FOREWORD

The world is being transformed by new technologies, which are redefining customer expectations, enabling businesses to meet these new expectations, and changing the way people live and work. Digital transformation, as this is commonly called, has immense potential to change consumer lives, create value for business and unlock broader societal benefits.

The World Economic Forum launched the Digital Transformation Initiative in 2015, in collaboration with Accenture, to serve as the focal point for new opportunities and themes arising from the latest developments in the digitalization of business and society. It supports the Forum's broader activity around the theme of the Fourth Industrial Revolution. Since its inception, the Initiative has analysed the impact of digital transformation across 13 industries and five cross-industry topics, to identify the key themes that enable the value generated by digitalization to be captured for business and wider society. Drawing on these themes, we have developed a series of imperatives for business and policy leaders that look to maximize the benefits of digitalization. We have engaged with more than 300 executives (both from leading global firms and newer technology disruptors), government and policy leaders, and academics.

Every industry has its nuances and contextual differences, but they all share certain inhibitors to change. These include the innovator's dilemma (the fear of cannibalizing existing revenue models), low technology adoption rates across organizations, conservative organizational cultures, and regulatory issues. Business and government leaders should continue to work towards addressing these challenges.

A notable outcome of this work is the development of our distinctive economic framework, which quantifies the impact of digitalization on industry and society. It can be applied consistently at all levels of business and government to help unlock the estimated $100 trillion of value that digitalization could create over the next decade. We have already started to leverage this framework for region-specific discussions with some governments.

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

Cheryl Martin
Head of Industries,
Member of the Managing Board
World Economic Forum

Jim Hageman Snabe
Chairman
World Economic Forum, USA

Pierre Nanterme
Chairman and Chief Executive Officer
Accenture

GRATITUDE GOES TO OUR **CEO CHAMPIONS** FOR THEIR SUPPORT

Jonas Prising
CEO
ManpowerGroup

Jean-Yves Charlier
CEO
VimpelCom

Arne Sorenson
CEO
Marriott International

T.V. Narendran
CEO
Tata Steel

Bob Dudley
CEO
BP

CONTENTS

1. INTRODUCTION TO THE
DIGITAL TRANSFORMATION INITIATIVE (DTI)

In a world where game-changing innovation has become the norm, the DTI provides a unique insight into the impact of technology on business and society over the next decade.

The past 12 months have brought a series of exciting technological breakthroughs. Self-driving Tesla cars can now be seen on the road; Uber is testing autonomous taxis in Pittsburgh; Google DeepMind's Alpha Go demonstrated a leap forward in artificial intelligence with a famous victory at the board game Go; and augmented reality hit the mainstream with the success of Pokémon Go. Game-changing innovation has become the norm.

Digital innovation is reshaping industries by disrupting existing business and operating models. But it is also having a profound impact on society, presenting a series of opportunities and challenges for businesses and policy-makers.

This executive summary introduces the approach taken to unlocking the value of digitalization. Over the past two years, the DTI has developed a unique value-at-stake framework to support a consistent way of measuring technology's impact on business and wider society. This is covered in the section on Unlocking Digital Value to Society: A New Framework for Growth.

The goal is for this framework to provide a base of evidence and a common language for public-private collaboration focused on ensuring that the benefits of digital transformation are fairly and widely shared.

Bruce Weinelt
Head of Digital Transformation,
World Economic Forum

Mark Knickrehm
Group Chief Executive,
Accenture Strategy

# THE **COMBINATORIAL EFFECTS** OF TECHNOLOGY ARE ACCELERATING CHANGE

The falling cost of advanced technologies is a defining characteristic of the digital revolution. It is playing a major role in accelerating innovation.

Cheaper and better technology is creating a more connected world: 8 billion devices are now connected to the internet; by 2030, that number is forecast to grow to 1 trillion.

As the cost of advanced technologies continues to fall, new applications will be opened for them, as well as opportunities to combine them in innovative ways. This unleashes "combinatorial" effects, where the capability of technologies working in tandem far exceed their capabilities when deployed separately.
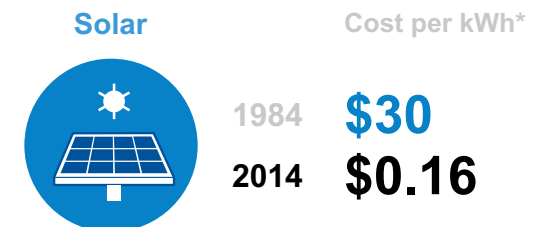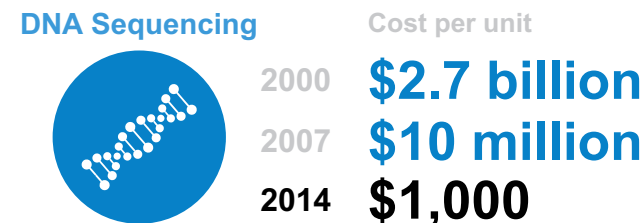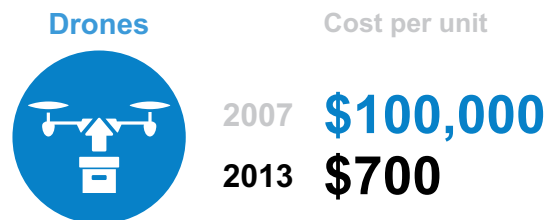
Take, for example, continuous liquid interface production (CLIP): it can produce isotropic parts with mechanical properties and surface finish similar to injection-moulded plastics. Carbon, a Technology Pioneer of the World Economic Forum, is using CLIP, the cloud and analytics in a platform-based business model to significantly advance what used to be a prototype technology into high-quality, scalable and low-cost manufacturing.

The combinatorial effects of base technologies, such as mobile, cloud, sensors, analytics and the Internet of Things (IoT), are accelerating progress exponentially. Technology is the multiplier.
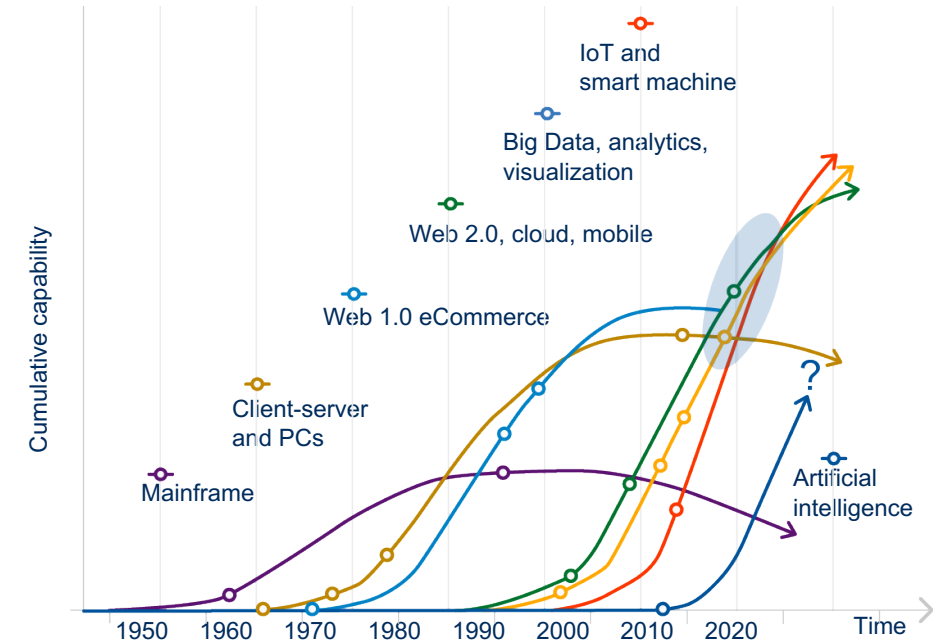
Source: World Economic Forum/Accenture analysis

Examples of the falling cost of key technologies

Drones — Cost per unit
2007 **$100,000**
2013 **$700**

DNA Sequencing — Cost per unit
2000 **$2.7 billion**
2007 **$10 million**
2014 **$1,000**

Solar — Cost per kWh*
1984 **$30**
2014 **$0.16**

* kilowatt hour

SEVEN TECHNOLOGIES ARE TRANSFORMING THE INDUSTRIES COVERED BY DTI RESEARCH

DTI research to date has identified seven key technologies that are expected to have the most impact among the industries analysed.

Note: This list is not comprehensive and does not include all the emerging technologies (e.g. blockchain) that were identified in only one or two use cases across DTI industries to date.
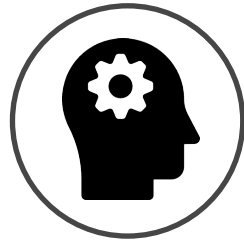
Artificial intelligence

Autonomous vehicles

Big data analytics and cloud

Custom manufacturing and 3D printing

Internet of Things (IoT) and connected devices

Robots and drones

Social media and platforms

NAVIGATING THE EXECUTIVE SUMMARY

The sections that follow offer a summary of the research into the impact of digitalization on industry and wider society.

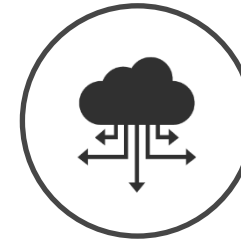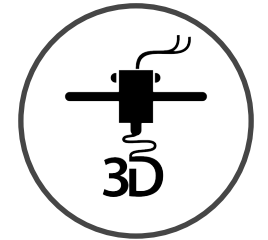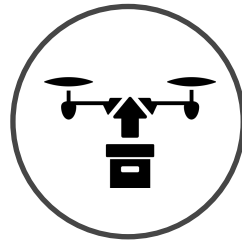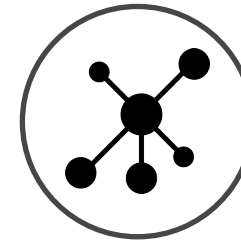Over the past two years, DTI research has focused on understanding the impact of digital transformation in 13 industries and drawing insights from the cross-industry themes that came out of that analysis.

In **section two** of this summary, five **cross-industry themes** are introduced. **Digital Consumption** explains how the rapidly changing expectations of digital customers are forcing enterprises to reinvent themselves. **Digital Enterprise** looks at how companies can respond by rethinking every aspect of their businesses. **Platform Economy** focuses on the immense impact of one type of digitally enabled business model – business-to-business (B2B) platforms. The adoption of new digital business and operating models is having a profound impact on society, a theme analysed in **Societal Implications**. A quantitative analysis of the impact of digitalization on business and wider society is then introduced in the final cross-industry theme, **Unlocking Digital Value to Society**.

In **section three**, in-depth **industry reviews are presented**. Thirteen industries were analysed: **Aviation, Travel and Tourism**; **Chemistry and Advanced Materials**; **Mining and Metals**; **Oil and Gas**; **Professional Services**; **Retail**; **Telecommunications**; **Automotive**; **Consumer**; **Electricity**; **Healthcare**; **Logistics**; and **Media**.

Finally, drawing on these cross-industry themes and industry reviews, **section four** proposes a set of **Opportunities to Improve the State of the World**.

13 Industry deep dives — Automotive, Logistics, Consumer, Electricity, Healthcare, Media, Aviation, Travel & Tourism, Professional Services, Telecommunications, Retail, Mining & Metals, Oil & Gas, Chemistry & Advanced Materials

5 Cross-industry themes — Digital Consumption, Digital Enterprise, Platform Economy (B2B), Societal Implications, Societal Value & Policy Imperatives

2.
Cross-Industry
Themes

DIGITAL CONSUMPTION: THREE BATTLEGROUNDS FOR THE DIGITAL CUSTOMER

Enterprises need to constantly reinvent their offerings to keep up with the rapidly evolving expectations of digital customers.

Click to download White Paper

Products and services to experiences

Offering products and services is no longer enough: successful companies will be the ones focused on delivering the most compelling experiences. In fact, 56% of business leaders believe that customer experience is their top digital transformation priority.

Selected case studies: amazonbusiness Disney *(Magic Bands)*

Hyper-personalization

Customers expect and value increasingly personalized interactions at all points of their journey, and digital technology is enabling companies to deliver personalization economically at scale. The challenge companies face, however, is to understand how much personalization customers want, as 90% of consumers say they would limit access to certain types of personal data.

shopkick ★macy's Ginger.io

Ownership to access

Enabled by digital platforms, customers are substituting ownership of goods with access-based models. The global market for shared goods and services across five key sectors is expected to grow to $335 billion by 2025. Companies should evaluate opportunities to cater to customer preferences for access-based models, before competitors or start-ups sweep in.

moovel DriveNow

DIGITAL CONSUMPTION:
PRODUCTS AND SERVICES TO EXPERIENCES

Companies are recognizing that digital customers increasingly demand high-quality experiences and guaranteed outcomes, rather than just products and services. This development is leading to new, outcome-based business models.

A Focus on Outcomes

AUTOMOTIVE
The connected car is enabling outcome-oriented experiences, such as personalized apps to help electric-car drivers minimize their electricity bills.

BANKING
Self-checking, greater security, predictive services to enhance wealth creation, and payment platforms are likely to be key emerging themes in personal finance.

CONNECTED HOMES
Managing energy, shopping, security, environment, entertainment, our diaries and budgeting are all becoming possible with new advances in the connected home.

EDUCATION
Personalized, automated learning services will help deliver a tailored, individual approach based on unique needs, with the ability to monitor how much a student has learnt more effectively.

HEALTHCARE
Digital is expected to have a profound impact on health and wellness, enabling a shift from population-based diagnostics and prescriptions to those centred on individuals.

RETAIL
Personalized services and more interactive in-store digital experiences could help companies provide a more integrated approach to managing customer journeys.

Why outcomes matter

The low cost and easy availability of connected sensors, coupled with breakthroughs in data analytics, have enabled outcome-based services to become a reality. In many instances, companies are using digital technologies to identify and target the outcomes that customers care about, giving them powerful tools to improve customer satisfaction and enhance customer lives.

This trend becomes highly relevant in today's world where customers tend to adopt products and services that deliver real value to them, but also use these experiences to define their expectations across all other industries.

DIGITAL CONSUMPTION:
HYPER-PERSONALIZATION

Customers increasingly expected relevant, personalized interactions through every engagement channel. Advances in AI and other technologies are opening up new possibilities for hyper-personalization.

The hyper-personalization spectrum

Digitalization has enabled two main forms of hyper-personalization:

	1 GIVING CUSTOMERS CONTROL TO CUSTOMIZE THEIR PRODUCT / EXPERIENCE	**2** PROVIDING MORE RELEVANT INTERACTIONS BY ANALYZING CUSTOMER DATA
EXAMPLES	*Brooks Brothers* — Create your own suit **NIKEiD.** — Customized shoes *Coca-Cola freestyle* — 100+ drink choices and customization options	**shopkick** — Personalized in-store shopping recommendations **Ginger.io** — Mobile app using machine learning to monitor mental-health patients **beatsMUSIC** — Music tailored in real time to mood and location
IMPLICATIONS	• Lower requirement for access to customer data • Requires more direct engagement from the customer (opt-in) at point of sale • Robust and agile supply chains to provide convenience and choice	• Requires (repeat) access to customer data • Usage data can be captured without direct customer intervention • Analytical capabilities to tailor personalized offers and services

DIGITAL CONSUMPTION:
OWNERSHIP TO ACCESS

The concept of ownership to access has emerged across a wide set of markets

A preference for access rather than ownership is now mainstream, with more than 110 million people in North America already participating in the collaborative economy. This shift towards access-based consumption patterns holds important implications for businesses, especially for traditional revenue models.

Ownership to access can also generate value for society. It does so by creating an economic system of marketplaces and platforms that unlock the value of underused assets and improve resource efficiency.

COHEALO

Cohealo, a US-based technology company, allows hospitals to share equipment, reducing the need to buy assets and boosting utilization rates. Cohealo says that its service has saved hospitals $1 million to $2 million each.

Which sectors are most likely to be disrupted by access-based models (grouped by net asset value)?

Factors determining the extent of access-based business models include:

Net asset value	Underutilized capacity	Shareability quotient	Regulatory environment
High			
Accommodation			airbnb
Automotive			DriveNow
Construction			YARDCLUB
Luxury Apparel			RENTTHERUNWAY
Medical Equipment			COHEALO
Medium			
Energy			vandebron
Sports Equipment			The QUIVER
Low			
Personal Care Products			DOLLAR SHAVE CLUB SHAVE TIME. SHAVE MONEY.
Food and Beverage			Bon Appetit

Aireen Omar
Chief Executive Officer,
AirAsia, Malaysia

"Do not reinvent the wheel. Partner with experts who have a competitive edge – a team effort across industry is necessary."

DIGITAL ENTERPRISE: HOW TO SURVIVE DISRUPTION AND THRIVE IN THE DIGITAL AGE

Disruption may not be bankrupting incumbents, but to succeed in the digital era, they will need to become digital enterprises, rethinking every aspect of their business.

Digital business models

Companies need to fundamentally change the way they identify, develop and launch new business ventures. A recent study forecast that 30% of industry revenues will come from new business models by 2020.

Digital operating models

Digital leaders follow a lean approach to both core and support functions. With this in mind, 90% of companies have significantly adjusted operations in the past two years.

Digital talent and skills

To attract, retain and develop talent, enterprises will need to embrace cultural change, focus on recruiting millennials and adapt to new ways of working. Companies need to prepare for greater automation, with 81% of managers believing that machines will make workers more effective.

Digital metrics for success

Traditional key performance indicators are no longer effective at measuring the performance of a business in the digital age. Leading enterprises track the metrics that matter, and react to them in real time. Companies that understand digital transformation earn 26% more profit than others.

Selected case studies:

(intel) · CISCO · GE · mi · glassdoor · P&G · focus@will · GENERAL ATLANTIC

DIGITAL ENTERPRISE:
DIGITAL BUSINESS MODELS

Companies can choose from several options when implementing a digital business model. The following factors are likely to determine the path selected.

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Traditional approaches

Build
Might be the best route:

- When the opportunity is related to the company's core business
- If there is still time until the market's inflection point
- If the company can hire the necessary talent

Buy
Usually most appropriate:

- When it is strategically imperative to "own" a market
- If the market inflection point is close, and hiring the right talent is not possible
- If the new opportunity bears little relation to the company's current business model

Partner
When there is no strategic need to own:

- Learn more from a "digital native" about the market and the partner's model
- Useful when deeper partnerships or future acquisitions are required

Additional approaches

Invest

- Allows an established company to connect with the right skills and capabilities
- Avoids hindering entrepreneurial forces with a set-up focused on internal governance and reporting, which would undermine the start-up's agility
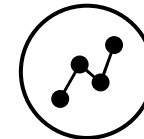
Incubate/Accelerate

- Allows for a close relationship to the funding company, enabling internal capabilities, infrastructure and resources to be deployed to help the start-up
- Benefits companies via increased deal flow in business models and technologies

Source: World Economic Forum/Accenture Analysis

DIGITAL ENTERPRISE:
DIGITAL OPERATING MODELS

Digital disruption is encouraging companies to re-examine their operating models. DTI research has identified five operating models for the digital age.

	ORGANIIZATION	PROCESS	PEOPLE	CULTURE	KPI
CUSTOMER-CENTRIC Makes customer lives easier and emphasizes front-office processes.	Decentralized	Front Office	Front-line empowerment	Client first	Net present value
EXTRA FRUGAL Thrives on a 'less is more' culture and a standardized organizational structure.	Standardized	Supply and manufacturing; support functions	Process optimization	Less is more	Cost
DATA-POWERED Builds intelligence around prowess in analytics and software intelligence.	Centre of excellence / hub and spoke	Supported by deep analytics capabilities	Agile test and learn	Serendipity	Return on investment
SKYNET Uses machines intensively to increase productivity and flexibility in production.	Standardized	Manufacturing	Automation	'Engineer'	Full-time employee ratio
OPEN AND LIQUID Creates an ecosystem built around the 'sharing customer'.	Local	Constant dialogue with outside world	Collaboration / crowdsourcing	Sharing	Net present value

DIGITAL ENTERPRISE:
DIGITAL TALENT AND SKILLS

To stay relevant, companies should consider how their talent requirements need to evolve, to meet the skills and workforce challenges created by rapid digitalization.

Attract, retain and develop talent

- Be a great place to work for millennials. Formulate a multi-year engagement strategy. Empower and incentivize the workforce through development opportunities.

- Create a workforce with digital skills. Whether it's developing training programs to obtain necessary skills or hiring digital natives, companies need to be aware of where talent is headed and how they can help.

Bring leadership into the digital age

- Leaders should hire people with digital mindsets and a willingness to change the status quo. Accept failure, and move away from the risk-averse mindset. Finally, embrace flatter structures and move away from hierarchies.

- Foster a digital culture from the top through communication, journey management, visible changes, and continuous change monitoring.

Adapt to different ways of working

- Create environments where humans and robots can work together successfully. Evaluate the value of automation, establish the extent to which automation will form the core of your business, and invest in developing internal automation capabilities.

- Prepare for the rise of the on-demand workforce but ensure that there is enough of a balance to maintain corporate culture.

The skills crunch

81% say they are looking for a wider mix of skills when hiring

73% of CEOs cite skills shortages as a threat to their businesses
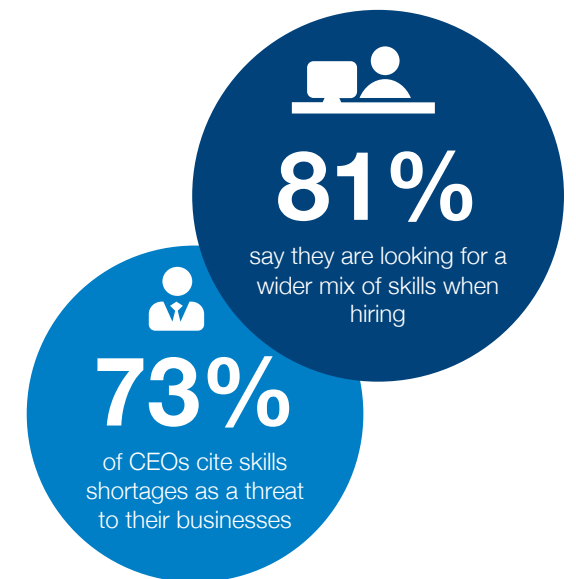
Source: PwC, People Strategy for the Digital Age

DIGITAL ENTERPRISE:
DIGITAL METRICS FOR SUCCESS

Many companies have discovered that traditional financial key performance indicators (KPIs) are no longer effective at measuring the success of a business. Digital traction metrics provide invaluable insights that complement financial reporting.

DIGITAL TRACTION

=

SCALE	X	ACTIVE USAGE	X	ENGAGEMENT

SCALE	**ACTIVE USAGE**	**ENGAGEMENT**
• Unique visitors • Number of visitors • Number of registered users • MOM (month-on-month) growth in registrations • Organic user acquisition	• Number of active users • Monthly active users (MAU) • Ratio of new users to repeat users / customers • Conversion rate • Abandon rates	• Time on site • Net Promoter Score (NPS) • Customer satisfaction index • Downloads • Cohort retention on metrics that matter for that business • Bounce rate • Sources of traffic • Customer concentration risk • Churn / exit rate • Posts contributed • Photos / videos uploaded and shared, and views completed • Number of likes and shares

Why is digital traction important?

Being able to measure digital traction – and find ways to boost it – is important for both digital disruptors and established businesses for two key reasons.

1. In some scenarios, strong digital traction (e.g. a high NPS) means that the cost of marketing falls to zero and, in the case of a peer-to-peer business model, service costs could also approach zero.

2. Strong digital traction can boost company valuations as digital enterprises have more scalable, highly engaged customers than traditional companies. In a down market, these scale effects become more pronounced in investor valuations.

PLATFORM ECONOMY: DIGITAL B2B PLATFORMS ENABLE THE FOURTH INDUSTRIAL REVOLUTION

In a platform-driven world, enterprises and policy-makers need to collaborate on new initiatives to unlock the potential of B2B platforms to deliver value for society.

Driving transformed business models

Interactions drive scale through network effects in digital B2B platform business models. Emergent innovation and outcome-based strategies across platform participants support these models.

Helping ecosystems expand

Digital B2B platforms are blurring industry lines and reshaping industries into complex, interconnected systems. In a survey of 2,000 business and information technology executives, 81% believe industry boundaries will become dramatically less distinct.

Creating a win-win for industry and society

Platform-driven interactions are expected to enable approximately two-thirds of the $100 trillion value at stake from digitalization by 2025. In contrast to other technologies, society is expected to gain as much as industry through digital B2B platforms.

Incumbents and disruptors are creating new platform business models across industries and geographies:

GE   PHILIPS Healthcare   GM   OPEN»PORT   rippleLabs

amazon   upwork™   Alibaba Group   #slack

NEW STRATEGIES AND OPERATIONAL CAPABILITIES FOR **SUCCESS IN THE PLATFORM ECONOMY**

Platform strategies shape **operational capabilities** to deliver desired outcomes within a platform ecosystem.

- The traditional pricing approach will progress to outcome-based **rewards sharing** across ecosystem participants

- Performance monitoring will need to transition to relevant **new digital metrics** (e.g. interactions) from traditional ones (e.g. customer conversions)

New digital metrics

Effective collaboration

Ecosystem governance

Reward sharing

New business models

ECOSYSTEM ACTIVATION

STRATEGIES FOR A PLATFORM WORLD

Ecosystem role

Value proposition

VISION AND AMBITION

Platform-driven innovation

ACCELERATING OPEN INNOVATION

Platform talent

Sponsorship

Organization alignment

TALENT AND BEYOND

Data capabilities

Foundational platform technologies

DATA AND TECHNICAL ELEMENTS

Emerging technologies

Strategic ← ENTERPRISE CAPABILITIES → **Operational**

- To unlock value, existing organizational structures must adjust by adopting a "**platform mindset**"

- Enterprises will need to foster a "**collaboration-first**" **culture** to cooperate both internally (across different business units) and externally (with other enterprises and policy-makers)

SOCIETAL IMPLICATIONS: THREE MAJOR IMPACTS OF DIGITAL TRANSFORMATION

Digital transformation is generating a fierce debate among policy-makers, economists and industry leaders about its societal impact.

Employment

Current estimates of global job losses due to digitalization range widely, from 2 million to as high as 2 billion by 2030. This analysis suggests that digitalization can be a net job creator in some industries. But, with both winners and losers resulting from digital transformation, a huge premium rests on the near-term ability of businesses to upskill employees and shape the next generation of talent.

Sustainability

It has not yet been possible to decouple economic growth from an increase in emissions and use of resources. Current business practices will contribute to a global gap of 8 billion metric tons between the supply of and demand for natural resources by 2030, translating to $4.5 trillion of lost economic growth. The analysis suggests that digitalization could make a positive contribution to this challenge.

Trust

Social media, user-generated websites and other innovations have been instrumental in increasing transparency and overcoming information asymmetries. However, trust in all technology-based sectors declined in 2015. Beyond privacy and security concerns, broader ethical questions about the way organizations use digital technology threaten to erode trust in those institutions.

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INTRODUCING **VALUE AT STAKE** AND **DIGITAL** VALUE TO SOCIETY (DVS)

The DTI value-at-stake framework and DVS metric developed here offer a distinctive approach to understanding – and unlocking – the value of digitalization for business and society.

Value at stake

The value-at-stake analysis assesses the impact of digital initiatives on industries, customers, society and the environment over the next decade (2016 to 2025). Over the past two years, more than 130 digital initiatives covering innovations as diverse as driverless cars, predictive analytics, remote healthcare and drones have been analysed.

Notes on methodology: Value at stake integrates all segments of an industry's value chain, capturing about 80% of revenues and profits. It considers the total addressable market and adoption/penetration rates over the next 10 years, and is based on research, industry reports, existing use cases and interviews with experts. Value-driver trees are used to assess key drivers against areas of impact for industry and society.

Digital value to society (DVS)

A new framework, digital value to society (DVS), was created by aggregating the key performance indicators that relate to the impact of digitalization on health and safety, employment, the environment and customers. The graphic on the right illustrates how DVS maps to value at stake.

Value at stake and DVS are intended to provide an evidence-based framework to encourage collaboration between enterprises and policy-makers, and to unlock the societal benefits of digitalization.

The components of value at stake and DVS

Example metrics

DVS

	Example metrics
Society and Environment	• Lives saved • Carbon emissions • Life expectancy
Consumer Benefits	• Time savings • Cost saving on consumption
Labour	• Net job creation • Median income growth • Income disparity
Industry	• Value addition (from new products / services) • Value migration (from shifting profit pools)

VALUE AT STAKE
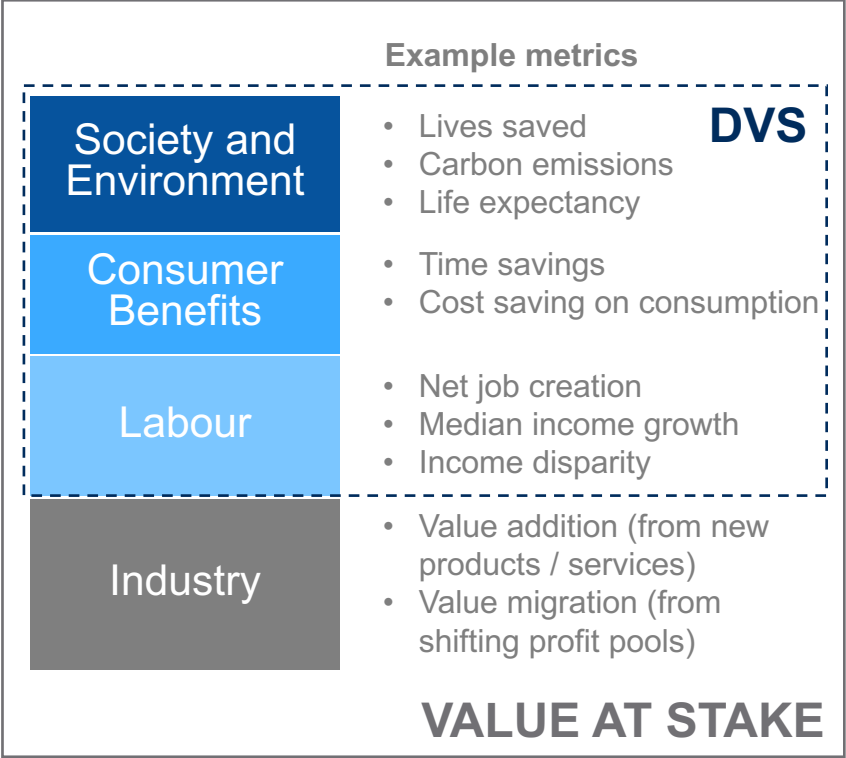
UNLOCKING DIGITAL VALUE TO SOCIETY: A NEW FRAMEWORK FOR PUBLIC-PRIVATE COLLABORATION

WORLD ECONOMIC FORUM

This distinctive economic framework helps business leaders, regulators and policy-makers to unlock the estimated $100 trillion of value that digitalization could generate over the next decade.

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ILLUSTRATIVE
(tailored to each industry)

VALUE IMPACT OF DIGITAL TRANSFORMATION

INDUSTRY IMPACT

Value Migration and Value Addition

Free Cash Flows/Operating Margins

Value Drivers
Revenues
Costs
Allocated Capital

SOCIETAL IMPACT

Society and Environment

Consumer Benefits

Labour

Value Drivers

CO_2 Emissions
Lives Saved/Security
Cost Savings
Time Savings
Net Job Creation
Injuries/Accidents Avoided

- The **economic framework** developed aims to quantify the impact of digital transformation on industry and broader society.
- The framework is **new and will be iterated further over the next year**, but it can already be applied at all levels of government and business, helping stakeholders to make the right decisions to deliver the full potential of digital transformation.

- It provides a **consistent base of evidence and set of definitions for digital concepts,** supporting a global, multistakeholder dialogue about digitalization and its implications.
- **Proof of concept** of the framework for 11 industries was achieved and its application successfully piloted on a national/state level (in the United Kingdom, Denmark, India, and the Indian state of Telangana).
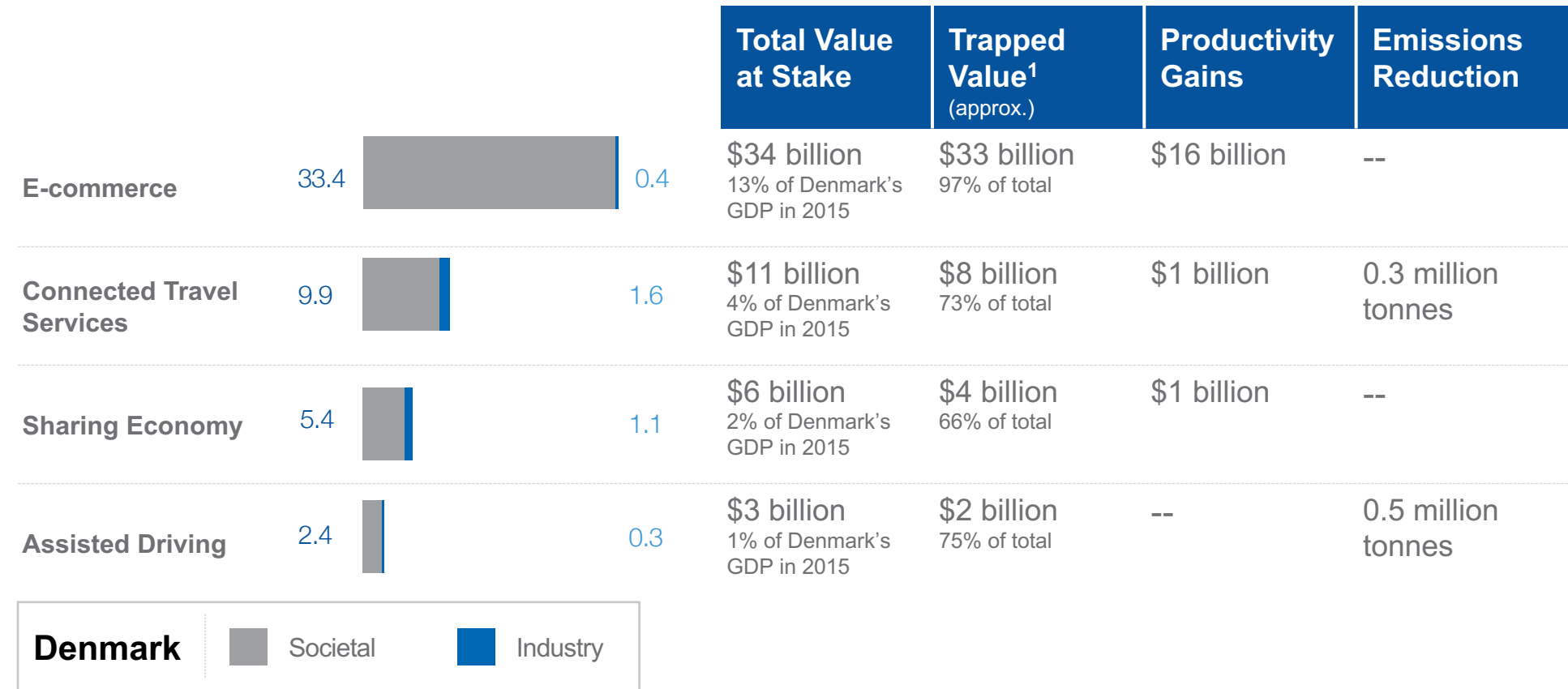
FOCUS ON DIGITAL DENMARK: **UNLOCKING MORE THAN $50 BILLION** OF VALUE OVER THE NEXT DECADE

Work has started with the Danish Ministry of Business and Digitization Council to identify and prioritize initiatives across major industry systems, including manufacturing, health, mobility, electricity and e-commerce.

The next step is to capitalize on public-private collaboration to unlock the trapped value of digital transformation, a focus for DTI in 2017.

Value at stake from digital transformation initiatives in Denmark (cumulative 2016-2025)

Initiatives are in the process of being assessed against converging industry systems

			Total Value at Stake	Trapped Value[1] (approx.)	Productivity Gains	Emissions Reduction
E-commerce	33.4	0.4	$34 billion 13% of Denmark's GDP in 2015	$33 billion 97% of total	$16 billion	--
Connected Travel Services	9.9	1.6	$11 billion 4% of Denmark's GDP in 2015	$8 billion 73% of total	$1 billion	0.3 million tonnes
Sharing Economy	5.4	1.1	$6 billion 2% of Denmark's GDP in 2015	$4 billion 66% of total	$1 billion	--
Assisted Driving	2.4	0.3	$3 billion 1% of Denmark's GDP in 2015	$2 billion 75% of total	--	0.5 million tonnes

Denmark   ▮ Societal   ▮ Industry

[1] Trapped value is the difference between societal value and business value, where societal value is greater than business value. It does not reflect any multiplier effects to either society or business, which are a factor of individual initiatives within each industry and market.

3.

In-Depth Industry Reviews: Key Insights

AVIATION, TRAVEL AND TOURISM:
DIGITAL THEMES AND INITIATIVES

The industry has been at the forefront of digital disruption in recent years, changing the way people travel. However, the sector should brace itself for another wave of digital transformation.

Living Travel Experience

Travellers will experience seamless journeys tailored to their habits and preferences, and travel will blend seamlessly with other everyday activities. Important initiatives are *Travel Centricity*, *Seamless Customer Journey* and *End-to-End Propositions*

Case studies:

Enabling Travel Ecosystem

Digital platforms enabling ecosystem alliances will continue to emerge, as asset- and information-sharing become increasingly important from a B2B perspective. Key initiatives are *Ecosystem Convergence*, *Battle for Customer Mindshare* and *Diffusion of Ownership*.

Digital Enterprise

Innovations such as 3D printing, artificial intelligence, IoT, virtual reality and digital platforms will transform operations and the workforce. Key initiatives include *Smart Manufacturing*, *Intelligent Assets* and *Next Generation Workforce*.

Safety and Security

As identity management transitions to digital, a collaborative effort to boost cybersecurity and protect traveller data privacy will be crucial to maintain customer trust and public safety. Major initiatives are *Data Dilemma*, *Modern Security Environment* and *Ubiquitous Tourist Safety*.

AVIATION, TRAVEL AND TOURISM:
UNLOCKING VALUE

The digitalization of aviation, travel and tourism could unlock $1 trillion of value for the industry and society over the next decade. Societal benefits include cost and time savings for consumers and reduced environmental footprints.

AVIATION, TRAVEL AND TOURISM:
Value at stake for industry and wider society, by digital theme (cumulative 2016-2025)

	Potential Business Impact ($ billion)		Potential Societal Impact ($ billion)	Total Value at Stake ($ billion)	Emissions Reduction (million tonnes CO$_2$)	Net Impact on Jobs (000s)
Living Travel Experiences	100		165	265	--	270
Enabling Travel Ecosystem	105		380	485	107	(940)
Digital Enterprise	190		20	210	143	(100)
Safety and Security	10		140	150	--	(10)
Total	405		705	1,110	250	(780)

Unlocking Societal Value: End-to-End Propositions

End-to-end propositions are starting to overhaul traditional methods of booking elements of a journey separately. Fully integrated and personalized travel experiences can be booked more quickly and easily. It could even be possible to create a push model for booking travel, where travellers are sent a proposition, based on events in their calendar and past travel preferences, before even starting to search for airfares or accommodation. All operational tasks would be handled in a smart machine-learning environment, with feedback loops continuously improving the service.

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CHEMISTRY AND ADVANCED MATERIALS:
DIGITAL THEMES AND INITIATIVES

The industry's contributions allow other sectors to turn innovations into sophisticated products that enable digitalization. Three themes are central to the sector's own efforts to capture the value of digital transformation.

Digitalize the Enterprise

Advanced digital technologies, such as the Industrial Internet of Things, automation, analytics and artificial intelligence, will take core operational functions to the next level (e.g. research and development [R&D], manufacturing and supply chain), and will augment workforce capabilities. Key initiatives are *Digital R&D*, *Digital Supply Chain*, *Digital Plant* and *Augmented Workforce*.

Case studies:

zymergen   syngenta

Go Beyond the Molecule

Digitalization presents the industry with opportunities to launch new digitally enabled offerings, create outcome-oriented business models and improve customer interaction. Major initiatives are *Digitally Enabled Offerings and Business Models*, *Advanced Customer Interaction*, and *Accelerated Circular Economy*.

carbon3D   AkzoNobel

Collaborate in Ecosystems

Accelerated innovation cycles will drive the industry to build flexible and interconnected innovation ecosystems. Intense collaboration and data sharing along the value chain will help to better address customer requirements and manage volatility. Key initiatives include *Innovation Ecosystem* and *Value Chain Collaboration*.

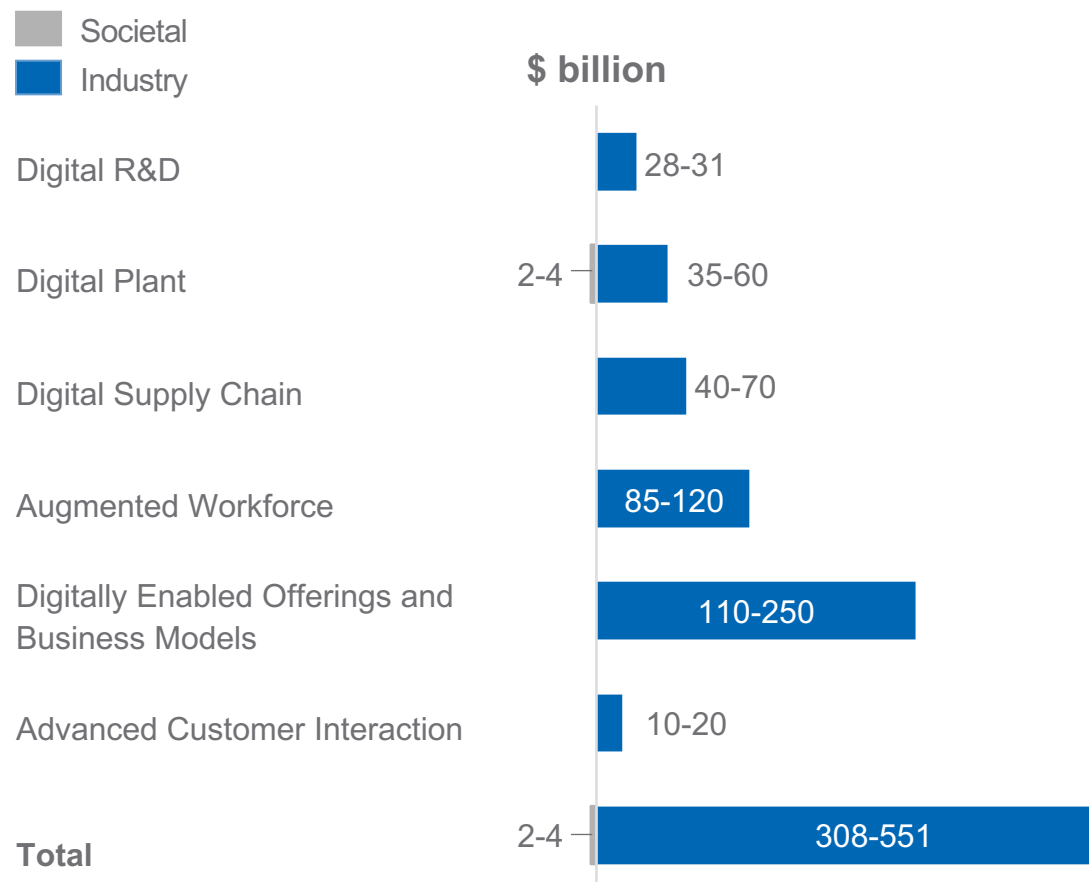BASF

CHEMISTRY AND ADVANCED MATERIALS:
UNLOCKING VALUE

Digitalization could unlock about $550 billion of value for the industry and wider society over the next decade. Positive societal impacts include reduced emissions and lower injury rates in the industry workforce. However, these were the smallest societal gains from the industries analysed.

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CHEMISTRY AND ADVANCED MATERIALS:
Value at stake for industry and wider society, by digital initiative (cumulative 2016-2025)

Societal
Industry

$ billion

Initiative	
Digital R&D	28-31
Digital Plant	2-4 / 35-60
Digital Supply Chain	40-70
Augmented Workforce	85-120
Digitally Enabled Offerings and Business Models	110-250
Advanced Customer Interaction	10-20
Total	2-4 / 308-551

Unlocking Societal Value:
Digital Plant

Further digitalizing assets and equipment with, for example, smarter sensors, allows companies to monitor asset condition and continuously process quality, throughput and emissions. Assets can send signals on their status and performance which, in combination with real-time analytics and in-memory computing, enable immediate intervention to prevent equipment failures and breakdowns. Combining real-time asset condition information with predictive analytics allows companies to predict the likelihood of asset failures and plan maintenance accordingly. This initiative can generate significant societal benefits, including reducing CO_2 emissions by up to 100 million tonnes.

MINING AND METALS:
DIGITAL THEMES AND INITIATIVES

The industry is embracing the opportunities of digital transformation and facing up to its challenges. Four themes will help players to capture value for the industry and wider society.

Automation, Robotics and Operational Hardware

Digitally enabled hardware tools are going to perform or improve activities traditionally carried out manually or with human-controlled machinery. Major initiatives include *Autonomous Operations and Robotics*, *3D Printing* and *Smart Sensors*.

Case studies:

RioTinto   AngloAmerican

Digitally Enabled Workforce

Connected mobility, as well as virtual and augmented reality, can empower field, remote and centralized workers in real time. Key initiatives are *Connected Worker* and *Remote Operations Centre*.

DAQRI   TATA STEEL

Integrated Enterprise, Platforms and Ecosystems

This theme concerns linking operations, IT layers, and devices or systems that are currently separate. Important initiatives are *IT/OT Convergence*, *Asset Cybersecurity* and *Integrated Sourcing, Data Exchange, Commerce*.

Schneider Electric   Teck

Next-Generation Analytics and Decision Support

Algorithms and artificial intelligence can process data from sources within and beyond the traditional value chain to provide real-time decision support and future projections. Key initiatives are *Advanced Analytics and Simulation Modelling* and *Artificial Intelligence*.

GOLDCORP   Mira Geoscience *...modelling the earth*

MINING AND METALS:
UNLOCKING VALUE

Digitalization could unlock more than $400 billion of value in industry and societal benefits, which include lives saved, fewer injuries and lower emissions.

MINING AND METALS:
Value at stake for industry and wider society, by digital initiative (cumulative 2016-2025)

	Potential Business Impact ($ billion)	Potential Societal Impact ($ billion)	Total Value at Stake ($ billion)	Emissions Reduction (million tonnes CO_2)	Net Impact on Jobs (000s)
Smart Sensors	34	8	42	161	(40)
Autonomous Operations & Robotics	56	19	75	396	(60)
3D Printing	--	3	3	35	--
Connected Worker	85	--	85	--	(201)
Remote Operations Centre	77	7	84	16	(12)
Asset Cybersecurity	21	--	21	--	--
Integrated Platforms	37	69	106	--	(5)
Advanced Analytics	11	--	11	--	(13)
Total	**321**	**106**	**427**	**608**	**(330)**

Unlocking Societal Value: Connected Worker

Connected worker technologies have numerous applications in the industry. For instance, equipping workers with connected, intelligent wearables and mobile devices allows mine and plant management to capture critical information in real time. This also enables seamless communication; immediate, remote expert assistance, diagnosis and real-time guidance; and "follow-complete-document" workflows that can be carried out directly in the field. Through better tracking of individuals, especially in dangerous events, it is estimated that up to 500 lives could be saved and more than 20,000 injuries prevented over the next decade.

Duncan Wanblad
Chief Executive Officer,
Base Metals and
Minerals, Anglo
American, South Africa

"Our ageing workers
know the mines and our
young guys know
digital. When we have
been able to have
a cohesive cross-
generational team,
it has been stellar."

OIL AND GAS:
DIGITAL THEMES AND INITIATIVES

The industry has a chance to move from incremental, digitally driven operational improvements to a broader embrace of digital technologies. Four themes will play a leading role in this transformation.

Digital Asset Life Cycle Management

Connecting end-to-end operations across the value stream can ensure that all systems, equipment, sensors and data are communicating and learning from actions. This will lead to increasing efficiency, productivity and compliance with health, safety and environmental standards. Key initiatives are *New Era of Automation*, *Advanced Analytics and Modelling* and *Connected Worker*.

Case studies:

Circular Collaborative Ecosystem

Digitalization will help with advanced and innovative collaboration models between producers, suppliers and society, as well as making operations transparent and driving out inefficient practices. Major initiatives are *3D Printing* and *Blockchain / Smart Contracts*.

Beyond the Barrel

Digital technologies open new avenues for customer engagement and provide additional services that help create new and innovative business models. Important initiatives are *Digital Customer Services* and *Omnichannel Retail and Experience-based Services.*

Energizing New Energies

Digitalization promotes new energy sources and carriers, and innovative models for the optimization and marketing of energy. The Oil and Gas industry must understand the full impact of this, and stay connected with millennials. Key initiatives include *Consumer Energy Choices.*

Columbia Pipeline Group — Schlumberger — MERCURIA — Shell — KWIK CHEK — Yoshi — TESLA — vandebron

OIL AND GAS:
UNLOCKING VALUE

Digitalization could unlock up to $2.5 trillion of industry and societal value. Societal benefits include reduced emissions and $170 billion in cost savings for customers.

OIL AND GAS:
Value at stake for industry and wider society, by digital theme (cumulative 2016-2025)

	Potential Business Impact ($ billion)	Potential Societal Impact ($ billion)	Total Value at Stake ($ billion)	Emissions Reduction (million tonnes of CO_2e)	Net Impact on Jobs (000s)
Digital Asset Life Cycle Management	745	110	855	370	(114)
Circular Collaborative Ecosystem	30	0.5	31	2	--
Beyond the Barrel	100	27	126	12	21
Energizing New Energies	70	500	570	900	35
Total	945	637	1,582	1,284	(57)

Unlocking Societal Value: Consumer Energy Choices

The shift to new energy sources could reduce CO_2e emissions by 900 million tonnes. This initiative could also add about 35,000 jobs, as generation from renewables, rather than fossil fuels, tends to be more people-intensive. Several super majors are already taking steps to mitigate this trend's impact on their businesses by investing in green or alternative energy (but this has been excluded from our value-at-stake analysis).

PROFESSIONAL SERVICES:
DIGITAL THEMES AND INITIATIVES

Disruptive technologies are fundamentally changing the economics of Professional Services. Four themes will be central to capturing digital value for the industry and wider society.

Business Model Transformation

Digitalization empowers firms to change every facet of how they go to market, including their services, value proposition, target customers and prices. Key initiatives are *Enhancing Go-to-Market Strategy* and *Fostering a Digital Environment*.

Case studies:

KPMG   BCG

Intelligent Automation

Emerging technologies such as blockchain, artificial intelligence and deep learning are augmenting professionals' abilities to "do", "think", "learn" and "feel". Major initiatives include *Modularizing Work* and *Augmenting Human Intelligence*.

McKinsey&Company

KENSHO

Digital Agility

Companies with an agile work culture and smart infrastructure can react quickly and adapt strategies and processes to disruptive events. Important initiatives are *Developing a Flexible Workforce, Nurturing an Agile Culture* and *Investing in Smart Infrastructure*.

pwc   eden mccallum

Talent Empowerment

In a digitalized world, there is a need to reimagine what it means to be an employee and revisit the employee value proposition for the workforce. Key initiatives include *Reimagining Hiring, Training Talent* and *Designing the Employee Experience*.

entelo

glassdoor

Expertise is the primary product of Professional Services. Machines are augmenting key human capabilities so that expertise can be provided to clients more efficiently, using combinations of humans and machines.

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TECHNOLOGIES ARE AUGMENTING PROFESSIONALS' ABILITIES TO "DO", "THINK", "LEARN" AND "FEEL"

THINK

Insight Generation
Kensho

Creativity
Project Dreamcatcher, Rembrandt

Cognition
Watson, DeepMind

Memory
Robo Brain

LEARN

Note: The degree to which human capabilities are being augmented by technology is indicated by the ideograms next to each capability.

DO

Communication
Quill (Narrative Science), Amelia

Presentation
BeamPro, Magic Leap

Organization
Amy Ingram (x.ai)

FEEL

Relationship Building
Crystal, LinkedIn

Empathy
Pepper

Instinct
Uniquely human

Appearance
Sophia

RETAIL:
DIGITAL THEMES AND INITIATIVES

Technology will transform retail's end-to-end value chain. The level of change in the next 10 years will far surpass what has been seen in the past 40 years.

Maintain Engagement with the Empowered Customer

Empowered consumers demand to be actively involved at every stage of their decision-making journey and expect increasing levels of choice, control and convenience.

Rapidly Adopt Disruptive Technologies

Eight emerging technologies* will be particularly disruptive over the next decade. Though the pace of their development will vary, all will impact the value chain, and rapid adoption will be critical.
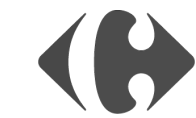
Evolve Business Models and Key Capabilities

Emerging business models will fundamentally alter the retail landscape, impacting subcategories to varying degrees. The right capabilities will be needed to compete in this evolving environment.

Manage Societal Impacts

Transformation in the retail sector has implications for labour, the environment and local communities, which will need to be managed.

Case studies:

BONOBOS

Carrefour   amazon go

REBECCA MINKOFF   Mall of the Emirates

amazon   GLAMSQUAD

* The eight technologies are the IoT, autonomous vehicles/drones, robotics, 3D printing, artificial intelligence (AI), augmented reality / virtual reality, digital traceability and blockchain.

RETAIL:
FRAMEWORK FOR ANALYSING TRANSFORMATION

Future of Retail for Consumer Industries

4 — Societal Impacts
1 — Empowered Consumer
2 — Disruptive Technologies
3 — Business Models and Key Capabilities

■ Direct Impact
▨ Indirect Impact
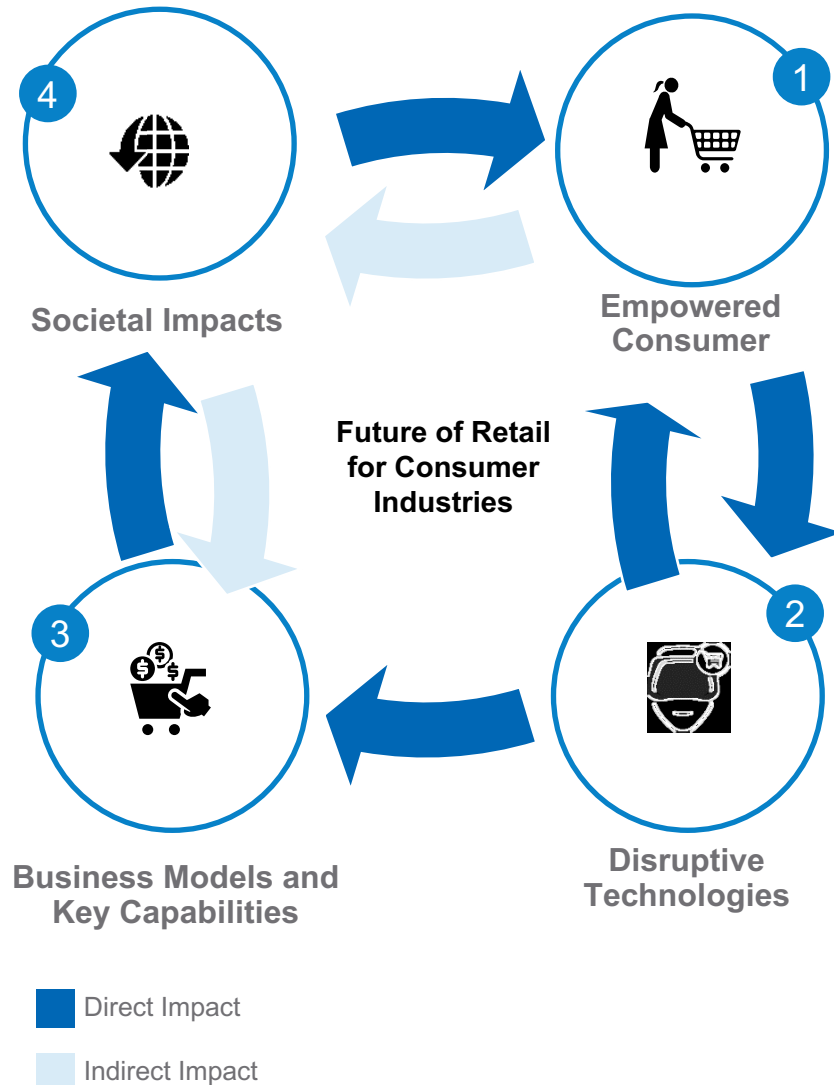
Empowered Consumers
- The consumer equation of **Cost + Choice + Convenience** is becoming more complex thanks to the additional dimensions of **Control + Experience**.
- Incumbents must **open up their value chain to consumers**, enabling them to participate and control a greater span of their experience.

Disruptive Technologies
- Based on their widespread application, resulting efficiencies and impact on labour, **AI / machine learning, autonomous vehicles / drones, IoT** and **robotics** will be the four **most transformational technologies** to the industry (among the eight assessed).

Transformative Business Models
- If current year-on-year growth is sustained, **e-commerce could reach penetration rates of more than 40%** in 2026 (in digitally developed markets), which will drive **$600 billion in value for business**.
- Four key business models will proliferate: Sharing Economy, Smart Replenishment, Curated Subscription, and Do It for Me. **Sharing Economy** will drive the highest value at stake, with **$1.7 trillion of value for society**.

Key Capabilities
- Intra- and extra-industry **partnerships** will be critical for developing ecosystems to remain competitive in the future.
- **Last-mile delivery** infrastructure currently comprises **25% of the total cost of delivery** and must become more efficient.

Societal Impacts
- **Public-private partnerships** will be critical for managing the impacts on the workforce, the environment and local communities.

Noreena Hertz
Author and Visiting Professor, University College London

"They (13-21 year olds, a generation I call generation K) do not know any different. This is their world – this digital ecosystem is their normality."

40

TELECOMMUNICATIONS:
DIGITAL THEMES AND INITIATIVES

The industry is a key enabler of digital transformation across industries, but the value of digitalization has so far eluded telecommunications operators. Four themes will be central to capturing it.

Networks of the Future

Amid rising demands on networks and associated cost pressures, operators are accelerating the development of "smart pipes" and new models of extending internet access. Key initiatives are *Software-Differentiated Networks, Autonomous Networks, Cyber-resilience* and *Extending Connectivity*.

Case studies:

Beyond the Pipe

Digitalization offers important opportunities to extend revenue streams beyond just connectivity. Important initiatives are *Integrated on IoT*, *Digital Services, Winning the Battle of Ecosystems,* and *Reimagining Communication.*

Redefining Customer Engagement

To win customer mindshare in a digital world, operators must change their approach to identifying and exceeding B2B and B2C customer expectations, while rethinking customer service. A key initiative is *Delighting the Digital Customers*.

Bridging the Gap on Innovation

The need to rapidly accelerate innovation cycles is forcing industry participants to look beyond in-house R&D and transform company culture to attract the best digital talent. A major initiative is *Outside 'In-novation'*.

TELECOMMUNICATIONS:
UNLOCKING VALUE

The digitalization of telecommunications could unlock $2 trillion of value for the industry and wider society over the next decade. By enabling the digital transformation of other industries, the sector also generates societal benefits.

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TELECOMMUNICATIONS:
Value at stake for industry and wider society, by digital theme (cumulative 2016-2025)

	Potential Business Impact ($ billion)	Potential Societal Impact ($ billion)	Total Value at Stake ($ billion)	Emissions Reduction (million tonnes CO_2)
Networks of the Future	440	580	1,020	183
Beyond the Pipe	650	290	940	106
Redefining Customer Engagement	30	2	32	--
Bridging the Gap on Innovation	160	1	161	--
Total	1,280	873	2,153	289

Unlocking Societal Value: Extending Connectivity

Technologies such as drones, satellites and balloons are extending affordable internet access in regions with low population densities. For telecom operators, these innovations can overcome significant cost barriers in reaching remote areas across developed and developing markets. The potential value to society of the Extending Connectivity initiative is $400 billion over the next decade, or almost half of the sector's potential overall societal impact, but concerted public-private action will be needed to capture this value fairly and at scale. Considerations include affordability, regulations that ensure fair competition, digital skills, cultural acceptance and accountable institutions.

AUTOMOTIVE:
DIGITAL THEMES AND INITIATIVES

The car – the pre-eminent consumer product of the Industrial Revolution – is facing what may be its greatest moment of change. Three digital themes will be central to this transformation.

Connected Traveller

The car is becoming a digital hub for real-time two-way wireless data transfer. The human and the vehicle are moving towards total connectivity across devices, databases and objects. Key initiatives are *Infotainment*, *Usage-based Insurance* and *Multimodal Integration*.

Case studies:

Autonomous Driving

Digitalization will usher in the era of autonomous vehicles. Manufacturers already offer *Assisted Driving* technologies, such as lane-warning crash avoidance and automatic parking assistance. These technologies could eventually transform the industry with *Self-Driving* vehicles.

Digital Enterprise

Digital initiatives could drive substantial improvements to the value chain. They include *Connected Supply Chains*, *Digital Manufacturing*, *Disrupted Retail*, *Connected Service and Maintenance*, *Transformed Aftermarkets*, *Automotive Data Marketplaces* and *Connected Infrastructure*.
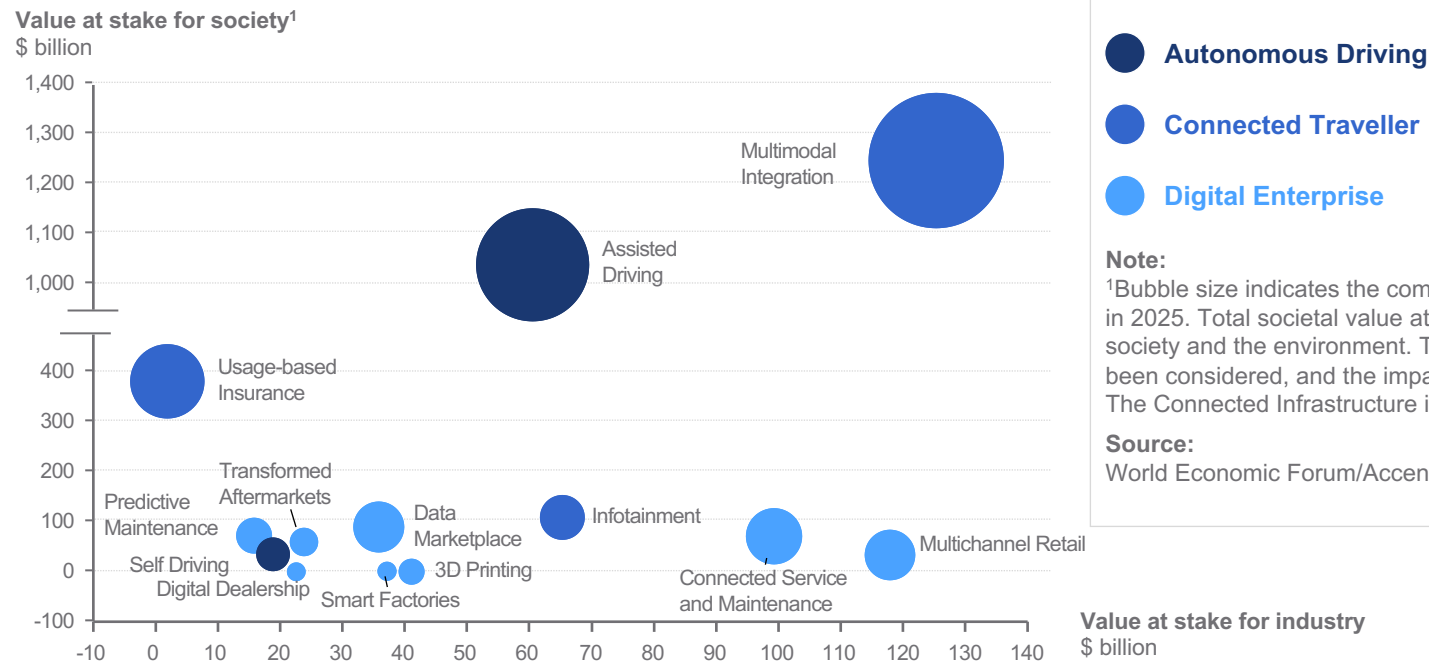
AUTOMOTIVE:
UNLOCKING VALUE

Digitalization could unlock $2 trillion of value for the industry and society over the next decade. Positive societal impacts include efficient traffic management, reduced congestion and fewer crashes.

AUTOMOTIVE:
Value at stake for industry and wider society, by digital initiative (cumulative 2016-2025)

Value at stake for society[1]
$ billion

- **Autonomous Driving**
- **Connected Traveller**
- **Digital Enterprise**

Note:
[1]Bubble size indicates the combined industry and societal value at stake in 2025. Total societal value at stake includes impacts on consumers, society and the environment. The impact on external industries has not been considered, and the impact on lives saved has not been quantified. The Connected Infrastructure initiative has not been valued.

Source:
World Economic Forum/Accenture analysis

Unlocking Societal Value: Multimodal Integration

Multimodal integration seamlessly links all forms of road, rail and ferry travel (including automobile driving and public transit), as well as walking and cycling. Full-scale integration could create more than $270 billion of societal and environmental benefits in the form of time savings from more efficient traffic management, reduced congestion, fewer crashes and lower emissions. It could also deliver consumer benefits worth nearly $1 trillion through lowering the cost of car ownership. Realizing these benefits requires concerted public-private collaborations bringing together original equipment manufacturers (OEMs), suppliers, regulators, and government planning and tax authorities.

CONSUMER INDUSTRIES:
DIGITAL THEMES AND INITIATIVES

Digital innovation is shifting power from brands to consumers, and transferring value from traditional players to digital insurgents. Four key themes will drive value creation for business and wider society.

Consumer Data Flow and Value Capture

Digitalization helps companies use consumer data to innovate and improve customer experiences. The growing importance of data will draw increased scrutiny and activism from consumers and regulators, as society puts an even higher premium on data privacy and transparency.

Case studies:

Experience Economy

Products will evolve into services, and services into experiences, with data as the backbone of their delivery. Hyper-personalization brings new revenue models in an environment where revenue is more closely linked to outcomes for individuals and society.

Omnichannel Retail

With online purchases growing in most categories, traditional stores must change to stay relevant. Omnichannel strategies will play an important role. Consumer-products companies will also need effective strategies to compete in e-commerce and capture value in the sharing economy.

Digital Operating Model

Smart supply chains and factories will enable mass customization of products and omnichannel experiences. A firm's ability to manage consumer experiences will be central to gaining a competitive advantage.
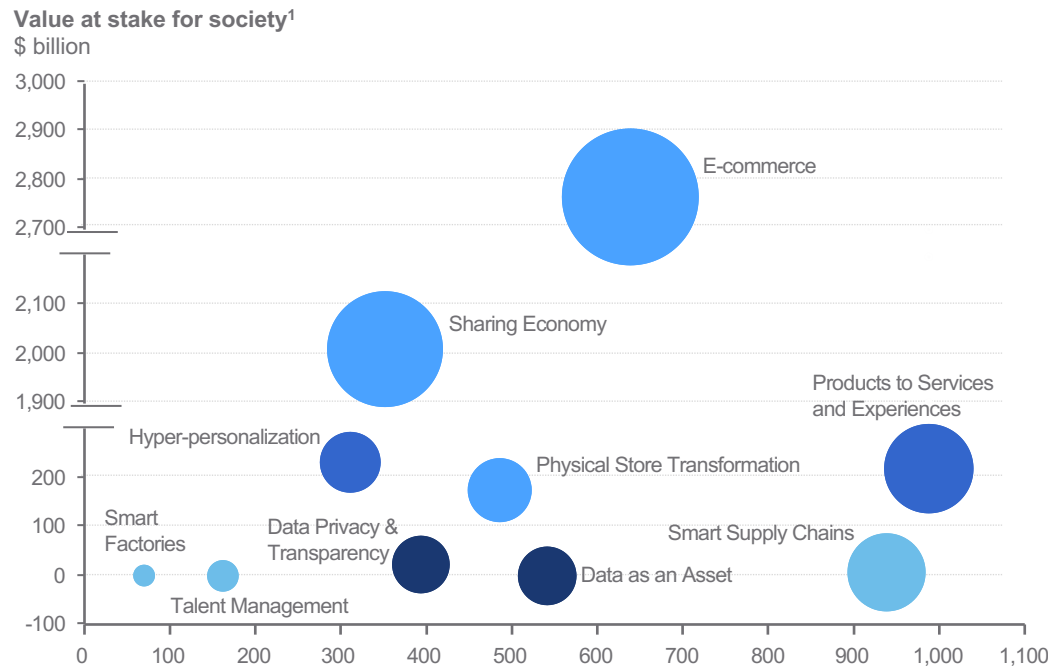
CONSUMER INDUSTRIES:
UNLOCKING VALUE

The digitalization of consumer industries could unlock more than $10 trillion in industry and societal value over the next decade. E-commerce is expected to drive much of the societal value.

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CONSUMER INDUSTRIES:
Value at stake for industry and wider society, by digital initiative (cumulative 2016-2025)

Value at stake for society[1]
$ billion

Value at stake for industry
$ billion

- **Consumer Data Flow and Value Capture**
- **Experience Economy**
- **Omnichannel Retail**
- **Digital Operating Model**

Note:
[1]Bubble size indicates the combined industry and societal value at stake in 2025. Total societal value at stake includes impacts on consumers, society and the environment. The impact on external industries has not been considered, and the impact on lives saved has not been quantified.

Source:
World Economic Forum/Accenture analysis

Unlocking Societal Value: E-commerce

Greater e-commerce penetration is changing the retail landscape, handing pricing power from manufacturers to online retailers. It is also levelling the playing field, helping smaller and niche players compete against the dominant large brands. E-commerce has a potential societal impact of $2.7 trillion as it reduces commute time by more than 250 million hours and gives access to a broader variety of products and lower prices. B2B and cross-border platforms could further increase e-commerce's societal impacts.

Erik Brynjolfsson
Professor of IT and Director, MIT Initiative on the Digital Economy

"Digitalization is creating new types of economic disruption … technological progress may leave some people – perhaps even a lot – behind."

ELECTRICITY:
DIGITAL THEMES AND INITIATIVES

The electricity sector is ripe for realizing value from rapid digital transformation. Value creation across the industry and broader society will be driven by four major themes.

Asset Life Cycle Management

Real-time, remote-controlled or predictive maintenance extends the life cycle or operating efficiency of generation, transmission or distribution assets and infrastructure. Key initiatives are *Asset Performance Management*, *Digital Field Worker* and *Smart Asset Planning*.

Case studies:

Grid Optimization and Aggregation

Grid optimization is possible through *Energy Aggregation Platforms*, *Real-time Supply and Demand Platforms*, *Real-time Network Controls*, and *Connected and Interoperable Devices* – enabled by connected assets, machines and devices, and advanced monitoring capabilities.

Integrated Customer Services

Digitally enabled products and services relating to energy generation and energy management can be bundled into an integrated customer service. Key initiatives are *Energy Storage Integration*, *Digital Customer Model*, *Energy Solution Integration* and *Energy Management*.

Beyond the Electron

Hyper-personalized connected services go beyond the electricity value chain and adapt to the consumer. In this way, electricity stops being a commodity and becomes an experience. The three initiatives are *Living Services*, *Industrial Services* and *Municipal Services.*
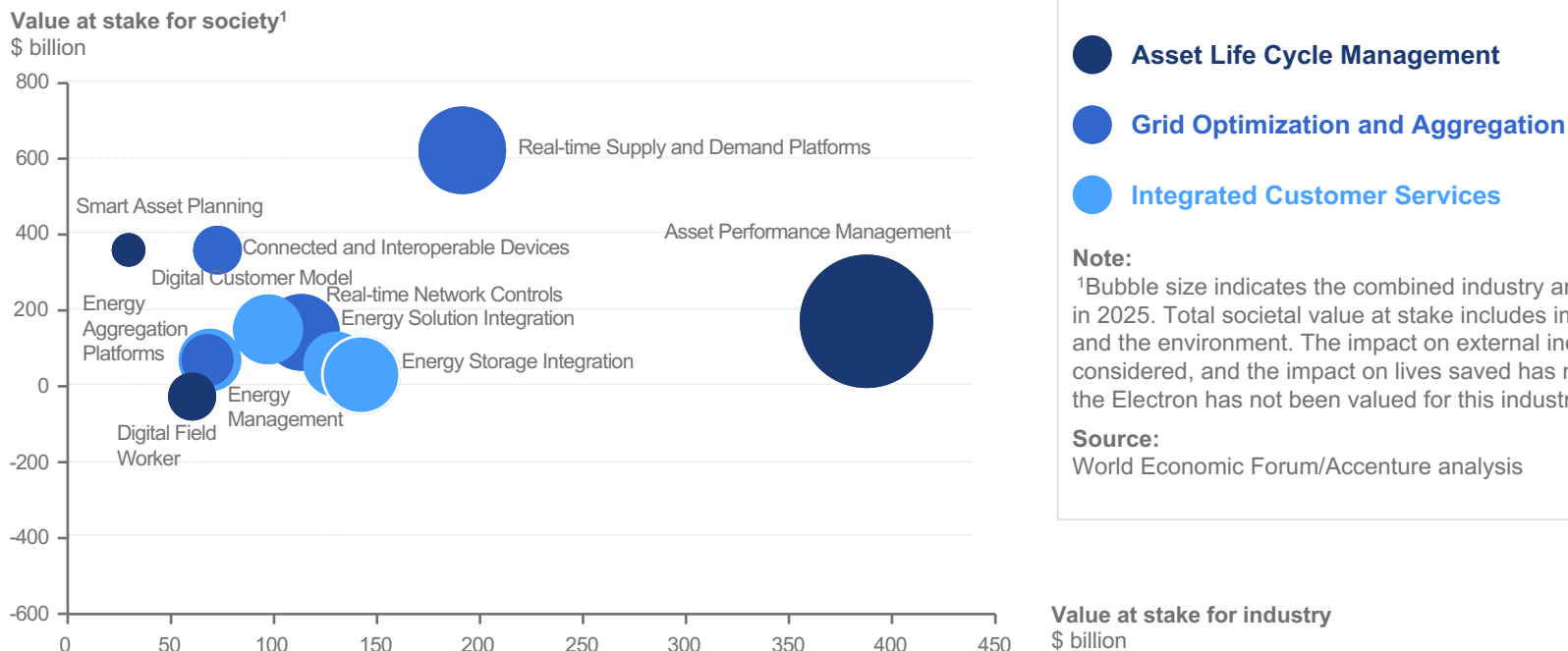
ELECTRICITY:
UNLOCKING VALUE

The digitalization of electricity could unlock $3.1 trillion in industry and societal value over the next decade. Societal benefits stem from value creation for customers and a reduction in emissions.

ELECTRICITY:
Value at stake for industry and wider society, by digital initiative (cumulative 2016-2025)

Value at stake for society[1]
$ billion

- **Asset Life Cycle Management**
- **Grid Optimization and Aggregation**
- **Integrated Customer Services**

Note:
[1]Bubble size indicates the combined industry and societal value at stake in 2025. Total societal value at stake includes impacts on consumers, society and the environment. The impact on external industries has not been considered, and the impact on lives saved has not been quantified. Beyond the Electron has not been valued for this industry.

Source:
World Economic Forum/Accenture analysis

Value at stake for industry
$ billion

Unlocking Societal Value: Real-time Supply and Demand Platforms

By monitoring and communicating real-time supply and demand, and pairing it to a discriminatory pricing framework, these platforms change behaviours through tariffs, localized pricing signals and interconnectivity. New behaviours could save customers $559 billion over the next decade. They could also lower peak-demand situations, thus reducing CO_2 emissions by 1 billion tonnes. For this initiative to be successful, system operators must put in place the necessary infrastructure.

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HEALTHCARE:
DIGITAL THEMES AND INITIATIVES

Demographic, market and technology trends make digital transformation increasingly critical to the future of healthcare. Four themes will drive new value for the industry and wider society.

Smart Care

Recent technological and scientific breakthroughs have propelled medicine into a new era of smart care. *Precision Medicine*, *Robotics* and *Medical Printing* are making healthcare smarter and more personalized.

Case studies:

Care Anywhere

Shifting care closer to home can broaden access to healthcare and reduce the strain on overstretched health systems. The technology that has enabled the IoT to proliferate will open up the possibility of "Care Anywhere" through the *Virtual Care* and *Connected Home* initiatives.

Empowered Care

The digital economy can now deliver a wide range of "living services" – intelligent digital services that respond contextually to the user's needs. These increase *Patient Engagement at Scale* and empower citizens to manage their own healthcare, preventing the onset of chronic conditions, such as diabetes.
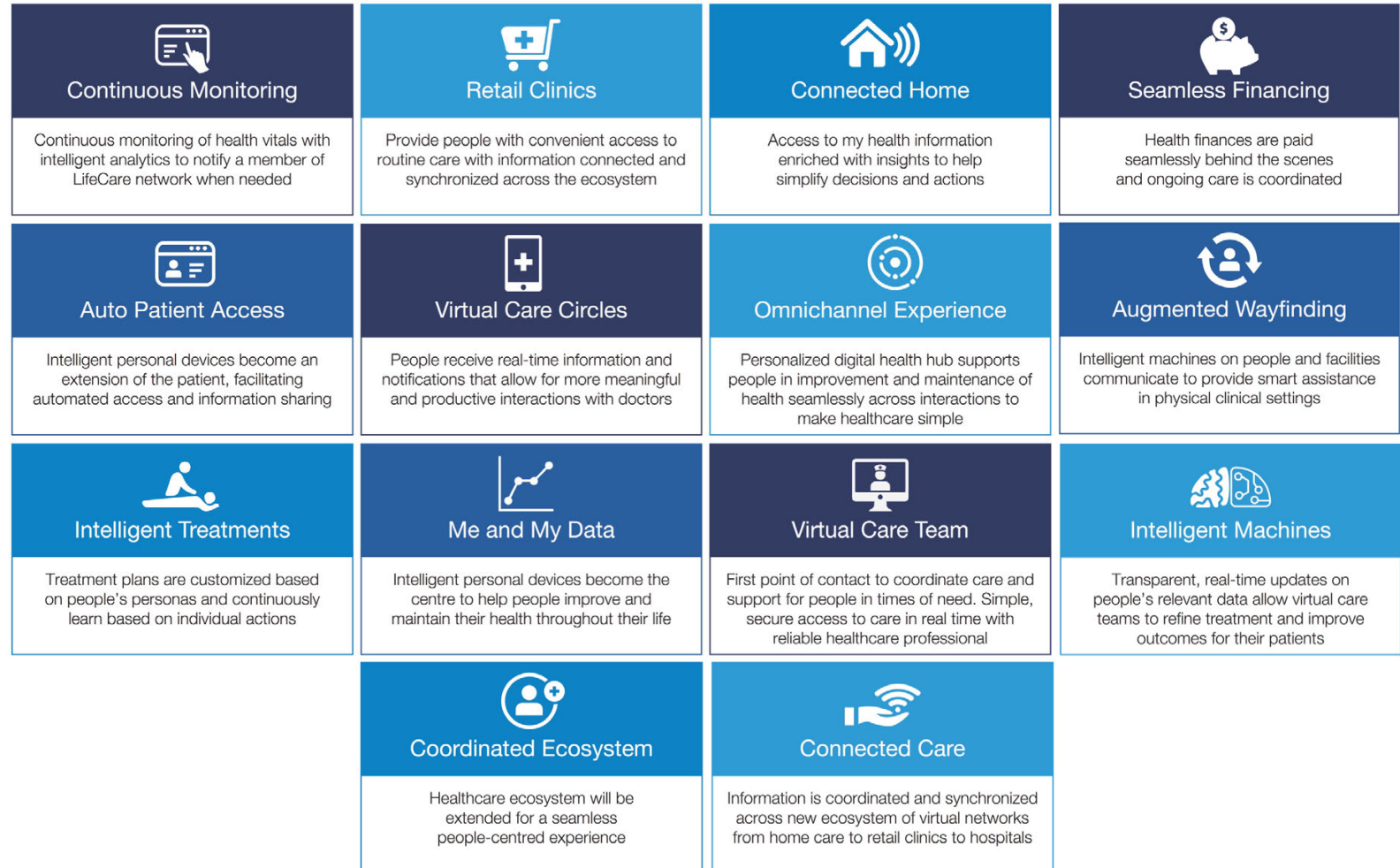
Intelligent Health Enterprises

Advances in data collection, storage and analytics have been accompanied by the proliferation of data – e.g. from sensors and devices, clinical information systems and electronic health records. Key initiatives are *Accessible Intelligence*, *Connected Worker* and *Intelligent Devices*.

HEALTHCARE:
BUILDING THE **HEALTHCARE SYSTEM OF THE FUTURE**

Today's model of healthcare provision is increasingly unsustainable. To deliver continued improvements to the world's health, it will need to be transformed, with digital playing a central role.

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Continuous Monitoring
Continuous monitoring of health vitals with intelligent analytics to notify a member of LifeCare network when needed

Retail Clinics
Provide people with convenient access to routine care with information connected and synchronized across the ecosystem

Connected Home
Access to my health information enriched with insights to help simplify decisions and actions

Seamless Financing
Health finances are paid seamlessly behind the scenes and ongoing care is coordinated

Auto Patient Access
Intelligent personal devices become an extension of the patient, facilitating automated access and information sharing

Virtual Care Circles
People receive real-time information and notifications that allow for more meaningful and productive interactions with doctors

Omnichannel Experience
Personalized digital health hub supports people in improvement and maintenance of health seamlessly across interactions to make healthcare simple

Augmented Wayfinding
Intelligent machines on people and facilities communicate to provide smart assistance in physical clinical settings

Intelligent Treatments
Treatment plans are customized based on people's personas and continuously learn based on individual actions

Me and My Data
Intelligent personal devices become the centre to help people improve and maintain their health throughout their life

Virtual Care Team
First point of contact to coordinate care and support for people in times of need. Simple, secure access to care in real time with reliable healthcare professional

Intelligent Machines
Transparent, real-time updates on people's relevant data allow virtual care teams to refine treatment and improve outcomes for their patients

Coordinated Ecosystem
Healthcare ecosystem will be extended for a seamless people-centred experience

Connected Care
Information is coordinated and synchronized across new ecosystem of virtual networks from home care to retail clinics to hospitals

Source: World Economic Forum/Accenture analysis

LOGISTICS:
DIGITAL THEMES AND INITIATIVES

Digitalization threatens to disrupt logistics, but could also reduce its inefficiencies and shrink its environmental impact.
Four themes will help deliver value for both the industry and wider society.

Information Services

Initiatives such as *Logistics Control Towers* and *Analytics as a Service* put data at the heart of logistics businesses, helping to reduce operating costs while improving operational efficiency.

Case studies:

Logistics Services

Global trade will increase through *Digitally Enhanced Cross-border Platforms*. Logistics firms can also satisfy growing demand for faster *Same-day Delivery*, and promote the concept of *City Logistics*, which will help them operate in "megacities".

Delivery Capabilities

The need to move physical goods from A to B endures, but delivery methods are changing. *Crowdsourcing*, and innovations in manufacturing (*3D Printing*) and technology (*Drones*, *Autonomous Trucks*) have widened the range of options and opened up logistics markets to new players.

Shared Logistics Capabilities

Shared warehouse and shared transport capabilities are expected to gain prominence among logistics firms, increasing asset utilization in the near future.

LOGISTICS:
UNLOCKING VALUE

Over the next decade, digital transformation of logistics has the potential to unlock $4 trillion of value for industry and society.

LOGISTICS:

Value at stake for industry and wider society, by digital initiative (cumulative 2016-2025)

Value at stake for society[1]
$ billion

- **Information Services**
- **Logistics Services**
- **Delivery Capabilities**
- **Shared Logistics Capabilities**

Note:
[1] Bubble size indicates the combined industry and societal value at stake in 2025. Total societal value at stake includes impacts on consumers, society and the environment. The impact on external industries has not been considered, and the impact on lives saved has not been quantified.

Source:
World Economic Forum/Accenture analysis

Unlocking Societal Value: Crowdsourcing

Crowdsourcing platforms – the "Uber" of logistics – can be a game changer. By helping smaller firms raise utilization levels, they will make the industry more competitive and bring societal benefits, such as reductions of $800 billion in logistics costs for customers. They could also reduce CO_2 emissions by 3.6 billion tonnes, while generating additional income for consumers who decide to use their own vehicles to deliver goods while on personal trips. Clear regulation will be needed to promote these platforms and increase adoption.

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Benedicte Javelot
Chief Strategy Officer,
Orange Group

"Customers are empowered by digital; they have new behaviours and new expectations that are pushing us to evolve. We have to be more reactive and more agile; we need to listen to what our customers expect and also track how our digital environment is evolving."

MEDIA:
DIGITAL THEMES AND INITIATIVES

Changing consumer behaviour and expectations are driving the transformation of media. Three themes are central to addressing these changes and creating industry and societal value.

Personalization and Contextualization

Marketers and content creators will need to produce *Personalized Content* and *Personalized Advertising* to engage consumers facing information overload.

Case studies:
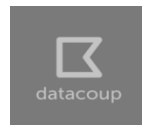
Content Fragmentation

Broadcasters should exploit the growing popularity of the "second screen" by creating integrated second-screen services. *Communities of Content* on instant-messaging and social platforms, as well as *Over the Top (OTT) Services*, look like fertile ground for advertisers. *Intellectual Property Frameworks for the Digital Age* is another important initiative.

Partnerships and Industrialization

Technology enables enterprises to partner with their audiences, and to fund or co-create innovative content. Technology must be at the heart of *The Digital Organization*. Key initiatives are *Engagement, Co-creation and Crowdsourcing* and *Flexible, Predictive, Precise Content Creation*.

MEDIA:
UNLOCKING VALUE

The digital transformation of media represents a $1.3 trillion opportunity for industry and society.

Click to download White Paper

MEDIA:
Value at stake for industry and wider society, by digital initiative (cumulative 2016-2025)

Value at stake for society[1]
$ billion
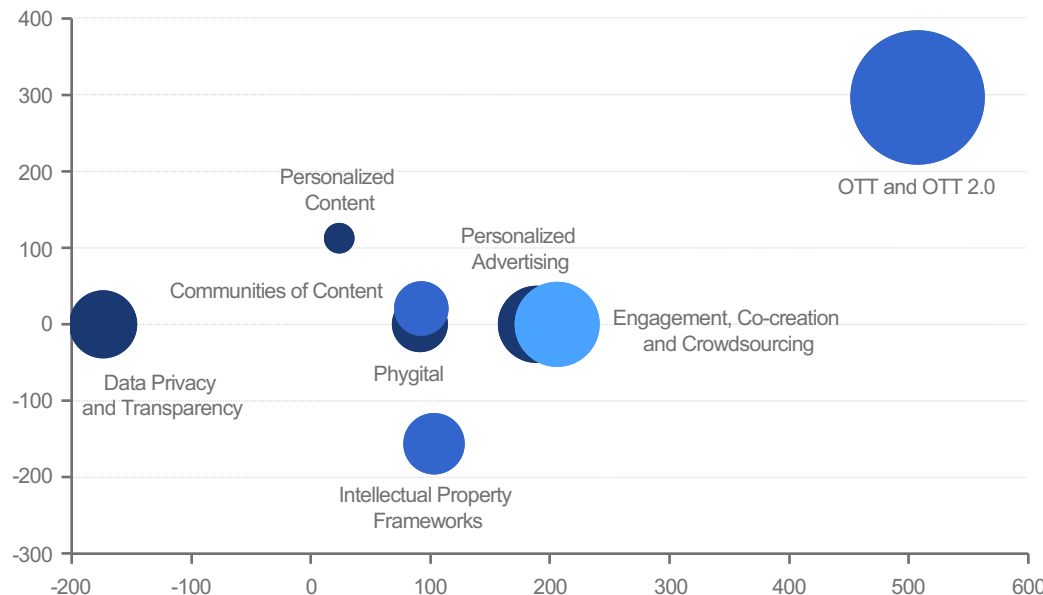
- **Personalization and Contextualization**
- **Content Fragmentation**
- **Partnerships and Industrialization**

Plotted points: OTT and OTT 2.0; Personalized Content; Personalized Advertising; Communities of Content; Data Privacy and Transparency; Phygital; Engagement, Co-creation and Crowdsourcing; Intellectual Property Frameworks

Value at stake for industry
$ billion

Note:
[1]Bubble size indicates the combined industry and societal value at stake in 2025. Total societal value at stake includes impacts on consumers, society and the environment. The impact on external industries has not been considered, and the impact on lives saved has not been quantified.

Source:
World Economic Forum/Accenture analysis

Unlocking Societal Value: OTT and OTT 2.0

OTT services such as Netflix and Hulu are revolutionizing media. The proliferation of OTT is a $300 billion opportunity in terms of value to society. Its advantages include access to cheap unbundled content leading to cost savings; lower emissions due to digital viewership; and wider access to educational resources from open-source platforms, such as YouTube and Coursera. Collaborations between different OTT players and telecom companies, and clear regulations around net neutrality, can accelerate the development of OTT and OTT 2.0 services.

WORLD ECONOMIC FORUM

Aviation, Travel and Tourism	Telecommunications	Professional Services	Mining and Metals	Oil and Gas	Chemistry and Advanced Materials
Ecosystem Convergence	Integrated on IoT	Enhancing Go-to-Market Strategy	Advanced Analytics and Simulation Modelling	Digital Customer Services – Hyperlocal Mobile Fuel Options	Innovation Ecosystem
Diffusion of Ownership	Reimagining Communication	Fostering a Digital Environment	Artificial Intelligence	Consumer Energy Choices	
Battle for Customer Mindshare	Winning the Battle of Ecosystems				
	Digital Services	Modularizing Work	Smart Sensors	New Era of Automation	Digital R&D
Smart Manufacturing	Outside 'In-novation'	Developing a Flexible Workforce	Autonomous Operations and Robotics	Advanced Analytics & Modelling	Digital Plant
Intelligent Assets		Training Talent	3D Printing	Connected Worker	Digital Supply Chain
Next Generation Workforce	Software-differentiated Networks	Investing In Smart Infrastructure	Connected Worker	Real-time Supply/Demand Balancing: 3D Printing	Augmented Workforce
	Autonomous (Zero Touch) Networks	Designing the Employee Experience	Remote Operations Centre	Digital Information Sharing and Operational Transparency – Block Chain, Smart Contracts	
Traveller Centricity	Cyber-resilience	Reimagining Hiring	Asset Cybersecurity		Accelerated Circular Economy
Seamless Customer Journey	Transforming for a Digital Workforce		IT/OT Convergence	Omnichannel Retail and Experience-based Services	Digitally Enabled Offerings and Business Models
End-to-end Propositions					Advanced Customer Interaction
Modern Security Environment	Extending Connectivity	Augmenting Human Intelligence			Value Chain Collaboration
Ubiquitous Tourist Safety	Delighting the Digital Customer	Nurturing an Agile Culture			
Data Dilemma	Brand Atomization		Integrated Sourcing, Data Exchange, Commerce		

Growth through digitalization (customer facing, e.g. revenue generating)

Efficiency through digitalization (internally facing, e.g. profit generating)

Digital experience (the combination of growth and efficiency)

WORLD ECONOMIC FORUM

Media	Healthcare	Logistics	Automotive	Electricity	Consumer
Personalized Advertising	Patient Engagement at Scale	Logistics Control Towers	Infotainment	Energy Storage Integration	Data as an Asset
Personalized Content		Analytics as a Service	Usage-based Insurance	Digital Customer Model	Data Privacy and Transparency
Data Privacy and Transparency Reform			Multimodal Integration	Energy Solution Integration	Data to Improve Experience
Phygital: Digital Media Becomes Physical	Precision Medicine	Drones		Energy Management	
"Advicetising": Advertising as Advice	Robotics	Autonomous Trucks	Connected Supply Chain	Industrial Services	Physical Store Transformation
	Medical Printing	3D Printing	Digital Manufacturing	Municipal Services	E-commerce
	Accessible Intelligence	Crowdsourcing	Disrupted Retail	Asset Performance Management	Sharing Economy
Engagement, Co-creation and Crowdsourcing	Connected Worker	Circular Economy	Connected Service and Maintenance	Digital Field Worker	Smart Supply Chains
The Digital Organization	Intelligent Devices	Shared Transport Capacity	Transformed Digital Aftermarket	Smart Asset Planning	Talent Management
Flexible, Predictive, Precise Content Creation		Shared Warehouse Capacity	Automotive Data Marketplace	Energy Aggregation Platforms	Smart Factories
			Connected Infrastructure	Real-time Supply and Demand Platforms	
OTT and OTT 2.0	Virtual Care	Digitally Enhanced Cross-border Platforms		Real-time Network Controls	Hyper-personalization in Goods
Communities of Content	Connected Home	City Logistics	Assisted Driving	Connected and Interoperable Devices	Products to Services and Experiences
IP Frameworks for the Digital Age		Same-day Delivery	Self Driving	Living Services	Health and Well-being Goods and Services

■ Growth through digitalization (customer facing, e.g. revenue generating)

■ Efficiency through digitalization (internally facing, e.g. profit generating)

■ Digital experience (the combination of growth and efficiency)

4.

Opportunities to Improve the State of the World

AT A CROSSROADS:
WHAT KIND OF DIGITAL FUTURE WILL BE CREATED?

The Fourth Industrial Revolution is under way. Digital innovation can benefit society by creating jobs, saving lives and reducing emissions. But these gains are not guaranteed – they depend on the decisions taken today.

Having reviewed the opportunities and challenges presented by digital technology across many industries, one thing has become clear: the world is at a crossroads. New technologies are opening up opportunities to increase economic growth, reduce inequality and promote inclusivity. At the same time, the world is deglobalizing, with civil wars and political populism driving uncertainty about international relations.

An important choice must be made: between a more open, inclusive and interconnected world, or one that is closed, siloed and unequal.

Digitalization is inextricably linked to the societal and economic forces fuelling these conflicting world views. Digital innovations can, for example, drive society towards the UN Sustainable Development Goals, and shore up the three pillars on which they are built: improving quality of life, fostering equitable growth and protecting the environment. But inhibitors such as inadequate regulation, limited innovation, and uneven adoption of technology all undermine the opportunities that digitalization presents.

The digital revolution provides a once-in-a-generation chance to drive radical change across the global economy. But this transformation will not happen by itself, and its negative, unintended consequences must be managed. Collaborative action is needed today to bend the curve of digital transformation towards a more prosperous tomorrow.

UNLOCKING **$100 TRILLION** FOR BUSINESS AND SOCIETY FROM DIGITAL TRANSFORMATION

Across 10 industries, the value-at-stake methodology identifies trillions of dollars in value for both society and industry. Scaled up across all industries, and including externalities, the estimated net benefits will be greater than $100 trillion over the decade to 2025.

Societal[1]

Industry

**Cumulative Value 2016-2025
to Society and Industry ($ billion)**

Industry	Societal	Industry	Reduction in CO_2 Emissions (million tonnes)	Jobs (000s)
Consumer	5,439	4,877	223	-3,249
Automotive	3,141	667	540	NA
Logistics	2,393	1,546	9,878	2,217
Electricity	1,741	1,360	15,849	3,158
Telecom	873	1,280	289	1,100[2]
Aviation[4]	705	405	250	-780
Oil & Gas	637	945	1,284[3]	-57
Media	274	1,037	-151	NA
Mining[4]	106	321	608	-330
Chemistry[4]	2	308	60	-670

(1) Total societal value at stake includes impact on customers, society and the environment; the impact on external industries has not been considered; (2) Excludes the Extending Connectivity digital initiative; (3) Reduction in emissions for Oil and Gas refers to reduction in CO_2e emissions (4) Aviation refers to Aviation, Travel and Tourism; Mining to the Mining and Metals industries and Chemistry refers to Chemistry and Advanced Materials.
Source: World Economic Forum/Accenture analysis

BARRIERS TO REALIZING BOTH INDUSTRY AND SOCIETAL VALUE

Overcoming the inhibitors to transformation will unlock significant value for business and society.

Key Inhibitors	Examples
1. Lack of collaboration for societal gains Incentives primarily focus on meeting profit targets; investors are not yet adequately rewarding businesses for generating societal benefits. Do organizations have a strategy for selecting investors that enables them to invest in societal benefits?	• Telematics is not yet mandatory in new cars or trucks. Insurers are providing optional add-ins, but the penetration rates are still relatively small. • While digital technology is increasing farming yields, not all technology is passing on benefits to farmers and workers.
2. Regulation and protection of consumer interests Innovation is taking place at a far greater speed than regulation. Is self-regulation supported by independent oversight workable?	• Legal frameworks around intellectual property need to be revisited for the new generation of on-demand media consumers. • Issues have arisen with regulations on drones.
3. Cannibalization of existing revenue streams Evolutionary (GM Super Cruise) versus revolutionary (Google Lidar) innovation is holding back incumbents, often due to cultural anchors.	• Utilities fail to lead with decentralized renewable energy products and services. • Telcos have been "strengthening the pipe", while digital businesses such as Skype, WhatsApp and Facebook have transformed communications.
4. Skills for tomorrow's workforce Skills gaps currently exist and are expected in the future for digital roles. Displacement stats vary greatly, from net positive to net negative.	• From top management to front-line managers, trust in the advice provided by intelligent systems is rapidly declining. • Various technologies have the potential to augment and/or replace human capabilities.
5. Technology adoption rates While some think that innovative technologies can bring significant benefits, others are concerned or sceptical about the impact of technological advances, and thus do not adopt technologies as and when they become available.	• Bluetooth and radio frequency identification technologies (RFID) have existed for nearly 20 years, but have only recently become ubiquitous.

IMPLICATIONS FOR BUSINESS LEADERS

How can business leaders change their organizations to be ready for digital impacts?

New Business Model

**Create new digital business models or digital offerings**
This can be done by refreshing, building, buying, partnering, investing and incubating to get ahead of disruption. Internally, legacy systems need to transform or connect into agile interoperable platforms to enable plug-and-play interactions among the ecosystem's partners. This will help with asset sharing and generate new, seamlessly integrated products.

Develop Ecosystems via Partnerships

Identify attractive partners inside and outside the industry
Identify and understand network partners, dynamics in the network, and the role partners want to play within the relevant innovation, supply and distribution, and offering ecosystems. This will provide consumers with a seamless experience and generate value for the companies involved. An attractive ecosystem of partnerships helps to promote loyalty among customers and users.
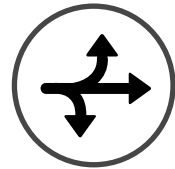
Cultural Shift

Reinvent, even if this requires short-term disruption
Digital should be owned by the CEO and challenge the status quo, from board room to the front line. Driving a strong sense of purpose and a diverse, high-digital-quotient workforce are critical. Leadership needs to release people's creativity and apply lean start-up methodologies, such as hackathons and design thinking.

Skills of the Future

Equip the workforce with tools to succeed
Reskilling current employees through continuous learning and training will support the transition of the workforce. At the same time, educational institutions must be empowered to design curricula that prepare the next generation to work collaboratively with intelligent technology.

Data Security and Privacy

Protect against attack
Increased connectivity requires companies to invest funds, skills and capabilities to protect their data. Spending on cybersecurity is expected to increase from an average of less than 1% of revenues to approximately 3% over the next decade.

IMPLICATIONS FOR GOVERNMENT AND POLICY-MAKERS

How can governments and policy-makers adjust regulations for digital impacts?

New Regulatory Structures

Revise regulations to encompass digital

Regulations will need to change in an age of cross-industry collaboration and consolidation around digital services and platforms.

Data Privacy & Security

Protect intangible assets

Data security needs to be a priority as more transactions occur on digital channels. Much more consumer information will be collected in the future, and data will be far more robust. Regulations need to keep pace with advancements in data.

Skills of the Future

Empower individual relevance

The changing nature of jobs demands that individuals develop new skill sets to remain relevant. How can regulatory bodies, organizations and employees work together to ensure a smooth transition of skills? What options are there for governments to work with industry to de-risk investments in areas that promise high societal and industry value, such as the IoT and digital infrastructure?

Digital Dividends

Enable societal value creation

How new incentive structures and technologies augment the coverage, quality, affordability and relevance of digital communications needs to be determined. This will create tangible steps for governments to follow and provide the "analogue complements" for creating societal value.
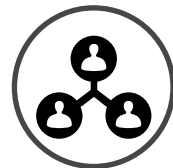
Community Impact

Localize efforts

The impact of digitalization can be substantial at the local level. For example, as stores close and the physical retail real-estate footprint shrinks over the next decade, what can government at all levels do to preserve local communities and mitigate negative impacts?

LOOKING FORWARD TO 2017

Using detailed industry and cross-industry perspectives, and its unique value framework, the Digital Transformation Initiative will focus on three themes in 2017.

The overall goal is to catalyse public-private multistakeholder dialogues that drive actionable, informed and inclusive decisions and outcomes.

Unlocking societal value and realizing impact at the macro (regional, country and state), industry, system and enterprise levels
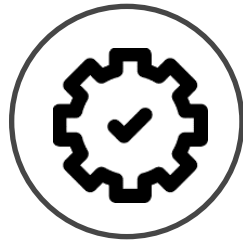
Using the operational efficiency imperatives of Enabling the Digital Enterprise (going from strategic direction to implementation)

Conducting an in-depth review of the B2B platform economy from a policy perspective

MORE INFORMATION ONLINE

All materials are available on http://reports.weforum.org/digital-transformation, including detailed White Papers and case studies from this executive summary.

Visit DTI website
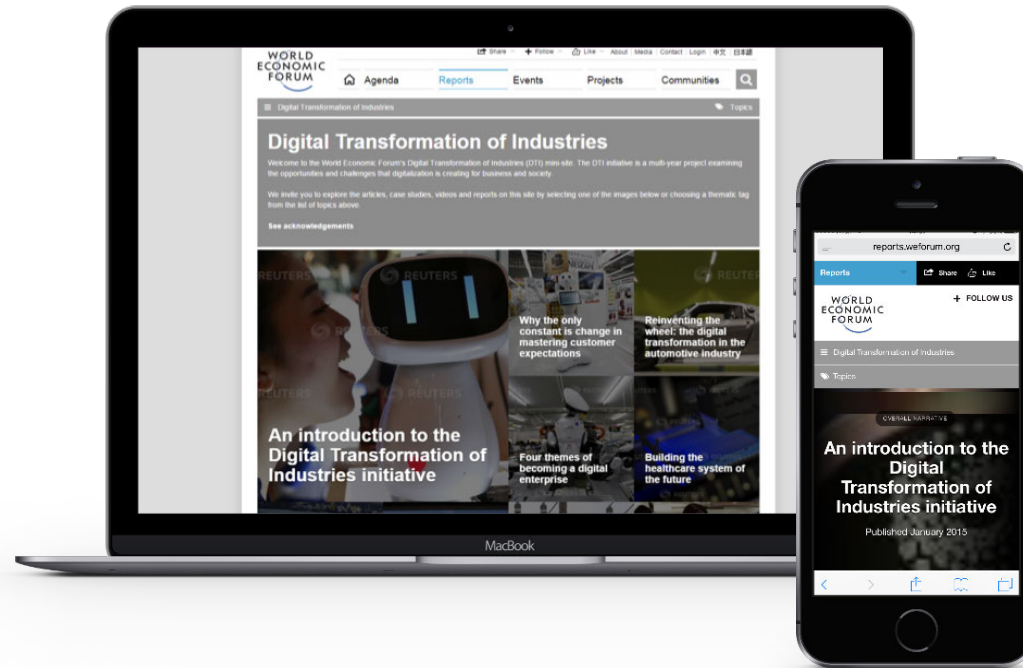
Key features

- Mobile-responsive, platform-agnostic site

- 13 industry White Papers

- 5 cross-industry White Papers

- 13 SlideShare summaries of White Papers

- Over 60 video snippets and mini documentaries

- Online case-study repository

- 4 animations on digital challenges

5.
Acknowledgements

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Antofagasta Minerals
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International Council on Mining and Metals (ICMM)
International Trade Union Confederation (ITUC)
International Transport Workers' Federation

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LetMeShip
Level 3
Liberty Global
Lockheed Martin Corporation
LVNL (Air Traffic Control Netherlands)
Mahindra
Majid Al Futtaim Holdings
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Tata Steel
Technogym
Teck Resources
Telecom Italia
Telefónica
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