DIGITALISATION
REPORT

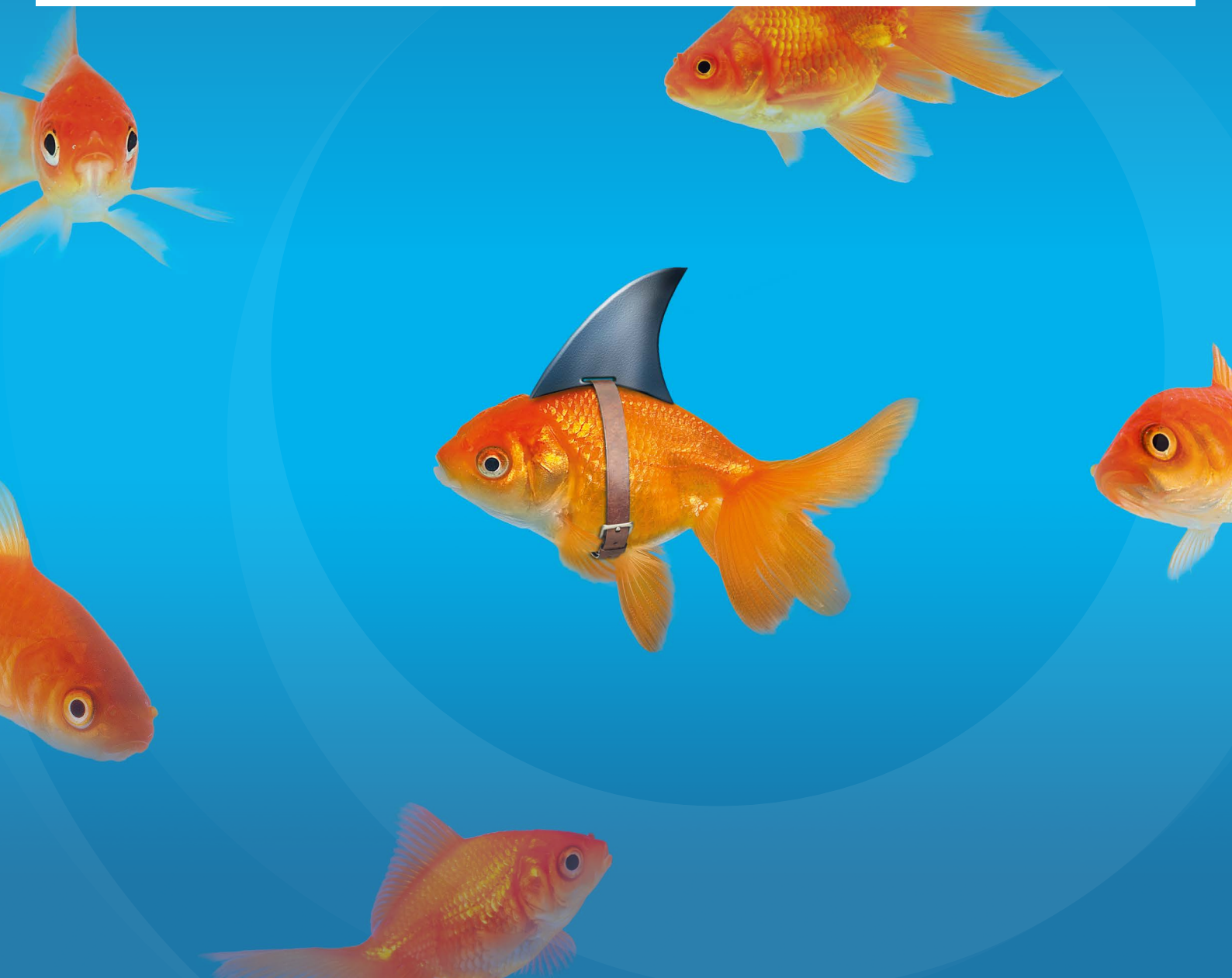
GOWLING WLG

LSE Consulting

TIDES OF DISRUPTION

HOW TO NAVIGATE BUSINESS TRANSFORMATION

2019



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INTRODUCTION

The world stands on the brink of yet further enormous technological change. Over the next decade, daily lives and long-established business processes will be transformed as a new wave of digitalisation propels disruption, displacement and innovation. Not all businesses will be affected in the same way – much depends on the market and sector in which they operate – but all will be disrupted to one degree or another.

This report, **Tides of Disruption: How to Navigate Business Transformation**, analyses the forces driving digitalisation and business' readiness for it. In doing so, it identifies not only a timeline of digital change, but also an assessment of how prepared different countries are for that change. And, working with the London School of Economics, we have identified the emerging business models and new industries which digital disruption is likely to drive to the surface. Familiar to some, unknown to many, they provide an insight into how businesses may transform all or part of their operations in the future.

There are two key pieces of research and insight which, when combined, give a compelling snapshot of the impact digitalisation is currently having on both countries and sectors – and forecasts the future impact and its implications on those running international organisations in Europe, Asia and North America.

Analysing data from the World Economic Forum and Economist Intelligence Unit, on pages 25-26 we have plotted 120 countries against a wave of digital readiness. The result is three distinct groupings of nations:

Ahead of the Wave
Nations already in a strong position who will continue to innovate to reap the benefits of new technologies at the earliest opportunity.

Just Keeping Up
Those countries that will keep pace with digital disruption without powering ahead.

Behind the Wave
Those struggling today that will fall further behind as digital disruption intensifies.

Although the development of technology is global, the distribution of its benefit is not. Those markets Ahead of the Wave are not just powering ahead because of business optimism and ambition, but because the wider infrastructure of their markets makes it possible. In this report, we outline how these technologies will transform businesses and cause a new wave of disruptive digitalisation, revealing how businesses can – and will – take hold of this change. There are many emerging technologies that will propel changes to business processes between now and 2030.

While many of these technologies are known and in the collective consciousness, very little unpacking and exploration of the impact has been discussed. All the focus has been on AI or VR, but the conversation is superficial, and lacks understanding and tangible actions that those running international companies need to take. These disruptive technologies have been arrived at by studying more than 30 reports written globally. The names of the technologies are known, however, the understanding, the implications and the behaviour at a senior level these technological changes should trigger is unclear.

We've partnered with Dr Carsten Sørensen, Associate Professor of Information Systems and Innovation at the London School of Economics, who has been studying, tracking and reporting about the effects of tech disruption on business and wider society since the late 1980s. Dr Sørensen has, using our insight, forecast the three most likely business models that the identified five disruptive forces are likely to trigger. On pages 17-24 he discusses some of the key drivers for this change. The hurricane of change blowing through industries and countries - particularly blockchain and AI - are a threat (and opportunity) to even the incumbent tech giants Amazon, Google and Apple, which currently dominate and influence service, platform and infrastructure.

Understanding the forces of disruption, their impact and the potential business models of the future is key to any business looking to transform all or parts of their business, disrupt new markets, merge or acquire a new business or develop a new product.

FOREWORD

By Dr Carsten Sørensen
London School Of Economics

LSE Consulting

The strategic and practical challenges of digital transformation are a priority for many businesses; concerns which have increased dramatically in the last few years. Yet, digitalisation has been happening for a number of decades, with one of the first working examples in the 1980s seeing networked personal computers automate back office procedures to reduce administrative tasks.

In the present climate, we're now seeing the acceleration of more and more emerging digital technologies such as procedural automation, deep learning, and human effort – all of which are already finding application within a business setting.

This opportunity has seen a number of digital platforms corner significant portions of the market, most prominently, the FAANGs (Facebook, Apple, Amazon, Netflix, Google), BATs (Baidu, Alibaba, Tencent), Uber, eBay, and Spotify. These digital platforms have provided means of organising business activities around themselves, implementing multi-sided markets with a very large number of users interacting through the platform.

Yet with each Goliath, we are also seeing an increasing number of challenger businesses emerge. With a wealth of innovation efforts made by smaller businesses seeking to establish contender platforms, ignite their user-bases, and gain market power.

As a result, the emergence of such digital technologies has already begun to trigger the transformation of industries. Here, under optimal conditions, digitalisation is seeing a small selection of digital platforms initiate an explosion of users and other contributors. Faced with an existential business challenge, executives and boards will seek to engage and challenge current business models, which can prove both difficult and costly, and, if approached incorrectly, ineffective.

In other areas, digitalisation shifts the skills needed, redefines the value arrangements, and can, therefore, create new opportunities for challenger firms. Control over infrastructure access can provide a barrier to entry for competitors, but also rapidly turn out to be a problem for incumbents when business models shift. Looking back, an example of this can be seen when mobile operators saw a shift from voice and SMS to consumers mainly needing access to data through a mobile Internet connection. Here, infrastructure ownership needed the flexibility to change the business model along with changing demand.

In the context of today, what we're seeing for owners of large hotel chains, for example, is that infrastructural cost is significant and will be problematic to compete with companies, such as Airbnb, which leaves the property investment risks to a large open community.

Through my own exploration over the past 35 years into the study of digitalisation and business processes, together with in-depth secondary research into the topic, this report outlines predictions of how digital technologies can trigger huge disruption to markets, industries and, of course, the face of business as we know them. However, the predictions drawn can only ever be arrived at by analysing the here and now.

History is littered with experts getting their forecasts wrong; such as DEC's founder Ken Olsen in 1977 not seeing any need for people having computers at home. It is therefore important to distinguish between the assessment of fundamental technological capabilities as expressed in expected technology roadmaps, and the associated societal and business impacts of the technologies.

Whereas the former to a greater degree can be estimated since the basic developments may be the results of long-term technological trajectories, the latter is fraught with uncertainty. It is not problematic to assume that the current work on 5G telecommunications networks will lead to faster network speeds and with associated potential for a reshaping of how networking and computing are delivered. It is, however, much more uncertain how the necessary infrastructure investments will stack up against the ability to define appropriate business models for making such investments.

With a career spanning over more than three decades, I have sought to understand how the different waves of digital technologies have influenced work, and how particular business conditions enabled some technologies to be successful and hindered the success of others. Later in this report, and based on the analysis of likely technological trajectories organised into five key themes, together with ongoing research into digital business architectures across a number of sectors during the past decade, I have outlined three business models which are likely to develop as a trigger of these technologies.

"Faced with an existential business challenge, executives and boards will seek to engage and challenge current business models, which can prove both difficult and costly, and if approached incorrectly ineffective."

THE FIVE FORCES OF DISRUPTION

To reach these Five Forces of Disruption, a range of emerging technologies has been analysed through an extensive literature review and horizon scanning, resulting in the analysis of circa 30 drivers leading to the isolation of those overarching trends which:

- **Would be relevant within a circa 10-year timeframe**
- **Would most affect how businesses operate, and disrupt existing models or industries**

Between now and 2030, there are five forces that will transform businesses. Each of these will present challenges and opportunities, with every leap forward offering the chance to consolidate positions of strength or upset the status quo.

- **5G – and with it, the Internet of Things (IoT)**
- **Artificial Intelligence (AI)**
- **Autonomy**
- **Hybridity**
- **Blockchain**

These developments are likely to have implications for all businesses – if not in day-to-day operations, then in the lives of their staff and clients. They also present the opportunity for entirely new tasks, roles and ways of doing business.

5G and the Internet of Things

5G is the fifth generation of mobile communications and is perhaps the most crucial technological development in this report, constituting the 'mesh' of humans, artificial intelligence, devices and connectivity that will come to define the world in which business operates.

5G and the IoT underpin many of the other technologies that will drive business digitalisation, facilitating communication between a vast range of devices and the wireless transfer of data produced by these new devices as they communicate with each other.

However, the IoT will not reach its business potential if no-one knows how to implement it, and so IoT platforms will be crucial to its uptake and efficient use. An IoT system needs hardware and connectivity, and in order to ensure ease and breadth of use, it also requires software and a user interface. This is where IoT platforms come in, acting as the 'face' of a highly complex network of wireless connectivity between potentially thousands of devices each feeding and receiving information from each other.

Artificial Intelligence

The vast majority of AI concerns algorithms and these are broken into two distinct categories:

- **Classic machine learning algorithms – including classification and regression**
- **Deep learning algorithms – algorithms that learn from mistakes using deep neural nets**

Programming automated data analytics or teaching conversational AI to a virtual assistant is incredibly complex and not all employees and businesses will have in-depth knowledge. Luckily, the model of Platform-as-a-Service (PaaS) is already in place.

As a result, the development of Artificial Intelligence-as-a-Service is inevitable. Rather than investing in the infrastructure required to develop their own artificial intelligence platforms, businesses which specialise in Artificial Intelligence-as-a-Service will step in, making the process more efficient.

Between them, the technologies can produce a wide range of services, and as businesses begin to offer these services to other businesses, we will see them spread as barriers to adoption recede.

Many businesses have already experimented with rudimentary forms of customer-facing artificial intelligence. Over the next decade, conversational AI will improve and these interactions will become increasingly 'human', driven in no small part by developments in another area of AI – data analytics and machine learning.

Autonomy

By autonomy, we mean the physical manifestation of artificial intelligence, such as robotics, and automated vehicles such as drones and cars. So, by 2030 we will begin to see the foundations laid for these ideas and small iterations will be transforming retail, transport and manufacturing industries.

In the controlled environment of the warehouse, British grocery-delivery business Ocado has a system in place and is experimenting with a robotic arm which will eliminate the human 'picker' from the process, foreshadowing the 'dark warehouse' of the future.

Drones and autonomous vehicles are playing catch-up – the complexity of the world outside warehouses making automation a more complicated process – and while the technology is unlikely to be fully realised by 2030, the applications are much wider. Automated vehicles in particular face significant barriers to market entry, with the very human space of roads and urban environments posing risks that need to be safely navigated before widespread use becomes a reality.

This does, however, create an opportunity for new business models when it comes to mobility. For example, with autonomous vehicles, access is likely to become more important than ownership as the automated vehicle plays an important role in the sharing economy and new transport networks.

Hybridity

Hybridity refers to the process by which our physical lives are mediated through technology in the form of augmented reality (AR), virtual reality (VR) and mixed reality (MR). In the future, hybridity will have implications for how we interact with the space around us.

At its most basic, advances in hybridity will allow employees to work more flexibly in terms of time and space. While we continue to work in offices, developments in VR, AR and MR will see employees' ability to replicate office or meeting conditions in their homes drastically improve. The 'Death of Distance' is a concept that has been regularly hypothesised as digital communications have advanced. Although this next, immersive wave of hybridity will not result in the 'end of geography', it can revolutionise businesses' day-to-day practices and engineer entirely new models of service and organisation.

As the technology improves and as hybrid technologies can better interact with the bricks and mortar of the real world, applications will spread across industry. In healthcare, hybridity could introduce new methods of training for surgeons, and later – along with 5G, the Internet of Things, and various other elements of technology – could facilitate remote surgery.

Blockchain

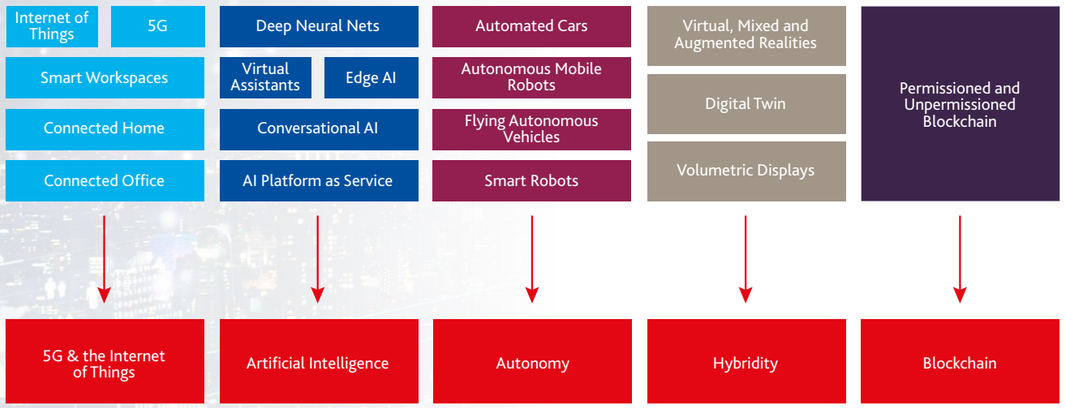
Blockchain is a database – or distributed ledger – that is stored, updated and shared either publicly or privately, which nobody can tamper with and everyone can inspect. In its simplest form, blockchain is a term for the configuration of transactions, agreements or actions into 'blocks' which are added – irreversibly – into a 'chain'. The adding of the block is witnessed by the entire network and stored in the distributed ledger.

Permissioned blockchain – in which access is permitted or denied by administrators – has enormous potential. Public sector agencies in more than a dozen countries are experimenting with the technology, with the most active public sector use cases being digital currency/ payments, land registration, voting and identity management. Smart contracts – also known as 'programmable money' – have the capacity to revolutionise payment and insurance processes, by creating conditional blocks which can see transactions executed if certain conditions are met.

Combined with the processes of AI Platform-as-a-Service, we can begin to imagine insurance businesses run by individuals, or small numbers of individuals, who simply co-ordinate the running of multiple automated processes that previously required hundreds of staff.

The below graphic explains how the wider technological forces at play will give rise to each of the five disruptors we've discussed.

Digitalisation Trends and Drivers

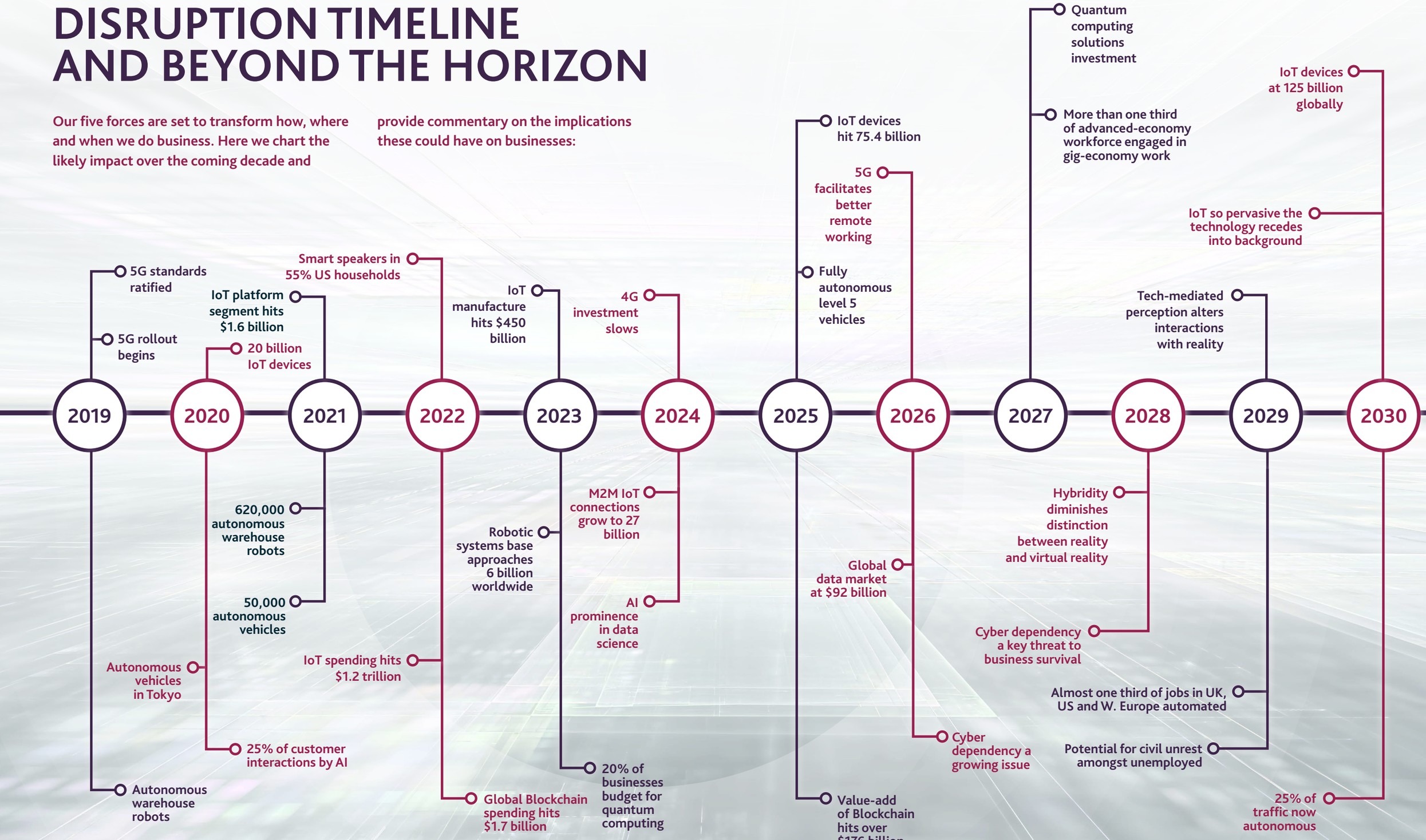


Five Forces of Disruption

"Although this next, immersive wave of hybridity will not result in the 'end of geography', it can revolutionise businesses' day-to-day practices"

DISRUPTION TIMELINE AND BEYOND THE HORIZON

Our five forces are set to transform how, where and when we do business. Here we chart the likely impact over the coming decade and provide commentary on the implications these could have on businesses:



2019

Headlines

- **5G rollout begins with first 5G devices released**
- **5G standards ratified**
- **Autonomous warehouse robots eliminate logistics jobs**

Commentary

5G rollout begins in leading markets with deployment across developed and developing nations throughout the 2020s. This will clearly have significant implications for the telecommunications industry, but these developments represent the starting gun for the Internet of Things, a technology that will be ubiquitous in augmenting business practice.

The logistics industry will see vast investment in automated processes. This will be compounded by development in the legislative architecture around autonomous flying vehicles.

Implications

Local businesses in US and Western European hotspots trial 5G connectivity for first time, leading to disruption from start-ups leveraging this new capability to deliver new services. Retail, transport and manufacturing industries start to experiment with IoT tech on the new network, with most success in those markets with the best e-commerce environments such as European markets: the UK, Germany and France, and others, such as Japan, South Korea and Australia.

2020

Headlines

- **Number of IoT devices reaches 20 billion**
- **Far-East car manufacturers race to release autonomous vehicles in Tokyo by 2020**
- **25% of customer service interactions carried out by AI customer assistants**

Commentary

By 2020, the number of IoT devices in the world will reach 20 billion – up from 6.4 billion in 2016. From 2015-2020, investment in IoT will grow by almost 400%, from $215 billion to $832 billion – driven primarily by manufacturing, transportation and utilities.

The rapid growth in data produced will see an increase in capacity for insight and analysis through automation, driving improvements in further AI and autonomous developments.

Meanwhile, the Tokyo Olympics is seen as a great tech opportunity, with Toyota and Honda racing to have autonomous vehicles on the road during the Games.

Implications

Service businesses – initially in North America and Europe – rollout crowdsourced analytics from citizens data scientists, expanding their analytics and development capacity without being dependent on number of trained data scientists in population.

Global harvesting and sharing of data to individual privacy by design arrangements, is likely 5-10 years out. However, the gradual shift by customer segments has already begun and could accelerate rapidly during 2019-2020 once a critical mass has been reached.

2021

Headlines

- **IoT as platform segment hits $1.6 billion**
- **620,000 autonomous warehouse robots shipped, valued at $22.4 billion**
- **50,000 units of autonomous vehicles shipped**

Commentary

Competition in the desire to break up the hold of the dominant incumbent players will intensify, and, chiefly led by Google, and will see rapid development IoT investment.

Commercial drone deliveries begin to gradually expand to parts of the US enabling more complex delivery operations, with the overall drone aircraft industry hitting $10 billion in value.

BMW plans to get highly and fully automated driving into production by 2021.

By 2021, blockchain will have grown in use, but 40% of the world's blockchain business value-add will be derived from the manufacturing sector. At this time, Dubai aims to run all of its governmental transactions through blockchain technology.

Implications

Manufacturing sectors in major exporters like Germany and China start to incorporate blockchain technology into their verification, supply chain management and tracking processes. Combined with developments in autonomous things and AI, burden of labour in these industries shifts from manufacturing and construction to management and monitoring. German manufacturing workforce starts to decline by 1% year on year, although output remains consistent.

Autonomy disrupts transport businesses globally as major players – Amazon and Alibaba – roll out commercial drone delivery, prompting a rethink of location of distribution hubs and a reduction in courier workers. The security industry in the Middle East is also disrupted as authorities invest in autonomous monitoring and policing, replacing personnel.

2022

Headlines

- **Spending on IoT hits $1.2 trillion**
- **55% of US households own a smart speaker**
- **Worldwide spending on blockchain solutions reaches $11.7 billion**

Commentary

In 2022 onwards we will see connected homes become mainstream technology. Voice shopping will be a $3.5 billion industry, while the global intelligent virtual assistant market hits $4.2 billion.

Globally, spend on Big Data and analytics solutions will reach $260 billion and businesses not making decisions based on advanced, AI-led analytics will fall behind. The largest investors in Big Data in 2022 will be those in banking, manufacturing, professional services, and governments, accounting for almost half of Big Data revenues.

Blockchain spending will grow, and some blockchain-based businesses will reach prominence, but the lack of proven business applications will slow its growth. However, it is estimated that there will be one business built on blockchain technology worth $10 billion.

Implications

The retail industry is transformed by further decline in instore sales due to voice shopping and hybrid customer service. Main cost becomes production, but businesses split between locating production in cheaper markets off shore and investing in locations closer to key consumers amid predictions that autonomous transport and production will pay dividends.

IoT transforms agriculture in emerging economies as greater monitoring of crops and yields and ability to centrally control acres of land from one hub reduces cost of labour and enhances productivity. Agricultural workforce shrinks by 5% in Indonesia, China and India.

2023

Headlines

- **Spending on manufacturing IoT solutions hits $450 billion**
- **20% of businesses will be budgeting for quantum computing projects**
- **Total robotic system base approaches 6 million worldwide**

Commentary

Blockchain technology will develop, however in 2023, applications of blockchain will be stunted by poor understanding, and a lack of proof in what will, at this point, be an unproven technology in at-scale business operations.

By 2023, 86% of ICT executives surveyed by the World Economic Forum anticipate that 10% of reading glasses will have internet connectivity. Representing a significant step forward for hybridity, with a significant proportion of society living with digitally augmented vision during portions of their day.

Implications

Developments in robotics see widespread automation of retail distribution hubs, especially in the US and the UK. Regulatory controls in the EU halt disruption for time being, but investment in smart factories in Germany indicates disruption on the horizon. The UK bucks trends of plateauing blockchain productivity as financial and professional services regains its pre-Brexit footing as a result of huge innovation in the City.

Urban transport in Scandinavia, some US cities and Singapore is transformed by the roll out of the first fully-automated ride hailing apps.

2024

Headlines

- **Investment in 4G technologies begins to slow as 5G edges toward primacy**
- **Machine to Machine (M2M) IoT connections grow to 27 billion**
- **Data science no longer hindered by lack of skilled humans as AI grows in prominence**

Commentary

Africa is lagging very far behind when it comes to 5G – but 2024/25 will be the years in which we see 5G becoming the primary target of investment by mobile networks globally.

Mobile connections will grow from 256 million at the end of 2014 to 2.2 billion by 2024. 5G will increase capacity and create greater opportunity for growth of IoT devices and connectivity, but by 2024, a significant proportion of IoT devices will have been designed to work with 4G.

Sophistication in Machine & Deep Learning will empower citizen data science, reducing the barriers to entry of high-level analysis and allowing for a far wider range of individuals to manipulate data and generate insight.

Implications

Developments in automated analytics transform business processes across HR, sales, accounting, marketing and procurement practices, leading to job displacement.

Parts of emerging markets – The Philippines, South America and major cities in Sub-Saharan Africa – leapfrog 4G (and in some cases, 3G) to lay 5G networks. In these nations, the pace of change in retail, ecommerce and agricultural industries massively accelerates.

2025

Headlines

- **IoT devices set to hit 75.4 billion**
- **Ford & Renault Nissan release fully autonomous – level 5 – vehicles**
- **Value-add of blockchain to hit more than $176 billion**

Commentary

The market for autonomous vehicles is likely to evolve initially with commercial vehicles using a car sharing pool in the same way that ride sharing is used in 2018.

By 2025, the blockchain market is expected to reach $16.3 billion dollars, with Estonia – long a leader in e-citizenship –using the technology in governance, seeking to attract 10 million e-citizens by 2025 by encouraging businesses to set up in the country.

500 million virtual reality headsets will be sold. In total, the AR/VR market will expand to 300 million units; 250 million VR HMDs and 50 million smart glasses.

Implications

Retail workforce – spurred by new consumer and office tech demands – grows by more than 1.5% year on year in India, Indonesia and China, despite declines in the sector in Advanced Economies.

Most new vehicles sold have some autonomous capacity although application and use are limited by extent of road mapping and variations in insurance and regulation. India continues to enforce anti-autonomous vehicle legislation to protect jobs, limiting disruption.

2026

Headlines

- **5G facilitates better remote working practice with opportunities for efficiencies**
- **Global Big Data market grows to $92 billion**
- **Cyber dependency becomes a growing issue across business size and industry**

Commentary

In the US, corporate and consumer applications of commercial drones will have an annual impact of between $31 billion to $46 billion on GDP.

As our dependence on tech grows, vulnerability due to its failure could damage productivity. More severely, cybersecurity threats will evolve – in part due to the emergence of quantum computing later in the decade. By 2026, no business will be able to work offline, and the ability to accept and mitigate these risks will be paramount.

Implications

Data analytics capability of service economy and customer-facing businesses transformed by virtual architects and artificial intelligence co-developers. Businesses in advanced markets highly vulnerable to privacy backlashes heighten transparency and allow citizens to trace their data rapidly and forensically.

Automation-related job-losses in retail and manufacturing sectors in Europe and agriculture in emerging economies countered by rapid growth in education, health and care industries, which are starting to unlock efficiencies through IoT, AI and autonomous technologies.

2027

Headlines

- **Businesses start to invest in quantum computing solutions**
- **Gig economy formalises with 37% of advanced-economy workforces now doing some kind of gig economy work**

Commentary

Advances in computing combined with the proliferation of connected devices we see businesses highly vulnerable to cyber-attack in 2027. The dawn of quantum computing will have significant implications for cybersecurity, with these systems capable of breaking through traditional low-strength cryptographic systems.

As consumers come to understand the monetary value of their data, economic models around data analysis could change as the practice becomes more expensive, and even, more targeted.

In 2027 we could see the start of a data economy, with individuals' incomes boosted by money earned by the personal data they allow to be analysed by businesses.

Implications

Investment in education and training facilities sees China granted more international patents than US for the first time. Precipitating a new wave of investment in professional and financial services in China.

Service economy businesses in North America, Europe, major cities in India and China and city-states like Singapore achieve a long-speculated ideal: the death of distance. Supported more heavily than ever before by virtual assistants, workforces can fragment, with more employees working either at home or local smart-office hubs.

2028

Headlines

- **Hybridity develops to diminish perceived distinction between reality and virtual reality**
- **Cyber dependency emerges as key threat to business survival**

Commentary

Businesses will be increasingly vulnerable to being hacked, and the consequences far more severe, beyond data breaches the likes of which we have seen in 2018, we could see the hacking of technology with dangerous physical capabilities i.e. the hacking of planes and automated vehicles.

The term "immersive, ambient user experience" will appear following growth in the use of VR/AR/MR headsets – and the increasing extent to which they will be assimilated into existing everyday technologies could lead to ubiquitously mediated realities.

Here, we will see the earliest stages of technology 'fading into the background'. Instead of using computers, the entire world around people will take the place of computers. However, this long-term smart space intelligent environment model won't exist until 2028 at the earliest.

Implications

The leisure sector serving affluent consumers in Western Europe is heavily disrupted by a new wave of hybrid devices accelerating the end of geography.

For businesses, the formalisation of the gig economy leads to more individuals choosing portfolio careers and new relationships with employers. Led by Scandinavia, Japan and South Korea – which offer the strongest protections of workers' rights through their blockchain-enabled personal tax and welfare systems.

2029

Headlines

- **Increasingly tech-mediated perception of the world alters the way people interact with reality**
- **Almost a third of jobs in the US, UK and Western Europe automated since 2018**
- **Potential for social unrest as individuals are displaced from jobs**

Commentary

Manufacturing, wholesale and retail trade, admin and support services and public administration are the sectors most affected by automation. Nations like China with significant levels of employment in these industries will face greater disruption as automation costs individuals their jobs, even as it creates jobs elsewhere.

Additionally, the perils of social unrest and cyber dependency will not be equal across nations; high forecasted levels of automation in the Chinese workforce in the coming years will see many employees displaced, while the nation will become highly dependent on technology.

Implications

The chief cost in supply chains of retail and manufacturing is now transport, leading to an acceleration in reshoring. An increasing number of global and major national businesses in these sectors – particularly those whose administrative operations are based in Western Europe and North America – move production closer to the place of consumption. Advanced markets in Asia-Pacific retain their supply chains, although cost of labour in India and China is increasing.

2030

Headlines

- **Global IoT devices number 125 billion**
- **IoT becomes so pervasive that in most advanced nations the technology starts to recede into the background**
- **25% of traffic is autonomous, with 76,000 drones in use in the UK**

Commentary

Connectedness has become ubiquitous and the process of changing the lighting, or turning the temperature up or down in an office is operated from individuals' desks.

Blockchain offers $3 trillion in business value add on globally. Cyber dependency requires significant improvements to business security and blockchain's uses become broader, touching everything from passwords to ID badges.

By 2030, the autonomous vehicle industry is set to be worth $87 billion dollars, with only self-driving cars available for purchase (new) in the United States. Drones could add £42 billion to the UK economy by 2030.

Implications

By 2030 all advanced economies have fully rolled out 5G networks, in sprawling western cities this has dramatically altered the transport, real estate and service industries, as job-location becomes a less powerful determinant of living location.

Blockchain is finally adding consistent benefits to business operations. Starting in the major financial powerhouses – the City of London and Frankfurt – the major innovations by 2030 are concentrated in two very different spheres: leisure and life-management, and public services. For government services, all identity checks and payments in Scandinavia and China (which has rapidly improved its e-government and cyber security position) are on a blockchain ledger.

Major barriers surrounding mapping and regulatory or ethical concerns in relation to autonomous vehicles are now starting to be overcome.

NEXT GENERATION BUSINESS MODELS AND INDUSTRIES

Dr Carsten Sørensen, London School Of Economics

The disruption timeline outlines the technology which is set to come to the fore over the next decade. Analysing this insight together with its predicted implications, Dr Carsten Sørensen explains how these technologies will also give rise to new business models.

Companies that require even a fragment of digital capability within their sales, manufacturing, operations or delivery and distribution are in complex multi-sided markets, with each layer dominated by a handful of players. In order to understand any emerging business models that will be triggered by the five forces discussed in this report, exploring these three value layers is essential.

Service

Value proposed or offered

The relationship between a customer and business has already been transformed by technology; it is increasingly automated, highly interactive and far more circular and equal than it has ever been before. This relationship between service propositions and the active engagement by consumers (in constructing and delivering the service) makes for a much more unpredictable and interactive relationship between supply and demand for goods and services.

AI and blockchain powered technology is changing demand and supply driven businesses in two crucial ways. First, the need for agility and flexibility – the idea of stock sitting in a warehouse will become a thing of the past as supply and demand are evenly matched. Secondly, what can be offered as a service will explode into unexpected areas such as middle management decision making, compliance and regulations. Accordingly, this will change large companies from the inside out and allow smaller companies to scale and flex when needed.

Platform

Value captured

The platform is the battleground of multi-sided markets. Existing transformations include the evolution of Apple's iTunes from music library to a digital shelf, of movies and on-demand businesses like Uber and Deliveroo connecting food, cars and consumers.

The diffusion of IoT may well create an explosion of platforms and entirely new infrastructures. This will impact on business profoundly because the way in which we order, pay and process what is made will be part of a different digital architecture, which could see increased risk and liability as information passes between different platforms. However, it could also mean that the reliance on a handful of tech platforms could be a thing of the past.

Infrastructure

Value delivered or distributed

Infrastructures are needed for value delivery, and for digital companies, the open Internet offers a pre-paid infrastructure onto which smartphone apps and 4K movies can be distributed at limited extra cost for the platform.

Both digital and physical infrastructures often represent barriers to entry for competitors. In the case of Amazon and Google, their heavy investment in physical and digital infrastructural assets makes it very difficult for competitors to provide similar value propositions, and therefore harder to exercise the same platform leverage. Physical and digital infrastructures can be a barrier to entry at the outset but can at a later stage become a burden on an incumbent. For example, global hotel chains once measured their market power in terms of their hotel portfolio. But as consumers start to rent from private individuals listing their properties on Airbnb (the new platform) then the game changes: investment in hotel stock is a debt needing to be serviced and potentially, a barrier to innovation elsewhere.

The current make-up of the value layers has been dominated by simplicity. Facebook, Amazon, Apple, Netflix and Google (FAANG) have significant presences in multiple sectors. They currently weigh heavily on service, platform and infrastructure and are inevitably going to be long-term players because without them, accessing tech and navigating the layers between each platform, service or infrastructure is complicated.

However, this is likely to change as disruptive forces like IoT, blockchain and AI present a challenge to the existing tech order. For those at the helm of large international companies, this requires a rigorous sense check on where value currently lies – and where it may lie in the future. While being in control at the point of service is a fundamental, influence in capturing value in a platform and in infrastructure is how companies will stride into a digital future

It is from this starting point that will see business models emerge from the adoption of blockchain, AI, autonomy and hybridity. Here we explore three new business models, the forces of disruption which will trigger them, and some new industries which could emerge. We'll also look at the type of behaviour, attitude and skills this will drive within the boardroom.

As ever with digitalisation, changes feed off one another, with nuances and paradoxes within each change. These business models, then, are connected to – and even trigger – one another.

"The relationship between a customer and business has already been transformed by technology; it is increasingly automated, highly interactive and far more circular and equal than it has ever been."

1. Decentralised Model

The explosion in IoT and blockchain mean large businesses which currently enjoy dominance in their industry will need to rethink their approach. The way blockchain will level out transactions and the transmission of data will open up connectivity and complex systems and call into question the value that a large business can capture from, and offer to, its customers. This will result in an explosion of organisations required to meet the demand generated by an increased number of devices, services, and possible interconnections across a range of IoT ecosystems. For existing players, this means fragmentation, being part of a bigger ecosystem of companies – or indeed controlling an ecosystem of companies – rather than one. For disruptive new companies, it means there is huge opportunity to challenge.

Reshaping relationships

As a key trigger for the Decentralised Model, blockchain is already essentially reshaping the existing relationships between a platform capturing value, and the underlying infrastructure being either controlled and/or, owned by that platform. This shift will, therefore, give rise to the emergence of value infrastructures based on distributed ledgers.

Finally, the advent of hybridity with digital twins will allow increasingly fluid arrangements across the digital/physical barrier, in turn triggering the necessary value-bearing blockchain infrastructures.

Unless current monopoly holders are able to control the explosion, which will lead to fragmentation, it is likely the long-term effect for businesses will be the fragmentation of products, services and even entire industries. This is essentially because decentralisation removes the interaction between the user and the product to where it would ordinarily charge their fees.

Decentralised Autonomous Corporation (DAC)

Driven by blockchain and enabled by the interconnectivity of 5G, this opens the door for a new way of operating: the **Decentralised Autonomous Corporation (DAC)**.

DACs have the potential to challenge our current economic structures by aligning the interests of operators, shareholders, customers and even the environment; reducing the need for a large coordinating platform. Currently, the ecosystem is lacking a trustless or decentral end-user interface, which makes it almost impossible for a customer to interact with the system in a meaningful way without having to trust intermediaries. This model allows for a lower entry cost for newcomers to build infrastructure in terms of backend, security, authentication and immutable data. It can create a level playing field when it comes to market entry. It can, however, also result in the formation of new powerful platforms based on distributed ledger infrastructures rather than on the open internet.

This model paves the way for verifiable, value accounting and cash flow all accessible on the blockchain. At enterprise level, firms have an incentive to automate and decentralise their infrastructures with the benefit of delivering cost reductions. While the model presents many benefits to the customer, there is a challenge in trustless interactions where customers are used to trusting the middle man that will be removed by decentralisation.

"At enterprise level, firms have an incentive to automate and decentralise their infrastructures with the benefit of delivering cost reductions. "

Future industry spotlight: Decentralised manufacturing

Companies with decentralised manufacturing are able to enjoy increased flexibility, a closer relationship to their customers, a more motivated workforce and low labour costs from different markets. Decentralised manufacturing not only improves the efficiency of decision making, it also empowers employees, letting them improve problem areas immediately without approval from a centralised organisation.

As an example, Bitcoin not only introduced the concepts of blockchain and cryptocurrency to the internet, it also demonstrated that rudimentary organisational structure can be accomplished through computer code alone. Bitcoin's blockchain software automatically compensates anyone who records a new block on the chain. In essence, the Bitcoin blockchain created the first Decentralised Autonomous Organisation (DAO): an organisation that is operated by rules encoded as computer programs anchored to the blockchain, and loosely regulated by an online social community.

Personalisation

Manufacturing will find radically new ways of engaging with customers thanks to disruption from a number of forces, including virtuality, autonomy, 5G connectivity, blockchain and additive manufacturing. The ability to engage in highly personalised manufacturing with instant delivery can render parts of manufacturing a service of lean, just-in-time analogue-digital hybrid products. One ready-made example is Adidas opening a 3D sneaker printing factory in the US.

There is also no reason to think that the connections will be mediated by global platforms. Rather, bespoke manufacturing supply-chains could just as well be conducted in temporarily reconfigured value networks, where the inter-personal or inter-firm trust would be mediated by a blockchain recording transaction and evaluation. This blockchain would in effect mediate trust in a more computational and transparent manner that is currently conducted by centralised digital platforms such as Etsy.

Such manufacturing networks could also superimpose or integrate complex EthTech solutions, for example, allowing for the specification and transparency of material recycling. With this in mind, it's possible that 'Maker Culture' in advanced markets is preparing new generations for such a possible scenario. The US military parts provider, Moog Inc, has shown how a blockchain can support the sharing of intellectual property in the form of 3D specifications for spare parts. Printed by 3D printers where needed, a system of accountability is created by recording the private key from the blockchain transaction in the part. This is an example of a digital and physical twin in action. The mergers of instant, bespoke, local manufacturing and delivery offer a range of possibilities to establish new businesses.

2. The Mass Platformisation Model

The decentralisation model will not only have the potential to reshape companies and industries into a myriad of ecosystems, but will see the mass platformisation of a range of sectors, which could see the end of a reliance on a handful of companies – the so-called FAANGs. The sheer scale and scope of IoT devices and ecosystems have the potential to overwhelm even these tech giants, and pop-up platforms for any and every type of business are likely to come to the fore.

This is very much on some of the FAANG's radar, as the battle for the home virtual assistant market between Google and Amazon ramps up. Last year, Amazon launched more than 100 products that were able to be connected to Alexa in an effort to control the connected home platform and feed its service and infrastructure businesses.

Inter-platforms

There is great overlap between the five forces of disruption outlined earlier in this report and, if the technological architecture of all the five categories is to work optimally, it will need to establish inter-platform markets allowing for more flexible business arrangements between separate firm-owned platforms.

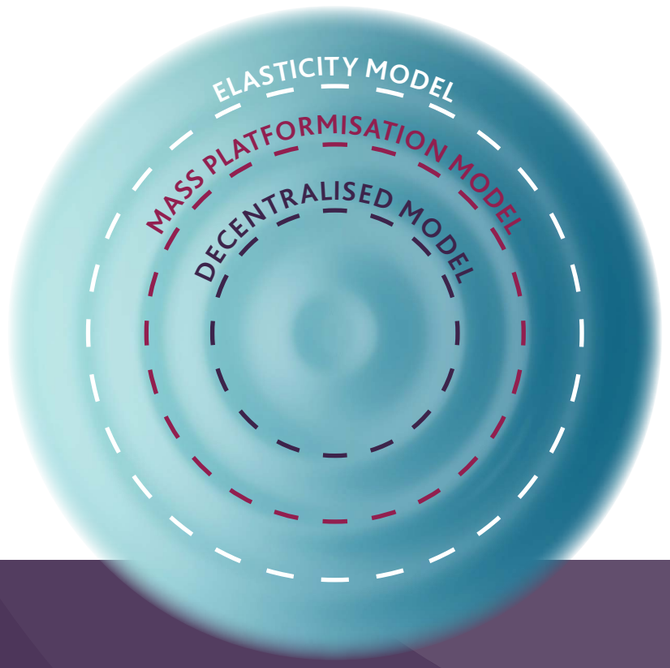
This, in turn, implies that the indexing and search will not only be of content and technical service protocols across networks, but of transaction networks as well. These would possibly implement value networks based on blockchains as a means of semi-automatic value exchange between devices. In this model it will not be unthinkable for your phone to pay a very small amount for access to print a photo on the spot when you are not near your own printer, and equally, your printer making money by allowing others to use it. If mass platformisation allows anyone and any device to capture value, then the corporate snow globe has been severely shaken – businesses could find themselves competing with their customers.

With the explosion of platforms, destabilising larger organisations giving rise to the subsequent myriad of ecosystems, at board level we will see a shift away from traditional industrial structures, instead of moving towards a fluid model which is built on multiple internal business markets. As a result of this diffusion of operations internally, board room activity will also mirror this, giving rise to dispersed management units within an organisation and of collective management. In order to do so successfully, the boardroom fundamentals of cooperation and trust will rise to the fore.

Increased value

At board level, the granularity of mass platformisation will see the C-suite look internally at how they can offer more value to end users. A result of this shift in focus will give rise to an increase in independent complex business units. However, the determining factor as to the success of such units will come about as a result of an organisations' ability to consolidate the mass pooling of data with the flexibility to react effectively to future technological disruptors.

The battle for our data has been the focus for the next ten years, and as the new industry discussed below indicates, consumers may begin to balance the power dynamic. However, the battle for control over our connected devices and how we are serviced by companies is where the Silicon Valley giants are currently looking towards.



Future industry spotlight: Privacy and Identity Industry

The combination of factors within the financial services industry makes some form of combined privacy and identity solution a distinct possibility.

This could be fuelled by an emerging interest in individual consumer privacy issues which would uphold the financial services industry's extensive cost of securing identity management regulations (Know Your Customer (KYC), Anti Money Laundering (AML)), and open banking (for example through Payment Services Directive II, and possible future PSD III), requiring significantly more interaction between bank data and trusted third-parties. It is estimated the annual total cost to the UK of identity management within financial services is around £3.3 billion. This could be brought down to around £150 million with a functioning identity management scheme.

Autonomy-driven innovations

Here, innovations such as drones and self-driving cars are likely to present significant privacy challenges by further linking the movement of parcels and people to known and tracked identities. However, already now, the wholesale collection and re-appropriation of consumer data is fuelling a growing debate on inverting the relationship from primarily one of Customer Relationship Management (CRM), where firms own and manage all customer data, to Vendor Relationship Management (VRM), where customers own data and relationships with the firms they relate to. The existing industrial order is used to adhering to a logic of scarce information and now seeks to operate under not only an abundance of information, but indeed a vast surplus. As this develops, it will possibly make sense for all parties to re-balance the relationship. If the "digital marriages" across multiple platform sides are to be harmonious, then some form of symmetry will likely be needed towards the demand-side. Critical voices against "surveillance capitalism" may prove a strategic challenge for incumbents and equally a business opportunity for new entrants.

The establishment of VRM arrangements will be necessary for service providers to target deep markets at scale, as these will rely on individuals managing much of this relationship themselves. The industrial revolution enabled cheap consumer goods as long as consumers accepted the deal that they could not be hand-made to individual specifications, but had to be mass produced (the classic example being the Ford Model T: available in any colour as long as that colour was black). The 21st-century service revolution will enable the provision of high quality deeply personalised services at next to no cost. This is only possible because those consuming the service will also be co-constructing it through automated self-service.

Balancing act

Rebalancing CRM with VRM will likely enable a whole range of business opportunities for firms at the level of services, platforms, and infrastructure. One such example is The Hub of All Things, which seeks to support and secure private ownership of data for Internet-based engagement in general and in the context of the Internet of Things in particular. Similarly, the emergence of several personal data stores or service firms and foundations, such as mydex.org is an attempt to facilitate VRM.

Blockchain-based infrastructures, enabling platforms offering complex privacy and identity services, will almost certainly be a disruptive future business model due to the specifics of blockchain-based systems enabling highly distributed trust arrangements. While this might be the end result, it is possibly not the first phase. Instead, there will be a rebalancing of control over private data – for example, the EU's General Data Protection Legislation. Although by no means a perfect compromise on the issue of privacy and data it can, over time, have a significant effect on what data firms are keen to store and what they will be equally keen for consumers to store and maintain.

"Autonomy-driven innovations, such as drones and self-driving cars, are likely to present significant privacy challenges by further linking the movement of parcels and people to known and tracked identities."

3. The Elasticity Model

The digitisation of products has helped to transform, disrupt, destroy and create new businesses. The moment that music went from CD to MP3 was a point of profound elasticity, where music could be chopped up, reshaped, stored, played and shared in a way that hadn't been possible. It broke the traditional model and paved the way for Apple iTunes and eventually, Spotify etc.

Music is perhaps one of the first examples of the Elasticity Model in action. Digital transformation will see an Elasticity Model explosion of not just products, media, data and information, but also services.

Anything becomes a service

Such is the case with the development of the Anything-as-a-Service (XaaS) model which has changed how numerous industries are running – from sales to transportation. In this model, businesses move far beyond software and data delivery with services ranging from storage to pet-sitting to food delivery.

This elasticity is a key driver for businesses of any size in any industry due to the flexibility and agility it delivers. Legacy systems cannot change fast enough to keep up with the changes currently facing the modern business world. Businesses, just like customers, demand increasingly personalised services. XaaS allows companies to change on demand, as they see fit – from personalising a process, choosing an entirely new XaaS supplier, or scaling up or down to fit a changing business season or climate.

With 5G mobile connectivity and the mainstream access and use of AI technologies, we will see elasticity become central to businesses. It will become more than flexible in how customers access a service and develop a scale in which we use it in different areas of business. The key transformation is the ability for companies to access – and sell – highly complex intelligent services as and when anyone (small or large firm) may need it.

In a similar manner to Amazon Web Services giving individuals and firms an easy way of scaling up storage and computing when needed, emerging services can construct future business models, rendering other resources available as and when needed. Elastic business-modelled businesses allow access to platforms when needed.

Plan B

With the Anything-as-a-Service (XaaS) model heavily reactive in nature, at board level, it, therefore, becomes important that an organisation encompasses a solid contingency model, which can be rapidly adopted. Stretching far beyond a traditional product-led model, the Elasticity Model will instead move towards one where strategic discussions are able to match the speed of disruption, but also agile enough to respond to these changes.

Here, we'll see boards that need to invest heavily in the skills to recognise such breakthrough digital disruptors, but also balanced out with the appetite for risk which will come with experimentation.

Future industry spotlight: The Uber of management

The reliance on large, hierarchical, and centralised organisations is a relic from the days of expensive communication. This made centralisation a necessity – businesses placed a value on proximity. The present and future are characterised by an abundance of cheap communication, enabling large, yet distributed, organisations to orchestrate a global supply network. In order to meet market demands for a more effective organisation of work, large organisations engaged through the 1980s and 1990s in a shift towards internal markets, business process re-engineering, and project organisation in matrix arrangements.

Digital platforms have shown the way as they overcome the existing boundaries for making business processes effective. Often this is done simply by placing a digital platform at the centre, staffed by innovators and engineers, and providing complex matchmaking between its constituent groups of participants across its multi-sided markets. The core platform mediates the relationships between the participants who each essentially engage in doing the necessary work in arrangements of automated self-service. For example, when a customer wants a new iPhone app, they simply go on to the App Store and find one, placed on the virtual shelf by a developer. On the other side, developers create and stock on this digital shelf all the things they want to sell without direct prompting from the platform. Customers can rate the apps they purchase and, in this way, provide feedback.

SMEs

It can be argued that much work in SMEs can be managed through peer-to-peer agreements. Here, it is not only easy to make such agreements, but also easy to validate if the promises people make to each other have been kept. Here, there is a significant potential market in supporting firms in the automation of parts of their management function to produce an 'Uber-everywhere' type of management as a service. The application of blockchain technology can provide support for this kind of management practice. This provides radically distributed collaboration across supply chains, beyond firms and down to individual levels, with various AI-based functions supporting scheduling of mutual interdependencies. Companies such as Workfusion are working in this way by engaging combinations of software robotics, simple process automation, machine learning, and human intervention to streamline previously complex human-centred administrative processes.

CONTROL THE CONTROL POINTS

Analogue companies will tend to have stable control over a well-defined part of the value-chain they participate in. This will be negotiated and contractualised. However, in the context of digital platforms and infrastructures, firms will frequently engage in tussles over control as digitalisation can remove previously tight couplings, providing long-term peace in the allocation of profit along the supply chain.

Control points can be characterised in four parts: Technical, Legal, Social, and Economic.

These are often combined in real-world business models, but in essence will change over time due to various external and internal pressures. For example, AT&T and Apple made an initial agreement that Voice Over IP (VOIP) was only allowed over WiFi and not over 3G data connections. This suited Apple as they initially had a business model where they would get revenue from operators on customer usage. However, as the public pressure mounted and as AT&T and Apple changed to a more traditional handset manufacturer-operator model, 3G VOIP was allowed.

When Apple enforced its control point that all news publishers on iOS would have to hand over customer data along with a 30% tax, The Economist magazine accepted this change, as they already have c.2 million outside iOS. The Financial Times, on the other hand, did not accept it and instead built its own HTML 5.0 website that looked and behaved much like an iOS app but could run inside Safari.

They could only establish such a strong, independent control point (and thereby protect their own interests), as they had the economic and technological power to invest in such significant effort. The legal and social aspects of control points can best be described by the tussle between the music industry and Napster. Napster's P2P protocol allowing the sharing of MP3 encoded music ripped from CDs was of course only possible as the music industry in effect had abandoned their main control point when digitising music.

The Napster protocol was, however, mainly a threat to the music industry because a large global base of consumers used it – a social control point through volume. Furthermore, as the music industry regained its control point (essentially suing its customers for downloading music) it managed to shut down Napster. However, a number of alternative sites popped up faster than they could be shut down, and the only real effect on illegal music sharing was to establish a properly working set of digital control points – Apple and Google handling the easy purchase of downloads and Spotify made it even easier – free music with adverts.

GLOBAL WAVE OF READINESS

However, the exploration into technological forces, and their projected timeline over the next decade, has identified businesses and markets which are not equally ready for the oncoming wave of digitalisation. Our analysis identifies three distinct national groupings, those Ahead of the Wave, those that are Just Keeping Up, and those that are Behind the Wave.

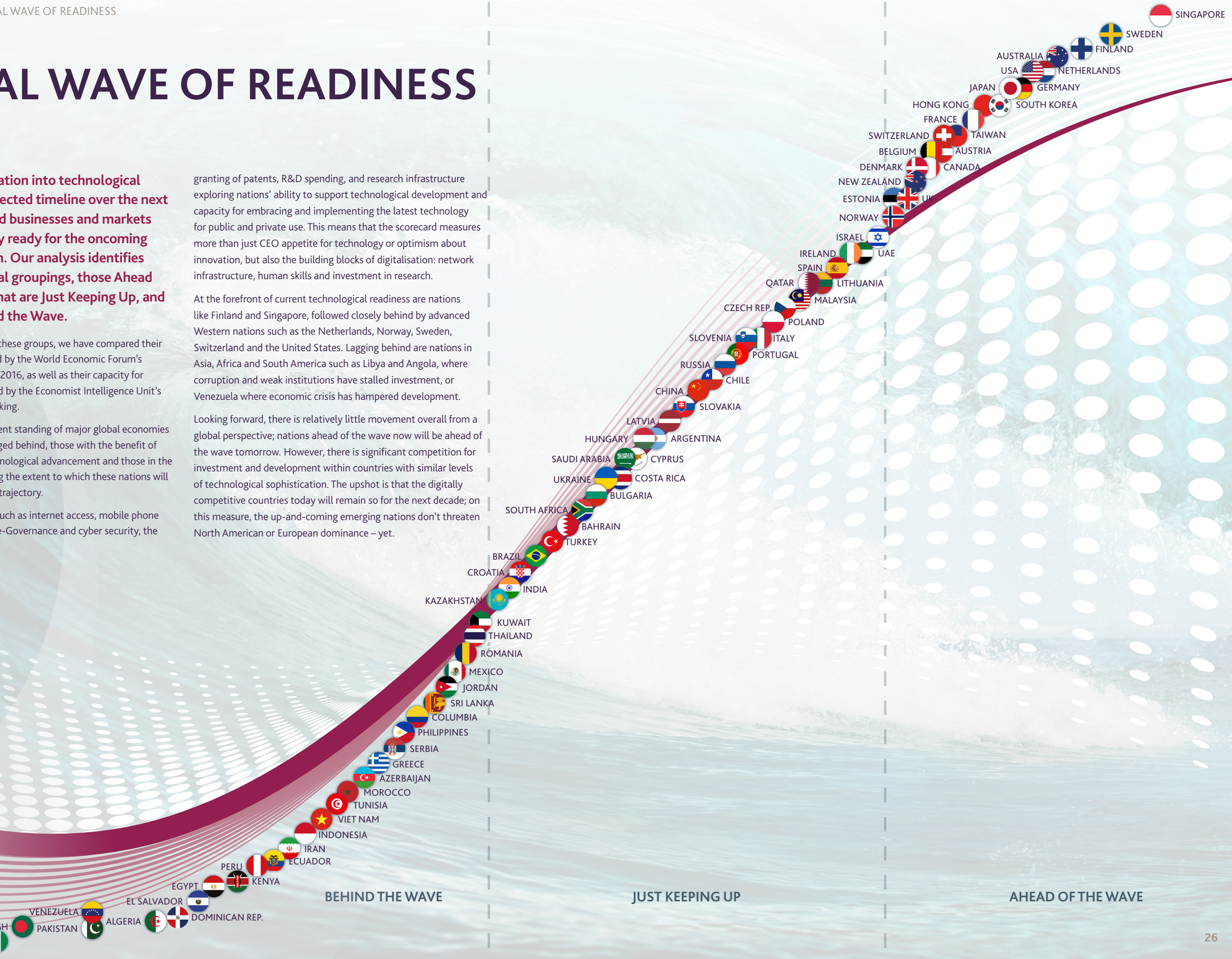
To position countries within these groups, we have compared their current readiness, as outlined by the World Economic Forum's Networked Readiness Index, 2016, as well as their capacity for future innovation, as outlined by the Economist Intelligence Unit's Technological Readiness Ranking.

Our analysis reveals the current standing of major global economies – those that have always lagged behind, those with the benefit of years at the forefront of technological advancement and those in the middle – while also indicating the extent to which these nations will continue along their current trajectory.

Readiness considers factors such as internet access, mobile phone subscriptions, e-commerce, e-Governance and cyber security, the granting of patents, R&D spending, and research infrastructure exploring nations' ability to support technological development and capacity for embracing and implementing the latest technology for public and private use. This means that the scorecard measures more than just CEO appetite for technology or optimism about innovation, but also the building blocks of digitalisation: network infrastructure, human skills and investment in research.

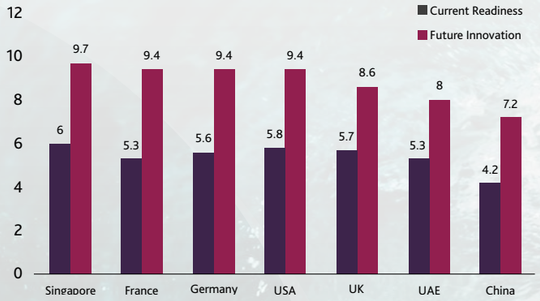
At the forefront of current technological readiness are nations like Finland and Singapore, followed closely behind by advanced Western nations such as the Netherlands, Norway, Sweden, Switzerland and the United States. Lagging behind are nations in Asia, Africa and South America such as Libya and Angola, where corruption and weak institutions have stalled investment, or Venezuela where economic crisis has hampered development.

Looking forward, there is relatively little movement overall from a global perspective; nations ahead of the wave now will be ahead of the wave tomorrow. However, there is significant competition for investment and development within countries with similar levels of technological sophistication. The upshot is that the digitally competitive countries today will remain so for the next decade; on this measure, the up-and-coming emerging nations don't threaten North American or European dominance – yet.



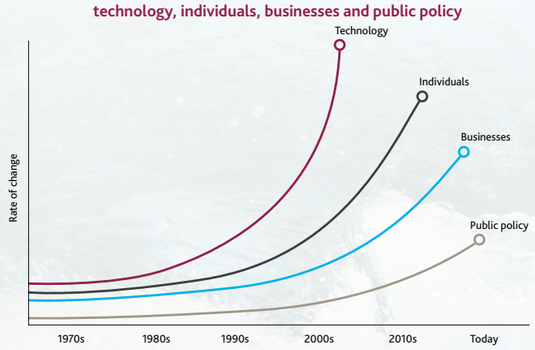
Across key markets including the UK, USA, France, Germany, China, Singapore and the UAE – there are relatively high levels of current and future readiness. With the exception of the UAE and China – both Just Keeping Up – they are all Ahead of the Wave. Singapore, is arguably the most tech-ready nation, scoring highest in both current and future readiness, followed closely by France, Germany and the United States. The UK is further back – a result of projected stagnation in future innovation.

Current Readiness and Future Innovation in Key Markets



The situation in China is illustrative of technological development in the BRICs and in emerging nations more widely. Brazil, Russia, India and China are vast, but still have lots of their population away from well-connected urban centres. While the most advanced cities in these nations – Rio de Janeiro, Sao Paulo, Moscow, St Petersburg, Mumbai, Delhi, Beijing and Shanghai – display incredibly high levels of technological sophistication, the national picture in these nations cannot compete with city-states like Singapore or wealthy nations like the United Arab Emirates. For these reasons, mature economies come out very strongly in our analysis, but that does not mean that emerging economies do not themselves display high levels of innovation.

Relationship between the rates of change of technology, individuals, businesses and public policy



As technological development continues to accelerate, a pattern has emerged between the rates of change among technology, individuals, businesses and public policy, with different levels of 'time lag' emerging. Using blockchain technology as an example, we can see how from the emergence of the technology in 2008 to the present day and into 2030, that the applications of blockchain by individuals have far surpassed those of businesses, driving the growth of the Dark Web economy and services like the Silk Road as well as the cryptocurrency boom observed throughout 2017. At the same time, businesses are still trying to figure out whether they can trust the technology and how it can be applied. This is an unavoidable reality of business and risk management. While blockchain represents a significant business opportunity, Bitcoin's correction throughout 2018 illustrates how volatile these new forms of technology – and their valuations – can be, and businesses must be cautious.

"There are major benefits for businesses, with robots significantly more efficient and accurate at carrying out routine tasks and the technology improving rapidly."

The Human Role

The role of individuals is important, however, education and the acquisition of skills such as coding or data science – whether acquired formally or informally – is essential to a nation's ability to push forward with technological development. For this reason, levels of higher education in nations are crucial to supplying workers that can keep up with the emergence of new technologies.

Automation looms, and with it, significant opportunity and disruption. Nations with high levels of employment in the manufacturing, retail and administrative industries face something of a double-edged sword when it comes to automation. There are major benefits for businesses, with robots significantly more efficient and accurate at carrying out routine tasks and the technology improving rapidly. However, the displacement of significant numbers of jobs has the potential to create social unrest, perhaps driving the type of nostalgia-based nationalism that has spread throughout the West in the form of Trump and Brexit. Nations with high levels of creative, cognitively dependent industries may be more stable politically as their employment will be insulated, however, they are also likely to miss out on the potential productivity boom that comes with implementation of automation-led efficiencies.

Each of the key markets highlighted in this report have their own strengths and weaknesses. In some markets, first mover advantage is rapidly diminishing and nations are at a crossroads; consolidate positions of strength and remain global leaders as seen in Singapore and the USA, or fall behind due to political or economic factors as seen in the UK. In France and the UAE, we see two markets which currently trail global leaders in tech, but have two very different futures; the UAE looks set to stand still while France is set to climb the global rankings.

The European key markets present three very different trajectories. **Germany** is a steady performer, with solid performance in both current readiness and future innovation. The **UK** finds itself in a complicated position; it is currently among the most advanced nations with regard to technological readiness, however, uncertainty surrounding Brexit has weakened its global standing with many large businesses seeking to reduce their exposure to the UK . While **France** lags behind its European rivals Germany and the UK for current readiness, the country is one of the big movers when it comes to future innovation. France is ranked joint 22nd for current readiness, however, looking toward 2022 the nation is set to be the joint 3rd most tech-ready country alongside **Finland**, the **Netherlands**, the **US**, Germany, and **Japan**. **Russia** ranks joint 36th for current readiness, in line with far smaller economies such as **Poland** and **Costa Rica**, and well behind other large economies such as Germany and the US. Similarly, when it comes to innovation in the coming years, Russia lags well behind other advanced nations, ranked just 32nd globally.

The key North American markets are currently in positions of significant strength from a global perspective, but **Canada** is set to fall behind its continental rival over the next decade. The US is already among the most advanced nations when it comes to tech, and while it will not grow this ability to the same extent as **Sweden**, **Australia** or France to 2022, there will be enough progress to remain among the top 5 tech-ready nations. Canada is one of the strongest performers in regard to its current readiness for technological innovations. However, its global prominence is set to decline, with it ranked 15th for future readiness alongside the UK and **Switzerland**.

Asian markets vary widely, from tech giants like **Singapore** to emerging markets like **China** with significant sophistication at the cutting edge of technology, but lacking the widespread technological infrastructure to challenge advanced markets when it comes to future innovation and readiness. Singapore is technologically the most advanced nation on earth, ranking highest for current readiness, and ranked as the joint-most sophisticated nation for future innovation. While at the frontier of technological development – Chinese businesses are driving some of the most interesting innovations in artificial intelligence and telecommunications – a lack of technological infrastructure in large parts of the country and the foundations for growth in the form of education and income have hampered China's scores for current readiness and future innovation. The **United Arab Emirates** holds its own with regard to technological readiness for digitalisation, ranking joint 22nd for current readiness alongside nations like France and the **Republic of Ireland**. However, while France is set to boost its technological readiness enormously in the years from 2018-2022, the UAE is set to simply maintain its pace rather than race ahead.

BEYOND THE HORIZON

A number of the technologies discussed at length in this report – namely artificial intelligence, autonomy and blockchain – will begin to have a significant impact on business digitalisation between now and 2030, but it is after 2030 that we are likely to see them make their mark on the world.

Autonomous Vehicles

Automotive manufacturers state that they will produce fully autonomous vehicles by 2020, 2021 or 2025, and they might be accurate, but it will take time for these vehicles to penetrate the market as consumers and businesses wait for costs to come down. As such, the Gartner Hype Cycle for Emerging Technologies places Level 4 automation – full autonomy but only within controlled areas – at more than 10 years away from reaching mainstream productivity. Level 5 automation – the ability for a car to act as, if not better than, a human in a non-controlled environment – remains someway off and its impact on the world will only be felt late in the 2030s if not later.

6G

In the 2030s, the 6th generation of mobile communications is likely to be taking shape. With the present nascence of 5G, 6G currently remains in a stage of conceptualisation. At the forefront of this conceptualisation is 6Genesis – an 8-year research programme situated within the University of Oulu's Centre for Wireless Communications – funded by the Finnish Government. 6Genesis's work will explore research areas such as near-instant unlimited wireless connectivity, distributed computing and intelligence, as well as materials and antennas at very high frequencies to be utilised in future for circuits and devices. However, it is not just technological advances that will impact what 6G looks like when it arrives. Digitalisation will bring significant societal changes, with the emergence of new business models and forms of public service, which will require not only new technological solutions, but also new forms of regulation and legislation.

Quantum Computing

Quantum computing has been mentioned sparingly throughout this report as it is likely that its impact will be felt minimally by 2030, but such is the anticipated impact that businesses are already budgeting for development of this technology. In classical computing, data can exist in one of two binary states, 1 or 0, but with quantum computing data can exist between these poles with significant ramifications for storage and energy consumption relative to classic computers. It may sound like a simple benefit, but one of the main impacts of quantum computing will be its ability to finding very large prime numbers; prime numbers are very important in cryptography and this could have severe effects for current modes of cyber security. Beyond cyber security, the technology is likely to have applications in science, with quantum machines thought to be significantly better than existing computers at modelling complicated chemical reactions.

Into the Future

Many of the most pivotal technological developments of our time have relied on previous breakthroughs and the emergence of new forms of medium, and it is likely that many of the emerging technologies discussed in this report will spawn new, yet theorised developments that will irreversibly change the way businesses can and do operate.

In each and every case, however, where there is disruption there is opportunity, and every time the picture changes there will be a chance for businesses to consolidate their strength or improve their position.

"Where there is disruption there is opportunity, and every time the picture changes there will be a chance for businesses to consolidate their strength or improve their position."

SUMMARY

Alexandra Brodie **David E Brennan**

Over the next decade, businesses, supply chains and daily life will be transformed by the next wave of digital disruption. As with all disruptions there will be winners and losers. Here our Tech Partners, Alexandra Brodie and David E Brennan, reflect on the findings of the report and give their view on what this will mean for businesses.

Some businesses operate in markets or sectors that are particularly well placed to take advantage of this transformation. A number of nations are evidently Ahead of the Wave. These markets already boast strong infrastructure, a highly skilled workforce and a culture of investment and innovation on which business ambition can thrive. Others, however, are Behind the Wave – lacking either the current infrastructure or the digital ambition to exploit the coming opportunities. Those markets best positioned are perhaps the usual suspects – Western European markets like Germany and France alongside the US and technologically advanced city states like Singapore. Behind them are the rapidly growing emerging economies like China and India.

This perhaps presents a counter to the broader global economic trends that see these markets 'catching up' with those usual suspects in Europe and North America; for the next decade these established economies will use their infrastructure and populations to leverage the most benefit from digital innovation. But it is important to reiterate that these emerging economies are not far behind – Brazil, Russia, India, China, Poland, Turkey and South Africa are all Just Keeping Up rather than Behind the Wave – and that the gap between these groups narrows with each new wave of digitalisation.

These market factors are important, but so are the individual ambitions and outlooks of businesses. The most future-facing and proactive businesses will find themselves best-positioned to take hold of the opportunities offered by digitalisation disruption over the next decade.

Recommendations for businesses:

Risk of fragmentation already understood by top tech tier

Continued investment into future-gazing, trend spotting, research & development, and innovation, by FAANGs is already seeing these tier 1 businesses mitigate the risk posed by fragmentation.

To this end, trust plays a significant role in the future success of larger platforms, with consumers often advocating loyalty to a brand above functionality. This will be one of the biggest hurdles challenger firms face when looking to launch a new product, service or platform.

It is therefore the case that such large players often have a better view of the market and, with it, better access to resources. For example, the recent partnership between Google and a leading automotive company in its inception alone occupies a significant portion of the market and one which will be difficult for challenger firms to obtain even if future products launched by challenger companies are able to offer better tech.

Elasticity has to snap

While the elasticity model is primarily built on services, this does not mean the role of humans will become obsolete. The elasticity of the Platforms-as-a-Service model will see a continued reliance on digital technologies, but this will also come with a rise in a business' vulnerability to technology too.

Yet, this model cannot be sustained with technology alone and will ultimately 'snap' as technology continues to rely on human control and operation. There will always have to be people in an office somewhere managing the technology which delivers the goods, service or platform.

This, together with the explosion of mass-platformisation, is likely to see the typical barriers posed by geography broken down, as workers are able to work outside of an office environment, and will likely trigger a shift in employment law. In order for businesses to navigate this shift and ensure companies are still able to hire, it is important that future laws take the technological developments and the increased need for flexibility into account. In addition, it's also likely we'll see challenges around hiring and retaining of employees, which is likely to come to the forefront of business agendas in regards to the freedom of movement following Brexit.

People still power the transformation

Technological change does not happen in a vacuum and business digitalisation will not only affect siloed, machine-only processes. Digital trends will necessitate a re-evaluation of workforce jobs and processes; some displaced due to automation, others requiring reskilling as the disruption sees existing employees working alongside new technologies. The location and nature of work could also change as immersive communications technology sees the premium that is placed on proximity diminish. For businesses seeking to benefit from new technology, it is essential that they consider the impact on their workforce as much as the financial implications.

GLOSSARY

Methodology

To reach these **Five Forces of Disruption** a range of emerging technologies has been analysed through an extensive literature review and horizon scanning exercise outlined below:

- Based on both Trajectory's proprietary sources and thinking, as well as a detailed review of publicly available analysis and forecasts
- An exploration, through desk research and trends analysis, what trends will drive digitalisation in markets around the world and how prepared current businesses, sectors and markets are for the change
- An examination of the development of these trends over a 10-year time horizon and identifying the key disruption points and landmarks on a digitalisation timeline

This process took place in two stages. At the end of the first stage a long list of circa 30 drivers were analysed by the research team. This led to the isolation of those overarching trends which:

1. **Would be relevant within a circa 10-year timeframe**
2. **Would most affect how businesses operate, and disrupt existing models or industries**

In many cases, these categories of trends are very broad, allowing for the exploration of many of the trends identified within the preliminary stages of research. For example, in exploring artificial intelligence, trends identified in preliminary research such as 'deep neural nets', 'conversational AI' and 'Artificial Intelligence Platform-as-a-Service' have been analysed in depth. In exploring 5G, 'connected home', 'IoT as platform' and 'smart workplaces' have been explored. Large drivers including cybersecurity and Big Data have been left out of this analysis because they are already both developed and known areas of disruption and part of these five forces in one way or another (e.g. Big Data's effectiveness will become meaningful because of IoT and 5G adoption).

Finally, two technologies – silicon anode batteries and carbon nanotube – were not included for analysis within the five key trend sections. These are important technological developments, allowing for greatly improved battery life which could have vast implications for autonomous vehicles, or robots in the case of silicon anode batteries, or in the creation of new materials such as graphene as in the case of carbon nanotube. While these technologies will be impactful, the impacts are likely to be in upgrading existing technologies like batteries or microchips, and leaving workplaces more efficiently run but perhaps not drastically altered, with more significant impacts – such as new technologies emerging as a result of these developments – likely to occur well beyond 2030.

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If you'd like to talk to anyone from Gowling WLG about our research and commitment to supporting businesses through digitalisation please contact:

Alexandra Brodie
Partner, Co-Chair of Global Tech
+44 (0)20 3636 7818
alexandra.brodie@gowlingwlg.com

David E Brennan
Partner, Co-Chair of Global Tech
+44 (0)20 3636 8051
david.brennan@gowlingwlg.com

GOWLING WLG (UK) LLP
T +44 (0)370 903 1000
gowlingwlg.com

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