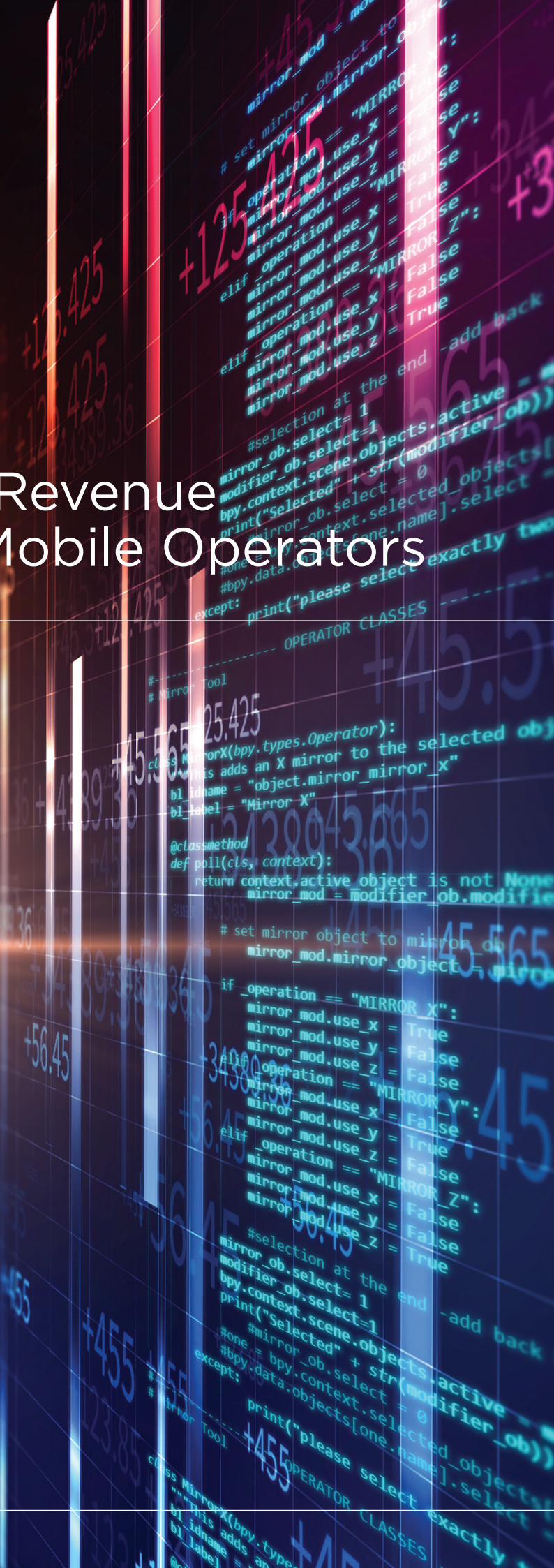




The IoT Big Data Revenue Opportunity for Mobile Operators

Prepared by PwC



FOREWORD

The past few years have seen a proliferation in both the Internet of Things (IoT) and Big Data, generating new value for consumers, governments and businesses, as well as new business opportunity for ICT companies spanning many industries and activities. Connected devices are enabling quicker, more precise and smarter decision-making (such as for consumers); safer, more efficient ways of working (such as in health or mining); and more sustainable ways of living (such as in smart and connected cities).

As Big Data techniques are applied to data sourced from the IoT and other sources (referred to in this report as IoT Big Data), there will be a race for firms to unlock value as businesses transform and scale new markets. A significant question hinges around the role to be played by Mobile Network Operators (MNOs), key to providing IoT connectivity but also to provide significant value beyond connectivity. Many MNOs around the world are exploring or actively pursuing such opportunity, to compete for a share of new value by deploying their significant capabilities, and also to diversify their IoT revenue base away from a reliance upon only connectivity.

Whilst significant, the profile and scale of this new cohort of opportunities needs to be better understood by MNOs. The purpose of this report is to:

- Estimate the **market opportunity** for MNOs in IoT Big Data, based on analysis, executive interviews and end-user perspectives and particularly focusing on 2025 as a point at which the estimated market will be worth **\$386 billion**.
- Explain **strategies** for operators 'beyond connectivity' in this exciting new marketplace, so that it becomes clearer how MNOs can carve out a role in IoT Big Data.
- Provide perspectives on **building essential capabilities** for operators to play a significant role as ICT providers in the emerging digital landscape.

- Describe **market developments** in IoT Big Data which illustrate what the opportunity consists of and how MNOs are currently taking action.
- Set out **next steps** for MNOs to succeed in the market.

The findings of this report have been informed by a PwC survey and interviews undertaken with 20 leading executives from MNOs, technology and IoT end-user companies, as well as desktop research to understand market size, major use cases and proliferation of IoT Big Data in different markets. Quotes from executives are included to indicate both market sentiment and lessons learned for MNOs in IoT Big Data.

This report also aims to provide essential context to address apprehensions held by operators – including that some aspects of the IoT Big Data space are too divergent from traditional business models for them to play a significant role. MNO positioning is critical, since the growth areas are diverse in nature and will scale uniquely by industry and region, meaning that careful planning of go-to-market strategies will be necessary. The investments in IoT Big Data will be significant, and the strategies set out in this report establish a framework for evaluating which opportunities to target, how to enter and how to ultimately succeed in this value-rich and potentially highly profitable space.

EXECUTIVE SUMMARY

IoT Big Data presents a significant opportunity for MNOs to diversify revenue sources and counteract the declining ARPU for cellular connectivity that is occurring in many parts of the world. IoT Big Data is emerging from growth in new data sets being collected through connected devices and the combination of this data with non-IoT sourced data. IoT Big Data projects are gaining traction world-wide as industries work to fundamentally change ways of living and working, as well as addressing new markets.

In 2025, the global addressable market for MNOs in IoT Big Data 'beyond connectivity' is estimated at approximately \$386 billion. This addressable opportunity forms part of a broader \$1.1 trillion opportunity in IoT as a whole as estimated by GSMA Intelligence¹. Addressing this opportunity will position MNOs for a wider role in enabling ICT-powered ecosystems in industries and cities, harnessing wider growth opportunities in Artificial Intelligence and Machine Learning.




\$386 bn  
global addressable market
for Mobile Network Operators in
IoT Big Data **'beyond connectivity'**
 **2025**



Figure 1: \$386 billion - IoT Big Data beyond connectivity opportunity

Source: PwC analysis

¹ GSMA Intelligence, 2018, *Global IoT Connections and Revenue Forecast*.

<https://www.gsma.com/newsroom/press-release/new-gsma-study-operators-must-look-beyond-connectivity-to-increase-share/>

Mobile Network Operators may adopt alternative strategies to address the market opportunity ‘beyond connectivity’, fashioned by options around how and where they develop capabilities in data use, big data analytics, storage, infrastructure and software. MNOs may partner across the value chain, make acquisitions where strategic, further develop support systems and organisational structure to scale up in these domains.

Regional opportunities will differ, particularly given the varied nature of IoT uptake, infrastructure, vertical opportunities, the industrial policy environment and the evolution of Big Data across the world. Although the IoT Big Data market as a whole is expected to grow evenly between the Americas, Europe, the Middle East and Africa (EMEA) and the Asia Pacific (APAC), the propensity to spend on ICT solutions in specific verticals will mature quicker in advanced markets and China.

Advanced countries are likely to develop more competitive, open and complex IoT Big Data ecosystems compared to emerging markets. In these markets, such as in North America, Europe, Japan and Australia, MNOs will have to pursue diverse tactics to compete for contestable opportunity in every value chain segment (beyond connectivity), either confronting other ICT ecosystem players head on, or partnering with ICT players. Developing countries in Asia, Latin America and Africa are likely to experience a steadier uptake in IoT Big Data over the period to 2025.

China is an outlier in the adoption of IoT Big Data, offering scale and depth as well as opportunities for local MNOs to develop end-to-end plays in IoT Big Data as part of a tightly coordinated ecosystem with other Chinese ICT companies. In this respect, China is already different to other markets with similar levels of development or GDP/capita. Favourable economic growth conditions and support from central agencies to invest in IoT Big Data are key enablers of the opportunity in China.

In other emerging markets, such as Indonesia, Thailand or Turkey, major MNOs are likely to play a pre-eminent role in the IoT Big Data value chain compared to their equivalents in larger or more advanced markets. This is because in such markets, MNOs are often perceived to be a major ICT player given the speed and scale with which mobile connectivity has grown in significance in such markets over the past two decades.



MNOs need to build specific capabilities to compete for a greater proportion of the IoT Big Data opportunity, with a particular focus on building:

Technical capabilities extending into newer areas such as analytics and integration (i.e. the interaction of networks, software and operations technology), and deeper into managing complex network coordination, data traffic management, latency, interoperability and security;

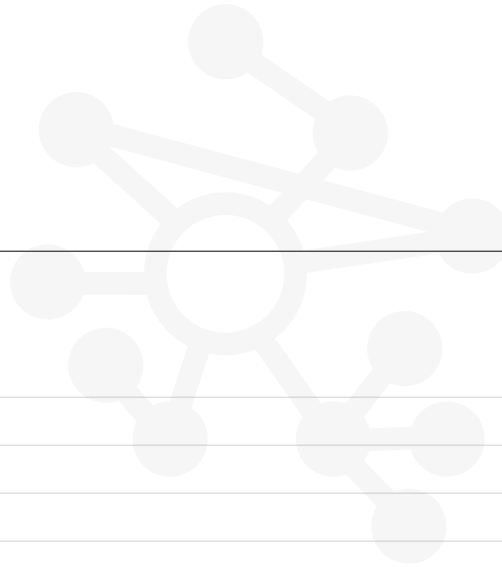
Commercial capabilities especially in building partnerships and novel collaboration models with other ICT companies as well as harnessing network assets which can be applied to solve industry problems. MNOs will have a key role in supporting customer transformation through IoT Big Data;

Cultural skills and organisational agility fit for the IoT Big Data world where MNOs will need to take on attributes that historically are more the domain of ICT companies. This will include a need to be nimbler, embrace a more consultative role in deal creation, business development and sales, applying “dev ops” skills as well as embracing cross-industry and partnership collaboration.

MNOs will also have to compete more effectively in the jobs market to win and secure the right talent, particularly in high demand areas such as big data, data handling, machine learning and artificial intelligence. In addition, skills, such as software-defined network engineers, are now in demand by many different types of organisations, some of which are proving more successful at attracting younger talent than MNOs. Therefore, resourcing will be an important consideration in addressing the new opportunities.



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1. MARKET OPPORTUNITY

1.1 DEFINING IoT BIG DATA

The IoT creates value at the outset from connecting devices. This is because expanded data sets are available from IoT devices which enable more advanced analytics capabilities to be developed. In turn these contribute to wider-reaching efficiency, automation and self-optimisation tools in doing business or providing services. Such opportunities give rise to “IoT Big Data”, comprising a range of activities that go beyond IoT connectivity and into activities such as artificial intelligence and machine learning. Big Data opportunities also combine both IoT and non-IoT sourced data (such as economic growth, trade, pricing, weather, environment, demographic or land title data). The breadth of applications for IoT Big Data is illustrated in Figure 2.



How should we alter our model of care to achieve the best outcomes for patients?

Where should we build new transport/retail/financial services infrastructure? How can we improve the sustainability and accessibility of our city?

What can I learn from weather patterns and historical crop yield to improve the way I use my land?

Figure 2: What is the IoT Big Data Opportunity?

Source: PwC analysis

1.2 THE EMERGENCE OF IoT BIG DATA

Around the world, IoT deployments are rapidly increasing. According to GSMA Intelligence, the number of connected devices (IoT and non-IoT) is predicted to climb to 25 billion globally by 2025.² Whilst broader digital transformation is still in its infancy, uses of IoT in conjunction with non-IoT sourced data and advanced Big Data analytics techniques are beginning to demonstrate transformative possibilities across industry and society, underlined by the following examples:³



PREDICTIVE ASSET MAINTENANCE

Using IoT Big Data solutions, the global capital goods manufacturer CNH Industrial N.V. reduced average downtime for tractors, combines and harvesting machinery by around 50 per cent.

According to PTC's Product Lifecycle Report, in a typical auto manufacturing factory, downtime can cost \$1.3 million per hour. IoT technologies have been releasing optimisation benefits of between 5-20 per cent of a typical factory's productive capacity in recent case studies.⁴



PROFESSIONAL SERVICES

Smart buildings are being commissioned world-wide. Early mover Intel created one of the first smart buildings in India in 2016, achieving increased energy efficiency, operational effectiveness and fostering a healthier, more productive workforce. For example, findings from sensors installed throughout Intel's office suites revealed that 50 per cent of all desks in the building were unoccupied at any given time, an insight which allowed the company to accommodate 40 per cent more workers into the same office space.⁵

² GSMA Intelligence, 2018, *Global IoT Connections and Revenue Forecast*.

³ Macquarie Research, 2018, *IoT*.

⁴ Gary Wollenhaupt, 2016, PTC, *IoT Slashes Downtime with Predictive Maintenance*, accessed 16 August 2019, <https://www.ptc.com/en/product-lifecycle-report/iot-slashes-downtime-with-predictive-maintenance>

⁵ Forrester, 2018, *Case Study: Use IoT To Transform Your Office Into A Smart Building*, accessed 16 August 2019 <https://www.forrester.com/report/Extend+IoT+Smart+Building+Solutions+To+Transform+The+Workplace/-/E-RES132901>



PUBLIC SERVICES:

A number of cities around the world, including several cities in Australia,⁶ are investing in smart bins and city sensors which not only automate and improve delivery of government services such as waste collection and street lighting. They also collect data on traffic and environmental issues such as flooding and air quality which inform public policy.



LOGISTICS:

Global logistics company DHL unlocked material operational efficiencies in its business through employing Huawei's cloud IoT platform, OceanConnect, which provides device management, connectivity, big data analytics, operations management, security and open APIs. In a solution pilot at one storage plant, efficiency was boosted by 25 per cent and the average job time was cut from 2,330 to 1,750 seconds. On-site labour costs were reduced by 50 per cent due to automated loading schedules, cutting schedule creation time by 87 per cent.⁹



EMERGENCY RESPONSE MANAGEMENT:

When Hurricane Harvey, a Category 4 hurricane which made landfall in the United States, Latin America and the Caribbean, flooded parts of Texas a Disaster Response Program developed by Esri was employed to assist first responders in coordinating relief efforts.⁷ The programme generated real-time data visualisations for relief workers by aggregating data sourced from public IoT sensors of the Federal Emergency Management Agency (FEMA), as well as data from flood gauge sensors, satellites, drones and apps with crowd-sourced information on traffic conditions.⁸

⁶ Discussion with PwC and City of Melbourne Representative, June 2019

⁷ Network World, 2017, *Tech enabled disaster response to Hurricane Harvey*, accessed 26 August 2019
<https://www.networkworld.com/article/3221334/tech-enabled-disaster-response-to-hurricane-harvey.html>

⁸ Esri, 2017, *The Think Tank Series: IoT and Big Data Get Real*, accessed 26 August 2019
<https://www.esri.com/about/newsroom/publications/wherenext/iot-big-data-get-real/>

⁹ Huawei Technologies, 2018, *Communicate*, Issue 84, accessed 27 August 2019
<https://www-file.huawei.com/-/media/corporate/pdf/publications/communicate/84/84-en.pdf>

MNOs who are exploring or venturing into activities across this value chain are already becoming involved in a number of these activities, described below:



CONNECTIVITY: Connecting IoT devices via secure and trusted networks to a scale far in excess of human used device connections, including device-generated data and transporting it seamlessly and securely over networks that span the world.



CLOUD AND HARDWARE: Storing bulk data (including IoT data) sets on public or private cloud servers, including providing data security and protection in storage, optimisation of data storage availability, facilitation of secure access and data storage back up.



PLATFORMS: Managing data (and devices) on platforms used by third parties. This includes connectivity management, device management, network security, device security, data security, application enablement, data processing such as image interpretation and conversion, security / credentials verification, and edge computing solutions to optimise data storage, caching and localisation.



APPLICATIONS: Solutions for IoT, including application development, application level security, de-identification services, load and latency management, energy efficiency, distribution and licensing and identity and attributes (security) layers.



ANALYTICS AND BIG DATA (BD) SOFTWARE: Analytics that includes the creation of complex algorithms, rule-based engines for applying analytics ethically and responsibly, developing software required to execute these advanced analytics techniques and providing bespoke reporting on applications (including data visualisation).



PROFESSIONAL SERVICES: Professional services to design, implement and operate IoT networks. Providing data treatment and consulting on solutions involving Big Data, Analytics, Artificial Intelligence (AI) and Machine Learning (ML) and planning mobile edge computing strategies.

1.3 MOBILE NETWORK OPERATORS CAN SUCCEED IN “BEYOND CONNECTIVITY” IN IoT BIG DATA

The IoT presents one of several gateways into digital frontiers which will play pivotal roles in the broader technological opportunity enabled by artificial intelligence and machine learning, sometimes referred to as the fourth industrial revolution (4IR). According to analysts, 4IR will create new value to the tune of 5-10 per cent of world GDP by the late 2020s.¹⁰ For MNOs, securing a role in the IoT value chain today presents a longer-term opportunity to capture revenue within this wider technological opportunity to leverage artificial intelligence and machine learning across economy and society.

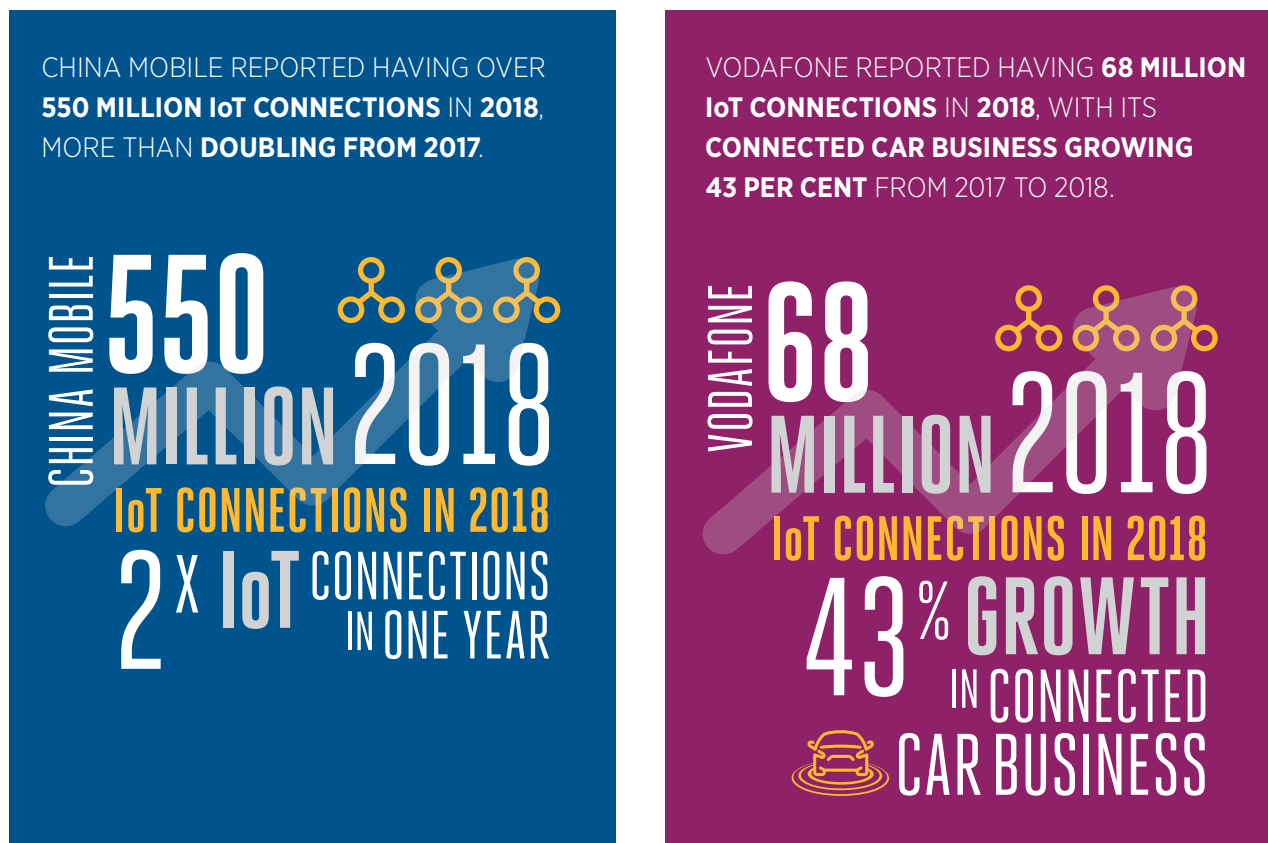


Figure 3: MNOs leading the charge are experiencing considerable growth in IoT initiatives

Source: PwC analysis

¹⁰ Gartner, 2018, Invest Implications: 'Forecast: The Business Value of Artificial Intelligence, Worldwide, 2017-2025' accessed 1 July 2019 <https://www.gartner.com/en/documents/3868494>

MNOs' capabilities in the following nine distinct areas can help them to leverage opportunities in IoT Big Data beyond connectivity:

1. IoT connectivity experience:

MNOs have a unique ability to connect multiple types of IoT connected devices onto common, interconnected mobile networks nationally and globally and provide interoperability with other networks, sensor types and data sources. MNOs have distinct connectivity capabilities (such as in optimised network design and efficiency, higher quality of service, ultra-low latency control, guaranteed route and traffic optimisation and network security) to differentiate core connectivity offerings and create relevance beyond connectivity.

2. Local market presence, penetration and reach:

MNOs' unrivalled market presence on the ground and ability to service the essential needs of a wide range of customers complements the skill sets of ICT players who have access to the latest innovation but struggle to penetrate local markets in multiple geographies and do not understand local buying behaviour. This is particularly the case in emerging markets in Asia, Latin America, the Middle East and Africa, where multinational ICT companies often struggle to compete locally due to a lack of distribution and channel partners.

3. Deploying at mass scale:

Mobile operators have a proven track record of achieving significant capacity, coverage and customer reach in geographic markets, scaling millions of connections and handling volumes of data generated with high reliability and minimal faults. Distributors help to enable the IoT partner ecosystem, procuring equipment from IT vendors and distributing to their large, on-the-ground customer base. This provides a channel to market for IT vendors that they could not afford to build on their own. A key differentiator for MNOs to play roles in these solutions is their unique ability to scale quickly through their retail sales and distribution channels to reach, service and charge businesses. Larger MNOs are providing data brokerage platforms for a similar purpose, such as Deutsche Telekom (Data Intelligence Hub), Telstra (Data Hub) and China Mobile (OneNET), used by IoT projects and businesses to create value. MNOs expressed during interviews that local market presence was a particular advantage in IoT Big Data.

4. Provisioning, pricing and billing for connected services at scale:

MNOs have the authentication, administration and billing capability to provision and scale up IoT services through standardised pricing and commercial arrangements for many different customers. This distinct capability can be leveraged to address the billing needs for mass IoT deployments to be monetised, benefiting from MNOs' established network provider role. All of the MNO executives interviewed for this report confirmed possessing carrier billing capability that can be valuable beyond connectivity.

5. Collection and ingestion of data into wider information sets:

MNOs are uniquely placed to factor network telematics and/or aggregated mobile network usage data and ingest it into big data and analytics platforms. Forty per cent of MNOs interviewed for this report indicated that the ability of MNOs to collect and process mobile data was a key advantage in IoT Big Data, referencing potential use cases such as asset tracking and logistics.

6. Provision of bespoke analytics and reporting:

Based on skill sets built over many years by engineers who keep networks running at high performance and optimised for cost, efficiency and spectrum scarcity – such skills and resources could be applied to driving the performance required from a distributed IoT network serving the individual Big Data needs of a wide range of customers.

7. Image and other diverse data processing:

With the advent of IoT Big Data and advances in artificial intelligence and machine learning, MNOs are in a unique position to harness their capabilities in processing different types of data that may be collected over mobile networks, such as images of objects, physical environments or people. As MNOs develop their object processing skills in areas such as compression, routing, ultra-high fidelity video/audio, secure transport, and convolutional neural networks they are likely to find new opportunities in big data analytics and activities which enable a variety of smart, AI-driven services.

8. Large and expanding data scale:

The volume and variety of data being collected over IoT networks is growing rapidly, with estimates that between 2016 and 2022, total mobile data traffic volumes will rise

at a compound annual growth rate of approximately 45 per cent.¹¹ As connected devices evolve, the richness of data will deepen. Increased volumes and demand for more granularity will provide an opportunity for MNOs to emerge as the foremost leaders in handling and transporting data across all types of networks (licensed/unlicensed wireless and fixed), as well as consulting and providing platforms for data management, presence, low latency processing and hierarchical storage.

9. Trust and security:

Over half of MNOs interviewed for this report considered trust and security to be among MNOs' top strengths in IoT Big Data. Operators have experience in handling sensitive data, secure transmission, storage, aggregation and anonymisation. Whilst such data management capabilities are diverse, MNOs are relied upon by governments and businesses for handling mission-critical communications, such as for defence, national security, emergency services or law enforcement. MNO executives interviewed stressed that trust emanates from their roles as licensed and regulated companies, accustomed to designing solutions under guidance from regulatory authorities and this has enabled MNOs to garner trusted reputations in the ICT market.

“ To successfully grow in the IoT economy, telcos will have to leverage their traditional strengths and differentiation by providing systems for managing large scale connections, low-latency connections for real-time monitoring/automation, and high data throughput capability for integrating edge to cloud networks. ”

Nathan McGregor,
VP APAC Data Analytics and IoT, Hitachi

¹¹ Ericsson, *Future mobile data usage and traffic growth*, accessed 8 August 2019
<https://www.ericsson.com/en/mobility-report/future-mobile-data-usage-and-traffic-growth>

1.4 SIZING THE ADDRESSABLE OPPORTUNITY FOR MNOS

By 2025, the addressable market for MNOs in IoT Big Data beyond connectivity is estimated at \$386 billion.¹² This is based on PwC’s analysis undertaken in preparing this report, derived from market estimates by various analysts including GSMA Intelligence. This report refers to the 2025 opportunity in most parts, representing what is expected by that time to be a more mature, addressable market for MNOs.

Opportunity by value chain segment

MNOs’ addressable revenues in IoT Big Data predominantly lie in Platforms, Cloud and Hardware, Applications, Analytics and Solutions and Professional Services. As shown in Figure 4, MNOs’ addressable segments of the IoT Big Data market outside of connectivity are expected to grow rapidly, such that by 2023 the addressable market opportunity in each of these segments outside connectivity is projected to overtake that of connectivity.

The growth in addressable revenue opportunity by going **beyond IoT connectivity** is **5-15 times** the IoT connectivity revenue growth opportunity. This is materially significant for operators, and a chance to capture new streams of profitable industry revenue growth.

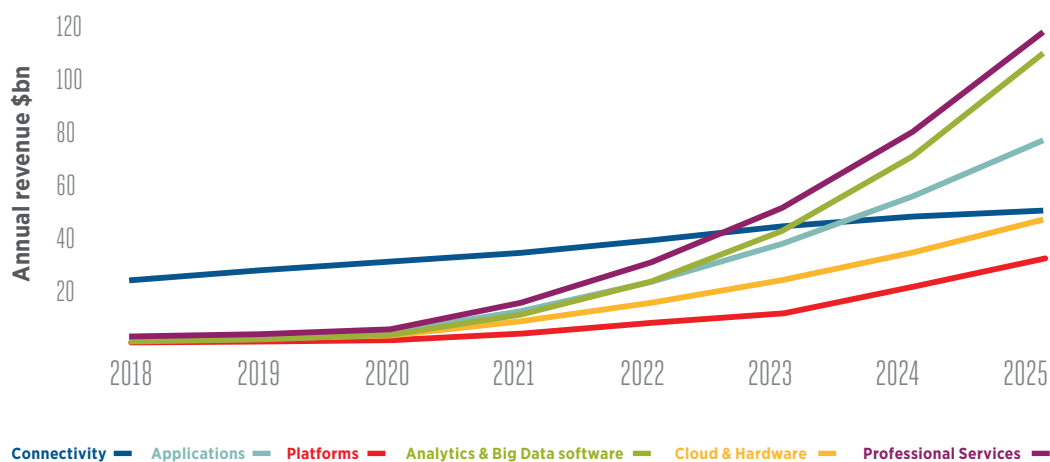


Figure 4: MNO addressable market across the IoT Big Data value chain (\$bn)

Source: PwC analysis

¹² Market sizing estimates are based upon data from GSMA Intelligence and Wikibon Research, on the global IoT and Big Data markets respectively, supplemented from other data from sources as summarised in Annex A.

The value chain opportunity in more detail

MNOs can address the market value for IoT Big Data 'beyond connectivity', as shown in the value chain below:



CLOUD AND HARDWARE: A number of MNOs are building or have built cloud and hosting capabilities which complement services from generic storage providers. Solution/application providers seeking coverage over wide geographical areas (national or international) may approach an MNO to provide data centre and cloud computing resources and connectivity which can leverage the infrastructure of the MNO's cloud across borders or regions. This offers advantages of optimising data transport for security, efficiency and latency.

\$48 bn 
addressable MNO
**market
opportunity**
in **2025**



PLATFORMS: Mobile operators have the capabilities required to build and operate device and data management platforms. MNOs can provide APIs that interact with devices, automate orchestration, conduct simple analytics and manage policy. A small number of major operators also see a specific role in providing data exchange platforms which will act as marketplaces for organisations to gain access to rich data sets hosted by MNOs.

\$32 bn 
addressable MNO
**market
opportunity**
in **2025**



APPLICATIONS: MNOs could invest further in skills and partnerships which enable applications for supporting IoT solutions and services, including solutions such as image processing, network security and asset tracking, as well as applied specifically into verticals. The applications segment is relatively advanced in many markets, larger than the platforms and cloud segments. This is not traditionally a space where MNOs have commanded a major market presence. The above examples illustrate specific spaces where MNOs can build and sustain an addressable role. In line with this, the interviewed MNOs expressed that applications were not to be a major strategic focus in the coming years, however, this still represents a significant opportunity space for those MNOs interested. The relatively larger size of addressable opportunity in this space reflects the overall size of the applications market.

\$78 bn 
addressable MNO
**market
opportunity**
in **2025**



ANALYTICS AND BIG DATA SOFTWARE: MNOs could provide value added services in IoT Big Data either through in-house capabilities or partnerships, whereby operators provide analytics downstream from consulting services.

MNOs such as Telefonica and Orange Business Services have branched out into acquiring businesses which provide consulting services in using data and developing big data insights and solutions (see box below). Such MNOs have an opportunity to enhance the addressable opportunity of such consulting units if they can combine their IoT connectivity offerings into wider propositions that span into monetising or leveraging IoT data. MNOs are also partnering with major consulting firms, taking up roles to provide expertise in line with their domain skills.

\$110 bn 
addressable MNO
**market
opportunity**
in **2025**

MNOs emerging as analytics providers – *Telefonica LUCA: Telefonica's Big Data Unit, LUCA, was conceived after Telefonica's acquisition of Synergic Partners in 2015. Scaled in over 20 countries across over 160 clients, LUCA provides business insights, tools and infrastructure for data analytics and consulting services. It also comprises Telefonica's data-based advertising business. Drawing on core capabilities acquired in artificial intelligence, LUCA's footprint extends outside its original regional market into China, partnering with China Unicom and in Israel with Pelephone, as well as undertaking other collaborations with Huawei, Qlick, Hortonworks and Stratio. Some of the specific solutions LUCA has provided include providing sports analytics services to increase performance in eSports and cycling.*



PROFESSIONAL SERVICES: Whilst MNOs are not traditionally strong in providing professional services per se, a number of operators indicated that opportunities are likely to emerge for providing support to organisations

(principally enterprises, such as logistics companies, mining operators or manufacturing plants) in planning for and executing complex network connectivity strategies to serve their communications enabled business activities. MNOs have a valuable role to play in professional services given their experience and market presence, for example by providing more agile and flexible processes for on-boarding and connecting devices. Distributors, value added resellers or systems integrators often bundle such solutions together with their own, offering integration, customisation, consulting, training and implementation services. Mobile operators such as Orange Business Services and Vodafone are offering professional services to consult and help their customers to implement IoT solutions, reflecting that traditional consulting firms need a better grasp of their customers' challenges being on the frontline of IoT Big Data. MNOs with experience in Big Data techniques and implementation experience should consider the market opportunity for greenfield projects in artificial intelligence and machine learning.

\$118 bn 
addressable MNO
**market
opportunity**
in **2025**

“ The Systems Integrator model is worth looking into for telcos, considering their closeness to local markets and ability to create optimum price points for customers. ”

Michael Stribling,
Digital Services Lead, Spark, New Zealand

Regional and vertical opportunity

The IoT Big Data opportunity splits relatively evenly across regions: the Americas, EMEA (Europe, Middle East and Africa) and APAC (Asia Pacific), at approximately \$145 bn MNO addressable opportunity per region in 2025 (see Figure 6). There are, however, important differences in the industry opportunity across regions, reflected in different GDP industry compositions, the openness and readiness of countries to technology adoption, and the propensity for countries to demand new levels of productivity and efficiency enhancement.

In mid to small sized emerging markets, MNOs are relatively more likely to play a pre-eminent role in the IoT Big Data value chain, compared to their equivalents in advanced markets, a point emphasised by interviewees in such markets. In these markets, such as Indonesia, Turkey or Thailand, where either the depth of general ICT skill may be limited or the MNO is a major ICT player, ambitions to compete for end to end business opportunity may be more realistic for MNOs.

Advanced countries in North America and Europe as well as Japan and Australia, have relatively more competitive, open and complex IoT Big Data markets compared to many emerging markets. In these markets it will be more difficult for MNOs to compete for opportunity in

every value chain segment (beyond connectivity) by confronting other ICT ecosystem players head on. In these markets, strategies to partner with ICT players may result in greater success for MNOs in addressing more of the available market in IoT Big Data. Advanced markets are also more likely to see the emergence of IoT Big Data opportunities focused on specific industries, such as manufacturing and mining, where businesses seek new ways to operate at lower costs.

Developing countries in Asia, Latin America and Africa are likely to experience a steadier uptake in IoT Big Data over the period to 2025. These countries are also likely to experience a relatively greater weighting of opportunity in agriculture than elsewhere as agri-industries use IoT to harness automation in functions such as irrigation. In the Middle East, as well as in mega-cities around Africa, Asia and Latin America, smart city solutions are likely to be a key source of demand for IoT Big Data solutions. Recent evidence suggests that such smart city initiatives are beginning to create monetisable opportunity. Emerging markets could benefit from automation and predictive analytics, such as in municipal services.

“ We receive bundled solutions from MNOs that we partner with to ensure that every corner of the city is reached with our Smart City initiative. ”

Surya Darmadi,
Chief Operating Officer, Qlue, Indonesia

In interviews with MNOs there was a strong consensus that understanding and addressing unique problems an industry or potential end user of IoT Big Data faces has correlation with project success. These examples for particular industries were provided during interviews:

““

IoT innovations need to keep pace with production in automotive and be forward looking for what lies ahead in 5 years. Motor vehicles are usually designed over a 2, 3 or 5 year cycle. ””

IoT in Automotive

““

Understanding the operating environment is critical in agriculture IoT – water tanks, animals, electric fences, temperature and weather conditions have a great effect on how it performs. ””

IoT in Agriculture

Figure 5: Vertical considerations for IoT Big Data projects, from interviews

Industry-leading MNOs, as illustrated in the example from Verizon below, may find that they are in a stronger position to drive IoT Big Data in areas where they have specific insights or skill sets.

Verizon going End-to-End with particular offshoots in its business – *Verizon's relatively new data brokerage platform, ThingSpace, is being used by IoT project runners as well as internally by Verizon such as its Agtech business, which uses the platform to build an end-to-end solution for farmers. Its offerings include analytics services with predictive recommendations and a common interface to manage operations, demonstrating Verizon are transforming its business and pursuing IoT Big Data. This example illustrates how some MNOs are actively building capabilities in IoT beyond connectivity, often focusing on specific verticals first.*

"IoT Big Data is an opportunity for MNOs to get even closer to our customers, understand their businesses better and work with them to create solutions to business problems and to generate new opportunities. In future, MNOs will play a range of roles, from communications provider to solution provider to professional service provider. We're entering an era of new value creation opportunities for providers and customers alike."

Andy Penn, CEO, Telstra

"GSMA predicts over 25 billion devices will be connected across the globe by 2025 with the growth of IoT, most of which will be creating data in real time. This heralds the transformation of the Internet into an ecosystem that at Orange Business Services we call the "Internet of Enterprises." This report is important for the mobile industry, as a holistic approach to IoT & Big Data represents a massive growth opportunity in the near future."

Helmut Reisinger, CEO, Orange Business Services

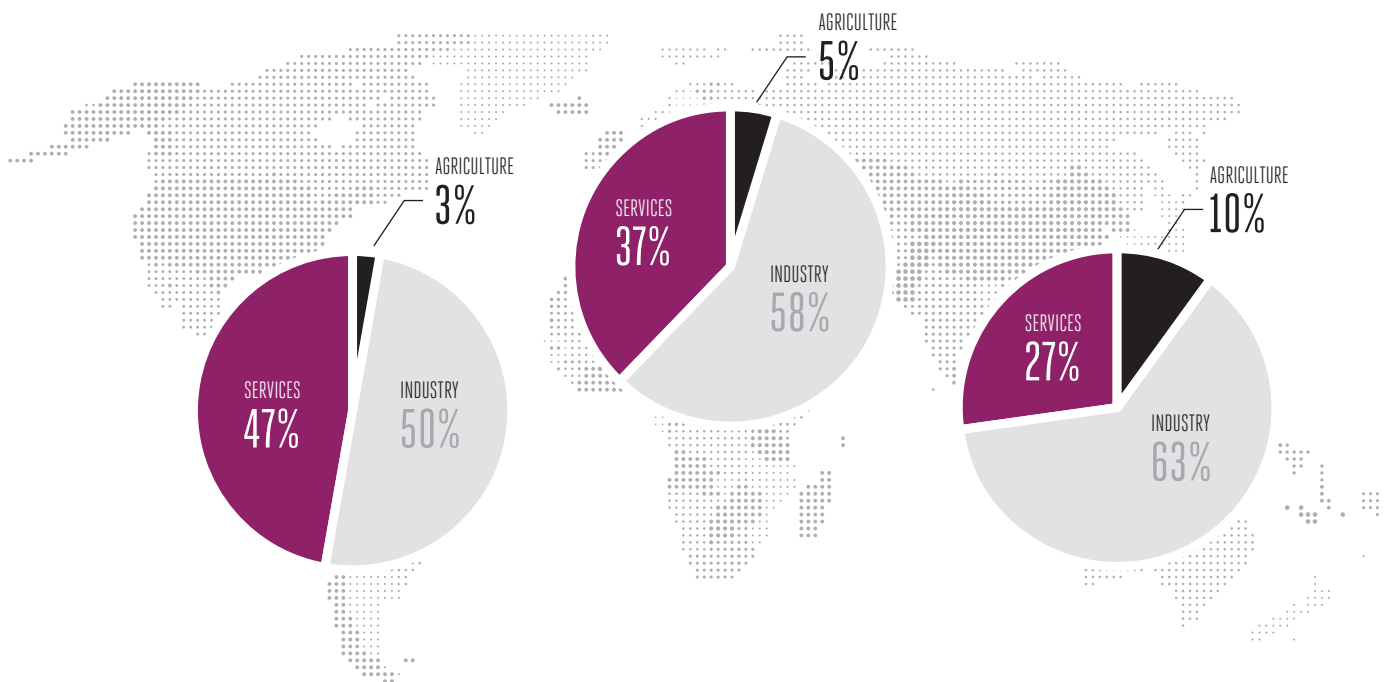


Figure 6: Proportion of IoT Big Data opportunity in high level vertical markets by region (2025)

Source: PwC analysis based on GSMA Intelligence, World Bank & CIA data

2. BUILDING ESSENTIAL CAPABILITIES

Mobile Network Operators need to extend or build new capabilities to compete for the addressable IoT Big Data opportunity, with a particular focus on developing commercial capabilities, adapting culture and organisational agility and building technical capabilities. Attaining greater capabilities in these areas will equip MNOs to partner better, conceive projects and scale IoT Big Data offerings. Figure 7 shows how MNO executives self-assessed their respective capabilities across four key areas of IoT Big Data:

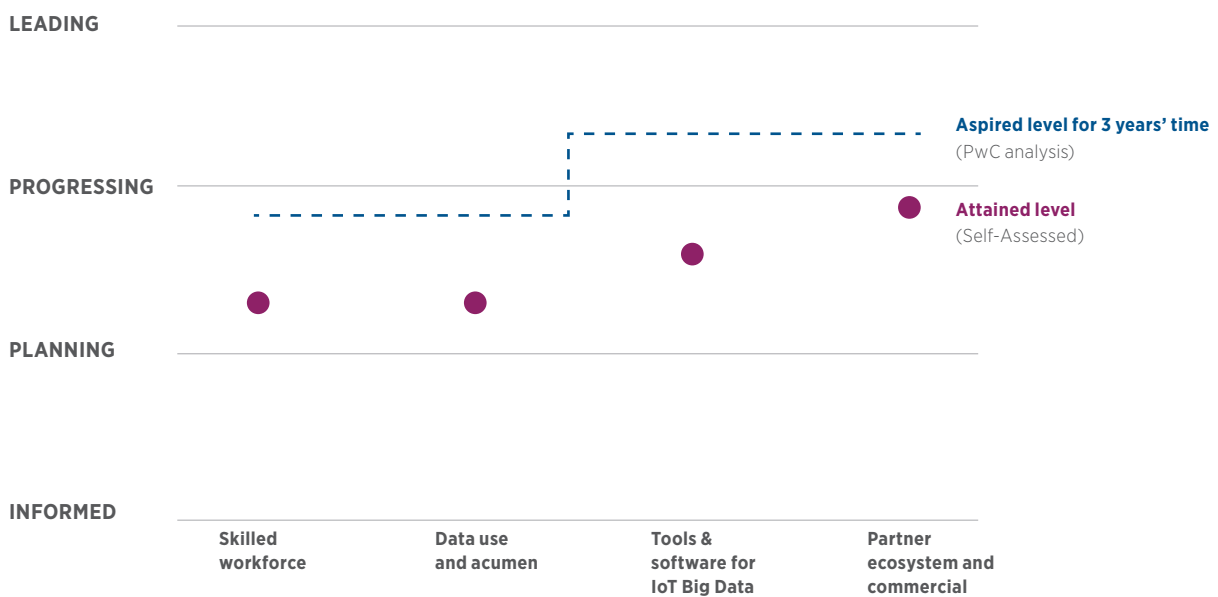


Figure 7: MNO IoT Big Data Capability, Self-Assessed (Average of MNOs surveyed)

Source: PwC analysis

By focusing on developing new capabilities, MNOs have an opportunity to create value ‘beyond connectivity’ in IoT Big Data through:

- ➔ Committing to a phased approach to scaling IoT Big Data, since revenues may not scale quickly at first.
- ➔ Creating meaningful industry-wide partnerships, such that other ICT players and enterprises recognise MNOs for being partners that create value beyond connectivity.

- ➔ Being recognised as a trusted supplier for handling IoT traffic complexity over multiple networks, across jurisdictions and for handling sensitive data.
- ➔ Being the go-to technical specialist of choice for optimised and secure mobile edge computing, a role that MNOs should be able to claim as a core capability as networks become more interoperable and complex.
- ➔ Establishing centres of expertise in AI and ML applied to the IoT and/or specific vertical sectors supporting the needs of enterprises.

2.1 COMMERCIAL CAPABILITIES

MNOs have expressed a need to increase their skills in building partnerships with other ICT companies and industry end users of IoT Big Data and make strong cases for change to succeed in this space. Approaching the market for IoT Big Data entails a greater degree of complexity than required for enterprise communications solutions that MNOs are historically accustomed to selling. MNOs interviewed highlighted the importance of:

➔ **Understanding the baseline and potential impact**

from the perspective of a buyer or customer, so that stakeholders understand the value to be realised from a solution, and how long it will take to conceive and implement a solution. This would require MNOs (either themselves or with their partners) to work with customers to understand the current state (e.g. a 10 per cent defect rate occurring), the variables that affect it (e.g. component quality, operator proficiency, humidity) and the extent to which the organisation can control these variables during the project.

➔ **Quantifying IoT Big Data business impact and value:**

rather than scoping and pricing deals on the amount of connectivity to be provided, MNOs will have to migrate to pricing and bundling IoT related services in ways that are comparable to customers’ own business challenges and KPIs, as well as being simple, scalable and profitable (to MNOs). Whether working within partnerships with other ICT or industry players, or by themselves,

this is a core consultative selling skill MNO sales teams will have to develop.

➔ **Growing importance of pre-sales, post-sales, legal and project management**

will be areas where MNOs will need to evolve, similar to the way IT companies had to between the 1990s to early 2000s. As IoT Big Data business scales up, deal complexity will increase. MNOs must be able to address such complexity to earn a share of the market in the broader addressable opportunity.

75 per cent of MNOs ranked ‘developing and justifying the IoT Big Data business case’ as a top 3 concern in entering the opportunity

→ **Compelling cases for change prioritised over**

Proofs of Concept (PoCs): PoCs are commonplace in the world of IoT and more specifically in telecommunications. MNOs are accustomed to PoCs and pilots. Whilst such PoCs can generate revenue themselves, in the world of IoT Big Data, compelling cases for change which address multi-dimensional business and change-related issues will be key to converting PoCs into scaled implementations on a broader scale. As opportunities in IoT Big Data continue to proliferate, working with society and industry to understand their problems and work out measurable ways to solve them through IoT Big Data solutions will be more valuable than solely demonstrating new technologies.

MNOs surveyed appear more focused at present on building their own commercial capabilities than on market competition, since only **20 per cent** raised **'competition for the market opportunity'** as a top concern.

“ MNOs are developing their offerings and sales capabilities for IoT Big Data and Data Analytics to cater to different buying centers in contrast to buyers of traditional mobile services. End users of IoT Big Data need to be approached differently. ”

Dr Felix Wunderer,
VP IoT Products & Services, T-Systems International

2.2 CULTURAL AND ORGANISATIONAL AGILITY

MNOs interviewed highlighted that it is critical for a cultural shift to occur in the mobile telecommunications industry when it comes to addressing the IoT Big Data opportunity:

→ **Business models:** a number of interviewees explained that MNOs must move away from a mindset of selling connectivity, at a given average rate per month, to delivering value measured through outcomes and priced against such outcomes. Whilst there are commercial skills associated with making this transition (highlighted above) the cultural challenge to make this change has been highlighted as well.

→ **Cross-industry and partnership collaboration:** a readiness to collaborate is an area highlighted by executives, who observed that MNOs have done well to adopt partnership-oriented models, but that there is more to do. Europe-based MNO executives expressed a greater degree of progress made on openness to collaborate, and MNO leaders in Africa and Asia the least.

“ To partner and to compete with other ICT players, we have to change our culture and DNA to keep pace and play our role in the value chain. ”

Gareth Rees,
Group GM of Enterprise Products, MTN

→ **New ways of working:** agility and new ways of working with data are areas where MNOs seek to embrace change, whereby traditional organisational structures are built around delivering connectivity services through “siloes” services organised by domain (such as network, product, customer care) are replaced with collaboration models that build more agile teams around market-facing topics, which can then be realigned around other topics in different combinations (such as a combination of professionals convened around building an industry-specific IoT solution, and later being reconfigured to address a big data opportunity in another vertical).

“ Rather than just for connectivity solutions, telcos have an opportunity to engage with automakers at an earlier and more strategic level, to be involved in the process of rethinking the way we architect auto design and discover new solutions to known challenges. For example, how will 5G change paradigms for autonomous vehicle design, and what does this mean to automakers? ”

Tony Thomas,
Group CIO, Nissan Motor Corporation.

2.3 TECHNICAL CAPABILITIES

As Mobile Network Operators seek to establish their role in IoT Big Data, it is important that their technical skills continue to both deepen and broaden, to ensure they bring value to the wider ecosystem. In this context, MNOs have to focus on what defines their competitive advantages and competencies in playing a valuable and sustainable role, to make them effective partners – i.e. to provide and go beyond connectivity by enhancing their skill sets in the following key areas:

→ **Harnessing data:** getting the basics right in enabling networks to collect various types of data, providing platforms for storing and analysing bulk data from IoT devices, and being able to ingest such multiple types of data into common, readable and analysable formats. This skill is particularly important for MNOs wishing to adopt an enabling strategy by focusing upon value-added services in analytics. The IoT Big Data world will consist of reading and interpreting data collected from a variety of types of sensors and connected devices, including data around heat, light, movement, water, air quality, noise and spread across numerous industries, including manufac-

turing, agriculture, defence, transport and many others. MNOs will need to develop mastery over disparate data collection, conversion into machine-readable information, and assimilation of unstructured data into big data to access the peak addressable market opportunity in IoT Big Data estimated for MNOs in 2025.

→ **Data science, bespoke analytics and reporting:** either complementing partners' analytics skills, or performing these directly, MNOs need to develop skills in data science such as understanding the needs for translating analytics insights into automation.

While MNOs recognise the need for more skills-based development along a number of the topics above, interview results show a growing challenge is emerging for MNOs in talent acquisition for IoT and Big Data/Machine Learning alike. Overcoming challenges in recruiting and retaining talent covering data science, engineering and other business and technology professionals will be crucial to ensuring adequate technical experience to address the IoT Big Data market. Executives have noted the challenge MNOs now face in the war for talent, for example for software-defined network engineers for whom demand hugely outstrips supply in many Organization for Economic Cooperation and Development (OECD) markets today.¹⁵ By adopting more assertive strategies for IoT Big Data, MNOs have an opportunity to stimulate greater interest amongst emerging talent in the market as they expand into new and exciting areas within IoT and Big Data.

→ **Providing security over networks:** this will be an area of increasing demand, both regarding network security from interception and hacking, as well as observ-

ing protocols regarding the handling of and inspection of personal or confidential data, as well as safeguarding national security and IT security, end to end. **Twenty-five per cent** of MNOs surveyed indicated their top concerns included building capabilities in **Privacy and Security** as it applies to IoT Big Data. Privacy and security was most consistently the top concern of European operators, which may in part derive from new regulatory measures in the region (i.e. GDPR). MNOs have an opportunity to develop skills in these domains to productise offerings, both to leverage the industry's reputation as trusted mobile carriers and to ensure high quality security to enable IoT Big Data projects to ensue. Productisation is likely to include the development of applications which provide buyers with specific services to enhance privacy and security, especially concerning network services but also extending to caching and storage.

¹⁵ According to one MNO executive, Australia produced 1,100 SDN qualified engineers in 2018, yet the demand in the job market was for 8,000.

3. MARKET DEVELOPMENTS

3.1 MOBILE OPERATORS ARE ALREADY EMBRACING ROLES BEYOND CONNECTIVITY IN IOT BIG DATA

The majority of MNOs surveyed are already working on making IoT Big Data a material part of revenue in the future. From MNO executives surveyed, 75 per cent explained that their company has either conceived or launched at least one IoT Big Data offering which is earning revenue or is about to do so. IoT Big Data is evidently important to MNOs, with only 10 per cent of executives responding that they are not pursuing the opportunity actively as yet. In most cases such offerings are still connectivity-led, but in almost all cases MNOs explained that their desire is to go beyond IoT connectivity.

- We have launched a solution in IoT Big Data and are deriving revenue. We plan to scale the offering considering its success and are looking into other opportunities to generate value from IoT Big Data.
- We have conceived an offering in IoT Big Data and established in-house technical and commercial delivery teams or acquired assets for the purpose of taking a solution to market.
- We have sized the opportunity (e.g. drawn up a business case), developed a high level strategy and road map for entering the IoT Big Data space.
- We are aware of use cases of MNOs monetising and using Big Data and are considering entering the IoT Big Data space, but have no specific plans to do so.

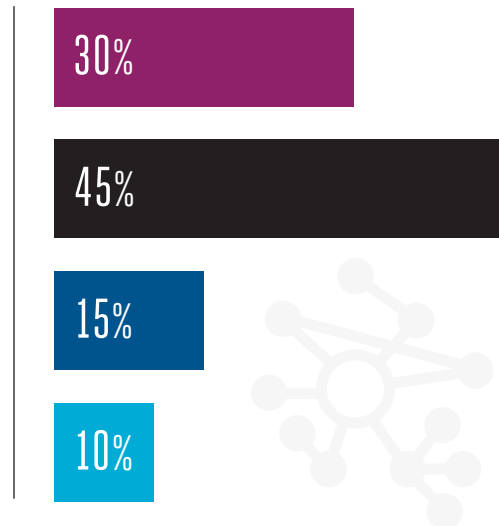


Figure 8: Where is your organisation in its plan to pursue the IoT Big Data opportunity?

Source: PwC analysis, World Bank, CIA, GSMA Intelligence

Globally, Mobile Network Operators are beginning to apply their emerging Big Data and IoT capabilities to provide a variety of use cases across different industries spanning transport, retail, agriculture, health, smart cities and energy, as shown below in Figure 9. Such use cases also span alternative functional skills provision, from traffic analysis, to operational and service improvement, and targeted marketing.

Operational 	SK telecom: SK Plant user traffic analysis	AT&T: Network optimisation Vodafone: Network operation efficiency T-Mobile: Wireless resources	BT: Security data analytics services France Telecom: Leveraging user experience	T-Mobile: User loss alert China Mobile: Anti-fraud and anti-scams in text messages and phone calls
Financial services 	Vodafone: Mobile banking AT&T, T-Mobile, Verizon: Mobile payment	China Telecom: Credit evaluation, insurance, counter-fraud China Unicom & China Mobile: Credit analysis		
Transport 	Telefonica & China Unicom: Smart Steps, customer concentration tracking at various locations	AT&T: Service Management platform for smart fleet	T-Mobile: Navigation system, accident calling system Orange: Traffic analysis service Verizon: Hum, roadside assistance and driver monitoring	China Telecom, China Mobile: Risk monitoring in logistics
Retail 	Telefonica: Smart footprint tracing customer shopping locations	Spring: Market insights and industry analysis		
Agriculture 	Viettel Mobile, MobiFone, VinaFone: IoT solution for Vietnam aquaculture farm, monitoring livestock Telefonica: Automated remote irrigation system in Spain	Telenor Connexion: TracVino – IoT and other Big Data to optimise harvest times, sustainability in southwest Germany		
Health 	Telenor: predicting & tracing disease spread Telefonica: Contagious diseases predictions NTT: Digital Health Consumer Platform	China Mobile: Healthcare Big Data services for hospitals in diseases treatment, diseases prevention		
Smart cities 	Telefonica: Smart city, municipal project investment analytics services SFR: Disperse audience traffic in football games	France Telecom: Establishing the public IT systems KT: Smart Seoul T-Mobile: Las Vegas Smart City	China Telecom & China Mobile: Smart City / Public safety surveillance	
Energy 	T-Mobile: Energy network development, analytics	Vodafone: Connectivity and customer/billing platform for Mobisol smart meters		

Figure 9: Example MNO IoT Big Data Use Cases by Industry and Capability

Source: PwC analysis, Macquarie Research, Forrester

MNOs see IoT Big Data emerging differently across verticals

In the survey on the opportunities in IoT Big Data undertaken for this report, MNOs were asked to rank their industries of interest from first to last preference. Figure 10 below shows the proportion of MNOs surveyed which chose specific industries as being those which they would seek to target first in IoT Big Data.

Manufacturing, logistics and smart cities, (e.g. large-scale, 'mission-critical' IoT projects) were among the highest industries of interest from MNOs surveyed, with 35 per cent ranking manufacturing and industrial IoT as their top

industry of interest, followed by transport and logistics at 20 per cent. Over half of surveyed MNOs placed transport and logistics in their top three industries of choice to target for IoT Big Data.

Although smart cities represented a small portion of MNOs' top industry preference, 50 per cent ranked it either second or third, indicating that whilst MNOs see smart city projects as having great potential, it will take time before such opportunities mature. Agriculture was ranked third by 35 per cent of MNOs (referred to as primary industries), with these responses predominantly from Australia and New Zealand (ANZ) and developing regions in Africa and South East Asia.

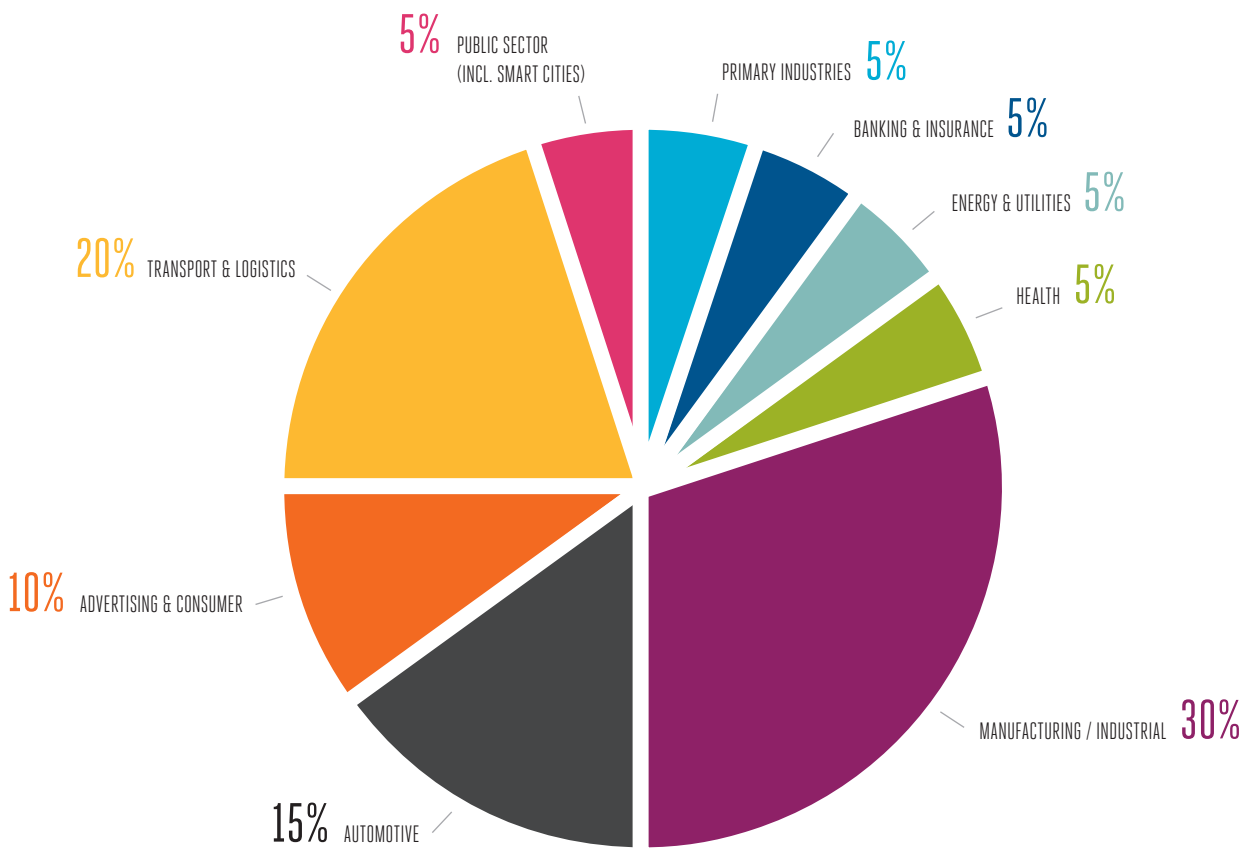


Figure 10: Top ranked industries to target for IoT Big Data, according to MNOs (% of survey responses)

Source: PwC analysis

The energy and utilities sector was ranked with relatively low interest from surveyed MNOs, with only 10 per cent placing it in their top three industries. This signals a frustration over the long lead time for utilities to undertake “brownfield” replacements of large numbers of old meters with smart, or sensor-connected meters, often taking up to 10 years to work through a typical cohort of customer premises in a large and established market.

Public agencies are seeing opportunities for IoT Big Data to create social impact

Governments and development agencies are seeking new ways to improve how they design, implement and monitor projects through harnessing more accurate, timely and accessible information. The proliferation of mobile networks combined with new capabilities in leveraging mobile and IoT big data presents an opportunity to address this problem. Connected solutions already offer unique public impact benefits in developing countries, often referred as Big Data for Social Good (BD4SG) and offering an important role for MNOs. In the case of Ebola, “smart” bandages can monitor patients and determine medical response. Patterns in migration and interaction based on analysing cellular data can also aid in the control of emerging pandemics. The United States Agency for International Development (USAID) has supported and employed many IoT solutions via sensor technology and analytics to monitor, predict, and protect Ebola patients in developing countries such as Liberia.¹⁴

Currently, some of the most extensive uses of IoT in the developing world are in projects involving providing clean water and/or sanitation, including biosensor networks using manual arsenic sensors being used to monitor water quality,¹⁵ and using IoT to record data on agricultural water usage and flow rates.¹⁶

China has already emerged as an outstanding market for IoT Big Data

Despite being an emerging market, China’s adoption of IoT connectivity and downstream solutions is outpacing that of wealthier, more advanced economic regions such as the US or EU. The relatively rapid emergence of the IoT Big Data opportunity in China can be attributed to three factors:

➔ The Chinese Government has incorporated IoT into its economic development agenda. The “Made in China 2025” and “Internet+” government plans set out strategies for China’s intelligent manufacturing era and for expanding the internet ecosystem to incorporate cloud and big data applied to specific industrial growth plans. For example, China is aiming for long-range connectivity to be included in 80 per cent of vehicles by 2025, and with connection targets for optical systems (optical cameras, night vision systems etc.), Radar and LiDAR, positioning systems and semiconductors.

¹⁴ PLOS, 2014, *Commentary: Containing the Ebola Outbreak – the Potential and Challenge of Mobile Network Data*, accessed 29 August 2019 <https://eprints.soton.ac.uk/370053/1/CommentaryEbolaOutbreak.pdf>

¹⁵ Marco Zennaro et al, *Wireless Sensor Networks: a great opportunity for researchers in Developing Countries*, accessed 15 August 2019 <http://users.ictp.it/~mzennaro/WSN4D.pdf>

¹⁶ China Mobile, 2010, *China Mobile: Enabling a Better Life – Sustainable Future with ICT*, accessed 8 August 2019 <https://www.chinamobileltd.com/en/ir/reports/ar2010/sd2010.pdf>

→ Chinese ICT players, including Mobile Network Operators and network equipment providers, are harnessing and combining their skills collaboratively to create the first signs of IoT Big Data solutions which extend into artificial intelligence and machine learning, going “end to end” for customers. For example, according to analysts China’s telecom operators own 60 per cent of national data centre capacity, indicating that MNOs in China plan to closely couple connectivity with storage¹⁷. In addition:

- ↳ China Mobile has established a standalone IoT business unit, which is separate to the rest of the mobile business, to pursue IoT opportunities. The company is investing in capabilities which include cloud storage, IoT security, analytics and big data capabilities. Whilst recognising that the revenue upside from carriage of data traffic will gradually diminish, China Mobile report that revenue from its IoT business increased by 43.8 per cent to CNY5.2 billion by the end of FY2019, having added 142 million connections to total 693 million.¹⁸
- ↳ China Unicom has developed partnerships with around 20 automobile manufacturers for “IoV”

(Internet of Vehicles), achieving breakthroughs in edge-computing for low latency vehicle control.

↳ China Telecom’s early move to NB-IoT, providing country wide coverage (310,000 NB-IoT enabled base-stations) and stability (800MHz frequency band with improved in-building penetration and wide area coverage) has seen it build a strong enterprise client base for its IoT business.¹⁹

↳ IoT penetration is associated with China’s relatively higher readiness for technology and efficiency of adoption compared to other emerging markets. One factor which may go towards explaining China’s accelerated adoption of IoT technologies is its strong manufacturing sector,²⁰ with 40 per cent of China’s GDP attributed to manufacturing, compared to 16 per cent in India. China’s burgeoning markets in aerospace technology, high-speed railway, civil and military technologies, supercomputing, quantum computing and consumer electronics are all industries which stand to benefit from IoT and Big Data innovation.

China Mobile’s OneNET:

Over 30 million connected devices and 20,000 IoT applications (including for Internet of Vehicles, environmental monitoring, agriculture and manufacturing) are using the OneNET platform, which provides IoT connectivity in 346 Chinese cities.

According to China Mobile, one enterprise customer has used OneNET successfully to significantly decrease R&D and server deployment costs and achieve parallel management of over 50,000 connected devices.

Other users of OneNET have used the platform to enable shared economies (through remote customer access management), smart city initiatives, real-time monitoring for safety appliances in the home and agri-tech solutions. For instance, data collected from sensors on agricultural sites which send raw data to the OneNET platform, which monitors and interprets data received, and based on preset conditions, triggers actions such as smartly controlled irrigation once soil moisture levels reach a minimum.

¹⁷ IoX, Macquarie Research, March 2018

¹⁸ Mobile World Live, 2019, *China Mobile profit tumbles as data growth stalls*, accessed 13 September 2019 <https://www.mobileworldlive.com/asia/asia-news/china-mobile-profit-tumbles-as-data-growth-stalls/>

¹⁹ Macquarie Research, 2018, IoX, p 81

²⁰ India Brand Equity Foundation and Statista

MNOs are seeking to develop distinct roles in new industries, such as vehicle automation. In major markets, such as the US and China, the move towards IoT enabled automobiles is supported by policy measures to encourage innovation and technology development, and MNOs in these markets are exploring the roles they can play. Low latency and high performance 5G network connectivity provides a core role for MNOs in connected vehicles, and from this base, operators such as AT&T, Vodafone and China Unicom are developing wider roles across the IoT Big Data value chain for vehicles. A major Asian auto manufacturer has explained that they are supported by a mobile operator to provide speech to text translation services for vehicles, another example of where MNOs are developing data-rich applications to provide business value to customers beyond connectivity.

Retail automotive examples show how MNOs can leverage their existing customer base in IoT: working with 10+ major automakers worldwide, AT&T enables connected cars to be added onto its mobile share data plan for only US\$10/month.



“Internet of Vehicles” (IoV) is in the national agenda for US and Chinese governments, with the Chinese Government aiming for long range connectivity to be available in 80 per cent of vehicles by 2025 and local governments in the US (such as Los Angeles) synchronising thousands of traffic signals to improve IoV operating conditions.

Edge-computing is of high value in IoV: China Unicom has major partnerships with circa 20 automakers for IoV, owing to its breakthroughs in edge-computing – a key technology in meeting IoV requirements due to lower latency. It also has partnerships with major digital content providers in China – which IoV partners can use to offer attractive infotainment services.

Providing connectivity for IoT projects such as in the above examples allows MNOs to develop vertical depth which can position them to provide value-added services, such as generating transformative insights from data collected.

Figure 11: Spotlight on Auto IoT

Source: PwC analysis, Macquarie Research

3.2 OPERATORS ARE ADDRESSING KEY CHALLENGES IN IoT BIG DATA

MNOs face distinct challenges in realising the full scale of the IoT Big Data opportunity. Key challenges being faced across the industry are highlighted below:

→ **Going beyond IoT trials:** some operators are considering how they will scale their role beyond basic connectivity, whether by acquiring capabilities or partnering with other ICT and industry players. Addressing these questions is critical for MNOs and a key priority is to “make market trials and pilots count”, moving beyond proving out use cases to establishing precedents which can be scaled competitively and commercially.

→ **Agility and culture:** while MNOs develop specific skills in this new space, the industry recognises that pivoting towards IoT Big Data requires cultural shifts to respond to new market opportunities. Diverse strate-

gies are emerging in the telecoms industry, with some MNOs focusing on partnerships and others developing or acquiring new capabilities, new ways of working and co-design of IoT solutions with customers and partners.

→ **Business case:** operator management teams and boards, under pressure to sustain the industry’s impeccable record of revenue and profit growth, are concerned that current and near-term IoT revenue streams remain small for most MNOs (at present IoT revenues, principally based on connectivity, in the mobile industry still account for less than 1 per cent of operator total revenue).



The strategies beyond connectivity span roles in enabling IoT Big Data to transforming businesses and consumer experiences through MNOs providing more comprehensive and integrated end to end plays across the IoT Big Data value chain. These strategies may be referred to as “Enable” and “Transform”:²¹

ENABLE



Describes the potential for MNOs to leverage their experience in data collection and analysis, security, distribution and deployment, device provisioning, billing, data management platforms and services including cloud and edge storage to specialise in an area of IoT Big Data beyond connectivity to enable projects.

In this strategy, MNOs provide select offerings across the IoT Big Data value chain adjacent to their connectivity role, and, deepen their expertise in the prescribed domains to provide a specialised service to enable IoT Big Data products. For instance, MNOs may draw upon their experience in data management platforms and cloud and edge storage to deliver a role as platform provider. In addition, they can leverage their experience in data security, device provisioning or billing to provide professional services to design and dimension the connectivity elements of IoT Big Data projects.

TRANSFORM



Represents the potential for MNOs to take a leading role across a wider scope of the IoT Big Data opportunity, going beyond the Enable strategy. MNOs pursuing a Transform strategy contest opportunity in IoT Big Data by competing or partnering with IT companies, platform players and major professional services firms, often applying more vertical-specific capabilities as well (for example in health or logistics).

²¹ These strategies bear reference to the roles beyond connectivity which can be played by MNOs in IoT, 'empower' and 'transform' contained in the following report, co-authored by the IDC and the GSMA: <https://www.gsma.com/iot/resources/iot-opportunities-report/>

4. NEXT STEPS

To build a sustainable role in IoT Big Data beyond connectivity, MNOs must focus on creating and capturing value, forming closer working relationships with other ICT players, and being bolder in shaping the market. Building on themes in this report, next steps around these three topics are explained below.

4.1 CREATING AND CAPTURING VALUE

Mobile Network Operators must take clearer steps to understand the IoT Big Data opportunity better in the context of the markets and industries in which they operate. Many operators are involved in proofs of concept and trials involving IoT and Big Data, but there is further opportunity to focus activities on value creation as well as proving technical challenges in trials, for example:

- ➔ MNOs in China have demonstrated how a focus on specific manufacturing or industrial value chains can yield commercial dividends, by committing time and skills to understand industrial processes, designing solutions which address problems and create value (for example, through cost savings or risk reduction). Involvement in industry ecosystems is paying dividends: by 2018, as much as 33 per cent of big data revenue for Chinese MNOs was being generated from financial services, retail and government sectors, while only 27 per cent was attributed to internal MNO uses²², indicating that Chinese MNOs have moved quickly into creating external value which they can monetise.
- ➔ Many smart city initiatives, the subject of much discussion, are frustrating MNOs who are seeking to provide solutions beyond connectivity, since the gestation period for city deals is long and complicated. MNOs can work more closely with city councils and ICT partners in understanding citizen needs and using these insights to design smart city services. They should leverage these engagements to conduct trials that build service offerings that can scale up. MNO focus must shift to service offerings that users will be willing to pay for, rather than simply proving technical outcomes.
- ➔ In North America and Europe, operators such as Vodafone have inserted themselves into the development cycle for auto design, gradually integrating themselves into situations where they are jointly involved in solution design for connected vehicles of the future. To date, much of the pay-off is restricted to connected cars with SIM cards as well as devices which enable tracking. However, this is positioning MNOs for greater value creation in future. In the same segment, for example, China Unicom has begun to explore opportunity beyond connectivity by applying edge computing to connected vehicles.
- ➔ A number of MNOs have identified data brokerage platforms as a route to monetisation, including Deutsche Telekom, Telstra and Verizon. In these cases, MNOs are not only looking to monetise data but to utilise derived analytical insights to create end to end solutions for industries, such as agriculture. Such activities provide an example of how some MNOs are envisioning a role in data analytics and insights to identify and capture value.

²² IoX, Macquarie Bank, April 2018

4.2 FORMING CLOSER RELATIONSHIPS ACROSS ICT CAPABILITIES

This leads to the second consideration, that MNOs must take steps to form more meaningful partnerships and combinations across ICT capabilities. MNOs will seldom be able to create value beyond connectivity without some restructuring of their organisations to broaden activities beyond the traditional connectivity focus. As MNOs venture into generating new value from IoT and Big Data, a fresh perspective on partnerships and capabilities expansion is critical, for example:

- ➔ Orange and Telefonica have acquired data analytics businesses. Telefonica's acquisition of Synergic Partners led to the launch of the Telefonica Data Unit 'LUCA' in 2016²³.
- ➔ Chinese MNOs' investment in data centre capacity. Providing examples of how MNOs are recognising the value in integrating their connectivity service capability with a wider set of ICT capability to capture more value.
- ➔ AT&T's goal to embed connectivity into US-supplied vehicles in order to provide an IoT-connected experience to car owners, by building relationships with automotive OEMs (such as Audi and General Motors) and banking on the expectation that over 75 per cent of cars shipped globally will be connected by 2020²⁴.



²³ Marco Zennaro et al, *Wireless Sensor Networks: a great opportunity for researchers in Developing Countries*, accessed 15 August 2019
<http://users.ictp.it/~mzennaro/WSN4D.pdf>
<https://www.telefonica.com/en/web/press-office/-/telefonica-launches-luca-its-new-big-data-unit-for-corporate-customers>

²⁴ IoX, Macquarie Bank, April 2018

4.3 BEING BOLDER IN SHAPING THE MARKET

IoT Big Data represents a new market opportunity which is not currently well understood by businesses, telecom operators or governments. MNOs have an important opportunity (and responsibility) to shape a better understanding of IoT Big Data, for example:

- ➔ Some MNOs are extending the culture of using data in managing networks and internal operations to creating value for customers and enterprises, such as Chinese operators, by aggressively recruiting data specialists and software-defined network engineers into the business, and being prepared to compete in the labour market to attract the best talent.
- ➔ Leading MNOs, referred to throughout this report, are confidently partnering in the ecosystem with other ICT players. These MNOs are prepared to collaborate and acquire new skills, investing time and resources in seeking out value, and are prepared to learn from mistakes as they innovate in this new market.
- ➔ MNO management teams must spend more time educating their boards, to secure longer term commitment to pursue these rich opportunities which may take time to mature over the next few years.
- ➔ Many businesses have a limited or partial understanding of the potentially significant impact of IoT Big Data, and this presents an opportunity for MNOs to work with partners to shape the view of business customers through commercially focused case studies and trials.
- ➔ Many Governments have a limited understanding of, or even scepticism for, the benefits offered by IoT Big Data, and MNOs have to take bolder steps to help policy makers see the benefit of both IoT and big data. Applications for IoT big data are likely not well understood, and MNOs must be more forthcoming in investing time and effort in defining and addressing key problems, so that they can steer policy makers towards successful outcomes.

IoT Big Data presents a generational opportunity for MNOs to leverage their fundamental role in connecting the world into a future which expands well beyond connectivity. Over the next few years, MNOs must be active in taking steps to demonstrate they can compete for the opportunity to transform economy and society, and benefit fully from a period of significant digital evolution.

5. ANNEX: MARKET SIZING APPROACH

5.1 DATA SOURCES FOR IOT BIG DATA MARKET SIZING

Market sizing data used for this report includes data from:

- GSMA Intelligence on the global IoT market opportunity in 2015 to 2025 (May 2018)²⁵
- Wikibon Research on the global Big Data market opportunity in 2020 to 2025 (March 2018)²⁶

These were supplemented with other data from the World Economic Forum, the United States Central Intelligence Agency and the World Bank from which regional economic and technological indicators were used to better understand the drivers for potential addressable market size in IoT Big Data for MNOs from 2020 to 2025.

5.2 VALUE CHAIN ANALYSIS FOR IOT BIG DATA MARKET SIZING

Key assumptions on addressable market percentages for each area of the IoT Big Data value chain were calculated based on internally generated insights and industry experience of Subject Matter Experts at PwC and further supported by desktop research. Wide ranging industry interviews with around 20 leading executives from mobile operator companies, technology companies and end user companies of IoT Big Data were conducted. These interviews were complemented by a market survey designed and distributed by PwC specifically for preparing this report. Together, these were used to derive and validate key assumptions and develop scenarios associated with the estimates, these led to the market share estimates as shown below which applied to the revenue estimates from GSMA Intelligence and Wikibon Research.

²⁵ GSMA Intelligence, 2018, *IoT: the \$1 trillion revenue opportunity*.

²⁶ Wikibon Research, 2018, *Wikibon's 2018 Big Data Analytics Trends and Forecast*.

IoT BIG DATA VALUE CHAIN SEGMENTS	TOTAL ESTIMATED MARKET (2025, \$M)	ESTIMATED MNO ADDRESSABLE MARKET SHARE (2025)	ESTIMATED MNO ADDRESSABLE MARKET (2025, \$M)
Platforms	71,654	45%	32,263
Cloud & Hardware	224,502	21%	47,789
Applications	287,375	27%	77,635
Analytics & Big Data software	202,878	54%	110,432
Professional Services (IoT & Big Data)	329,657	36%	118,424
Total 'Beyond Connectivity'	1,116,065	35%	386,544
Connectivity	51,173	100%	51,173
Total IoT	1,167,239	38%	437,717

Figure 12: MNO addressable market for 2025

Source: GSMA Intelligence, Wikibon Research, PwC analysis

MNO ADDRESSABLE IoT MARKET GLOBAL (\$M)	2021	2022	2023	2024	2025
Platforms	3,959	7,979	11,562	21,741	32,263
Cloud & Hardware	9,514	16,476	25,002	35,403	47,789
Applications	13,340	24,337	38,608	56,492	77,635
Analytics & Big Data software	11,999	24,519	43,506	71,607	110,432
Professional Services	16,501	31,691	52,210	80,911	118,424
IoT Beyond Connectivity	55,314	105,002	170,888	266,155	386,544
Connectivity	35,256	40,039	45,267	48,958	51,173
Total IoT	90,570	145,040	216,154	315,112	437,717

Figure 13: MNO addressable market from 2021 to 2025

Source: GSMA Intelligence, Wikibon Research, PwC analysis

5.3 REGIONAL AND VERTICAL ANALYSIS FOR IoT BIG DATA MARKET SIZING

Regional and vertical analysis of the opportunity was conducted to inform research for this report. Firstly, efficiency enhancement and technology readiness indicators from the World Economic Forum was applied to IoT intensity indices provided from PwC across three high level sectors, Agriculture, Industry and Services, to gauge the relative intensity and readiness for IoT across nations and between verticals in those regions. The resultant indicator for each country per vertical was multiplied by the country's share of regional GDP and the regional IoT market opportunity in 2025, as forecasted by GSMA Intelligence.



Figure 14: Calculation for regional IoT Big Data market analysis

The results of the country by country analysis informed interview discussions, added context to survey insights and were used to guide research and support recommendations made in this report.



About the GSMA

The GSMA represents the interests of mobile operators worldwide, uniting more than 750 operators with over 350 companies in the broader mobile ecosystem, including handset and device makers, software companies, equipment providers and internet companies, as well as organisations in adjacent industry sectors. The GSMA also produces the industry leading MWC events held annually in Barcelona, Los Angeles and Shanghai, as well as the Mobile 360 Series of regional conferences.

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