Next-generation connectivity
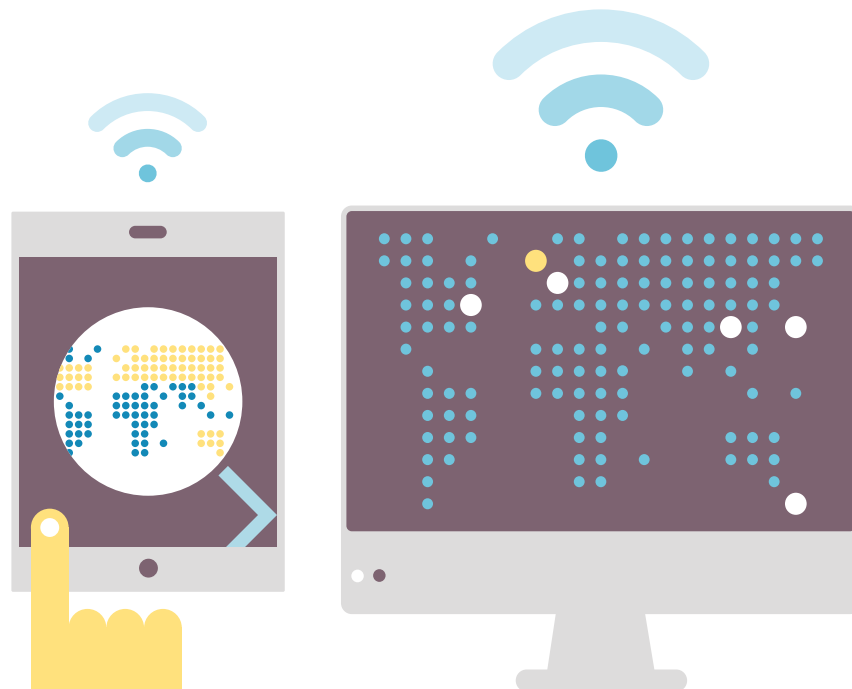
Foreword

Is it really only just over ten years since the iPhone was launched? In that decade, we've also had the advent of 3G and 4G services. So, in an astonishingly short space of time, our ability to communicate and access information has changed beyond all recognition. Debates over who scored the last French goal in the 1998 world cup final are at best, nowadays, brief.

Looking to the next ten years, what's clear is that the tech-led future we have all been promised is predicated on a new level of connectivity.

To deliver this golden era of superfast, always on, ubiquitous connectivity and to avoid it becoming a new dot-com bubble, we need to balance the need for connectivity to become a utility—as plentiful and inexpensive as water from the tap—with the sizeable costs of building the infrastructure to deliver it.

Equally, unlike previous connectivity developments, speed isn't the whole story. It is all too easy to get caught up with the hype of ever-increasing download and upload speeds. In the future, just as necessary (or maybe even more so), are the developments in low-power networks for use with the Internet of Things, where speed does not count, but energy conservation does.

This report examines the potential for businesses to adopt new and forward-looking business models, and its findings are fascinating. It explores implications including means of transport, such as Mobility as a Service business models, to the impact of enhanced connectivity on the energy and property sectors, and asks where the future lies.

What is clear is that connectivity is evolving, both in terms of how it is delivered and how it is used. There is hardly a day that passes without tales of some new data breach. As we develop and build new business models, we must not lose sight of the need to build in security.

We have helped our clients thrive using the advances in connectivity over the past decade. We look forward to another decade of helping them succeed.

"We need to balance the need for connectivity to become a utility with the costs of building the infrastructure to deliver it"

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Executive Summary

Internet connectivity has proven to be one of the most profound enablers of social change and economic growth of our time. Beginning with fixed narrowband internet connections and moving through successive generations of increasingly pervasive and powerful networks, connectivity has come to underpin our working and personal lives, empowering businesses to operate more efficiently and with wider reach. In turn, connectivity has sparked and fuelled countless new industries, products and services that are coming to define our modern age. Connectivity has proven to be a vital ingredient for business success.

Over the next five years, the next generation of wired and wireless connectivity, characterised, in particular, by (5G) fifth generation mobile networks, full-fibre broadband and satellite internet technology, is widely touted by industry and observers for its potential to deliver a step change in connectivity and its capabilities. Enthusiasts for 5G—in truth a broad marketing label for several mobile technologies that will evolve, in time, into the next-generation telecommunication standard—promise a tenfold increase in wireless speeds that could, in some cases, make wired infrastructure redundant. But, critically, next-generation connectivity is characterised not just by speed but by its other attributes, such as greater capacity and low-latency, effectively instantaneous connections that promise to enable such applications as driverless car technology, remote surgery and sophisticated real-time drone management.

Aided, too, by large-scale satellite arrays, ubiquitous connections between devices anywhere in the world could deliver the infrastructure that a truly global Internet of Things requires. Such connectivity promises to enable sensor-laden buildings and cities, transform transport infrastructure, facilitate asset tracking across the globe and extend smart electricity grids to remote areas.

Equipped with next-generation connectivity, business leaders have the opportunity to rethink the ways they do business, to reduce inefficiencies, reach new audiences, better serve existing ones and open up new revenue streams. They also face new competitive threats and risks.

The overall pace of change is blistering—but the anticipation and adoption of next-generation connectivity is affecting industries in different ways and at different rates.

This research seeks to investigate this change. It is based on a survey of 550 senior executives from 11 countries at organisations in five key business sectors: digital business; energy and utilities; financial services; real estate and infrastructure; and transport and automotive. The key findings include:
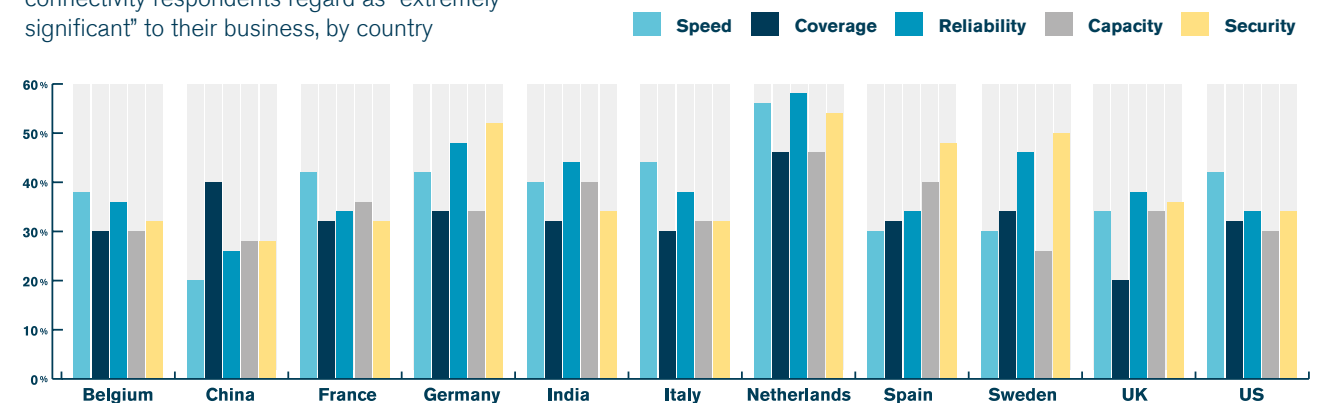
- Capital-intensive, "physical" sectors such as energy, real estate and transport have been historically slower to adopt digital connectivity to the same extent digital industries have, but expect significant advances from next-generation connectivity. Respondents in these physical sectors are most likely to predict greater interconnectivity in their business over the next five years, and more likely to have adopted formal strategies around connectivity adoption.

- Nearly nine in ten respondents (87%) report that connectivity will become more important to their business in the next five years.

- Almost nine in ten respondents (87%) regard 5G specifically as being "strategically important" to their business over the next five years, with the energy and transport sectors being the most bullish in this respect.

- Next-generation connectivity is enabling new technologies, including autonomous vehicles.

It also paves the way for new business models, such as a growing trend for businesses to provide their products as a service, and charge based on usage and add-on services: a model made possible through real-time remote connectivity.

- Security, data protection and privacy concerns present notable barriers to the adoption of greater connectivity. Two-thirds of survey respondents (66%) say that security concerns are very or extremely likely to lead their business to avoid or withdraw from greater connectivity in some cases, a sentiment particularly pronounced in the energy and utilities sector.

- Businesses in the Netherlands and Germany stand out as leading enthusiasts for next-generation connectivity: Dutch respondents were found to be much more likely to regard various attributes of next-generation connectivity as "extremely significant" for their business (see chart 01). German respondents are the most likely to have taken measures to prepare for the adoption of next-generation connectivity—adopting formal strategies and building standalone divisions, in particular.

Dutch encouraged

01_ Various attributes of next-generation connectivity respondents regard as "extremely significant" to their business, by country

Legend: Speed, Coverage, Reliability, Capacity, Security

Countries: Belgium, China, France, Germany, India, Italy, Netherlands, Spain, Sweden, UK, US

Introduction

Connectivity now and next

Throughout history, connectivity and prosperity have been intrinsically linked. From early road systems and seaports, through to railroads and telephone lines, wherever infrastructure has existed to connect people, communities have thrived.

In recent decades, the internet has supercharged global connectivity—and the pace of its expansion has been extraordinary. The internet has not just transformed the way that people connect to each other, but it has also quickly become vital to the way that businesses organise themselves and sell their products and services. It has presented new business model possibilities, and opened up new industries or upended existing ones, as demonstrated by the likes of companies from Spotify to Uber. Digital platforms are now the basis for seven of the world's ten largest companies by market capitalisation.

Internet traffic volumes will continue to grow. In part, this is because connectivity has extended its reach to include a vast range of physical objects that make up the fabric of our daily lives. In the age of the Internet of Things (IoT), connected buildings, vehicles and infrastructure such as utilities networks bristle with sensors, actuators, meters and other devices that use connectivity to report on their status and respond as data are collected.

Harnessing the benefits of next-generation connectivity will require investment, strategic initiatives, new partnerships, and redesigned business processes and even business models. This report seeks to understand
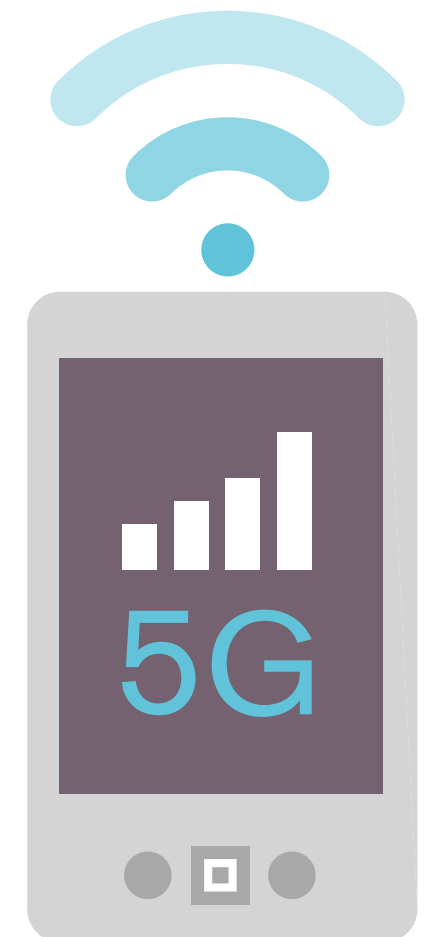
Five generations of connectivity

In this report, "next-generation connectivity" refers to anticipated technological advances such as 5G mobile networks, full-fibre broadband and more usable and affordable satellite internet access, which will offer greater capacity and coverage for internet connectivity, both fixed and mobile.

Since the first mobile networks were rolled out in the early 1980s, each subsequent generation of the technology that underpins them has followed around a decade later. Cellular data emerged with rudimentary text messages carried by 2G networks in 1991, while 3G, which emerged in the early 2000s, brought faster data speeds, and a true internet experience on mobile devices. These were superseded by 4G networks with data speeds theoretically five times faster than 3G, enabling such applications as mobile audio-visual streaming and pervasive ecommerce. In addition to mobile networks, other wireless connections have emerged over this period including Wi-Fi, Bluetooth, and still-emerging low-power networks and satellite systems.

The fifth generation of cellular network technology is expected to outperform 4G in terms of access speeds, latency, number of connections and energy consumption. Most experts agree that 5G will feature network speeds at 20 gigabits per second (Gb/s) or higher (compared with 15-29 Mb/s average 4G speeds typical in the UK, for instance) and offer latency of around 1 millisecond (compared with 50 milliseconds with 4G).

the true potential of next-generation connectivity, its applications and their value, and the extent to which businesses are embracing the opportunities it affords.

Exploring these points prompts many questions. If next-generation connectivity will enable autonomous vehicles, what action is the transport industry taking? Is the data deluge that results from ever-multiplying connected devices a headache for businesses, or an opportunity? Do security concerns put businesses off further connecting physical and digital systems? What would assuage those fears?

When asked how important connectivity is today to the running of their business and the provision of products and services, nine out of ten executives agree that it is somewhat or very important. This in itself isn't so surprising. Yet almost the same proportion (87%) believes that connectivity will be more important to the running of their business in the next five years. However, this sentiment varies widely by industry, with some, such as real estate and transport, placing more value on future importance than current importance (see chart 02).
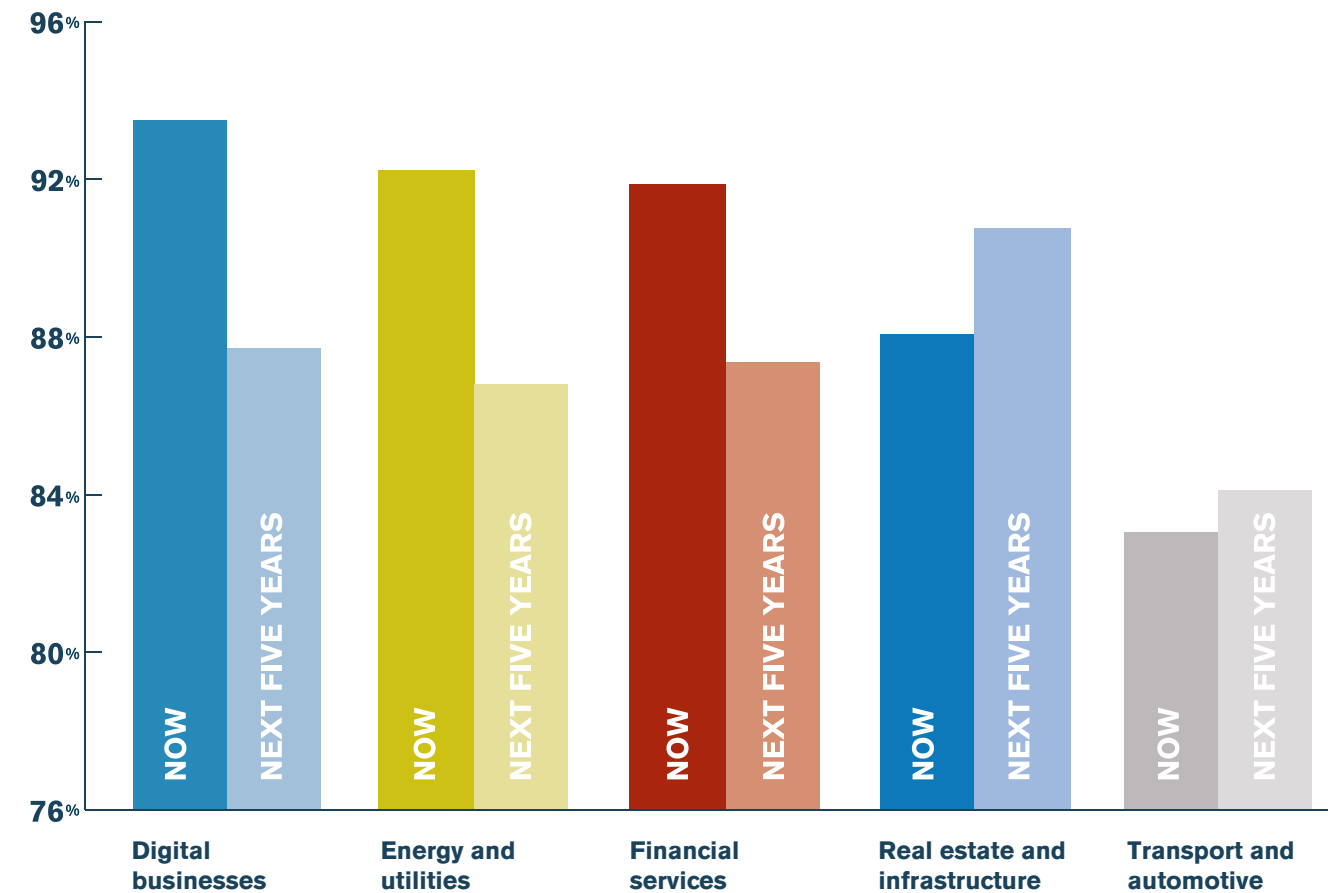
As this report shows, many business leaders are already preparing for the impact of next-generation connectivity. More than a third of survey respondents (34%) say they have formally assessed the opportunities that lie before them, and the same amount say that they have adopted a formal strategy to prepare for its adoption and made investments (34% in each case). More than one in five (21%) have redesigned business practices. There is variation across sectors here too, with energy companies and utilities the most likely to have formally assessed opportunities and transport companies the least.

This is not to say that greater adoption of next-generation connectivity is without challenges or risk, be it the trade-offs of greater cost against marginal improvements in connectivity, or cyber-security concerns that stem from connecting critical infrastructure or building more complex systems. As this report discovers, businesses in different industries see different barriers and threats as much as different opportunities (see chart 02.1).

87%

believe that connectivity will be more important to the running of their business in the next five years

02_Percentage of respondents in each industry who perceive connectivity as somewhat or very important to their business currently, beside the number who anticipate connectivity as being more important to their business in the next five years.

02.1_Barriers to adoption

Asked to rank their top three of nine possible barriers their organisation might face with regard to next-generation connectivity, the barriers respondents most commonly ranked first or second, in each industry, were as follows:

Digital business	Data protection and privacy concerns
Energy and utilities	Security concerns
Financial services	Lack of talent and skills
Real estate and infrastructure	Lack of talent and skills
Transport and automotive	Security concerns

Connectivity merges physical and digital

What applications can we anticipate from next-generation connectivity?

In a world where practically any physical object can be connected to the internet, elements of both physical and digital play a key role in business processes. Consumers have come to expect that they can order a book online using their smartphone but pick it up at a bricks-and-mortar bookstore. The retailer can check the inventory and locate the item in their warehouse, track the truck that delivers it to the store and then alert the customer of its availability. In other words, connectivity makes a huge amount of digital information relating to the physical availability and location of an item available to both buyer and seller.

A new normal

As the physical and digital worlds have converged, this combination has rapidly become the new normal in business. When asked to what extent their business relies on the combination of physical and digital processes, the vast majority (95%) of respondents agree that it does so if not entirely then to a great extent.

This reliance is only set to grow. Almost half of respondents (49%) expect to see greater interconnectivity between the physical and digital worlds in five years' time and a further third expect it to be significantly greater. The UK is the most bullish in this respect, while China is the least, according to our survey sample, despite being a global leader in offline-online business models already (see chart 03).
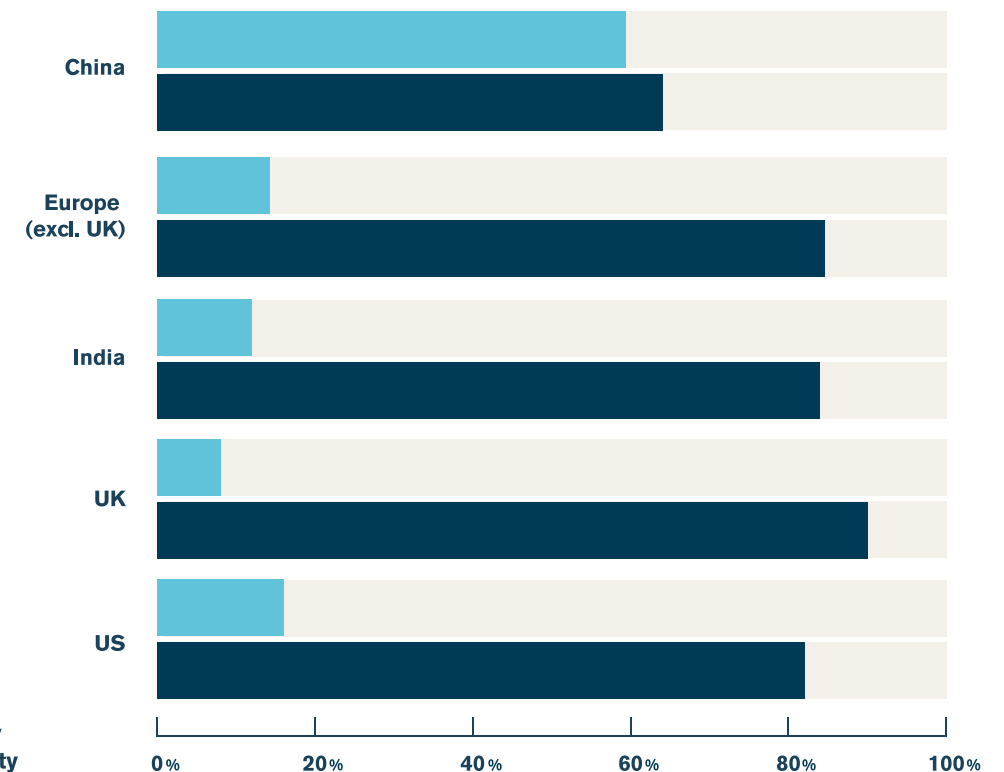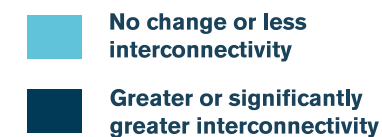
Chinese respondents in our survey were the least likely to anticipate greater interconnectivity, with a third saying there will be no change or that it will decrease. But Chinese respondents are among the most likely to report the importance of connectivity currently, with half of all businesses reporting connectivity as very important to the running of their businesses (compared with 42% on average). The country has emerged as a global leader in mobile payments, and so-called online-to-offline business models: those that straddle the digital and physical world.

The IoT is a huge driver of this convergence. Companies are already adding low-cost electronic devices to previously unconnected physical items to allow those items to connect to the internet and communicate, including products from domestic appliances to goods in transit. This enables insights

Connectivity with Chinese characteristics

03_ Percentage of respondents anticipating greater interconnectivity in the next five years compared with respondents anticipating no change or less connectivity.[1]

1 Figures exclude "don't know" responses

Legend:
- No change or less interconnectivity
- Greater or significantly greater interconnectivity

(Chart: China, Europe (excl. UK), India, UK, US — axis 0% to 100%)

into their performance and location. This new-found connectivity is digitally transforming many businesses that have previously been purely "physical" in nature.

Earlier this year, for example, Italian energy giant Enel announced that its global thermal generation division is working with General Electric (GE) to monitor the performance of assets in 14 thermal power plants located in Europe and Latin America.

The data they generate will be collected in GE's Predix software and analysed in order to detect any operational issues that may require maintenance, with a view to reducing repair costs, outages and overall revenue losses.

In the real-estate sector, meanwhile, French facilities management company Sodexo recently announced that it is working with IBM to collect smart building data from a wide range of client facilities, including offices, hospitals, schools and factories. The idea is to monitor air quality, temperature and lighting more closely in these buildings, with a view

to improving the wellbeing and productivity of occupants. IBM's cloud-based Maximo platform is providing Sodexo with real-time data analysis across 2.5m assets in buildings that the company manages worldwide.

It's no surprise then that, when asked about the opportunities that various connectivity-dependent technology trends present over the next five years, IoT stands out, and is described as an opportunity by more than four out of five (82%) respondents (see chart 04).

IoT-fuelled connectivity opens the doors to a number of other key trends that in turn present new opportunities. For a start, IoT devices create huge volumes of data that, once analysed, can provide insights into business performance and customer behaviour, and clues as to how efficiencies might be achieved. They can also help pinpoint likely sources of untapped demand. Four out of five respondents say they see data analytics as a source of new opportunity between now and 2023.

Over three-quarters (78%) of respondents see particular opportunities to be gained from augmented, virtual and mixed reality, as mobile devices and connected headsets are used to overlay views of the physical world with data. For example, prospective new tenants of an office or residential building that is under construction can use augmented reality (AR) to inspect the site and see their view of it overlaid with images of how its architect envisages the final result. There are ample opportunities in media, publishing and entertainment, too. In our survey, 44% of digital businesses regard augmented, virtual and mixed reality as a significant opportunity for their business. When this sector was asked which industry-specific applications they regarded as the most significant for their business, the enhanced ability to deliver virtual and augmented reality was the most selected response, ahead of even real-time data analytics.
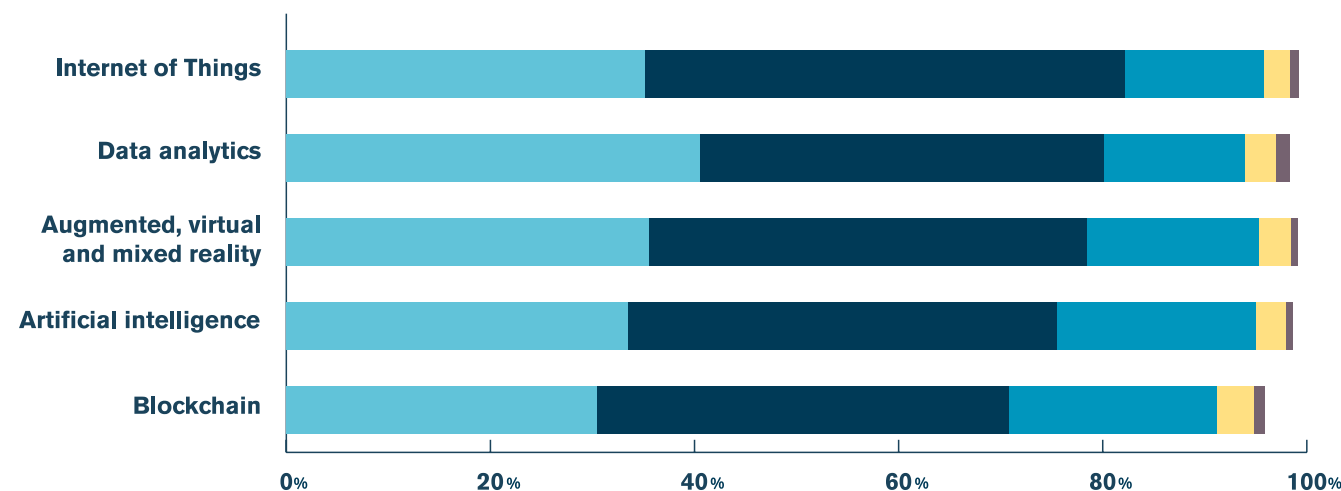
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Augmented reality: a game changer for business

Augmented reality (AR) provides an interface that merges the digital and physical and allows vast amounts of data to be translated into a real-world environment. The current approach of applying information extracted from a computer to a physical scenario is hugely inefficient. The capacity of AR to instead access and overlay data in real time, which is then viewed as part of the seen environment, is a game changer for business process and efficiency. Many pilot AR projects are now morphing into widespread corporate adoption with huge gains in productivity and quality. With that comes a range of legal issues from intellectual property to privacy and health and safety, but it's this enterprise application of AR where the real change and investment will take place and have the biggest impact across all industries. Connectivity is a vital component that enables the virtual and actual to merge in this way.

04_Asked to weigh opportunities against threats, on balance respondents perceive a range of technological trends as strong opportunities for their business
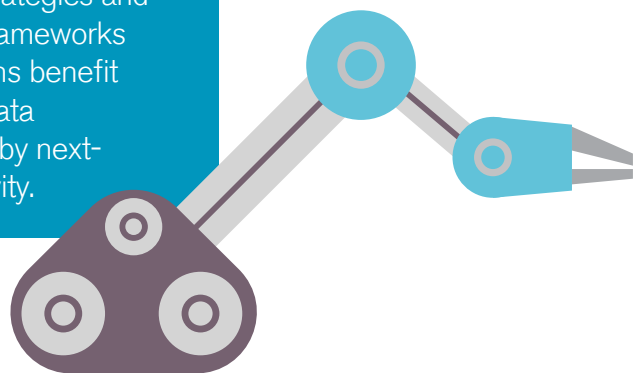

Legend:
- Significant opportunity
- Opportunity
- No impact
- Risk
- Significant risk

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Exploiting big data

The development of data-driven business models is still in its early stages, not least due to insufficient connectivity. The same applies to the legal framework for the data age. The exploitation of data for commercial purposes harbours numerous legal challenges: data ownership; the specific restrictions of the principle of purpose limitation for the use of personal data; and the requirements for their sustainable anonymisation are just three examples of such open points.

Irrespective of legislative activities across the globe, the legal cornerstones for building a data economy will remain unclear for the foreseeable future. Yet, the technical development of more and more business-relevant big data applications will not wait. For businesses, this means transitioning to the data age on the basis of the existing legal framework. Only by designing data strategies and data management frameworks early will organisations benefit from new forms of data exploitation enabled by next-generation connectivity.

Meanwhile, 76% of respondents report opportunities in artificial intelligence (AI), a term that is broadly used to define computer systems that replicate a function of human intelligence and today typically referring to machine learning systems that can self-improve their outputs by reference to inputted data. Connectivity has been a key driver in generating data from a wide range of sensors, machines and devices, and next-generation connectivity will ramp up the potential for AI tools to respond immediately to real-time data. AI will be key in transport and logistics, for example, as it will enable connected vehicles and robots to navigate their surroundings autonomously, avoid collisions and learn from errors in order to refine future responses or actions.
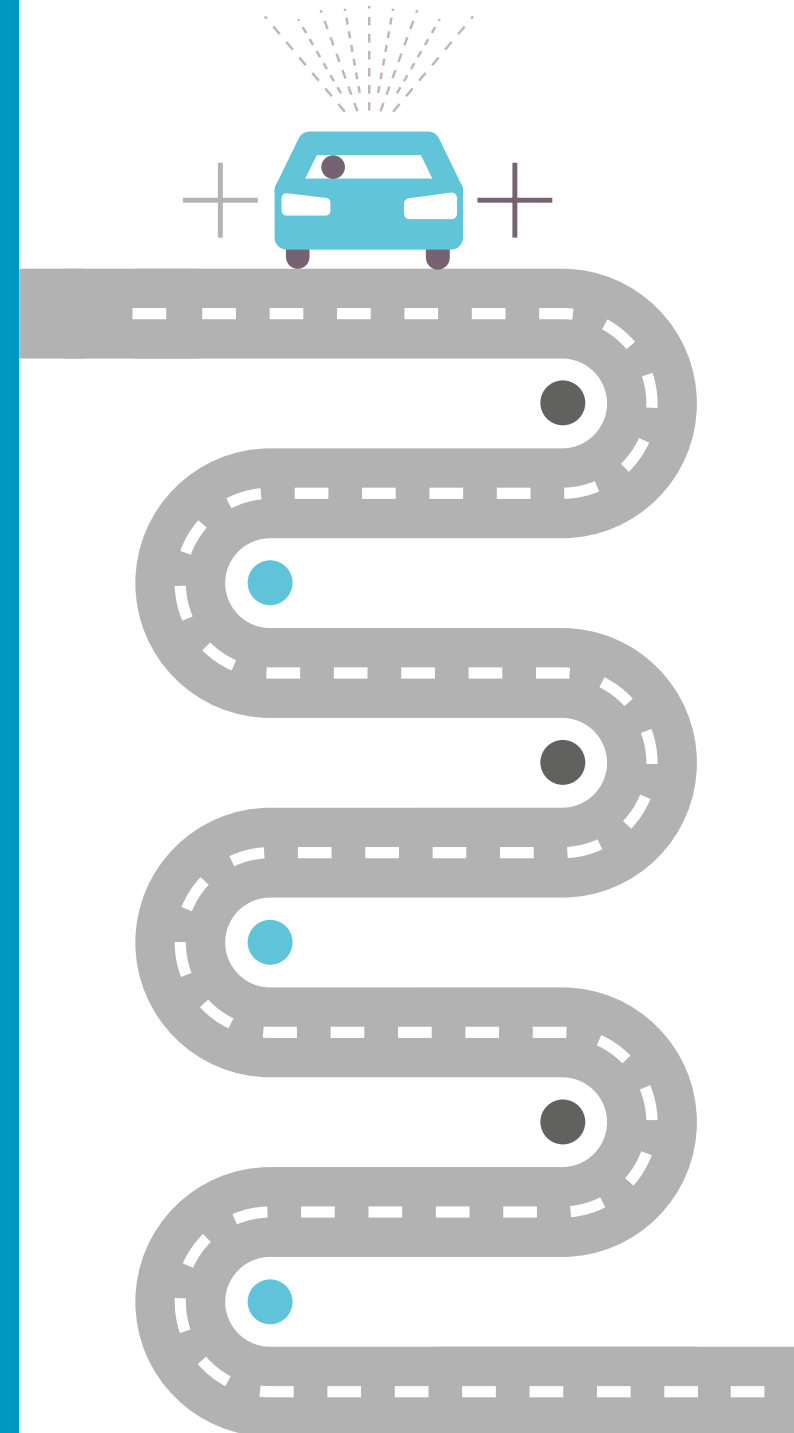
> " This new-found connectivity is transforming many businesses that have previously been purely 'physical' in nature "

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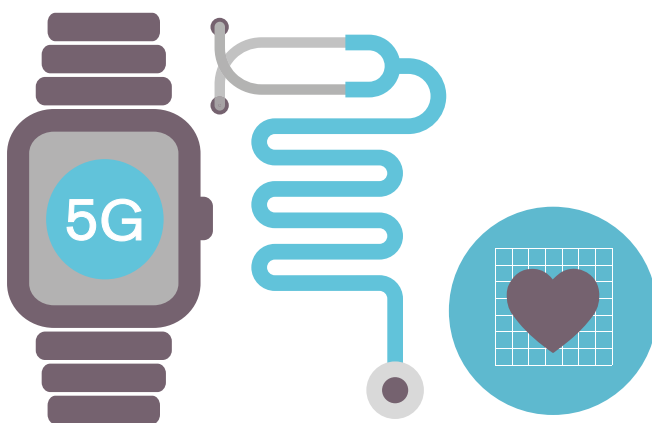**osborneclarke.com,**
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Smart streaming and intelligent functioning

Connectivity is vital to the operation of networked devices that gather and process big data and in turn power the analytics of artificial intelligence.

"Always-on" devices connected via the Internet of Things will require levels of hyper-connectivity and resilience in communications infrastructure, which is capable of supporting real-time interrogation, uploading and downloading of data. "Smart streaming", as this is sometimes called, is already being considered by the EU in the context of the standardisation of future communications infrastructure. This will enable smart vehicles to communicate with smart highways, allowing for traffic management and analytics data to be exchanged between intelligent, centralised traffic management systems and other vehicles.

Furthermore, we are likely to see intelligent functionality being introduced to communications networks themselves, either directly or via third party "artificial intelligence as a service" providers, the trailblazer for which has been Telefonica's AURA system.

Connectivity pushes boundaries

What are the true capabilities of next-generation connectivity?

3

5G

Connecting ever more devices and processes requires infrastructure that can support it. Taking advantage of new technology trends, such as increasingly sophisticated data analytics, will require access to new levels of connectivity for businesses—and the demands they place on that connectivity will be more exacting.

Autonomous vehicles are a case in point. Leaps forward in AI and cheaper sensors have made self-driving cars a near-future reality. But such technology will critically depend on next-generation connectivity for their advancement on the open road. Autonomous vehicles must communicate with cars, smart city infrastructure and remote data centres in order to navigate roads safely and avoid collisions. Much of the technology for this exists, according to researchers from a Chinese technology company, Huawei, or soon will. However, "the most prominent missing component is a high-reliability, low-latency communications system," the researchers write.[2] These high-speed, low-latency links will be essential if autonomous driving systems are to mimic or improve on the split-second response times that might be seen in a human driver.

Similarly, demand for AR and VR streaming is pushing demand for connectivity that can handle large amounts of data without lag, whether for an entertainment business serving consumer gamers, or a digital

healthcare business investigating the viability of remote surgical operations.

For some, 5G mobile networks could provide the answer. Standards for the fifth generation of wireless technology will not be finalised until the November 2019 World Radiocommunications Conference, but the claims being made for it are impressive: lightning fast speeds, incredibly low latency and the capacity to handle massive numbers of connections simultaneously.
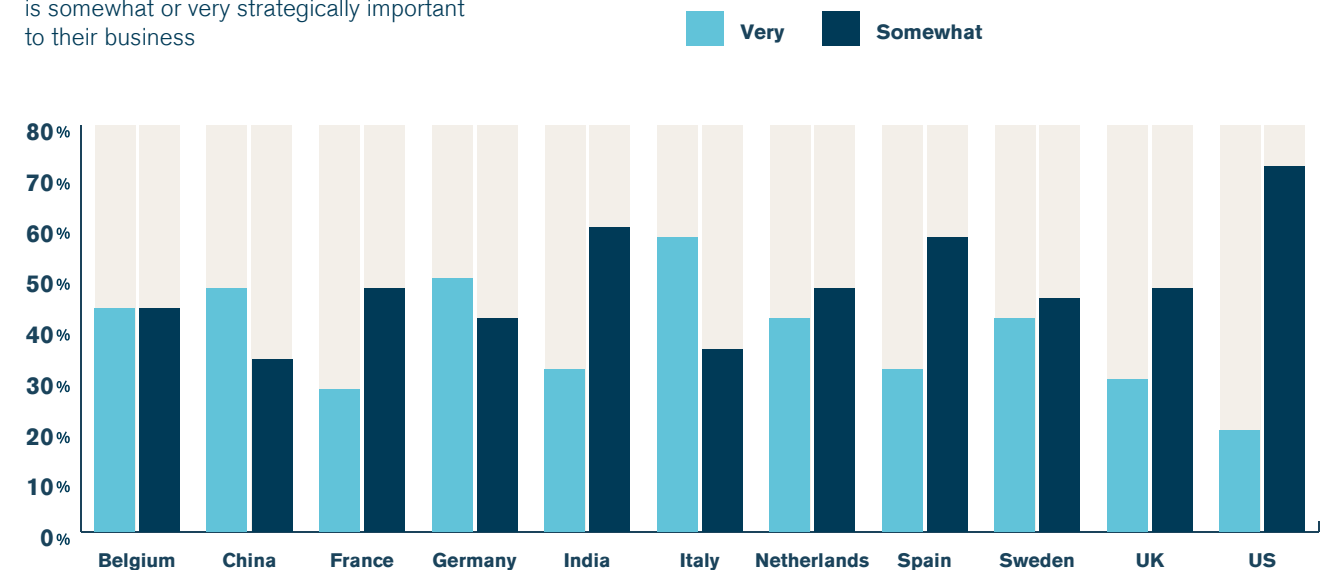
There is still much work to be done. In particular, service providers will need to install new antennae, base stations and fibre-optic cables. This is costly work, so many may delay until there is evidence of clear demand, and that demand is likely to be led by consumer-focused mobile broadband services rather than business use cases. For that reason, and because of the time it takes to build the infrastructure, analysts at McKinsey, a consultancy, reckon market trials and small-

scale launches will continue, but large-scale deployment of the technology "is unlikely to take place until the early 2020s".[3]

While they may have to wait, survey respondents are thinking ahead. Nearly nine in ten (87%) respondents agree that 5G will be strategically important to their business by 2023. Respondents in Germany, India, Italy and the US were most likely to regard 5G as strategically important, and those in France and the UK the least (see chart 05).

There will need to be a clear business case before many companies make the shift to 5G, warns Guido Jouret, chief digital officer at ABB, a Swiss-Swedish manufacturer of robotics and industrial automation equipment. Cost is a big issue. "For industrial companies, at least initially, the costs associated with that kind of high-performance, low-latency connectivity might mean it does not make sense simply to connect equipment on a factory floor, because previous-generation

05_Respondents who assert that 5G is somewhat or very strategically important to their business

Very ■ Somewhat

	Belgium	China	France	Germany	India	Italy	Netherlands	Spain	Sweden	UK	US

[2] https://arxiv.org/abs/1712.017543

[3] https://www.mckinsey.com/industries/telecommunications/our-insights/are-you-ready-for-5g/

connectivity that exists today could be perfectly adequate and appropriate," he says.

Indeed, our survey findings confirm that cost is a significant barrier. Nearly two-thirds (65%) of executives surveyed said cost concerns are likely to lead their business to avoid or withdraw from greater connectivity in some cases.

Into orbit

5G connectivity isn't the only next-generation connectivity technology promising new business capabilities. For business operations that span remote and hard-to-reach locations, particularly those where harsh

> " **Nearly two-thirds of executives surveyed said cost concerns are likely to lead their business to avoid or withdraw from greater connectivity** "

environmental conditions prevail, satellite connectivity is proving highly valuable.

Once prohibitively expensive for most everyday applications, this technology is maturing and extending to new business cases. At satellite connectivity provider Inmarsat, Paul Gudonis, president of the Inmarsat Enterprise division, says that the kind of service-level agreements (SLAs) that previously appealed principally to companies in the maritime transport sector are now finding favour elsewhere. SLAs, associated with satellite adoption, guarantee the level of quality of the service provided.

"Satellite connectivity services are typically offered at higher SLAs, whilst cellular operators offer lower SLAs to deliver connectivity to a mass market," he explains. In other words, satellite ensures reliability while cellular delivers capacity. "In the age of IoT, many organisations are finding that a mixture of the two can provide the best trade-off between service level and cost."

Inmarsat has partnered with mobile operators including Vodafone and Jersey Telecom to offer a mix of satellite and cellular services. In transport, for example, many companies find that a satellite provider can give them a single point of service across multiple regions, instead of forcing them to switch between multiple operators when roaming, says Mr Gudonis. This can be particularly useful for achieving a joined-up view for companies running networks of ships and trucks. This oversight, and data gleaned from it, allows businesses to operate much more efficient logistics, and to spot and fix problems more quickly.

In its niche of agriculture tech, start-up CropX sees value in the combination of cellular and satellite technology. The company's smart soil sensors are planted in fields to communicate information about

soil quality—and what it needs for crops to thrive—via a platform that farmers can access from mobile devices. This mix of cellular and satellite connectivity enables soil sensors in even the most far-flung rural locations to relay information, explains CropX's CEO, Tomer Tzach. Farmers are typically looking for higher yields while looking to curb any unnecessary costs around irrigation and fertiliser. "In this way, they are spared from having to visit sometimes very distant areas of their farms to make an assessment," he says.

No time to wait

What's clear is that while companies are alert to the potential of next-generation connectivity, they are not waiting for new standards to be ratified or for infrastructure to be built. Instead, they are exploring the uses of connectivity that are available today. This may explain why 82% of respondents agree that 5G, in particular, is best regarded as an "evolution of existing network technology, rather than a significant step change in capabilities".

It makes sense for companies to focus on what they can do today, agrees Stefano Gastaut, CEO of the global IoT business at mobile operator Vodafone. "We too see 5G as an evolution, certainly, but it's an important evolution that will enable a couple of things. First, it will enable an environment of hyper-connectivity, so that companies can connect, concurrently, a multitude of devices or a multitude of sensors. Second, it will support very high performance, so that this multitude of devices or sensors can transfer a lot more data, faster. As with all technologies, it'll be a case of companies trying to work out what's possible once it's available, trying to figure out what makes sense. Only then can new use cases emerge."

In some regions of the world, even quite basic connectivity remains a challenge. At Safexpress, an Indian business-to-business logistics company based in New Delhi, chief information officer Kapil Mahajan says that much has already been achieved in terms of greater visibility into company operations using wired and wireless connections between the company's data centres, distribution hubs and franchisee offices, along with barcode readers and GPS inputs from 5,000-plus trucks.

"This has enabled us to create an IoT platform that gives operational staff a screen-based view of our operations—for example, how many trucks will arrive at a hub in the next hour and how many trucks are delayed," he says.

But in a country as geographically diverse as India, achieving that connectivity is dependent on Safexpress engaging with a large number of different providers and on building in redundancy in case a particular service goes down. "That can be both complicated and costly," says Mr Mahajan.

Survey results confirm that the opportunities and challenges wrought by next-generation connectivity, and perspectives on them, vary country to country. More developed countries are more likely to see connectivity as currently important than less developed countries, though just as likely to anticipate future importance. In India, respondents are highly likely to feel that 5G will be strategically important, but they also rate all barriers to adoption more highly than other countries, with particular concerns around safety and managing more complex systems.

Dutch and German businesses stand out as leading enthusiasts for next-generation connectivity: respondents from these countries are the most likely to think that connectivity is important to business and most positive about a wide range of business applications.

4

Preparing for the next wave of connectivity

What actions are businesses taking?

The technological capabilities of next-generation connectivity prompt significant opportunities for businesses, as tried-and-tested business practices, and even business models, are fit for reimagining.

When asked what organisational capabilities are needed for the successful adoption of next-generation connectivity, a third of respondents agree that technology innovation will be key, and this is closely followed by business model innovation, cited by 31%.

"Digital transformation is a boardroom issue in pretty much every company worldwide right now and many are addressing how connectivity might change their engagement with the customer and the way they develop their products and services," says Jeff Travers, head of IoT at communications equipment company Ericsson. "These conversations lead them very quickly to 'We must be more connected—and so must our products.'"

Rethinking business models: learning from leaders

In many product companies, greater connectivity allows for promising new business models based less on selling a piece of equipment or hardware, but charging the customer based on how they use it, through information gleaned from monitoring, says Mr Travers. A good example is Rolls-Royce, which increasingly charges customers of its aircraft engines based on miles flown. Ericsson is currently working with a manufacturer of water pumps

looking to charge its customers on a similar basis, charging monthly usage fees rather than a single, upfront purchase price. "That changes the whole basis of a business—its billing processes, its revenue model," he says.

In industry terms, it's no surprise that digital businesses are ahead of the game in embracing connectivity. Companies in this sector, many of which will have been "born digital", are more likely to feel that connectivity is currently very important to their business (51%, compared with 42% across the survey base) and are highly enthusiastic about its impact on different aspects of their business.

Today, for companies in the digital business and financial services sectors, in particular, connectivity is vital, says William Newton of WiredScore, the company behind a digital connectivity rating scheme for commercial office space called Wired Certification.

"Connectivity isn't an area where companies can compromise, especially in the era of the cloud, where employees are reliant on being able to download and upload essential corporate data and information in ways they never did before and at great speed," he says.
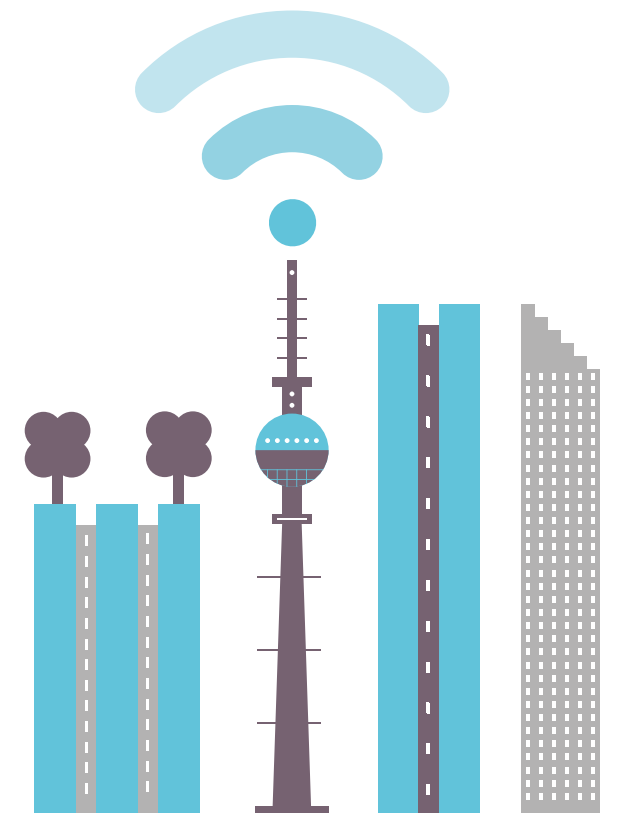
Mr Newton's company assigns a WiredScore based on its review of the range of internet service providers available to the tenants of a building, its connection access points, its capacity to support future equipment installation and its infrastructure redundancy.

"As digital businesses continue to explore newer technologies like AI, VR (virtual reality) and AR, they'll be increasingly reliant on connectivity to support new business models. That's going to drive huge new requirements," Mr Newton predicts.

Newer digital businesses build in connectivity right from the start, says Mr Gastaut at Vodafone. "Look at a bike-sharing business,

> "Digital transformation is a boardroom issue in pretty much every company worldwide right now"
>
> Jeff Travers, head of IoT, Ericsson

of the kind we see in many major cities now: this is about technology underpinning the original business model at a new business, rather than an older business using technology to change itself, which is an entirely different and a much more complicated proposition."

Connectivity is so integral to digital businesses that there's less room for more. Those we surveyed in this sector were less likely to predict greater interconnectivity over the next five years than their counterparts in other sectors. Meanwhile, companies that have thus far been less reliant on interconnectivity between the physical and digital worlds see big changes ahead. Greater or significantly greater interconnectivity is more commonly predicted among respondents of "physical" industries—such as real estate, energy and transport.

A mixed picture

In other sectors, the picture is more confused. In the transport and automotive industry, the survey shows that companies are least likely to feel that connectivity is currently important to their business and also least likely to feel that it will become much more important in five years' time.[4]

[4] See chart 02 on page nine

Transport and automotive are least likely to feel that connectivity is currently important

36%

say that this is the case, compared to a cross-survey average of 42%

But within this sector, there are great variations. Today's cars are essentially travelling computers, boasting a wide range of connections that draw in data from onboard sensors, GPS units, "infotainment" systems and mobile devices that monitor its performance and condition.

These features have become critical features for consumers, but also helped automakers introduce new services. In the EU, as of April 2018, connectivity has been made compulsory for new cars by the eCall automated emergency call requirements, whereby location and impact sensor information is automatically relayed to emergency services in the event of a serious accident.
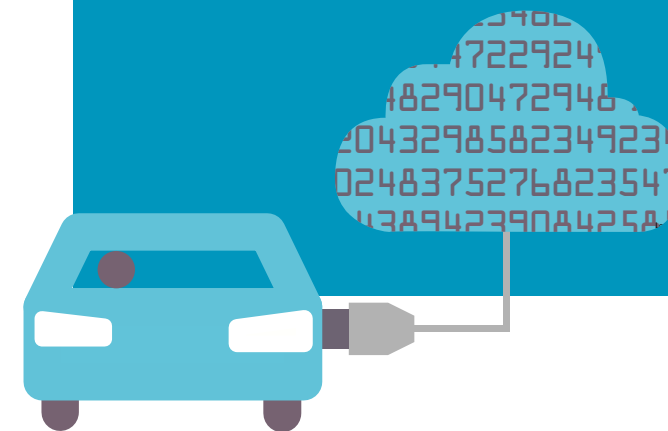
Reliable and widespread connectivity is underpinning innovation around the idea of "Mobility as a Service" (MaaS), the move towards using transport as a service rather than owning the mode of transport yourself. In Helsinki, for example, residents navigate and pay for travel, whether public or private transport and including suburban trains, ride-sharing services and city-centre bikeshares, through one app, Whim. Asked what they regarded as the most significant applications driven in whole or in part by next-generation connectivity in the next five years, respondents in the transport and automotive sector ranked MaaS most highly.

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Car data essential for competition

Data are key for automotive business models of the future. It will be essential for pointing vehicles to garages for servicing and repairs, tailoring motor insurance premiums or even targeting advertising to individual motoring consumers. EU law encourages interoperability and requires vehicle manufacturers to offer independents access to vehicle data needed for effective competition in servicing and repair markets. The limits of this statute are currently being tested in the EU's highest court. Even beyond repair and maintenance information, antitrust law can require incumbents to share essential data with innovative businesses. The legal framework needs to encourage innovation, protect competition, and balance these with cyber-security concerns.

Case study: The road ahead for First Bus

At bus company First Bus, which transports 1.6m bus passengers each day in the UK, managing director Giles Fearnley concedes that public transport has been slow to embrace the business model transformation potential of connectivity, but insists his company is quickly catching up. "We've probably done seven to ten years' worth of work in the past two years."

First Bus has introduced real-time journey planning information with tracked vehicles, and used the data to optimise timetables and routes. But there is a great deal more business-model transformation planned, says Mr Fearnley.

The company is exploring the idea of providing on-demand shuttle services on large housing estates, using taxis or minibuses, so that passengers don't have to walk the "last mile" to and from their homes and a bus stop. Trials of "My First Mile" are already under way in Bristol. The business is also involved in trials of driverless pods.

Driverless double-decker buses, heavily reliant on digital connectivity and sophisticated artificial intelligence systems, are still at least a decade off, not least for safety reasons, Mr Fearnley believes. But guided busways are already here, running on dedicated concrete "tracks", where the only requirement for the bus driver is to accelerate and brake, as seen with First Manchester's recently launched route between Leigh and Manchester.

"We're in the business of moving large numbers of people around efficiently on limited road space. The ability to move large volumes of data around, using connectivity, is already vital to that process and is key to informing the kind of business we will be in the future," says Mr Fearnley.

Companies in the real estate and infrastructure sector, meanwhile, are among the most convinced that connectivity will become more important to their business in the next five years. Here, next-generation connectivity could fuel a "smart building" boom, based on sensors that monitor conditions to improve office management, boost energy efficiency and increase employee health and wellbeing.

Much will depend on the owners of real estate to procure vital infrastructure that is "smart" enough to generate data. Take, for example, Swiss company Schindler Group, which provides buildings with elevators, escalators and moving walkways. Schindler is working with GE Digital to connect some 1m pieces of its equipment to the internet, enabling them to collect and relay performance information, says Deborah Sherry, chief commercial officer of GE Digital Europe.
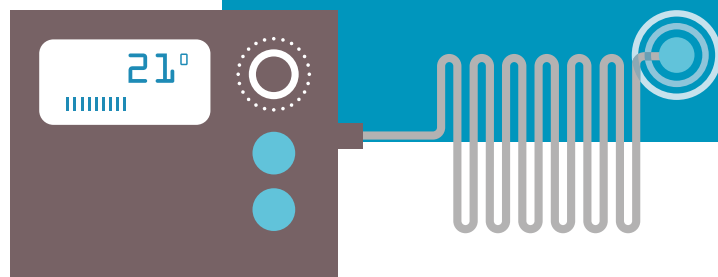
Power outages in a building can negatively impact that flow of data, says Ms Sherry, but Schindler equips new elevators with a so-called edge computing device (whereby some data are processed locally before communicating with the cloud) containing a modem that typically uses 3G or 4G connectivity to keep data flowing and raise alarm calls. For infrastructure companies like Schindler, the new business case is based not on dispatching a service engineer when something goes wrong, says Ms Sherry, but "more on anticipating a problem before it happens and getting it fixed, so that people keep moving."

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Smart grid technology versus the regulated energy sector

The adoption of connectivity has been phenomenal over the past few years. It is now an integral part of most industry business models, including those, like energy, which were previously considered off limits due to security and regulatory constraints. Smart grids are a perfect illustration of this difficult equilibrium. For them to succeed, they need to automatically and autonomously adapt electricity production by connecting directly decentralised energy producers with their consumers. As we head towards a more carbon conscious future, there will be a need to balance the regulatory position (in relation to security and the NIS Directive, for example) with the need for interoperable standards so that we make the desired environmental gains.

Only connecting?

Businesses do see potential roadblocks ahead in the pursuit of greater connectivity. In fact, cost and privacy concerns, each cited by nearly a third (32%) of respondents, as well as safety concerns around, for example, the malfunction of systems (31%), could lead some to avoid or withdraw from the pursuit of greater connectivity in some cases.

Greater connectivity leads to greater complexity, too. A vital part of preparing for next-generation connectivity will lie in behind-the-scenes work to ensure compatibility between systems so that smart products and systems are able to interconnect to deliver the best outcomes for companies and their customers.

Two-thirds of survey respondents (66%) say that security concerns are very or extremely likely to lead their business to avoid or withdraw from greater connectivity in some cases, a sentiment particularly pronounced in the energy and utilities sector. Here, businesses are bullish about the potential for next-generation connectivity to fuel applications including electric vehicle infrastructure and intelligent balancing of distributed networks. But a move away from large, centralised energy production to many small, flexible energy networks, including domestic installations, and the prevalence of web-connected devices such as smart meters, brings remarkable complexity and many points of vulnerability. Opportunity for the sector is not without risk.

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Cyber-security: greater connectivity, more vulnerability

Internet connectivity brings a greater opportunity for sophisticated criminals and hostile state actors to hack into systems and steal information or simply cause disruption.

For energy and utility companies and certain digital service providers, not only do they have the protection of personal data under the General Data Protection Regulation (GDPR) to consider, but also the NIS Directive, which is concerned with the protection and maintenance of critical infrastructure. Both carry stringent regulatory notification regimes and fines of up to €20m or 4% of global annual turnover. The consequences of being attacked and using out of date cyber-security software can be severe. Notification often leads to publicity and the potential for significant reputational damage.

For businesses that rely heavily on the internet, for example, in the retail and financial services sectors, cyber-attacks are an unavoidable risk. While counter technical measures are improving, there is a drive towards establishing and practising incident response and crisis management procedures: 72-hour notification deadlines have put these procedures into sharp focus.

Conclusion

The survey clearly suggests that those companies that are already the most reliant on connectivity and recognise its importance to different business applications are also those best positioned to capitalise on next-generation connectivity.

These businesses are already highly reliant on the digital tracking of physical assets and expect to be more so in the years ahead—and they are already laying the groundwork for that reliance. They are formally assessing opportunities, but already have adoption strategies figured out, putting them ahead of the curve.

At the same time, sectors where connectivity has been less relevant or prevalent historically are likely to see the greatest transformation in the future. So what lessons can "follower" companies learn from leaders? Interviews conducted for this report and survey results offer some indication:

Experiment: adopt a "fail fast" approach, focused on identifying early wins where connectivity can quickly be shown to increase productivity, boost revenue or eliminate inefficiencies. This may be a trial-and-error process but will reap dividends in the longer term.

Invest in skills: by hiring new talent, investing in skills and setting up digital divisions that focus on the kinds of experimentation discussed, companies will breathe new life into their business models and introduce fresh thinking that can take them beyond tried-and-tested approaches.

Build new partnerships: since next-generation connectivity is expected to fuel a reliance among businesses on third-party data, serious conversations need to be had between business leaders on how they can open up key data systems to each other, while preserving the integrity of commercially sensitive data and the confidentiality of customer information.

Tackle security concerns: connected machines and devices can quickly become targets for hackers. Yet some measures that might protect these connected things are routinely neglected, such as changing default passwords and keeping on top of software upgrades. Every company that runs on connected machines, or creates them for customers, needs a disciplined approach to IoT security.

The lesson is clear. Next-generation connectivity will be of little use to those companies that have failed to take advantage of today's connectivity. Those who truly understand its potential, by contrast, have everything to gain.

About this report

Next-generation connectivity is an Economist Intelligence Unit research programme, commissioned by Osborne Clarke. In this report The Economist Intelligence Unit looks at businesses' anticipation of, readiness for and adoption of next-generation internet connectivity.

To do this, we surveyed 550 senior executives with familiarity of their business' connectivity strategies in April-May 2018. The survey focused on executives from five sectors: digital business; energy and utilities; financial services; real estate and infrastructure; and transport and automotive. Half of the respondents are either members of their companies' boards or hold C-level positions, and, furthermore, half are from organisations with global annual revenue exceeding US$500m. Respondents were drawn from Belgium, China, France, Germany, India, Italy, the Netherlands, Spain, Sweden, the UK and the US, in equal numbers.

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