WORLD ECONOMIC FORUM

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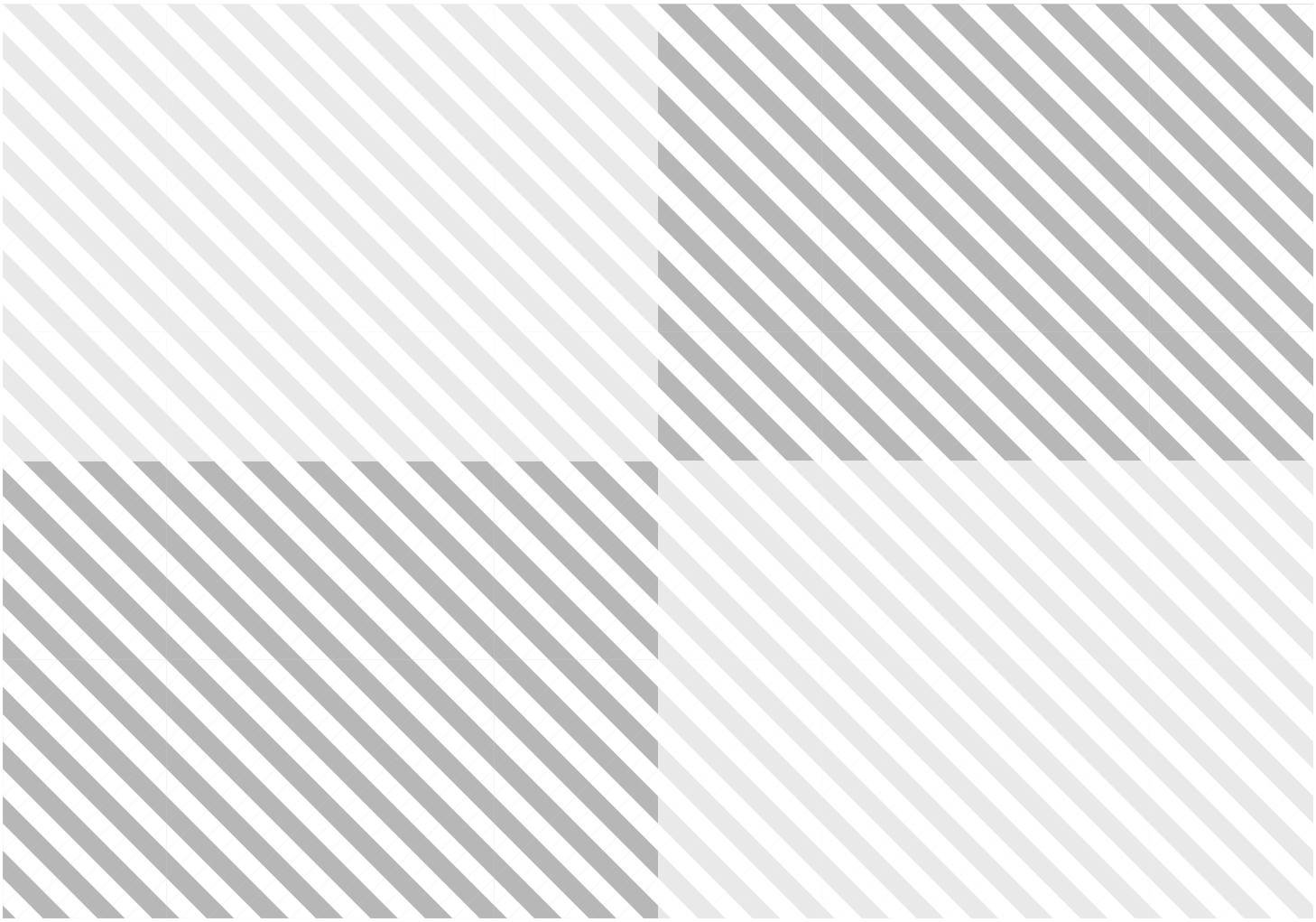
White Paper

Digital Transformation Initiative

Telecommunications Industry

In collaboration with Accenture

January 2017



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The Digital Transformation Initiative

The Digital Transformation Initiative (DTI) is a project launched by the World Economic Forum in 2015 as part of the System Initiative on Shaping the Future of Digital Economy and Society. It is an ongoing initiative that serves as the focal point at the Forum for new opportunities and themes arising from latest developments in the digitalization of business and society. It supports the Forum's broader activity around the theme of the Fourth Industrial Revolution.

To find out more about the DTI project, visit
http://reports.weforum.org/digital-transformation

1. Foreword

Digital transformation is emerging as a key driver of sweeping change in the world around us. It has the potential to significantly improve consumer lives and create broader societal good, while providing businesses with new opportunities for value creation and capture.

The telecommunications industry is at the forefront of this transformation, both as an industry witnessing large-scale change in its market environment and as a key driver of worldwide digitization. Investment by the telecommunications industry in technology and interoperability has underpinned an immense shift in information and capital flows through the global economy, while providing the building blocks for the emergence of entirely new business models across industries. In parallel, access to a globally connected network has empowered millions of people around the world, by giving them access to real-time information, marketplaces and social programmes that will have long-term implications for quality of life.

It is clear that digitization will be a source of transformational change, but there are a number of challenges that need to be overcome. In many cases, the gains from digitization have been inequitable, with the benefits not reaching those who need them most. At the same time, the exponential increase in global information flows has created new risks for data privacy and security. Businesses across sectors are grappling with challenges related to changing customer expectations, cultural transformation, outdated regulation and skill shortages, among others.

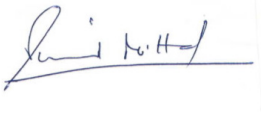
The World Economic Forum is committed to helping leaders understand these implications and supporting them on the journey to shape better opportunities for business and society. The Digital Transformation Initiative (DTI) is a project launched by the World Economic Forum in 2015 to serve as the focal point for new opportunities and themes arising from the latest developments in the digitization of business and society. It supports the Forum's broader activity on the theme of the Fourth Industrial Revolution.

In 2015, DTI analysed the impact of digital transformation on six key industries – automotive, consumer goods, electricity, healthcare, logistics and media – and on three cross-industry topics – digital consumption, digital enterprise and societal implications. In 2016, DTI was extended to cover seven additional industries, including telecommunications, and two new cross-industry themes: platform economy, and societal value and policy imperatives. Through its broad focus, DTI has driven engagement on some of the most pressing topics facing industries and businesses today and provided business and policy leaders with an informed perspective on how to take action.

This white paper was prepared in collaboration with Accenture, whom we would like to thank for its support. We would also like to thank the members of the World Economic Forum's Telecommunications Industry Steering Committee and the more than 40 experts from industry partners, government and academia who were involved in shaping the insights and recommendations of this project.

We are confident that the findings will contribute to improving the state of the world through digital transformation, both for business and society.

Gavin Patterson
Chief Executive, BT Group
Chairman Telecommunications Industry
World Economic Forum – 2017



Sunil Bharti Mittal
Chairman, Bharti Enterprises
Chairman Telecommunications Industry
World Economic Forum – 2016

Bruce Weinelt
Head of Digital Transformation
World Economic Forum

Executive Summary

Industry digital transformation context

Enabling the Fourth Industrial Revolution

The ever-wider availability of technologies such as mobile, artificial intelligence, cloud, analytics and platforms is dramatically altering the way we live, work and interact – in what has been termed the Fourth Industrial Revolution.[1] The telecommunications (telecom) industry is playing a critical role in enabling this digital revolution unfolding around us.

The telecom ecosystem has provided the fundamental building blocks – access, interconnectivity and applications – that are enabling this digital revolution to take place. A large share of potential value stemming from digitization across global industries over the next decade is dependent on the telecom industry delivering essential infrastructure, applications and productivity improvements in many areas.

- **Retail**. Broadband penetration will be essential to the growth of e-commerce, which could directly result in almost $100 billion in value migration from offline to online retailers over the coming decade.
- **Automotive**. Customized networks that make telematics and usage-based insurance a reality could save more than 120,000 lives by reducing traffic accidents.
- **Electricity**. Telecom industry infrastructure will enable connected devices on the grid and in consumer homes to drive a potential $170 billion in cumulative cost-savings for consumers over the coming decade.

Missing out on a digital windfall?

The industry faces a rapidly changing economic and competitive landscape driven by internal and external digital disruptions. So far, the role that telecom operators have played in accelerating digital business and service models has not translated into new value for the operators themselves. Operators' share of the industry profit pool has declined from 58% in 2010 to 47% in 2015, and is forecast to drop to 45% in 2018. Pressure on traditional revenues means that it is increasingly important for operators to look at new digital business models to make sure that they share in the value from digital transformation.

Future horizons

The digital transformation of telecommunications represents a $2 trillion opportunity for industry and society

The next decade of digitization will look markedly different from the past and companies across the industry will need to be well-prepared to take advantage of the sweeping transformation taking place in consumer lives, enterprises and the broader economy. Our research has identified four broad digital themes, each including tangible digital initiatives that firms can implement, which we expect will have the biggest impact on telecom companies.

Networks of the Future. Virtualization and an abstraction of the physical hardware layer promise to fundamentally change the basis of future service differentiation by creating self-optimizing and secure zero-touch networks.

Beyond the Pipe. The increased digital transformation of consumers' lives and businesses presents the telecom industry with important opportunities to extend revenue streams beyond connectivity, through integrated internet of things (IoT) solutions, consumer and enterprise digital services, and reimagined models of digital communication leveraging advances in natural human interfaces and augmented reality/virtual reality.

Redefining Customer Engagement. To win the race for customer loyalty and mindshare, telecom industry players will need to increasingly deploy features and tools that deliver delightful digital experiences. This is especially important as customers now expect the high-quality digital experiences they receive in one industry to be matched by companies in other sectors.

Bridging the Gap on Innovation. The need for rapid innovation, greater convergence and new services means that telcos must fill capability gaps using new innovation models and revamped talent strategies for a digital workforce.

The magnitude of impact of the four themes highlighted above will be immense, with more than $2 trillion in value at stake for industry, consumers and wider society over the coming decade. Of this, the value to the telecom industry could exceed $1.2 trillion in cumulative operating profit from 2016 to 2025, with initiatives under Networks of the Future and Beyond the Pipe representing the largest-value opportunities. These themes also stand to create more than $800 billion in value for society and consumers, the majority of which will come from efforts to connect the billions of people still unconnected to the internet.

Figure 1: Value at Stake for Industry, Consumers and Wider Society, 2016-2025

	Units	DIGITAL THEMES				TOTAL VALUE
		Networks of the Future	Beyond the Pipe	Redefining Customer Engagement	Bridging the Gap on Innovation	
Value to Industry	$ billion	400	650	30	160	1280
Value to Society	$ billion	580	290	2	1	873
Total Value at Stake	$ billion	**1,020**	**940**	**32**	**161**	**2,153**

Note: Some values have been rounded off for simplification. Source: World Economic Forum/Accenture analysis

Key imperatives for industry and policy leaders

Inhibitors to change

Some significant barriers stand in the way of this value capture: firms are encumbered by legacy assets; there is limited collaboration between the public and private sectors; the "innovator's dilemma" encourages inertia; and the culture at incumbent firms is impacting their ability to attract and retain the best digital talent.

There are other challenges hindering societal value creation. For instance, slow or uneven adoption of digital communications or the internet in under-penetrated regions can exacerbate the digital divide by concentrating most of the benefits in the population segments that are better prepared to benefit from the technology – the wealthy, the educated and the skilled. Unlocking wider value for the lowest economic segments will need focused action to address the analogue challenges – affordability, fair competition, locally relevant content and accountable institution.

Imperatives for industry and policy-makers

Network transformation will be necessary to enable new business models beyond the pipe and address changing customer expectations.

Enabling new cross-industry business models in areas such as IoT will require flexible and agile networks that allow ubiquitous coverage of people and things, software-defined network functions and analytics, personal data protection and cyber-resilience, ultra-reliable low-latency communication, and enhanced mobile broadband.

New business models leveraging emerging technologies will require strong collaboration with vertical industries and internet platforms.

Competitive advantage in digital services and IoT will be driven by the capability to collect and analyse large pools of data specific to vertical-market use cases and to target value opportunities through customization of services and offerings.

Operating in the digital age requires corporate cultural change along with new organizational structures.

Creating a culture of innovation will be dependent on breaking through established organizational hierarchies and orthodoxies. This will be driven mainly by a change in governance, incentives, metrics and talent strategy.

Digitization of the industry will require a transformation of existing policy and regulatory models.

Transformational change in networks and business models will have to be accompanied by greater flexibility in regulation, especially on spectrum management, consistency across jurisdictions and fiscal policy. This paper also provides near-term practical recommendations for industry leaders to drive successful transformation.

Telecommunications Industry and Digital Transformation Context

The digital transformation of the telecom industry is unfolding along two paths. The industry faces a rapidly changing economic and competitive landscape driven by internal and external digital disruptions that point to a fundamentally different future reality. At the same time, the industry is increasingly critical to realizing the large societal and economic benefits generated by the digitization of other industries.

a. Enabling the Fourth Industrial Revolution

Combining technologies such as cloud, mobile, social, data analytics, artificial intelligence and drones in innovative ways has the potential to magnify their capabilities exponentially. The "combinatorial effect" is thus far greater than the impact of deploying these technologies separately. The confluence and ever-wider availability of these technologies promise to fundamentally alter the way we live, work and interact – a development that has been termed the Fourth Industrial Revolution.

> **The internet of things and industrial digitization have the potential to have as big an impact on people as the incarnation of the internet itself had, possibly even bigger than that.**
>
> Kathrin Buvac, Chief Strategy Officer, Nokia

Enabled by telecom technology, the growth in information and money flowing through the global economy is mind-boggling. Global flows of goods, services and finance could triple from $26 trillion in 2012 to more than $80 trillion in 2025. To put these figures in perspective, the total value of these flows increased only 1.5 times in the 20 years between 1990 and 2012. Global broadband speeds are increasing at 20% a year (rates of 1,000 Mbps are now becoming a reality), opening tremendous possibilities for businesses and society. The importance of the telecom industry's role is only likely to grow as companies across industries integrate cloud, mobile and global digital services to drive their business models and thus increase the importance of the underlying network enormously.

An Explosion in Connectivity and Data

400 million Factor by which total mobile data traffic has grown in the past 15 years[3]

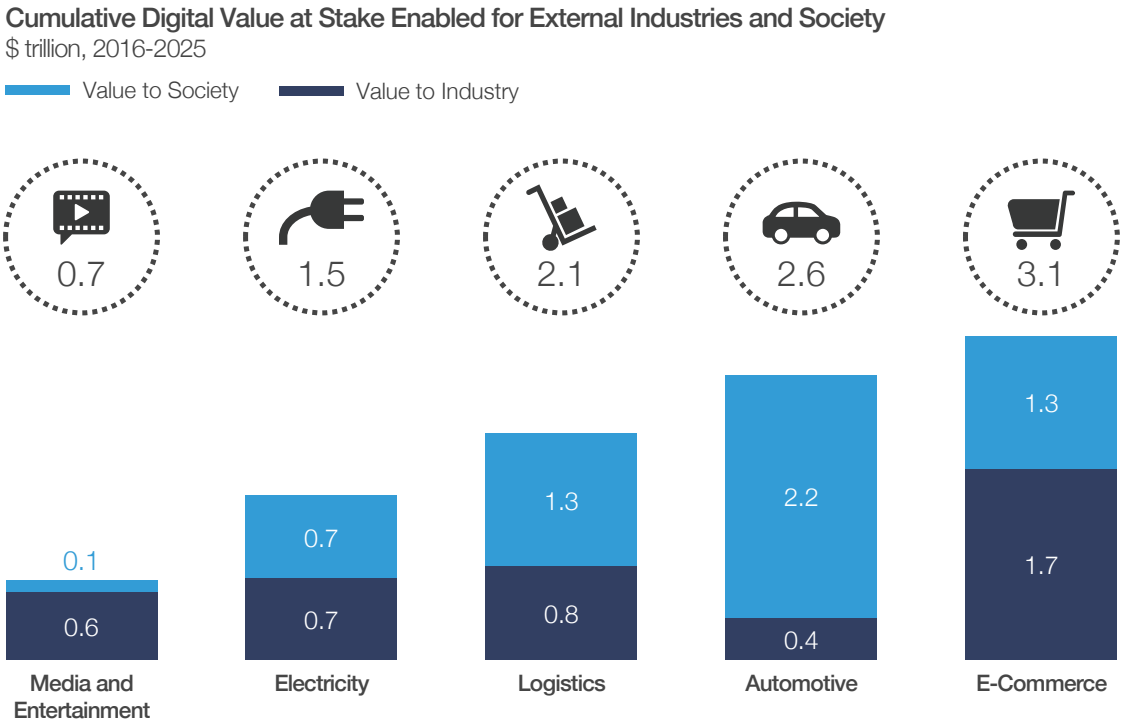
44 zettabytes Forecast annual data flows in 2020 (equivalent to 44 trillion gigabytes)[4]

40% Proportion of all data stored or processed in the cloud by 2020[5]

Over the same period, the number of connected devices, which enable and drive business models in the IoT, could reach 30 billion. New technological initiatives such as drones and autonomous vehicles will depend heavily on reliable and secure connectivity. We are already at a stage where networks going down could put entire businesses and perhaps human lives at risk.

The telecom industry is playing a critical role in supporting the digitization of other sectors. Our estimates point to more than **$10 trillion** of value from digitization in five key global industries over the next decade (see Figure 2) being directly dependent on essential infrastructure, applications and productivity improvements delivered by the telecom industry.

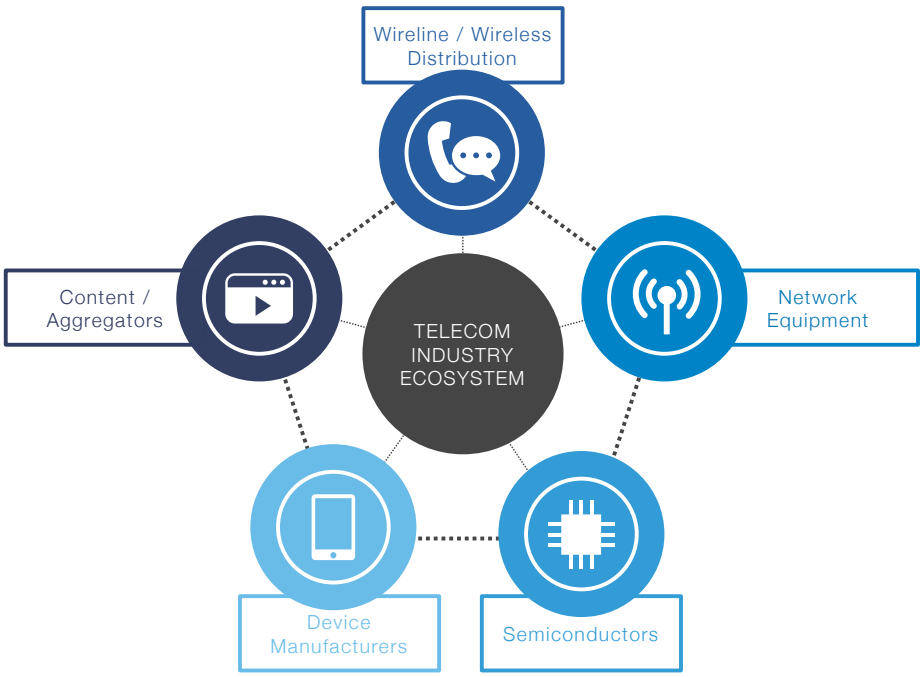
Figure 2: More than $10 Trillion of Value from Digitization in Five Key Industries over the Next Decade Depends on the Telecom Industry



Note: The values above reflect only the share of total industry and societal value directly enabled by telecom infrastructure and applications. Rounded values may not add up. Source: World Economic Forum/Accenture analysis

It is important to note that this value capture will not be enabled by communication service providers (CSPs) or application developers alone. Digital transformation has started to break down decades-old silos within the telecom industry and has given rise to an integrated digital communications ecosystem. As Figure 3 illustrates, the landscape of the telecom industry is shaped by an ecosystem of business segments, with disappearing boundaries.

Figure 3: The Digital Communications Ecosystem



b. Value from digital transformation has eluded operators

The role that telecom operators have played in accelerating digital business and service models for external industries, as well as their own initiatives to refocus business models, have not translated into new value for the operators themselves. They now account for a smaller portion of the overall industry profit pool than five years ago and this share is forecast to fall even further.

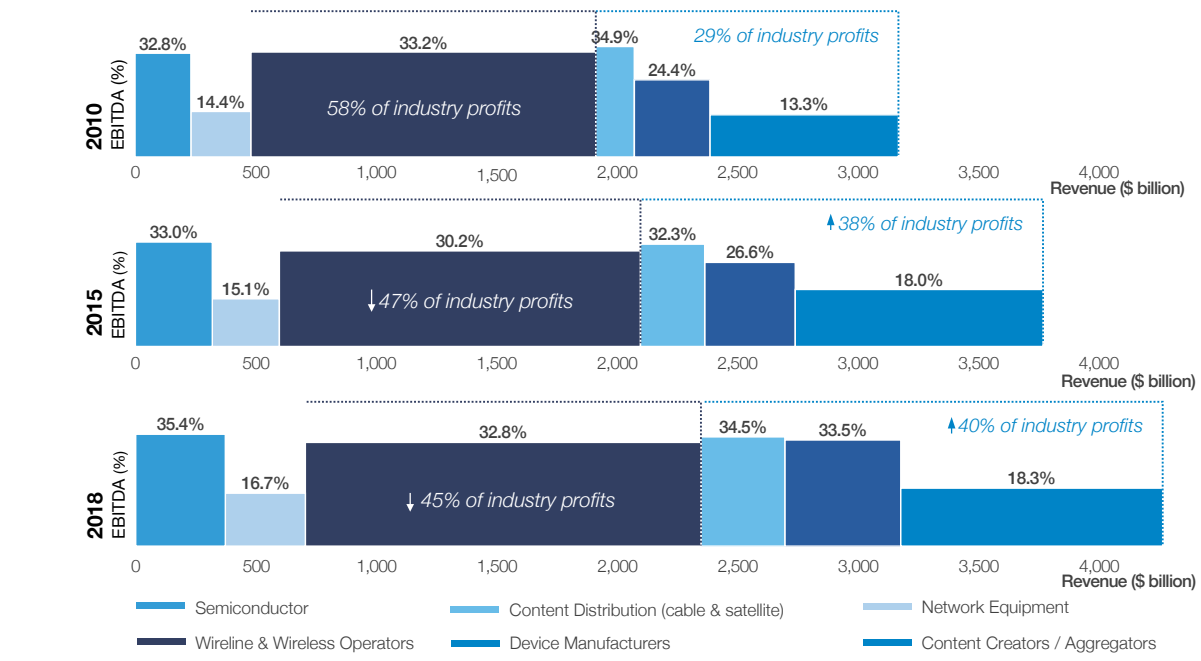
It is well-established that operators have not been successful in protecting their traditional voice and messaging revenue streams from digital businesses. Estimates have shown that over-the-top (OTT) applications generate 50% to 90% less revenue for CSPs. While the exponential rise in data consumption has provided some relief, this has not been enough to overcome the consistent decline in mobile voice average revenue per user (ARPU). Competitive pricing pressure and OTT disruption have been accompanied by rapidly increasing costs as demands on bandwidth and speed have continued to grow exponentially.

13%-36% Decline in APRU in all regions globally since 2012[6]

$2 trillion Value of network investments needed to keep pace with demand over the next decade

While legacy revenues have been under pressure, telecom operators have largely failed to launch and scale new business models. CSPs may have made large strides in the technology, standards and interoperability underlying wireless and wireline connectivity but they have consistently lost out to both new, nimbler digital businesses such as WhatsApp and incumbent technology players that are aggressively acquiring digital communication capabilities (e.g. Microsoft and its acquisition of Skype). Colliding pressures on revenue and costs, overlaid with operators' failure to monetize the digital opportunity, have resulted in profit and value pools shifting away. Operators' share of the industry profit pool has declined from 58% in 2010 to 47% in 2015 and is forecast to fall further, to 45% in 2018 (see Figure 4).

Figure 4: Wireless/Wireline Operators Account for a Shrinking Portion of the Telecom Profit Pool



Source: World Economic Forum/Accenture analysis based on data from S&P Capital IQ

However, not all segments of the telecom ecosystem have struggled to create value. Digital content creation, distribution and aggregation companies have seen large increases in profits and shareholder value over the past 10 years. Together with device manufacturers, the combined share of industry profits of these segments is expected to increase to 40% in 2018, up from 29% in 2010. Digital content creators and aggregators, including Google, Netflix and Facebook, have achieved scale and captured value by effectively leveraging the global penetration of the internet to deliver unique digital services and experiences to end-consumers. Device manufacturers have grown their market capitalizations through the groundbreaking product and design innovation that has made smartphones an indispensable part of our digital lives.

Fixed-line and cable companies have benefited from the rapid growth in IP broadband networks, especially with the large increase in demand for fibre (FTTx) deployments, but have also been largely successful at monetizing the convergence of TV and broadband. The investments in complementary businesses that drive the demand for connectivity through their pipes (e.g. Comcast's acquisition of NBCUniversal; BT's foray into sports broadcasting) are also indicative of greater convergence across the digital communications ecosystem.

Looking ahead, what might the distribution of industry profits in 2025 look like? Interestingly, many of the executives we interviewed believed that the share of wireless/wireline operators in industry profits could fall even further, implying that these companies are still not doing enough to capture long-term value from digitization.

> **At the end of the day, the digital divide will be between those who take advantage of technology and those who do not. We are playing a big role in transforming to a new world where everyone has the same access to technology and what will differentiate us is the ability to use that technology for something useful and good.**
>
> Ulf Ewaldsson, Senior Vice-President, Chief Strategy and Technology Officer, Ericsson

c. The competitive and regulatory environment is evolving

There are signs that the next phase of competition in telecommunications may look different from the past, accelerating the need for operators to abandon incremental initiatives in favour of transformational innovation. A number of key trends are likely to increase pressure on margins by forcing operators to undertake large investments at a time when competition in the industry is intensifying. These trends include:

– **1,000x capacity driving new technology paradigms**
The growth in data consumption and the surge in the number of connected devices are likely to require future networks to have 1,000 times more capacity than is available today. At the same time, a growing number of real-time applications will demand that end-to-end network latency be reduced to milliseconds, to enable a seamless and lag-free experience in browsing, watching videos or even remotely controlling robots or vehicles.

To cope with bandwidth demand, mobile networks will transform into a massively dense heterogeneous network ("HetNets") with a high degree of flexibility afforded by technologies such as software-defined networking (SDN), network function virtualization (NFV) and Cloud RAN. With spectrum efficiency and bandwidth coming to its logical limits, the new normal will be densifying cells by up to a factor of 100. Some of these requirements will be met through the expected transition to the next-generation (5G) network, but the rapid increase in demand is likely to drive much faster development and adoption of these technologies on legacy networks as well.

– **Colliding on platforms: "the fight for the middle"**
The emergence of the digital economy has meant that networks and semiconductors now form the infrastructure layer of application-specific technology stacks, with other layers consisting of enabling platforms (integration software, operating systems), applications and digital services for end-users. Until now, these layers have developed independently, with large numbers of participants in each layer competing to build and provide services for specific-use cases. However, we are already seeing increased convergence and consolidation towards the middle platform layer. Application developers and digital service providers are developing their own integration systems and middleware as these aspects become critical to their business models and also provide large revenue and profit opportunities (Amazon Web Services is a prime example). At the same time, network operators are developing new capabilities in these areas to move beyond the relatively slow-growing infrastructure layer. For those that succeed in this "fight for the middle", the benefits are likely to be significant.

> **The platform layer is just getting going. This is the piece in the middle and this is where the big change will occur – whatever service people use needs specific functionalities that are becoming more and more uniform – billing, customer service – this is not something that people need to build but just use an existing platform that they can plug into.**

Gregg Rowley, Chief Strategy Officer, Saudi Telecom Company

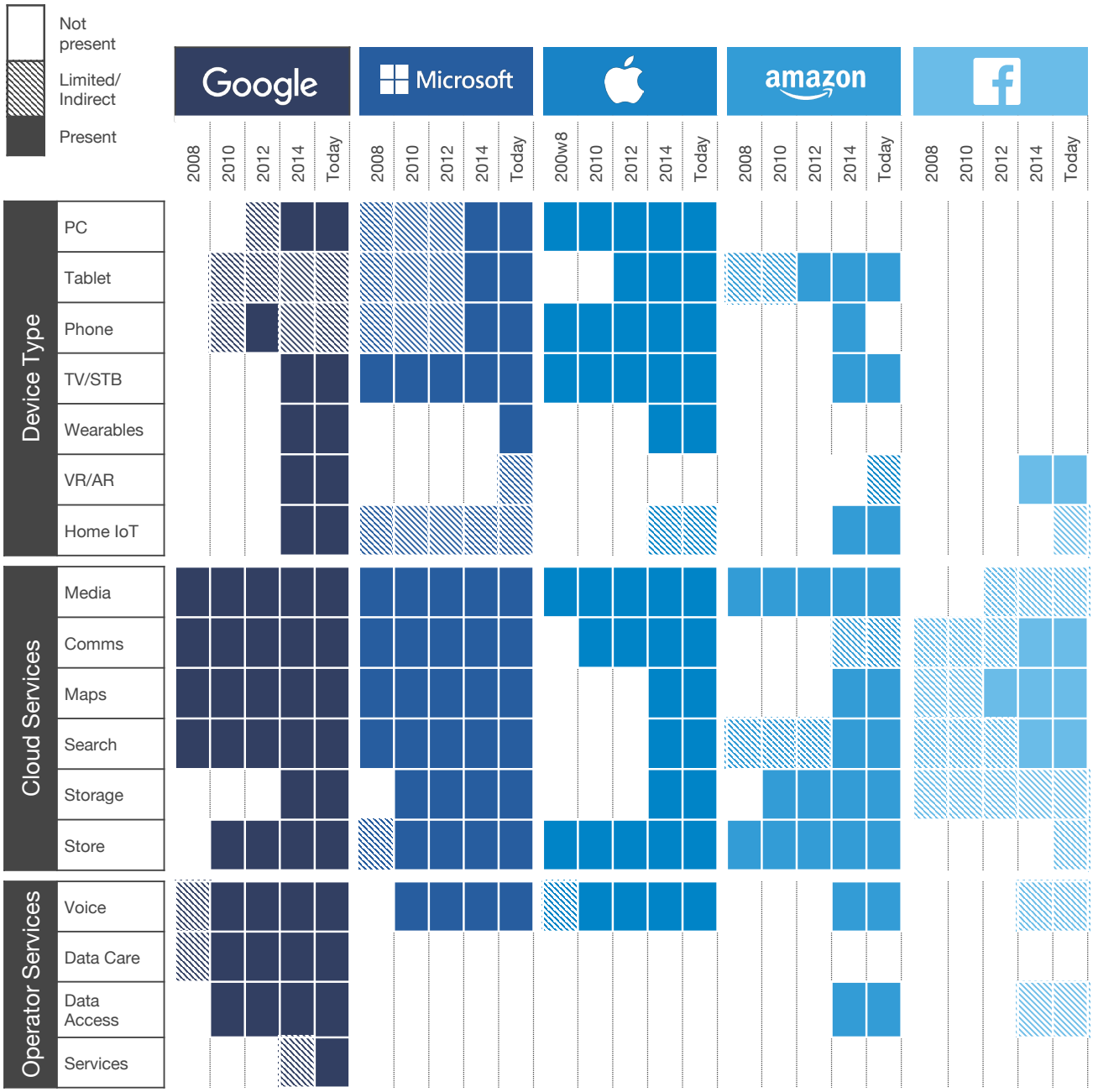
– **Diminishing differentiation**
The emergence of data-driven business models now means that competitive differentiation is driven by companies that can best utilize consumer data to drive business models. Telecom players, already lacking OTT businesses in this respect, face a real threat of being left to compete on two inherently contradictory fronts – price and throughput – that could put margins under further pressure. Telcos could be left to compete as IP-connectivity pure plays. In the extreme scenario, increasing commoditization of the core offering could see margins drop to the levels of utility companies.

– **Customer 3.0**
Customers are beginning to judge the quality of the products or services they receive not only against competitors within that sector but also against the best customer service they have experienced in any industry. Customers now expect levels of personalization, on-demand access and quality that match the leaders in any industry. This will become increasingly important for operators as expectations evolve faster than the industry's ability to meet them. Almost 20% of customers responded in a recent survey that they don't care who provides them with communications services as long as those services meet their needs.

– **Networks as national assets**
Governments are recognizing the potential for telecom networks to drive competitive differentiation at a national level, but they also view the industry as a key source of government revenue through licensing fees and sectoral taxes. Several countries – including Japan, New Zealand, Singapore, India, Australia and the Republic of Korea – are deploying widespread fibre-to-the-premises (FTTP) networks at a national scale to bridge an emerging digital divide and deliver key social benefit programmes. However, these efforts that put networks at the centre of government or political agendas could mean higher profitability pressures on operators through greater regulatory scrutiny, pricing pressures or even wide-ranging nationalization of telecom assets.

– **Web-scale disintermediation**
The disintermediation of telecoms has gone beyond just OTT services displacing CSP offerings to the disintermediation of the entire relationship between customer and operator. Current limitations in network quality and capacity, along with a relatively high cost of access for consumers, have meant that some digital businesses are choosing to reduce their reliance on existing service providers. Web-scale players such as Google, Microsoft and Facebook are moving quickly – more quickly than telecom operators in most cases – to fill key gaps in core telecom services and connectivity (see Figure 5). Google has active projects exploring both fixed-line IP and last-mile connectivity (Google Fiber, Project Loon and Project Fi), while Amazon and Apple have been making investments in removing the need for the customer to choose, or even know, which network providers enable their devices. Facebook has now even announced plans to launch its own "white box" optical networking switch, a plan that stands to disrupt existing revenue streams of network equipment providers . Armed with a greater focus and ability to meet customer demands, these digital businesses will put increasing pressure on established telecom customer relationships.

Figure 5: Web-Scale Companies Are No Longer just OTT Players



Source: World Economic Forum/Accenture analysis

Future Horizons: Digital Transformation of Telecoms Is a $2 Trillion Opportunity for Industry and Society

A series of digital, industry and customer trends is accelerating digital transformation in telecommunications. The industry is gearing up for a massive increase in demand from other industries. Customer expectations are crossing industry boundaries and raising the bar across industries, forcing telecom operators to redefine customer experience. Networks themselves will evolve from being differentiated on proprietary hardware to an era of software-defined systems. And pressures on traditional revenues have meant that operators are looking at new digital business models and service areas, with areas such as IoT likely to emerge as new battlegrounds.

Our analysis has identified four digital themes that we expect to have the greatest impact on digitization in the industry over the next decade:

Networks of the Future. Virtualization and an abstraction of the physical hardware layer promise to fundamentally change the basis of future technological differentiation by creating networks that will be self-aware, self-optimizing, self-healing and self-secure.

Beyond the Pipe. The increased digitization of consumers and businesses presents the telecom industry with important opportunities to extend revenue streams beyond just connectivity – through IoT, digital services and entirely new models of digital communication.

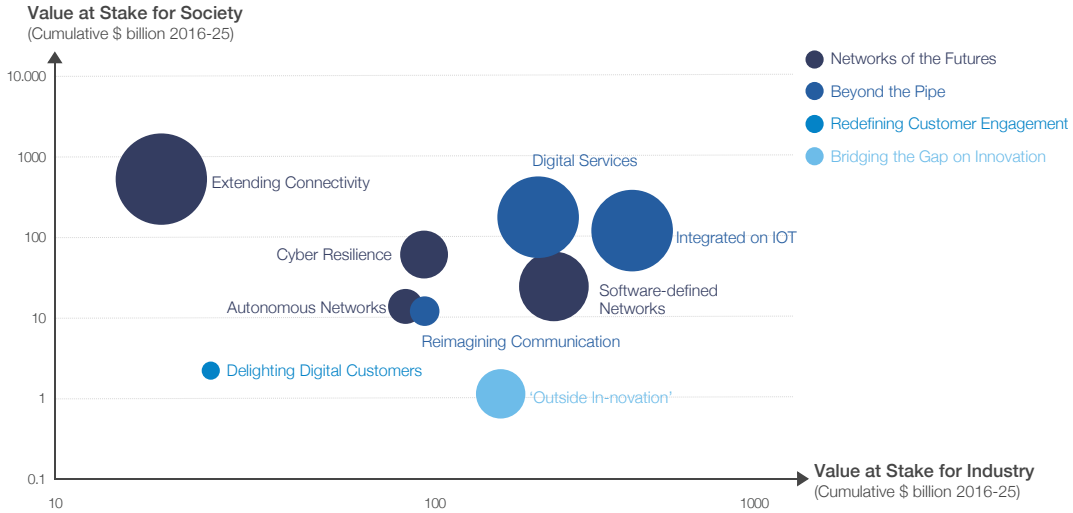
Redefining Customer Engagement. To win the race for customer loyalty and mindshare, the telecom industry will need to increasingly deploy features and tools that deliver delightful digital experiences. This is especially important as customers now expect the high-quality service they receive in one industry to be matched by companies in other sectors.

Bridging the Gap on Innovation. The need for rapid innovation, greater convergence and new services means that telcos must fill key capability gaps using new innovation models and revamped talent strategies for a digital workforce.

Within each theme is a set of tangible *digital initiatives*, which companies can implement to drive digitization forward. Despite new competitive pressures, digitization represents a significant opportunity for the telecom industry to create value. Our analysis of the main digital transformation themes and initiatives found that digital transformation in telecommunications could unlock more than $2 trillion in value for the industry, consumers and wider society over the next decade (see Figure 6).

The following section of the report describes each future digital initiative, its potential impact on the telecom ecosystem and the challenges to widespread implementation.

Figure 6: Mapping the Value of Digitization in the Telecom Ecosystem for Industry and Society, 2016-2025



Note: Bubble size represents the total cumulative value at stake for industry and society between 2016 and 2025. The value at stake from digital initiatives *Winning the Battle of Ecosystems, Transforming for a Digital Workforce*, and *Brand Atomization* has not been quantified. Source: World Economic Forum/Accenture analysis

How we calculated the value of digital transformation in telecommunications

Our value-at-stake methodology aims to assess the impact of digital transformation initiatives on industry, customers, society and the environment. It provides likely value estimates of global industry operating profits that are at stake from 2016 to 2025, and the contribution that digital transformation can make to customers, society and environment in that time frame.

A full explanation of our value-at-stake methodology can be found in the Appendix below.

a. Networks of the Future

One of the key achievements of the telecom industry has been to establish the vast physical networks of local, national and global connectivity that have transformed the world. However, the ability of physical infrastructure to drive differentiation has diminished drastically. In the future, networks are likely to evolve in two main ways. First, advances in digital and cloud capabilities will transform operators' cost bases, moving away from expensive, proprietary hardware to generic, commoditized equipment that allows a greater share of resources to be invested in increasing reliability, flexibility and innovation through software. Second, an explosion in diverse use cases across industries will require networks that are flexible, autonomous and customized, while ensuring that underlying data flows are reliable and secure.

Software-differentiated networks

Over the coming decade, network functions traditionally implemented on costly hardware will be replaced with lightweight software solutions supporting standard "IT-like" or API-based interfaces, deployable on very inexpensive, general-purpose hardware platforms. This shift is being led by technologies built on and enabled by the cloud, such as software-defined networking (SDN) and network function virtualization (NFV).

While the industry is yet to arrive at a common vision for future networks, most view SDN and NFV as central to their plans. These technologies promise several important benefits: SDN by separating the control and data layers; and NFV by replacing complex network functions with easy-to-manipulate virtualized software. Widespread adoption of these technologies will be driven primarily by network cost reduction – 64% of operators rated this as the main adoption trigger in a recent survey. It is estimated that SDN and NFV could generate savings of 25% to 75% of overall operator operating expenditure thanks to significantly reduced provisioning, monitoring and hardware costs. These technologies also promise to create value for customers through flexible services, faster times to market and improved user experiences. The ability to view and manipulate network functions on demand, and at a granular level, will catalyse service innovation and allow stronger collaborations between customers and providers.[12]

From the outside, the deployment of SDN and NFV may look like any other industry technology push, but many analysts are comparing the scale and scope of the transformation to be equivalent to the introduction of IP-based networks (which enabled the global internet). While current adoption levels are negligible, SDN and NFV are forecast to be a fundamental part of telecom networks across the world by 2025, with significant potential benefits for both the industry and its customers. While there is yet to emerge a common defined standard for deployment across carriers and technologies, large network carriers – AT&T, Deutsche Telekom, NTT, Telefónica and Verizon among others – are likely to lead the efforts to develop and standardize critical components of SDN and NFV.

Case Study: AT&T – Pioneering the Adoption of SDN and NFV

AT&T has emerged as a leading adopter, setting itself the target of covering and controlling up to 75% of its network using SDN and NFV technologies by 2020. Its Domain 2.0 vision for its networks includes rich APIs that manage, control and consume services on demand and in real time, and common infrastructure that can be provisioned as data-centre pods. This will help to create the blueprint for other global carriers to follow.

Value-at-stake impact

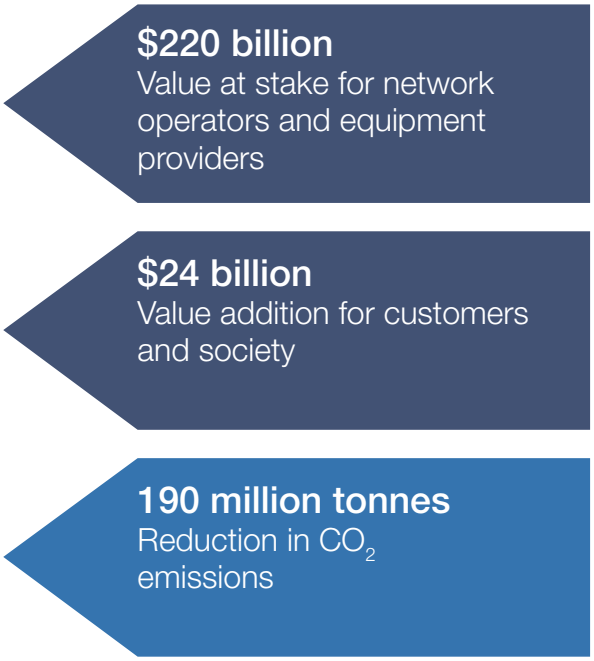
Value for industry. SDN and NFV could be worth a total of $220 billion for network operators and equipment providers over the next decade. Much of that figure comes from a drop of up to 30% in network and operational technology spending, coupled with energy cost reductions of up to 50% by 2025. New operating profits of $14 billion for network equipment providers – from the sale and implementation of SDN and NFV across carriers and enterprise customers – will offset a reduction in revenue from the shift towards generic and low-cost physical hardware. Over the next decade, lower network spending by operators is likely to move $8 billion of existing profits away from network equipment vendors and towards operators.

Value for consumers and society. By reducing energy use, software-differentiated competition could save society more than 180 million tonnes of potential CO2 emissions. Pricing pressures and market saturation in key developed regions mean customers can expect to benefit from a significant reduction in network operating costs. If 5% to 10% of operators' cost savings are passed on to them directly, customers would benefit by $15 billion.

The wider impact of this initiative will not be entirely positive. The significant reduction in network-related costs and a fundamental shift away from large hardware deployments could impact thousands of jobs in the industry, particularly those related to network deployment and maintenance. The industry will have to take concrete steps to address this impact, probably by reskilling workers to operate in a software-oriented world. At the same time, new roles will be created, as a high level of software development skills will be needed to support new network architecture.

Software-differentiated Networks: Value at stake in numbers

(All figures cumulative for period 2016-2025)



Autonomous (zero-touch) networks

The rapidly increasing capabilities and computing power of machine-learning technologies pave the way for networks that are self-aware, self-optimizing and self-healing. Networks that can identify and rectify problems before they occur, while automatically provisioning bandwidth to where it is needed most, are likely to become essential as complexity increases exponentially. A network servicing 10 million endpoints and 10,000 nodes could see these numbers increase by up to five times by 2020. In terms of incidents per hour, this would lead to a 25 times increase from 400 incidents to as many as 10,000 per hour – an amount that is impossible to handle manually.[13] According to some experts, networks are already approaching a point where it will be impossible for human beings to control and manage them by using manual interventions.

Automated networks will be a reality soon. Automation has been a key part of IP and Ethernet network technologies, and the importance of self-organizing networks (SON) was identified by 3GPP as critical to an optimal end-user experience in 4G/LTE radio-access networks. The coming years will see automation get smarter and also cover the end-to-end network, including backhaul. Automation of key self-provisioning, self-healing and self-optimizing functions will evolve to create "self-aware" networks, capable of handling complex end-to-end optimization tasks autonomously and in real time.

However, barriers to adoption do exist. Lack of interoperability in proprietary back-end network technologies, disjointed IT systems and lack of compelling end-to-end solutions mean that global adoption is likely to reach only about 25% by 2025, mainly characterized by small-scale adoption across segmented parts of large national networks. These challenges will likely result in wider collaboration between network operators and equipment providers. Companies such as Cisco, Huawei, Ericsson and Nokia have taken the lead, although case studies of network-wide deployments are yet to emerge.

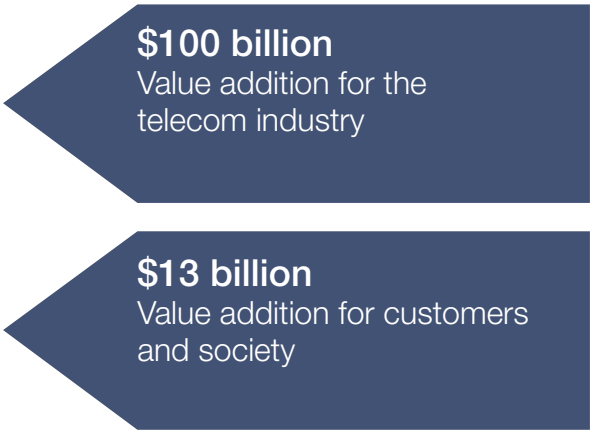
Value-at-stake impact

Value for industry. Autonomous networks could provide cumulative cost savings of $27 billion for the telecom industry over the coming decade, assuming a fall in mobile network infrastructure spending of 30%, coupled with reductions in related spend on professional and managed services in build, design, operations and support. These cost-reduction benefits will be augmented by greater network reliability and customer satisfaction. Indeed, the largest benefit to operators is likely to accrue from the reduction in churn associated with better network quality, potentially saving $46 billion in customer acquisition costs and lost revenue. Improved network quality could add an additional $9 billion in operating profit from reduced frequency and duration of network outages. As operator spending on network services falls, network equipment providers could see value migration of $2 billion. However, this will be offset by new profits of up to $14 billion generated from the sale of SON solutions to operators.

Value for customers and society. Fewer field visits resulting from a reduced need for maintenance and faster provisioning could save more than 30,000 tonnes in CO_2 emissions globally. Consumer benefits from autonomous networks could exceed $12 billion. Most of that figure is likely to come from operators passing on some of their network cost savings to consumers. Consumers will also make time savings through a reduction in dropped calls: our analysis suggests 2.5 billion hours in total time savings up to 2025, translating into productivity gains of up to $3.8 billion. At the same time, network automation is expected to displace jobs in the industry, particularly those of field workers engaged in maintenance and configuration of network equipment and systems.

Autonomous (zero-touch) networks: Value at stake in numbers

(All figures cumulative for period 2016-2025)



Cyber-resilience

A global and digitized economy brings significant risks to consumer privacy and security, businesses and society as a whole by magnifying the potential impact of cyberattacks. Recently, the scale of cyberattacks has been increasing globally at an alarming rate.

>1 billion Records of personally identifiable information stolen in 2014

$3.8 million Average total cost of a data breach, up 23% from 2013 to 2015

The costs associated with this growing threat are already significant and could rise in the future. A World Economic Forum study found that more frequent cyberattacks could result in a backlash against digitization. The report's authors argued that, if attacker sophistication outpaced defender capabilities, resulting in more destructive attacks, a wave of new regulations and corporate policies would slow innovation. They estimated this would result in a negative economic impact of about $3 trillion by 2020.[16]

Telecom operators find themselves at the forefront of this battle, with operators such as Deutsche Telekom registering close to 1 million hacker attacks a day in 2014. The impact on operators can be particularly significant. For instance, a 2015 breach at an Experian data centre resulted in the personal records of 15 million T-Mobile customers being stolen. The German government cancelled its contract with Verizon when the company could not convince the authorities that its information was secure from "snooping" attacks by the US National Security Agency (NSA). Meanwhile, AT&T had to pay a $25 million civil penalty when some employees stole and sold the confidential personal information of 280,000 subscribers.[18]

Increasing risks point to greater responsibility for operators to ensure a secure global internet. Though the percentage of total attacks on networks is marginal, the industry can play a key role in integrating cyber-resilience measures across network hardware, software, applications and end-user devices. A powerful call to action is likely to come from regulators looking increasingly to telecommunications, and the wider information and communications technology industry, to lead efforts to ensure global data privacy and security. This approach can be problematic when industry and governmental interests collide, as happened between

Apple and the FBI over iPhone encryption in the aftermath of the San Bernardino terrorist attack.

Cyberattacks pose a significant threat, but cybersecurity also presents an important opportunity for the industry as carriers of global internet data. Recognition of new risks means that global information security spend is likely to exceed $100 billion by 2019,[19] creating an opportunity for individual operators and vendors to provide important security services. At a wider industry level, collaboration between operators can lead to greater resilience and new business opportunities.

Case Study: GSMA Mobile Connect – Helping Consumers to Secure their Data

The GSMA, the industry body for mobile operators, has spearheaded the effort to develop an industry-wide solution to help consumers take greater control of securing their data. The Mobile Connect authentication service is available to network operators globally and enables users to create and manage a digital universal identity via a single login. The service securely authenticates users, enabling them to digitally confirm their identity and their credentials, and grants safe access to mobile and digital services, such as e-commerce, banking, health, digital entertainment and e-government. In this way, the GSMA is helping operators fulfil an important role in customer identity, while also enhancing customer convenience and experience by removing the need to remember multiple passwords.

Case Study: Lookout – Harnessing Machine-Learning to Boost Mobile Security

Smaller companies and start-ups are also showing how digital technologies such as machine-learning and artificial intelligence (AI) can help companies build up cyber-defence mechanisms in line with the growing threat and complexity of attackers. Lookout, a Silicon Valley-based mobile security start-up, collects data from millions of mobile devices to continuously train its mobile security algorithms to detect and predict potential security risks and vulnerabilities. By creating a massive database of all mobile codes in the world, the company can deploy predictive algorithms at a scale that allows it to learn of new risks in real time and deflect attacks before they take place.

Case Study: Google – Securing Networks through Device- and User-Level Encryption

Other companies, such as Google, AT&T, Accenture and Verizon, have focused on revamping internal security strategies to increase cyber-resilience. Google has recently moved all its corporate applications to the internet. It is breaking away from the idea of a secure internal network protected by perimeter firewalls to one where user access to corporate functions is encrypted and protected at a device- and user-level. Employees can only access corporate functions from devices that are authenticated and, at the next layer, have to provide specific user authentication. This approach helps administrators control access and monitor individual users and devices, and protects other parts of the network in case of a breach.[20]

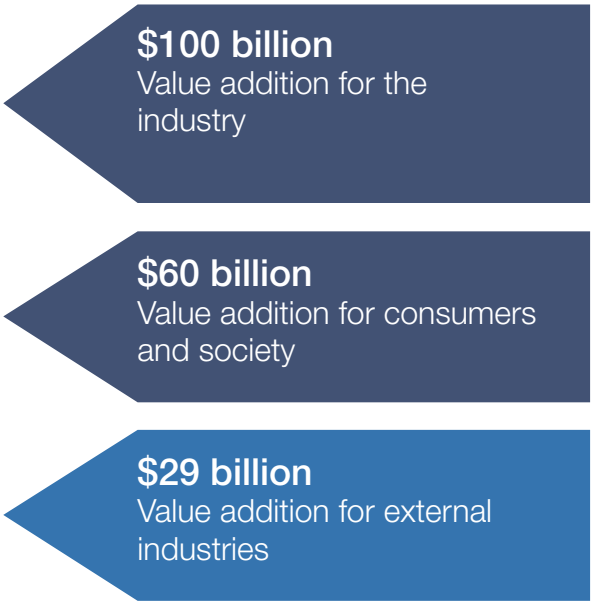
Value-at-stake impact

Value for industry. As consumers shift a larger share of their personal lives to the digital sphere, they are becoming increasingly careful about whom they trust with their information. Increased cyber-resilience is likely to create value for operators and device manufacturers in two key ways. First, efforts to reduce the direct and indirect costs associated with data breaches (e.g. curbing losses of sensitive information, faster remediation and minimizing damage to business continuity) could lead to direct cost savings of almost $80 billion. Second, efforts to increase cyber-resilience and establish greater trust with consumers in data security is likely to drive market-share shifts within the industry. We estimate these shifts to be worth $70 billion in value migration across operators and device manufacturers. However, we project that increased information security costs could equate to more than 2% of revenue by 2025, offsetting some of these cost savings.

Value for society. Customers are likely to benefit from reduced costs associated with the loss of personal information through fraudulent transactions. They will also need to spend less time resolving these incidents as cybersecurity measures reduce incidences of fraud. We calculate that these benefits translate into savings of up to $60 billion for consumers globally. Greater annual spend on information security is likely to increase the demand for professionals in this area. It is estimated that thousands of roles could be created across the industry to support companies' cyber-resilience efforts, with some of them filled by reskilled employees from other areas.

Cyber-resilience: Value at stake in numbers

(All figures cumulative for period 2016-2025)



Extending connectivity

Global internet penetration stood at 43% in 2015,[21] meaning that more than half of the world, predominantly in emerging markets, is yet to join the digital economy. With digitization increasing rapidly around the world and becoming a priority for policy leaders and companies alike, we expect to see an increasing push to connect the unconnected. However, significant challenges remain. As these untapped markets often exist in small clusters in remote regions, extending traditional network access is not economical for network operators, given a high cost per bit and limited ability to monetize data usage.

A number of new technologies are offering operators and equipment providers the opportunity to overcome some of these financial and operations challenges through innovative means of extending affordable last-mile connectivity. Companies such as Facebook, Google and OneWeb are piloting new lower-cost methods to expand the reach of existing terrestrial networks using drones, hot air balloons and satellites. As subscriber growth in the developed world reaches stagnation, these companies are keen to accelerate the pace at which untapped markets are brought into the digital fold. In most cases, these companies partner directly with local telecom operators to access or provide backhaul capacity and let the operator take the lead in managing the end-user relationship.

For telecom operators, these new innovations have the potential to overcome significant cost barriers in reaching remote regions across developed and developing markets. By partnering with new entrants, telecoms will be able to retain control of key customer relationships, drive wider access and enable large societal benefits from connecting the unconnected. It is important to note, however, that while access to lower-cost networks has the potential to empower millions of people, the societal benefits will not be realized by extending network access alone and need concerted public-private action to address challenges of affordability, skills and locally relevant content.

Case Study: Google, Facebook, OneWeb and SpaceX – Connecting the Unconnected

Google's Project Loon aims to spread connectivity to remote areas by establishing a network of balloons in the stratosphere, at a height twice as high as aircraft flight paths and weather systems. By entering into spectrum-sharing partnerships with telecos, each balloon has the potential to provide LTE coverage directly to consumer devices within an 80km-wide area. After a successful pilot in New Zealand in 2013, the company has launched similar pilots in Indonesia, Brazil and Australia. Facebook has been also conducting pilots, using drones rather than balloons to beam wireless broadband access over remote areas.

Other space-age projects with the same goal of extending connectivity are being run by OneWeb, a consortium whose target it is to launch more than 600 satellites by 2018, and SpaceX, which plans to launch up to 4,000 satellites in space by 2030.[22]

Value-at-stake impact

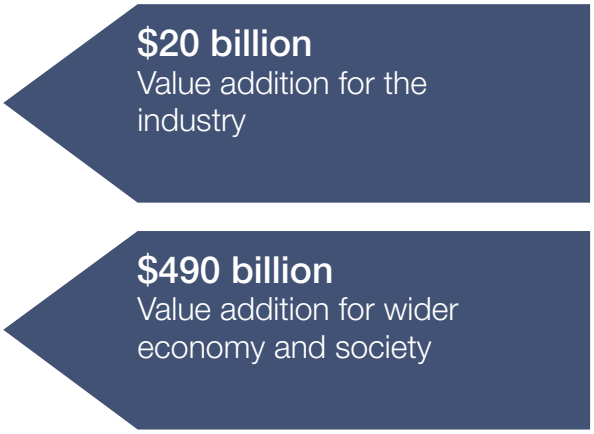
Value for industry. An increase in the subscriber base will add value for telecom operators. Provided the right frameworks and partnerships are in place, we have assumed that alternative network technologies could raise global mobile broadband penetration by approximately 6% on a cumulative basis by 2025 (over and above standard network rollouts). Adjusting for higher operating margins per user (due to lower network costs), we expect an overall increase in cumulative operating profits for operators of $8 billion. The relatively small size of the opportunity can be explained by the fact that the majority of new subscribers are likely to be in low ARPU regions ($3 to $4) with limited adoption of value-added services. At the same time, other parts of the telecom ecosystem are likely to benefit from access to new subscribers. An increase in advertising and subscription revenues for content creators and aggregators, plus new mobile sales for device manufacturers and semiconductor companies, could add another $12 billion to total industry profits.

Value for society. This could unlock significant value for society – not only for new users brought online but also from the multiplier effect on the wider economy. Using empirical estimates of the impact of increased mobile broadband penetration on GDP per capita, we believe that approximately 500 million new subscribers connected by alternative technologies could generate benefits for society worth $490 billion across developing and developed markets. The follow-through effect of increased economic activity could also mean significant job creation. Our analysis of the value from alternative connectivity goes beyond estimating the impact on the telecom industry alone (and hence is not directly comparable to other value-at-stake numbers in this white paper), primarily to highlight the significant impact that these technologies stand to have at a societal level.

However, the potential benefits to society will not be realized by providing connectivity alone. According to the World Bank, while digital technologies have spread widely throughout the world, the broader developmental benefits from connectivity have lagged behind and have too often accrued to sections of the economy that are already well-positioned to take advantage of digital communication. Industry and governments will have to work together to ensure that the necessary "analogue complements"[23] are in place to enable wide-scale and equitable value capture. These analogue complements include affordability, regulations that ensure fair competition, skills, awareness and cultural acceptance, and accountable institutions.

Extending connectivity: Value at stake in numbers

(All figures cumulative for period 2016-2025)



b. Beyond the Pipe

The industry-wide shift to internet-based business models provides operators with an extraordinary opportunity to drive new revenue growth. IoT, in particular, will be significant, with several operators looking to capture new revenue streams from the massive deployment of sensors, analytics and machine-learning. These developments offer the telecom industry a unique opportunity to also contribute to a fundamental reimagining of how we work and communicate today. As competition across digital services continues to intensify, capturing value will depend on aggressively building the capabilities that drive new digital revenue streams.

> **The cloud players and wireline operators are positive additions to the competitive landscape – Facebook, Google, Amazon, Comcast. They are all working hard to provide their services and drive lower-cost connectivity. In the past, only radio spectrum was absolutely critical. Now data is the new currency. Cloud players have large subscriber bases and immense analytical capabilities and these are becoming just as important as spectrum.**
>
> Matt Grob, Executive Vice-President, Qualcomm Technologies and Chief Technology Officer, Qualcomm

Integrated on IoT

IoT is likely to be the next major value opportunity across industries. Industrial IoT, for instance, is forecast to add $14 trillion of economic value to the global economy by 2030. As providers of key connectivity – between sensors, devices, data centres and people – the telecom ecosystem will be integral to the proliferation of the "internet of everything". As business models evolve over the coming decade, linking more than 50 billion new legacy sensors to a common network will require industries to work closely with the telecom ecosystem.

While the telecom industry stands to benefit from meeting the massive increase in demand for data packets – its core "product" offering – several companies within the ecosystem are recognizing the potentially large value opportunity that lies beyond just providing the infrastructure necessary to meet additional demand. Operators are investing to move up the technology stack towards building the platforms, applications, integration and analytics capabilities that unleash the real power of IoT.

Case Study: Qualcomm – Building Interoperable IoT Offerings across Diverse Sectors

Semiconductor specialist Qualcomm has taken an integrated and interoperable approach when developing its offerings in IoT. By developing advanced chipsets and modules to bring various IoT use cases to life, it is moving towards building a comprehensive, cross-sector suite of IoT solutions that help companies and users overcome some of the largest challenges on interoperability and integration. Qualcomm Life, for instance, is an end-to-end, open and device-agnostic healthcare platform that integrates healthcare devices, stores and communicates health information, and provides remote monitoring.

IoT applications for telecom companies are likely to extend across both consumer and enterprise applications. The biggest markets for consumer IoT services are likely to emerge in health and fitness, home security, automotive, information and entertainment, and home automation and energy management. Enterprise services around IoT will broadly be concentrated on connectivity, consulting, implementation and operations services.

However, achieving success in these new markets and services will require telecom operators and ecosystem players to build entirely new capabilities and offerings – from analytics and cloud services to systems integration and APIs – and compete in an increasingly crowded marketplace that includes major technology companies and nimble start-ups. The telecom industry will be in a race to acquire critical talent with digital skills and implementation expertise, while driving innovation to establish differentiation in an evolving market. In the short run, this will require telecom companies to compete aggressively for acquisitions and partnerships, especially as IoT platforms compete to define standards and acquire scale. In the longer term, companies will have to refocus organization and business models to better integrate front- and back-end systems, and harmonize multiple offerings and processes.

While operators are at the beginning of a journey to build integrated IoT solutions across vertical markets, some ecosystem players are further ahead. Intel, for instance, has launched its integrated suite of IoT solutions under its Intel IoT Platform, which provides device connectivity, cloud hosting and analytics support. Similarly, device manufacturers such as Apple and Samsung are developing integrated home IoT suites providing horizontal interoperability and connectivity between devices. As very few operators globally have launched or developed platforms or services on a similar scale, we expect that they will capture limited market share in core IoT solutions over the next few years. However, despite relatively low market-share predictions, the overall size of the IoT opportunity across the telecom ecosystem remains large.

Value-at-stake impact

Value for industry. The value opportunity here stretches across the IoT value chain and telecom ecosystem. Rising demand for IoT sensors and chipsets could earn semiconductor companies additional operating profits of $120 billion. IoT hardware and device manufacturers stand to generate $65 billion in operating profits from sales of consumer and enterprise hardware systems across IoT applications. Operators and network equipment providers play a key role in providing the backbone that supplies essential connectivity between billions of cloud applications and sensors. We estimate that increasing bandwidth and data usage could generate an additional $65 billion in operating profits for these organizations. The largest opportunities lie in providing the suite of consumer and enterprise applications and services that enable IoT to become a reality, potentially bringing in an additional $100 billion in operating profits across the industry by 2025. Of this, network operators and device manufacturers could together capture up to 15% of the market for consumer IoT services, which would mean an operating-profit uplift of $23 billion. The market opportunity from enterprise services could be more significant, with up to $75 billion in operating profits up for grabs across consulting, implementation and operational services.

Value for society. The wider societal implications from IoT will also be significant. We estimate that adoption of IoT services across automotive, home-energy management and logistics fleet management alone could lead to 26 million tonnes of avoided CO_2 emissions over the coming decade.

The main benefits to consumers from IoT services will emerge in time- and cost-savings from specific applications. Consumer adoption of application solutions provided by the telecom industry across automotive infotainment, health and fitness, and home-energy management alone could

bring cumulative savings exceeding $100 billion over the next 10 years. Automotive infotainment, for example, could deliver fuel and time savings worth $17 billion as a result of better route optimization and less time spent driving around looking for parking. Intelligent healthcare devices enabled by telecom ecosystem participants could lead to $47 billion in lower healthcare costs. IoT is also likely to be a key creator of new job roles. We estimate that more than 400,000 new jobs will be required across the industry to support new revenue streams arising from IoT services. These roles will be partially filled by reskilling and redeploying existing resources within organizations but will nonetheless create thousands of new jobs across the industry.

Outside the industry, the impact of IoT could be much wider, especially in achieving global societal developmental goals. For instance, IoT use cases can directly enable the achievement of at least 12 of the 17 UN Sustainable Development Goals (SDGs; see Figure 7).

Integrated on IoT: Value at stake in numbers

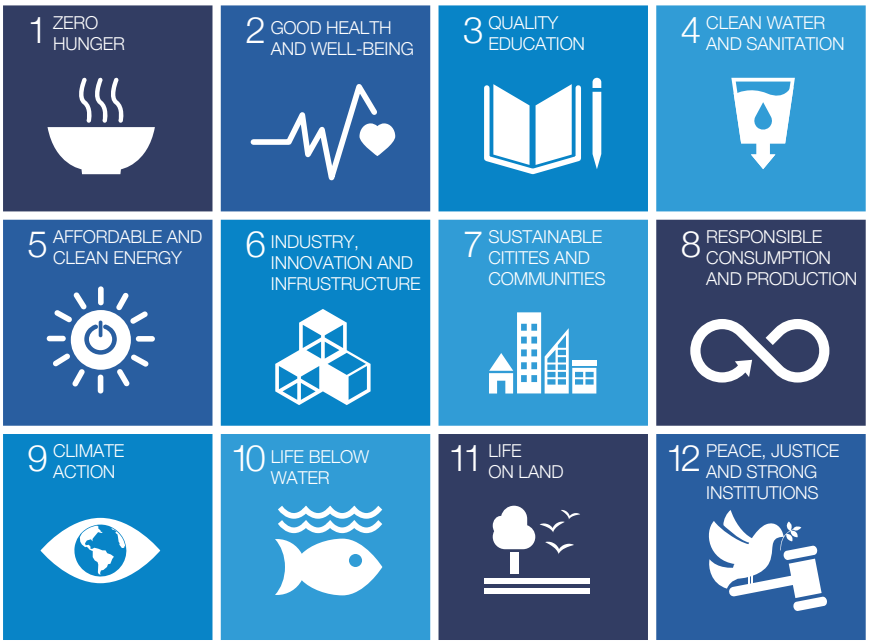
(All figures cumulative for period 2016-2025)

$350 billion
Value at stake for the industry

$104 billion
Value addition for consumers and society

26 million tonnes
Reduction in CO_2 emissions

Figure 7: IoT Can Support 12 UN Sustainable Development Goals



Source: World Economic Forum/Accenture analysis

Digital services

As digital disruptors and OTT players attack traditional communication revenues, telecos are pursuing opportunities to move up the digital stack to the services layer. With a large customer base, ownership of key infrastructure and strong technology capabilities, telecom operators will try to take on the role of digital services providers, often emerging as disruptors to other industries. In a recent survey across global operators, almost a quarter of companies reported that they expect digital services across consumer and enterprise applications to account for more than 25% of total revenues by 2020.[24] The next decade will see operators make an aggressive push to transform their revenue mix through focused initiatives across a number of key services applications.

Case Study: SK Telecom – Earning more than $1 Billion a Year from Digital Services

SK Telecom, one of the Republic of Korea's largest telecom carriers, was an early entrant into digital services, launching SK Planet in 2011. By the end of 2012, SK Planet had earned more than $1 billion in revenue, driven by its 11th online marketplace. Since then, the company has made significant investments, establishing a presence in Silicon Valley to access start-ups based there.[25] More recently, the company launched the 020 marketing platform, offering data-driven advertising and marketing solutions.

Case Study: Orange – Creating Mobile-only Banking Services

Orange, the largest telecom operator in France, recently signalled its very strong intent to build new digital revenue streams in mobile banking. In April 2016, the carrier acquired a 65% stake in French insurer Groupama's banking unit, with the intention of setting up a 100% mobile-only "Orange bank". The entity is expected to attract about 2 million customers in France alone and, together with Orange's existing mobile payments businesses, generate around €400 million in revenue by 2018.

New digital services, however, do not need to be in entirely new industries or at the scale envisioned above. Operators are recognizing the value of the customer data they gather minute-by-minute and are developing models to monetize this anonymized data.

Case Study: Telefónica – Generating Insights for Business from Mobile Network Data

Telefónica's Smart Steps programme helps businesses make strategic decisions based on aggregated mobile network data across all of Telefónica's mobile users. The solution uses big data assets to analyse movement patterns of millions of people, as well as their online behaviour and demographic profile. The data is then extrapolated to provide insights that are representative of the total population in each area.[26] The company has been successful in tailoring insights for several applications, including public transport and retail. Furthermore, the development of an "as-a-Service" model can allow Telefónica to market its analytics platform to other operators globally.

The industry has been quick to recognize the opportunity that digital services represent and over the past decade several companies have launched multiple offerings. Few, however, have been able to capture significant value at the scale and speed of digital disruptors, despite having access to several key ingredients, including millions of customer relationships and proprietary data. Most companies have yet to overcome key inhibitors on talent, legacy IT systems and unfavourable regulation to compete effectively against internet companies that are faster to market with new products and unhindered by large legacy businesses. Our value-at-stake analysis shows a very large potential value opportunity for industry participants. However, this will require aggressive and transformative changes that can only be accomplished through stringent focus at board and CEO levels.

Value-at-stake impact

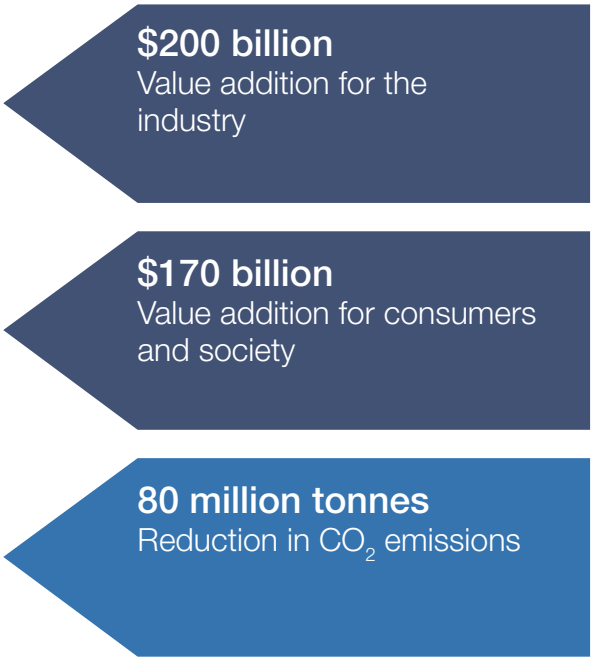
Value for industry. While digital services open up a universe of possibilities for new revenue streams, the telecom industry is likely to focus on a few key applications across consumer and enterprise markets. In consumer applications, telecom operators are likely to focus on developing business models in video and entertainment, healthcare (virtual care), mobile financial services, location-based or lifestyle services including retail, and on-demand information services such as maps, travel services or restaurant bookings. These services could generate up to $142 billion in additional operating profit for operators over the next decade, accounting for up to 15% of total consumer telecom services revenue by 2025. The largest opportunities in enterprise digital services will likely be in information security, enterprise mobility management, unified communications, cloud services and analytics. Together, these could add a further $48 billion in operating profit across network operators and equipment vendors. Benefits from digital services will extend beyond a direct uplift in sales. The provision of relevant and contextualized services to customers should improve customer retention: a 0.5% to 1% annual reduction in churn could generate additional operating profits of $10.3 billion over the coming decade.

Value for society. More than 80 million tonnes in CO_2 emissions could be avoided over the next decade by digital services reducing the need for travel. For example, remote medicine and telehealth services could cut emissions by 63 million tonnes through removing the need for patients to visit doctors or hospitals in person.

Digital incumbents such as Google and Facebook have entrenched themselves in the digital lives of their subscribers by providing direct time and cost benefits through several key services. A similar opportunity is available for telecom operators if they can prioritize consumer convenience and value creation while developing new digital services. Key services across mobile banking, virtual care, on-demand video and consumer lifestyle services could drive as much as $170 billion in cumulative value for consumers through time- and cost-savings. To succeed in digital services, however, the industry will need to commit a significant amount of resources to support new revenue streams. We estimate that hundreds of thousands of new roles will need to be filled across the telecom industry to support service delivery across consumer and enterprise applications.

Digital services: Value at stake in numbers

(All figures cumulative for period 2016-2025)



Winning the battle of ecosystems

There are growing signs that the next wave of digital competition will not be between organizations or industries but between large, cross-industrial ecosystems aggregated around specific consumer use cases. By embracing the transformational power of platforms, enterprises across all industries are capturing new growth opportunities and changing the way they do business.

$2.6 trillion Market capitalization of the top 15 public "platform" companies around the world[27]

The top 15 public platform companies are attracting unprecedented levels of capital investment through the value-creating power of their platform ecosystems and digital assets. The International Data Corporation (IDC) predicts that by 2018 more than 50% of large enterprises – and more than 80% of enterprises with advanced digital transformation strategies – will create and/or partner with industry platforms.

Platforms are different from traditional models in two key ways. First, platforms can acquire scale at unprecedented rates, mainly driven by the low cost of customer acquisition and network effects. This is often achieved by subsidizing one side of the platform (as Google does by making its search engine and maps free for users) to attract the other (in Google's case, advertisers). Second, platform ecosystems allow enterprises to accelerate innovation and develop features at a pace that is not possible when they operate alone. Apple accelerated the development of new apps for its devices by allowing open access to third-party developers.

With millions of subscriber relationships and decades of experience in driving interoperability and collaboration, telecos are uniquely positioned to compete in the platform economy. However, to capture value, they will have to clearly identify a strategy to build, buy or partner for each customer use case. For instance, a telecom operator with an existing mobile payments service could leverage this to attract partners to integrate on to its existing platform and maintain control over the end-user relationship. Where other incumbents may have already established a platform – in connected cars, say – telecos may be better positioned to be a core part of the ecosystem by providing essential connectivity and applications.

Case Study: Deutsche Telekom – Collaborating with Vertical Industry Partners to Build a Smart Home Platform

Deutsche Telekom's Qivicon smart home platform is an alliance between leading industry partners from hardware, software and energy to develop a single platform as an open ecosystem for living-service offerings. The solution allows interoperability with a wide range of products, devices and applications by enabling developers to connect to the platform through easily accessible software development kits and interfaces. The company is also working on building a large developer community to continuously add and improve product features.

Platform-based innovation and business models will become more common in IoT applications and other digital services that require multistakeholder collaboration. Creating the incentives for product and service developers to plug into an existing platform can save substantial R&D expenses and allow product features to develop much faster than

would be possible if the company maintained internal control of innovation. The industry does not have to look far to find examples that support this. The fact that Apple's App Store and Google's Android platforms allow app developers to develop products and services independently for consumers is a major reason why these operating systems succeeded in driving Nokia's Symbian and Blackberry's OS out of the market. Platform models are also becoming increasingly prevalent in B2B industries and applications, including healthcare (Philips HealthSuite), logistics (Coyote) and industrial equipment (GE Predix).

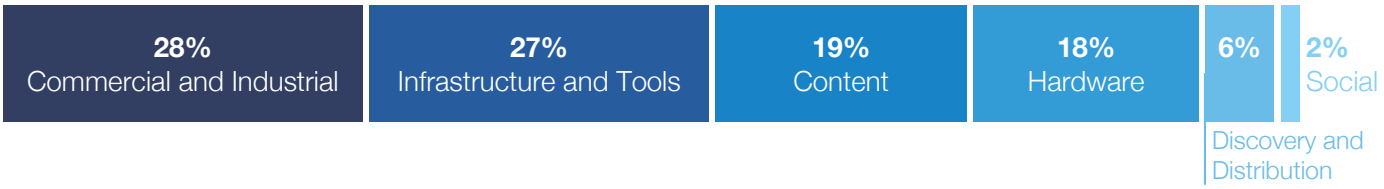
Reimagining communication

Innovations ranging from natural user interfaces and holography to augmented reality (AR) and virtual reality (VR) show the potential to change how we interact with one another and the world around us. These technologies point to the future of smartphones – and maybe beyond. By 2030, the PC will be 50 years old and the smartphone almost 15 years old. What will be the new normal for communication devices?

According to Goldman Sachs, VR and AR have the potential to become the next big computing platform and possibly emerge to be "as game-changing as the advent of the PC".[28] This is particularly relevant in light of the transformational change that personal computers and smartphones brought to everyday lives of consumers and employees (and the value these firms created in the process). While telecom operators missed out on a potential windfall with the explosion in mobile, a focus on emerging technologies can ensure that significant value is captured for shareholders.

AR and VR could herald a shift away from the screen and significantly reduce the gap between our digital and physical worlds, in the process reshaping existing ways of buying products, getting medical care or communicating with those around us. In the first quarter of 2016 alone, total AR and VR funding deals reached $1.1 billion, demonstrating the increasing confidence and support for potential benefits and applications. The application of AR and VR is likely to extend beyond just social media and gaming: recent analysis shows that the majority of investments in these technologies have taken place in commercial and industrial applications, together accounting for 28% of all deals. The variety of those commercial and industrial applications – including labour training, retail, real estate, security, manufacturing, logistics, healthcare and data analytics – are evidence of the VR/AR potential to transform how we work, socialize, learn, entertain and consume.

Figure 8: Global AR and VR Funding Deals by Category



Source: CB Insights data

The scope of this transformation goes beyond AR and VR. Reimagined communication technologies will be driven and enabled by a number of different innovations in human-machine interface.

Most major technology companies, including Google (Magic Leap), Facebook (Oculus Rift) and Alibaba (GnomeMagic Lab), have been quick to realize the future potential and have made large bets in this area, mainly through acquisitions. However, with the exception of leading device and semiconductor manufacturers, we have yet to witness significant announcements regarding these technologies from within this industry.

Case Study: Microsoft – Investing in Augmented Reality

Microsoft has made early investments in developing a large mixed-reality platform, HoloLens, which uses a head-mounted display to let users interact digitally with their surroundings via natural user interfaces. In the future, the device will allow users to directly interact with others in a virtual environment and customize the device to support critical business or commercial applications in design, architecture or engineering. The company has started shipping developer versions of its device and has made software development kits (SDKs) available for developers to build customized applications.

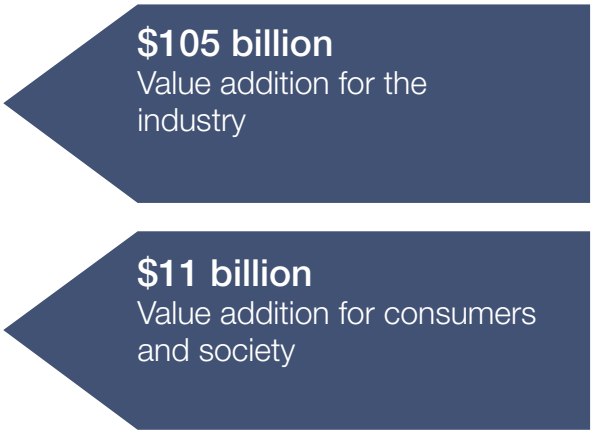
Value-at-stake impact

Value for industry. The potential value of AR, VR and similar applications for the telecom industry is likely to stem from a few key sources: operating profits for semiconductor, hardware and device manufacturers from the sale of head-mounted and other devices; additional demand for connectivity services and bandwidth; services revenue from the development of content enablement, integration and application platforms; and direct advertising and subscription revenue from content developed for AR or VR applications. Based on market estimates from Goldman Sachs, IDC and other research agencies, the total value at stake across these categories could exceed $100 billion over the coming decade, with the largest opportunities emerging in advertising and subscription revenues from content ($40 billion), and software and application services ($30 billion). The total AR/VR hardware market size could reach $45 billion by 2025, resulting in $17 billion in cumulative operating profits for semiconductor and device manufacturers.

Value for society. Consumer benefits from AR and VR stem from time- and cost-savings across key applications. For instance, immersive VR content in real-estate broking could save more than 8 million hours for prospective buyers who would otherwise have to visit each property recommended by a broker. Together with similar applications in retail, live events and entertainment, this would translate to $7.4 billion in productivity gains for consumers.

Reimagining communication: Value at stake in numbers

(All figures cumulative for period 2016-2025)



At a societal level, AR- or VR-based content that relies on natural human interfaces and gestures will remove some of the language and skills barriers to the adoption of digital services. According to the GSMA, almost 25% of subscribers in Asia do not use mobile broadband (and digital) services due to a lack of digital literacy and skills. AR and VR applications can help users navigate some of these challenges by transferring control to simple human gestures. We estimate the total societal benefit of increased adoption of digital services to exceed $3.5 billion over the coming decade.

c. Redefining Customer Engagement

Customer expectations in the digital era are markedly different from those of the past. A series of rapid technological advances have helped transform these expectations, while simultaneously providing enterprises with the digital tools to create the beguiling experiences they now need to satisfy customers. Today, companies are offering experiences that customers would not have thought possible five years ago, let alone become a part of their everyday lives. These expectations now cut across traditional industry boundaries, as customers now expect the high-quality service they receive in one industry to be matched by companies in other sectors. The rapid evolution of on-demand, seamless and personalized services across industries is a direct manifestation of this trend.

> **The question of what is digital is irrelevant for the next generation. It is only us who have lived in the 'transition age' who need to differentiate between what is digital and what is not. For the coming generation, the bigger question is what is not digital?**
>
> Mauricio Ramos, Chief Executive Officer, Millicom

Historically, however, the telecom industry has not been successful at meeting and exceeding customer expectations. Benchmarked Net Promoter Scores in 2015 showed that telecos ranked among the bottom two when compared with a set of industries, scoring lower than logistics, the public sector and financial services. This has translated directly into higher churn and customer-acquisition costs, and an even more significant impact on the industry's ability to grow ARPU through customer loyalty.

Redefining customer engagement will require telecos to overhaul their approach to assessing and meeting customer expectations, not only by adopting digital tools but also by realigning back-end processes to support the delivery of key customer outcomes. At the same time, telecos will have to allow users to shape their brand, transferring an increasing amount of control to the end user.

Delighting the digital customer

The concept of personalized products and services is not new but digital technologies enable companies to deliver them at a scale and in ways that were previously unimaginable. Firms across the digital domain are developing smart algorithms that analyse customer data in real time to deliver customized and contextualized experiences to millions of customers simultaneously. Netflix's recommendation engine, for example, is said to drive 75% of the viewing activity on the site. While previous models of customization were dependent on high levels of customer engagement, today's contextualized experiences are automatic and seamlessly integrated into every experience using artificial intelligence (AI), predictive analytics and real-time feedback loops. For instance, Amazon Echo ("Alexa") is a voice-operated AI assistant that automatically and continuously captures and analyses customer behaviour data to increasingly personalize its recommendations.

What the 'Digital Customer' Wants

A number of essential attributes characterize customer expectations in today's digital world. At every stage of buying a product or service – research, decision, purchase, payment and aftersales – customer expectations are becoming increasingly exacting.

1. Contextualized interactions. Whether it is personalized viewing suggestions from Netflix's renowned recommendation engine or specific discounts for shoppers from Shopkick, customers expect a product or service that is tailored to their needs.
2. Seamless experience across channels. From becoming aware of a product to researching it and then buying it, customers expect a seamless service that works across all the channels through which they interact with the company. They also demand payment and delivery options that are hassle-free and quick to arrange. Retailers such as Amazon are constantly experimenting with delivery options to keep up with customer expectations.
3. Anytime, anywhere. The advent of the internet has brought the customer expectation of real-time access to information about a product or service into the mainstream. In today's digital age, this expectation has extended to the product or service itself, where customer experiences in industries such as financial services and e-commerce set the standard for on-demand products or services across industries.
4. Great service (it doesn't matter who provides it). A recent study found that two-thirds of consumers had switched providers in at least one industry because of poor service they had received. Almost half of customers surveyed were open to products or services from "non-traditional" industry players.
5. Self-service. Customers across industries are now willing to take greater control of their own product, service or brand experience, not only in cases where they can customize product features but also for models that provide them with the necessary tools and information to resolve issues. As innovations such as 3D printing enter users' homes, this aspect could gain much greater importance.
6. Transparency. Customers expect to be able to access transparent information, which clearly sets out the features of a product or service, before making a purchase. They also value transparency from companies about the extent of data collection before, during or after a purchase. Users want to keep control of their personal data and are comforted by the choice to opt into data-sharing in exchange for an explicit value proposition.
7. Peer review and advocacy. Increasingly, customers attach more importance to peer recommendations than product reviews in the media or information supplied by businesses. Bad reviews carry particular clout, reaching twice as many people as positive reviews.

Source: World Economic Forum/Accenture analysis

A recent survey indicated that almost 70% of operators consider customer service and personalized customer experience as the most important initiatives to improve customer engagement.[31] Hyper-personalization is being deployed to drive differentiation in a novel way: by targeting customer outcomes. Companies are increasingly shifting towards monetizing their ability to deliver the outcomes that matter to individual customers. Take Monsanto, an agricultural products company that has expanded beyond its product portfolio to offer farmers actionable and precise intelligence on crop growth, irrigation, climate and equipment to help them improve yields. As a result, the company stands to capture a much wider customer base and a larger share of wallets than it would have by offering its agricultural products alone.

Case Study: GiffGaff – Revolutionizing Customer Service

GiffGaff, a large UK-based mobile virtual network operator (MVNO), decided to completely do away with a call centre-based customer service model. Instead, the company developed an online community where its own members share and resolve queries. In doing so, the company not only saved a massive amount of costs but also was able to significantly drive up customer engagement. The company's transparency and customer centricity (it sends users a text message every month on how they can save money on their phone plans) has meant that it has overtaken more than 160 other MVNOs in the country to become the third largest. GiffGaff's innovations in this area show that customers are willing to shift to new models of customer service, a traditional pain-point for major operators.

When telcos set out to transform the customer experience, they should be aware of varying preferences between regions and customer segments. Studies have indicated how, for example, customers in the United States are more inclined towards physical interactions in a store as compared to other developed markets in Western Europe, an important finding that explains the differences in adoption of self-service digital channels in these regions. Starker differences can be seen when comparing developed and emerging markets, where adoption of digital channels often faces barriers related to language and lack of digital literacy.

How can the telecom industry begin to deliver delightful experiences to its customers? Some options include customizing the supply of bandwidth based on individual users' data usage patterns or delivering personalized digital services and applications. Various tools can help operators stay ahead of rapidly evolving customer expectations:

- Complement traditional customer-segmentation methods with those based on digital behaviour. By identifying and tracking metrics that reveal a particular customer's engagement and behaviour, operators can target improvements in customer lifetime value by identifying the level of personalization appropriate to each customer. This can be achieved, for example, by allowing customers to adjust their plan configuration through an online interface, thus "revealing" the customers with greater engagement.
- Since hyper-personalization depends on customers sharing information, operators must incentivize them to share this data. These incentives could vary from monetary and emotive drivers to establishing trust in aspects of consumer data and privacy.
- Develop a culture of "design doing" that combines principles of design thinking with prototyping and experiential pilots. Create the integrated product, research and back-office silos focused on customer-experience goals, as these are necessary to drive a "customer first" innovation mindset.

> **Customers are empowered by digital; they have new behaviour and new expectations that are pushing us to evolve. We have to be more reactive and more agile. We need to listen to what our customers expect and also track how our digital environment is evolving.**
>
> Benedicte Javelot, Chief Strategy Officer, Orange

Case Study: Comcast – Anytime, On-demand Access to TV Programmes across Multiple Devices

Comcast is taking significant steps to meet the demands of customers today. Its Xfinity X1 platform integrates features of an online service into its core cable-TV offering, allowing customers anytime, on-demand and seamless access to their favourite TV programmes through multiple devices. At the same time, the platform provides important user-level data that the company can leverage to personalize and improve its offering.

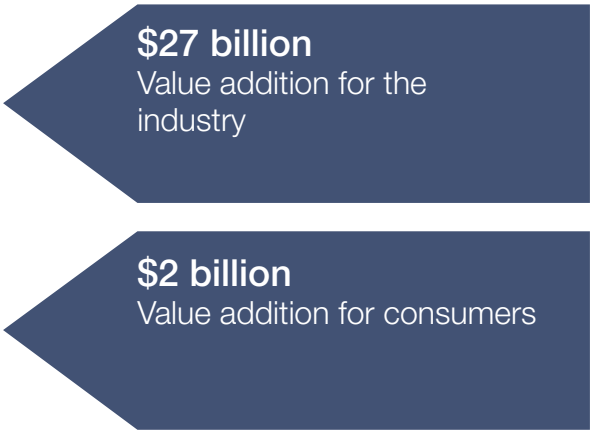
Value-at-stake impact

Value for industry. Digital tools that allow operators to improve customer experience through personalization and digital customer service options will create value for operators by both growing revenue and reducing costs. Better customer engagement will result in more satisfied customers and lower churn, boosting revenue and avoiding customer acquisition and marketing expenses. Moreover, better targeted offers and contextualized engagement should lead customers to spend more with their existing operators. Together, these two drivers could generate up to $9 billion in new value over the coming decade. Larger value creation is likely to result from reduced customer service costs as customers transition to digital and self-care service models. Customer service accounts for almost 10% of total operating costs for many operators and also occupies a large part of an operator's workforce. We estimate that a reduction in customer service, marketing and related IT costs from integrated digital customer service offerings could generate almost $18 billion in additional operating profits by 2025.

Value for society. Consumers can benefit from spending less time in contact with telco customer services teams, thanks to the adoption of self-care and digital customer services channels, such as live chat assistants. Our estimates show consumers could save almost 1.5 billion hours over the coming decade, translating into productivity gains of at least $2.2 billion. It is also important to consider the potentially adverse impact on employment of a shift in customer service models, with many traditional customer service jobs potentially at risk.

Delighting the digital customer: Value at stake in numbers

(All figures cumulative for period 2016-2025)



Brand atomization

As digitization intensifies the race for customer mindshare, companies are allowing their brands to be distributed through a wide range of service providers, relinquishing control of every single user experience. Google Maps and PayPal allow users to experience the core attributes of their brands through a plethora of complementary service providers, while retaining brand identity. This approach, called brand atomization, shapes brand experiences according to each user's requirements and allows greater reach than can be achieved by company's self-driven channels.

As companies in the telecom ecosystem move towards digital business models, their brand strategies will have to encompass a world full of digital plugs and sockets, adapting to the increasing need for partnerships and collaboration. In the future, businesses will need to integrate with one another, share information and collaborate freely to enhance products and services. In this context, a rigid approach to brand proliferation could make organizations lose opportunities to capture customer mindshare and reduce the chances for collaboration. This is particularly relevant for telecos looking to establish ecosystems or launch their own digital services.

Case Study: Spotify – Pioneering Brand Atomization

Spotify has become a pioneering example of an atomized service, achieving ubiquity by enabling access through multiple third-party touchpoints (e.g. Sonos, Ford, iOS, Android and Samsung Smart TVs). It has released SDKs for iOS and Android developers, and more recently launched the Spotify and Uber integration, allowing users to remotely control music in enabled Uber rides.

d. Bridging the Gap on Innovation

Innovation within the telecommunications industry has made an immense contribution to global productivity. The evolution of fixed- and mobile-network technology has brought lightning-fast connectivity to users across the world, changing the way we collaborate and interact. The industry has set benchmarks in collaboration, with bodies such as the GSMA driving the development of global standards to enable widespread adoption.

In the digital age, however, the industry's traditional innovation models (with investment cycles stretching five to seven years), the development of industry standards, licensing contracts and wide infrastructure development have not protected it from external disruption.

Digital disruption today is characterized by declining technology costs, rapid innovation models and a fail-fast culture. Digital has dramatically reduced entry costs at almost every point of the value chain, making it increasingly difficult to predict the emergence of new competition. Encumbered by large and clunky legacy infrastructure stacks, an ageing workforce, lack of an innovation culture and in some cases regulation, operators are finding it difficult to compete.

The need to provide agile, integrated and seamless connectivity and digital services, juxtaposed with telcos' traditionally long investment and innovation cycles, should force operators to sharpen their focus on new innovation models.

"Outside in-novation"

The industry's long history of innovation has been marked by controlled collaboration through industry bodies and staged deployments that span multiple years. In the digital age, however, the need to develop and deploy new services at scale are driving companies to review innovation strategies that keep the development of new technologies within internal R&D teams. The past few years have seen an increasing trend towards alternative innovation approaches – ones that are based on far greater collaboration as well as independence of innovation teams.

A study of the most innovative companies in the technology, media and telecommunications sectors found that open innovation (25%), individual freedom to conduct projects (30%) and corporate venture groups (21%) are among the methods that are likely to drive the highest growth across companies in these industries in the future. Among operators, we have seen a growing preference for some of these models, especially to overcome some of the key internal inhibitors to innovation.

Case Study: Singtel – An Acquisition-led Approach to Innovation

Singapore's Singtel has pursued an acquisition-led approach to building applications-based services in analytics and digital marketing. The operator acquired Amobee in 2012 and then Adconian to build and market its digital marketing platform. It also acquired DataSpark, which provides insights and analysis on consumer behaviour using data from cellular networks. Integrating DataSpark's big-data capabilities with its own anonymized subscriber data, Singtel provides focused offerings based on geo-location to customers including Singapore's Mass Transit Authority.[34]

Case Study: Telecom Italia – Building a Collaborative Research Platform

Telecom Italia has launched the Joint Open Labs initiative, which creates collaborative research platforms between itself, academic institutions and external research laboratories. These platforms also incubate start-ups focusing on its areas of interest. Other "outside-in" models include Nokia's Open Innovation Challenge, which combines crowdsourcing and partnerships with digital companies.

Case Study: Telefónica – Partnering to Invest in Innovative Start-ups

Telefónica announced in 2015 that it would invest up to $200 million in a strategic partnership with Coral Group, a venture capital firm that invests in innovative start-ups. Telefónica will work with Coral Group to expand the activities of Telefónica Open Future, an online platform that focuses on helping start-ups grow.

A significant number of operators in the industry have had venture capital arms and innovation centres for many years, but a comparative analysis of the funding of these centres with similar initiatives at web-scale companies suggests that telcos are still unable to compete in new business model categories. Exceptions exist, of course: Comcast, Verizon, Intel, Cisco and Qualcomm were recognized as being among the 20 most active corporate venture capital arms in 2015. However, even where companies have been able to establish dedicated innovation teams within the organization, these teams have largely lost out to the priorities laid down by quarterly reporting and a near-term product focus driven by business units responsible for implementation.

Any organization that will think too much about owning the IP and rights to everything will not survive. We need to open up. The main focus should be on getting stuff done that matters to your customers and then seeing how you can make some value from it. Companies can negotiate with others regarding rights and IP but only if they are able to get a seat at the table.

Peter Borsos, Senior Vice-President Group Communications and Chairman of Division X, Telia Company

Outside innovation is not only about driving "inorganic" innovation models. Often the focus in open innovation models tends to be more on the outside-in component whereby outsiders and non-firm employees are allowed to contribute to the development of products and services and achieve scale that belies the firm's internal capabilities. At other instances, however, *inside-out innovation* can ensure that a firm's internal projects can continue to develop to maturity without facing the internal axe from budget cuts, resourcing difficulties or strategic de-prioritization. This process involves companies taking internal innovation projects outside its own walls, often by relinquishing 100% control over its development.

Case Study: BT – Creating Spin-off Companies from Home-grown Intellectual Property

After the IT bubble burst in 2000, BT needed to refocus its resources to prepare for harsher economic times. Rather than stall or put internal projects on the shelf, however, the company put its home-grown intellectual property in external hands by entering into strategic partnerships with venture capitalists that spun off these businesses – including Azure Solutions, Vidus and Psytechnics – and ran them as independent businesses. These companies now supply products that are part of larger BT offerings.[36]

The potential benefits of these new models could be significant. Not only can companies free up operating expenses normally spent on internal R&D but also they can spread these resources across a much wider pool of ideas and projects, greatly enhancing the chances of success. The natural selection process of open-innovation models also ensures that better ideas are more likely to succeed in these models, accelerating revenue realization and generation.

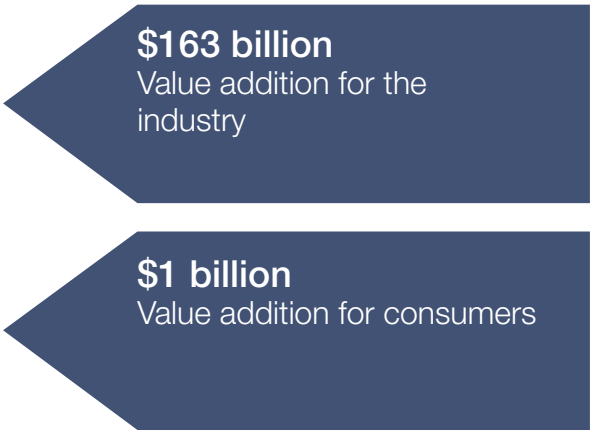
Value-at-stake impact

Value for industry. Opening up R&D projects to partners will potentially impact both future revenue realization and internal R&D spend. We estimate that companies adopting open innovation across the telecom ecosystem could see as much as a 10% reduction in in-house R&D spend as costs of projects are shared with partners, resulting in cumulative value-added of more than $40 billion by 2025. The largest of these gains will go to semiconductor companies and device manufacturers, which will together account for more than $27 billion in R&D cost-savings. Open-innovation projects will also impact R&D spend in two other key ways. First, a more efficient innovation process will potentially result in a reduction in failure rates (percentage of innovation projects that do not make it to the commercialization stage). A 10% cumulative reduction in innovation failure rates could directly result in $11 billion in new operating profit for the telecom industry over the next decade. Second, greater adoption of open innovation has been seen to accelerate innovation speed. We assume that the time and resources saved from a reduction in project durations will be redeployed to new innovation projects, driving new revenue growth at the existing R&D efficiency rate. Redeployment of R&D resources could drive almost $110 billion in new operating profit for the telecom industry.

Value to society. Our estimation assumes that competitive pressures will force operators and device manufacturers to transfer some of the operating cost (R&D) savings to consumers. Assuming that 5% of costs saved every year are transferred to consumers in the form of discounts and offers, we estimate that *Outside Innovation* could lead to cumulative benefit of more than $1 billion to consumers. *Outside Innovation* will also impact jobs. While a reduction in R&D spend could result in a reduction in some research jobs, these will be offset by job creation required to support new revenue streams. Cumulatively, open innovation could result in the creation of 90,000 new roles in the industry over the coming decade.

"Outside in-novation": Value at stake in numbers

(All figures cumulative for period 2016-2025)



Transforming for digital talent

A key differentiator in today's competitive, digitally enabled world is access to the right skills and knowledge in your workforce. What is needed is not just analytical, coding or engineering skills; digital natives are transforming industries through an inherently innovative culture that celebrates internal disruption, flexibility and collaboration.

> **In our company, the average age of the workforce is well above 40 years. It is a challenge to compete with more digital capabilities. We are talking about things like transformation of the networks, how to digitally transform customer-related processes, how to acquire better knowledge and expand engagement with the customer through a widespread use of analytics. The big challenge is to deliver a digital transformation engaging people who are attached to the legacy systems from 20 years ago. It's also matter of creating digital knowledge and leading a cultural switch.**

Mario Di Mauro, SVP Strategy and Innovation, Telecom Italia and Chief Strategy Officer, TIM

The talent challenge in the telecom industry will likely emerge in two main areas. First, the shift in network differentiation towards software capabilities will require a large shift in employee skills and organization. Second, the need for rapid evolution and innovation in new digital services will require companies to build new capabilities and culture – merging new and traditional workforces, acquiring deep industry expertise and overcoming cultural barriers to change.

These two things have not traditionally been strengths of telcos and there is evidence that a lot still needs to change. Consider a typical CSP's workforce composition compared to a Silicon Valley firm: 45% of the CSP's recent job postings were in sales and customer service, with only 12% in engineering or IT; for Silicon Valley companies, those numbers were nearly flipped, with only 13% of open postings in sales and customer service, and 51% in engineering and IT. To compete effectively, CSPs must change the makeup of their workforces: from armies of sales and customer service workers to cohorts of software engineers and product developers.

In the digital economy, two factors have become influential in attracting and retaining talent:

- **Transparency** is the new normal. Applicants can access a wealth of inside information and peer reviews, with Glassdoor alone sharing more than 8 million reviews of more than 423,000 companies. Organizations are now publicly accountable for the way they operate.
- Millennials and future generations have **markedly different expectations**. According to a World Economic Forum survey, career advancement (48%), company culture (38%) and training or career-development opportunities (32%) are what millennials want most from their employer.[39]

As incumbents around the world look to reposition their talent strategies for a digital age, there are useful examples emerging from other industries for the telecom industry.

Case Study: Digital Upskilling and Innovative Organization Structures

Nestlé set up the Digital Accelerating Team (DAT) to upskill its employees on digital. DAT experiments with new and emerging technologies, working with start-ups and tech companies through corporate hackathons. Online clothing retailer **Zappos** uses a unique management ethos to align with the working styles of millennials and foster innovation and collaboration. It uses a "holacracy" model, a management structure based on the tasks a company needs to accomplish rather than a standard reporting structure. These models do not guarantee success, but they illustrate the targeted steps that companies are taking to drive cultural change within their organizations. Ultimately, this will position them better to compete in a rapidly evolving marketplace.

Within the telecom industry, companies have successfully adopted a "sandbox" approach to innovation, establishing innovation centres and R&D hubs that are autonomous and unencumbered by the talent policies and processes in the rest of the organization.

Case Study: Driving Innovation through Independence

AT&T Foundry is the North American operator's gateway to the latest technology trends. It incubates collaborations between start-ups, entrepreneurs and its own R&D facility to drive service innovation. Successful pilots are scaled and integrated into existing or new products and services. Similarly, Spanish telecom provider Telefónica created a separate corporate entity, **Telefónica Digital**, with significant autonomy to make it more agile.

Capturing Value at Stake Will Depend on Overcoming Key Inhibitors

The telecom industry has attempted several course corrections but has largely not been able to keep up with the pace and scale of competition and innovation by digitally native businesses. Structural and organizational challenges continue to hamper agility. Telecom operators will have to overcome several key inhibitors to realize potential value from digitization:

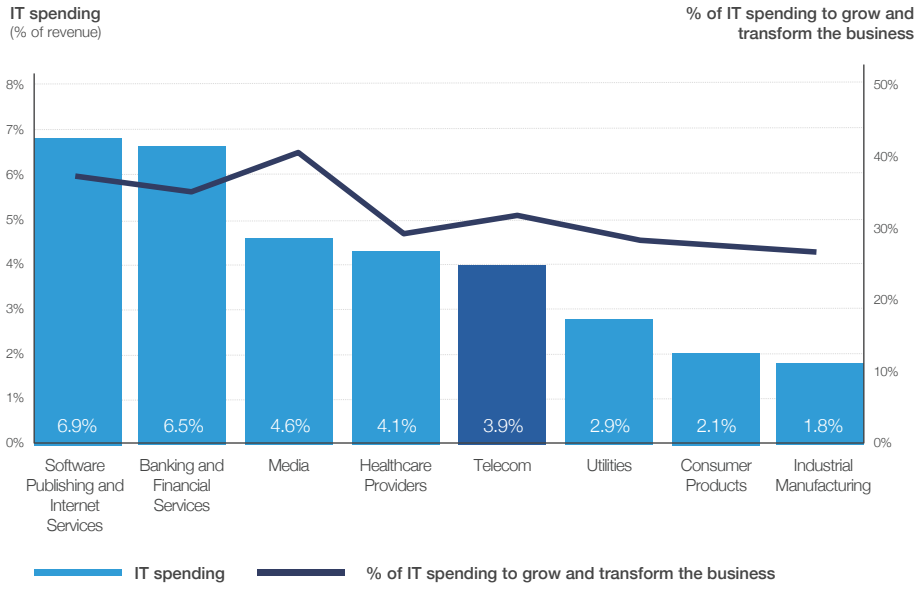
Encumbered by legacy

The telecom industry's largest assets – physical infrastructure, national scale of operations and sophisticated front-end (BSS) and back-end (OSS) systems – are turning into one of their largest inhibitors to rapid innovation. Large, clunky and disjointed IT stacks, modular operating company ("op-co") organizational structures, and operating models built around large physical assets have left them with little flexibility and agility to deploy enterprise-wide or global digital businesses. Efforts to launch seamless digital experiences or services for customers are often blocked by a lack of integration between BSS and OSS systems. A focus on maintaining legacy assets means there is limited cost flexibility to focus on innovation. Telcos can invest only about 10%-15% of their revenue in customer experience and product innovations, compared with 35% for digital businesses and 70% for a traditional consumer products company.[40]

> **The largest bottleneck is in the mindset and the legacy IT systems (BSS/OSS). It is very important to overcome these quickly. You can create all the services and apps that you want, but if you're of disjointed infrastructure, you're not going to get very far.**
>
> Mauricio Ramos, Chief Executive Officer, Millicom

A near-term solution to clunky IT systems lies in strengthening partnerships and collaboration with digital service providers. However, to truly transform the customer experience, companies may need very strong leadership and often brute force. In moving its cable TV subscribers to its cloud-based X1 platform, Comcast managed to transform the traditional TV experience to one for the digital age, while being able to better leverage its investments in content creation and delivery. However, to do this, it had to transition millions of subscribers to the new platform (the company was said to be deploying more than 40,000 X1 boxes per day), fend off resistance from its vast supplier base, reskill its engineers, revamp customer service channels and reorient internal IT systems.[41] The company is said to have invested at least $300 million in this endeavour to transform its customer experience.

Figure 9: IT Spending in the Telecom Industry Lags behind other Sectors such as Media, Banking and Healthcare[42]



Source: World Economic Forum/Accenture analysis based on data from Gartner

Limited public-private collaboration

Regulatory frameworks originally put in place to protect consumer interests are not always aligned with the need for the industry to rapidly evolve business models. Regulators have focused on protecting consumer interests while trying to ensure widespread availability of critical network connectivity. In many cases these objectives have proved contradictory and, in tandem with rising spectrum costs, have restricted the ability of telecom operators to raise prices to cover the cost of innovation and infrastructure investments. Differences in regulatory policy governing technology companies and telecom operators – with stricter rules for operators and cable companies – have created an uneven playing field in some cases.[43] The need to protect consumer interests, especially with respect to data privacy and competitiveness, has meant that regulatory involvement has increased in the form of stringent anti-trust, data privacy, cross-border data flow or net neutrality regulations. Rapid and sweeping changes across industries means that the role of regulation will have to evolve in a way that enables structured competition and incentivizes innovation.

The innovator's dilemma

Publicly listed incumbents are being held back from radical innovation because of conservative corporate cultures and the short-termism of stock markets. Under leadership that is focused on driving shareholder returns from the physical infrastructure that has been built up over decades, businesses often pursue short-term, incremental innovation rather than large transformational changes that may cannibalize existing revenue streams. While wireless mobile operators have focused on incremental innovation in technology standards from 2G to 3G to 4G/LTE – in effect, strengthening the pipe – digital businesses such as Skype, WhatsApp and Facebook have been transforming the entire product and customer experience across communications and other industries. Companies in other industries have overcome the innovator's dilemma to launch services that may often compete with existing sales – **Daimler**, the German automotive major, recognized the emerging shift in customer aspirations away from owning a car to accessing mobility on demand to launch its digital mobility application, **moovel**. While the success of initiatives such as these will be dependent on effective execution, they point towards the ability of companies to overcome the innovator's dilemma.

> **There is the innovator's dilemma involved with transforming a 40% EBITDA margin business to compete with a 5% EBITDA business. One way to get around this is to create a separate business that we partly own, is measured differently for investors and that can participate in these services.**
>
> Balan Nair, Chief Technology Officer, Liberty Global

Digital skills and culture

The telecom industry faces skill gaps that go beyond a shortage of digital skills and an ageing workforce. Successfully competing in a digital world will require telcos to supplement decades of in-house network expertise with deep industry-specific and digital skills. To make this transition successfully will require more than just setting up a separate digital business unit or appointing a chief digital officer. Companies across the board will have to build generational diversity and digital literacy to successfully digitize.

Here, company and leadership culture is likely to play a massive role in determining how companies evolve to compete. The telecom industry and digital new entrants operate with distinctly different "received wisdoms". At telcos, they are holding back breakthrough innovation and transformation. Current behaviours, processes and metrics do not encourage risk-taking or collaborative behaviour, creating resistance to change. A narrow focus on short-term targets further creates a fear of failure. Responsibility for creating a culture in which innovation can thrive and digitization can accelerate starts with the CEO, who must be accountable for the success of the company's digital transformation.

Imperatives for Industry, Regulators and Policy-makers

With sweeping changes ahead, the telecom industry must adapt. For some, that means transforming their way of working. The largest pools of value will be found by those not just with the best-quality networks but who quickly embrace digitization across all aspects of customer experience, internal organization and innovation. At the same time, the industry as a whole must work harder and more closely than ever with governments and policy leaders globally to overcome key inhibitors to industry and societal value.

What follows are practical recommendations for industry leaders and policy makers to conquer these inhibitors and drive cultural change towards succeeding in a new, digitally transformed world.

a. Imperatives for industry

Define near-term action plans for main transformation areas

Digital transformation will drive changes in business and operating models that impact several parts of the industry and require focused action. Below is an indicative action plan that could help business leaders assess the scope of change and define a clear action plan of their own.

Identify a model for effective vertical-market collaboration

Deep expertise in vertical-market use cases will be a prerequisite for telecom companies looking to succeed in enterprise and consumer digital services in areas such as IoT. Competitive advantage is likely to be driven by companies that are able to collect and analyse time-series data to identify value opportunities specific to each use case and target value capture through customization of services and offerings. Open collaboration with vertical markets and technology will be key to access and co-developing these offerings through two-sided markets. Telecos are currently pursuing different models of collaboration, ranging from relatively closed direct partnerships to open platform-based models. The appropriate choice for each use case will be driven by capabilities, revenue potential and the ability to address challenges.

	100-day plan	One-year plan
 NETWORKS OF THE FUTURE	• Create a comprehensive assessment map of existing network architecture components to transition to software-based control and deployment • Conduct gap assessment of current cyber resilience across the network • Create an inventory of current network functions and assess scope for virtualization and automation • Assess scope (based on cost per bit) of alternative technologies to support network access in areas with low population density	• Map each deployment to potential client/consumer impact and delivery of new services • Define a clear roadmap for deployment across the network architecture, including definition of a business case • Identify most appropriate vendors and partners to support deployment
 BEYOND THE PIPE	• Conduct detailed assessment of consumer and enterprise segments to understand latent demand for digital services • Conduct gap assessment on current capabilities required for delivery • Develop plan for effective vertical-market collaboration to gain expertise on use cases and co-develop business models (see next section)	• Pilot and refine new services • Develop an ecosystem strategy that will allow you to work with a portfolio of potential partners • Restructure operating models and governance to provide network functions as a service to digital business units
 REDEFINING CUSTOMER ENGAGEMENT	• Adopt techniques like design thinking across customer service teams to focus on improvements in customer outcomes • Establish automated feedback tools to gather insights on customer experience • Augment current customer segmentation strategies with insights on individual digital behaviours to provide more personalized experiences	• Conduct a detailed assessment of your customer service model. Identify what percentage of your consumer base can be effectively transitioned to digital/self-service channels • Ensure cross-functional ownership of the customer experience from the network to the application layer • Acquire/build deep expertise in leveraging real-time analytical tools, including emerging AI systems to improve customer experience
 BRIDGING THE GAP ON INNOVATION	• Assess ongoing and future projects for aspects that can be ‘opened’ to external partners and / or moved out of internal R&D teams • Evaluate structures, governance and organizational readiness to allow innovation to flow across the organization to every employee • Establish employee engagement and collaboration tools to drive co-development of ideas • Establish a direct connection with the start-up ecosystem either through communities, incubators or corporate venture capital	• Define guidelines and governance for innovation project teams to pursue open innovation. Decentralize decision making to business units. • Create a new talent engagement strategy, keeping in mind what millennials demand from their employers. Develop a plan that will allow workers to contribute to projects they are passionate about, move freely through the organization, and find work that best suits native skills with digital technology

Figure 11: Vertical Industry Collaboration Models

	DIRECT PARTNERSHIP	INVESTOR	COMMUNITY APPROACH	PLATFORM APPROACH
DESCRIPTION	• Telcos partner directly with enterprises to build or enable digital services in vertical-market use cases • Operators / network vendors provide key network capabilities and assets which may extend to associated services like analytics and cloud services	• Telcos directly invest in or acquire companies building services in vertical market applications • The offering is allowed to develop organically and the telco remains only a strategic investor • Allows the telco to gain market expertise across a number of vertical markets through multiple investments	• Telcos build or participate in communities focused on driving development of vertical market applications • Communities may include telecom industry participants, enterprises (users), and technology partners • Products and services are co-created with other members of the community	• Telco creates or joins a platform-based business model in one or more vertical-market use cases • Platform enables wide collaboration and scale through network effects • Platform provider takes the lead in driving open innovation, standards and interoperability
POTENTIAL REVENUE MODEL	• Revenue share on core product offering • Enterprise services revenue • Data and network services revenue	• Share of profits • IPO / stake sale • Integration of target companies	• Licensing / royalty • Commercialize revenue share on core offering	• Subscription / ad-based revenue • Revenue share on core offering commercialized by enterprise partners
MOST RELEVANT FOR	• Telcos looking to build enterprise services expertise in specific use cases • Co-development of new technologies / applications	• Companies looking to access wider range of technologies and ecosystems and at a faster pace than possible through in-house innovation	• Development of large-scale services requiring collaboration from multiple parties to drive standards and interoperability	• Two-sided business models based on network effects • Products and features enhanced through open innovation
CHALLENGES	• Scale in use cases partly dependent on partner's expansion plans • Monetization may still be tied to a SIM card	• Valuing investments reasonably • Portfolio management • Integration challenges • Limited control over service / offering development	• Clear definition of benefits to different participants in the community • Definition of shared goals and objectives	• Definition of clear value proposition for vendors / consumers • Establishing technical standards and interoperability • Remaining neutral and accountable to consumers
EXAMPLE	at&t, OTIS, GE, SUNPOWER	QUALCOMM	5G AUTOMOTIVE ASSOCIATION: HUAWEI, Audi, BMW, ERICSSON, NOKIA, QUALCOMM, DAIMLER	QIVICON Leben im Smart Home

Source: World Economic Forum/Accenture analysis

> **For a very long time, whenever the industry has come together to innovate, we have said that we will build an interoperable environment, but this interoperability has always been defined only between telcos. Global internet businesses are not based on interoperability between connectivity standards but with other industries, business models and processes.**

Phillip Malloch, Vice-President and Head of Group Public Affairs, Telia Company

Drive cultural change from the top

Internal organizational culture has been increasingly identified as one of the main inhibitors to transformation. Employees at telecos have a number of strengths: strong discipline in business units; a high level of technical orientation; the ability to plan for long-term investments; and experience in managing complex geographies and diverse business models. However, hierarchical cultures and limited collaboration often mean that these strengths do not percolate down to all levels of the organization. Cultural change will need to be exemplified at the board and C-suite level, include all employees, and boost openness and collaboration.

b. Imperatives for regulators and policy-makers

Create regulatory certainty across jurisdictions

With policies on spectrum allocation, sector taxation, infrastructure deployments and regulation of digital platforms varying substantially between jurisdictions (international, federal and state levels), regulatory frameworks are disjointed and create investment uncertainty at a time of radical transformation for the industry. This undermines the ability of the telecom and technology sectors to create seamless and consistent digital experiences. It also hinders large global organizations from creating value from centralized data control and analysis. Countries have taken steps to protect the privacy and rights of citizens (e.g. the suspension of "safe harbour" agreements between the European Union and the United States), but a lack of consistency across borders threatens to result in the creation of many local internets – sometimes described as the "Balkanization of the internet" – in place of the single global network that exists today. Further, regulatory regimes for telecom operators and digital new entrants often differ, meaning that operators are left unable to compete. The need for a common framework of governance is pressing.

Drive coordination through national digital agendas

Clearly defined, long-term national digital agendas – including incentives for infrastructure rollout and ecosystem development – can play a big role in underpinning value creation for industry and wider society. Programmes such as Digital India aim to transform the country into a digitally empowered society and knowledge economy by encouraging collaboration across government agencies at the national and state levels. Similarly, Singapore's Next Generation Nationwide Broadband Network plan lays out a series of guidelines to shape the country's digital infrastructure for the next 20 to 25 years.[44] This process was carried out in consultation with the telecom industry through competitive dialogue, requests for proposals and joint studies. The government worked closely with the industry as early engagement was vital for the private sector to better appreciate the project's impact and implications – this will be critical when it eventually designs, builds and operates Singapore's future digital infrastructure.

Design regulatory and policy incentives for industry to unlock societal value

Coordinated regulatory efforts will be required to maximize the value of digitization for society and across industries. For example, the industry business case for extending network coverage to remote areas is often eroded by siloed licensing mechanisms and a short-term revenue collection imperative. Connectivity infrastructure based on alternative technologies, such as those being tested by OneWeb, Facebook and Google, are seeing more support from local governments, but there are still economic and logistical barriers to wide adoption. Further, the benefits of digital communications don't always accrue equally and require focused action to ensure fair competition, affordability, proliferation of digital skills and strong institutions. Greater facilitation and incentives from policy-makers could help reduce the cost per bit of these connectivity models.

Digital transformation has the potential to transform the way we work and live to an extent that is comparable to past major industrial revolutions. While the potential for digital transformation to benefit industry and society is tremendous, it is by no means guaranteed that the full value of digitization will be unlocked – to do so will require focused and determined action on the part of all major stakeholders. At the same time, societies and industries will need to prepare for any undesirable consequences of this transformation, particularly in relation to employment, data security and privacy.

For the telecom industry, the impact of digital transformation has already been significant and the coming decade will be critical in defining the industry's role in the wider digital economy for many years to come.

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Appendix

Value-at-stake methodology overview

Value at stake is a framework designed for assessing the impact of digital transformation initiatives on the industry, customers, society and the environment. It provides a differentiated and evidence-based understanding of the extent of impact that digital transformation will have on the industry and where potential value creation opportunities exist. It provides likely value estimates of global industry operating profits that are at stake, from 2016 to 2025, and the contribution that digital transformation can make to customers, society and the environment in that time frame.

Industry value

Value at stake for the industry comprises two elements. First, the potential impact on the industry's operating profits that will be generated because of the digital initiatives (value addition). Second, operating profits that will shift between different industry players (value migration).

Value to society

Value at stake for society includes three elements: customers, society and the environment. Each element is measured as follows:

1. Value impact for customers: the potential gain to customers (both B2B and B2C) in the form of cost- and time-savings, discounts and ability to earn additional profits (for B2B only).
2. Value impact for society: the impact (both financial and non-financial) of digital initiatives on productivity gains and jobs.
3. Value impact on the environment: the estimated impact of the digital initiatives on increasing or reducing CO2 emissions.

Approach

The value at stake has been calculated using a top-down approach involving three key steps:

1. Identification of the total addressable market and the adoption/penetration rates over the next 10 years for each digital initiative based on secondary research, industry reports, existing use cases and interviews with subject and industry experts.
2. Creation of a value tree to represent the different industry and society-value categories mentioned above.
3. Testing, revision and validation of assumptions and results with Accenture experts, Digital Transformation Initiative working group members and select Industry Partners of the World Economic Forum.

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