beyond.

A nautical analogy

John Seely Brown, co-chair at the Deloitte Centre for the Edge and visiting scholar at the University of Southern California, conjures a nautical analogy for the transition that businesses have been contending with in recent years. “Companies moved from steam-liners to sailing boats to white-water kayaks,” he says. “Until recently, you could predict what was going to happen because the

20th and early 21st centuries were laminar. The flows sped up occasionally but did not become turbulent.”

According to Mr Brown, the white-water epoch of today requires rapid improvisation and an increased ability to withstand uncertainty, which demands entirely new mindsets and attitudes. This white-water theory, developed by Mr Brown in partnership with Ann Pendleton-Jullian, an architect and fellow at Stanford University’s Centre for Advanced Study in the Behavioral Sciences, aims to equip businesses for a world that is continually changing. “Any time a kayaker faces a new rapid, they need to comprehend what the ripples really are and what is beneath the surface,” he says. Adapting to this reality requires a shift from top-down control to a culture that embraces agility, adaptation and digital transformation. Successful businesses will be quick to seize the opportunities presented by change.

Innovating through a crisis

Few events are as radically contingent as a global pandemic that has seen many safe and steady businesses, from airlines to real estate, disrupted overnight. The companies best positioned to cope with the crisis have been those in safer sectors, like cloud computing and e-commerce, as well as those with the most agile, flexible mindsets.

The financial services industry, for instance, has long been considered a slow-moving sector, with incumbent banks threatened by digital challengers that were out-innovating them and winning growing numbers of customers. But the response of mainstream banks to the crisis has been

encouraging, according to Nadjia Yousif, managing director and partner at Boston Consulting Group. Some have turned to help companies digitise their payments systems, for instance. As conduits for government aid and furloughs, they have also fixed many cumbersome internal processes for measuring risk, allowing them to use their own capital to extend loans to viable businesses. “I have been impressed by the ability of banks and financial players to pivot products and services quickly,” says Ms Yousif.

The food and beverage sector, another industry that is not famed for being innovative, has also adapted swiftly to the challenges brought by the lockdown. “Nestlé introduced visualisation tools to provide technical support to factories from off-site locations to avoid travel, both improving efficiency and cutting emissions,” says Béatrice Guillaume-Grabisch, the company’s executive vice-president and global head of human resources and business services. Noting the huge increase in home cooking during the pandemic, Nestlé has also used its digital channels to provide recipe ideas and has doubled the number of chatbots used by the brand to suggest recipes and give cooking tips, according to Ms Guillaume-Grabisch.

Rewriting culture

There is, of course, much room for improvement. Jon Messenger, telework expert at the UN’s International Labour Organisation, says that some frontline managers have not shifted optimally to the new remote-work reality. “There has been managerial resistance, among supervisors espe-

cially, to managing remote staff," he says. "We have seen some cases of managers trying to claw back a command-and-control style, such as by contacting teleworkers all the time and requiring constant updates. This shows that it's not enough to give your blessing to telework; if there is resistance down the chain, it won't work effectively." Mr Messenger advises setting "clear expectations and accountability, giving workers time sovereignty and the ability to manage themselves". Autonomy was already a key piece of the agility toolbox before covid-19; it is a necessity now.

Companies also need to ensure that when they adapt their processes, like shifting permanently to hybrid or remote working, they factor in the needs and preferences of all staff, and especially those whose voices have too often been ignored, such as those with disabilities. "This is an opportunity, if we harvest it and foster it, to make the world a more inclusive place," says Liz Johnson, a British Paralympic swimmer and gold medallist at the Beijing Olympics who now advises companies and organisations on inclusion best practices. "We have seen that everyone can adapt, and it is possible to step away from the norms." Ms Johnson warns, though, that one should not make assumptions about what different workers want in the future workspace once social-distancing policies end and firms shift towards either a return to normal or a hybrid of working from home and on company premises. One such assumption is that all people with disabilities will want to work from home

in the future. Yet Ms Johnson says: "Some disabled people want to work in an office environment—and it's with responsibility of the organisation to make sure that is still possible."

Companies and staff also need to step up their reskilling efforts. Threatened perhaps by the rapid improvement of automation technology, many workers – and companies – were already aware of the need to strengthen their digital capabilities; the pandemic has only strengthened this imperative. "While we don't yet know exactly what the 'new normal' will look like, one thing is clear: both new jobs that emerge and existing jobs that remain will require digital skills," says Karin Kimbrough, chief economist at LinkedIn. "And people will need to build more technology skills – both basic and specialised – in order to get back to work, creating a huge skilling challenge ahead."

While not every job will require advanced technology skills, Ms Kimbrough explains, all roles will require basic competencies such as digital literacy, web development or graphic design. "We're already seeing roles in areas like sales and marketing beginning to require a basic understanding of artificial intelligence (AI). And the three fastest-growing clusters of jobs before coronavirus – cloud, engineering and data clusters – require disruptive tech skills like AI, robotics or cloud computing."

The change in the composition of executive boards will also accelerate as chief technology, data and information officer functions acquire more clout and companies emphasise greater collaboration across the

domains of data, technology and business strategy.

The role of purpose

Finally, the pandemic has underscored the crucial role of purpose as part of the navigating system of a modern company. Many brands, conscious of their ability to contribute to the response, have lent time, resources and effort to supporting public health: witness the fashion brands requisitioning their facilities to mass-produce masks, the hotels and room-booking apps offering facilities and services to accommodate health workers, and the manufacturers exploring ways to produce makeshift ventilators.

Evan Goldberg, founder of Oracle NetSuite, identifies a trend in management culture towards acknowledging a company's wider responsibility within society; key moments include a high-profile annual letter to chief executives from Larry Fink, chair of management titan BlackRock, who advised leaders to run their companies with social good in mind. "This shift is driven in no small measure by a new generation of employees who want to feel a sense of purpose in what they do," says Mr Goldberg. "There needs to be a balance between profit and the good of the world, and that is trickling up to management and executives." The global crisis will provide companies with a golden opportunity to prove their commitment to goals that go beyond satisfying their shareholders. ■

Workforce adaptability as the foundation for resilience



Anand Birje,
Senior Corporate Vice President and
Global Head, Digital & Analytics,
HCL Technologies

The covid-19 pandemic delivered sharp lessons about digital transformation. Massive forced changes in workforce practices occurred faster than anyone expected, exposing weaknesses in technology and security stacks.

Sudden digital reskilling brought home the point that a culture of change is far more about the will to act than about a new technology stack. Before the crisis, cultural agility lagged behind technological change in most organisations, hindering digital transformation.

Remaining gaps between digital migrants and natives can no longer be tolerated. Business and technology leaders must instil a culture of adaptability that stands ready to meet customer expectations.

When executives know that their organisation is primed for change, management may act decisively, even radically, with confidence that progress will occur. That makes it possible to reliably evaluate near-term impacts and to prepare for change in the long-term.

The adaptable organisation rejects siloed, top-down structures in favour of multidisciplinary teams headed by digital leaders. Employ-

ees are valued not just for filling a narrowly defined role but for contributions that reverberate across the business. These are the T-shaped employees made famous by IDEO: people with depth of expertise and the ability to collaborate.

As an added benefit, companies open to adaptation attract the most desirable talent who bring the skills and creativity needed to enhance customer experiences. Frequent retraining reinforces those traits.

In a company prepared for adaptation, the guiding principle is readiness for change. Mutually supporting technologies empower safe, rapid experimentation and evolution. Composable systems provide building blocks of technology services, reconfigurable for new challenges. Those blocks are easily consumed, encouraging creative responses from diverse contributors.

Flexible technology is important, but forward momentum is sustainable only if a company cultivates a culture of embracing growth. Adaptability is important to business continuity, but, more importantly, flexibility creates a virtuous feedback loop in which change is a prized commodity that contributes to long-term success. ■

A different dystopia
July 2030

What if robots don't take all the jobs?

The real danger to future prosperity could be too few robots, not too many. An imagined scenario from 2030

It is hard to believe now, but a little more than a decade ago people were seriously worried about robots taking all the jobs. Back in 2018 the chief economist of the Bank of England, Andy Haldane, gave a warning that “large swathes” of the population would become “technologically unemployed”. He argued that the “fourth industrial revolution” of automation and artificial intelligence (AI) would create even more disruption to people’s working lives than the previous three. Robots would do everything. There would be universal leisure but mass unemployment. Similar warnings were a fixture at the World Economic Forum’s annual meeting in Davos. Bestselling books predicted dystopian outcomes in which society split into a wealthy, robot-owning plutocracy and an unemployed underclass, and repressive governments would be needed to rein in social discontent. But robots did not take all the jobs—and today, in 2030, much of the world faces the opposite problem as



populations age and workforces shrink. What happened to the supposedly inexorable march of the machines?

At the height of the concern about the coming jobs apocalypse, in the late 2010s, the most vulnerable people were thought to be older, unskilled workers. In 2017 the McKinsey Global Institute, part of a business consultancy, predicted that 800m people in 46 countries, or roughly a third of the workforce, could lose their jobs to machines by 2030. Older workers were thought to be especially vulnerable because they were engaged in repetitive, unskilled manufacturing, the kind that was easiest to automate. In 2018 Mercer, another consultancy, used an index of risk developed by Carl Frey and Michael Osborne of the Oxford Martin School to calculate that three-quarters of Chinese workers aged over 50 were at risk of being replaced by robots. In America just over half of older workers ran the same risk, while in Germa-

ny and Italy about 60% did.

But these dire forecasts did not come to pass, for two reasons. First, AI failed to advance as quickly as some people thought it would. In 2018 Rodney Brooks, a professor at the Massachusetts Institute of Technology (MIT), forecast that driverless-car services comparable to conventional taxis were unlikely before 2032 and that a robot which could navigate its way around the steps and clutter of an ordinary home would not become widespread until 2035. With just a few years to go, he seems likely to be proved right on both counts. During the 2020s robots powered by AI became more widespread, changing many industries and taking over repetitive jobs. But they were not cheap and still cannot handle many tasks requiring human discretion or empathy. In nursing and social care, in particular, robots are not up to the job.

Second, the 2020s showed that the level of employment depends on more than just

automation: it also depends on ageing and immigration. As their populations aged, rich countries saw their workforces shrink. Many invested more in robots as they aged, and some let in more migrants, plugging some of the skills gaps and boosting productivity. Countries with relatively slow ageing and lots of robots did best. But those that underinvested in automation, or shut themselves off from the world, were hard hit.

Help wanted

Britain was an extreme example of the second group. In the 2020s its economy was still suffering a trade shock from Brexit and its political system was in turmoil. But the longer-term problems were demographic, made worse by the increased difficulty of hiring workers from abroad. Between 2000 and 2015 the British population had expanded by 11% and the workforce had grown by 14%, thanks to an influx of foreign-born workers. Over the next 15 years these trends went into reverse. As ageing began to have a larger effect, the population increased by just 6.5% between 2016 and 2030, while net migration dropped to a few thousand a year. The workforce grew by barely 1% in total dur-

ing that period.

That itself might not have been an insuperable problem. After all, the workforce was at least still growing, unlike Japan's or China's. But Britain was already suffering from a skills shortage, which suddenly got much worse. In 2015, 35% of the workers in health and social care, one of Britain's biggest employers, were over 50; 18% were foreign born. A poll in 2015 found that a third of doctors in the National Health Service were planning to retire by 2020. So as doctors retired and Spanish-born nurses went home, the country found it increasingly difficult to replace them, giving rise to a series of stomach-churning medical scandals which undermined the health service's already-tattered reputation. Similarly, successive governments' promises to build more houses foundered on a lack of suitable workers. In 2018 two-thirds of small and medium-sized building firms said they could not find enough bricklayers, carpenters and joiners, in part because they had become overly reliant on importing plumbers from Poland and carpenters from Hungary. Brexit meant those options vanished altogether in the 2020s.

Had Britain invested more

heavily in automation, it might have been better able to cope. As Daron Acemoglu of MIT and Pascual Restrepo of Boston University showed in 2018, countries which age fastest tend to invest the most in robotics—causing their GDP growth to hold up better than you might expect. Britain, though, was a technological laggard. According to the International Federation of Robotics its “robot density” (the number of industrial robots per 10,000 manufacturing workers) was only 85 in 2017, compared with an average of 106 across Europe, and 710 in South Korea. Risk-averse businesspeople and technophobic unions ensured that Britain failed to catch up in the 2020s.

The results were painful. As the workforce stopped growing, labour markets tightened and wages rose. But overall output stagnated and tax revenues fell, reducing the funding available for public and social services, just as they were also being hit by skills shortages and the increasing demands of an older population. Class sizes increased as schools struggled to find enough teachers. Standards of service declined in health care, transport, hospitality and other labour-intensive sectors. A series of strikes successfully blocked an unpopular effort to raise retirement ages more quickly. In 2026, caught between the militancy of its supposed allies and the hostility of markets, Jeremy Corbyn's Labour government prevaricated, backtracked, appealed to voters and then finally collapsed.

Britain was an extreme case. Other countries faced different problems, or managed them better. Japan and South Korea have seen their workforces shrink in absolute terms but, by investing in robots and software to perform repetitive tasks, and by retraining

workers for employment in caring professions, both countries softened the blow of the demographic transition and maintained high productivity growth.

Germany also had to deal with an ageing, shrinking workforce but reaped the rewards of allowing a large number of migrants into the country in 2015-16. America's population did not age as quickly as those in other rich countries so its workforce did not contract. After the isolation of the Trump years, the country has become more welcoming to immigrants; it has also maintained its traditionally high investment in automation. As for China, its workforce has contracted dramatically, damaging the Communist Party's attempt to introduce a proper pension- and social-security system, and making it hard even to find enough soldiers for the People's Liberation Army. Social disruption and discontent have reined in China's global ambitions.

The dystopia predicted in the late 2010s, of widespread technological unemployment, has not come to pass. Even at the time, the evidence for an imminent jobs apocalypse was noticeably lacking: employment across the rich world reached record levels in 2019, while productivity growth in many countries was anaemic. That suggested machines were not displacing human workers after all, and their ability to do so had been overstated. In retrospect, the doom-mongers of Davos were worried about the wrong thing. Today another dystopian scenario looms instead: that of a world in which there are too few robots, not too many. ■

The 2020s showed that the level of employment depends on more than just automation: it also depends on ageing and immigration.

Human-machine interface

Data-labelling startups want to help improve corporate AI

A clutch of firms is generating the feedstock for machine-learning algorithms: tagged data



Corporate boards are besotted with artificial intelligence. Worldwide spending on AI is expected to rise from \$38bn this year to \$98bn by 2023, estimates IDC, a research firm. So far, though, only one in five companies aware of the technology's potential has incorporated machine learning into its core business. One reason for the slow uptake is the dearth of quality data to teach algorithms to perform useful tasks. The most common form of AI, called "supervised learning", requires feeding software stacks of pre-tagged examples of, say, cat pictures until it can tell a feline image apart by itself. Data-labelling is the sort of grunt work that corporate AI-users would prefer someone else to do for them. An industry is popping up to help.

The market for data-labelling services may triple to \$5bn by 2023, reckons Astasia Myers of Redpoint Ventures, a venture-capital firm. Some outfits, like Mechanical Turk (owned by Amazon, an e-commerce giant), act as middlemen connecting freelancers ready to perform all manner of "micro-tasks", of which things like tagging pictures is one example, with

taskmasters. Other firms specialise. Hive has turned data-labelling into something "like playing Candy Crush", explains its boss, Kevin Guo, referring to a hit tile-matching game. Its mobile app makes it easy for users to identify objects, earning money instead of points. Its 1.5m players across the world serve more than 100 corporate customers.

Because human data-labelling is labour-intensive, most of it happens in low-wage countries like India, Vietnam and the Philippines. In such places data-labelling "is the easiest way to earn money", says Hafiz Arslan, a Pakistani software engineer who was recently paid \$200 for classifying 4,500 images by the sport they depicted (football, cricket or tennis).

A distributed workforce is, however, prone to human error. That is a problem for AI, which is only as good as the data it learns from. So other startups want progressively to cut humans out of the process. Scale AI, from San Francisco, lets its own algorithms take a first pass at labelling with humans reviewing the work. "We are extremely, extremely qual-

ity-conscious," insists its boss, Alexandr Wang. He says revenues have grown tenfold from a few million dollars last year. Labelbox helps firms gauge the accuracy of labelling.

AI.Reverie goes further, dispensing with human labellers altogether. It uses techniques developed for video games to create and automatically label scenes that can be used to train image-recognition algorithms. Its approach is particularly useful for exposing software to scenarios that might be hard to find in data gleaned from the real world. It can generate scenes set underwater, or featuring heavy fog or torrential rain. The company's backers include In-Q-Tel, a venture fund for America's intelligence services.

The industry's short-term future seems assured. In the longer run a threat may come from developments in "unsupervised learning", which aims to identify patterns in data that have not been labelled by humans. Manu Sharma, boss of Labelbox, says this remains "primarily an academic pursuit". How long for is anyone's guess. ■

A distributed workforce is, however, prone to human error. That is a problem for AI, which is only as good as the data it learns from.



OPEN TO

SUSTAINABLE CONSUMPTION

The global imperative to weather
the curve beyond covid-19

The global imperative to weather the curve beyond covid-19

Urgent action is needed if we are to prevent the extreme droughts, heat, floods and poverty that will be caused by global warming. According to scientists, greenhouse-gas emissions would have to fall by 45% by 2030 to prevent ice caps disappearing, coral reefs dying and sea levels rising further. Yet global emissions are set to hit a record high this year and countries are at loggerheads over efforts to stop them rising further.

Against the backdrop of bruising international climate talks, many businesses have been steering themselves towards a lower-carbon future. Increasingly, this means setting “science-based” targets that are in line with what scientists say is needed to limit catastrophic climate change.

Ahead of the 2019 climate negotiations in Madrid, 87 companies, with a combined market capitalisation of over US\$2.3trn, said that they would set targets aligned with the Paris Agreement goal of keeping global warming to 1.5°C above pre-industrial levels. These targets apply to their entire value chains, not just the smaller operations that corporations have tended to focus their cuts on in the past.

Some multinationals have gone further, pledging to slash their net emissions to zero by 2050. Others say that they will take more carbon out of the atmosphere than they put into it by investing in renewable energy and carbon storage through reforestation and agriculture.

Their motivations are not only reputational. Some executives are acting in anticipation of future taxes

on carbon emissions. Investors are pressing companies to act on climate risks and global standard-setting bodies are promoting the development of climate risk tools that will be used to assess corporate risk and performance.

“Companies are increasingly aware of their climate risk profiles and taking steps to measure and manage them,” says James McMahon, CEO of The Climate Service, a start-up that provides climate risk analytics services to clients, including the US federal government. “There are several factors creating a large uptick in demand for climate risk analytics, including regulation, pressure from investors and actual observed instances of losses from climate-related events.”

The Task Force on Climate-related Financial Disclosures, set up by the US Financial Stability Board to develop voluntary climate-related financial risk disclosures, has been “the main regulatory push that has been embraced by many of the world’s largest investors and businesses,” says Mr McMahon. “Investors are increasingly putting pressure on asset owners to measure and manage their climate-related risks and opportunities; large companies that don’t do this are oblivious to one of the biggest threats to asset valuations.”

Companies see the financial consequences of catastrophic events and the broader sea change away from fossil fuels in their bottom line. “With financial losses from catastrophic events rising every year”, says Mr McMahon, “it is incumbent on business leaders to properly account for the changing climate in their invest-

ment and strategic decision-making process. Otherwise, multi-billion-dollar infrastructure investments could quickly depreciate in value or be rendered ineffective long before the expected time frame”.

Ørsted, for instance, says it can reduce emissions from its energy production by 96% by 2023 because its fossil-fuel business had “started to decline and present a real risk to our future profitability”. It has reinvented itself to focus on renewables, divesting from oil and gas, replacing coal in its power plants with sustainable biomass and deploying offshore wind farms.

A technology-aided transition

Advances in renewable energy, technology and engineering have armed executives with more ways to clean up their businesses than ever before. Companies can cover their roofs with solar panels and replace delivery vehicles with lower-carbon upgrades. Sophisticated route-planning software can be deployed to cut the emissions belched out by their service vehicles. Businesses have used work-from-home initiatives, enabled by improved connectivity, to reduce the pollution created by their employees’ commutes.

Investors caution, however, that public incentives will be needed to bring more technologies to market as clean tech and sustainability are struggling to attract major private investment. “This is a sector of very high inertia,” says Yossi Vardi, one of Israel’s earliest and most successful high-tech entrepreneurs and former director-general of Israel’s Ministry of Energy. “It can take decades compared

with the digital sector where you can get 100m users in a few weeks. There is a fundamental difference with investing in high tech — internet, cyber, fintech or artificial intelligence (AI) businesses and so on — and clean energy.”

Mr Vardi, who has invested in start-ups acquired by the likes of AOL and eBay, believes public-sector incentives will be critical. He is, however, optimistic that the digital sector could open up new opportunities in the area of energy demand management that might help citizens and businesses to shrink their energy footprints.

Mr Vardi observes: “The beauty of a fully connected world is on the demand side. Before the internet, you could only affect supply, not demand. You couldn’t get into the home of the user and turn the air conditioning on and off. Demand management is now very interesting.” Combined with energy-efficiency improvements in technology, he believes that this trend towards demand optimisation can reduce the amount of energy required for each unit of GDP.

Big data for the big clean-up

Big data and advanced analytics are important weapons in the fight to reduce emissions. By installing sensors across a factory or data centre and using machine learning to make sense of the readings, a company can tally its energy consumption, or locate harmful emissions along its supply chain, and take action to reduce waste.

Even in the dirtiest industries, remote surveillance and machine-learning technologies promise to reduce emissions. Both Shell and Norway’s Equinor have installed solar-powered devices that scout for leaks of methane, a planet-warming gas. The US-based Environmental

Defence Fund (EDF) says that over time the “digitisation” of oilfields will allow companies not only to find and fix methane leaks more efficiently but also predict them and stop them from happening.

The same technologies can be applied to the businesses that still shroud their emissions in secrecy. Last year the then governor of California, Jerry Brown, announced that his state would launch a satellite to pinpoint emissions with “unprecedented precision, on a scale that’s never been done before”. The project will complement a satellite to be launched by EDF in 2021 which will track emissions from oil- and gas fields that account for about 80% of global hydrocarbons output.

Satellites and machine learning are being used to keep an eye out for illegal logging and emissions in the power sector too. Watt Time, a not-for-profit emissions-reduction software company backed by Google’s philanthropic arm, recently announced that it will launch a satellite system that will use AI to track the carbon dioxide (CO2) emitted by every major power station on earth.

Businesses are also using predictive technologies to plan for how climate change might affect them. Jupiter, a start-up that has raised more than US\$30m of investor capital in two years, uses AI and detailed information about an area’s terrain to produce “climate risk assessments” that can peer up to 50 years into the future. Say a company owns a warehouse in a low-lying area. The maps Jupiter produces would alert it to what might happen if sea levels rise or a hurricane strikes. If the building would be swamped, the company can plan to move it to higher ground, hedge with more insurance or focus future investment in another area.

Staying the course during a crisis

As the covid-19 pandemic forced much of the world into lockdown, daily global CO2 emissions fell by 17% compared with 2019 levels. However, as economies restart and pollution-as-usual sadly returns, an emerging worry is whether the investments and initiatives that companies were rolling out or planning in 2019 will be dropped as they rush to protect the bottom line.

John Elkington, corporate responsibility expert and author of the book *Green Swans*, thinks the real test of companies’ commitment to sustainability will come in the months ahead. “When the economic shocks hit at the end of furlough and of subsidies, when people lose their jobs and when the aftershock or second-wave virus goes through economies, I think people are going to be challenged to keep some of the programmes and initiatives they’ve been invested in. There will be a shake-out.”

Mr Elkington hopes that governments will take the opportunity to preserve and even deepen the climate transition by tying aid and subsidies to green commitments from recipients, especially in polluting industries. European groups have called for government bailouts of sectors like air transport in countries including France and Austria which include green conditions such as transitioning to cleaner fuels.

Mr Elkington also believes that the pandemic, and the worldwide anti-racism protests that have followed, should prompt the kind of major political and economic rethink that has been lacking in climate discourse so far. “Our economies and societies are more fragile than we thought. We have to start investing in systemic change.” ■

The opportunity to shape a better world



Kalyan Kumar,
Corporate Vice President and Chief
Technology Officer, IT Services,
HCL Technologies

Covid-19 revealed the pressing need to reconsider the role of technology in sustaining and enhancing human life across the globe. We have an opportunity to make technology a healing force, but this requires shifting the focus from isolated problems to technology ecosystems that advance the quality of life for all. Widening our view reveals opportunities to improve the human condition.

Throughout the pandemic, cumbersome healthcare systems were reshaped to become more effective. Patient-facing applications increased their capacity to serve patients. We witnessed increased online enrollment of seniors, previously alienated by technology, and streamlined approval of drugs. Virtual doctor visits made it possible to test treatment efficacy and drive iterative changes, increase knowledge and improve outcomes. This is possible when technologies pull together towards a single end.

Enhanced diagnostic telemedicine tools enabled clinicians to evaluate remote patients. We can do more. Diabetes can be monitored through retinal scans rather than blood tests. Syringes can be infused with nanotechnology to make them tamper-proof. Through quantum entanglement, researchers

can also use syringes to position individual atoms and control their quantum properties. Quantum computing facilitates high-resolution modelling of complex molecules to accelerate drug development.

Food supply chains buckled under the pressure exerted by covid-19, underscoring the need for technology that bolsters sustainability. By tracking food wastage using machine learning and advanced imagery, recognising food as it is discarded and calculating its value, it is possible to take informed action to reduce waste.

With copious data converted by quantum computing into high-resolution models, we are about to enter a new era of analytics and visualisations that will be limited only by our imaginations. It is up to us to create new platforms that will be the foundation for an efficient, unified system for addressing humanity's greatest issues.

If there are to be benefits derived from covid-19, it is essential that technologies be considered as part of a fabric of solutions that improve lives. With their choices, tech visionaries and world leaders have an opportunity to improve human lives and the health of the planet we inhabit. ■

Saving Water

The best way to solve the world's water woes is to use less of it

And much of that has to do with agriculture

If the world is to reduce its use of water, the most obvious area in which to look for savings is where most water goes: agriculture. How much water this accounts for varies enormously from country to country. In Britain, which is a huge importer of embedded or “virtual” water (that consumed in producing any crop or product) accounting for as much as two-thirds of its water needs, it is relatively little. In Egypt it is about 84%, and in India as much as 90%. Viewed more broadly, as a global water “footprint”—a concept developed by Arjen Hoekstra, a Dutch scientist—including not just the direct uses of water in agriculture, but the indirect ones all the way along the chain from field to fork, agriculture accounts for 92%.

Much of this is wasted. “Flood” irrigation systems, where water is released to inundate fields or furrows, lose water to evaporation, or to percolation (ie, to the soil itself before it can be absorbed by the crop’s roots). A common estimate is that flood-irrigation squanders 50% of the water it releases. Sprinkler systems can help with efficiency. But these, too, are imprecise, vulnerable to the wind and to loss of water through evaporation.

Far more effective are “drip” irrigation



systems introduced in Israel in the 1960s and since spread around the world. As the name suggests, these direct limited amounts of water to the plants themselves, so that they get enough but not too much. Avi Schweitzer, chief technology officer of Netafim, an Israeli company that sells drip-irrigation equipment and technology in 110 countries, says that, by minimising both evaporation and percolation, it manages to achieve 95-97% efficiency in delivering the water to the photosynthetic process.

This saves large amounts of water and increases yields. Precise amounts of nutrient and crop-protection chemicals can be added to the irrigation water. And the new generation of systems employ remote sensors that can monitor weather, soil and plant conditions and calibrate how much water is delivered. Mr Schweitzer, however, concedes that, for now, the high capital cost precludes the use of drip irrigation in much of the world, and limits its use to cash crops. The goals for the future are to reduce costs for commodity crops such as grains, and to improve precision even more. The market will expand. Climate change is likely to mean that more rain-fed farmland—at present estimated to make up about 80%

of the world’s total—will be irrigated.

Greater efficiency, however, comes with risks of its own: that farmers persist in planting thirstier crops than is rational in an arid climate, or switch to more water-intensive ones. Even in Israel, just south of the shrinking Sea of Galilee, swathes of irrigated land are covered in plastic-draped banana plantations.

So reducing the water consumed by agriculture will depend not just on improving efficiency, but on rationalising crop-planting. And that in turn will depend on demand and hence on changes in diet and even fashion. A foretaste of controversies to come was a furore that arose last year over avocado-eating—criticised by many as an emblem of selfish millennial hipsterdom. Avocado consumption in America increased by 300% (to about 4.25bn avocados a year) from 2010 to 2015. Farmers scrambled to meet demand, including in very dry places, such as some parts of Chile and in Mexico, where the craze was blamed for a surge in deforestation. A kilo of avocados can need up to 2,000 litres of water, so local sources were strained, and activists mobilised to campaign against the culinary fashion.

In future, people around the rich

world at least are likely to be made more aware of the water footprint of what they eat (and wear: the global average water requirement for producing a kilo of cotton is 9,359 litres). Avocados may need more water than tomatoes (214 litres) but they are far more frugal in their water needs than meat – chicken takes 4,325 litres per kg, mutton 10,412 and beef 15,415 (see chart). Globally, however, the trend is not towards a low-water diet. On the contrary, as countries such as China grow richer, meat-eating is on the increase. Over the past 50 years, global meat production has quadrupled.

Another way in which water is used inefficiently in agriculture is in waste or loss of food, which adds up to as much as a third of global production. In countries such as India, the inadequacies of the cold chain and logistical hurdles mean that much never reaches the shops. Even in rich countries, food shops and consumers end up discarding vast amounts of uneaten food.

A new report by the World Economic Forum, a think-tank, emphasises technological fixes to this problem. Sell-

by and use-by dates could be replaced, it argues, by remote sensor technologies, such as near-infrared spectrometers and hyperspectral imaging, capable of evaluating the perishability of individual items. It looks forward to the day when the imaging technology is available on shoppers' smartphones.

A less visible but perhaps more shocking waste is in the form of "non-revenue water"—that is, water supplied by utilities but never paid for. Some is diverted and stolen; much is simply lost through leakage. The lost revenue often leads to a vicious circle. Money is too short to maintain and repair the system, leaks increase, prices rise and theft becomes more widespread. The problem is most obvious in poor countries. Delhi's water board, for example, reported in 2011 that 53% of the water it distributed was non-revenue. In Hanoi that figure was 44%. But even in the rich world, where pipes and other infrastructure may be old, rates can also be staggering. London, for example, reported 28% and Montreal 40%. Again, technology is helping. Sensors and smart valves that use the water it-

The goals for the future are to reduce costs for commodity crops such as grains, and to improve precision even more. The market will expand. Climate change is likely to mean that more rain-fed farmland—at present estimated to make up about 80% of the world's total—will be irrigated.

self to send a pulse, which alters when there is a leak, can make it easier to pinpoint trouble-spots.

In almost every aspect of water usage the scope for using less is enormous. It is a question of incentives. Optimists point to signs that this is changing. Some governments still use the availability of cheap and plentiful water as a lure to foreign investors. But some businesses are seeing water-efficiency as both an economic goal in itself and as an important part of their image-building. In the Canadian province of Ontario, for example, the local arm of Nestle, a Swiss food-and-drinks giant that is one of the world's biggest sellers of bottled water, has found itself embroiled in a lawsuit between First Nations representatives and the provincial government, which has led to a moratorium on issuing new bottling permits.

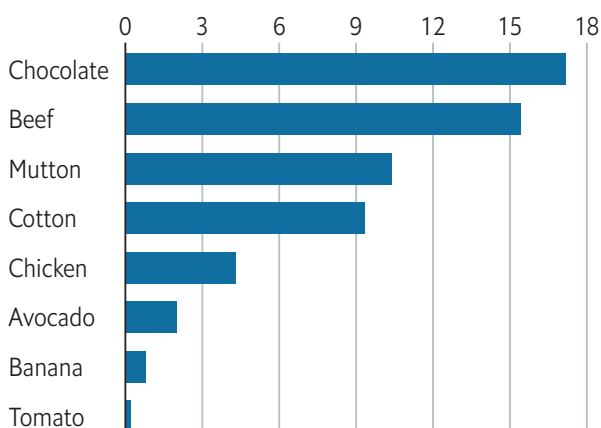
Elsewhere, Nestle is making much of its efforts to save

water, aiming to reduce usage in every product category between 2010 and 2020 (a target it says is already within touching distance). In some countries, for example, such as America, Brazil and South Africa it makes baby milk in "zero-water" factories, reclaiming water evaporated from cow's milk used in the manufacturing.

Unilever, another multinational, also has set "sustainability goals". One is to keep the water used in its manufacturing processes to 2008 levels, despite greatly increased production. Already, it says, it has cut water use per tonne of production by 39% since 2008 in seven water-scarce countries representing half the world's population. Less successful has been its drive to reduce the amount of water its customers use by making products, such as detergents, for example, that need less water. Since 2010, per-consumer use has fallen only by 2%. ■

The worst for thirst

Volume of water required to produce 1kg
2010, litres '000



Sources: Institute of Mechanical Engineers; Water Footprint Network

What are companies for?

Big business is beginning to accept broader social responsibilities

Pursuing shareholder value is no longer enough, it seems



At a recent dinner in London, a chief executive promised that his airline would soon offer electric flights. A credit provider enthused about increasing financial inclusion in the developing world; a luxury-car executive promised to replace the leather in her vehicles' opulent interiors with pineapple matting and mushroom-based faux leather. They seemed to think such things made the companies they run sound more attractive. They probably felt that they were doing good.

Businesspeople, being people, like to feel they are doing good. Until the financial crisis, though, for a generation or so most had been happy to think that they did good simply by doing well. They subscribed to the view that treating their shareholders' need for profit as paramount represented their highest purpose. Economists, business gurus and blue-chip CEOs like those who make up America's Business Roundtable

confirmed them in their view. In a free market, pursuing shareholder value would in and of itself deliver the best goods and services to the public, optimise employment and create the most wealth—wealth which could then be put to all sorts of good uses. It is a view of the world at the same time bracing in its simple rigour and comforting in the lack of social burdens it places on corporate backs.

It is also one which has faced increasing pressure over the past decade. Environmental, social and governance (ESG) criteria have come to play a role in more and more decisions about how to allocate financial investment. The assets managed under such criteria in Europe, America, Canada, Japan, Australia and New Zealand rose from \$22.9trn in 2016 to \$30.7trn at the start of 2018, according to the Global Sustainable Investment Alliance. According to Colin Mayer at the University of Oxford, whose recent book

"Prosperity" is an attack on the concept of shareholder primacy, ESG has shot yet further up investors' agendas since. Some of the world's biggest asset managers, such as BlackRock, an indexation giant, are strongly in favour of this turn in events. The firm's boss, Larry Fink, has repeatedly backed the notion that corporations should pursue a purpose as well as, or beyond, simple profits.

The discontent does not end with investors. Bright young workers of the sort businesses most desire expect to work in a place that reflects their values much more than their parents' generation did. And the public at large sees a world with daunting problems—most notably climate change and economic inequality—that governments aren't solving. It also sees companies which it holds partially responsible for these dire straits using their ever greater profits (see chart 1) to funnel cash to stockholders, rather than investing them in ways that make every-



one's life better. The lollygagers should be pulling their weight.

If they won't do so willingly, perhaps they should be forced. Senator Elizabeth Warren, one of the leading contenders for the Democratic presidential nomination, says that being a big company is a privilege, not a right. She wants big American companies to apply for charters that would oblige them to look after stakeholders, especially local ones. Those who let the side down would have their charters revoked. Ms Warren talks of herself as a defender of capitalism; many see her plans as bordering on the socialist. But that may not matter. Among young Americans, socialism is ever less of a boo word (see chart 2).

In the face of this rising tide, the Business Roundtable has either seen the light or caved in, depending on whom you ask. On August 19th the great and good of CEO-land

announced a change of heart about what public companies are for. They now believe that firms should indeed serve stakeholders as well as shareholders. They should offer good value to customers; support their workers with training; be inclusive in matters of gender and race; deal fairly and ethically with all their suppliers; support the communities in which they work; and protect the environment.

There was an immediate backlash. The Council of Institutional Investors, a non-profit group of asset managers, swiftly denounced it. Others railed against it as "appeasement" of politicians like Ms Warren, and a decisive step towards the death of capitalism. This might seem extreme: at first glance, the roundtable's recommendations border on the anodyne. But if the purpose of the company slips its shareholder-value moorings, who knows where it might end up?

Whose company is it anyway?

The most quoted assertion of the primacy of shareholder value comes from Milton Friedman, an economist. In 1962 he wrote that "there is one and only one social responsibility of business—to use its resources and engage in activities designed to increase its profits so long as it stays within the rules of the game, which is to say, engages in open and free competition without deception or fraud."

At a time when governments expected companies to be patriotic and communities saw some of them as vital resources his forthrightness shocked many. But though subsequently traduced as extreme, Friedman's position had a fair amount of give in it. He called on companies not just to stay within the law but to honour society's more general ethical standards, too; he did not equate shareholder interests with short-term profitability.

But that was not how it felt. The way that business schools and management consultants in America, Britain and continental Europe proselytised for shareholder value in the 1980s and 1990s offered little by way of nuance. The biggest corporate-governance concern was the agency problem: how to align managers with the interests of the value-seeking shareholders. "Any chief executive who went against [that] orthodoxy was regarded as soft and told to get back on the pitch," recalls Rick Haythornthwaite, the chairman of Mastercard.

Such heretics can now hold their heads up again. This is not simply because of the political climate or the public mood. Some economists argue that Friedman's position belongs to a simpler time.

Oliver Hart of Harvard University and Luigi Zingales of the University of Chicago see his argument as principally motivated by a form of the agency problem; he didn't like managers being charitable with shareholders' money, even if it was ostensibly in the firm's interests. The shareholders could, after all, lavish their profits on such good causes themselves.

True, perhaps, back then, say Mr Hart and Mr Zingales. Now, they argue, the externalities that businesses impose on society are sometimes impossible for shareholders to mitigate as individuals, particularly if the political and legal system is a barrier to change. Individual shareholders cannot do much in law to prohibit weapons in America, for example. But they can exercise their rights as owners to influence the firms that sell guns. Thus companies can have purposes—but owners must provide them, not managers.

Others argue that the idea of shareholder value, while still central, needs some modifications. Raghuram Rajan, an economist at the University of Chicago and former head of India's central bank, advocates taking note of the non-financial investments workers and suppliers make in a company with a new measure of "firm value" which explicitly takes note of a specified set of such stakeholdings.

Some companies have taken on board the idea that their increased power puts new demands on them. Satya Nadella, chief executive of Microsoft, says that a sense of purpose—together with a mission that is "aligned with what the world needs"—is a powerful way for his company to earn public trust. And because trust matters, this puts purpose at the core of

Microsoft's business model. "As technology becomes so pervasive in our lives and society, we as platform companies have more responsibility, whether it's ethics around artificial intelligence, cybersecurity or privacy," he says. "There is a moral obligation."

Firms in other industries are having similar thoughts. In each business, says Mr Haythornthwaite of MasterCard, a wave of digitisation is likely to lead to one company pulling ahead. Because of that concentration of power, he says, the winning platform will need to forge a close link with society to maintain trust.

Climate change is perhaps the most obvious example of companies doing more than they have to in a good cause. Twenty-five big American companies, including four tech giants, campaigned against America's withdrawal from the Paris agreement in 2017. Globally, 232 firms that are collectively worth over \$6trn have committed to cut their carbon emissions in line with the accord's goal of limiting global warming to less than 2°C.

Some 1,400 companies around the world either already use internal carbon prices or soon will. Many big firms now aim for carbon neutrality in their operations. Some have made big investments to that end. Apple has a renewable energy capacity equivalent to its total energy use.

Laudable as some of this is, it is hardly a response commensurate to the climate crisis. Companies going carbon-neutral are mostly consumer-facing ones, rather than intensive emitters. Money for coal may now be scarce, at least in the rich world, but big institutional investors own a sizeable chunk of the world's major oil companies—many of which apply a

theoretical price of carbon to investment analysis but still keep pumping fossil fuel. And net-zero pledges may reinforce the misapprehension that the best way of fighting climate change is through the choices of individual companies and consumers, rather than a thoroughgoing economy-wide transition.

Companies are also backing liberal social causes. In 2015 Marc Benioff of Salesforce, a software firm, led other bosses, including Apple's Tim Cook, into opposing a bill in Indiana that would have allowed discrimination against gay people. After President Donald Trump's election in November 2016, bosses mounted the barricades over his ban on travel to America from Muslim-majority countries. In 2018 Nike created an advertisement featuring Colin Kaepernick, a quarterback fired after kneeling during America's national anthem in protest against police racism. PayPal has blocked some groups, including white nationalists, from using its services.

The firm's boss, Dan Schulman, says PayPal's aim is to broadcast its broader purpose. Others might deride it as "virtue signalling". But that modish phrase does not quite capture what is going on. In economics and evolutionary biology, where the idea of signalling grew up, a valid signal needs to be costly—otherwise it can be easily faked. These corporate positions do not look costly; indeed they may well be profitable. A stand in favour of Colin Kaepernick fits Nike's brand, which celebrates the goal-oriented individual and has keen black fans. Nike's stock dipped a tad when the controversy hit: but its sales rose immediately and its shares soon recovered.

There are risks to such



strategies. Nike had little to fear from red-staters calling for boycotts. Others may be more susceptible. Backlash can come from the other side, too; corporate sponsorship of Pride marches in London and New York has led some LGBTQ activists to organise alternative events from which business is excluded.

From each according to their abilities

There is also the problem of setting yourself up for a fall. Salesforce stumbled last year when its software turned out to be being used by US Border Patrol to deal with illegal immigration. Ben & Jerry's, which sprinkles its ice cream with a do-the-right-thing anti-capitalist vibe, found itself scolded by Britain's advertising regulator this summer for plastering ads for fatty frozen calories around schools in London.

The politics of the consumer are not the only ones that firms need to consider; in tech, particularly, the politics of the workforce matter. It

was the company's employees who complained about Salesforce's links to immigration control. Last year, employees at Google forced the firm to stop providing the Pentagon with AI technology for drone strikes and to drop out of the procurement process for JEDI, a cloud-computing facility for the armed forces. Google depends, perhaps more than any of its peers, on a smallish number of cutting-edge data scientists and software engineers; their views carry weight. Microsoft, despite similar misgivings from its employees, is still in the running for the JEDI contract. Amazon, for its part, is facing employee pressure over contracts with oil and gas companies.

If corporate political stances can be justified in terms of keeping workers or consumers happy it does not mean that they are insincere—simply that they may be over-determined. This can be irksome for the right. Companies rarely make a stand for the rights of the unborn, or for border

security. But this is the market at work. Companies tend to have a preference for both consumers and employees who are young, educated and affluent—which is to say, who can be expected to embrace socially liberal politics.

What the world has not yet seen is a situation where ESG issues come into material, systemic conflict with profits. Purpose is flavour of the month, says Stephen Bainbridge, professor of law at the University of California, Los Angeles, “but are companies really going to give shareholders a 10% haircut for the sake of stakeholders?”

Such issues become particularly clear when it comes to increasing spending on the poorer parts of the workforce. Relentless downsizing makes little sense. “There are diminishing returns from firing people over and over again,” says Jeff Ubben of ValueAct Capital, a hedge fund. “It is not the right strategy for the future”. Some firms have lifted minimum wages and are spending more on retraining workers to cope with future automation. But profits are very sensitive to labour costs. According to Darren Walker, president of the Ford Foundation, one of America’s biggest charitable endowments, plenty of chief executives are having conversations about how to spend more on workers and benefits, but feel they cannot do so alone. “They will need cover,” he says; a broader shift towards corporate purpose could provide it.

Many influential investors and bosses imagine a return to something like the “managerial capitalism” of earlier times, when some CEOs, their interests presumably insufficiently aligned with those of shareholders, paid more attention to stakeholders and local communities. Not all

are enthusiastic. Paul Singer, founder of Elliott Management, the world’s biggest activist hedge fund, says that the current debate over corporate purpose “risks obscuring the fact that earning a rate of return for pension plans, retirement accounts, universities, hospitals, charitable endowments and so on is itself a social good—a very high one”. What is more, he notes, this social good is one that no entity other than the corporation can sustainably provide.

There is also a problem of accountability. “Once the corporation decides that earning returns is no longer its primary purpose, to whom will it be accountable?” says Mr Singer. The answer, he thinks, is “the loudest and most passionate political activists”—though others might hope the settled convictions of the shareholders would come into play.

One answer to these criticisms could be to devise a framework that would allow companies and bosses to state clearly that they want to do more besides make a profit. Almost 3,000 companies worldwide have been certified “B corporations” in the past decade, which means that their ethical, social and environmental practices have been certified by independent monitors to meet the standards laid down by B Lab, a non-profit group in Pennsylvania. But not many big companies have applied. Those which have are mostly consumer brands.

An alternative to this approach would be to have companies say what purpose they had beyond shareholder value and then hold them to it. This is the approach Mr Mayer of Oxford recommends for Britain: a legal requirement for companies to have a purpose in their articles of association and provide measures to

“As technology becomes so pervasive in our lives and society, we as platform companies have more responsibility, whether it’s ethics around artificial intelligence, cyber security or privacy. There is a moral obligation.”

— Satya Nadella, chief executive, Microsoft

prove it is being fulfilled. Stating the purpose in such a way as to make it open to such measurement, though, would prove hard.

As capitalism takes flak from all sides, it is hard for those in the business and investing class to object to firms voluntarily doing their bit to tweak the system. But when reliable returns are put at risk, things can change. Last year Jason Perez, a police sergeant in Corona, California, had enough. His state could no longer afford wage increases for police and other public servants partly because CalPERS, one of the world’s biggest pension funds, was underfunded. It had also been an early standard bearer for ESG investing. In 2001 it dumped tobacco stock—which then outperformed.

By 2017, CalPERS was underfunded to the tune of \$139bn. Its ESG strategy had cost only about \$2bn. But Mr Perez took the reasonable view that a couple of billion was real money. “Eleven people in my family are in law enforcement and I had to make sure their pensions were protected,” he says. To that end he campaigned for a board seat at CalPERS on the basis of letting the fund invest in law-abiding, profit-maximising companies purely on the basis of potential returns. Pitted against the fund’s chief ESG guru, Priya Mathur, he won. However companies reset and refine their purposes in the years to come, they will still need to perform for people like Mr Perez. ■

End Notes

Re-invention

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Disruption

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