

# Opportunities, Risks and Strategies for a More Inclusive Digital Economy and Society

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## Introduction

The digital revolution is causing technological change to accelerate faster than in preceding industrial revolutions. Developments in advanced materials and hardware (e.g. sensors and connected devices, nanotechnology, robotics, 3D printing) combined with artificial intelligence (AI) and big data (e.g. machine learning, neural networks, cloud and quantum computing) are enabling the creation of new technologies that are rapidly altering political, social and economic structures. Crowdsourcing platforms can leverage the power of citizens to make governments more accountable and transparent by collaboratively drafting constitutions, policies and laws.<sup>1</sup> The sharing economy can disrupt traditional markets, enabling greater financial and economic inclusion.<sup>2</sup> The nearly 16 billion connected devices worldwide can enable unprecedented data collection and insights, resulting in more informed economic, social and environmental decision-making.<sup>3</sup> Advances in 3D printing can facilitate the growth of small to medium-sized enterprises (SMEs), supporting localized micro-production and networks of producers able to respond to local consumer demand.<sup>4</sup>

These developments are just as relevant for the emerging and developing countries that are home to the next 2-3 billion internet users as they are for the economies of the developed world. The digital revolution can do much to help and support the least advantaged, improve social and economic inclusion and drive new and innovative business models.

*“In this digital age, we have an opportunity to transform the lives of people in ways that were hard to imagine a couple of years ago.”*

*- Narendra Modi, Prime Minister of India*

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Yet, this future hangs in the balance. The risks of the digital economy are complex and interconnected. Its effects transcend national sovereign borders, putting strain on established economic, social and political models. These effects could lead to an anti-technology backlash and fuel nationalistic and populist views that may increase the risk of internet fragmentation. Such fragmentation – driven either by political interests, commercial concerns or technological choices – will likely undermine the potential benefits made possible by a globally interconnected digital economy and society.<sup>5</sup>

The extent to which these technological shifts result in disproportionate positive and negative effects may not be set *a priori*. To achieve its full potential, the digital economy must remain open and become more secure, trustworthy and inclusive. Leaders will need to develop new models that support agile strategies that balance the benefits and risks afforded by the digital economy.

In this document, we highlight the economic, social and governmental effects of technological advancements in the digital economy, consider the trade-offs between the risks and opportunities, and propose strategies to ensure the digital economy maximizes the benefits and minimizes the risks for all.

## Economic Impacts

After a quarter of a century of commercial use, and with over 3.5 billion users globally, the internet has transformed business models, reshaped employment patterns and created a digital economy worth well over \$4 trillion in the G20 alone.<sup>6</sup> The coming decades will see even more transformation as the number of users increases, new technologies emerge and more industries are affected. While until now the internet has mostly affected consumer-facing industries such as media and entertainment, retail and financial services, going forward it will increasingly impact manufacturing and process industries, and other B2B activities. Just over half of the names of companies on the *Fortune* 500 have disappeared since the year 2000. Within a decade, nearly 40% of today's top 500 companies will no longer exist.<sup>7</sup>

The impacts of the digital economy on industries and labour will vary; jobs will be created and displaced, and the automation of tasks will change the nature of work and the mix of skills required. The challenge is whether the new technologies will increase labour productivity, boost growth and create more fulfilling jobs, or whether the benefits will mostly be captured by the owners of capital, lowering wages and creating an oversupply of labour.

For many large-scale industries, a global shift is emerging towards network and platform-based business models. These newly enabled network-driven models of collaboration facilitate mutually beneficial partnerships between large and small firms. Coordination formerly available only within a single organization can now be facilitated between many organizations with reliable flows of data, rapid feedback and real-time process tracking.

Platforms work differently from traditional business in important ways. Historically, value has been created upstream and systematically pushed down the value chain to the consumer. Platform business models create value in an iterative and continuous manner across entire ecosystems. They rely on trust between the market participants, and through network effects can accelerate the velocity with which value is created. Online platforms rely heavily on big data, algorithms and analytics. Poorly designed algorithms can create unintended consequences, while the control of data combined with the predictive power of advanced analytics raises fears of one commercial player generating insights that other participants cannot achieve. Adequate governance is required to ensure that platforms deliver value while avoiding the risks of discrimination (such as price, competition, and product and service discrimination) and market dominance.

Advances in digital technology and automation will have differential effects on income, employment and wealth distribution. Growth in jobs and competitiveness are mirrored by risks of greater unemployment in certain sectors and demographics. It is projected that in the next 10 to 20 years, around half of today's jobs will be threatened by automation.<sup>8</sup> Yet there is great opportunity to apply AI-enabled technologies in ways that complement and augment human labour, increasing worker productivity and prosperity. To create resilient workforces, able to respond successfully to technological change and thrive in this new environment, educational programmes that teach a combination of digital skills and soft skills (e.g. creativity, emotional intelligence, communication skills) will be required. For example, the US "Education Dominance" programme funded by the Defense Advanced Research Projects Agency (DARPA) used an AI-enabled digital tutor

to successfully train US Navy recruits with a high school diploma over the span of months to outperform Navy IT technicians with 7 to 10 years of experience.<sup>9,10</sup>

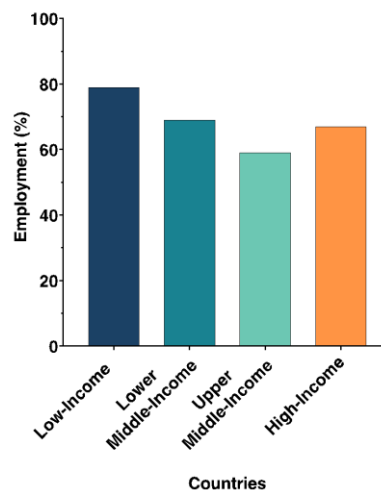
*“Today a street stall in Mumbai can access more information, maps, statistics, academic papers, price trends, futures markets and data than a US president could only a few decades ago.”*

*- Juan Enriquez-Cabot, Managing Director, Excel Venture Management, USA*

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SMEs are critical to 21st-century job creation, as they account for more than half of the world’s GDP and two-thirds of all employment (Figure 1).<sup>11</sup> Strong evidence shows that SMEs that make extensive use of the web to market, sell and support customers, interact with suppliers and empower employees grow faster than those that do not.<sup>12</sup> Either alone, or by leveraging platforms such as eBay or Alibaba, enterprising SMEs can become “micro-multinationals” with significant export sales. Yet in many countries – both advanced and less advanced – the share of SMEs with an online presence is abysmally low, driven by a lack of internet connectivity, limited digital skills, excessive – or unclear – rules and regulations, and lack of access to capital. New funding models, such as peer-to-peer fintech platforms, offer one opportunity to support bottom-up innovation by bridging the \$2 trillion funding gap left by risk-averse banks and investors to fund local start-ups, and in turn support local economic growth.<sup>13</sup>

**Figure 1: Contribution of SMEs to Employment**



Note: Values are based on World Bank data.

Source: Edinburgh Group, *Growing the global economy through SMEs*, 2013, Figure 1.2, available at [http://www.edinburgh-group.org/media/2776/edinburgh\\_group\\_research\\_-\\_growing\\_the\\_global\\_economy\\_through\\_smes.pdf](http://www.edinburgh-group.org/media/2776/edinburgh_group_research_-_growing_the_global_economy_through_smes.pdf).

SMEs are particularly vulnerable to systems lacking data security and resiliency at their core, making them susceptible to cyberattacks. More secure models for digital identity and data management will be critical, with blockchain technologies offering one opportunity to track and protect domestic and international transactions between

SMEs.<sup>14</sup> In early 2017, seven leading European banks established the Digital Trade Chain (DTC) for use by SMEs across Belgium, Luxembourg, France, Germany, Italy, the Netherlands and the United Kingdom. The DTC uses blockchain technology to create a transparent and distributed ledger to reduce administrative paperwork and transaction risks with new partners and markets.<sup>15</sup>

*“AI is a rare case where we need to be proactive in regulation instead of reactive because if we’re reactive in AI regulation it’s too late.”*

*- Elon Musk, Chairman, Tesla Motors, USA*

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As the internet continues to evolve, so do barriers to digital flows. A recent study estimates that data flows accounted for \$2.8 trillion of global GDP in 2014, and that cross-border data flows now generate more economic value than traditional flows of traded goods.<sup>16</sup> Yet the number of restrictions imposed around the world has increased, with localization mandates topping the list of most frequently identified digital trade barriers.

Beyond the economic impact of free-flowing data, its effect on innovation is unequivocal. It allows the sharing of ideas and information, the dissemination of knowledge, and the collaboration of individuals, businesses and governments with one another, regardless of geographic boundaries.

The full economic benefits afforded by the digital economy will not be realized unless an enabling environment that fosters equitable digital inclusion and collaboration across diverse institutions is created. For example, electric-car-sharing services in cities require the collaboration of automotive companies, power utilities, telecommunications providers, financial services companies and city authorities to enable an inclusive and seamless pay-by-use service. The inefficient governance and regulation of platform-based business models limits competition, hinders innovation and increases the possibility of more concentrated markets that benefit incumbent firms.

### **Key considerations**

#### **Opportunities**

- Platform businesses offer major new growth opportunities to create services around physical products.
- New technologies increase labour productivity, boost growth and create more interesting jobs.
- The internet and devices support the development of SMEs.
- New governance processes are adopted that favour cooperation and participation over centralization and control.

#### **Risks**

- Market dominance and discrimination could increase with more platform business models.
- Automation and AI benefit capital over labour and aggravate conditions of oversupply of labour and lower wages.
- SMEs do not adopt the internet sufficiently and lack digital skills.
- Internet fragmentation and barriers to digital trade flows rise.

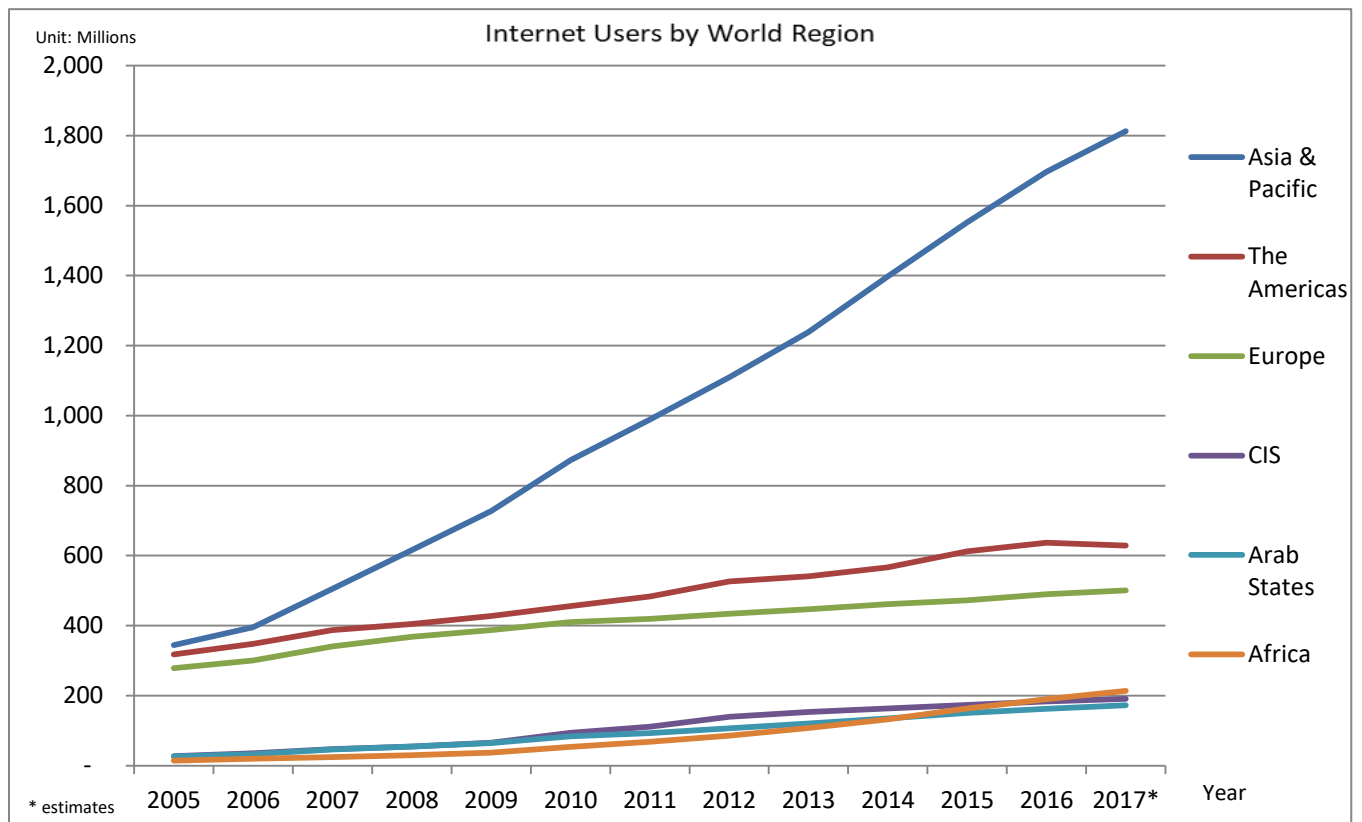
**Strategies**

- Foster a principle-based approach to building trustworthy platform models that stresses security, accountability, transparency, auditability and fairness in value allocation
- Embrace the changing nature of work and an environment in which business and governments focus on supporting individuals rather than jobs by providing digital skills and lifelong learning, and creating new roles in which technology complements human skills
- Improve internet connectivity, affordability, digital skills and localized content for SMEs
- Adopt agile governance principles that favour outcomes over rules-based compliance and open, transparent collaboration with the best available sources among stakeholders and citizens

## Social Impacts

The digital economy offers opportunity for widespread public participation and engagement in the design, use and application of technology to enable neighbourhoods, villages, towns, cities and regions to thrive. With half the world's population – more than 3.5 billion people – online (Figure 2), and the amount of data produced doubling annually,<sup>17</sup> the internet combined with data analytics and machine learning can deliver unprecedented insights into changing societal needs, priorities, opportunities and risks.

**Figure 2: Internet Users by World Region, 2005-2017**



CIS = Commonwealth of Independent States

Source: ITU World Telecommunication/ICT Indicators database, <http://www.itu.int/en/ITU-D/Statistics/Pages/facts/default.aspx>.

Enabling the widespread use of digital technologies can ensure a future in which humanity's major challenges, such as healthcare and disease control, climate change, poverty and adequate education and agricultural production, are addressed in an inclusive and sustainable manner. Indeed, the path to achieving many of the UN Sustainable Development Goals (SDGs), adopted in September 2015, can be accelerated by harnessing digital technologies (Figure 3).

*"If we can extend [the internet] to more people, we increase voice ... we increase economic opportunity ... and we increase equality."*



- Sheryl Sandberg, Chief Operating Officer and Member of the Board, Facebook, USA

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New digital technologies can empower individuals with increased access to information and resources to inform decisions and actions, while agencies can monitor and track overall progress, supporting investment and the scaling of successful intervention strategies. But the careful application of digital technologies is critical. If digital technology is to create more inclusive and sustainable societies, it must do so through a human-centred process.

**Figure 3: UN Sustainable Development Goals**



Source: United Nations, Sustainable Development Goals, <https://sustainabledevelopment.un.org/?menu=1300>.

By 2050, 25% of the world's population will be over 60 years of age and nearly 70% of the world's population will live in cities.<sup>18</sup> Changing demographics and population density necessitates reformed health, environmental and educational strategies. Digital technologies offer unprecedented opportunity to inform targeted approaches that improve the collective well-being of our communities. New leadership competencies for harnessing social networks for improving lives within communities are essential social components for any digital transformation to be sustainably effective.<sup>19</sup>

Digital technologies can fundamentally shift healthcare costs from treatment to early detection and prevention. Financial pressures and ageing populations are refocusing healthcare to person-centred care, shifting focus from hospitals to home, and creating new opportunities for services to be expanded from urban to rural locations. A human-centred design approach for e-health strategies is critical to ensure adoption and appropriate use. If not, the application of digital technology risks aggravating the digital divide, as many will feel forced to adjust to unfriendly technology at a time when learning new skills can be difficult. Care must be taken to ensure the digital divide does not exacerbate health and healthcare inequalities between the rich and poor, urban and rural, and young and old.

***“The G20 bloc needs to expand access to the digital economy and reduce the digital divide between the North and the South.”***

- Xi Jinping, President of the People's Republic of China

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Community health is inextricably tied to environmental health. The World Health Organization has warned that pollution is now a greater health threat than Ebola and HIV. Over 28,000 people die in the United Kingdom each year from complications caused by air pollution.<sup>20</sup> In a 15-block area of Los Angeles, drivers spent an additional 100,000 hours looking for parking, resulting in the use of 47,000 gallons of fuel and emitting 730 tons of CO<sub>2</sub> within the span of a year.<sup>21</sup> The more frequent and granular tracking of traffic patterns, parking availability and air quality through the use of sensors, open data and mapping can help support more efficient city transit planning and increase public environmental accountability.<sup>22</sup>

Digital technologies can also help governments to address the challenge of youthful populations.<sup>23</sup> About a quarter of the world's population is under 15 years of age, but this share rises to a third, or even a half, in some of the world's least developed countries. To reap the benefits of this demographic dividend, investments are required in education, but with massive increases in school enrolment occurring annually, it is clear that traditional "bricks and mortar" approaches to education are significantly challenged: EdTech can help.<sup>24</sup>

While digital tools offer great potential to meet the SDGs, half the world's population – mostly in developing countries – remains offline. Lack of affordable internet access, a limited amount of locally-relevant content and insufficient digital skills continue to serve as barriers.<sup>25</sup> Technological challenges remain, but technology is no longer the biggest barrier to global connectivity: affordable internet access also requires far-sighted approaches to spectrum auctions and tax and competition policies, digital skills require investments in education and training, and local content generation must be supported by entrepreneurialism and the removal of red tape and bureaucracy. The World Economic Forum's Internet for All initiative is developing guiding frameworks to support businesses, governments and civil society organizations in forming public-private partnerships that support widespread and sustainable internet adoption and application.<sup>26</sup>

To access the full benefits of the digital economy and society, formal personal identification is frequently required, yet nearly one-fifth of the world's population – an estimated 1.5 billion people – lacks such an identity. Given its critical role in the facilitation of service delivery and the execution of economic, social and political rights, the SDGs have set a target to "provide legal identity for all, including birth registration, by 2030" (listed as target #16.9).<sup>27</sup> Digital identity systems offer one opportunity to create formal personal identification to ensure more inclusive access to a range of rights and services, such as online financial payments and education courses. One of the most successful is India's Aadhaar programme, which has created digital identities for nearly 1.1 billion people, enabling access to governmental, non-governmental and private-sector services.<sup>28</sup>

*"I hope that we'll be in a situation where I can store data wherever I like, but it's stored there in a way it's treated as mine."*

*- Sir Tim Berners-Lee, Professor of Engineering, MIT Computer Science and Artificial Intelligence Laboratory (CSAIL), USA*

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Large digital identification platforms can increase inclusion, but they can also be susceptible to cyberattacks and issues of privacy. More policies and practices will be required with the

expansion of digital identity systems to address privacy concerns, test security, monitor attacks and create interoperable security standards.

### *Key considerations*

#### **Opportunities**

- The creation of secure digital identity platforms can increase inclusion in the digital economy and society.
- Healthcare spending efficiency can be increased through patient-centred digital healthcare.
- The promotion of the use of sensors and open data can cut waste, increase asset productivity and enable environmental sustainability.
- Solutions can be developed that help people make more informed decisions on their health, education and finances.

#### **Risks**

- Cyberattacks undermine the adoption and use of digital platforms.
- Healthcare fails to make the investments in digital health to accelerate the transition to a more patient-centred, decentralized system.
- Environmental standards are not prioritized (e.g. air quality).
- Unequal internet provision and lack of digital literacy and skills widen the digital divide.

#### **Strategies**

- Develop secure digital identity programmes that enable citizens to control how, when and where their digital identity is shared
- Promote digital healthcare strategies focused on shifting the location of care out of the hospital to closer to home, and transforming the type of care from diagnose and treat to prevent and manage
- Promote the adoption of environmental solutions powered by digital technology (smart grids, storage, electric vehicles) and develop frameworks for environmental data verification and sharing
- Promote digital education strategies focused on ensuring that all children have access to education, even in the fastest-growing and least-developed countries
- Support public-private partnerships in broadband roll-out, including public Wi-Fi, and digital literacy training to enable greater inclusion in the digital economy and society

## The New Digital Landscape

Data and digital technologies can improve business and government accountability and efficiency. The opportunity is to shift centralized decision-making in departmental silos to more transparent and participative models that engage outside of traditional hierarchies. For example, open data initiatives, automation and AI-enabled decision-making, as well as crowdsourcing platforms, can lead to faster and more informed government programmes and services at the regional, national and local levels, from eGov to ePublic Service.<sup>29</sup>

*“Trust is a serious problem – we have to get to a new level of transparency – only through radical transparency will we get to radical new levels of trust.”*

*- Marc R. Benioff, Chairman and Chief Executive Officer, Salesforce, USA*

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Open data initiatives not only allow the increased transparency of business and government programmes, but can also spur the development of customer-led and citizen-led technologies and insights of value to the public and private sectors. Open data must be curated and presented in a way that is easily usable and supports the collaborative development of digital tools and applicable insights. Launched under the Obama Administration in the United States, the White House Opportunity Project shared regional, national and local data sets to empower citizen developers to create digital tools that help their communities identify resources, opportunities and risks.<sup>30</sup>

The combination of open data platforms, such as data.gov and data.gov.uk, with collaborative e-participation platforms (e.g. crowdfunding, crowdsourcing, wiki-style collaborative editing) offer the potential to leverage the power of citizens to make governments more responsive to their needs and priorities. Decisions made in isolation can be wrought with bias or issue blindness. Increasingly, businesses are engaging more deeply with their customers in innovative ways to design interactions, products and services.<sup>31</sup> Collaborative e-participation platforms allow for-profit and social enterprises and governments to tap into the collective intelligence of their suppliers, stakeholders, customers and constituents, revealing novel insights into how to better target and effectively solve problems in the ecosystem.

Automation and AI-enabled decision-making can help governments better manage and allocate resources and services effectively by reducing backlogs, overcoming resource constraints, and improving real-time tracking and predictions. Deloitte has estimated that over 95 million federal working hours could be freed up each year in the United States through the application of AI, resulting in savings of nearly \$3.3 billion.<sup>32</sup> Computer vision and natural language processing can scan documents for relevant data points that are automatically entered into a database, and machine learning can formulate predictive models to inform decisions and allocate resources accordingly. However, AI-enabled tools are prone to replicate bias inherent in data and model assumptions.<sup>33</sup> Thus, it is imperative that the application of digital technologies be carefully considered, especially in areas that may result in biased decision-making and risk legal due process.

Vast amounts of information gleaned from personal data and metadata have enabled the development of “persuasive technologies” – systems, devices or applications that tailor persuasive messages to intentionally influence, or “nudge”, individual and collective action.<sup>34</sup> These technologies are increasingly applied in politics to facilitate “big nudging”, analysing and applying big data to inform targeted marketing and outreach to influence individual and collective thoughts and actions in alignment with political goals.<sup>35</sup> In order for persuasive technologies to have an effect, there must be resonance (i.e. messages must be sufficiently personalized to each individual). This can lead to the development of an “echo chamber effect”, reinforcing beliefs and strengthening social polarization. In effect, government use of persuasive technologies can unravel social cohesion and slow large-scale opinion change.<sup>36</sup>

The digital economy offers great opportunity to make enterprises and governments more inclusive and accountable to their stakeholders, customers and constituents. Open data initiatives, automation and AI-enabled decision-making, and collaborative e-participation platforms can lead to faster and more informed programmes and services at the regional, national and local levels. However, this approach will meet resistance unless mechanisms that ensure trust in data, algorithms and tools are established. To do so, partnerships that promote greater transparency and accountability between government, the private sector, academia and the public will be increasingly necessary.

### *Key considerations*

#### **Opportunities**

- Faster and more transparent information will make governments and enterprises more accountable.
- The more efficient and cost-effective use of personnel and services will be made in government decision-making.
- The crowdsourcing of ideas promotes more effective policy decisions and execution.

#### **Risks**

- Data and algorithmic-bias applied within enterprise and government decision-making can further disenfranchise individuals and groups.
- Data complexity and data cleansing hinder open data.
- Social polarization could increase.

#### **Strategies**

- Create a collection of Application Program Interfaces (APIs) that allow customer, stakeholder and citizen developers to access relevant data
- Implement collaborative e-participation platforms that help to gather and sort public insights
- Critically evaluate and rigorously test the application of automation and AI, identifying and correcting for bias and discrimination and risks to legal due process
- Create a framework that provides qualitative indices and quantitative measures to highlight how to balance the trade-offs between the digital benefits and risks

## Conclusion and Recommendations

The intent of the Global Future Council on the Digital Economy and Society is to create a baseline understanding of the opportunities and risks of the digital revolution and catalyse strategies that enable greater inclusion and collective well-being.

Digital technologies amplify economic, social and political opportunities and risks. They are a force that can improve or hinder progress on the big global challenges of inequality, environmental degradation and resource scarcity. The fear that digital technologies will reinforce current power inequalities could provoke a global anti-technology backlash. This could result in commercial, technological or governmental fragmentation of the internet, undermining potential benefits made possible through a globally interconnected digital economy and society. It is therefore critical that open dialogue and collaborative approaches – top-down and bottom-up – be fostered to develop agile strategies that enable both benefits and risks to be identified and assessed and that facilitate approaches aimed at creating a more equitable digital future.

*“Ultimately, it’s the way human beings, with our vast stores of ingenuity, deploy the power of the technology and tools that makes the biggest difference.”*

*- Bill Gates, Co-Chair, Bill & Melinda Gates Foundation, USA*

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The digital future should reflect human values. Collaborative, multistakeholder dialogues that support creative, innovative and experimental models will be necessary to keep pace with the scale of change. These systems should be transparent and adaptable, so that all stakeholders can have a voice in shaping the benefits and risks of the digital revolution. This points to the need for a more open approach to policy-making, greater emphasis on experimentation, a stronger framework for citizen engagement, and a better understanding of societal costs and benefits. The digital economy requires a more inclusive and collaborative approach, necessitating an open, secure, trustworthy and inclusive internet that can support the shared development of technologies across business, government and civil society.

### Recommendations

The digital economy and society permeates every aspect of daily life from the way people shop, work, live, stay healthy and travel. Nine recommendations are proposed to help enhance the digital opportunities and mitigate the risks, under three categories: Technology, Human-centred design and Governance:

#### 1. Technology

- 1.1 Improve internet connectivity, affordability and localized content for SMEs
- 1.2 Develop secure digital identity programmes
- 1.3 Test and correct AI algorithms and applications for bias and discrimination

#### 2. Human-centred design

- 2.1 Build individual-centred policies and practices focused on digital skills, lifelong learning and roles in which technology complements human skills
- 2.2 Promote digital health, environment and education policies focused on outcomes: preventive healthcare, environmental sustainability and educational attainment
- 2.3 Foster greater transparency in data sharing and privacy policies for both consumer data and industrial applications

### **3. Governance**

- 3.1 Adopt agile governance principles that favour outcomes, collaboration and self-organization over rules, control and centralization
- 3.2 Promote platform models based on security, accountability, transparency and fairness in value allocation
- 3.3 Develop frameworks to balance the trade-offs between digital benefits and risks

## Endnotes

- <sup>1</sup> Iceland conducted a crowdsourcing process from 2010 to 2013 to formulate a new constitution. While the crowdsourced constitution received support from two-thirds of voters, the Icelandic Parliament opposed it so it was never ratified. See Equal Citizens, “On Iceland’s Crowdsourced Constitution”. Available at <https://medium.com/equal-citizens/on-icelands-crowdsourced-constitution-ad99aae75fce>.
- <sup>2</sup> See the World Economic Forum report, *Deep Shift: Technology Tipping Points and Societal Impact*, Global Agenda Council on the Future of Software & Society, September 2015. Available at [http://www3.weforum.org/docs/WEF\\_GAC15\\_Technological\\_Tipping\\_Points\\_report\\_2015.pdf](http://www3.weforum.org/docs/WEF_GAC15_Technological_Tipping_Points_report_2015.pdf).
- <sup>3</sup> The growth of connected devices is expected to contribute to the development of a nearly \$7 trillion market by 2020. See “Internet of Things By The Numbers: Market Estimates And Forecasts”, *Forbes*, 22 August 2014. Available at <https://www.forbes.com/sites/gilpress/2014/08/22/internet-of-things-by-the-numbers-market-estimates-and-forecasts/#746e9d8fb919>.
- <sup>4</sup> See *Deep Shift: Technology Tipping Points and Societal Impact*, World Economic Forum, op. cit.
- <sup>5</sup> See the World Economic Forum White Paper, “Internet Fragmentation: An Overview”, Future of the Internet Initiative, January 2016. Available at [http://www3.weforum.org/docs/WEF\\_FII\\_Internet\\_Fragmentation\\_An\\_Overview\\_2016.pdf](http://www3.weforum.org/docs/WEF_FII_Internet_Fragmentation_An_Overview_2016.pdf).
- <sup>6</sup> See the BCG report, *The Internet Economy in the G-20, The \$4.2 Trillion Growth Opportunity*, March 2012. Available at <https://www.bcg.com/documents/file100409.pdf>.
- <sup>7</sup> See Scientific American article, “Will Democracy Survive Big Data and Artificial Intelligence?”, 25 February 2017. Available at <https://www.scientificamerican.com/article/will-democracy-survive-big-data-and-artificial-intelligence/>.
- <sup>8</sup> Ibid.
- <sup>9</sup> See “AI for Good: Maximizing the economic and societal benefits of AI”, 29 March 2017. Available at <http://cra.org/ccp/wp-content/uploads/sites/2/2017/04/aiforgood-032917.pdf>.
- <sup>10</sup> See also Acuitus, “Education Dominance: DARPA – Education Dominance, Training and human effectiveness”. Available at <http://www.acuitus.com/web/education-dominance.html>.
- <sup>11</sup> See Finextra Research blog post, “Fintech to bridge \$2 trillion SME funding gap – World Economic Forum”, 27 October 2015. Available at <https://www.finextra.com/newsarticle/28039/fintech-to-bridge-2-trillion-sme-funding-gap---world-economic-forum>.
- <sup>12</sup> See Microsoft news article, “New Microsoft and Boston Consulting Group research highlights potential for technology to help fuel significant revenue and job growth for SMEs in Singapore”, 27 February 2014. Available at <https://news.microsoft.com/en-sg/2014/02/27/microsoft-and-bcgreport-highlights-tech-benefits-for-singapore-smes/>.
- <sup>13</sup> See the World Economic Forum report, *The Future of FinTech: A Paradigm Shift in Small Business Finance*, Global Agenda Council on the Future of Financing & Capital, October 2015. Available at [http://www3.weforum.org/docs/IP/2015/FS/GAC15\\_The\\_Future\\_of\\_FinTech\\_Paradigm\\_Shift\\_Small\\_Business\\_Finance\\_report\\_2015.pdf](http://www3.weforum.org/docs/IP/2015/FS/GAC15_The_Future_of_FinTech_Paradigm_Shift_Small_Business_Finance_report_2015.pdf).
- <sup>14</sup> See *Deep Shift: Technology Tipping Points and Societal Impact*, World Economic Forum, op. cit.
- <sup>15</sup> See the Rabobank press release, “Seven banks plan blockchain platform to help European SMEs increase trade”, 16 January 2017. Available at <https://www.rabobank.com/en/press/search/2017/20170116-banks-platform-dtc-blockchain.html>.
- <sup>16</sup> See the McKinsey Global Institute report, *Digital globalization: The new era of global flows*, February 2016. Available at <http://www.mckinsey.com/business-functions/digital-mckinsey/our-insights/digital-globalization-the-new-era-of-global-flows>.
- <sup>17</sup> See “Will Democracy Survive Big Data and Artificial Intelligence?”, op. cit.
- <sup>18</sup> See World Health Organization, “Ageing and health”, Fact sheet No. 404, September 2015. Available at <http://www.who.int/mediacentre/factsheets/fs404/en/>.
- <sup>19</sup> See the Wiley article, “Federal Health Care Leadership Skills Required in the 21st Century”, 15 December 2015. Available at <http://onlinelibrary.wiley.com/doi/10.1002/jls.21397/abstract>.
- <sup>20</sup> See *The Telegraph* article, “Pollution is now a greater threat than Ebola and HIV, the World Health Organisation warns”, 6 March 2017. Available at <http://www.telegraph.co.uk/news/2017/03/06/pollution-now-greater-threat-ebola-hiv-world-health-organisation/>.
- <sup>21</sup> According to Donald Shoup in his book, *The High Cost of Free Parking*, Chicago, IL: Planners Press, 2005.



<sup>22</sup> See CITRIS and the Banatao Institute, *IOT & Sustainability: Practice, Policy and Promise*, Center for Information Technology Research in the Interest of Society and the Banatao Institute, University of California, June 2016. Available at [http://citriss-uc.org/wp-content/uploads/2016/07/CITRIS\\_IoT-and-Sustainability-White-Paper.pdf](http://citriss-uc.org/wp-content/uploads/2016/07/CITRIS_IoT-and-Sustainability-White-Paper.pdf).

<sup>23</sup> See World Economic Forum blog post, “The world’s 10 youngest populations are all in Africa”, 9 May 2016. Available at <https://www.weforum.org/agenda/2016/05/the-world-s-10-youngest-countries-are-all-in-africa/>.

<sup>24</sup> See the World Bank blog about the economic challenges and opportunities facing Africa, “How significant could Africa’s demographic dividend be for growth and poverty reduction?”, 2 March 2015. Available at <http://blogs.worldbank.org/africacan/how-significant-could-africas-demographic-dividend-be-for-growth-and-poverty-reduction>.

<sup>25</sup> See World Economic Forum blog post, “4 billion people still don’t have internet access. Here’s how to connect them”, 11 May 2016. Available at <https://www.weforum.org/agenda/2016/05/4-billion-people-still-don-t-have-internet-access-here-s-how-to-connect-them/>.

<sup>26</sup> Ibid.

<sup>27</sup> See United Nations Development Programme (UNDP), Goal 16 Targets. Available at <http://www.undp.org/content/undp/en/home/sustainable-development-goals/goal-16-peace-justice-and-strong-institutions/targets/>.

<sup>28</sup> The Aadhaar programme links a person’s biometric data (i.e. fingerprints, iris scans and facial photo) and demographic information with a unique 12-digit number (see “Unique Identification Authority of India” at <https://uidai.gov.in/your-aadhaar/about-aadhaar.html>).

<sup>29</sup> See the People-Centered Internet interview with David Bray, Chief Information Officer, Federal Communications Commission (FCC), USA, 4 June 2017. Available at <https://peoplecentered.net/2017/06/04/251/>.

<sup>30</sup> See The Opportunity Project, “Creating digital tools that strengthen American economic opportunity”. Available at <https://opportunity.census.gov/>.

<sup>31</sup> See SuperOffice, “How to Create a Customer Centric Strategy For Your Business”, 2 August 2017. Available at <https://www.superoffice.com/blog/how-to-create-a-customer-centric-strategy/>.

<sup>32</sup> See Deloitte University Press, “Artificial intelligence in government”. Available at <https://dupress.deloitte.com/dup-us-en/focus/artificial-intelligence-in-government.html>.

<sup>33</sup> A machine learning model to predict recidivism was found to disproportionately identify black defendants as high-risk, while white defendants were wrongly identified as low-risk. See the Pro Publica article “Machine Bias: There’s software used across the country to predict future criminals. And it’s biased against blacks”, 23 May 2016. Available at <https://www.propublica.org/article/machine-bias-risk-assessments-in-criminal-sentencing>.

<sup>34</sup> See “Persuasive Technologies” by B. J. Fogg in *Communications of the ACM*, Vol. 42, No. 5, May 1999. Available at <http://dl.acm.org/citation.cfm?id=301396>.

<sup>35</sup> The 2012 Obama campaign was a success in large part due to its use of big data and persuasive technologies to inform voter characteristic modelling, mobilization tactics and persuasion models. See *MIT Technology Review* article “A More Perfect Union: How Obama’s Team Used Big Data to Rally Voters”, 19 December 2012. Available at <https://www.technologyreview.com/s/509026/how-obamas-team-used-big-data-to-rally-voters/>.

<sup>36</sup> See “Will Democracy Survive Big Data and Artificial Intelligence?”, op. cit.