LEAD OR LOSE

A VISION FOR EUROPE'S DIGITAL FUTURE

INTERVIEW HIGHLIGHTS FROM DISCUSSIONS WITH C-SUITE EXECUTIVES, SENIOR GOVERNMENT LEADERS AND HIGHLY ACCLAIMED THOUGHT LEADERS

"Human beings are an empathic species, soft-wired to contribute to their communities, so the idea that people are going to be idle in the digital age is absurd. Future jobs are going into the social economy."

Jeremy Rifkin · Economic Advisor to Heads of State

"There is a huge opportunity to create a digital Europe. Our industry can play a pivotal role by providing the jobs of tomorrow, the values of tomorrow and the future growth opportunities. In Europe, we have the brains, skills and universities, and we really need to ensure we keep the jobs, the value creation and the tax income here."

Dominique Leroy · CEO, Proximus

"Innovation happens where there is scope for experimentation. Regulation cannot be imposed before you have created a market. It is the other way around: first you need to learn and then adapt where things need corrective steering."

Timotheus Höttges · CEO, Deutsche Telekom

"We need to empower consumers to make informed decisions about their digital lives. The role of policy makers should be to raise consumers' awareness and provide them with the necessary skills to fully understand the digital world and how it impacts them in terms of security and privacy."

José María Álvarez-Pallete · Chairman and CEO, Telefónica

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EXECUTIVE SUMMARY

Remember the last time you used an app to hail a ride? It probably went something like this: after waiting for a few minutes, a car pulled up, you got in, and off you went. But how would you feel if your ride was an all-electric vehicle without a driver in the front seat? During the ride, you tap on the vehicle's interfaces. They light up with alerts and updates from your social networks. Even the song you were listening to outside picks up exactly where it left off – that is, until you start a video chat with a friend. This scene illustrates just some of the ways that digitization will shape our lives, not to mention the future of Europe.

EUROPE STANDS AT A CROSSROADS WITH HUGE RISKS AND OPPORTUNITIES FOR PEOPLE, PLANET AND PROSPERITY.

Europe stands at a **crossroads** regarding its digital future. The road we choose today will have huge implications for the lives of Europeans in 2030. Along one path, Europe becomes an economically thriving, competitive, and climate-resilient region full of empowered citizens who enjoy privacy and security. Along the other path, Europe faces accelerating unemployment, an ill-equipped workforce, crippling cyber-attacks, runaway climate change, and a marginalized position in the global economy. What does Europe need to do to get on the right path? To find out, Accenture Strategy, at the request of ETNO, interviewed a dozen European telco CEOs, and another twenty thought leaders, bestselling authors, and senior policy makers. Their insights, which appear throughout this report, highlight the risks of business-as-usual approaches to digitization in Europe. But they also emphasize the enormous opportunities if we get it right.

Europe's digital future will define how we lead our lives as citizens and consumers. Most of us aspire to live dignified, safe, healthy, and fulfilled lives, but digitization is changing how we go about it. Take our working lives, for example. Automation through robotics and artificial intelligence (AI) could **affect over half of current European jobs[1],** which will be redesigned or cease to exist by 2030. Technology will help us tackle this challenge by providing the access and scale to allow **11% of the EU population[2]** to complete high-quality online courses by 2030. This adds up to 57 million e-degrees[3] that will help employees build new skills and

employers keep pace with the changing requirements for any given job in the digital age.

Digitization can also help Europe mitigate climate change: 12 digital solutions alone can fulfill and even exceed the EU's climate commitment by avoiding 1.5 Gigatons of CO_2e emissions in 2030, achieving a **34% reduction from current EU emission levels[4]**. This could help reduce the intensified droughts, floods and other extreme weather events that are expected to **displace 72 million people globally** by 2030[5]. Decreasing the number of "climate refugees" forced to abandon their homes would also ease the social and financial pressures of mass migrations into Europe.

Digitization will also have big impacts on economic growth and distribution of wealth – both within European societies and between Europe and the rest of the world. The economic opportunity from digitization in Europe is over **€4 billion in value per day,** which translates to over €7 per EU citizen per day[6]. To tap this huge potential, European businesses and policy makers need to be radically more ambitious, and prioritize innovation and open ecosystems. Over the past decade, **Europe has lost €100 million in telco EBIT every day** to digital disruptors[7]. These disruptors grow to scale in Asia and the United States – large markets with favorable regulatory environments. Meanwhile, European companies have been held back by backward-looking, cost-based regulation and limited investment and innovation in the European digital ecosystem.

What makes *now* such a pivotal turning point for Europe? The answer is speed. The pace at which digitization is changing every aspect of our lives is accelerating, and it will only continue to do so. The rapid virtualization of our world is driven by **exponential technologies** like AI, virtual reality and robotics. Exponential technologies often double their performance every two years while cutting their costs in half. If this trend continues until 2030, we would see an accumulated cost-performance increase by a factor of over 8,000. This means that once-unaffordable innovation would become available to the mass market at almost zero cost. One example of this is Google's light detection and ranging system, a key enabler for autonomous driving. It cost $75,000 just a few years ago, but by early 2017, the price had dropped 90% to $7,500[8]. By 2030, it might be virtually free.

EUROPE AT A CROSSROADS – OPPORTUNITIES AND THREATS ON THE WAY TO THE DIGITAL AGE

2030

72M climate refugees due to rising sea levels, floods and droughts by 2030

-34% CO_2e emissions in EU through digital solutions by 2030

Over half of current European jobs affected by digitization

11% of EU population to complete high-quality online courses in 2030

€100M in European telco EBIT lost every day to digital disruptors

€4bn in value per day from digitization for Europe

2017

DIGITIZATION WILL IMPACT ALL AREAS OF OUR LIVES.

Autonomous Mobility is just one **experience area** for exponential technologies by 2030. Virtualization will fundamentally change essentially all aspects of life. This report considers eleven experience areas, ranging from *Liquid Work, Personalized Health* and *Connected Buildings, to Seamless Transactions and Supply Chains.* For instance, *Personalized Health* will put people more firmly in control of their health choices. Advancements in data analytics and AI, as well as plummeting costs for DNA sequencing, will pave the way for more effective, personalized healthcare that emphasizes preventive measures over fighting illness. Diagnosis and treatment will no longer need to be conducted face-to-face because technology will enable remote and digitally enhanced patient-doctor interactions and automated diagnostics, enhanced by crowdsourced peer-advice, drastically cutting costs for the healthcare system.

THREE FOUNDATIONAL CAPABILITIES ARE THE PREREQUISITES FOR EUROPEAN DIGITAL LEADERSHIP: AN ECOSYSTEM AROUND THE INTERNET OF EVERYTHING, LOW-LATENCY PERVASIVE NETWORKS AND RECREATED INSTITUTIONS.

As digitization affects the various experience areas and, thus, Europe's place in the world, how can we ensure Europe emerges stronger? This research identifies **three foundational capabilities** that are the prerequisites for a strong Europe in the digital age: an ecosystem around the Internet of Everything, pervasive networks of the future, and reinvented institutions. Getting these foundational capabilities right will determine whether Europe is poised for a successful digital transformation, creating prosperity and benefitting its people and the planet. The first foundational capability is an **ecosystem around the Internet of Everything** that protects industrial value creation in Europe. In this open ecosystem, data is easily accessible from interoperable sources, securely transmitted and stored, and data exchanges and marketplaces allow anyone with a secured identity to participate and profit. As everything gets connected, Europe needs **pervasive, reliable communication networks** to power future industrial applications – everything from autonomous vehicles to distributed renewable energy. Such networks are highly virtualized with the capability to provide ubiquitous connectivity,

reduce latency to milliseconds, and enhance performance through real-time analytics. The third foundational capability centers on the **recreation of our institutions** so they can support digital interactions that are fast and efficient, but also secure and private. Our institutions need to establish digital identification and transaction security, as well as transparency and control over the use of personal data.

TELCOS CAN PLAY A CRUCIAL ROLE IN DEVELOPING THE FOUNDATIONAL CAPABILITIES IN EUROPE AND GAIN SCALE THROUGH SECTOR INITIATIVES.

European telcos are well-positioned to deliver the three foundational capabilities, and could profit greatly from doing so. There are tremendous **opportunities,** and the telco CEOs are ready to pursue them, but policy action is critical to support success. To this end, Europe's telcos are already transforming their organizational cultures and investment priorities, and reskilling their workforces.

To gain scale, European telcos can benefit from cooperation with each other and with players from other industries. **Sector initiatives** could support telcos in bundling their resources and scaling their digital pilots into pan-European models that may eventually give rise to globally leading standard solutions. This report features seven concrete sector initiatives:

- An open smart city platform
- Connected public buildings
- Digital transport nodes
- Digital identity
- An integrated health and patient data platform
- An open SME platform
- A cross-industry think tank on AI

URGENT POLICY ACTION IS NEEDED TO CREATE THE RIGHT ENVIRONMENT FOR DIGITAL LEADERSHIP.

But European telcos and other companies cannot do it alone. Support from policy makers in the EU institutions and national governments is urgently needed to turn the three foundational capabilities into reality for Europe. Over the last twenty years, Europe has been a laggard in digitization. An unfavorable policy environment has caused Europe to fall behind other regions.

To win the next wave of digitization, **urgent and decisive policy action is critical.** This includes a bold and positive approach to crucial regulatory initiatives such as the Electronic Communications Code and the new ePrivacy Regulation. There are three key **policy priorities:**

- **Support European digital leadership** to scale an ecosystem around the Internet of Everything by enabling telco cooperation, supporting pan-European collaboration and consolidation, enforcing the implementation of a unified Digital Single Market, and facilitating scale for global relevance through outcome-based investments in strategic technologies

- **Multiply European investment capacity** by promoting fair and equal competition across the whole digital value chain, creating a long-term perspective and investment certainty for infrastructure roll-out, and acknowledging the need for quality-of-service differentiation

- **Enable institutions for the digital age** by creating a common authority to manage unique personal identities as trust anchors, creating institutions for secure digital transactions, making public ledgers digitally available, and creating a commonly agreed environment for the safe use of new technology such as AI

Digitization is already changing Europe. Whether or not we can leverage its opportunities to foster prosperity, human well-being and sustainability depends on the strategic decisions taken today. Will the continent work together to embrace these opportunities, or will it let this unique chance pass? This is one of the most important decisions Europe can take in the next decade. It will determine which path the continent takes into the digital age shaping the way we all live, work and play. It is high time that Europe took action.

2.
SHAPING THE DIGITAL FUTURE OF EUROPE

By 2030, all of our interactions with people and our environment will be enriched by data. How will this affect our everyday lives? We will not need a key anymore, because facial recognition will teach our homes who we are. Our workspaces will adjust temperature, smell and light to our needs and preferences, using predictive analytics and behavioral pattern analysis to understand what makes us comfortable. It will know at what time of the day we might need a change of position or light to get fresh inspiration or stay calm in a stressful situation.

The sensors and devices in our environment make this possible by collecting a steady stream of data about us. The average European creates between 3.5 and 4 Gigabytes (GB) of data traffic using a smartphone each month, and Ericsson predicts this will multiply by a factor of five over the next five years[9]. The combination of all of these data sources will create a seamless record of almost every second of our lives, including our mental state, our worries and our joys. This knowledge will be used to personalize our experiences, to keep us safe and healthy, and to support us when we need help. At the same time, we run the risk of losing our privacy, being manipulated, and having our personal freedom replaced by an autocratic system that controls not only our environment, but also what we experience, who we meet, what we talk about, and what we feel.

"Our fundamental rights remain the same, but they need to be adapted to the new digital reality. This could be achieved by agreeing on a Digital Bill of Rights that defines our shared principles for the digital future."

José María Álvarez-Pallete · Chairman and CEO, Telefónica

The deepening digitization and virtualization of all areas of our lives will shape Europe in 2030. We are witnessing a turning point akin to the invention of the automobile and telephony. Increasingly, we see the outlines of two drastically different futures: on the upside, an economically thriving, competitive, people-centric and climate-resilient Europe with equitable prosperity and empowered citizens. On the downside, digitization threatens to create winners and losers, thus contributing to a growing social divide with negative impacts far bigger than globalization's effects on the middle class. We are also at risk of facing accelerating unemployment for large shares of the population, the threatening impacts of unmitigated climate change, vulnerability to costly and threatening cyberattacks of unprecedented impact on companies and individuals, and a marginalized economic position for Europe in the global economy.

"The big challenges with digitalization will be inclusive growth and managing inequality. And the key question is, 'what do you do about the losers?' just as much as, 'how do you manage the winners?'"

Mark Spelman · Co-Head, Digital Economy and Society System Initiative, WEF

In sum, digitization puts Europe at a major crossroads, and the path we take will largely determine our quality of life, our planet and our economic prosperity.

2.1 IMPROVING QUALITY OF LIFE

First, digitization has a fundamental impact on the way we live our lives in dignity, good health, with an open and trained mind, realizing individual fulfillment in a world without violence. On an individual level, this raises fundamental questions about our everyday life. How will the digital future impact me as a consumer of services? Will they be free, or will I pay with my data? Will my data work for me? How will I interact with my environment, family and friends? What will my children learn in school? And what kind of life and career awaits them?

On the upside, the digital future could deliver tremendous benefits to consumers. We could lead longer, healthier lives by harnessing sensors, devices, apps and big data analytics. These tools could help us prevent, detect and treat non-communicable diseases like diabetes, heart disease or cancer. We could feed more people with better food while consuming fewer resources through supply chain transparency, tracking solutions, precision farming and lab production. While there are a multitude of ways our lives as consumers and citizens can improve, these benefits are all but guaranteed. The following scenarios illustrate just how diligent Europe will need to be to make digitization work for its people.

Digitization will transform Europe's labor market. Technologies like robotics and artificial intelligence (AI) will drive unprecedented automation, while the skills needed for any given job will evolve rapidly and constantly. The biggest fear is continued polarization of employment away from middle-skilled jobs towards low- and high-skilled jobs, probably at a faster rate than what we experienced over the past two decades[10]. This will lead to unemployment and underemployment, especially among Europe's youth, as well as a growing gap between the "haves" and the "have-nots". Some estimates predict that **over 50% of current European** jobs will be altered by digitization or will cease to exist by 2030[11]. But all estimates of digital's impact on employment share two observations. First, not all types of activities are equally prone to automation. Comparatively few jobs will disappear completely, while the majority will shift in their requirements in the medium-term. Second, it is easier to forecast what jobs will disappear than it is to envision the new jobs that will be created. For example, completely new categories of jobs will emerge by 2030 due to innovative technologies, such as "trainers" who teach AI systems how to decipher and credibly mimic human behaviors like empathy and irony[12]. Concrete examples could be a coach who trains AI to behave in accordance with a certain company culture, or a robot counselor who helps customers figure out which robot servant or caregiver is right for them.

"Our jobs are getting redefined and more sophisticated. We have observed this phenomenon in past automation waves: for instance, the job description of a secretary nowadays diverges substantially from what it used to be – today it is all about human interaction."

Carl Benedikt Frey · Co-Director and Oxford Martin Citi Fellow, Oxford Martin School, Oxford University

Tasks that involve carrying out physical activities or operating machines in a predictable environment are among the most susceptible to automation. Hence, middle-skill clerical and manufacturing jobs, which are often dominated by routine tasks, will disappear faster than high-skill roles that carry out complex cognitive tasks, or even low-skill jobs that involve non-routine

manual tasks requiring hand-eye coordination. The rise of connected, autonomous vehicles endangers Europe's currently over 3 million truck driver jobs[13], of which up to 1.8 million could be replaced by 2030, according to OECD estimates.

"There are 250,000 unfilled data science positions in the US right now. But if you're a truck driver, it's a long way to become a data scientist."

Salim Ismail · Co-founder, Singularity University

To appropriately steer this profound change of our labor market, and avert widespread job migration, unemployment and stagnating incomes for many households, Europe's key priority should be ensuring extensive and easily scalable access to life-long learning and on-the-job training. Workers who constantly refresh and update their skills and knowledge will safeguard their employability in the digital world. Here, the unparalleled scalability of digital solutions for *Learner-centric Education* helps overcome a challenge that traditional classroom training cannot. In 2030, people in the EU will complete **57 million e-degrees[14],** including secondary and university degrees, as well as company training. This represents 11% of the EU population in 2030 completing high-quality online courses. Augmented reality (AR) delivered through visual headsets could be an essential tool for effective and enjoyable on-the-job training to workers on a large scale. By adding an additional layer of information overlaying the shop or office, AR could guide learners through new processes, and teach the required material in a gamified experience. Workers already using AR for learning purposes have been found to be more productive and satisfied, while making fewer mistakes[15].

"The role of the teacher is changing, but not disappearing due to automation. Learning is a profoundly human experience, and teachers will be needed to guide the individual learner."

Iris Lapinski · Founder and CEO, Apps for Good

Access to online classes anywhere and anytime will help employees and employers prepare for the future of work in the knowledge economy. It also creates a market potential of €68 billion for learning centers and €12 billion for telecommunications companies for developing e-learning platforms in Europe[16]. On a macroeconomic level, online training is an efficient way to improve the overall level of digital skills in Europe, which will drive greater economic growth. More specifically, an additional 1.6 to 4.2% growth in GDP across major European economies in 2020 can be achieved if governments strike the right balance between upskilling the labor force, investing in technology and creating a favorable environment[17].

2.2 PRESERVING OUR PLANET

Digitization creates opportunities and risks for the planet's future. Looking at the pressing challenges of climate change and its impacts, it's time to ask ourselves some fundamental questions. Will the world be on a sustainable path by 2030? Will we successfully contain global warming to less than 2° Celsius? How will we preserve the mesmerizing biodiversity of our world? Can we feed over 8 billion people with one planet's resources? Will digital technology help humans survive on Earth, or are we speeding toward extinction?

Environmental benefits are achievable across all areas of our lives if we harness the power of digital solutions. These include telecommuting and digital collaboration that curtails CO_2e emissions from business travel; precision farming, that reduces the need for deforestation, fertilizer and pesticides; *Autonomous Mobility,* that leverages the Internet of Everything (IoE) for smoother traffic flow, lowering vehicle emissions; and *Smart Manufacturing,* that utilizes more efficient processes that can prevent hazardous waste.

Of all the potential environmental benefits to be reaped from digitization, mitigating climate change is particu-

larly exciting. The European Union's plan to cut 80% of its emissions by mid-century (compared to 1990 levels) is in a decisive phase. Unleashing the emission-reducing potential of digital solutions could tip the balance between a future burdened by climate refugees, floods and droughts, and a future where Europeans prosper. Unmitigated climate change would have disastrous economic and social consequences for the EU. These include flood damage, scarcity of fresh water, low crop yields, health problems, loss of biodiversity, as well as a strain on social systems from an influx of climate refugees. To avert this gloomy future, the EU wants to cut emissions by 40% on 1990 levels by 2030 (equal to 3.4 Gigatons of CO_2e in 2030), which will contribute to achieving the 2015 Paris agreement goal of limiting global warming to below 2°C. This EU target represents a 23% decrease in emissions compared to today's levels. Digitization will help make this possible. Twelve digital solutions alone can fulfill and even exceed the EU's climate commitment by avoiding **1.5 Gigatons of CO_2e** emissions in 2030[18], thereby achieving a 34% reduction from current emission levels. The three areas with the highest abatement potential for the EU are digital solutions around *Renewable Energy* (35% of total reduction), followed by *Smart Manufacturing* (27%) and *Connected Buildings* (11%). Along with helping the EU meet its climate commitments, these digital solutions also help companies become more efficient in the consumption of resources, and decouple business growth from environmental degradation. Currently, large European economies like the UK and Germany do not fully consider these digital solutions in their national emission reduction plans, and often give preference to more expensive, non-digital abatement measures. In the face of the US government pulling out of the Paris climate agreement, the EU can lead a global turnaround towards a sustainable future, but only with the help of digital technology.

2.3 CREATING EQUITABLE PROSPERITY

Finally, a digitized European market will impact economic growth and distribution of wealth – both within European societies and between Europe and the rest of the world. We will need to answer the following questions: What does digitization mean for wealth generation and preservation? Will European citizens and companies benefit from data generated in Europe, and, in turn, provide employment and value creation? How will economic benefits be redistributed? Who will gain and who will lose? And what role will the Europe have in the global economy in 2030?

In aggregate, the digital transformation could create **€4 billion of value per day**, which equals 9% of expected European GDP[19], or a little over one time the current GDP of Spain, which is the fifth largest economy in the EU. Half of that – over **€2 billion** – will accrue as **value to society.** This includes consumer benefits, such as time and cost savings for European citizens; benefits for society and environment like improved health, safety and climate protection; and labor benefits in the form of net job creation and fewer injuries and accidents[20]. This value to society will be matched by **value to business.** *Smart Manufacturing* for example, will virtualize the entire value chain. It deviates from the traditional plan-build-operate process by designing and testing a virtual twin of a given product before planning and sourcing the physical production. Across all sectors, sourcing of input factors will increasingly be organized via electronic marketplaces offering the best agents who can fulfill the task, driving both quality improvements and efficiency gains. To realize these projections, European businesses and policy makers need to move forward in a coordinated manner, and steer our economy towards digital prosperity. For instance, European industry and consumers can benefit tremendously from the emergence of driverless vehicles, but only if there is enough investment in sensor and charging infrastructure, the right policy adaptions and industry standards and the business ambition to develop new services. This vision of prosperity evaporates if European businesses and policy makers take only cautious steps that do too little, too late to strengthen Europe's position in the global digital economy.

So far, none of the globally leading platforms of the digital age comes from Europe; they all come from the US and Asia. The US giants Google, Apple, Facebook and Amazon combined would be the seventh-largest economy in the world measured by their market capitalization compared to national GDP data[21]. Similarly, Asian platform companies are scaling fast, with China being the global leader in digital platforms for on-demand bike and car sharing[22]. And Asian e-commerce platforms like Alibaba and Jingdong are aggressively pursuing leading positions in the global logistics sector[23]. Value is already being lost by hesitant digitization in Europe. Over the past ten years, we have witnessed a **daily value loss of €100 million in European telco EBIT**[24] to digital disruptors and telcos from other regions of the world. This represents a gradual loss in global profit pool participation of EU companies over the past decade from 36% in 2006 to

11% in 2016. However, telcos in other regions are not experiencing this decline: Asian players remained at 18% profit pool participation over the past 10 years. Similarly, American telcos have kept a 16% share in the growing global profit pool. And American players in adjacent steps of the digital value chain, such as device manufacturers, content providers and internet companies, almost doubled their profit pool participation over the past decade from 25% in 2006 to 46% in 2016. Part of this could be attributed to an unfavorable policy environment in the European digital ecosystem, as well as to Europe's tentative approach to investment and innovation. Today, European companies realize only 11% of the global telco industry's total EBIT, a considerable drop from 36% in 2006.

To protect and strengthen the EU's economic position in the world, investments in innovative digital technologies need to be scaled urgently. This includes venture capital (VC) investment in promising start-ups working on artificial intelligence, advanced analytics, blockchain and cybersecurity. The disparity in such investments between the EU and the rest of the developed world is highlighted by the fact that only **6.5% of global VC investments in so-called unicorns** (start-ups valued at over $1 billion) between 2014 and 2017 went to unicorns from the EU[25]. EU unicorns only account for 10% of all unicorns worldwide[26]. On a more positive note, investments in European AI start-ups have picked up recently. VCs provided €1.4 billion in funding to over 1,150 EMEA AI-related companies[27] in 2016, amounting to 36% of all global VC investment in AI that year.

Besides investment, European digital leadership also depends on enforcing data protection and security. This is essential to prevent the growth in cyberattacks worldwide. Today, economic damage from cybercrime has reached **€750 billion annually** in Europe[28]. This adds up to 5% of total EU GDP. Scotland Yard estimates that approximately **one million EU citizens are falling victim to cybercrime every day**[29]. This presents a serious risk for business and society, and could make the public weary of otherwise beneficial steps toward digitization of – for example – energy, mobility, healthcare, and government. Additionally, Europe has rightfully started to think about how economic benefits can be derived from the data generated in Europe to create growth and jobs. Experts are calling data the "new gold" or the "new oil." Companies that are able to leverage the behavioral insights that lie in consumer data outperform their peers by 85% in sales growth and more than 25% in gross margin[30]. The ever-growing streams of

data that already capture every step of our lives fuel the dematerialization of the economy, shifting us from ownership of goods to on-demand access to services, as exemplified by the sharing economy. International Data Cooperation (IDC) predicts that data volume will double every two years – reaching 44 trillion Gigabytes by 2020 and 1.4 quadrillion (or 1,400,000,000,000,000) Gigabytes by 2030[31]. This sheer explosion of data is expected to drive double-digit annual expansion of the global data analytics market from $130 billion in 2016 to $203 billion in 2020[32]. Digital solutions already make up 20-30% of GDP in Europe's top six economies[33]. And this share will grow. Driven by data, the internet economy will grow up to 13 times faster than the economy as a whole, with digital GDP growth representing around 40% of overall economic growth between 2010 and 2020[34]. These figures should compel European policy makers and businesses to take urgent action. This involves creating the right environment for digital businesses in Europe to scale and to shape global standards of the digital economy and compete on the global stage.

> *"Building a unicorn is a great achievement, but what Estonia has accomplished in creating the world's leading digital society is truly unique."*
>
> **Kersti Kaljulaid · President of Estonia**

Europe has already watched the US and Asia take the lead in the first wave of digitization, being too hesitant and tied up in internal discussions to compete. But digital platform economics tend to benefit only the one to two top players in any market due to the first-mover advantage. This advantage is particularly prominent when it comes to leveraging data, because data accumulates quickly, enabling companies to provide better, faster, smarter and even hyper-personalized services. Hence, late movers in the digital platform economy will be at the receiving end of digital technologies. This would mean that European companies and governments lose out on revenue, tax income, employment and control. But if Europe takes action now to create the platform businesses of the new generation of the internet – the Internet of Everything – we have a chance to reinvigorate our role in the digital economy, harvesting benefits for ourselves and the planet.

3.
ENABLING THE FUTURE OF OUR EXPERIENCES

We are at a turning point for our destiny as Europeans in the digital age. The urgency comes from the speed at which digital technologies are changing our lives. This change will continue to accelerate as technology becomes cheaper and more widely accessible. Exponential technologies, such as artificial intelligence (AI), augmented and virtual reality (AR/VR) and robotics scale fast, and thereby amplify the virtualization of our world. They often double their performance every two years while cutting their costs in half. By 2030, this continued doubling would lead to an accumulated cost-performance increase by a factor of over 8,000. These dramatic cost-performance improvements lead to explosive growth. For example, the number of connected sensors is expected to reach to 1 trillion by 2025, over 65 times the number of sensors connected in 2015[35]. "AI can realize efficiency gains of up to 90% on production and a significant reduction of labor costs," says Chris Boos, CEO and founder of Arago, the leading European player in general artificial intelligence. "The question then is," Boos continues, "what happens to companies that cut 90% of their operating expenses? They need to invest these efficiency gains into the development of new business models, and this will require human creativity."

> *"It is difficult to make 2030 predictions, particularly in the telco and technology industry. Typically, we over- or underestimate future developments. Instead of thinking that we know the future already and commit to one course of action we need to become flexible, so that we can adapt."*
>
> **Gavin Patterson · CEO, BT**

Let's have a look at how these technological changes affect the different aspects of our lives. This will inform the strategic moves Europe should make today to ensure that society and businesses can reap the benefits of the digital transformation tomorrow while being protected from the risks.

Liquid Work can sound either promising or threatening. It depends on how old you are, how good your education is, and whether you are on your own or have family responsibilities. *Personalized Health* is a great vision, but can everybody participate? And how does it get personalized? The data needed may also threaten fundamental rights of informational autonomy and self-determination. Will *Learner-centric Education* be an opportunity for all, or just for a few? When we connect buildings, supply chains and manufacturing, and enable new kinds of transactions, can we ensure security, protect property rights and safeguard trusted data access?

The impact of the digital transformation will be felt in all aspects of our lives – or "experience areas," as they are called in this study. Collectively, these experience areas describe our digital future: *Liquid Work, Sustainable Nutrition, Personalized Health, Learner-centric Education, Immersive Realities, Renewable Energy, Connected Buildings, Autonomous Mobility, Smart Manufacturing, Seamless Transactions* and *Supply Chains,* and *Digital Governance* (see Figure 1). Each of these areas will change dramatically over the next 10-15 years.

Change in these experience areas will be powered by three foundational capabilities: an ecosystem around the Internet of Everything (IoE), pervasive networks of the future and recreated institutions. As enablers of the aforementioned experience areas, they are cross-cutting in nature. Chapter 4 describes them in detail.

We will now take a closer look at three experience areas: *Seamless Transactions and Supply Chains* – because they fundamentally change financial and trade interactions of the future –, *Personalized Health* – because it touches the quality of life of every individual – and *Connected Buildings,* because they are the prerequisite to achieving the renewable energy revolution in Europe and establishing the Internet of Everything. After these three deep dives, an introduction to the other eight experience areas is provided.

Figure 1: Experience areas enabled by three foundational capabilities. Note: experience areas not included in this study are banking and insurance, as well as retail and apparel.

FOUNDATIONAL CAPABILITIES & EXPERIENCE AREAS
EMERGING CITIZEN-CENTRIC EXPERIENCE AREAS ARE ENABLED BY THREE FOUNDATIONAL CAPABILITIES

Liquid Work	Sustainable Nutrition	Personalized Health	Learner-centric Education	Immersive Realities	Renewable Energy	Connected Buildings	Autonomous Mobility	Smart Manufacturing	Seamless Transactions and Supply Chains	Digital Governance
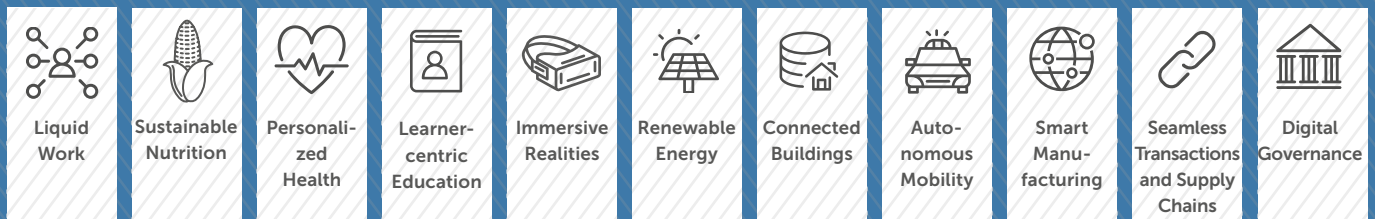
FOUNDATIONAL CAPABILITIES

CREATING AN ECOSYSTEM AROUND THE INTERNET OF EVERYTHING
Establish a platform-based business enriched by OTT and industry partners to enable the Internet of Everything, including digital twins (customer-centric)

ESTABLISHING PERVASIVE NETWORKS OF THE FUTURE
Manage software-defined, ubiquitous, low-latency, self-provisioning, self-optimizing and self-healing networks enabled by analytics (infrastructure-centric)

RECREATING INSTITUTIONS
Provide solutions for the new governance frameworks and institutional architectures of the digital world to enable responsible and secure interactions

3.1 DEEP DIVE: SEAMLESS TRANSACTIONS AND SUPPLY CHAINS

200 paper forms currently needed to export tomatoes from Uganda to the Netherlands becoming obsolete due to blockchain applications[36]

Seamless and near-real-time connection between all stakeholders along a supply chain will substantially speed up transactions while reducing transaction costs to zero, making financial intermediaries increasingly obsolete. Trust-enforcing technologies, – like blockchain –, enable smooth transactions and smart contracts between unfamiliar parties, creating immutable traces of the agreements.

KEY ASPECTS: NEAR-ZERO TRANSACTION COST · IMPROVED RELIABILITY/TRUST · SUBSTANTIAL SPEED INCREASE

3.1.1 Target state

If we imagine the future of transactions and supply chains, many fundamental questions arise. How will we pay and be paid for goods and services in 2030? Can we trust the labels on the products we buy? Will we benefit from sharing our most expensive assets, like our homes, cars and data? Can we be sure of the ownership titles attached to our intellectual property, such as art and innovation? And what would it take for me to trust a stranger in a financial transaction?
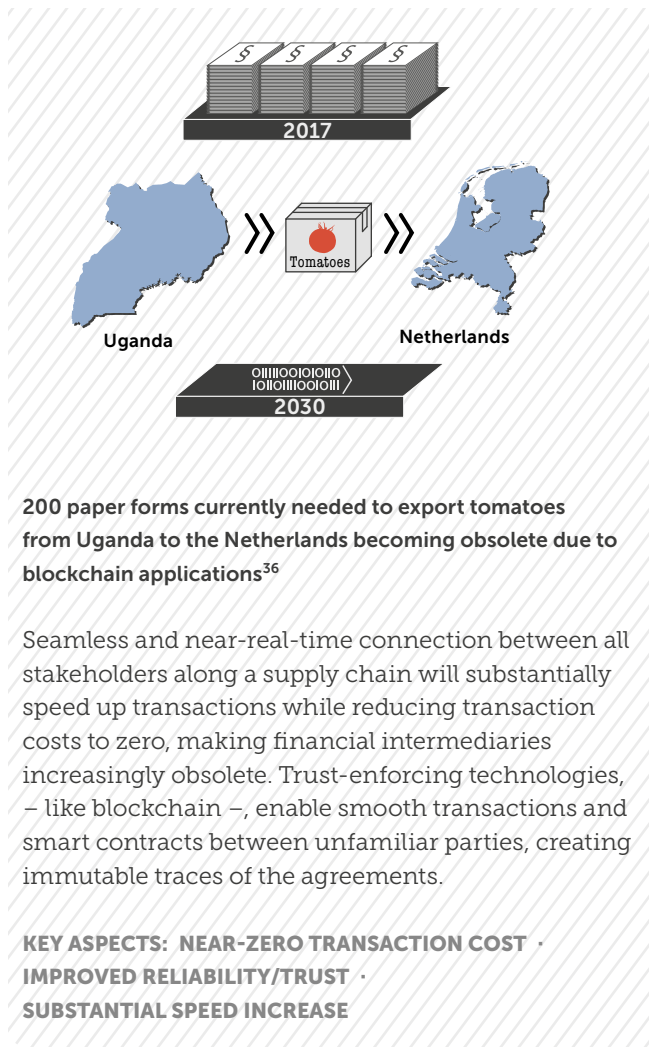
To address any of these questions, we could rely on a secure, auditable, public and immutable system to record our contract and steps in a supply chain. Such a system ensures security of ownership, transparency of

data processing and trust in other parties, especially in the digital space, where it's sometimes difficult to know whether our counterparts really are who they say they are.

What are the applications of such a system, and how would it change the way we interact as Europeans? Accenture Strategy expects that by 2030, we will see the following changes to transactions and supply chains:

- **Near-zero transaction cost and dramatic speed increase:** Today, we rely on powerful and trusted intermediaries, such as governments, banks, notaries and insurance companies to verify and execute even straightforward payments between friends or trusted business partners. By 2030, decentralized, distributed and democratic digital networks of millions of users will be able to bear witness to and approve of any transfer of value between two parties. This could be a simple pay-ment between two people or a complicated business contract between many stakeholders. This network of users will take over the role of current intermedi-aries. Since these efficient computer networks don't have the large overhead, margin requirements and centralized bargaining power of current intermedi-aries, they will request much lower fees, while providing faster service.

- **Transparent global supply chains:** Even a seeming-ly simple supply chain like exporting a container of tomatoes still requires tiresome and costly bureau-cracy[37] with very limited additional information for supplier and customer. Accenture Strategy's research sees a future that is more seamless and transparent. By 2030, the 200 forms needed to ship a container of tomatoes will be long gone. Instead, every product and service we trade and consume will be connected to a trail of information about its origin, lifecycle, current status and suitability for our needs. For example, consumers will be able to confirm that the gems in a piece of jewelry bought for a loved one didn't come from a mine owned by warlords who disrespect the basic human rights of miners.

- **Trust among all involved stakeholders:** The extensive transparency in our supply chains and trade system of the future are the pivotal ingredients to extend trust beyond those people and organiza-tions that we know and have worked with. The immutable track record of data connected to each transaction and transacting party allows us to trust

new business partners. This will increase fluidity of trade and reduce barriers to market entry for many small companies. It opens up opportunities for completely new business models and value chain structures among these parties, where trust is the explicit currency.

- **Democratization of the sharing economy and monetization of data:** Keeping all our transactions and global supply chains in a decentralized and distributed network will help us democratize the platforms of the sharing economy. While today's asset-sharing platforms like Uber and Airbnb have become mighty middlemen that earn fees on any transaction made via their platforms, the future platforms could give this value back to individuals. This logic can be transferred to other assets, such as our personal data. By virtue of eliminating transaction costs and making contracts fast and seamless without mighty middlemen, new business models to monetize our personal data become viable. We could decide to share insights generated through our anonymized data with certain organizations for specific purposes, for a set period of time. These organizations would be able to share the revenues they can generate based on these insights with everyone who shared their anonymized information. Even if amounts per sharing incident are as low as a few cents, a near-zero-transaction-cost system makes it worthwhile, and possibly a second source of income.

Which technologies enable this vision of a secure, auditable, public and immutable internet of values?

- **Blockchain:** The blockchain is software that stores information across a network of personal computers, making the information decentralized and distributed. Therefore, no central institution or company owns the system, yet everyone with access to the internet can use it. This makes processes on the blockchain more efficient by reducing transaction costs, and more democratic by transparently sharing value with all users. The participants of the blockchain use their computers to hold bundles, or "blocks" of chronological records that other members submitted to the network. The information contained in these blocks could be steps and processes along a supply chain or smart contracts. The blockchain uses cryptography to protect the data records from being count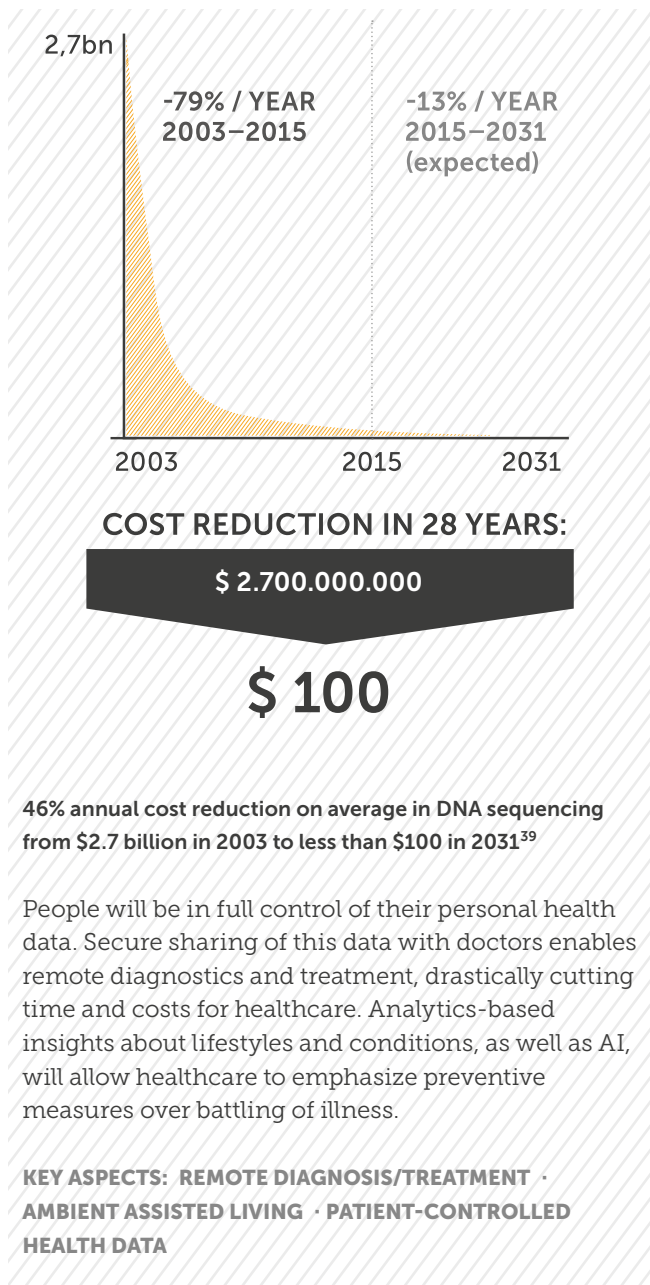erfeited or changed by anyone. The distributed nature of the blockchain creates security by ensuring that no single person or computer could corrupt or take down the system.

- **Sensors and cameras:** Sensors and cameras, especially if their cost continues to drop, will be everywhere – in every car, house and shipping container of tomatoes. These sensors and cameras create a data trail for the asset they monitor, making it possible to create a digital mirror image of the asset on the Internet of Everything and on the blockchain. This enables us to enrich transaction data on the blockchain with qualitative information about the values we exchange, making supply chains even more transparent.

- **Quantum computing and big data analytics:** A prerequisite for being able to digitize our transactions and supply chains is extensive computing power and the ability to instantaneously analyze large amounts of data for insight-driven decisions. Here quantum computing and big data analytics will deliver the power for frictionless trade, while optimizing supply chains.

3.1.2 Illustrative use case

The sharing economy represents the attractive idea of citizens connecting to one another by pooling their assets, such as cars, homes or tools. Today we rely on global platforms like Uber, Airbnb and NeighborGoods to enable these interactions. If you are a home sharer, Airbnb deducts a commission of up to 20% from you and your guest for each night you share your home via their platform[38]. These fees have helped Airbnb become a $30-billion hospitality company without owning a single room. Now imagine an alternative, blockchain-enabled application that let you rent out your space directly to travelers. You could reap the full value you generate by sharing your home, or you could offer your rooms more cheaply, making it affordable to a larger community of sharers. While today Airbnb's commission can be justified by the user identification, screening and insurance services it offers, these services would become obsolete on a blockchain-powered scenario.

3.2 DEEP DIVE: PERSONALIZED HEALTH

2,7bn

-79% / YEAR
2003–2015

-13% / YEAR
2015–2031
(expected)

2003   2015   2031

COST REDUCTION IN 28 YEARS:

$ 2.700.000.000

$ 100

46% annual cost reduction on average in DNA sequencing from $2.7 billion in 2003 to less than $100 in 2031[39]

People will be in full control of their personal health data. Secure sharing of this data with doctors enables remote diagnostics and treatment, drastically cutting time and costs for healthcare. Analytics-based insights about lifestyles and conditions, as well as AI, will allow healthcare to emphasize preventive measures over battling of illness.

**KEY ASPECTS: REMOTE DIAGNOSIS/TREATMENT ·
AMBIENT ASSISTED LIVING · PATIENT-CONTROLLED
HEALTH DATA**

3.2.1 Target state

Health is fundamental to our ability to lead happy and fulfilled lives. We often realize this only once we experience pain or sickness. Over the past decades, health and life expectancy in Europe has steadily improved. But this has come with its own set of challenges, such as an aging population that increasingly suffers from so-called "lifestyle diseases", such as obesity and diabetes, as well as age-related conditions like dementia and Parkinson's disease. The surging prevalence of these

illnesses has led to more investment in research around them, delivering astonishing successes, but at ever-increasing costs for the health system. This development is pervasive in developed regions like Europe, and is not sustainable in the long run.

Looking ahead, digital solutions could play a major role in solving this problem while refocusing healthcare on what it should be about: enriching quality of life rather than just combating illness; individualized solutions rather than blockbuster drugs; and quantifying value of treatments based on improved patient outcomes, rather than volume of drugs prescribed. Let's look at it more concretely. What changes can we expect in *Personalized Health* for Europeans by 2030?

- **Empowered people, equipped with the knowledge and tools to manage their own health:** Over the past decade, health and fitness apps, as well as online platforms where patients can discuss symptoms and find treatments for common diseases, have made us more informed about our own health. But in traditional doctor-patient interactions, information asymmetries still persist. In the envisioned patient-centric healthcare system of 2030, information flows are fully virtualized and people are strongly in control of their own health data. We can decide who to share it with for which purpose, e.g., providing detailed scans to doctors for diagnosis and more high-level findings to insurance companies for reimbursement. And we will be aided by digital solutions, such as peer-sourced or AI-supported diagnostics to make sense of this health data and obtain insights into which choices are right for us. This emancipates patients, leads to more equal relationships with doctors, and makes sure that our personal needs and choices are put at the center of our care.

- **Personalization of diagnosis and treatment:** As our health information is digitized, our health records will paint a more complete picture of our bodies and minds, as data will be stored in one centralized place that we control access to. This will lead to much more personalized diagnoses and treatments. Our digital health records, combined with developments such as the falling costs for DNA sequencing, will enable caretakers and their technological assistants, such as AI, to base treatments on a more detailed understanding of our individual health status and history.

- **Strengthened preventive healthcare and enhanced early diagnostics capabilities:** Health check-ups today involve a visit to a doctor or tedious, costly tests in a health facility. By 2030, digital solutions, such as sensor data analysis and AI diagnosis could create a seamless preventive care and early diagnostics experience. As our world becomes virtualized, large amounts of data about us are collected. Analyzed, they reveal insights about our health in an effortless, non-invasive manner. For instance, it is already possible to diagnose progression of Parkinson's disease based on big data analytics of someone's voice in a simple phone call with 99% accuracy[40]. In our digital future, these kinds of improved analytics will enable us to identify common illnesses earlier and emphasize prevention over treatment, improving our overall health.

- **Improve quality of life and reduce costs by using resources more efficiently:** European health systems are under mounting pressure to deliver better, more expensive solutions to an aging population. By 2030, digital support in the form of sensors in our home, caretaking robots and artificial intelligence will have matured to deliver health services anywhere at lower cost. For instance, chronically ill patients will be able to live at home and receive treatment there rather than having to stay in a treatment facility or visiting a doctor on a regular basis. Artificial intelligence could analyze sensor data, photos and videos to help medical staff identify conditions and treat people effectively with less effort required from doctors. These developments will improve our quality of life and alleviate cost pressure on the health system.

Which technologies will help us achieve this vision of more personalized, prevention-focused and resource-efficient healthcare system in Europe?
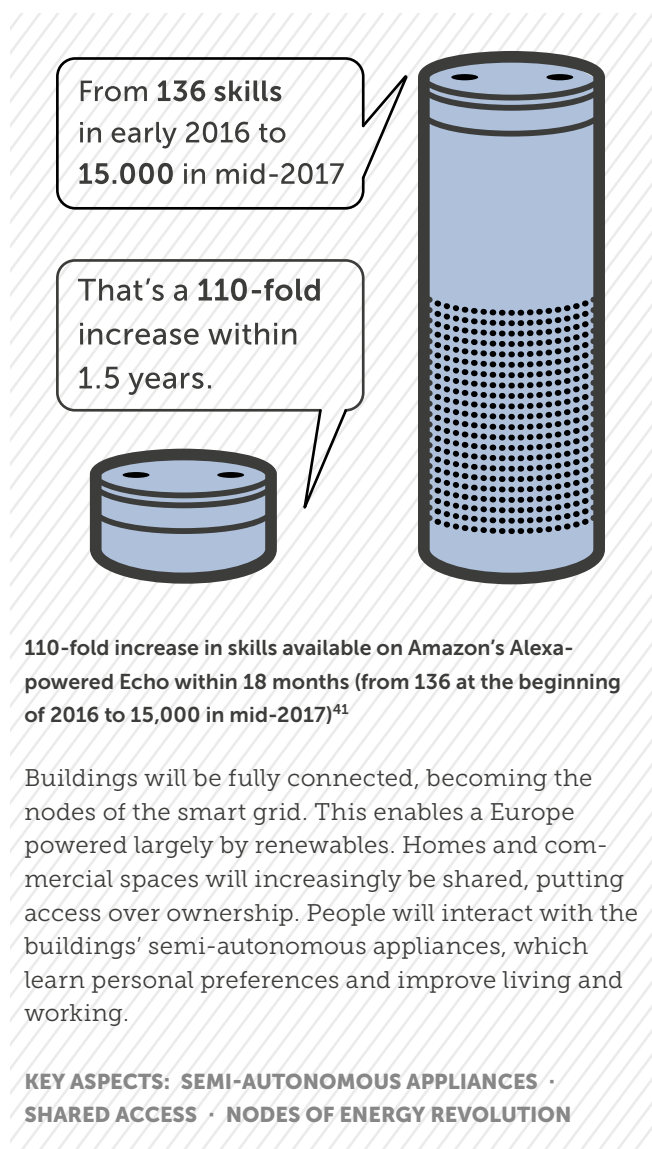
- **Sensors and wearables:** With increases in processing power and the advent of wearable technology, smart devices will play an essential role in delivering the healthcare of the future. Devices like smartphones or smartwatches, combined with health-oriented applications and biosensors, will be able to monitor health conditions. This will keep both users and doctors informed in real time, make insightful recommendations and even permit the remote diagnosis of diseases.

- **Big data analytics and AI:** The increasing availability of data in the healthcare sector along with access to large, secure databases enable deeper insights about our bodies. Through automatic processing and interpretation of this data, big data analytics can identify relationships and patterns, and arrive quickly at precise diagnoses. Paired with AI, this could support patients and medical staff by offering self-directed health recommendations.

- **DNA and pathogen sequencing:** The costs of DNA and pathogen sequencing are expected to drop significantly by 2030, allowing more people to have their DNA or pathogens sequenced. This will be the key driver of personalized medicine and tailored treatments. It helps us to identify the unique physical make-up of individuals and consequently the varying effectiveness of treatments on each of us.

3.2.2 Illustrative use case

One of the many challenges of today's healthcare system and demographics is the chronic lack of doctors, especially in rural areas. As a consequence, we spend hours sitting in waiting rooms. Even getting an appointment sometimes takes weeks, and might even convince us to put off a doctor's visit a little longer with unforeseeable consequences to our health. What would change in a world with virtualized health records and data, where big data analytics and AI supported medical professionals? For instance, imagine you are working late at the office, and you start to feel feverish and faint. Rather than ignoring the symptoms or dreading a visit to the emergency room, as you would today, you could walk down the hall to your company's digital health kiosk. Here, you could consult immediately with a doctor by video call. Authenticating yourself with your fingerprint and iris scan, you authorize them to review your digital health records and analyze data from your fitness tracker. If need be, the doctor could even measure your heart rate, blood pressure and temperature via the kiosk interface. Within minutes, you would have a diagnosis, a prescription, or possibly even the medicine delivered to your office. More likely, the doctor will just urge you to go home and get some rest, informing your employer that you are ill and won't come into work the next day.

3.3 DEEP DIVE: CONNECTED BUILDINGS

From **136 skills** in early 2016 to **15.000** in mid-2017

That's a **110-fold** increase within 1.5 years.

110-fold increase in skills available on Amazon's Alexa-powered Echo within 18 months (from 136 at the beginning of 2016 to 15,000 in mid-2017)[41]

Buildings will be fully connected, becoming the nodes of the smart grid. This enables a Europe powered largely by renewables. Homes and commercial spaces will increasingly be shared, putting access over ownership. People will interact with the buildings' semi-autonomous appliances, which learn personal preferences and improve living and working.

KEY ASPECTS: SEMI-AUTONOMOUS APPLIANCES · SHARED ACCESS · NODES OF ENERGY REVOLUTION

3.3.1 Target state

We spend a large part of our time in buildings, whether we are working at an office or enjoying leisure time, sleeping or eating at home. Digitization is already enhancing buildings. Digital access cards, for example, are replacing keys, while voice-controlled home entertainment systems are becoming commonplace.

Accenture Strategy identifies three major shifts in the area of *Connected Buildings:*

- **The networked home and the ecosystem:** Household devices like washing machines, heating systems, refrigerators or lighting will be able to communicate with each other and with buildings. People will be able to control them wirelessly via an easy-to-use dashboard or through voice-controlled digital assistants. Buildings will also connect with the ecosystem that surrounds them, including a smarter energy grid, mobility services or weather forecasts. This means that by the time you leave the house, an electric shared autonomous car will be waiting outside, and will have already calculated – based on the latest traffic and weather updates – the best route to the appointment in your calendar.

- **The high-efficiency and safer commercial building:** Digital solutions increase energy efficiency of buildings and make them safer. The efficiency gains from smart solutions can already help reduce energy costs of commercial buildings by over 20%[42]. But the current speed of innovation suggests we can expect even higher gains. Looking ahead to 2030, smart energy management systems could save European households approximately €95 billion in energy costs in 2030. Intelligent facility management optimizes temperatures and operating times. Diagnostics software makes previously undetected faults visible and eliminates inefficiency. Meanwhile, automatic analytics unveil the financial benefits to capture. And there is another benefit for people and employers: *Connected Buildings* provide a safer environment by utilizing proactive fire, gas and structural failure detection technology.

- **Buildings as nodes for the smart and renewable energy revolution:** A great combined benefit for people, the planet and prosperity lies in retrofitting and constructing buildings as the nodes for a smart energy revolution. Today, buildings account for around 40% of global energy consumption[43]. This consumption is costly for individuals and companies, and – as long as the energy comes from fossil fuel sources – makes buildings major contributors to climate change. *Connected Buildings* contribute to two key prerequisites of the shift to renewables: decentralization of energy production and energy storage. Buildings can be producers of clean local energy, with rooftop solar panels and wind turbines feeding excess energy into the smart grid. As

buildings become connected, they can also store energy in batteries in the house, in an electric car, or in smart appliances. Through this load shifting, buildings can alleviate the pressure on the grid due to the intermittent nature of renewable energy – that is, if load and excess capacity is steered intelligently. Here, smart appliances and semi-autonomous agents could determine the most appropriate time to consume energy and carry out household chores based on data from manifold sources and algorithms that help prioritize information. For instance, a smart vacuum cleaner's decision to clean a building could be a function of messiness in the building, the presence or absence of people, the amount of excess energy that needs to be absorbed from the grid and the resulting energy price. Similarly, the decision of a semi-autonomous agent to unload the battery of an electric car into the grid would need to weigh the value loss due to shortened battery lifetime against the current energy price, as well as the need to recharge for the next trip.

"We are going to retrofit our buildings to transform them into distributed big data centers, micro power generators, transport nodes and charging stations – all running digitized on top of an IoT platform."

Jeremy Rifkin · Economic Advisor to Heads of State

The following technologies are key to enable this vision of networked, highly efficient, safer buildings and their role as nodes for the renewable energy revolution:

- **Sensor technology and machine-to-machine communication:** Harnessing the benefits of *Connected Buildings* is only possible based on Internet of Everything (IoE) infrastructure. Buildings themselves provide key physical anchors for the sensors that the IoE requires. These sensors convey a broad range of information, such as temperature or the number of people in an area, which enable *Connected Buildings* solutions.

- **Machine-to-machine (M2M) communication:** Semi-autonomous agents take M2M to the next level as the intelligent software on the sensors and machines is enabled to take semi-autonomous

decisions in selected cases, for example, deciding when to charge an electric car and when to use the car's battery to temporarily power your home.

- **Smart meters:** The transition to renewable energy requires a connected grid, which entails smart meters that collect and transmit data about consumption. This data is then used to analyze and optimize consumption patterns. Moreover, they build the basis to make informed decisions on the path to a more decentralized energy system.

- **Big data analytics:** Insight-driven adjustments based on big data analytics can increase the benefits from *Connected Buildings*. Examples of these insights might be discovering energy guzzlers and ways to rely more on cheaper base-load energy instead of costly peak load phases.

3.3.2 Illustrative use case

Imagine you are a single parent living in a large city, and working to provide for your family. You spend about an hour a day commuting to and from work[44]. Add this to the daily trips to the grocery store, cleaning the house, helping out with homework and getting the kids off to bed, and your day is jam-packed.

What if your home could help you with some of this stuff? At work, you receive a push notification on your smartphone reminding you of something that's been in your calendar for weeks: friends are coming over tonight. Rather than inducing panic, the notification offers you a shopping list – the same items you ordered the last time you had dinner guests. With a few swipes, you modify the order to include some eggs for your kids' breakfast. The home delivery service coordinates the ideal drop-off time with your smart home system – the groceries will arrive just after you do. You just saved the twenty minutes you would have needed to go to the store[45]. When you get home, it's a breath of fresh air. Literally. While you were at work, your smart home system dynamically managed air quality. And no need to clean the floor either, because your connected vacuum cleaner robot already handled that for you. You can just relax and enjoy cooking a nice meal for your friends and kids. *Connected Buildings* won't just save energy and money; they can also improve our quality of life.

LIQUID WORK

**76%** of millennials interested in freelancing

meanwhile...

9.6M

Growth in freelance jobs (in millions)

7.7M

+24%

'08 '09 '10 '11 '12 '13 '14 '15
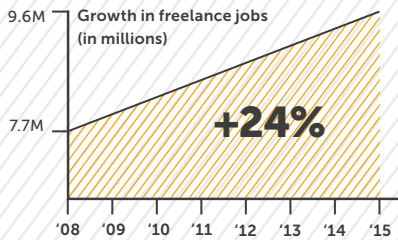
76% of millennials interested in freelancing and a 24% increase in freelance jobs[46]

The nature of jobs will become more flexible. As employees' location loses relevance, and on-demand scalability of personnel increases, organizations turn into lateral, entrepreneurial networks. Automation will eliminate many medium-skilled jobs, but opportunities in personal care, education and social work will grow.

KEY ASPECTS: ON-DEMAND "GIG ECONOMY" · LATERAL NETWORKS · CIVIC ENGAGEMENT

SUSTAINABLE NUTRITION

+30%
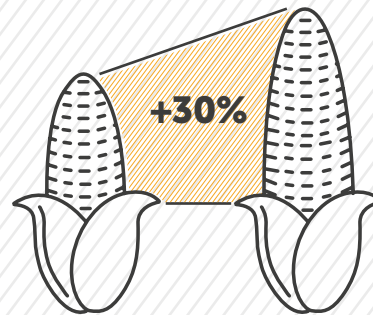
+30% agricultural yield by 2030 from smart farming[47]

Precision farming will increase crop yield and quality while reducing the resources needed to provide nutrition for a growing population. Lab-grown nutrition will supplement produce from intelligent farms. And the farm-to-table value chain will be fully traceable through sensors and blockchain solutions.

KEY ASPECTS: PRECISION AGRICULTURE · LAB AGRICULTURE/FARMING · TRACEABILITY

LEARNER-CENTRIC EDUCATION

+229% per year
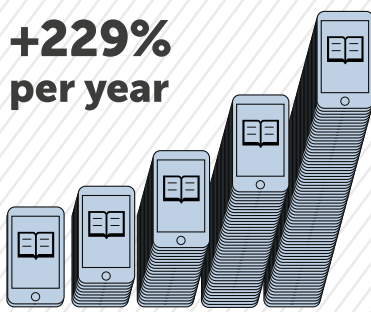
2012 2013 2014 2015 2016

+229% CAGR in MOOCs contribute to 57 million e-degrees in Europe by 2030[48]

Classroom training blended with virtual environments will make the learning experience of students more personalized, collaborative, accessible and fun. Gamification and AR/VR will foster engagement across age-groups. Employees will rely on life-long learning to adapt to changing job requirements.

KEY ASPECTS: LIFE-LONG LEARNING · FLUID & COLLABORATIVE FORMATS · GAMIFICATION

IMMERSIVE REALITIES

855× more VR Users
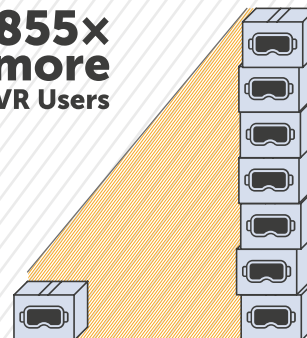
2014 2018

855x more active VR users worldwide[49]

Augmented and virtual reality will create unprecedented levels of engagement and near-real-life entertainment experiences. We will be able to include content curated by friends in our analytics- and AI-enabled, hyper-personalized entertainment programs, which we will enjoy across a wide range of devices.

KEY ASPECTS: LAYERED REALITY (AR/VR) · USER-CURATED CONTENT · CROSS-DEVICE CONSUMPTION
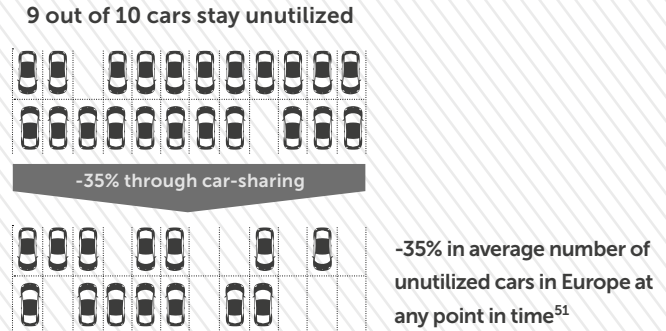
RENEWABLE ENERGY

$ 400

$ 120

-70%

1 MWh
in 2015

1 MWh
in 2030

-70% in cost of energy
storage by 2030[50]
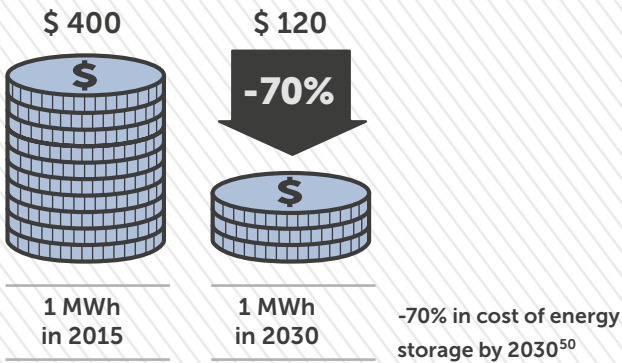
Electrification and decarbonization will define the future of energy. Decentralized autonomous agents will ensure supply reliability and robust net stability despite higher volatility in production volumes. Smart appliances, higher storage capacity and availability of energy data across the system will be key enablers.

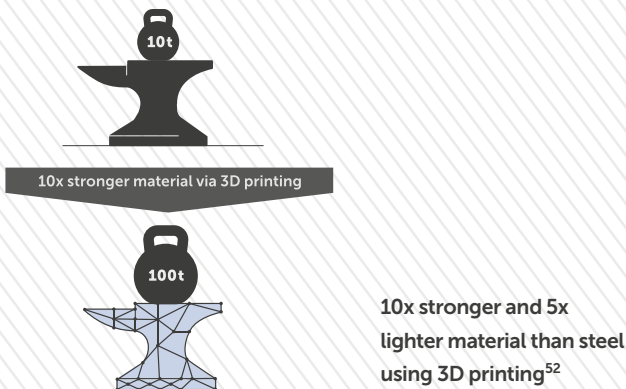**KEY ASPECTS: ALL-ELECTRIC ENERGY · AUTONOMOUS GRID · AUTONOMOUS AGENTS**

AUTONOMOUS MOBILITY

9 out of 10 cars stay unutilized

-35% through car-sharing

-35% in average number of unutilized cars in Europe at any point in time[51]

All vehicles will be connected and self-driven, reducing accidents and allowing people to spend travel time engaged in other activities. Mobility becomes access-driven, with increasing car-sharing and ubiquitous, intermodal public transport. Intelligent infrastructure will substantially reduce traffic jams.

KEY ASPECTS: SELF-DRIVING VEHICLES · ACCESS OVER OWNERSHIP · SMART INFRASTRUCTURE

SMART MANUFACTURING

10t

10x stronger material via 3D printing

100t

10x stronger and 5x lighter material than steel using 3D printing[52]

Virtual simulation of objects before their production will transform manufacturing. Electronic marketplaces will optimize sourcing, production and circular remanufacturing of goods. Additive printing makes large factories obsolete, and triggers a convergence of production and consumption: prosumption.

KEY ASPECTS: PROSUMPTION · 3D/4D PRINTING · CIRCULAR ECONOMY

DIGITAL GOVERNANCE

42

4x
faster

10

1

2004

2016

exp.

4x faster to register a business in the EU[53]
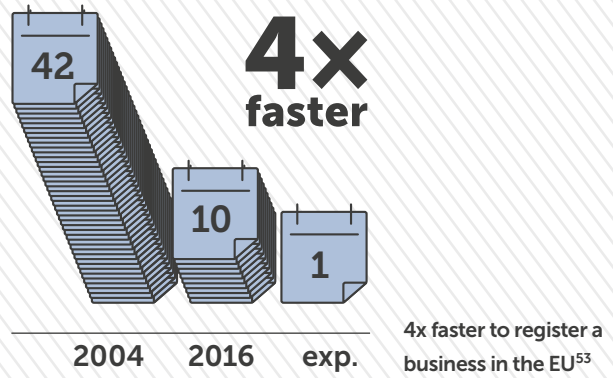
Open source public data will reduce bureaucracy among public institutions, and between governments and citizens. User-centric digital services and e-engagement will create seamless public-private interactions, holding governments more accountable. Digital forensics support security in the physical world and cyberspace.

KEY ASPECTS: OPEN SOURCE PUBLIC DATA · DIGITAL FORENSICS · E-ENGAGEMENT

4.
FOUNDATIONAL CAPABILITIES FOR THE DIGITAL AGE

To realize the vast potential from digitalization described in the previous chapters, Europe needs to build up three types of foundational capabilities. These capabilities are the pillars of digital value creation and essential for fostering digital innovation in Europe.

4.1 FOUNDATIONAL CAPABILITY #1: CREATING AN ECOSYSTEM AROUND THE INTERNET OF EVERYTHING

4.1.1 Definition

The first wave of digitization enabled us to communicate and collaborate anytime from anywhere. What we are witnessing today is the second wave of digitization, characterized by the Internet of Everything (IoE). By 2020, over 20 billion devices will be connected to the internet globally; and by 2025, this number could surpass a trillion[54]. In the future, this will also include digital twins – virtual representations of objects, buildings, systems, processes and someday even living beings. Eventually, we could end up with an almost complete virtual representation of reality. Figure 2 illustrates this concept of an ecosystem of the Internet of Everything based on digital twins in four exemplary experience areas.

The IoE increasingly blurs the boundaries between industries and value chains, allowing new competitors to enter traditional industrial markets. Europe may be a global market leader in many long-established industrial domains, but value creation in the virtualized world follows a very different business logic: businesses scale most dramatically if they are based on horizontal platforms that cut across domains, disrupting vertical silos. The key trait of these emerging horizontal platforms is that they "plug in" vertical capabilities, and make them available to all kinds of applications. The Amazon Echo platform, for example, already boasts a library of 15,000 skills across a broad range of vertical domains, such as home appliances, mobility solutions and retail. By the second quarter of 2017, the platform was acquiring new skills at a rate of 55 per day[55].

Another consequence of horizontal platforms is collaboration between new partners, sometimes even competitors. Europe needs to create a digital framework around which a horizontal and open ecosystem of partners can evolve. This ecosystem will allow businesses to provide, exchange and use data for all kinds of purposes. The main components of such an ecosystem are a semantic model that ensures interoperability, data security standards that protect intellectual property based on identity management, and an open marketplace for data and applications that maximize the reach of all players on the platform (see Text Box 1).

ECOSYSTEM OF INTERNET OF EVERYTHING (IoE)

CONNECTED BUILDINGS   SMART MANUFACTURING   AUTONOMOUS MOBILITY   SUSTAINABLE NUTRITION

✓ Digital twin / smart sensors already existing
✗ Digital twin / smart sensors not existing yet

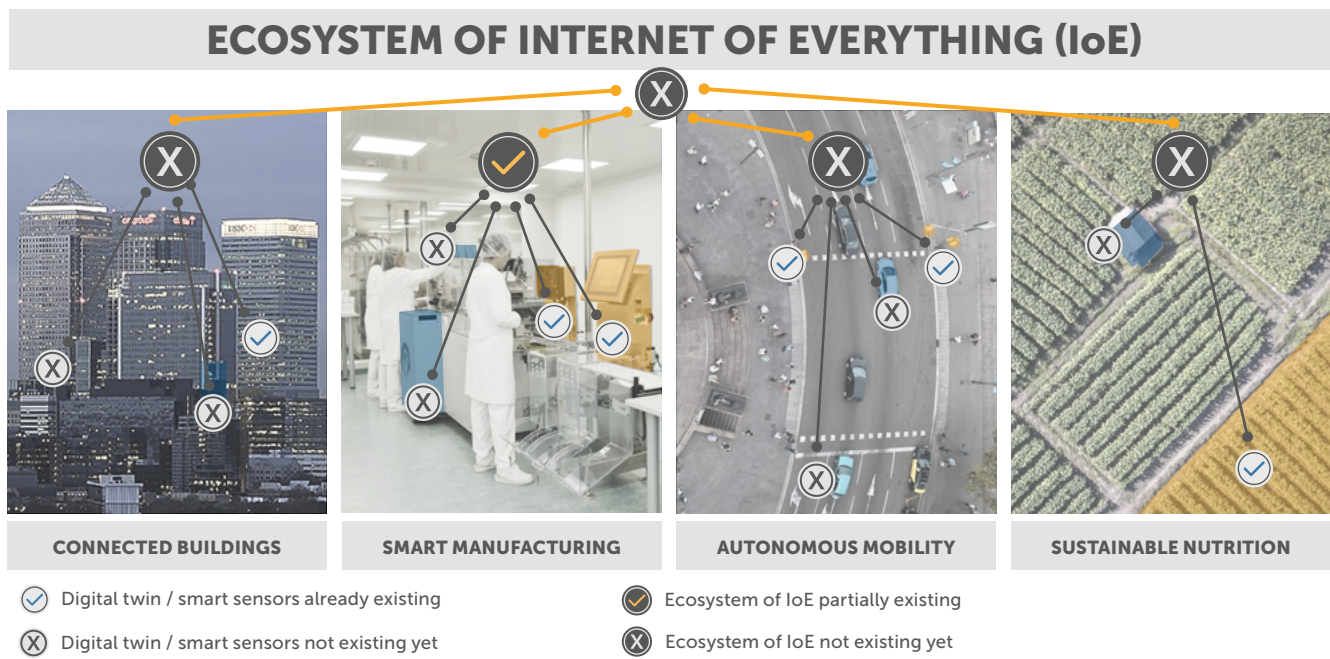✓ Ecosystem of IoE partially existing
✗ Ecosystem of IoE not existing yet

Figure 2: Ecosystem of the Internet of Everything illustrated based on digital twins in four exemplary experience areas

KEY COMPONENTS OF THE IoE ECOSYSTEM

- **A meta-data layer** built on a universal **semantic model** ensures **interoperability** between existing standards and systems, including interfaces (APIs) for third party operators to connect to the ecosystem (e.g., to feed data from external sensors onto the platform). Rather than holding or owning the data, the real value of the meta-data layer is that it normalizes and creates contexts so that application developers can use it for their purposes. The meta-data repository should not be centrally governed, but rather built on a common model and framework, while otherwise being contribution-based and open source.

- **A trust center institution** that establishes data security standards and builds trust among participating companies, institutions, developers, and end users. Such security standards include the control of intellectual property within the ecosystem, and defining who may participate and how.

- **An open marketplace** for data and applications to maximize reach among partners, customers and developers, and to offer transaction support services (e.g., identification, verification, billing and pay-ment), analytics services, as well as the provision of the technical infrastructure and main operations.

Text Box 1: Key components of Foundational capability #1

The open ecosystem around the IoE adds value in two ways. Firstly, it enables partners to do digital business with their customers. The provider of the ecosystem can offer their business partners the following under-lying services:

- **Application software** for the problems the partner wishes to solve
- **Professional services,** including deployment, integration, consulting, support and maintenance
- **Platform provisioning and operations** for provid-ing, maintaining and supporting a cloud-based, unified meta-data platform

Secondly, the provider of the ecosystem can offer a number of data-driven services directly to consumers:

- **Secure authentication:** allowing customers to authenticate themselves via the network and securing the network on the devices at the end-points
- **Service integration:** providing end-to-end trace-ability by connecting various data sources along a given supply chain
- **Remote facilitation:** providing over-the-air service and maintenance for components of engines
- **Application features and services on the platform**

Launched in February 2017 as a beta-version, Telefónica's AURA platform is an example of an EU-based horizontal and open ecosystem for partners across industries and regions. The AURA platform aims to enhance customer experiences by making cognitive sense of data from Telefónica's network, IT systems and products and services. Additionally, the platform gives customers security, transparency and control over their personal data. Customers decide whether Telefónica can share the insights generated on AURA with part-ners in the ecosystem, such as UNICEF and Facebook. One application of AURA's insights for UNICEF is the prediction of pandemic outbreaks, which could alert first responders and trigger prevention activities at the first signs of an outbreak[56].

4.1.2 Rationale for Europe

Europe has a well-diversified portfolio of strong and successful industries. These businesses create highly innovative products and services – often by serving specialized stakeholders with "fit-for-purpose" offer-ings. By doing so, they contribute to job creation, GDP and tax incomes across the European economies. But progressing digitization, particularly improved automation capabilities and rapidly scaling horizontal platforms, poses a threat to these cornerstones of European competitiveness.

So far, Europe has not really benefitted from global-scale platform players that leverage the data of European citizens and businesses. Today's major B2C platform players have emerged from the US and Asia, mostly creating jobs, growing GDP and – to a certain extent – paying taxes in these regions. Moving forward, Europe needs to be more competitive. We need to create an EU-based ecosystem around the Internet of Everything, connecting industry lines with our own horizontal, cross-industry offerings. Put simply, this ecosystem would help businesses and governments to fully leverage the power of data. Furthermore, it would create a level playing field that fosters new types of value creation across industries. This would retain value and jobs in Europe, and prevent an undesirable dependence on international players with perhaps different standards of data protection and consumer rights.

4.1.3 How it enables the experience areas

Creating an open ecosystem around the Internet of Everything fundamentally transforms businesses' ability to cooperate across silos, create new business models, and add value for their customers. This is particularly noticeable in the experience areas of *Smart Manufacturing* and *Personalized Health.*

Smart Manufacturing

The envisioned ecosystem around the Internet of Everything will revolutionize traditional manufacturing. By using digital planning tools, a manufacturer could plan all its assets virtually – be this a new product or a plant on a different continent. Imagine a company considering expansion of its production to Indonesia. In a *Smart Manufacturing* scenario, the digital model of the planned factory could be generated, simulating the whole production process according to local conditions. Even the digital products created by the simulated factory could undergo an automated, virtual end-to-end test. After finishing all scenario analyses and tests, the manufacturer would order all specified components and hire contractors via the open marketplace of the ecosystem. Onboarding staff and product sales would be supported by the virtual reality representations of the digital twins of the plant and resulting products. For example, virtual products could be integrated into the digital replicas of value chains of the manufacturer's customers, demonstrating the product's benefits. Aspects like compliance reviews of the supply chain and certifications for the Indonesian market would also happen seamlessly in the digital space, as all relevant players could be granted access to the respective data and digital models of the factory, its assets and products. Indonesian authorities could define acceptance tests for future products based on the simulation that would ease market introduction later.

Personalized Health

Making *Personalized Health* a reality in 2030 will go beyond mirroring the physical interactions of doctors and patients on the IoE ecosystem. New digital workflows will emerge between all stakeholders in the healthcare system, including digital twins. Insights drawn from the huge amounts of data in this ecosystem will boost our capability to lead healthy lives and cure illnesses. Hospital devices, such as MRI scanners or vital sign trackers, are already producing data. In the future, data would also come from sensors on people, such as wristband wearables or implants. Even smart nano medication could share data after being swallowed by the patient. The open ecosystem around the Internet of Everything unleashes the full potential of all this data by managing it through a unified approach, and connecting many service providers to store, exchange and analyze their various sets of data. This will let health professionals monitor chronically ill patients at home, reducing costs for the healthcare system and drastically improving patient comfort. Moreover, digital twins could eventually evolve to enable doctors to test medications or simulate surgical procedures. But the most immediate benefit for healthcare will be empowering people to engage in more equal relationships with their caregivers and doctors, equipped with the insights provided by big data analytics. Anonymized health records could yield a wealth of insights about the correlations between certain behaviors or treatments and health outcomes.

"I think the security aspects of digitization are underthought at the moment. In a recent demonstration, it was possible to hack and program a robot vacuum cleaner to listen to any conversation in that house."

Gavin Patterson · CEO, BT

4.2 FOUNDATIONAL CAPABILITY #2: ESTABLISHING PERVASIVE NETWORKS OF THE FUTURE

4.2.1 Definition

Europe needs to build its digital future on ubiquitous, highly reliable, and secure networks that are pervasive, software-defined and low-latency. While there is still money going into increasing data capacity, the networks of the future will be technically capable of meeting growing demand. Customers of these networks will primarily pay for quality of service and latency, as well as services enhanced by real-time analytics and a deep understanding of context, local conditions and vertical needs. The next generation of networks includes the following key components: new digital highways with unparalleled levels of service, domain-specialized connectivity platforms offering close proximity to the client, and smart cloud connectivity depending on specific conditions (see Text Box 2).

"The world will move to real-time networks. In the future, telco customers will pay for latency, not bandwidth or volume."

John Donovan · CEO, AT&T Communications

What will we need our networks to do better in the future? Three things stand out:

1. **Massive mobile connectivity,** which drives the need for enhanced mobile broadband

2. **Connectivity of millions of devices**, which drives the need for massive machine-type communication

3. **Resilient, instantaneous connectivity,** which drives the need for ultra-reliable and low latency communications.

Text Box 2: Key components of Foundational capability #2

KEY COMPONENTS OF THE NEW GENERATION OF NETWORKS

- Digital highways – new internet of services providing pipes and hubs for content and application inter-changes with federation, syndication and interoperability houses. Digital highways will ensure network connection, network quality, and high security levels, and will be enabled by infrastructure upgrades to 5G and fiber, for example.

- Specialized network clouds – connectivity platforms dedicated to domain players, such as *Autonomous Mobility* or *Renewable Energy.* European solutions would benefit from the proximity to the clients and their needs.

- Smart cloud connectivity – access to specific clouds depending on specific conditions such as context, terrain, priority and urgency. Operators have more flexibility in providing the most efficient and lowest routing cost option.

Pervasive networks combine existing network technologies with wireless computing, voice recognition, and artificial intelligence to provide unobtrusive and uninterrupted connectivity. These networks become possible through converged, flexible IP-based networks with a focus on software-defined networks (SDN) and an open, decentralized architecture. This enables the move away from closed architecture with legacy influences from circuit- and voice-centric engineering, vendor dependency on solutions and support, unscaled procurement and high physical maintenance of networks. This opens the possibility for real-time network analytics, strong network virtualization capabilities including network functions virtualization (NFV), low-touch and self-serve tools, and massive machine-type communication. To enable the smooth "plug-in" of self- or third-party developed applications, operators also need to create an application programming interface (API).

It will take innovation, investment, and improved regulation to meet these demands, but the following benefits would make it worthwhile:

- **Performance:** networks will offer unparalleled capacity, speed and reliability

- **Resilience and redundancy:** networks will offer the high-quality service that applications require, particularly latency (below 1ms), pacing, durability and resilience

- **Flexibility and configurability:** networks will offer specialized support to different industries, applications and users, thereby unleashing innovation in product and service design for the Internet of Everything

- **User-centricity:** new networks will be far more attentive to user demand, regardless of whether the user is a person or a machine. These networks will utilize cloud, software and "network slicing" solutions – all of which contribute to a more flexible, reactive network – and can be managed by both the operator and content providers.

Eventually, such networks offer the ability to connect the exploding number of devices in combination with faster broadband and lower latency. New networks should be well-equipped to support the anticipated growth of new services, such as those based on virtual and augmented reality, autonomous mobility, robotics, mobile healthcare and smart cities.

4.2.2 Rationale for Europe

High-performance communication networks are the foundation for connectivity, and vital for secure data transport, storage and access. With the ever-increasing number of connected devices and the exploding amount of data, the networks will play a critical role as data highways.

To be internationally competitive, Europe needs the connectivity and access that the next generation of network provides. To make these networks reliable and trustworthy for European businesses and citizens, we should maintain control of security standards and traffic management. It has to be an open network platform with additional services, such as real-time analytics. Europe should also reap the economic benefits, reducing dependency on non-European network providers and keeping innovation, employment and value creation in Europe.

> *"There is no place to hide. Foreign software service providers and hardware network equipment manufacturers monitor any move we make in Europe through their planted backdoors – unless we push for European-based security solutions."*
>
> **Niels Zibrandtsen · CEO, Zibra Group**

4.2.3 How it enables the experience areas

Autonomous Mobility

Autonomous Mobility is among the experience areas that could benefit most from the arrival of the pervasive networks of the future. Most car manufacturers are already conducting trials with automotive-specific mobile networks around Europe in collaboration with telecom operators and road infrastructure providers. This experience area is largely driven by new safety and security features, infotainment and navigation services, relying on or augmented by a mobile connection. New networks will allow for more infotainment applications inside the car (e.g., streaming HD video and uploading media). Lower latency will help to support the shift away from human drivers towards fully autonomous mobility while improving road safety. Autonomous vehicles must communicate with infrastructure and other vehicles, whilst also gathering real-time environmental and traffic information that will influence the route, braking or speed. The potential for software-defined networks to dynamically configure networks could effectively address different user demands. For example, emergency vehicles, autonomous trucks, monitoring cameras and maintenance units all have differing needs, and these can vary based on road conditions. These networks will be used in combination with other critical pieces of equipment, such as sensors, global positioning systems and artificial intelligence.

Immersive Realities

Within the experience area *Immersive Realities,* consumer behavior is continuously changing with the adoption of new devices and services, while the quality of the experiences is constantly increasing. HD video and music streaming has become the norm on mobile devices, and with 4K/8K streaming on the horizon, the bandwidth requirements will continue to increase. More consumers also use their mobile devices to upload high-quality video to social media platforms, further pushing up upload bandwidth requirements. Meanwhile several virtual reality (VR) headsets rely on mobile devices to download content, and market estimates show that large adoption of virtual reality is just around the corner. The latency and bandwidth required for mobile live streaming of VR content, whether it's a sports event or an online VR game, will require next generation mobile networks such as 5G to guarantee a good user experience.

4.3 FOUNDATIONAL CAPABILITY #3: RECREATING INSTITUTIONS

4.3.1 Definition

Over the past decade, the rapid virtualization of our world has led to more transactions being handled digitally. Already half of travel revenue in Europe is booked online[57], and this is just one of the areas where digital transactions are taking over. The next generation of the internet – the Internet of Everything – will connect and digitally duplicate assets through sensors and exponential technologies. This will only accelerate the trend towards digital interactions, and expand it into all domains of our life, as laid out in the eleven experience areas described in Chapter 3.

> *"We're moving into a world where the rules are not written in law books; they're encoded software in the form of an algorithm."*
>
> **Robert Tercek**
> **Pioneer of digital media and author of** *Vaporized*

The result will be dramatic reductions in transaction costs combined with increasing speed and efficiency, and phenomenal new growth opportunities. But digital interactions, especially financial transactions and democratic decisions, require institutions through which they can be executed. Moreover, a framework is needed to ensure that the consequences for people, goods and property rights can be tracked and verified in court, if need be. By institutions, this report refers to governance and legal frameworks, for example registries and laws, as well as organizations that create and enforce these laws, such as courts. This includes, for example, public registers and ledgers that record the identities of people, their birth or marital status, as well as the ownership of real estate or the governance of a business. All of these legal institutions were not designed to match the speed and efficiency of digital interactions. Even our policy making, regulation and courts have fallen behind.

Most of our laws and regulations emerge from a complex political process. Policy makers try to establish rules that provide clear guidance for individual situations. Looking ahead to 2030, this may not always be possible anymore. The ways that rights can be infringed on and laws can be broken will change fast. Regulation will always be a few steps behind. The result is an ever-increasing tension between the opportunities from digitization and the institutional framework that makes sure these opportunities are beneficial to people, planet and prosperity. Resolving this tension is one of the most important challenges of the digital age. If our institutions do not keep up with digitization, the benefits will not be reaped – at least not in Europe. Even worse, we will be more exposed to the negative, unintended consequences of digitization, such as growing inequality and value loss.

Our institutions need to be reconstructed from the ground up, and guided by a "digital constitution" or "digital civil code" that guarantees fundamental rights, sovereignty, trust and the effectiveness of digital institutions, even in the fast-changing contexts of the future. To do this, we need to create three practical capabilities:

Identity management

Institutions in Europe will need to be able to ascertain and certify the unique identity of people engaging in digital interactions, such as online contracts or voting. The eIDAS regulation on electronic identification and trust services for electronic transactions in the internal market sets the regulatory basis for this, but it could be updated to include more identification mechanisms, such as iris and fingerprint scanners. This authentication could then be translated into a digital ID that is certified by governments or other legitimized agents, which attach the ID to the digital interactions a person engages in.

INTERVIEW HIGHLIGHTS FROM DISCUSSIONS WITH C-SUITE EXECUTIVES, SENIOR GOVERNMENT LEADERS AND HIGHLY ACCLAIMED THOUGHT LEADERS

"European society and institutions are not yet equipped to keep up with the pace of change. The biggest strides need to be made on security. We need to collaboratively design security if we want to connect everyone and everything."

Kathryn Brown · President and CEO, Internet Society

"Policy makers need to make institutions fit for the digital age. To get there, Europe could put telcos at the center of this digital development and make them guardians of our data privacy and operators of digital identities."

Vittorio Colao · CEO, Vodafone Group

"Europe needs to answer one big question: how will governments manage the inevitable disruption to the industries that have been large contributors to GDP?"

Michael Fries · CEO, Liberty Global

"We are exposed to global competition, but we regulate and deal with the industry as if we were alone on Earth."

Michael Tsamaz · Chairman and CEO, OTE Group

Transaction security

Transaction security refers to ensuring that legitimate and legally enforceable claims – such as digital property rights – arise out of contractual agreements in the digital world. This requires the definition and enforcement of data as a tradeable good, trusted documentation of digital contracts, mechanisms to defend digital rights and the creation of evidence of infringement of these rights, which can be used in courts or by law enforcement. Blockchain technologies could be a viable option here. For example, digital institutions could ascertain property rights for a given piece of land or check the legitimacy of votes in an election by using smart, self-executing contracts, and keeping a digital ledger that contains an immutable record of the chain of all transactions for a certain value.

Transparency and control over data use

Finally, our digital institutions will need to ensure privacy and trust to make digital interactions viable and attractive for European consumers. This entails creating transparency about who accesses our data, how it is processed, how it is used and what the consequences of this use could be. Moreover, these recreated institutions will need to create opportunities for data owners to stay in control, and be the final arbitrators of how their data can be used. Interoperable databases for citizens' personal data, which keep a secure and immutable record that traces who accesses which data for what purpose at what time, could be a technical implementation of transparency. On top of this, user-friendly opt-in and opt-out options for specific uses of their data, as well as the option to modify and delete personal data, would strengthen citizens' control.

4.3.2 Rationale for Europe

Recreating our institutions for the future will be the most important challenge in the digital age. Without institutions that manage digital identities, safeguard transaction security, ensure transparency and control over the use of data, Europeans will hesitate to engage in digital interactions. They would fear that their interests and basic rights are not protected. As a consequence, businesses and consumers alike would be denied the advantages of digitization across the broad experience areas. Hence, backward-looking law making and the dampening effects of out-of-date institutions and legal frameworks create a considerable threat to the future of Europe in the face of bold and innovative competition from the US and Asia. The institutions we recreate for the digital age will not only

determine how business is done in Europe, but also our ability to defend our values, freedom and security. A lot is at stake.

Therefore, Europe can seize the opportunity ahead by proactively shaping the institutions that will enable our digital interactions across all experience areas. By doing so, we can translate our shared moral norms and legal cornerstones into governing elements of the new use cases and behaviors that characterize our digitized lives. The goal is to move to outcome-based laws and regulations. Building on this, Europe will need smart mechanisms to enforce these outcomes. Smart algorithms, supported by artificial intelligence, will execute them, and new security architecture and blockchains will handle enforcement by tracking chains of contractual agreements and the identities of the involved parties.

4.3.3 How it enables the experience areas

Realizing the opportunities across all previously described experience areas hinges on the recreation of our institutions for the digital age, to create security, trust and legitimate claims in digital interactions. This becomes tangible when shifting to *Digital Governance* or *Seamless Transactions and Supply Chains.*

Digital Governance

Issuing identification documents and legal registers for people and businesses is among the most important services carried out by governments. In the virtualized world, the equivalent will be certified, unique digital identification and open public ledgers that record a person's birth, marital status and death, as well as ownership of land and registration of a business. These *Digital Governance* artefacts will rely on digitally-enabled legal frameworks that ensure enforcement of smart contracts and votes entered into digital ledgers. These frameworks will enable courts and police to recognize breaches of digital contracts, and to settle disputes, for example, through digital forensics. With these things in place, there can be trusted and reliable digital interactions among citizens, their governments and administrative bodies, for example, in the form of e-participation or transparency services to hold administrations accountable for their promises. Potentially, this can support more direct forms of democratic participation, such as elections or referendums. "Google or any other webscale player are not the right fit for the most sensitive digital services, such as e-voting," says Estonian President Kersti Kaljulaid. The President

adds: "Providing a secure, digital identity is a core function of every government, and telcos can help bring this to market." Another major effect that recreated institutions will have on *Digital Governance* will be smoother cooperation between government departments and among administrative offices and citizens. An important prerequisite for this is the digitization of the vast amounts of state-owned data in European open databases and ecosystems, increasing their reach and relevance.

Seamless Transactions and Supply Chains

One condition for a fast and frictionless trade system is mutual trust among the contracting parties. In this context, the third foundational capability empowers blockchain-based *Seamless Transactions and Supply Chains* by certifying the identity of everyone on the blockchain, ensuring digital property rights and establishing data as a digitally tradeable good. The last aspect will become more important as the data economy in Europe grows. Digitally capable institutions allow anyone to engage in a contractual relationship – even complete strangers. This will lead to new supply chain relationships, making them more diverse, and creating opportunities for small providers. A key success factor will be society's level of trust in the digital trade system's ability to enforce and settle transactions.

5.
OPPORTUNITIES FOR EUROPEAN TELCOS
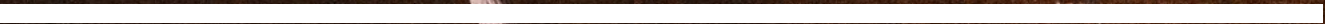
The three capabilities set out in Chapter 4 are the prerequisites for Europe's success in the digital age. Accenture Strategy believes that European telcos are well-positioned to deliver them. Telcos are already the most trusted partners of companies, consumers and government institutions to secure communication, manage interoperability and provide reliable services[58].

For this report, Accenture Strategy spoke to a dozen telco CEOs and another twenty thought leaders from inside and outside of the industry. These leaders stressed the importance of the three foundational capabilities, and identified huge opportunities to establish European digital leadership and create value across the experience areas laid out in this report. Perhaps even more strikingly, the interviews revealed that these leaders are already working on making it happen.

5.1 URGENCY TO ACT

The time for Europe to take action is now. Too much time has already been lost. If Europe wants to remain relevant in the digitized world and stop the downward spiral of value erosion, it needs fast and decisive policy and industry action. Almost every industry in Europe faces the challenge of agile and powerful digital disruptors. European car makers, for example, are under pressure from innovators like Tesla, whose Model S car in the US outsells Mercedes S-Class, Porsche Panamera and BMW 6/7 Series combined[59]. Or take traditional manufacturers who are watching their processes become increasingly automated and transferred to decentralized, cloud-based, and internet-enabled models. Telco operators were among the first ones impacted: digital service providers like WhatsApp, Facebook, YouTube or Google leveraged their global platforms for search, community-based communication and other services "over the top" of the telcos' networks. This increased the telco operators' cost, while at the same time eating into their revenues and profits. The global web-scale players are the new competition: they apply boundary-free thinking on a global scale, and benefit from being large and unregulated when it comes to using customer data. Data is the currency on which they build their businesses. "If Europe continues on this path of overregulation and overfragmentation," says Michael Tsamaz, Chairman and CEO of OTE Group, "telcos will look very differently in Europe in 2030. Most of their business will be long gone or bought by American or Asian companies. We are exposed to global competition, but we regulate and deal with the industry as if we were alone on Earth."

> *"Telcos will need to be very smart in understanding where they have a real advantage, and use this to drive a differentiated experience."*
>
> **Vittorio Colao · CEO, Vodafone Group**

To speak or text with friends and colleagues, European consumers – especially younger generations – are using web-scale competitors, such as Skype, WhatsApp, Viber, Apple Facetime or Facebook. Users in European markets like France, Netherlands and Germany already spend almost half an hour per day on WhatsApp alone[60]. These services are transforming customer expectations about convenience and user experience. For example, a US study finds that two thirds of consumers use social media as a platform for customer service[61], preferring its convenience and flexibility over other company channels. Services like Amazon's Alexa-powered Echo platform, as well as popular excitement over the Pokémon Go game, suggest that consumers are getting used to voice control and augmented reality. This will raise expectations for digital services even higher. Orange's Deputy CEO Pierre Louette describes this development as a "world beyond apps," where we will use and consume applications completely differently. "Apps will be integrated in platforms and controlled by voice," says Louette. "They will no longer be visible, but at the same time, experiences will become more immersive."

> *"If we do not want to become pure wholesale infrastructure resellers we need to become platform players that scale across Europe and enable the ecosystems in the digital world."*
>
> **Milan Vašina · CEO and Chairman, T-Mobile Czech and Slovak Telekom**

So far, European telcos have largely missed out on newly created value, while new players and consumers have profited tremendously. Traditional voice services, both fixed and mobile, are delivering lower revenues. While in 2008, the European average revenue per user (ARPU) from mobile phone calls was €14 per month, this fell to just €6.4 in 2016 – a 54% drop in just eight years[62]. Meanwhile, digital services increase demand for connectivity, especially on mobile devices. Consumer trends illustrate this. In early 2017, video accounted for 54% of the time people spent on mobile devices in early 2017, up from 42% at the end of 2016[63]. In France and Germany – Europe's largest markets – the average time spent online on mobile phones has reached almost two hours per day. That's nearly quadruple the time spent only five years ago[64]. In contrast, telco ARPU per month from mobile data grew only slightly during this time (from €5.8 in 2012 to €6.3 in 2016)[65], while ARPU from fixed broadband even declined (from €26 in 2008 to €24.4 in 2016). Overall, ARPUs in the EU telco sector have declined from €44 in 2008 to €37 in 2016[66]. As Pierre Louette points out, some regions are not experiencing such drops, nor a lack of investment: "ARPU is more than double in the US, as is investment per customer."

These sobering trends have led to declining investment capacity in Europe, just at a time when a new era of investment and innovation in networks and digital services is needed. While ARPUs are declining fast, network expansion investment as a ratio to revenues is reaching record highs just to keep up with increasing traffic. Most EU telcos spend around 22% of revenues on CAPEX, up from the usual 18-19%[67]. Investments for the next generation networks would push this up even higher, unless ARPUs rise significantly. Providing network speeds above 100 Mbps for consumers and 1 Gbps for public institutions, transport hubs and digitally intensive businesses will cost €660 billion, representing 25 years of investment at the current pace[68]. Investment in R&D for new digital services is equally necessary. "It is clear where new technologies and innovation come from," says Pierre Louette. "They emerge where there is investment." Here telcos face competitors with very deep pockets. The combined R&D investment by Alphabet (Google's parent company), Apple, Facebook and Amazon in 2016 was over ten times that of nine leading European telcos[69].

Fragmentation – especially in the mobile sector – and pessimism about returns on additional investment in infrastructure and digital services is holding back the sector. "Under the current circumstances, European leadership in 5G is a pipedream," says Michael Fries, CEO of Liberty Global. He elaborates: "The investment capacity isn't there today, and is unlikely to be there in the future without further consolidation in the mobile space."

> "GAFA[70] are so rich from monetizing the data of billions of Internet users, and they use a big part of the network capacity. I believe it is fair to say that they should pay somehow a part of the cost."
>
> **Dominique Leroy · CEO, Proximus**

These trends create a real urgency for telcos, policy makers and other industries to act. Regaining European digital leadership will be critical to securing future prosperity. The first wave of digitization demonstrated that a 10% increase in broadband penetration yields an additional 1.21 percentage points of GDP growth in developed economies[71]. For the next wave of digitization, the foundational capabilities are the motors of value creation in Europe. Keeping European employment levels rising or steady will be difficult without the jobs created by the foundational capabilities and emerging experience areas. To illustrate this, the World Bank estimates that for every high-tech job created, nearly five additional jobs could be added in other sectors[72].

5.2 THE OPPORTUNITY AROUND THE FOUNDATIONAL CAPABILITIES

Accenture Strategy's conversations with telco industry leaders revealed a universal acknowledgement of the business opportunity across the foundational capabilities and their pivotal importance for the successful digitization of Europe. European telcos are ready to make it happen, together with industrial partners, start-ups, and policy makers.

5.2.1 Ecosystem around the Internet of Everything

The market opportunity of the Internet of Everything (IoE) is expected to be over $9 trillion[73] globally by 2021. Most of the value will be created from large IoE platforms that guarantee interoperability, security of transactions, as well as scale for services around data and artificial intelligence. Until today, none of the existing vendors has a complete IoE ecosystem solution yet, leaving enterprises with no choice but to implement solutions from multiple vendors that require integration into central enterprise resource systems in the long-term[74]. This points to an uncaptured market opportunity for an open, integrated and interoperable ecosystem where partners can connect, exchange and contribute across industry sectors and countries via open data exchanges and marketplaces. Telcos may play an active role in this area. Deutsche Telekom CEO Timotheus Höttges says his company's strategy is based on the "understanding that partner ecosystems and cooperation will be pivotal to drive return on investment and accelerate value creation."

The business opportunities that lie in creating this open ecosystem around the Internet of Everything is attracting investment. There are five players who could contribute to building the ecosystem. There are the digital disruptors like Google, Amazon and Facebook that built their businesses largely on the back of customer data. After introducing Alexa, Amazon – together with Chinese giant Tencent – invested $300 million into Essential's Ambient, an AI-powered IoE operating system to connect everything to the Internet. Then there are players like Bosch, Philips and GE that are fighting to bring their product business into the cloud and to find new digital service revenue streams. There are start-ups in this field, such as evrythng, cloudera, ThingWorx and several start-ups in the Next Big Thing incubator in Berlin, Germany. Next, there are the telcos. And finally, there are the equipment vendors like

Huawei that could aggressively move up the stack and establish themselves in the ecosystem around the IoE. While the digital disruptors and players like Huawei can leverage almost infinite resources and scale, the other groups may find common ground on which they can win over customers. Trust and interoperability are the key success factors that would play into such an alliance of industry, telcos and start-ups. Telcos could play the role of the horizontal, neutral players that help the traditional industries to step out of their silos and profit from exchanging data and services at the intersections of traditional business boundaries – the very place where the new value is created. Getting this equation right is where European telcos could lead the change.

Telcos are already the trusted partners of businesses, governments and consumers to provide secure communication. Additionally, they safeguard interoperability of communication services globally. Building on these strong customer relationships, their global presence and proximity in local markets, in addition to their expertise in running technology platforms, telcos are well-positioned to become the enablers of the emerging ecosystem. Telco CEOs know this. Timotheus Höttges highlights Europe's unique "pole position": "Europe has a strong manufacturing industry. Telcos will become the drivers for digitalization of these manufacturing capabilities." Meanwhile Michael Fries from Liberty Global emphasizes the relationship aspect: "We have deep relationships with our customers. We're in their homes and in their offices. We are trusted partners, and we have the local presence. This is an advantage of course, but also means we are held to a higher standard."

Especially on the European market, where data security and privacy are a growing concern, telcos might have a unique position when competing with international disrupters. Digital disrupters build their indirect business models on collecting large amounts of personal data in exchange for free services, but with limited transparency for the end user. European telcos, however, are moving into the market of customer-centric transparency solutions on their platforms. They give customers transparency and easy control of their data, while still allowing them to benefit from data-driven services without the tedious process of consenting to each and every service they would like to use. For example, Telefónica's AURA platform provides easy-to-manage safety, transparency and control services. AURA's timeline feature lets users see the data they generate chronologically as they use the

company's products and services. Users decide whether to share part of the insights generated from their data with third parties to enrich their digital experiences[75]. By building these types of transparency and control features into their services, Europe's telcos build on their competitive advantage as trusted, local partners.

But digital disruptors, such as Google, Amazon and Facebook could also become the providers of the ecosystem around the Internet of Everything. They bring experience in building reach and managing a diverse and open ecosystem to create seamless customer experiences. And they are not held back by market fragmentation and regulatory constraints. Time will tell whether European telcos and other industries can capitalize on their local roots and deep process know-how, or whether their market position will be eroded by globally operating platform players. After all, digital disruptors are making a huge effort to change the perception consumers have of them, and build trust.

> *"For the last 10 years, Europe has relied on American information empires with some hesitation, but now consumers and businesses are seriously concerned. The change of government in Washington has sent a very strong signal that the US has turned into an unpredictable ally."*
>
> **Robert Tercek**
> **Pioneer of digital media and author of *Vaporized***

Established industry players, such as Bosch, SAP, Philips, Airbus, Alstolm and GE, as well as the European manufacturers and the car industry are natural partners for telcos in creating an open ecosystem. Together, these players and the smart solutions already created by European start-ups could prove an effective alliance. The ecosystem and pervasive, high-performing networks will enable our industrial players to create purpose-fit customer experiences, and develop them with their established user bases. Timotheus Höttges recognizes this trend: "Competitors will share data openly through open data exchanges, while searching for differentiating features. Companies may use behavioral data and will compete on relevance. Moreover, Deutsche Telekom will provide standard services around adminis-

tration, data management and security."
This emerging ecosystem will create massive investment opportunities in new technologies, services and solution providers that will surface around it.

5.2.2 Pervasive networks of the future

Even though we are still years away from having pervasive and ubiquitous networks in Europe, and the 5G standard is only expected by 2020[76], both are important for realizing many IoE use cases. Particularly differentiated levels of latency will enable many unprecedented services, for example in the areas of *Autonomous Mobility*, remote health care and virtual reality.

To Europe, the pervasive networks of the future represent both a tremendous opportunity for renewed growth and a risk, considering the capital needed to make this infrastructure faster and more reliable with lower maintenance costs. On the upside, developing 5G networks could put Europe back on the map of digital technology leadership, creating business globally for European providers along the 5G value chain. On the downside, the tremendous capital investments needed to build both 5G networks and create software-defined network clouds make it difficult to build a business case in today's regulatory framework in Europe. "We are investing in infrastructure like never before in history," says Timotheus Höttges. "We are almost at 21% CAPEX of revenues." Such investments will have to be rewarded with adequate returns to ensure the roll-out of pervasive networks across Europe. Here, the ability to generate revenues from business models based on insights from network data will unlock the capital for large-scale infrastructure investments. But to succeed with data-based business models policy changes are required.

Telcos are clearly qualified to provide the pervasive networks of the digital age. They have a long track record in building up and operating critical telecommunications networks and infrastructure. This includes experience with the typically long investment cycles of infrastructure-based services. European telcos cannot outsource this burden to equipment providers. If they do, equipment vendors like Huawei might soon become de-facto monopolies. Rather, European companies, with the support of public institutions, could take this opportunity to demonstrate leadership in selected core technologies by focusing R&D efforts, for example, on areas that protect our networks from cyberattacks and espionage. The decisions that European policy makers take today will determine if European telcos can roll-out

pervasive networks and provide protective services against cybercrime, enabling all other industries across the continent to drive digital growth.

> *"We are making our networks smart and software-based. There will be no difference between fixed and mobile anymore. Customers will automatically be routed into the best network available where they are."*
>
> **Timotheus Höttges · CEO, Deutsche Telekom**

New digital start-ups are also rushing into the market around the pervasive networks of the future. For example, American start-up Cohere claims to have developed a modulation scheme that uses both time and frequency data about wireless channels to alleviate signal fading and multipath noise. The result, the company claims, is higher-capacity and stronger reception networks that meet the 5G standard – a challenge that larger companies like Qualcomm, Huawei, and Alcatel-Lucent have been working on for a long time[77]. Similarly, shares of Straight Path Communications, a wireless technology start-up that owns US-wide airwave licenses suitable for 5G wireless service, spiked sharply in Spring 2017, with AT&T and Verizon competing for control[78]. Both examples illustrate that European telcos need to step up their game. "Europe needs to focus on races that it has not already lost," says Eelco Blok, CEO at KPN. "We can still win on 5G, but we need to be decisive and fast." Timotheus Höttges says that differentiation will be key for future networks: "In the future, there will be no dedicated network for low latency services, for voice, messaging or automated driving," says Höttges. "It will all be based on hybrid networks with dynamic allocation of resources to the specific needs of each service. Hence, it is essential to be allowed to treat services differentially, e.g., by price and quality levels."

5.2.3 Recreating institutions

When it comes to recreating institutions for the digital age, the key challenge is providing solutions that certify identity, secure digital transactions and enable transparency and control over data use. Telco CEOs see their companies as natural partners equipping institutions across Europe with the tools they will need. "Telcos should play the role of providing identities and act as trust centers for the next internet," says Eelco Blok at KPN. Dominique Leroy from Proximus agrees that "telcos can certainly play a role in this market," citing the example of "Itsme, a unique collaboration between Belgium's mobile operators and leading banks creating a reference for mobile identity and digital privacy." Many initiatives in the field of digital identity are spreading now across Europe. They include the digital identity platform "Verimi", recently launched by Deutsche Bank, Daimler, Allianz, Axel Springer, Postbank, Here and COREtransform, and joined by Deutsche Telekom. Together with the competing Log-In Alliance by ProSiebenSat.1 Media, RTL, United Internet and Zalando, these initiatives show that European industry is taking action here. What is missing is a common framework that embeds and manages trust in the emerging ecosystems.

Who will provide these digital solutions to governments? The potential players range from European telcos to innovative technology companies to government agencies. Telcos qualify themselves as capable suppliers of such solutions from a reputational and stakeholder management perspective. "We are more trusted than the web players, and we need to do everything we can to keep that trust," says Eelco Blok. "We need to enable companies and governments to digitize their interactions and relationships in a way that protects the individual's rights to privacy and security and puts them in control of their own data." Telcos also have operational experience and technical expertise in developing and enforcing security standards, and certifying identities as trust center authorities. This experience would be valuable when operating certification agencies of digital identity among other applications, especially because telco providers have strong reputations as guardians of personal data. They enjoy the trust of over a third of users in a recent Accenture Strategy survey, and come in second only behind device manufacturers in a ranking of most-trusted company groups[79].

> *"We need to inject ethics and humanity into technology."*
>
> **Pierre Louette · Deputy CEO, Orange**

This position of trust could make European telcos the preferred partners of governments when it comes to recreating frameworks that govern our digital interactions. Timotheus Höttges expects broad application areas: "We will have unique identifiers for every product. Technologically we can already do that, but we need to recreate Europe's digital institutions around it to make it executable." The prerequisite here is collaboration between telcos and a broad range of industry players, including banks, insurers, media industry players, as well as civil society institutions.

5.3 SEIZING THE OPPORTUNITY

European telcos play an important role in supporting the digital transformation of every industry across the continent. But they, too, are in the grips of transformation. This entails deep changes in culture and talent, investment priorities and business partnerships.

Cultural shift

European telcos have already begun to build open ecosystems, creating mutually beneficial relationships with partners, such as start-ups, developers and players from other industries. For example, Deutsche Telekom CEO Timotheus Höttges emphasizes a "win with partners" strategy that guides their cooperation with organizations like Zalando and the *Die Welt* daily newspaper. Together with these allies, telcos deliver new value across previously separated industries. This opening up of value creation to third parties will need to be accompanied by a shift to agile operations, allowing faster time to market and rapid adjustment of offerings based on customer feedback. Orange Deputy CEO Pierre Louette sees this as part of a greater transformation: "We need to shed our skin, and reinvent ourselves as a new animal – a platform player."

Investment pivot

If telcos are serious about becoming digital players, they will need to increase their investment in new sources of growth. Michael Fries from Liberty Global sees a need to focus on continued network-centric investment to deliver gigabit speeds, while ramping up investment in software capabilities, data applications and content.

Additionally, less asset-heavy, customer-reach-oriented platform and service models will require different key performance indicators (KPIs) and value drivers. European telco leaders recognize that mature, infrastructure-driven business models and emerging digital business models may require different approaches to the ways they are set-up and steered.

Skills transformation

Telcos' future success hinges largely on whether they can take their workforce into the digital era. As current gaps in digital skills and knowledge persist, telcos must reconsider their approach to talent. They will need to constantly reskill their people for the digital age, putting them at the core of the business and rallying them behind a shared purpose. This will help companies close the digital skills gap among current employees while gaining access to sought-after talent pools that will develop the innovative solutions of the future. To attract this international top talent, European telcos need to adapt more flexible and fluid work patterns and environments. According to Orange Deputy CEO Pierre Louette, telcos need to "embrace the diversity of cultures and abilities of entrepreneurs, data scientists and developers."

Need for cooperation

In addition to the transformative shifts each company will undergo individually, European telcos can benefit from bundling their resources and scaling pilot projects into pan-European models that eventually give rise to globally leading standard solutions.

> *"As an industry, we need to work on a couple of broad areas together, with focused programs, multi-national and multi-sector involvement, and the latest technology."*
>
> **Eelco Blok · CEO, KPN**

"Telcos have the technology know-how, the vendor relationships and the customer interactions that enable us to compete with webscale players. We can create a viable alternative to them for Europe."

Atanas Dobrev · CEO, Vivacom

"The EU is based on the free movement of people, goods, services and capital, but in the digital age, one thing is missing: the free movement of data."

Kaja Kallas · Member of the European Parliament

"All European telcos and even the US players are sub-scale compared to the platform players. It would be good to develop a common ecosystem. But it is challenging if there is a dominant party that wants to own it or has their own view on the degree of openness."

Gavin Patterson · CEO, BT

"The other thing that Europeans don't want to hear is that it's a winner take all world. In the new tech world, there's first, second and nobody else."

John Donovan · CEO, AT&T Communications

Accenture Strategy has identified seven potential initiatives to drive collaboration and build European digital leadership. These initiatives fall into two strategic categories: collaboration among telco operators to expand their geographic coverage and reach scale, and collaboration between telcos and other players to create value at the intersection of current industries.

- **Open smart city platform:** Smart city initiatives require the cooperation of many different players, such as public transportation, utilities, analytics providers and public authorities. They also serve a broad variety of users, including local businesses, logistics systems providers and individual consumers. The result is a diverse ecosystem of data sources with different ownership and access rights, multiple use cases and a variety of concerns over security and privacy. Hence, scalability, interoperability and high security standards are key success factors for smart city platforms. Telcos could play an important role in developing the secure, open and interoperable platform for Europe's cities that allows for the seamless flow of information between all participants. Their key contributions could be connectivity, semantic interoperability, security, identity and authentication management, as well as platform analytics. Telcos would act as a "neutral" connector for smart city stakeholders, who might otherwise be reluctant to join each other's proprietary platform. This role suits telcos well, since they are already trusted providers of secure communications. Unfortunately, current European smart city initiatives often work in silos with limited use cases. More ambitious efforts are happening elsewhere. For example, Singapore is rolling out sensors and cameras to feed data into the "Virtual Singapore" platform. It will enable unprecedented data-driven insights for the government and Singaporeans, even for seemingly unrelated topics like disease control. The government cooperates with players across multiple industries to bring smart city solutions to life[80]. A similarly ambitious European initiative would help create a common standard that could be adopted across the continent.

- **Connected public buildings:** Renovation of public buildings and energy conservation are large line items in the budgets of European governments. Today, most of this budget is spent on passive measures, and completely ignores opportunities from new technology. A lack of widely accepted standards is a critical barrier. A European initiative

on connected public buildings would identify best practices and help codify them into European norms for public tenders for refurbishment and energy conservation, making them scalable across Europe. Telco operators could seize the opportunity of digitizing public buildings. They could provide government agencies and education institutions with sensors, software to transform data into insights and platform services. Data from these buildings combined with analytics would unlock savings, like reduced energy costs. This data could also make education more relevant for students. For example, students could use insights from their school's or university's data, as well as other environmental data to optimize the energy flow in their buildings. While telcos could profit from providing connectivity, software and the ecosystem platform for these buildings, they would also help strengthen the practical digital skills of the next generation. Singapore already does this. It organizes hackathons for students to identify digital transportation solutions based on publicly available data[81].

- **Digital transport nodes:** Every day millions of passengers and tons of freight pass through European transport nodes. These "nodes" include airports, ports and logistic hubs. Optimization and coordination are key success factors for higher transport capacity and increase of overall network efficacy. While the demands on the transport network will continue to grow, expanding infrastructure is often costly. Telco operators can play a central role in optimizing transport flow by providing sensors and software that make infrastructure and assets smart. They can offer an integrated platform connecting and analyzing all relevant data, including traffic flow and loading progress of vehicles. Telcos are already active in this space: KPN and Proximus are working together to transform the ports of Antwerp and Rotterdam into the digital harbors of the future. Deutsche Telekom and SAP have teamed up to increase throughput in the port of Hamburg despite a scarcity of space[82]. A European initiative around digital transport nodes would help establish unified data models and procedures to handle information from all participants, making them accessible wherever needed. That would greatly economize information gathering, syndication, and synchronization of data flows, significantly boosting the efficiency and capacity.

- **Digital identity:** Certified digital identities are a cornerstone of Europe's digital future and open up many new use cases. Telcos could cooperate with the financial industry and governments to develop a unified European authentication standard for digital interactions. Cooperation with multiple partners increases scale with ripple effects in many industries. Proximus is already working with other telco operators and banks in the field of digital identity. Their "It's me" platform offers a single digital identity associated with a person's SIM card. This is an example of a cross-industry collaboration that taps the great potential of scaling standards on digital identity across Europe to ultimately create a globally leading standard solution. A European initiative could build on the eIDAS directive for identity management to establish a system for unique and unforgeable identities in a consistent common security framework.

- **Integrated health and patient data platform:** In most European countries, there are initiatives underway to create integrated patient data records as a basis for a digital health system. There are many requirements for such a system: high security standards, connecting of diverse data sources to create interoperability and scale, clearly defined access and usage rights and flexibility for the evolution of data sources, nature of data, services and legal frameworks over time. Telcos' role would be to provide connectivity, software and the platform that connects and analyses the data, while ensuring interoperability, data security and privacy. Telcos are already involved in these initiatives. Deutsche Telekom is one of two main contractors developing the digital patient data platform for the German health system, while OTE already provides a similar solution in Greece[83]. A European initiative around the integrated health and patient data platform would build on the insights from existing projects. It would also establish common frameworks for defining and managing roles and access rights, as well as secure identification, authorization, authentication and interoperability.

- **Open SME platform:** Small- and medium-sized businesses (SMEs) in Europe are just as exposed to digital disruption as large companies and governments. Telcos could help SMEs digitize their products and services by offering them an open platform to connect their data with the data of their suppliers and customers, and gain analytics insights based on this. Components of such a platform would be the security framework, semantic metadata models to normalize data from different sources, as well as data exchanges and service marketplaces that are easily accessible for SMEs. This would reduce costs for SMEs, as they would not need to shoulder large investments for their own platform or analytics services. At the same time, it would significantly reduce complexity and increase data insights. Simple SME marketplace platforms for European craftspeople already exit. They typically operate in national markets, like Travaux.com in France and Werkspot.nl in the Netherlands. Telcos could develop a meta-ecosystem that connects the data from these platforms with data from SMEs in other sectors to enrich the insights for all players on the ecosystem. A European initiative in this field would enable SMEs to exchange data securely while creating the prerequisites for a Europe-wide platform on which providers could bundle all kinds of services and effectively make them available to SMEs.

- **Cross-industry think tank on artificial intelligence:** Improvements in artificial intelligence will support an increasingly symbiotic relationship between humans and machines. AI will power manifold use cases, ranging from semi-autonomous agents that steer energy consumption to algorithms that define who gets shortlisted for a job interview or how cars react when an accident is inevitable. Across these use cases, the think tank could develop and share best practices on how to ensure inclusivity, fairness, transparency, security and privacy, and create industry standards for the interoperability of systems and the collaboration between people and AI systems. Additionally, the think tank could provide guidance for ensuring trustworthiness, safety and robustness of AI and facilitate multi-stakeholder dialogues between industry, government and civil society about the values and ethics of AI and how to deploy it in ways that achieve positive societal outcomes.

Across those initiatives, there are common themes that go back to the foundational capabilities for the digital transformation in Europe: enabling the digital ecosystem with a common security architecture, creating interoperability that scales across and beyond these initiatives, providing pervasive networks, as well as recreating institutions that keep pace with technological change. Leveraging synergies between these initiatives is vital because they not only create value in their respective areas, but also help build the foundation for all emerging experience areas in the digital age.

6.
PRIORITIES FOR POLICY MAKERS

6.1 KEY PRIORITIES AND ACTIONS

An ecosystem around the Internet of Everything, pervasive networks and recreated institutions are the three foundational capabilities that are critical for Europe's successful digitization. The policy decisions we make now will largely determine whether we can actually build these capabilities. But Europe will need to change its approach. The sheer force of the digital revolution has made – and will increasingly make – many of the positions that dominate today's policy debates obsolete. European policy makers should look beyond the assumptions and entrenched positions that no longer match the emerging realities of the digital age.
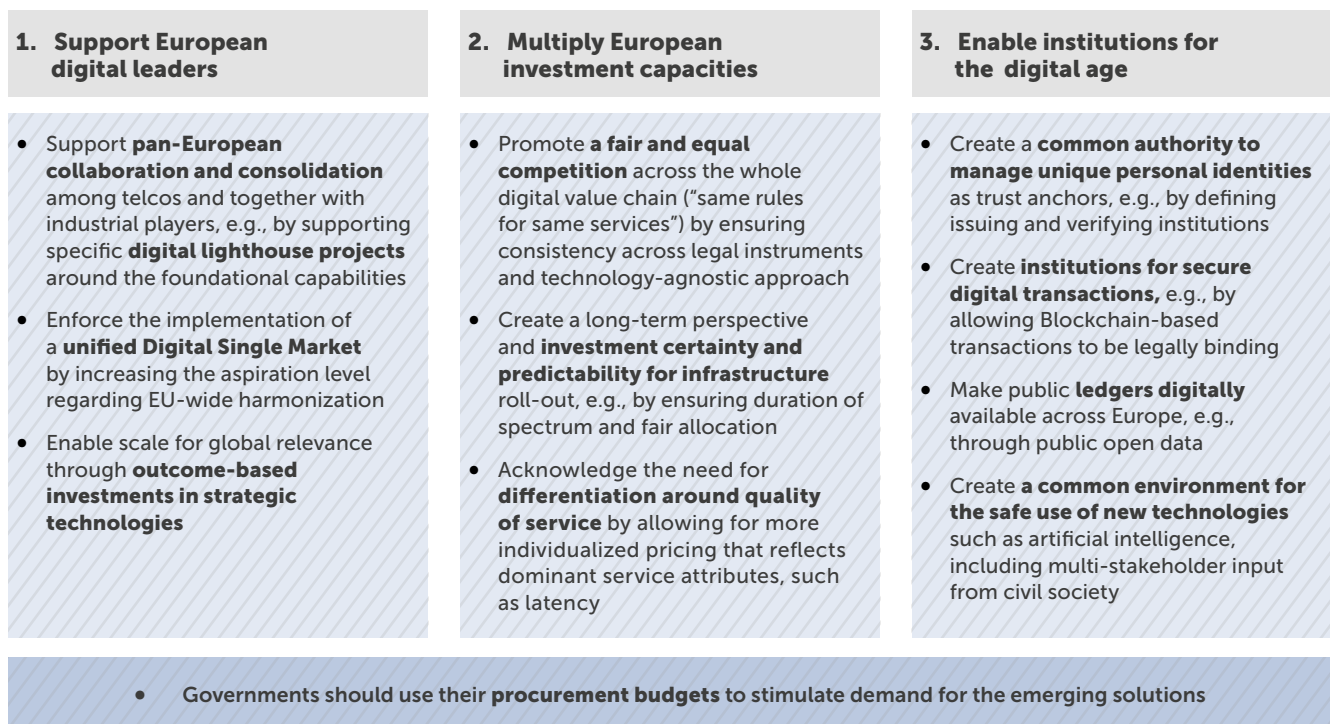
Urgent policy action is required to strengthen each of the foundational capabilities:

- Scaling a Europe-based ecosystem around the Internet of Everything requires **European digital leadership**. Policy action is required to reach scale, enforce the single digital market and create outcome-based investment vehicles for strategic technologies. That is best achieved by aspirational initiatives that create real value for European citizens and demonstrate global leadership. Such initiatives include the open smart city platform, connected public buildings and the digital transport nodes outlined in Chapter 5.

- Financing the deployment of low-latency, pervasive networks demands a favorable environment that **multiplies European investment capacity** and incentivizes the building and updating of physical infrastructure, e.g., for 5G and fiber. There is the urgent need to scale the investment capacity for the digital industries across the whole digital value chain. This requires the same rules for the same services, a long-term perspective for improved investment certainty and acknowledgment of the need for quality-of-service differentiation.

- The digital age requires **enabling institutions** in specific areas to recognize digital identities, secure digital transactions, make public ledgers digitally available and promote the open and safe use of new technology, such as artificial intelligence.

Governments are in a strong position to use their procurement budgets to drive innovation across these three policy priorities. They can also stimulate demand for emerging solutions. Figure 3 provides an overview of the suggested policy priorities, and the next sections explain them in more detail.

Figure 3: Overview of priorities and actions for policy makers

1. Support European digital leaders	2. Multiply European investment capacities	3. Enable institutions for the digital age
- Support **pan-European collaboration and consolidation** among telcos and together with industrial players, e.g., by supporting specific **digital lighthouse projects** around the foundational capabilities	- Promote **a fair and equal competition** across the whole digital value chain ("same rules for same services") by ensuring consistency across legal instruments and technology-agnostic approach	- Create a **common authority to manage unique personal identities** as trust anchors, e.g., by defining issuing and verifying institutions
- Enforce the implementation of a **unified Digital Single Market** by increasing the aspiration level regarding EU-wide harmonization	- Create a long-term perspective and **investment certainty and predictability for infrastructure** roll-out, e.g., by ensuring duration of spectrum and fair allocation	- Create **institutions for secure digital transactions,** e.g., by allowing Blockchain-based transactions to be legally binding
- Enable scale for global relevance through **outcome-based investments in strategic technologies**	- Acknowledge the need for **differentiation around quality of service** by allowing for more individualized pricing that reflects dominant service attributes, such as latency	- Make public **ledgers digitally** available across Europe, e.g., through public open data
		- Create **a common environment for the safe use of new technologies** such as artificial intelligence, including multi-stakeholder input from civil society

- Governments should use their **procurement budgets** to stimulate demand for the emerging solutions

6.2 SUPPORTING EUROPEAN DIGITAL LEADERS

An emerging ecosystem around the Internet of Everything raises big new challenges for competition policy. Exchanges for data and services will emerge, on which competitors will share data and become partners in wide parts of their current markets. Market definitions will change fundamentally. The key areas of future value creation – represented in the eleven broad experience areas laid out in this report – are all emerging at the intersection of existing industries. It may sometimes even become impossible to define the boundaries of markets where competition law could be applied. Overly rigid rules and market definitions would only disadvantage European collaboration partners against their global competition.

So far, Europe has produced very few major digital disruptors. Two big reasons for this are that our regulatory system is not built to support success (but to control power), and that we are not focusing on creating scalability across Europe. We need horizontal players that build pan-European platforms across the foundational capabilities. The resulting scale, a unified digital market and a vibrant start-up ecosystem around emerging technologies would allow European digital leaders to emerge. These are the main action items within this first priority:

- **Support pan-European collaboration and consolidation** by allowing for cooperation among telcos – and between telcos and other industrial players – to build an open ecosystem platform for the Internet of Everything. An improved opportunity for pan-European collaboration also supports the buildout of scalable, pervasive, software-defined networks, and enables digital institutions that span across Europe. Pan-European collaboration could evolve around specific digital lighthouse projects, such as the digital transport nodes and smart, connected public buildings described in Chapter 5.

"Digital regulation should eliminate redundancies and create an environment in which companies can make their policies around soft laws not through strict rules but opening the floor for stronger cooperation."

Michal Boni · Member of the European Parliament

- **Enforce the implementation of a unified Digital Single Market** by increasing the ambition and aspiration level regarding EU-wide harmonization of rules for digital services. A unified Digital Single Market benefits both existing players and start-ups aiming to scale new solutions. The well-functioning of a Digital Single Market depends on well-defined property rights, and well-defined rights to digital data in particular. The general policy issue that needs to be addressed is the question of who has the right to use what data in what circumstances. Additionally, standardization is also critical to enabling an open, scalable ecosystem around the Internet of Everything, including a common framework for trust anchoring, security classes, as well as interoperability between existing industry silos. Barriers stemming from regional differences – for example in taxation, copyright, and privacy law – should ideally be eliminated to scale new digital services quicker across the continent and beyond. Trade policy should aim to drive a common approach to this digital policy architecture as it concerns trade partners outside the EU.

"As a key policy priority, Europe must ensure the free movement of data across borders."

Kersti Kaljulaid · President of Estonia

- **Enable scale for global relevance through outcome-based investments in strategic technologies.** It is impossible to anticipate all the new technology on the horizon. But as we have already identified the key foundational capabilities that will lay the groundwork for success in the digital age, we can also identify the technological areas where

Europe wants to take a leading role. Such strategic core technologies center around, for example, endpoint and cybersecurity, transaction technologies, such as blockchain, semantic interoperability in IoE, real-time analytics, immersive and virtual reality and voice recognition. Dedicated funding programs need be tied to distinct outcomes or the creation of a de-facto standard instead of supporting open-ended research. Investment vehicles already exist, and some funds have been allocated. But overall, European investment in research and development is lagging behind other countries. The average gross domestic expenditure on R&D in the EU28 is only 2.03% of GDP. Compare this to 2.73% in the US, 3.48% in Japan, and 4.15% for South Korea[84]. Europe needs to raise both the ambition level and funding available, and start investing strategically in global leadership positions instead of many competing ideas.

"Bureaucrats are bad investors. Policy makers should give money to 3-5 professionally managed funds that not only invest in projects, but help them succeed along the whole value chain and from startup to global leader."

Léo Apotheker · Chairman of the Board, Schneider Electric

6.3 MULTIPLYING EUROPEAN INVESTMENT CAPACITY

Upgrading Europe's infrastructure to support pervasive, ubiquitous, secure, software-defined networks across fixed and wireless technologies requires massive investment. Finding this investment will be a challenge, mostly due to the limitations of the industry's current scale and profitability. Any solution must involve an overhaul of backward-looking regulation at the European level. Yet current reform discussions are locked in legacy concepts developed for telco networks and services. As mentioned before, software-based networks (see section on foundational capability #2) will scale across physical networks, and use them in a service-defined and dynamically managed way in the future. Voice services, messaging services, machine-to-machine communications,

and complex control chains for IoE applications will use network resources in completely different ways. They will require different security classes, different availability and latency, as well as different support from real-time analytics in the network. Separate network providers will probably use elements of the same infrastructure, and multiple infrastructures will be connected to a single network, sometimes only for a specific purpose. Therefore, the incentives to invest need to be created across the whole system. In a recent report, 64% of investors said Europe's digital industry is still lagging behind the US, while only 21% considered it an attractive investment opportunity[85]. Perhaps not surprisingly, 86% agreed that less regulation would make the sector more attractive. Here are the actions that could help increase investment capacity:

- **Promote fair and equal competition across the whole digital value chain** ("same rules for same services") by ensuring consistency across legal instruments, the same conditions for use of personal data for all market participants and, in turn, all consumers. That means that European telcos and platform-based digital disruptors can monetize on data-driven services equally, but must also comply with European regulation equally. The current revision of European ePrivacy regulation will be an interesting test: will it deliver on these requirements by aligning rules on processing data with the General Data Protection Regulation, or prevent telcos from competing the same way as other market participants?

"OTT players and telcos should operate on a level-playing field. But here's the twist: telcos should be regulated like OTTs, not the other way around."

Kaja Kallas · Member of the European Parliament

- **Create a long-term perspective and investment certainty for infrastructure roll-out.** This includes creating a regulatory framework that ensures the necessary certainty and predictability investors need, be it for long-term fixed network investment or mobile networks. The ongoing reform of the European Communications Code on the new European Electronic Communication Code (EECC) is a key area where this long-term certainty should

be established. In mobile technology, spectrum and frequency availability, long license duration, expected renewal and fair allocation are all important for the emergence of 5G. "The EU needs to incentivize investments, including longer licenses", Michal Boni, Member of the European Parliament, confirms. He adds: "We need to create rules where licenses are not simply given according to price, but also level of investment." In fixed technology, it is essential to limit regulatory intervention that creates unfavorable or unstable investment conditions. Legacy regulatory concepts, such as price-regulated network access, no longer allow for economically efficient market behavior and discourage risk taking in the form of investments in better networks. Here, price differentiation benefits all users because it helps new investments to become economically viable, leveraging people's willingness to pay for better quality.

> *"My ability to predict 2030 is limited and yet, I am asking investors to commit to payback periods well beyond 2030. They need much more regulatory certainty to commit the funds required."*
>
> **Gavin Patterson · CEO, BT**

- **Acknowledge the need for quality-of-service differentiation** – i.e. different services with different quality produced on the same network. Policy makers should allow for differentiated classes of services that can be priced in a much more individualized and contextualized way, e.g., based on dominant service attributes. Dominant service attributes are zero-outage, latency, and speed, while digital networks are more dynamically managed and service-defined. Overly restrictive application of net neutrality rules will hinder innovation and result in inefficient use of capacity.

6.4 ENABLING INSTITUTIONS FOR THE DIGITAL AGE

Existing institutions, both in a legal and organizational sense, should be doing a lot more to serve the needs of the digital age and the development of the skills needed to underpin industrial digitization. For example, they

need to establish important trust anchors for consumers, and provide traceability and credibility for digital transactions. Making public ledgers digitally available is critical to facilitate transactions. Additionally, we need frameworks for the safe use of emerging technologies to protect us from the unwanted consequences of digitization. Policy makers need to take action today, particularly on the following aspects:

- **Create a common authority to manage unique personal identities as trust anchors** across member states, clarifying a common definition, the information that it contains, as well as the authorities that are allowed to issue, verify and manage digital identities of citizens.

- **Create institutions for secure digital transactions.** As more transactions will be completely digital, the verification in court of blockchain transactions, for example, needs to be guaranteed, and mechanisms to secure transactions need to be commonly defined.

- **Make public ledgers and registers** digitally available at regional, national and European levels, for example through public open data. This may include moving verification and authorization of the content of such registers to completely automated and digitized transactional processes.

- **Create a commonly agreed environment for the safe use** of new technology, and for collaborative R&D. With all the benefits of machine learning, real-time analytics and artificial intelligence, there is a need for a wider debate and common rules. For example, Google, Facebook, Amazon, IBM and Microsoft have formed a "Partnership on Artificial Intelligence"[86] to set societal and ethical best practices for safe deployment of artificial intelligence. Even if we are still far away from autonomous cognitive agents, our cars and household devices are becoming more intelligent. That's why we should start creating an enabling environment for the safe and secure use of this and other types of technology. "We need to ensure whether the rules of the analog world apply to digital solutions, including AI," says Estonian President Kersti Kaljulaid. Inaction or overly restrictive policy making would exclude Europe from future technological advances or expose citizens to significant dangers.

"We need a new Geneva Convention around AI. Nobody wants to see AI used in the wrong way, by the wrong people."

René Obermann · Partner, Warburg Pincus

6.5 GOVERNMENTS AS DRIVERS OF THE DIGITAL REVOLUTION IN EUROPE

Public procurement averaged 14% of GDP across EU countries in 2016[87]. As the OECD puts it, public procurement "offers an enormous market potential for innovative products and services. Used strategically, it can help governments boost innovation[88]." Accenture Strategy's research demonstrates that the increased deployment and use of digital solutions can unlock tremendous benefits across the three dimensions analyzed in Chapter 2 – people, planet and prosperity[89].

However, digital solutions and their benefits are under-represented in current government procurement priorities across European countries. For example, national plans for maintaining and retrofitting public infrastructure, such as roads, buildings and transport nodes focus mostly on investment in plain refurbishment instead of digitizing public infrastructure. Governments could play a crucial role in accelerating the digitization of Europe if they dedicated more of their vast procurement budgets to digital solutions, such as smart cities, connected buildings and transport nodes.

Hence, government procurement priorities across European countries urgently need an update. Concretely, governments should analyze their potential contribution to digitizing Europe's infrastructure across all material line items of public procurement to drive positive impacts for people, planet and prosperity. The minimum requirement would be for governments to leverage their procurement budget to support the seven sector initiatives outlined in Chapter 5 in an outcome-driven way: developing an open smart city platform, connecting public buildings, digitizing transport nodes, providing universal digital identity, creating an integrated health and patient data platform, offering an open SME platform, and establishing European leadership in artificial intelligence.

But what can government authorities do? Focusing on outcomes means that the ultimate target is to help create solutions that can compete on a global scale and winning platforms around the foundational capabilities. There is a variety of initiatives that government authorities across the EU could start. Let's take one example – the smart city platform. Let's assume there has been a multi-city initiative with a number of industrial players, telcos and start-ups that created an open, scalable solution that provides horizontal interoperability and security solutions, with an open eco-system of partners providing solutions. There will be a number of open standards and norms coming out of this project. Public procurers could include compatibility or adherence to these norms whenever they procure the following:

- **Sensors to equip public infrastructure,** e.g., roads, streetlights, parking lots and public buildings

- **Solutions that enable smart decision making** based on data from these sensors, e.g., public building management software

- **Artificial intelligence solutions that help connect the insights obtained from this data with open databases,** e.g., to enable new services on an open smart city platform

- **Partners and educational institutions to upskill the workforce to leverage data,** e.g., training public officials to process and interpret open source data, and extract insights

- **Solutions for public management that rely on public data sources** that can be made available through an open smart city platform

Today, thousands of authorities buy such solutions, but instead of building on a standard, they rather focus on local solutions or proprietary developments. The motivation is often not to create a standard that can compete on global scale, but to support local businesses and keep local decision making power. Taking a broader view could help procurers make a bigger long-term impact. Similarly, Europe's policy makers need to broaden their perspective and shift their mindsets when it comes to their approach to regulating telcos.

6.6 HOW POLICY CAN HELP TELCOS CONTRIBUTE

Over the last twenty years, European telco regulatory policy has focused on creating services-based competition and low consumer prices. This approach has been successful. However, while prices for connectivity services have dropped and the number of telco players in Europe is very high compared to the rest of the world, competition remains largely reliant on regulatory support. With more digital global disruptors entering the market, the participation of European telcos in the global industry[90] profit-pool has declined sharply, reducing their ability to invest in the sector. European policy makers will have to change their regulatory mindset if they want telcos to help build up the foundational capacities that are the cornerstones of a successfully digitized Europe.

Here are five policy shifts that are needed to support European telcos' contribution to the digital revolution in Europe:

- **Shift from telcos' vertically integrated power towards layered competition:** Traditionally, regulators have focused on the vertical market power of telcos. After all, it has been telcos – along with utilities and municipalities – that have traditionally invested in telecommunications infrastructure, providing their affiliated services on top of it. But ownership of the infrastructure will no longer define information services as they evolve into more virtualized, dynamically managed, service-defined, cloud-based software layers. It is on these platforms that data exchanges will occur, services will be offered and value will be created. This trend will certainly challenge market definitions for regulatory and competition law purposes, and the vertical market power of telcos across those layers. If policy makers manage to perform this mindset shift, new opportunities will open up for European telcos in the increasing competition within each layer.

- **Shift from sector-oriented policy making towards horizontal, technology-agnostic rules:** Digitization is not only causing vertical disintermediation of telecom operators, but also a convergence of markets and technologies. Most future value creation will happen at the intersection of the industries we know today. Companies will still compete, but we can also expect them to share and cooperate more along future value chains. Policy makers therefore need to understand the limitations of sectoral regulation. They also need to rethink how to create desired outcomes from horizontally spreading platforms. We are moving towards a digitalization of the economy as a whole, which implies that a horizontal approach to digital challenges is required.

- **Shift from an infrastructure view towards a market view:** Telecommunications networks historically created huge network effects and significant economies of scale from the integration of a widespread physical presence to the service. They therefore resembled potential natural monopolies. This required access-oriented regulation and close controls on pricing. But today we have competing infrastructures and a weakening link between infrastructure and service. As a result, infrastructure providers are no longer able to capture the benefits of network effects or fully appropriate the returns from valuable services produced provided on their networks. They rely more on partnerships with third-party applications and service providers. This shift may significantly benefit the digital ecosystem, particularly in Europe, provided that telcos maintain their ability and incentives to invest. But because infrastructure investments are urgently needed, policy makers need to refocus their attention away from limiting the benefits of network effects and economy of scale for infrastructure providers. Instead, they should create market conditions under which investment in infrastructure and innovation across all layers of the future digital stack are fostered in Europe. Such a shift should not only be recognized in policy documents, but it should also be reflected in concrete regulatory initiatives – such as the new Electronic Communications Code.

- **Shift from fragmentation towards single market:**
  When Silicon Valley start-ups look at an opportunity, they often don't see the same regulatory hurdles and limits that European start-ups do. They have a "playground" in the United States that is uniform and large enough to give it a head start globally, including ready access to venture, or seedcorn, capital. Meanwhile, their counterparts in Europe struggle to scale across Europe's 28 markets. They typically operate within one country, because the business and regulatory contexts – even in neighboring countries like Germany and France – can be vastly different. This makes competing with US or Chinese players on a global scale a daunting prospect. Many powerful digital disruptors come to Europe already having grown to scale in large markets. In the future, intense cross-sector and cross-border collaboration between European players needs to be encouraged, not prevented. A more ambitious Digital Single Market strategy is critical to overcoming today's fragmentation. Key aspects of this strategy should be a focus on investment and innovation, horizontal and harmonized rules for digital services and alignment to seeking of reciprocal market access via trade policy.

- **Shift from ex-ante towards ex-post policy making:**
  European policy makers tend to regulate before technologies mature and innovative solutions scale. Digital disruptors and connectivity providers from the US, however, innovate in an ex-post regulatory environment that allows for experimentation. Regulators intervene only if things go wrong. To support ideation and the testing of new services, European companies also need this freedom. We may even need to turn a few paradigms upside down. Although competition law requires authorities to scrutinize collaboration between large industry players pursuing new market opportunities, it must be used very carefully in order not to stifle innovation in Europe, setting the right framework to stimulate such collaboration instead.

Some of these shifts may seem obvious. Yet recent EU legislative projects, especially in light of their discussion by the EU legislative bodies, do not reflect the new mindset that is required. For example, both proposals for EECC and the ePrivacy regulation reflect sector-specific, ex-ante regulation. By and large, the EECC is trying to solve the problems of the past. For example, the EECC applies end-user protection regulation to transmission services, applying similar standards to person-to-person communication and machine-to-machine services, such as data coming from refrigerators. It also continues to rely strongly on legacy price regulation of networks, possibly even extending regulation to wireless networks. Likewise, the ePrivacy proposal continues the conventional approach to policy making. Instead of aligning with the new horizontal framework for data protection in the EU, the General Data Protection Regulation (GDPR), it imposes stricter rules for the processing of data by overly relying on consent, which makes it harder for telcos to provide big data-driven services compared to other players only subject to the GDPR. Traditional players are still burdened with regulation, while less-restrictive requirements are applied to new entrants offering similar services.

With this kind of regulation, Europe risks becoming a backwater, leaving digital leadership to other regions. **The vision outlined in this report will be unattainable without a fundamental turnaround of our policy approach.** While policy discussions tend to recognize the need for change, this should also be reflected in the outcome of legislative initiatives. The prize for doing so is worthwhile: unlocking the innovation, investment and cooperation that will help Europe to compete and prosper in the next wave of digitization.

7.
THE WAY FORWARD

Europe stands at a crossroads and the decisions taken today will determine Europe's future place in the world. Over the last twenty years, Europe has been a laggard in digitization, and has watched value slip away. To break this trend and "win" the next decade of digitization, Europe needs to build three foundational capabilities: an ecosystem around the Internet of Everything, pervasive networks of the future, and recreated institutions. Getting these foundational capabilities right will determine whether Europe is poised for a successful digital transformation, creating prosperity and benefitting its people and the planet.

Urgent policy action is required to enable a European buildout of these foundational capabilities including a change of course in the ongoing legislative debates at EU level and targeted new initiatives. Three priority areas are most crucial for policy intervention:

- **Support European digital leadership** to scale an ecosystem around the Internet of Everything by enabling telco cooperation, supporting pan-European collaboration and consolidation, enforcing the implementation of a unified Digital Single Market, and facilitating scale for global relevance through outcome-based investments in strategic technologies

- **Multiply European investment capacity** by promoting fair and equal competition across the whole digital value chain, creating a long-term perspective and investment certainty for infrastructure roll-out, and acknowledging the need for quality-of-service differentiation

- **Enable institutions for the digital age** by creating a common authority to manage unique personal identities as trust anchors, creating institutions for secure digital transactions, making public ledgers digitally available, and creating a commonly agreed environment for the safe use of new technology such as AI

On that basis, European telcos are well-positioned to deliver the three foundational capabilities. And the telco c-suite interviewed for this study sees a tremendous opportunity to establish European digital leadership across them. They are ready to act.

In order to succeed, European telcos can benefit from cooperation among themselves and with players from other industries. Seven concrete sector initiatives could support them in bundling their resources and scaling their digital pilots into pan-European models that may eventually give rise to globally leading standard solutions:

- An open smart city platform
- Connected public buildings
- Digital transport nodes
- Digital identity
- An integrated health and patient data platform
- An open SME platform
- A cross-industry think tank on AI

Getting the digital transformation right will benefit Europe's economy and every European citizen, creating equitable prosperity while protecting the planet. It will take teamwork to make it happen. Let's get going!

APPENDIX

LIST OF INTERVIEWS

José María Álvarez-Pallete
Chairman and CEO, Telefónica

Léo Apotheker
Chairman of the Board, Schneider Electric

Eelco Blok
CEO, KPN

Chris Boos
CEO and Founder, Arago

Kathryn Brown
President and CEO, Internet Society

Vittorio Colao
CEO, Vodafone Group

Andrew Collinge
Assistant Director, Greater London Authority

Arnaud de Puyfontaine
Executive Chairman, TIM

Atanas Dobrev
CEO, Vivacom

John Donovan
CEO, AT&T Communications

Carl Benedikt Frey
Co-Director and Oxford Martin Citi Fellow, Oxford Martin School, Oxford University

Michael Fries
CEO, Liberty Global

Prof. Dr. Torsten Gerpott
Head of Business- and Technology Planning / Telecommunications Industry, Mercator School of Management Duisburg-Essen

Timotheus Höttges
CEO, Deutsche Telekom

Salim Ismail
Co-founder, Singularity University

Kaja Kallas
Member of the European Parliament

Kersti Kaljulaid
President of Estonia

Iris Lapinski
CEO and Founder, Apps for Good

Dominique Leroy
CEO, Proximus

Pierre Louette
Deputy CEO, Orange

Michal Boni
Member of the European Parliament

René Obermann
Partner, Warburg Pincus

Gavin Patterson
CEO, BT

Alberto Prado
Head of Digital Accelerator, Philips

Ram Ramachander
CDO, Hitachi Europe

Jeremy Rifkin
Economic Advisor to Heads of State

Vincent Sabot
VP Germany, France and Spain, Sigfox

Afke Schaart
Head of Europe, GSMA

Mark Spelman
Co-Head, Digital Economy and Society System Initiative, WEF

Steven Sprague
CEO, Rivetz Corp

Robert Tercek
Pioneer of digital media and author of Vaporized

Michael Tsamaz
Chairman and CEO, OTE Group

Milan Vašina
CEO and Chairman, T-Mobile Czech and Slovak Telekom

Niels Zibrandtsen
CEO, Zibra Group

Lars Zimmermann
Managing Director, Hy GmbH

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ABOUT ETNO

ETNO has been the voice of Europe's telecommunications network operators since 1992 and has become the principal policy group for European electronic communications network operators. Its 39 members and observers from Europe and beyond are the backbone of Europe's digital progress. They are the main drivers of broadband and are committed to its continual growth in Europe.

ETNO members are pan-European operators that also hold new entrant positions outside their national markets. ETNO brings together the main investors in innovative and high-quality e-communications platforms and services, representing 70% of total sector investment.
ETNO closely contributes to shaping the best regulatory and commercial environment for its members to continue rolling out innovative and high quality services and platforms for the benefit of European consumers and businesses.

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INTERVIEW HIGHLIGHTS FROM DISCUSSIONS WITH C-SUITE EXECUTIVES, SENIOR GOVERNMENT LEADERS AND HIGHLY ACCLAIMED THOUGHT LEADERS

"A government-secured digital ID is a central success factor for the 2030 vision, and telcos can help bring this to market."

Kersti Kaljulaid · President of Estonia

"5G will have the most profound impact on our digital experiences over the next 15 years. This is why we need a forward-looking policy framework that enables European players to lead globally in 5G infrastructures and innovative services."

Arnaud de Puyfontaine · Executive Chairman, TIM

"We must put the benefits of digitization into the hands of everybody. Technology is far too important to leave it to the Americans."

Pierre Louette · Deputy CEO, Orange

"Industry, government and telcos need to collaborate to create the digital society. But to win, we need to forget the idea that 27 agendas need to be aligned to move ahead."

Eelco Blok · CEO, KPN

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