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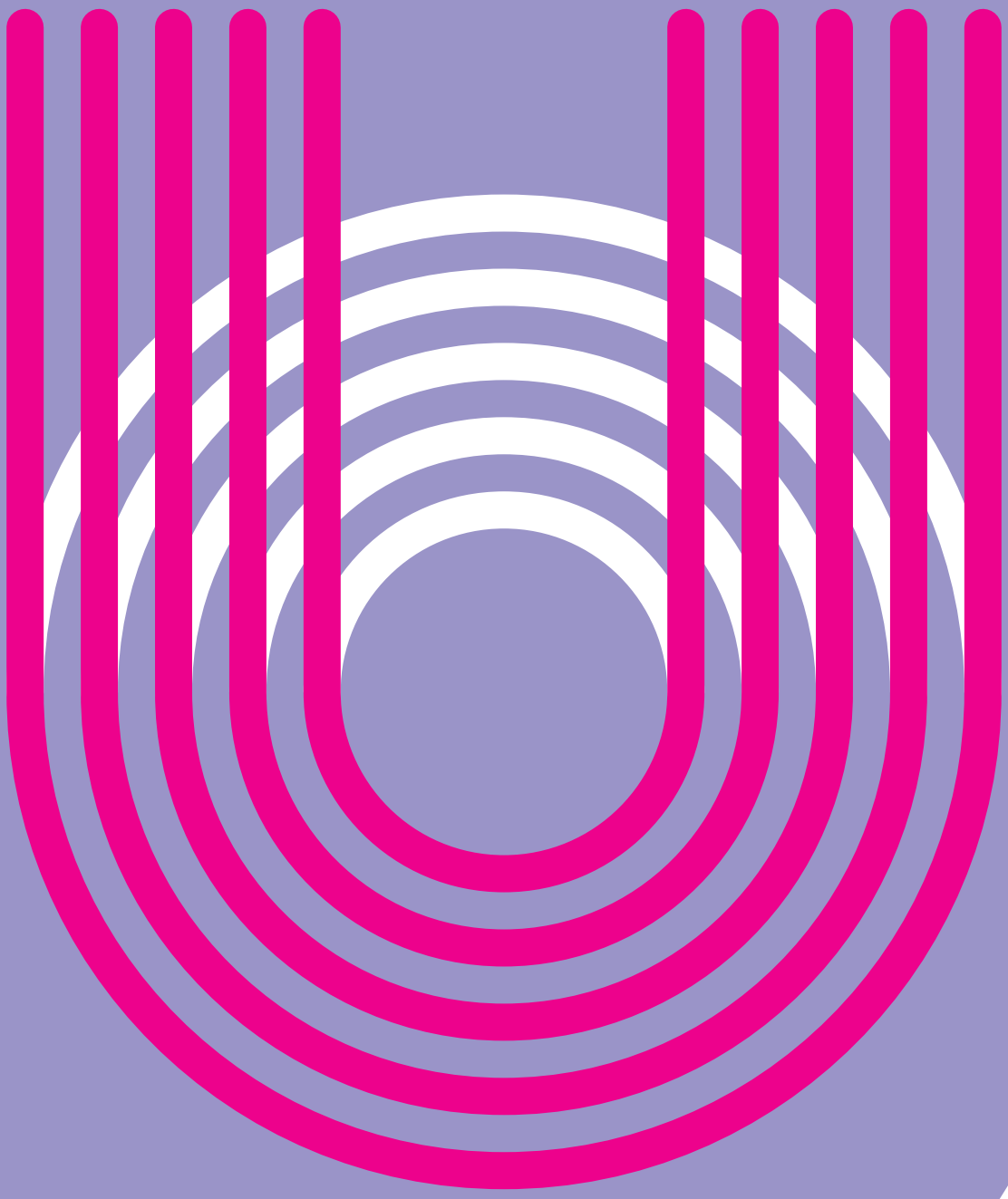

GOING DIGITAL IN A MULTILATERAL WORLD

OECD
BETTER POLICIES FOR BETTER LIVES

Going Digital in a Multilateral World

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Going Digital in a Multilateral World - An Interim Report to Ministers

Executive Summary

1. In January 2017, the OECD launched *Going Digital: Making the Transformation Work for Growth and Well-being* (the Going Digital project). The project aims to help policymakers better understand the digital transformation that is taking place and create a policy environment that enables their economies and societies to prosper in a world that is increasingly digital and data-driven. This report provides interim results from the Going Digital project; a list of specific deliverables can be found in Annex III. A final synthesis report, based on an integrated policy framework, will be released at a high-level conference on 11-12 March 2019, following the completion of all of the work under the Going Digital umbrella.

2. Economies, governments and societies across the globe are going digital. Almost half of the world's population is now connected to the Internet, up from only 4% in 1995. In 2016, 83% of adults in the OECD area accessed the Internet and 95% of firms in OECD countries had a high-speed Internet connection. As of June 2017 there were almost 102 mobile broadband subscriptions per 100 inhabitants in the OECD area, on average more than one per person. In OECD countries, digital transformation is now characterised by almost universal connectivity, but also by ubiquitous computing, and draws on the generation and use of vast amounts of data.

3. Today, the world is at critical point in the ongoing digital transformation. Technologies continue to develop rapidly and are combining in novel and innovative ways, pushing digital transformation in new and often unpredictable directions. Policy making under uncertainty requires a consideration of several possible future scenarios, including the various uncertainties that underpin them, to ensure that policies put in place today remain resilient to the changes to follow. Together, governments and stakeholders must shape a common digital future that makes the most of the immense opportunities that digital transformation holds to improve people's lives and boost economic growth for countries at all levels of development, while ensuring that nobody is left behind.

4. Digital transformation affects all aspects of the economy and society in complex and interrelated ways, challenging existing policies in many areas. As a result, silos of all types are disintegrating, and hard borders are becoming less relevant. This means that stronger co-operation and collaboration domestically are critical, as well as a re-think about how policy is developed and implemented. In particular, a flexible, forward-looking and integrated policy framework that cuts across policy silos is essential to ensuring a coherent and cohesive whole-of-government approach to fully realise the potential of digital transformation and address its challenges. To support policy making in the digital age, better measurement of digital transformation and its impacts is critical,

including in areas such as national accounts, data and data flows, citizen trust, and digital trade. Such data may not necessarily come from traditional statistical sources.

5. Governments – at the local, regional and national levels – have an opportunity to be remade by digital transformation as they use digital technologies to improve efficiency and targeting, enable innovative policy design and rigorous impact evaluation, and expand citizen and stakeholder engagement.

6. At the same time, the Internet cuts across national borders and changes conventional notions of location, distance, and jurisdiction, requiring stronger international and multi-stakeholder co-operation which are critical factors in effective and multilateral action in many areas. For example, digital transformation offers both opportunities to tax administrations (e.g. to increase efficiency and raise tax compliance) as well as challenges (e.g. the use of distributed ledger technologies and crypto-currencies for illicit purposes), requiring now more than ever co-operation and co-ordination across jurisdictions.

7. Data are a foundational driver of digital transformation as well as an enabler. Data analytics, data-driven innovation, and other data-intensive activities, including machine learning and artificial intelligence (AI), benefit from open and interconnected information systems and networks that enable efficient, flexible and cheap data flows among potentially unlimited actors. Enhancing access to data can maximise the social and economic value of data, provided that all stakeholders have sufficient evidence to assess the possible trade-offs of data utilisation.

8. Data are also essential for trade and investment. Reaping the benefits of digital trade requires international dialogue on regulatory approaches that ensure the interoperability of differing regulatory regimes, for data or other transversal issues. Emerging measures impacting cross-border data flows raise concerns for business activity and the ability to benefit from digital trade; on the other hand, important public policy objectives, such as the protection of privacy, security and intellectual property rights (IPRs), must be taken into account.

9. A people-driven and inclusive approach to policy making is essential, as also highlighted in the OECD's 2018 Ministerial report on Inclusive Growth. If we lose sight of the individual and the need for all individuals to be engaged and benefit from digital transformation, the transformation cannot be positive and inclusive. Ensuring connectivity and affordable access for all, as well as the protection of individual's privacy and consumer rights, are key elements of an inclusive and people-driven approach.

10. Addressing the impacts of the digital transformation on jobs and skills is also key to an inclusive and people-driven outcome. Effective social dialogue should be combined with innovative approaches to addressing worker transition, including the use of technology to identify skills needs or to link skills to available opportunities, as well as public-private partnerships (PPPs) to develop new initiatives to facilitate worker transition. More data are also needed to enable the development of more effective policy approaches (for example, a better understanding of the challenges involved in worker redeployment, life-long training, and longitudinal data on skills/jobs development).

11. New OECD estimates suggest that on average 14% of jobs are at a high risk of automation in the next 15-20 years. Another 31% of jobs are at risk of significant change

in terms of task content as a result of automation. However, new jobs will be created too, and there is no evidence that, to date, technological change has been associated with net job losses overall.

12. But new jobs are not the same as those that are lost and polarisation in the labour market is a concern. High-skilled workers have thus far tended to benefit relatively more from technological change, while the share of employment in middle-skilled jobs has decreased. Going forward, low-skilled workers are most at risk of losing their jobs and being left behind.

13. Ensuring a smooth and fair transition for all workers requires a comprehensive package of co-ordinated policies, including facilitating worker redeployment, investing in skills, education and training, providing social protection and adequate employment protection to all forms of work, strengthening social protection, forward-looking labour market regulation, fostering social dialogue, and prioritising resources that can support the transition process.

14. While assuring the transition for workers, digital divides by age, education, gender, income, degree of disability, and geography persist across and within countries and must be reduced. Addressing these divides, e.g. by broadband policies aimed at providing affordable access and services to all, is crucial to ensuring a positive and inclusive transformation.

15. The impacts of digital transformation on well-being must be better understood and measured. Digital transformation may have both positive and negative impacts, and there may be heterogeneous effects across population groups, depending on age, gender, income level or skill-set. Placing people at the core of the design and delivery of policies and services, enabling new mechanisms for engagement and collaboration in policy making and service delivery, and making access and use of digital services more relevant and simple, is an imperative to fully seize the opportunities offered by digital transformation to improve people's well-being.

16. Policy makers can also help translate digital transformation into growth and productivity. Technologies – in particular frontier technologies – and related business models and organisational practices aren't diffusing as well as they need to. The diffusion of digital technologies is more advanced in sectors in which firm dynamism is higher. Harnessing digital transformation for firms requires policies that foster business dynamism and efficient resource reallocation, strengthening technology and knowledge diffusion, fostering investment in tangible and intangible capital, helping SMEs engage with digital transformation, facilitating structural adjustment to enable the growth of digitally-intensive firms, and ensuring sound competition.

17. Digital transformation enables firms to improve market intelligence and access global markets and knowledge networks at relatively low cost, opening up new opportunities that require complementary investments in organisational changes, process innovation, new systems and new business models (as well as skills). The scale and complexity of these complementary investments is growing, which makes digital transformation difficult for firms lacking key capabilities, such as traditional SMEs. Comprehensive national digital strategies that take into account SMEs (including by providing them with practical guidance and incentives to adopt good practices), policies

that facilitate access to finance, knowledge networks and skills, and SME engagement with competency centres and/or technology extension services, can be helpful.

18. As all sectors of the economy go digital, it is essential to encourage good digital security risk management practices by taking into account cross-border and cross-sector interdependencies and fostering trust with and among private operators to enable information sharing about threats, vulnerabilities and incidents, including for SMEs. To do so, responsibilities for digital security must be shared among individuals, business and governments.

19. As digital transformation progresses, individuals are increasing asking what personal data is stored, how it is subsequently used and whether they can access their data, on the job and at home. Technological advances can help increase trust through "privacy by design" processes whereby privacy preferences are embedded or coded in technologies from the start. For example, encryption can play an important role for privacy as mobile devices and the Internet of Things (IoT) expand.

20. At the same time, privacy in an increasingly data-driven economy requires a multifaceted strategy, reflecting a whole-of-society vision, and supported at the highest levels of government. Such strategies need to strike the right balance between the social and economic benefits of enhanced reuse and sharing of data and analytics, and individuals' and organisations' concerns about such openness, including the protection of privacy and intellectual property rights. Co-ordinated privacy strategies at the national level would enhance privacy protection in an increasingly data-driven environment.

21. The competitive environment is changing in digitally-intensive sectors. For example, mark-ups – the wedge between the price a firm charges for its output on the market and the cost the firm incurs to produce one extra unit of output – have been increasing on average across firms and countries, especially for firms at the top of the mark-up distribution and those in digitally-intensive sectors. Mergers and acquisitions are growing too, in particular in digitally-intensive sectors.

22. These changes may not necessarily be a source of concern, as they may be inherent to the nature of digital transformation, but they should be further examined and considered by policymakers. For instance, competition frameworks designed for traditional products may not be suitable for a global digital economy. Governments may also need to enhance co-operation across national competition agencies to address competition issues that are increasingly transnational in scope or involve global firms.

1. Introduction

23. The ongoing digital transformation of the economy and society holds many promises to spur innovation, generate efficiencies, and improve services, and in doing so boost more inclusive and sustainable growth as well as enhance well-being. But these opportunities will not materialise automatically and may require policy action to make digital transformation work for growth and well-being. Our interactions with one another and with society more broadly are also being transformed, as are the nature and structure of organisations and markets, raising important issues around jobs and skills, privacy, security, and how to ensure that technological changes benefit all in society.

24. The future direction of digital transformation is uncertain. Policymakers must understand the core aspects of the transformation and identify a policy mix that will enable their economies to maximise the benefits of an increasingly digital global economy and adequately address the related challenges. Policy stakeholders – including governments, civil society, trade unions, business and the Internet technical community – need to work together to shape a future that realises the potential of digital transformation for all, thus supporting inclusive growth, as highlighted in the OECD's 2018 Ministerial report on Inclusive Growth. This requires overcoming organisational barriers to collaboration among government bodies, sharing and horizontal decision making, a stronger emphasis on anticipating potential changes and impacts, and greater use of data and digital technologies in policy making.

25. A balanced policy approach that includes a combination of self-regulation, voluntary and market-driven standards and sharing of best practices, application of existing regulations, and updated policy and regulatory frameworks, needs to be considered. The digital transformation will also require the development of healthy digital ecosystems, and the sharing of responsibility between people, business, trade unions, civil society organisations, and governments.

26. It is critical for governments to be forward-looking. As these changes unfold and new technology-based applications such as artificial intelligence (AI), the IoT and distributed ledgers become deployed, the gap between policy and the changes induced by digital transformation are likely to only become greater. Moreover, in many policy areas international, multi-stakeholder co-operation is important and multilateral action often required.

27. To chart the road ahead, in June 2016 Ministers and high-level representatives from 41 countries and the European Union committed to work together to preserve an open Internet, close digital divides, promote digital skills and generally do more to seize the potential of the digital economy in the OECD Ministerial Declaration on the Digital Economy: Innovation, Growth and Social Prosperity (the Cancún Declaration) [C(2016)116]. Adherents – the OECD Members plus Argentina, Colombia, Costa Rica, Ecuador, Egypt, Indonesia and Lithuania as well as the European Union – vowed to:

- Increase access to broadband Internet and services to bridge digital divides.
- Reduce barriers to investment in and adoption of digital technology in all sectors.

- Work to develop global technical standards that enable interoperability and a secure, stable, open and accessible Internet.
- Develop privacy and data protection strategies at the highest level of government, while also encouraging the availability and use of data, including public sector data.
- Adopt technologically neutral frameworks that promote competition.
- Use open, transparent and inclusive processes to shape global Internet governance.
- Reduce impediments to e-commerce within and across borders with policies that strengthen consumer trust and product safety.
- Improve education and lifelong training to respond to the demand for general and specialist digital skills.

28. Building on the Cancún Declaration, in January 2017 the OECD launched *Going Digital: Making the Transformation Work for Growth and Well-being* (the Going Digital project). The project aims to help policymakers better understand the digital transformation that is taking place and create a policy environment that enables their economies and societies to prosper in a world that is increasingly digital and data-driven. This report provides interim results from the Going Digital project; a detailed report on the implementation of the project can be found in the latest Going Digital State of Play report (OECD, 2018b) and a list of specific deliverables can be found in Annex III. A final synthesis report, based on an integrated policy framework, will be released at a high-level conference on 11-12 March 2019, following the completion of all of the work under the Going Digital umbrella.

Box 1.1. The Multi-stakeholder Model: A Key to Good Policymaking in the Digital Age

Stakeholder outreach is an integral part of the OECD philosophy and way of doing things; broad consultation enriches the debate, sheds new light on complex issues, and ultimately leads to better policy outcomes. The OECD is unique among its peers. Right from the beginning, it established institutional relations with trade unions and business through two advisory committees: the Business and Industry Advisory Committee (BIAC) and the Trade Union Advisory Committee (TUAC). BIAC and TUAC have become integral players in the OECD ecosystem and contribute actively, across the board, to the work of the organisation.

The OECD's policy-making process, however, goes far beyond these institutional relations to include other interlocutors. At the OECD Ministerial Meeting on the Internet Economy in 2008 in Seoul, both the Civil Society Information Society Advisory Council (CSISAC) and the Internet Technical Advisory Committee (ITAC) were formally recognised in the work of the Committee on Digital Economy Policy. Seoul was a first step toward creating the unified, inclusive multi-stakeholder model that has served so well since.

Multi-stakeholder co-operation brings tangible benefits that genuinely lead to better policies and outcomes. The legitimacy of policies taken with input of all stakeholders is strengthened. The quality of outputs is improved with the technical, social and business insights that make it into OECD reports and recommendations. This approach to digital economy policy development has grown from the Internet's own DNA: open, distributed, and borderless.

2. Understanding Digital Transformation and Designing Policy under Uncertainty

2.1. Understanding digital transformation and its policy impacts

29. Ubiquitous digital devices, connectivity, software, and data are empowering individuals and organisations to change behaviours, relationships, business models, and markets. Better understanding the ways in which digital transformation (Box 2.1) affects the economy and society is crucial to form a coherent response that is co-ordinated between tiers of government and across traditional policy domains.

Box 2.1. Defining digital transformation

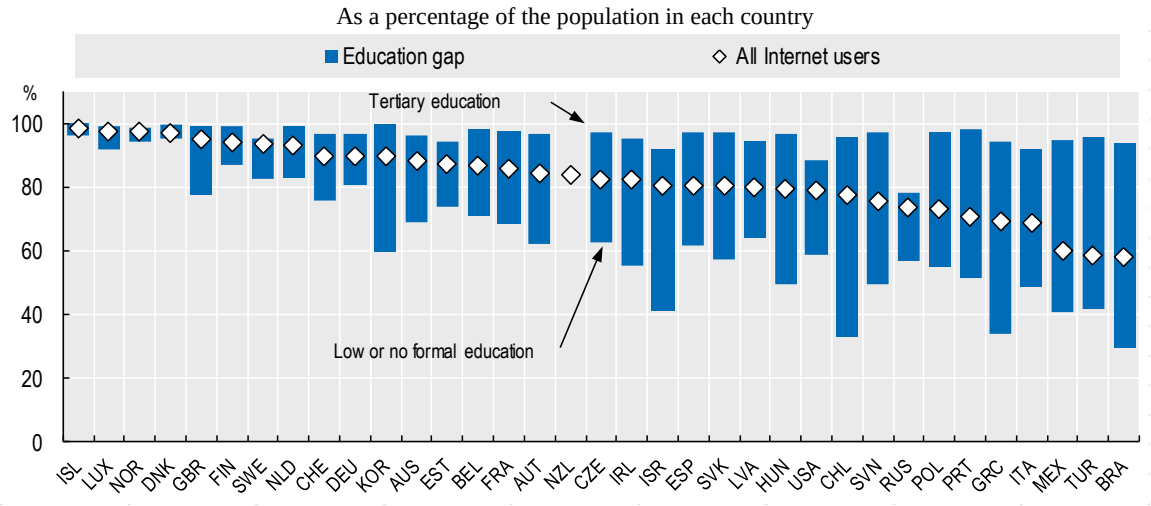
Digital transformation refers to the economic and societal effects of digitisation and digitalisation. Digitisation is the conversion of analogue data and processes into a machine-readable format. Digitalisation is the use of digital technologies and data as well as their interconnection which results in new or changes to existing activities.

Technology diffusion and data are driving digital transformation

30. Although digital transformation has already been underway for about half a century, digital technologies have only now reached almost all individuals in OECD countries. In 2016, 83% of adults in the OECD area accessed the Internet and 95% of firms in OECD countries had a high-speed connection to the Internet. As of June 2017, there were almost 102 mobile broadband subscriptions per 100 people in the OECD, more than one per person (OECD, 2018h), and OECD mobile data use surged by 37% between 2015 and 2016 (OECD, 2017a). The fact that most people in OECD countries now own a constantly connected computer in the form of a smart phone – which is equivalent in speed and processing power to a super-computer from the mid-1990s – shifts the impact from the economy to society more broadly.

31. Despite the rapid uptake of digital technologies, important digital divides remain, in particular at the global level, with less than half of the world population connected to the Internet. In OECD countries, the uptake of digital technologies still differs by age, education and income levels, although these gaps have been closing over time (OECD, 2017a). For example, while in countries like Iceland, Luxembourg, Norway and Denmark the gap between those with higher and lower levels of education has almost disappeared, it remains sizeable in other countries (Figure 2.1). Access to high-speed fibre networks also differs strongly across OECD countries, with over 75% of the population connected in Korea and Japan, and less than 5% in other OECD countries (OECD, 2018h).

Figure 2.1. Gap in Internet use by educational attainment, 2016



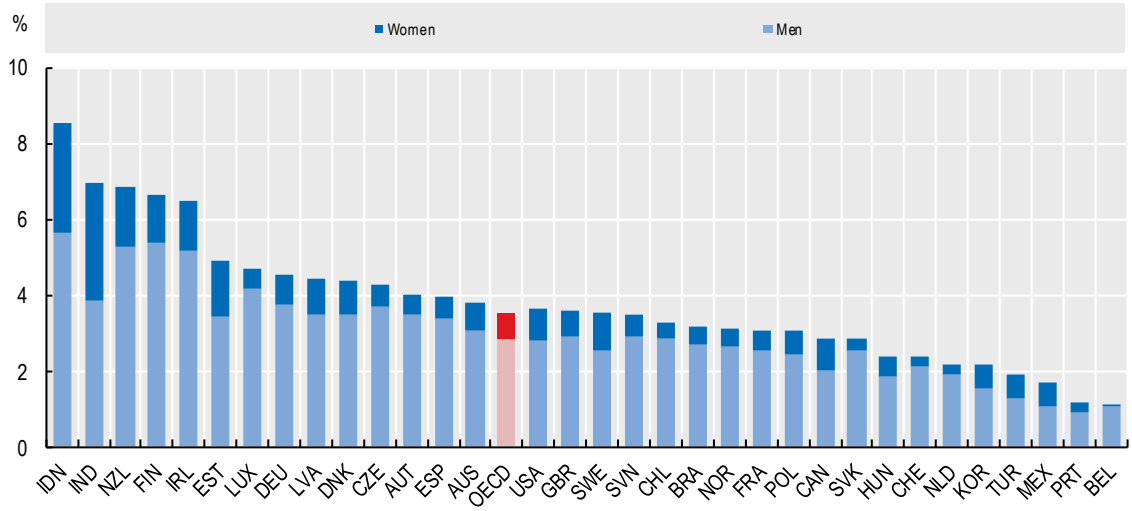
Source: OECD 2017b.

32. In addition to access, other dimensions such as age, gender and education also affect how the technology is used. For example, young people dominate digital communication, content creation, social networking, online purchases, cloud computing, and software downloads, whereas older people are more frequent users of e-government and e-banking (OECD, 2017b). Higher education levels are associated with the uptake of more sophisticated activities such as online purchases, cloud computing and job search.

33. Other digital divides are also important in several countries, notably urban versus rural, high versus low income levels, as well as gender gaps (OECD, 2017a; 2017b). For example, large gender gaps remain in the access and use of digital technologies, with women particularly under-represented in STEM fields. Moreover, women account for only 20% of tertiary graduates in ICT fields; are 20% less likely to hold a senior leadership position in the mobile industry, make up only 8% of investing partners in the top 100 venture capital firms and only 17% of the scientists earning more than USD 105 000 (Figure 2.2) (OECD, 2018a). Addressing and closing these gaps is important to ensure an inclusive digital transformation.

Figure 2.2. Tertiary graduates in ICT fields, by gender, 2015

As a percentage of all tertiary graduates

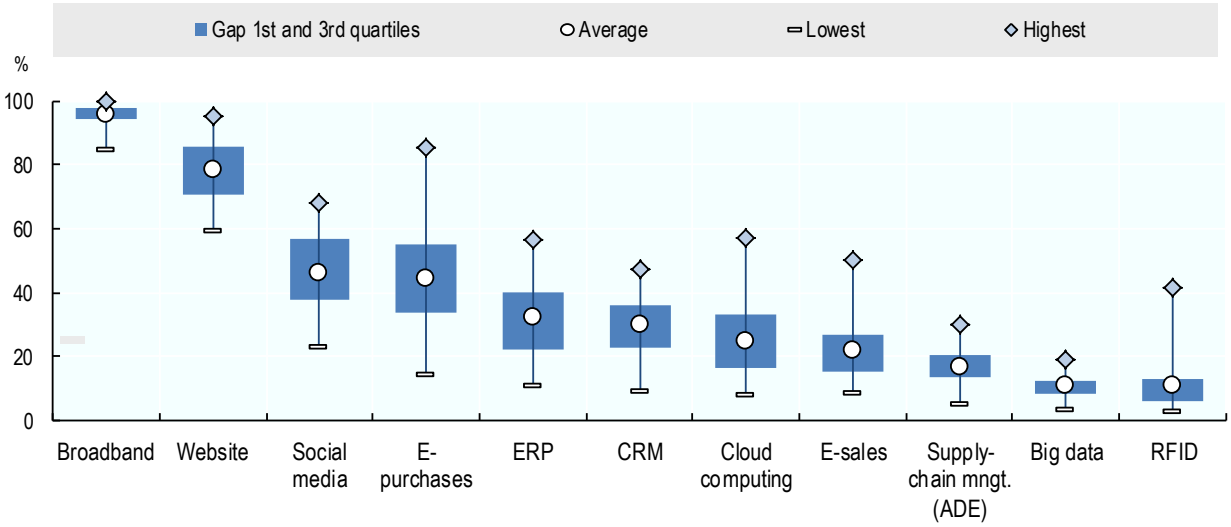


Source: OECD 2017b.

34. Firms' access to digital technologies has also grown rapidly over the past decade, as discussed in more detail in Section 4.2. Across the OECD, most firms now have access to broadband networks, although there are large differences in the use of more advanced digital technologies, in particular by SMEs. Underpinned by the use of digital tools, firms are advancing the digitalisation of their business processes (enterprise resource planning - ERP), business organisation (cloud computing), product and process innovation (big data), and market integration (customer relationship management - CRM), and are increasingly making use of radio-frequency identification (RFID) (Figure 2.3). The uptake of digital technologies also differs substantially across sectors, with the ICT sector among the more advanced adopters (Calvino et al., 2018).

Figure 2.3. Diffusion of selected ICT tools and activities in enterprises, 2016

As a percentage of enterprises with ten or more persons employed

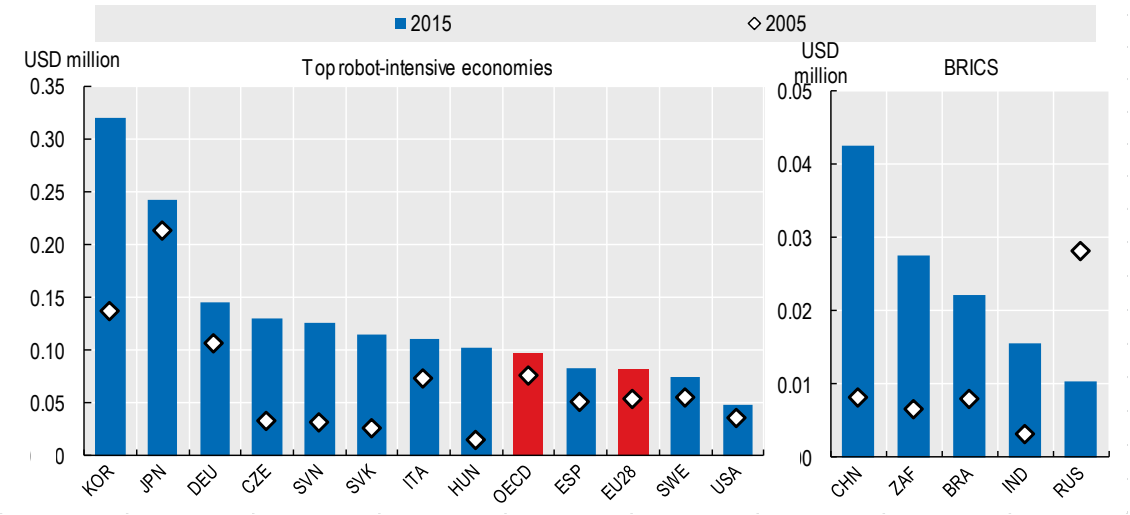


Source: Based on OECD 2017a.

35. Production processes, in particular in manufacturing, are also being transformed by the deployment of industrial robots. Available data show that Korea and Japan lead in the uptake of robots in manufacturing, well above the OECD average. Central European countries have also been experiencing a rapid increase in the use of robots, as we well as China and some other BRICS countries (Figure 2.4).

Figure 2.4. Top robot-intensive economies, 2005 and 2015

Industrial robot stock over manufacturing value added, millions USD, current values



Source: OECD 2017b.

36. Digital transformation is not only about the uptake of digital technologies, however. It is also about the transformation within society and within business that is needed to turn new technologies into economic and social opportunity. This requires investments that complement the technology itself, in skills, in organisational change, in new processes and business models, and also in the intellectual assets that help create value from the new technologies, as well as sound competition. Recent studies (e.g. Brynjolfsson, et al., 2017) suggest that this part of the transformation is more complex and costly than the diffusion of the technologies themselves, and moving more slowly, implying that the impacts of new technologies are often slow to emerge (see Section 4.2).

37. At the same time, progress in science and innovation continues to expand the digital frontier, e.g. in areas such as AI. Powered by machine learning (ML), extensive use of big data, sophisticated algorithms and networked computing, AI is used in many areas already today (although concerns about bias, accountability and algorithmic transparency remain), including digital data processing and transfer as well as applications used for transport and health (OECD, 2017a). However, up to 30% of inventions used for medical diagnosis (e.g. eye testing or general medical examinations) incorporate embedded AI-related components, underscoring the potential of AI to assist in providing better diagnoses and handle varied patient cases. Together with other digital technologies such as the IoT, big data analytics and distributed ledger technologies, a wide range of disruptive technologies is therefore affecting the production and distribution of goods and services as well as intellectual property (IP) systems.

Box 2.2. Blockchain and Artificial Intelligence - A Tale of 2 Emerging Technologies

Blockchain

Like the Internet, Blockchain has the potential to revolutionise our economies and our societies. It is a general purpose technology with multiple uses and characterised by three core attributes: transparency, traceability and trust.

Its core applications consist of authenticating the ownership and enabling the secure transfer of value in a variety of different assets. Blockchains can be public or "unpermissoned", whereby access and transfer are between parties unknown to each other (e.g. Bitcoin). By contrast, more promising are private or "permissioned" blockchains, whereby access and transfer are by known parties using appropriate digital identity, are executed much more quickly and are traceable. Blockchain technology is rapidly evolving. The third generation, which is currently unfolding, allows interoperability across different blockchains.

Its main applications so far have been in the financial sector, but it is already starting to affect many other sectors including but not limited to agriculture, manufacturing, retail, healthcare, energy and transport and also the public sector. Examples include tracking inputs used along a global supply chain for due diligence purposes, ensuring the provenance of medicine, food and commodities, validating and exercising land rights and refugees' rights, allowing SMEs to be paid or have their debt repaid automatically via smart contracts upon delivery. Tracking development aid, facilitating automatic exchange of tax information, enforcing law, enabling secure voting systems are just a few example of public sector applications.

Policy frameworks that enable businesses to innovate while addressing risks are critical. International co-operation is particularly important to promote best practices, establish legal certainty, prevent regulatory arbitrage and market fragmentation and raise awareness of the potential risks. With its experience with capacity building, policy dialogue and stakeholder engagement, and best practices setting, the OECD is well-placed to support these efforts.

Artificial intelligence

Another innovative force at the digital frontier is AI. While there is no universally accepted definition of AI, Nils J. Nilsson (2010) provides a useful characterisation: "Artificial intelligence is that activity devoted to making machines intelligent, and intelligence is that quality that enables an entity to function appropriately and with foresight in its environment". Machines understanding human speech, competing in strategic game systems, driving cars autonomously or interpreting complex data are currently considered to be AI applications. Intelligence in that sense intersects with autonomy and adaptability through AI's ability to learn in a dynamic environment. Applied AI is often contrasted to a (hypothetical) artificial general intelligence (AGI), which would enable autonomous machines of general intelligent action, like a human being, including generalising and abstracting learning across different cognitive

functions.

AI is mainly intangible in its manifestations, whereas robotics is mostly physical. However, the distinction between cognitive and motor functions is porous and evolving. For example, mobility requires the ability to sense and analyse the environment, and machine-learning AI plays a key role in computer vision. Popular examples of the convergence between AI and robotics are self-driving cars and humanoid robots.

AI applications hold many promises, including as a means to generate productivity gains, improve the efficiency of decision making and lower costs. Much of AI's recent progress in applications is driven by machine learning, leveraging the availability of big data, dramatically increased processing power, and cloud computing, which enable AI to process data at enormous scales and accelerates the discovery of patterns in data. For example, by helping scientists to spot complex cause and effect relationships, AI is expected to contribute to solving complex global challenges, such as those related to the environment, transportation or health. AI could also enhance quality of life by impacting healthcare, transportation, education, security, justice, agriculture, retail commerce, finance, insurance and banking, among others.

AI applications are raising policy questions and issues. For example, AI is expected to replace and/or augment components of human labour in both skilled and unskilled jobs, requiring policies to facilitate professional transitions and to help workers develop the skills to benefit from, and to complement AI. Another issue is that of ensuring transparency and democratic oversight of AI-powered decisions that impact people and citizens and of preventing algorithmic biases and discrimination and privacy abuses. For example, it's important to know why a self-driving car decided to break suddenly, or why an individual's credit request was denied. In addition, the widespread usage of algorithms could also pose possible anti-competitive effects by making it easier for firms to achieve and sustain collusion without any formal agreement or human interaction (OECD, 2017l). AI also raises new liability, responsibility, security and safety questions, as well as concerns about the fair distribution of AI's benefits among society.

Source: OECD 2017a and OECD Secretariat.

38. A fundamental condition for digital innovation, including AI, big data analytics and distributed ledger technologies, is the effective use of data. Today, much data is generated online and collected by online platforms in digital markets or ecosystems, a trend that is certain to strengthen with the deployment of sensors and the networking of connected objects. Maximising the social and economic value of data largely depends on ensuring access to data and global data flows (Box 2.3).

Box 2.3. Data access and global flows

Data play a fundamental role in digital transformation. The collection, flow, processing and manipulation of data, including across borders, drive digital transformation and create value synergistically. Data facilitate innovation and create value as a resource and asset in and of itself. As a result, data are considered a foundational driver of digital transformation as well as an enabler.

Data analytics, data-driven innovation, and other data-intensive activities, including machine learning and AI, benefit from open and interconnected information systems and networks that enable efficient, flexible and cheap data flows among potentially unlimited actors. Digital governments can leverage digital technology and data to foster economic and societal value creation by opening up government data.

Data is constantly circulating across national borders; nevertheless, no widely applied typology of such data has been agreed so far, but it is clear that data are highly variegated and heterogeneous and as such different policies are needed for different types of data processing. International accords that cover cross-border data flows are mostly concerned with data protection for privacy or with trade-related issues.

Enhancing access to data across nations, sectors, and organisations can maximise social and economic value of data by leveraging it as a general-purpose productive capital. There are, however, reasons for keeping data "closed" including to protect confidential information (i.e. personal data and trade secrets).

Instead of using a binary definition of closed versus open data, degrees of openness can be identified on a continuum ranging from closed or limited access (only by a data controller) to open and public access (figure below) to enable more differentiated approaches to data sharing and reuse.

The optimal level of "openness" depends on the domain, security considerations as well as the legal and the cultural environment in question. This calls for all relevant stakeholders to assess the possible trade-offs in data utilisation (how to reconcile risks and benefits), including across borders, when addressing the tension between risks and benefits of relative openness and "closedness".

Source: OECD, 2015b; OECD 2017e.

2.2. Vectors of digital transformation and policy implications

39. In order to better understand the transformative effects that the use of digital technologies and data can have across the economy and society, the OECD has identified seven "vectors of digital transformation" (vectors) that identify key properties of digital transformation (Box 2.4). These vectors provide one lens of analysis to ensure that existing or new policies are well-suited to a digital economy and society. Rather than being structurally discrete, the vectors are intertwined and can have differential and reinforcing effects across policy domains.

Box 2.4. Vectors of digital transformation

Scale without mass. The low marginal cost of many digital products allows firms to scale quickly and globally - more easily than with physical products - while making comparably less investment in tangible assets and amassing fewer employees.

Panoramic scope. The digitisation of functions, both through data flows and through processes enabled by software, lowers the barriers to gaining scope through the ability to combine, process, and integrate digital resources within and across different products and at a global level.

Speed: Temporal and intertemporal dynamics. The use of digital technologies accelerates interactions, generating economic and social opportunities but also disruptions, and enhances the value of past information, making it more easily accessible and reusable.

Intangible capital and new forms of value creation. Data flows and online platforms are being used to develop the service potential of capital goods, e.g. jet engines, tractors, computers, houses, or cars, and to enable value creation that is decoupled from any specific location.

Transformation of space. The possibility to move intangible digital value across the global Internet undermines conventional constraints of location, distance, and jurisdiction and changes the role that space used to play for production, trade and consumption.

Empowerment at the edges. The Internet's architecture and digital technologies empower intelligence at the edge of networks, broadening markets and communities and increasingly moving previously centralised responsibility, e.g. privacy and security, to decentralised users.

Platforms and ecosystems. Digital intermediation, for example in e-commerce, social networks, content distribution, or search and storage, leads often to the centralisation of flows, access to -and control of data, which in turn can become a strategic asset and competitive advantage.

Source: OECD (2018d).

40. The vector analysis shows that many policy settings are likely to be affected by digital transformation as they were designed for a world of tangible products and assets, fixed geographic boundaries and locations, transaction costs that limited the scale and scope of interactions and offerings, and supply and demand conditions that reflected scarcity. In particular, the analysis reveals a growing need in many policy areas for:

- Reviewing policy frameworks that were conceived in an analogue era in light of digitally-induced behaviours and business models;
- Considering flexible policies and a broad, principle-based approach to regulation rather than overly specific regulation that may hamper dynamism;
- Fostering policy co-ordination beyond traditional boundaries, including internationally, to foster interoperability, e.g. across IT systems and data formats, and based on open and voluntary standards;
- Supporting those who benefit least from digital opportunities such as SMEs, the elderly, less educated, or those who are worse off than before in a digital world of work;
- Promoting data-driven innovation, notably in the public sector, powered by the set of skills that workers need to succeed and innovate in a digital environment.

2.3. Shaping digital transformation in an uncertain world

41. Over the coming years, digital transformation will drive rapid – and potentially accelerating – change on an unprecedented global scale. This heightened pace and scale of change means that a broader range of outcomes are possible within a shorter time frame, creating a context of increased complexity and uncertainty for policy making. In this context, individuals, organisations, and governments cannot rely on planning for a future based on a single extrapolation of current trends. Rather, they must explore and prepare for a range of alternative future scenarios to ensure that policy frameworks put in place today will be agile and adaptive in the face of the potential directions that digital transformation could take.

42. Several common elements are likely across a range of plausible future trajectories for digital transformation. Connectivity will likely continue to spread across the globe, reaching more citizens and locations. Digital business models will likely to continue to disrupt most industries, enabling new forms of value creation. Production of physical goods may become more local and automated, and global trade may be increasingly carried out through bits and bytes. Many more work tasks could be automated, new types of jobs created, and new work arrangements could grow, such as virtual work through global online platforms.

43. Beyond these likely common elements of future digital transformation there is also a range of key uncertainties. These are issues on which there is significant debate among experts and a wide divergence of views regarding the potential direction of change and future outcomes. Several of these uncertainties are summarised below.

44. A first set of uncertainties concerns data control. Digital transformation is making it possible to collect, store, and transmit increasingly vast amounts of data generated by online activities and by a proliferation of sensors embedded in the IoT, and to derive valuable insights from this data through advanced analytics and AI. What is unclear is who will own, control and take responsibility for this data: individuals, governments, corporations, intermediary organisations or nobody?

45. A related uncertainty involves market structure and concentration and its effects on competition. Will network effects and economies of scale cause global data-driven markets to be connected through only a few online platforms serving as intermediaries?

Or could an abundance of data and accessible AI lead to a decentralisation of economic activity to a large number of smaller firms?

46. Further uncertainty concerns the future of the Internet and international trade. In a world where open access to online communications is essential, we expect much broader and deeper reliance on it. Will the current principle of 'open Internet' endure in the face of attempts to impose online borders that mirror offline ones or reflect national/regional blocs? How could this affect international trade – will digital trade be free or be confronted with new barriers?

47. The world of work is also rich in uncertainties (see Section 4.1). Through robotics, AI, and other technologies, digital transformation could lead to considerable automation of labour, as well as significant disruption to the forms of work we are currently used to. Uncertainties include to what extent automation will take place in routine operations, and to what extent advances in machine learning and automation replace or complement human activities. How many new human jobs will be created, and what kind of skills will they require? Will an automated world see higher or lower unemployment, and to what extent will traditional employment contracts be replaced by self-employment and "gig work"?

48. Uncertainties also surround many aspects of human well-being, such as inequality, health, and the environment. If globalisation until 2017 has been associated with rising income inequality in many countries, will further digitally-driven development until 2030 worsen that inequality (see OECD 2017k)? What will be the effects of constant connectivity, including on younger generations, on mental health and cognitive development? Will digital transformation improve well-being though better prevention, diagnosis, and treatment of illnesses? Will distributed ledger technologies foster greater trust, or will individuals feel increasingly powerless in the face of the rapid changes occurring around them?

49. Further uncertainty concerns the future of security and privacy. Will improved security measures lead to lower levels of digital risks or will more sophisticated malware and greater integration of the physical and digital worlds increase risks and conflict? Will a more interconnected world lead to the end of privacy, or will technologies be developed to strongly protect privacy at the source of data collection?

50. A final set of uncertainties relates to the role for governments in an increasingly interconnected and multilateral world. Will a growing number of governments take a more active role in facilitating digital transformation by providing unique digital identities to citizens and building the infrastructure digital firms operate in? Will global governance continue to be dominated by national governments or will it include a larger role for non-state actors such as corporations, sub-national governments, civil society organisations and citizens? Will the same mechanisms of governance (e.g. legislation, regulation, enforcement) continue or will they be replaced by effective new models based on big data analytics, transparency, and voluntary compliance? Will standardisation mostly confer the benefits of interoperability or will it hamper innovation because of technological constraints?

Box 2.5. Four scenarios of a hyper-digital future

In this context of uncertainty and complexity, the OECD developed four Going Digital Scenarios that represent broad trajectories for the future. None of the scenarios summarised in this box are predictions, and it is assumed that none of them are likely to come about as described. Rather, the aim of the scenarios is to provide a sense of the broader range of future possibilities than is commonly considered, and to use this exploration to develop robust and agile policies, pushing policy thinking beyond what might otherwise be considered and helping policy-makers prepare for the unexpected.

Each scenario serves to highlight potential future policy opportunities and challenges that could emerge or grow. The scenarios also serve as a lens to consider whether current and proposed policies and actions by stakeholders are likely to be successful, under a range of plausible future conditions, in shaping a digital transformation that supports growth and well-being for all.

- **Scenario 1 "iChoose"**: This is a world where individuals have taken their online data and identities into their own hands, and are using it increasingly in active ways to further their economic opportunities, civic participation, and personal development. Governments and firms are at the service of empowered individuals and they have responded with a series of regulations and innovations aimed at giving individuals greater say over their digital lives. This has greatly broadened opportunities, but also created new and larger inequalities. Collective solutions to grand challenges are driven by new grassroots and civil society initiatives working with existing multilateral and corporate structures.
- **Scenario 2 "Platform governments"**: In this scenario, a number of governments are taking a highly active role in digital transformation and gaining increasing effectiveness and relevance as a result. These governments are developing their own online platforms to manage interactions with citizens, business, and civil society. This provides these governments with a foundation of reliable data on which to build more efficient and responsive public services and to enable a more competitive and productive market economy.
- **Scenario 3 "Corporate Connectors"**: Large global technology firms are becoming one-stop shops for virtually every aspect of our lives. Socialising, shopping, entertainment, health monitoring and diagnosis, many education courses, and even some social security provision are all provided by private sector online platforms. Through their constant interactions with their members, these global corporate ecosystems are better attuned to the popular will and have earned more trust than most governments. On the basis of this legitimacy they are taking a more active role in global governance and in addressing challenges such as climate change and digital security. Through their new role within society, the corporate connectors have developed means to ensure continued transparency and competition, while citizens hold them accountable to societal goals.
- **Scenario 4 "Artificial Invisible Hands"**: A super-abundance of data, artificial intelligence and universally accessible tools of digital innovation have created a world where economic activity is highly decentralised and in a constant state of disruption and churn. Automation has advanced rapidly, with AI replacing many of the co-ordination functions previously performed by firms. AI enables humans to understand their motivations and behaviour better than they ever could alone, and can guide them to make choices that improve their individual and collective well-being. A total loss of privacy is matched with the ability of big data and algorithms to help root out corruption; overcome cognitive biases and selfish interests; and develop solutions to the world's grand challenges. However, questions are intensifying about the future of human autonomy and control in face of the growing capabilities of AI.

Source: Based on OECD 2018e.

51. While nobody can predict the future, ongoing efforts to identify emerging changes and explore a range of future scenarios and their implications can help policymakers develop policies today that will be more agile and adaptive to changing conditions. This work can also help guide current and future efforts to build global governance, as well as multilateral and multi-stakeholder co-operation for digital transformation.

3. An Integrated Approach to Policy Making in the Digital Age

52. Digital transformation is challenging almost every aspect of the economy, government and society, and a wide range of policy areas need to be considered and all actors (individuals, firms, governments, trade unions, civil society and other stakeholders) need to be involved in the policy making process. Individuals must be engaged and firms need to continue to act as a catalyst of transformative change. At the same time, governments need to reach across traditional policy silos and across different levels of government to develop a whole-of-government approach to policy making using the multi-stakeholder model that has underpinned the development of the Internet so well.

53. One aim of the Going Digital integrated policy framework is to help change the way policy makers think about digital transformation and in doing so change the way polices are made in the digital age. Rather than considering narrow policy silos, the framework aims to support an integrated approach because policy changes in one domain may have implications in another domain. It is essential to be aware of interconnections and relationships across policy domains and to develop digital policy making with them in mind.

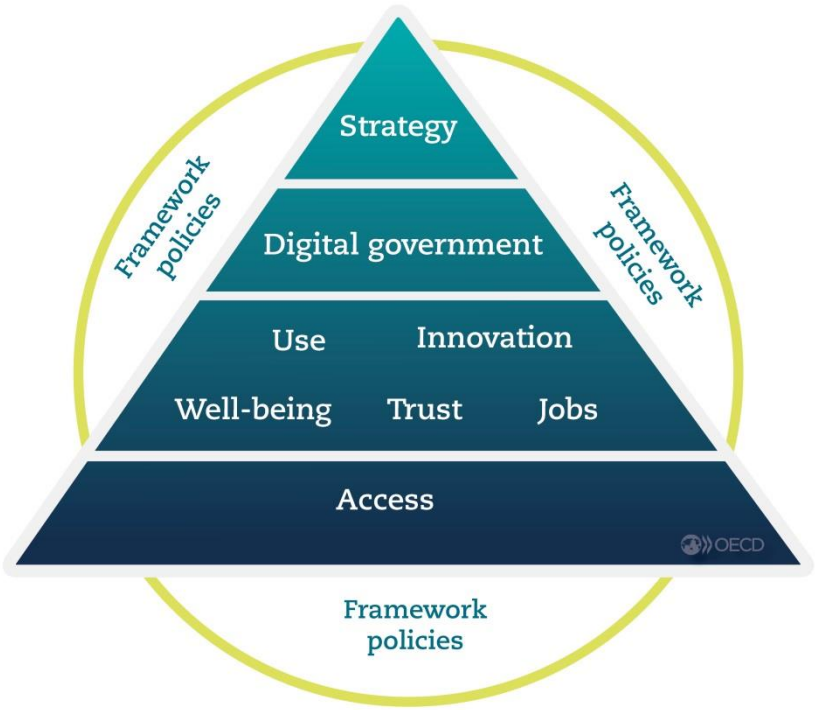
54. In due course, the integrated policy framework could be useful in guiding OECD reviews of digital transformation in specific countries, helping countries self-assess how prepared they are for an increasingly digital world (including through the development of a core set of Going Digital indicators), supporting the development of national strategies for the digital age, and analysing digital transformation in particular policy areas from a holistic perspective.

55. The Secretariat has developed a preliminary integrated policy framework for making digital transformation work for growth and well-being (Figure 3.1). While still work in progress[1], it is based on input from the 14 core Committees involved in the Going

[1] The OECD Committee on Digital Economy Policy will discuss a revised version of the integrated policy framework at its meeting on 16-18 May 2018. This revised version includes a new component on market openness among other modifications [DSTI/CDEP/GD(2018)5].

Digital project, the Going Digital Steering Group, and with colleagues from across the OECD Secretariat. This section will briefly discuss its key components in its draft form and what they mean for policy making; these components will be further elaborated in the final synthesis report. At the same time, this summary does not prejudge what the ultimate shape and content of the integrated policy framework will look like.

Figure 3.1. An integrated policy framework for making digital transformation work



Source: OECD (2017f).

3.1. Framework policies

56. Digital transformation does not occur in isolation; it is shaped by (and helps shape) the broader economy and society as a whole. Framework policies play an important role in ensuring that the right conditions exist for digital transformation to flourish. Open trade and investment regimes can create new avenues for rapidly upgrading technologies and skills, and increasing specialisation (see Section 4.3 for a detailed discussion of digital trade and market openness). Efficient, open financial markets help in allocating financial resources to firms investing in digital transformation, while competitive product markets foster consumer welfare, allow new firms to challenge incumbents, efficient firms to grow, and inefficient ones to exit. Well-functioning labour markets can support the inevitable structural change. Sound policies for intellectual property can help foster value creation from digital transformation and support innovation and diffusion. More broadly, sound macroeconomic policies can help reduce uncertainty

and create an enabling environment for digital transformation to thrive. In some cases, framework policies will need to be reviewed to ensure they are suited for the digital age. For example, tax policies are currently being reviewed to ensure they are suited to the digital age (Box 3.1), while financial regulation is moving towards a service-based approach, rather than an institutional approach to better mitigate the risks.

Box 3.1. Tax challenges arising from digital transformation

Digital transformation is impacting many aspects of our everyday lives, as well as at the macro-level in terms of the way our economy and society is organised and functions. The breadth and speed of change have been often remarked upon, and this is also true when one considers the implications of digital transformation on tax matters.

The challenges of the digitalisation of the economy were identified as one of the main focuses of the Base Erosion and Profit Shifting (BEPS) Action Plan leading to the 2015 BEPS Action 1 Report. In March 2017, the G20 Finance Ministers mandated the OECD, through the Inclusive Framework on BEPS, to deliver an interim report on the implications of digitalisation for taxation by April 2018. This report, *Tax Challenges Arising from Digitalisation – Interim Report 2018* (the Interim Report) has now been agreed by the more than 110 members of the Inclusive Framework.

The Interim Report provides an in-depth analysis of the main features frequently observed in certain highly digitalised business models and value creation in the digitalised age, as well as the potential implications for the existing international tax framework. It describes the complexities of the issues involved, the positions that different countries have in regard to these features and their implications, and which drive their approach to possible solutions. These different approaches towards a long term solution range from those countries that consider no action is needed, to those that consider there is a need for action that would take into account user contributions, through to others who consider that any changes should apply to the economy more broadly.

Members agreed to undertake a coherent and concurrent review of the "nexus" and "profit allocation" rules - fundamental concepts relating to the allocation of taxing rights between jurisdictions and the determination of the relevant share of the multinational enterprise's profits that will be subject to taxation in a given jurisdiction. They will work towards a consensus-based solution, noting that at present, there are divergent views on how the issue should be approached. It was agreed that the Inclusive Framework would carry out this work with the goal of producing a final report in 2020, with an update to the G20 in 2019. The Inclusive Framework's Task Force on the Digital Economy will meet next in July 2018.

At the same time, various initiatives have already been taken at the OECD level. The 2015 BEPS reports are directed toward one overarching objective: the alignment of the place of taxation with the place of value creation in order to reduce corporate tax avoidance. Parts of the BEPS project are already addressing the BEPS tax challenges posed by the digital economy, for example through the revision of the concept of permanent establishment which establishes the right to tax for a country (Action 7), the conditions under which a country can introduce a lower tax rate for income derived from intellectual property (e.g., through so-called patent boxes, Action 5) and the revision of the rules used for the allocation of profit across different entities in a multinational group (Actions 8-10 on Transfer Pricing). However, these may not address some of the broader direct tax challenges arising from digitalisation.

Rules and implementation mechanisms were also developed to ensure the effective collection of value added tax (VAT) on supplies of goods and services from online sales, based on the country where the consumer is located. The absence of internationally agreed standards in this area had led to increasingly significant VAT revenue losses and to growing competitive distortions between domestic and offshore sellers. These rules and mechanisms were adopted by OECD Members and G20 Leaders as part of the BEPS package, and they were included in the OECD's International VAT/GST Guidelines that were embodied in the 2016 Recommendation of the Council on the Application of Value Added Tax/Goods and Services Tax to the International Trade in Services and Intangibles [C(2016)120]. They are being implemented by countries worldwide, by OECD Members as well as non-members, which has already resulted in significantly increased tax revenues. The European Union, as an early adopter of these rules and mechanisms for specific e-

services, such as telecommunication and broadcasting services, identified total VAT revenue paid through this system as approximately EUR 3 billion in 2015, its first year of implementation.

Digital transformation has also given tax administrations new opportunities to modernise and increase efficiency, raising tax compliance and providing the means for more inclusive spending policies. Digital transformation has led to the greater collection of data in electronic form, including on payments and parties to transactions, and the rise of multi-sided platforms may increasingly attract users whose activities were previously within the informal economy. Where tax administrations can access this information it can lead to the recovery of previously unpaid tax, increases in taxpayer registration and the shrinking of the informal economy. The increase in third party data offers greater ability to pre-fill tax returns and therefore, to simplify citizens' compliance with their tax obligations. A larger amount of more sophisticated information also allows the tax authorities to carry out their risk assessment activities with greater efficiency. Of course there are also challenges for tax administrations from the misuse of new technology such has been seen in the spread of sales suppression software, false invoicing and the use of distributed ledger technologies and crypto-currencies for illicit purposes. The potential for the rapid spread of such activity as technology develops will require tax administrations and policy makers to respond in an agile and co-ordinated manner.

3.2. Access

57. Digital infrastructures, including efficient, reliable and widely accessible broadband communication networks and services, data, software, and hardware, are the foundations on which digital transformation is based. The Cancún Declaration underscored the need to "Increase broadband connectivity and harness the potential of interconnected and converged infrastructures and digital services to bridge digital divides and foster innovation by adopting technologically neutral frameworks that foster investment in broadband networks, protect consumers, promote competition and enable opportunities for all."

58. In this context, it is essential that governments promote investment in digital infrastructures and competition in the provision and take-up of high-speed networks and services, ensuring that key complementary enablers are in place (e.g. fibre optic back-haul, sufficient spectrum and increasing uptake of IPv6 Internet addresses) and cover maximum territory, and that critical network infrastructures are resilient. Individuals, businesses (including SMEs), governments, and educational institutions need reliable, affordable and widespread access to digital technologies and services to benefit from digital opportunities. It is equally important that governments and all stakeholders work together to lessen any related digital divides (e.g. by females, migrants, those with disabilities or low levels of income, etc.) to promote an inclusive digital transformation.

59. Indeed, much of the future growth in demand for devices connected to digital infrastructures is expected to come from the IoT. Cisco's Visual Networking Index projects that M2M devices globally will grow from 4.9 billion in 2015 to 20 billion by 2020, i.e. more than 400% in five years (Cisco, 2016). The automotive industry is a case in point regarding IoT use and increased data generation. In-car Wi-Fi hotspots connected with 4G LTE have been introduced in a growing number of countries. In the United States, Chevrolet customers consumed more than 3 million GB of data in the two years to June 2016 (Chevrolet, 2016). While average US use per vehicle is currently less than the overall average per subscription to smartphones, this may not be so in the future.

Box 3.2. Innovative practice: Increasing access and fostering competition in the Mexican telecommunication sector

Increasing access to telecommunication services for consumers is the first foundational step for enabling economies and societies to benefit from digital transformation. Nearly 60% of the global population is still offline and unable to fully participate in the digital economy. Increasing access, including for the least fortunate, often calls for an increase in competition among infrastructure and service providers to improve the quality of service of communication services and to bring prices down for consumers.

In 2012, the Mexican telecommunications sector was characterised by a high degree of concentration and high average prices for telecommunication services. A single company controlled 80% of the landline phone market in Mexico and 70% of the wireless market, while over three quarters of households lacked access to the Internet. A review of the sector carried out by the OECD recommended 31 actions to improve competition in the telecommunication market, ensure the consistent and transparent application of telecommunication regulation, improve the legal and regulatory framework and stimulate competition more broadly throughout the economy.

Almost all of the recommendations were fully implemented in a wide-ranging reform of the legal and regulatory framework in 2013, with partial implementation for just three recommendations. Five years later, the OECD was invited to review the implementation of the recommendations and the effects of the reform of the Mexican telecommunication sector and to put forward a set of further recommendations to maintain the momentum.

A subsequent OECD Telecommunication and Broadcasting Review in 2017 found that increased competition as a result of the reform helped to drive down prices for telecommunication services in Mexico. The OECD high-usage basket, for example, had the sharpest drop in prices, from 101 USD PPP to 24.93 USD PPP, representing a decline of over three quarters of the original price. Almost 50 million mobile broadband subscriptions had been added since the reform, most of them with higher quality offerings than before. This decline in prices and increase in the quality of telecommunication services especially benefitted lower income households and disenfranchised communities and individuals throughout Mexico. Foreign entry into the marketplace has spurred investment in infrastructure and the *Red Compartida* – a shared wholesale wireless network – will likely further this trend.

However, Mexico still needs to catch up to leading OECD countries with respect to further increasing fixed and mobile access to the Internet, an essential precondition for engaging with the digital economy. At the same time, the country should undertake further efforts in the broadcasting sector, a sector where concentration increased and prices have risen 5% over the past few years.

The *OECD Telecommunication and Broadcasting Review of Mexico 2017* encourages Mexico to go even further, given an expected further increase of convergence of broadcasting and telecommunication services. Specific recommendations relate to competition, market conditions and national policies, all underpinned by the necessity to uphold sound legal and institutional frameworks. The OECD believes that the adoption of these recommendations would further expand access to telecommunication and broadcasting services for Mexicans, including for those in communities with lower levels and quality of Internet access.

Source: OECD 2017f.

3.3. Use

60. Digital infrastructure and services provide the technical foundation for the digital transformation of economy and society, but do not necessarily ensure effective use by itself. Education of teachers and pupils and skills are key factors in ensuring effective use. Effective use also requires firms to take into account in their decision making and operational processes the management of the risks related to the use of digital technologies, particularly with respect to digital security (e.g. theft of trade secrets, disruption of operations, reputational damages, financial losses, etc.) and privacy.

61. Moreover, it is crucial that governments enable the diffusion and adoption of digital technologies in fostering complementary investments in data, research and development (R&D), worker and management skills, and other knowledge-based capital such as organisational change. This is especially important for SMEs, many of whom lack the know-how but whose participation in digital transformation is essential in ensuring an inclusive digital transformation. Effective use of digital technologies in an economy can also be affected by a lack of firm dynamics, which can lead to the coexistence of poorly performing firms, with very low levels of ICT use, with star performers. Several aspects of this challenge are discussed in Section 4.1 of this paper.

Box 3.3. Innovative Practice: The Portuguese National Initiative on Digital Competences 2030

Improving the general level of ICT-specific and complimentary skills is necessary to improve the effective use of digital technologies, increase productivity and competitiveness and thereby maximise the benefits of digital transformation across OECD economies.

One approach to this policy challenge is the Portuguese National Initiative on Digital Competences 2030 (INCoDe.2030). This programme aims to broaden digital literacy, promote employability and professional training in digital technologies and to raise the national participation in the R&D international network, namely in the production of knowledge in all the areas associated with digital transformation.

INCoDe.2030 aims to make use of the existing Portuguese training infrastructure to improve the overall level of competence for ICT, particularly in terms of human capital and Internet usage level. However, the programme takes a broad view of competences, including not only digital literacy but also information processing, communication and digital content production skills. Similarly, improving competences for the digital age encompasses the use of digital technologies and the ability to handle and manipulate data. Increasing the understanding of advanced communication networks and mobile systems, network hardware and software and cyber-physical systems like robotics are also considered.

INCoDe.2030 includes a range of interventions alongside the promotion of digital competences. It enables citizens to benchmark their level of digital skill on a dynamic framework based on the European initiative DigComp2.0, which can then be used to identify knowledge gaps. Specific programmes have also been targeted towards disenfranchised groups, who are able to use a freely accessible online training platform. Further elements of the programme include lifelong learning and active labour market programmes for disenfranchised workers to help workers adapt to a dynamic labour market.

Source: OECD 2017f.

3.4. Innovation

62. Science and innovation are important sources for digital technologies that drive digital transformation, with all of them, and notably the Internet, drawing on a long history of public investment in fundamental research. Continued investment in public and private research and innovation is needed to drive digital transformation further and develop and diffuse new technologies, products, applications, business models and organisational structures. In turn, the adoption and use of digital technologies, including data analytics, are associated with higher innovation performance across the economy. At the same time, digital technologies can facilitate vocational education and training (VET) as well as education services across borders, thus improving the skills base for science and innovation.

63. For instance, the share of businesses adopting digital technologies is 20-70% higher among innovators, depending on the year, the type of digital technologies and the

type of innovation considered (OECD, 2016d). Technologies, smart applications (including data analytics) and other innovations can also improve services and help address policy challenges in a wide range of areas, including education, finance, health, transportation, energy, agriculture and fisheries, between and within countries. Digital technologies contribute not just to innovation in goods and services, but also to innovation in processes, business models, and organisational arrangements, as well as the process of science and innovation itself.

64. Experimentation also plays an important role in boosting innovation (see Box 3.4). Experimentation involves designing a portfolio of policies to solve problems step-by-step; monitoring and evaluating intermediate outcomes swiftly; and constant feedback, learning and adjustment. Critical to the experimentation process is the recognition that policymakers can and should learn from failure.

Box 3.4. Digital technology and financial innovation: Fintech

Innovation in financial services based on digital technologies, or Fintech, is having some potentially disruptive effects in the financial industry, cutting across a wide variety of financial services, including digital banking, consumer and small business financing, payments, insurance ('Insurtech') and pension provision, and investment management. Although the level and pace of Fintech innovations differs across sectors, products and geographies, their main drivers are similar. These involve efficiency ('nimbleness' and speed, and often 'cutting out the middle man'), simplicity, transparency and streamlined margins stemming mainly from a lower operating cost base and scale effects.

For example, Fintech allows transactions between two parties without a trusted intermediary. Applications of DLT can range from payments and settlement to 'smart' contracts, compliance and more. The benefits of Fintech innovations to customers can include a superior and seamless customer experience, a wider range of products and services at a lower cost and potential for access to financial services for underserved customers (such as some SMEs) or the underbanked.

Table 3.1. Applications of new technologies to financial services

DIGITAL TECHNOLOGY	FINANCIAL ACTIVITIES AND SERVICES							
	Payment services	*Advisory & agency services Planning*	*Investment & trading*	*Lending & funding*	*Insurance*	*Security*	*Operations*	*Communica-tions*
Distributed ledger technology	x	x	x	x	x	x	x	x
Big Data		x	x	x	x	x	x	x
Internet of things					x			x
Cloud computing				x			x	
Artificial intelligence		x	x		x			x
Biometric technology					x	x		
Augmented / Virtual reality		x	x					x

Source: OECD 2018g.

Fintech innovations pose specific challenges regarding privacy, digital security and operational risk. New technologies potentially increase digital security vulnerabilities that could undermine the privacy of financial consumer and businesses, and, and undermine critical financial infrastructure which could have systemic implications. Lending and underwriting practices could become discriminatory when big data analysis is used to evaluate the insurability or creditworthiness of consumers, or to target product advice and marketing.

While the digitalisation of financial services brings potential benefits, Fintech also brings a number of potential structural implications that pose challenges for financial policy objectives, including concerns about the applicable regulation and maintaining financial stability, adequate protection of financial consumers, and ensuring market integrity.

In addressing these challenges, policymakers need to:

- Balance innovation vs. consumer protection and market integrity: enable competition and encourage innovation while promoting investor and consumer trust and confidence and ensuring fair and efficient markets;
- Protect and equip financial consumers and micro and small businesses (including potential groups at risks) through better risk awareness, as well as robust financial consumer protection and financial education;
- Provide a regulatory level playing field but with some proportionality: lighter (at least temporarily) rules to allow innovators/start-ups to enter the market, although this principle should be applied fairly and without favour to domestic and foreign firms; and
- Facilitate international coordination of regulation for FinTech solutions (which are potentially borderless).

Regulators and policymakers also need to reckon with changes brought by Fintech and build their capacity to understand and deal with these innovations. "Regulatory sandboxes" provide a useful regulatory approach that fosters innovation while safeguarding financial stability.

FinTech has been shown to enhance financial inclusion among the world's most marginalised groups. However, less tech-savvy financial consumers need to be supported to avoid new forms of exclusion, highlighting the need for targeted financial education and financial consumer protection. Likewise, contingency plans may need to be considered for poorer or otherwise disadvantaged consumers that fall through "algorithmic cracks" of lending and insurance services, or are otherwise excluded from the benefits of FinTech services. At the same time, to the extent that FinTech allows borrowers easy access to credit that they cannot repay, risks of over-indebtedness need to be monitored and curbed.

Source: Based on OECD 2018g.

3.5. Trust

65. Trust in the digital environment can be undermined in many ways, including through identity theft and personal identification in electronic transactions. Once lost, trust can be hard to regain. As a result, trust is fundamental to digital transformation; without it, individuals, firms and governments won't fully use digital technologies, and an important source of potential growth and social progress will be left unexploited.

66. It is essential to encourage good digital security[2] risk management practices by taking into account cross-border and cross-sector interdependencies and fostering trust with and among private operators to enable information sharing about threats, vulnerabilities and incidents, including for SMEs. To do so, responsibilities for digital security must be shared among individuals, business and governments.

67. As digital transformation progresses, privacy and data protection are increasingly important. Countries have different approaches to protecting privacy, but the OECD recognises privacy as a fundamental value and a condition for the free flow of personal data across borders. Privacy extends to data protection, with individuals' increasing asking what personal data is stored, how it is subsequently used and whether they can access their data. Technological advances can help increase trust through "privacy by design" processes whereby privacy preferences are embedded or coded in technologies from the start. For example, encryption can play an important role for privacy as mobile devices and the IoT expand (OECD 2017a).

68. Countries may benefit from greater cross-border co-operation if they develop comprehensive and coherent national strategies for digital security and privacy to address issues such as protection of personal data (including data breach notification), protection of trade secrets, resilience of essential services (e.g. water, energy, finance, public health and safety, see Box 3.5), the creation of incentives (e.g. cyber insurance, public procurement), support to SMEs, and related skills development, in consultation with all relevant stakeholders. At the same time, it is important to continue promoting effective protection to consumers engaged in e-commerce and other online activities, and to foster the use of electronic identity, authentication and e-signatures, to promote trust.

69. Public-private dialogue, social dialogue and co-operation will be important to enhance trust in the digital economy. Engaging governments, citizens and other key stakeholders in the digital security debate, including across borders, will be key to support confidence in the adoption of digital technologies. It is essential to foster cross-sector synergies and bring together government and business leaders to join forces in addressing digital security challenges.

[2] The OECD recommends that digital risk should be approached as an economic risk; it should therefore be an integral part of an organisation's overall risk management and decision making processes. The notion that digital security risk merits a response fundamentally different in nature from other categories of risk needs to be challenged. To that effect, the OECD no longer uses the term "cybersecurity" (OECD, 2015c).

Box 3.5. Digital security and resilience in essential sectors

One important issue inherent to digital transformation is the need for resilience and better security to mitigate possible disruption of economic and social activities by digital security incidents. Traditionally understood as breaches of availability, integrity and confidentiality of ICTs and data, digital security incidents are increasingly frequent and sophisticated. They can take advantage of the global nature of the Internet to rapidly propagate across jurisdictional, organisational and sectoral boundaries, as demonstrated by the recent Wannacry, NotPetya, and Dyn attacks.

Digital security incidents can disrupt the activities of all businesses, both SMEs and larger firms, governments and individuals and generate financial and reputational harm. For example, NotPetya caused a temporary production shutdown at several global companies such as Merck which had to borrow doses of its vaccines from the US Center for Disease Control and Prevention stockpile to fulfil customer orders, reducing the company's third-quarter sales by USD 240 million.

Incidents can also cause physical damage, as demonstrated by a digital security incident that caused electricity service outages in Ukraine affecting approximatively 225 000 customers in 2015. Such incidents could evolve into large-scale crises affecting infrastructures critical to the functioning of the economy and society such as finance, energy, transport and essential government services. In addition to such catastrophic scenarios, digital security incidents can also have subtle but long-term negative effects by undermining trust in the digital environment, limiting innovation, slowing down the adoption of new technologies, as well as hampering digital transformation and its related benefits.

Most critical infrastructures and essential sectors have been relying on digital technologies for many years and therefore their operators have some experience in managing digital security risk. However, the breadth of the changes brought by digital transformation raise new challenges for policy makers approaching these issues from a whole-of-government perspective and for regulators and policy makers in each sector as some operators increasingly engage into new areas for them such as data-driven innovation and the Internet of Things.

There are many differences across critical infrastructure and essential services with respect to digital security. The financial sector, for example, has been a major target of cybercrimes and has been working to address digital security risks for many years. This highly digital-dependent sector is internationalised with significant cross-border infrastructure to manage cross-border payment, inter-bank transfer and foreign exchange settlement systems. As a result, financial regulators have placed increasing attention on digital security risks at the institutions they oversee, and implemented a number of international co-ordination initiatives to share experience and ensure the integrity of the common systems on which they depend. At the same time, policymakers and regulators have an interest in ensuring an efficient and innovative financial system that meets the needs of its users. A key challenge is therefore to balance the need for high security standards to maintain the integrity of the financial systems while ensuring sufficient openness to new innovation. An interesting area is the payment capture and settlement systems where significant innovation driven by digital technologies – including

blockchain – is taking place, making digital security a priority issue. Additionally, several innovations have arisen to make digital transactions more secure and to ensure trust in the online environment.

The energy sector has been an early adopter of digital technologies, with power utilities using ICTs to facilitate grid management and operation already in the 1970s. But the growth of the IoT combined with the diversification and decentralisation of energy technologies will link millions of new small-scale "prosumers" and billions of potentially vulnerable devices into the electricity system (IEA, 2017). Digital technologies used in centralised energy systems are also changing, with a move from proprietary or vendor-specific solutions to newer, open-protocol industry standards, more automation and a shift to cloud computing. These newer systems might have a higher general level of security, but lose the protection provided by secrecy of proprietary product design ("security through obscurity") and by the need for potential attackers to acquire highly specialised energy system knowledge. The attack surface is thus changing and vastly expanding.

In the transport sector, which is an essential enabler for public services, freight transport and logistics, many experts are predicting a revolution in terms of how mobility is provided, resulting in particular from the emergence of ride-sharing platforms and vehicle automation, both enabled by big data analytics and progress in data science. Vehicle automation, particularly when combined with e-hailing and possibly also with urban freight delivery, is likely to be among the first use cases to be implemented (ITF, 2017). Digital security will be an important aspect of car-to-car/-infrastructure communication, including strong data security safeguards to prevent digital security attacks on critical transport infrastructure and to ensure acceptable resilience levels in response to incidents.

Many Governments' facilities and agencies can also be considered a critical infrastructure, as well as providers of essential services. In recent years, governments have faced a growing deluge of increasingly sophisticated and stealthy digital threats. They include attacks by cybercriminals who hold government data for ransom, by State-sponsored actors aiming to steal State secrets and the personal information of civil servants, and by some political activists who protest by disrupting and defacing government websites. For governments, digital risk goes beyond digital security attacks. Public trust in governments per se is vulnerable to "hybrid" threats such as the use of online channels to spread disinformation campaigns that aim to influence political processes or erode social cohesion. Many governments are still not able to mitigate advanced digital security attacks or agile enough to develop timely counter narratives to hybrid threats.

One important challenge of digital transformation across the finance, energy, and transportation sectors is the increasing role taken by smaller actors such as SMEs which extends digital security risks beyond the realm of large central players such as banks or electricity companies. Such SMEs include start-ups offering innovative payment systems, blockchain-based energy trading technologies, or mobility services in the area of transport. Besides start-ups, well-established SMEs involved in providing essential services play an increasingly important role in managing digital security risk to mitigate risk to larger firms in their value chains.

In a context of generalised digital transformation, governments are struggling to create the conditions for a higher level of digital security in all essential services and critical infrastructures. While many digital security risk and risk management practices are

similar across sectors, some aspects are sector-specific, for example to take into account sophisticated technical equipment, particular market characteristics (e.g. value chain structure) and regulatory requirements (e.g. minimum service requirements), etc. However, a number of policy challenges cut across all sectors, including how to encourage good digital security risk management practices by all organisations including SMEs, how to take into account cross-border and cross-sector interdependencies, how to embed security in the design of IoT devices, and how to foster trust with and among private operators to enable information sharing on threats, vulnerabilities and incidents.

OECD work will continue to explore the effects of growing digital transformation on the resilience of critical infrastructures and essential services which rely increasingly on cross-border digital infrastructure. This will aim to cut across silos of expertise to explore how an integrated whole-of-government approach to digital transformation of the economy and society can best help address the protection of critical infrastructure and essential services against digital security risk.

3.6. Jobs

70. Digital transformation has already begun to change the nature and structure of organisations and markets, raising important questions about which jobs might disappear and where new ones will come from, what they will look like and which skills will be required, who might be most affected, and what can be done to foster new job creation and to align skills development with the changing skills requirements of jobs. Evidence indicates that labour market polarisation away from middle-skilled jobs and into low- and high-skilled jobs is pervasive across OECD countries (OECD, 2017c). Much of this polarisation has happened within industries, and the evidence suggests that the fall in the number of middle-skilled jobs in manufacturing is associated with increased ICT adoption such as robots. Going forward, low-skilled jobs are likely to be most at risk of being displaced, however, as discussed further in Section 4.1, and the job content of a large share of workers is likely to change as a result of automation.

71. At the same time, technological advances are facilitating the expansion of new forms of work (online platform work, such as “crowd work”, “gig work”, and other forms of on-demand labour). Digital transformation may increase the already sizable number of workers in non-standard forms of employment (one-third of the OECD labour force) that are in many cases a poor fit with traditional social protection systems predicated on the archetype of full-time, permanent work for a single employer. Individuals in such jobs may also face increased job and income insecurity, and experience a lack of coverage by conventional employment standards and protections. Such developments may also facilitate the outsourcing and off-shoring of tasks.

72. As these changes take place, it is important to ensure that effective adjustment mechanisms are in place to help individuals navigate the transition from one job to the next or evolve within the existing job, particularly with respect to the acquisition of a mix of skills including general cognitive skills, complementarity skills such as problem solving, creative thinking, communication collaboration, emotional intelligence, ICT and generic skills and technical skills, and a strong ability to continue learning. It is also essential to ensure that complementary policies – in the form of a social safety net, employment regulation and skills policies – are in place to support those people for whom the transition is lengthy, or who are ultimately unable to transition effectively to new

skills and jobs. Effective social dialogue is essential in this respect, as various stakeholders decide together what the future world of work should look like. These issues are discussed in more detail in Section 4.1.

Box 3.6. Innovative Practice: Job Security Councils in Sweden

Digital transformation is changing the nature and structure of organisations and markets, and transforming the ways in which people work. As economies transition, effective adjustment mechanisms are needed that help individuals transition between jobs and ensure that people don't get left behind.

Another challenge of developing appropriate labour market adjustment mechanisms is that digitally-displaced workers may be difficult to identify. While the transition will have impacts on whole sectors, much of the changes in employment structure that have been observed across OECD countries to date have affected the middle of the skills distribution. There may therefore be a need for early intervention measures that are able to reach such individual, often white-collar, cases.

In Sweden, the labour market is characterised by a high percentage of unionisation and collective bargaining coverage and a unique degree of co-operation between social partners. This is exemplified through the Job Security Councils, a structural mechanism developed by trade unions and employers in the 1970s that operate independently from the government and public employment services. The Councils are financed by employer contributions based on collective agreements between social partners in specific industries and sectors, with reference to employment protection legislation.

More than ten Job Security Councils cover almost 80% of the Swedish labour force, including white-collar workers, blue-collar workers and public employees. The Councils provide transitional services to displaced workers based on their individual circumstances and requirements. They also provide tailored advice and counselling services to both employers and trade union representatives during the earliest stages of restructuring, with the aim of managing voluntary and compulsory redundancies. Crucially, Job Security Councils provide tailored advice to both employers and trade unions at the very early stages of the unemployment process, often even before workers are officially unemployed. As a result, the majority of re-employment offers to displaced workers are made before the end of the formal redundancy transition period. In 2016, the Council responsible for white-collar private sector employees (*Trygghetsrådet)* was successful in finding new employment opportunities for 88% of laid-off workers.

The Job Security Councils in Sweden are remarkable in their capacity to provide rapid response services in the case of mass layoffs of entire workplaces, but also in terms of extending early intervention measures to individual and small-scale layoffs. This helps workers from all backgrounds and competences transition to new work, regardless of the nature of the previous employment. The Job Security Councils further highlight the role of constructive engagement among all concerned parties, including the individual, trade unions and former employer, while also accommodating the specific needs of displaced workers.

Source: OECD 2017f and TUAC 2018.

3.7. Well-being

73. Digital transformation changes how people from different cultures access information and interact with one another and with society more broadly. For example, digital technologies can promote social inclusion by enabling better access to health care through online services, as well as new opportunities for skills development by offering access to education, as well as flexible working arrangements for families. They can also help disadvantaged groups connect. On the other hand, the increasing spread and use of some technologies has the potential to reduce face-to-face interactions further isolating some individuals, and in some cases digital services can lead to the creation of like-minded groups that do not interact with others. For example, news feeds that filter certain types of content may lead to biases among groups of people. Security and privacy also become more urgent issues to address as the Internet of Things and intelligent connected objects, such as self-driving cars, become deployed. Skills "for life" and digital literacy also become important aspects of ensuring broader well-being, along with many others (see Section 4.4).

Box 3.7. Innovative Practice: Citizen-based analytics for better social investment in New Zealand

Well-being for individuals is often linked to optimal social outcomes from the efficient and effective delivery of services. Digital transformation gives governments the ability to collect and use longitudinal and multi-domain data about their communities, including with respect to biological, family, social and environmental factors, which can in turn be used to inform policy making and improve well-being.

In New Zealand, policy makers have developed an Integrated Data infrastructure (IDI) to facilitate targeted and more effective social expenditure. The IDI gathers over 166 billion points of longitudinally-linked and de-identified data about health and safety, justice, benefits and social services, tax and income, education and training, student loans and allowances, travel and migration and family and households from a range of sources, including the Census, government agencies and non-governmental organisations. The unprecedented depth and richness of these data have enabled researchers to better understand the economic and social outcomes of specific groups and households over time, and thus develop more sophisticated methods of targeting public services.

Often interventions made by governments are serial and the benefits disseminate through multiple domains, including throughout families and communities. Similarly, social interventions are often undertaken by more than policy community or ministry. Linking data and analysing social outcomes as a result of programme delivery across the eco-system of the public service can better enable whole-of-government co-ordination.

For example, an analysis using linked longitudinal data was conducted to understand the wider benefits and costs of government-funded housing in New Zealand, particularly for those previously incarcerated. It was found that the provision of social housing reduced the expenditure by the Department of Corrections per prisoner by 25% by reducing the average length of time that the recipients spent in prison. However, there were also additional downstream effects. It was found that additional social housing also resulted in a further NZD 16 million spent on education for the children of ex-prisoners as they were more likely to spend more time in education, while an additional NZD 31 million was spent on social development and welfare payments.

By better collecting and using information in an integrated way, digital transformation enables a fuller reckoning of the costs and benefits of public interventions, including an understanding of potentially underestimated positive spillovers. This in turn enables policy makers to develop more targeted policies to improve well-being for individuals and their communities.

Source: OECD 2017f.

3.8. Digital government

74. Digital transformation of governments and public services requires new forms of partnerships and engagement, new skills, leadership and accountability models for the public sector. Digital technologies offer opportunities to increase access, reach and quality of public services, and to improve policy making and service design by making these processes more user-driven (Box 3.8). To fully leverage the opportunities of digital

technologies and large data sets across the public sector, it is important to let the needs and demands of users drive the development of services and policies. To do so, a number of issues need to be addressed, including issues around how to leverage new digital opportunities to rethink how the public sector functions, including the governance of ICT use in the public sector and the regulatory environment concerning these new (potentially disruptive) areas, and how to interact with the public. This requires overcoming organisational and regulatory barriers to integration, sharing and horizontal decision making, and use of data and digital technologies across the public sector, as well as taking into account the fact that the progression towards a more mature digital government capable of using new technological opportunities to deliver public value should not result in new forms of digital divides. The growing importance of digital government is discussed in more detail in Section 4.4 of this paper.

Box 3.8. Using digital technologies for better public policies

To date, the profound impact of digital transformation in the private sector has not been mirrored by equally significant changes to how policy is made or how governments interact with their citizens. However, the application of digital technologies holds the potential to reshape existing policies, enable innovative policy design and rigorous impact evaluation, and expand citizen engagement in local and national policy making. The extent to which this potential is realised will depend on whether governments prove willing and able to scale the use of digital technology, and how successfully privacy concerns and digital security vulnerabilities are addressed.

From the first pioneering experiences of policy applications, it is possible to identify three areas in which digital transformation promises to improve policy making. The first area is the improved efficiency and targeting of existing policies. The increased possibility to monitor outcomes directly, for example thanks to sensor technologies, and the availability of data that were previously imperfectly observable, or only observable at significant administrative cost, enables more effective enforcement of existing rules and lowers the cost of policy targeting.

In the area of finance, financial flows can now be tracked at a level of granularity and periodicity that was not previously possible and allow for the better enforcement of existing financial market regulations and improved public finance management. In agriculture, remote sensing and digital land parcel identification systems allow countries to grant direct subsidies to farmers and to enforce other regulatory measures related to the sustainability of agriculture. Yet the increased complexity of policy coupled with privacy concerns remain significant barriers to more widespread use of policy targeting and differentiation, for example in social and education policy.

The second area in which digital transformation holds the potential to improve public policy is in improving policy design and evaluation. Digital technologies broaden the suite of policy instruments available to governments and can lower the cost of policy experimentation and evaluation. In cities, digital cameras that automatically register the license plate of vehicles entering a congestion zone have made it more feasible to design, implement and enforce congestion pricing schemes. Merging congestion data with public transport use data from smart cards can be used to evaluate the effect of urban policies on travel behaviour. In education, being able to track all students over their study path has allowed some countries to uncover study patterns in some institutions that were at odds with study design and led to the experimentation of new study paths. Governments have also started using online laboratory experiments as low cost approaches to test the impact of alternative labelling schemes, enabling more effective policy outcomes upon roll-out.

The third area of promise is the potential of digital transformation to reshape government-citizen interaction and expand stakeholder engagement. Many OECD countries are making more data freely available to enhance accountability in the public sector and allow for evaluating the effects of current policies. Making pollutant release and transfer registers publicly available online can facilitate civil society oversight on regulated entities, making compliance efforts more transparent and breaches more open to public scrutiny. As an example of improved engagement of regulators with the private sector, the creation of regulatory sandboxes in Fintech has allowed companies to test the introduction of new technologies in a controlled and monitored environment and facilitate regulator-firm engagement.

However, digital transformation poses a number of challenges: the increased granularity of data and increased data-sharing between government agencies and across public-private partnerships can generate digital security vulnerabilities and concerns over individual privacy. While these apply to both government and private sector applications of digital technology, these concerns are arguably more acute in the public sector as it may own more private or accurate data about individuals. Further, the insufficient public infrastructure to link disparate source of data is a key bottleneck. This raises the question of interoperability of data systems within and across different areas. Finally, while the availability of more data usually helps to improve policies, it is not a panacea and comes with risks that will need to be tackled over the next decade: in some instances, less data is better than more. This has meant that public sector adoption rates remains low relative to the private sector, with the majority of policy examples identified only implemented at the local level or representing pilot projects. Mainstreaming digital best practices across national institutions might be the largest challenge to be tackled.

Source: OECD 2018f.

3.9. Strategy

75. Digital transformation affects all corners of the economy, society, and government activities. To realise its full benefits, governments need to reach across traditional policy silos and across different levels of government and develop a whole-of-government approach to policy making. This means more co-ordination when making decisions and implementing policy measures across ministries and levels of government as well as more active involvement of all key stakeholders, including the business community, trade-unions, civil society and Internet technical community, in the policy making process as well as implementation and monitoring. By identifying the inter-dependencies among policy areas affected by digital transformation, it will be easier to link up the relevant ministries and government bodies that need to be co-ordinated to ensure that policies are mutually reinforcing. At the same time, governments must also reach out to each other and work together at the international level to address policy issues raised by digital transformation that transcend borders.

76. National digital strategies (NDS) are a key component of ensuring a whole-of-government approach. Current approaches to governing NDS vary across countries. Information from 35 countries provides an overview of the responsibilities allocated for the development, co-ordination, implementation, and monitoring of NDS (OECD, 2017a,

Table 3.2). The lead on strategy development is often taken by a ministry or body that is not dedicated to digital affairs, while only a minority of countries so far is charging a ministry or body that is dedicated to digital affairs. Almost all countries engage multiple private stakeholders and public bodies to contribute input to developing their NDS. Only few countries (Austria, the Czech Republic, Hungary, Luxembourg, Mexico, the Slovak Republic) have a single high-level government official, e.g. in the Prime Minister's Office, Presidency or Chancellery that leads the development of or co-ordinates the NDS. Effective co-ordination is essential for developing and implementing a whole-of-government approach with an NDS. The implementation of the NDS is the responsibility of several ministries, bodies or institutions in the majority of countries, and in some, multiple stakeholders are involved in implementing it. Bodies responsible for monitoring the implementation of the NDS tend to be the same as those who lead the development and the co-ordination of the NDS.

Table 3.2. National digital strategy governance, 2016

Number of countries that have allocated respective responsibilities	Lead the development	Contribute input	Co-ordinate	Implement	Monitor
Government, e.g. Prime Minister, Presidency, Chancellery, Ministerial Council	AUT, CZE, HUN, LUX, MEX, SVK	--	AUT, BRA, CHL, CZE, DEU, FRA, MEX, SVK	SVK	AUT, BRA, CHL, CZE, PRT, RUS, SVK,
Digital affairs ministry or body or ministerial position	BEL, CHN, EST, ITA, JPN, POL, SVN, ESP, GBR		BEL, CHN, JPN, LUX, POL, PRT, SVN, ESP, CHE, GBR	CHN, POL	BEL, CHN, ITA, JPN, LUX, POL, ESP, SWE
Ministry or body not dedicated to digital affairs	BRA, CAN, CRI, IRL, ISR, LVA, LTU, NLD, PRT, RUS, SWE, CHE, TUR	FIN, SVN	CAN, EST, IRL, ISR, LVA, LTU, NDL, NOR, RUS, SWE, TUR	SVN	CRI, EST, IRL, ISR, LVA, NDL, NOR, SVN, CHE, TUR
Several ministries, bodies or institutions	CHL, FIN, FRA, DEU, HUN, KOR	CAN, CZE, ESP, HUN, ISR, ITA, JPN, KOR, LVA, MEX, NOR, POL, RUS, SVK, CHE, GBR	CRI, ITA, KOR, SGP	AUT, BEL, BRA, CAN, CHL, CRI, CZE, ESP, EST, FIN, FRA, DEU, HUN, IRL, ISR, ITA, JPN, KOR, LVA, LTU, MEX, NOR, RUS, SGP, SWE, CHE, TUR, GBR	CAN, FRA, DEU, HUN, KOR, LTU, SGP, GBR
Multiple public and private stakeholders	SGP	AUT, BEL, BRA, CHL, CHN, CRI, EST, FRA, DEU, IRL, LTU, LUX, NLD, PRT, SGP, SWE, TUR	--	LUX, NDL, PRT	--

Note: Information for DEU, ESP, FRA and HUN was updated in 2018.
Source: Based on OECD 2017a.

77. Designing better policies for a digital economy and society not only requires better knowledge about the technological changes underway, flexible enough policies in order to keep pace with innovations, and a holistic strategy, but also further efforts to

improve measurement, evidence and analysis (Box 3.9). All countries need to work together to fill the data gaps and in doing so enable better benchmarking, evidence building, policy development, and the identification and prioritisation of policy review and action. At the same time, new opportunities are emerging thanks to digital technologies, e.g. through the use of big data analytics and non-official data sources.

Box 3.9. Measurement challenges related to digital transformation and how to address them

The rapid growth and pace of change of the digital economy is creating significant measurement challenges, both for traditional macro-economic accounting frameworks and in many new and emerging policy areas.

The Going Digital project has already made considerable progress in assessing the overall robustness of current accounting frameworks, emphasising the importance of a complementary 'satellite account' that better highlights the, often hidden, role of the digital economy and that capture important phenomena outside of these frameworks (Ahmad and Schreyer, 2016).

Chief amongst these concerns data, both in its use as a knowledge based asset and as the oil that greases the wheels of the digital economy, including in particular cross border data flows, where policy restrictions have risen in recent years. Ongoing work is helping scope the challenges and options for measurement in this area. In addition, policy indicators measuring the impediments to digital trade will be released in 2018 (Digital STRI).

Another significant area of research relates to prices, where changes in quality induced by digital technologies, and the changing nature of competition driving price differentials between goods and services sold online versus offline present measurement challenges, with implications on measures of economic growth, investment and productivity (see joint OECD-IMF work in Ahmad, Ribarsky and Reinsdorf, 2017; and Reinsdorf and Schreyer, 2018).

The notion of digital products, which are typically knowledge-intensive, non-rival and subject to close to zero marginal cost, also raises new challenges as transactions in those products are related to the right to use the product. The measurement module will be looking at improving the measurement of royalties, license fees and other transactions related to the use of digital knowledge-products and intellectual property in the system of national accounts and the balance of payments.

In response to these challenges, work is also being undertaken to identify best practices in the compilation of official statistics related to the digital economy and digital trade. Work is underway to advance on these issues, and provide impetus for developing more granular information in the form of a digital economy satellite account.

However, as ICTs, the Internet, and data itself, become basic infrastructure for businesses and society, it will be increasingly difficult to measure the digital economy as distinct from the overall economy. Alternatively, one could develop better tools for identifying economic activities as they go digital. Recent OECD work (Calvino et al. 2018) develops a taxonomy of sectors by their extent of digital maturity, taking into consideration a multiplicity of indicators by their intensity (e.g., robot use, software investment etc.).

Digital technologies themselves are generating enormous flows of information at an unprecedented pace. They have reduced the complexity and the cost of the collection, storage and treatment of data. Furthermore, digitally-enabled activities, e.g. e-commerce,

cloud services and Internet of Things, provide new sources of information on the behaviour of individuals and firms. As a result of these trends, a large wealth of private source data coexists today with the established set of official statistics. While private source data open new opportunities for analysing trends and impacts of the digital economy, their use raises new challenges. Private source data typically does not meet the quality standards that are the trademark of official statistics. In addition to these quality concerns, its use for analytical purposes may raise issues of privacy, security, data ownership and sharing. Nevertheless, these obstacles can be overcome, for example through effective partnerships (e.g. involving data sharing). Therefore, OECD work will also aim at developing frameworks and standards for the use of private sector data for statistical and analytical purposes.

As digital transformation progresses some policy issues need to be revisited and will pose new challenges, as well as the need for fresh evidence to substantiate those debates. As the OECD and the broader international community develop international policy guidelines on issues related to "trust" in digital environments, such as the use of personal data, issues of digital security and protection of consumers online, the OECD's work on measurement will scope the availability and reliability of sources to measure citizens trust in online environments, including platforms for interacting with governments.

For centuries, technological developments have made old skills obsolete and led to the demand for new skill sets. ICTs are at the forefront of this transition today and are generating policy interest about new skills needs and new forms of work. This has raised the debate on what measures best capture the range of skills consumers and workers need. And on whether it is possible to define such ICT skills based on existing metrics and statistics and to what extent private source data can be used, for example, to monitor job vacancies and the emergence of new job profiles, or the offer of new services and business models in the sharing economy, not yet captured by official statistics. These are issues that will be looked at in the context of the OECD's work on measurement.

The digital economy extends beyond businesses and markets – it includes individuals, communities and societies. This broader perspective encompasses new themes such as the rapid growth of social networks and free and rapid access to social media and other user-created content. This gives rise to a wide range of policy issues including cyber bullying, the right to have one's past forgotten and Internet "addiction", as well as on-going concerns about the protection of children online and persistent digital divides. The majority of current ICT metrics focus on the role of ICTs in business performance and fall short in terms of measuring the well-being impacts of ICTs and their contributions to social outcomes. The module on well-being will be identifying the need for new metrics in this space.

The measurement strand of the Going Digital project has already delivered a set of experimental metrics on digital transformation recently published in the 2017 edition of the OECD STI Scoreboard. Further work in 2018 will refine some of these indicators, complement them with others drawn from a wide range of areas and developed in the context of the Going Digital project, and bundle them in a publication/online portal. The aim is to map those indicators against current digital economy policy issues, as reflected in the policy framework that will be developed with the project. By doing so, gaps in the current metrics and measurement tools will be identified and progress made by some initiatives towards filling these gaps will be assessed. This work will lay the foundations for future measurement initiatives by developing a medium-longer term Measurement Road Map for the Digital Transformation.

4. Making the Transformation Work for Growth and Well-being - Key Areas for Policy Action

78. While the process to develop the preliminary integrated policy framework has shown that many policy domains need to be considered, this section considers some of key areas where policy action will be needed to make digital transformation for growth and wellbeing – jobs and skills; productivity and competition; trade; and well-being.

4.1. The future of jobs and skills in the digital world

79. Advances in AI, ICTs and robotics have the potential to profoundly change the world of work. Most people now regularly use digital tools like touchscreens, computers or smartphones at work and many see their jobs change as a growing share of the tasks they undertake can be automated and production processes get redesigned and embedded in ICT infrastructures. Digital technologies have also facilitated the rise of the "platform economy", in which workers frequently perform "gigs" (i.e. short- or long-term engagements), either in the real world (such as delivering food or providing rides) or entirely online (such as photo tagging, transcription, product categorisation, etc. – also sometimes referred to as "crowd work").

80. On the whole, it is difficult to predict how digital transformation will affect the total number of jobs: while some jobs might disappear as a result of automation, new ones will be created, too. What is clear is that digital transformation will lead to a restructuring of the labour market and changing skills needs which, if not well-managed, could result in growing skills mismatch, structural unemployment and rising inequalities. Indeed, there has already been a longstanding trend of skill-biased technological change. As the kinds of jobs that are emerging are not necessarily the same as the ones that are disappearing, some groups of workers can be left behind. Moreover, although digital technologies will help automate some strenuous work, improve work safety and free workers to engage in more interesting and creative work, it may deteriorate the quality of other jobs in some cases – e.g. through a rise in digitally-enabled precarious work. Making sure that digital transformation leads to more and better jobs will depend on the kind of policies that accompany it, including in the areas of: labour, social protection, social dialogue, and education and skills. As the impacts may be concentrated in some industries and regions, sectoral and regional policies will be important too.

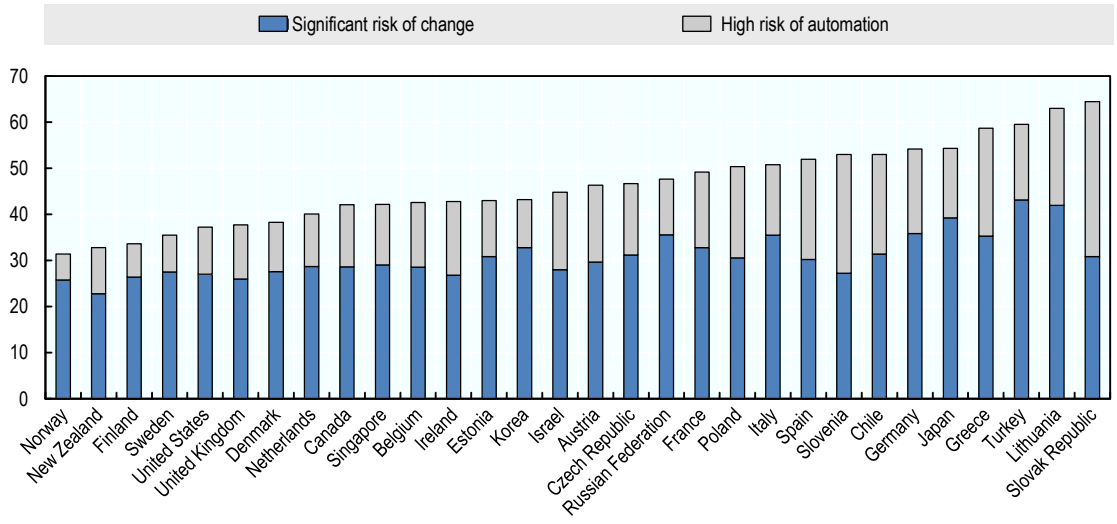
Digital transformation both creates and eliminates jobs

81. Estimates of the number of jobs potentially at risk of automation vary considerably. While bounded by uncertainty, the latest OECD estimates place the percentage of jobs at a high risk of automation in the next 15-20 years at 14%, on average in those countries that participated in the Survey of Adult Skills (Figure 4.1) (Ljubica and Quintini, 2018). Another 31% of jobs are estimated to be at risk of significant change as a result of automation, implying that half of all jobs will experience significant change. However, there are several reasons why the risk of automation may not necessarily translate into actual job losses overall. These include the fact that technology

development and adoption depend on a host of economic, legal, ethical and social factors, as well as on the availability of the requisite skills and organisational changes. Consequently, there is a large gap between what can be automated from a technical point of view, and what is currently being automated by firms (see section 4.2). In addition, while destroying some jobs or changing the task content of others, technological change also creates new jobs. It does so both directly, through the emergence of entirely new occupations, and indirectly, as a result of rising productivity and prosperity. While the future is uncertain, there is no evidence that, to date, technological change has been associated with net job losses overall (OECD, 2017). One critical uncertainty is the extent to which humans will retain their comparative advantage over machines, including with respect to cognitive skills.

Figure 4.1. A significant share of jobs could be affected by automation

Percentage of jobs at high risk of automation and at risk of significant change



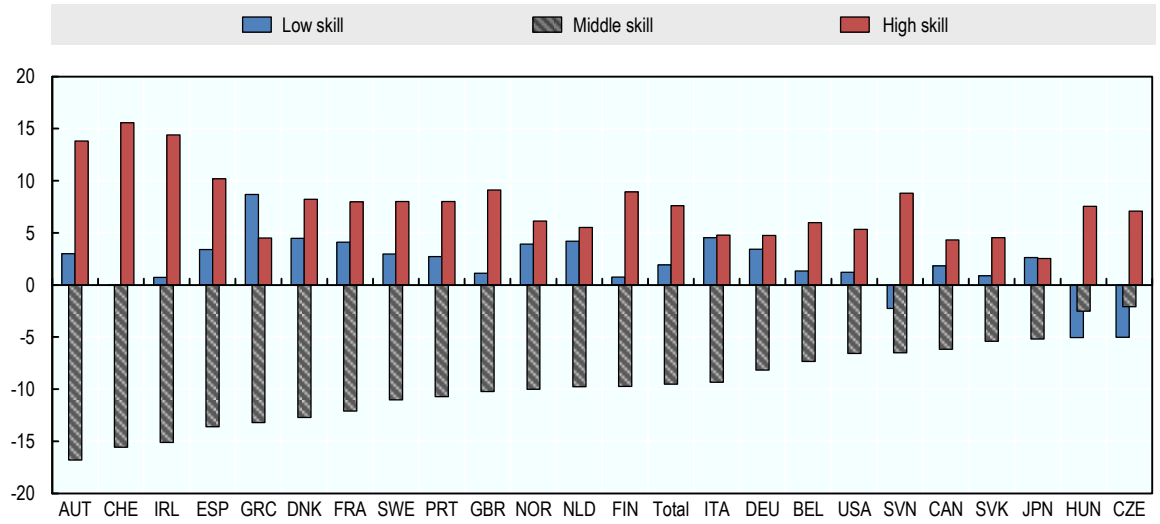
Source: Ljubica and Quintini, 2018.

Newly created jobs are not the same as those that are lost

82. While it remains difficult to assess the impact of digital transformation on overall employment levels, there is mounting evidence that it results in considerable restructuring of the labour market, thereby affecting the distribution of jobs, wages and income. High-skilled workers have tended to benefit relatively more from technological change as they have skills that complement technology in undertaking non-routine tasks, such as problem-solving, or creative and complex communications activities. Over the past two decades, most OECD countries have therefore experienced a process of labour market polarisation whereby the share of employment in high-skilled (and to some extent in low-skilled jobs) has increased, while the share of employment in middle-skilled jobs has decreased (Figure 4.2).

Figure 4.2. Labour markets have polarised in nearly all OECD countries

Percentage point change in share of total employment, 1995 to 2015



Notes: High-skill occupations include jobs classified under the ISCO-88 major groups 1, 2, and 3. That is, legislators, senior officials, and managers (group 1), professionals (group 2), and technicians and associate professionals (group 3). Middle-skill occupations include jobs classified under the ISCO-88 major groups 4, 7, and 8. That is, clerks (group 4), craft and related trades workers (group 7), and plant and machine operators and assemblers (group 8). Low-skill occupations include jobs classified under the ISCO-88 major groups 5 and 9. That is, service workers and shop and market sales workers (group 5), and elementary occupations (group 9).
Source: OECD 2017c, *OECD Employment Outlook 2017*.

83. Looking forward, however, low-skilled workers are most likely to bear the costs of digital transformation. While some high skilled tasks also face a risk of automation, low-skilled workers look most likely to lose their jobs, face increased competition for jobs from middle-skilled workers, are least likely to be able to adapt to new technologies and working practices, and are also least likely to benefit from the new opportunities that arise as a result of digital transformation. This is already putting downward pressure on their wages (Acemoglu and Restrepo, 2017; Dauth et al., 2017; Graetz and Michaels, 2017).

84. Digital transformation may also exacerbate inequalities between regions, as new jobs appear in places other than where they have been lost. Evidence from the United States shows that new industries have mainly appeared in urban locations that have a large share of high-skilled workers (Berger and Frey, 2015). Similarly, regions vary in their exposure to digital transformation, often depending on their industrial structure, and those most exposed to the adoption of robots have seen negative effects on employment and wages (Acemoglu and Restrepo, 2017).

The emergence of new forms of work raises concerns around job quality

85. Technological advances and the introduction of new business models have given rise to the "platform economy" and have led to the emergence of new forms of work such as "crowd work", "gig work", and other forms of on-demand labour which, despite

currently representing only a small share of employment, appear to be growing fast. Non-standard forms of work which already represent one-third of jobs, coupled with the new business models enabled by digital transformation, can offer an important source of income and flexibility for workers, including on working time, while at the same time contributing to enhanced innovation and productivity. They may also facilitate the labour market integration of under-represented groups (and therefore promote inclusiveness) by e.g. helping individuals overcome barriers to participation. However, labour market outcomes vary greatly across non-standard workers, in particular in terms of pay, job security and social protection. In addition, workers may not be covered by collective bargaining arrangements and/or some labour regulations, and may receive less training and suffer more job strain. Given that certain population groups are over-represented in non-standard forms of work (typically women, youth, the least-skilled, workers with disabilities, and workers in small firms as well as migrants), on-demand labour risks being a source of inequality in access to good jobs (with some groups confined to less attractive types of work), thus resulting in increased labour market segmentation. If firms use such forms of work to avoid tax and other financial obligations, there is also a risk that a rise in non-standard forms of work results in a transfer of fiscal responsibilities from employers onto government and individuals.

Ensuring a smooth transition will require a comprehensive package of co-ordinated policies

86. Because of the many uncertainties linked to digital transformation, including the time frame over which it will unfold, it is difficult to foresee all the potential changes that might affect the world of work in years to come. What is important is that these changes require workers, businesses and governments to prepare, now, for this new world of work, rather than to look for ways to stop or reverse digital transformation. Despite all the uncertainty about the depth and speed of change, clinging to the status-quo is not an option; rather a people-driven "adaptation agenda" needs to be formulated so that all individuals may benefit from a positive, forward-looking plan that does not leave anybody behind and puts people's wellbeing at the centre. By doing so, both people and firms will benefit. Policy makers should therefore target efforts on making labour markets, education and training systems, and social institutions more resilient and adaptable, so that firms and workers can manage the transition with the least possible disruption, while maximising the potential benefits. In particular, policy will need to facilitate worker redeployment, invest in skills, adapt social protection, future-proof labour market regulations and promote social dialogue.

- **Facilitating worker redeployment**. Adapting to technological progress will require policies facilitating the redeployment of workers across businesses, industries and regions. The efficient reallocation of resources depends on the flexibility of firms and the mobility of workers, i.e. the ease with which entrepreneurs can start or liquidate a business, firms adjust their workforce in response to changing business conditions and workers move across firms and places in search of better matches for their skills and ambitions to enhance their career opportunities. The efficiency of reallocation is to an important extent determined by the functioning and regulation of financial, housing and product markets, including through policies that affect entry and exit, but labour market policies and institutions also play an important role by determining the flexibility

with which firms can adjust their workforces (e.g. employment protection) and the ease with which workers can move across firms. The latter depends to an important extent on the transferability of skills and the portability of benefits, availability of effective employment services and active labour market programmes to facilitate job transitions. Worker mobility also depends on wage incentives for workers to move from low to high-productivity firms, highlighting the importance of allowing sufficient scope to adjust wages to business conditions at the firm level, especially in countries where collective bargaining predominantly takes places at the sector or national level.

- **Investing in skills.** People, especially youth, need to prepare for the jobs of the future by being equipped with the right mix of skills required to successfully navigate through ever-changing, technology-rich work environments. This mix includes general cognitive skills, complementarity skills such as problem solving, creative thinking, communication collaboration, emotional intelligence, ICT and generic skills and technical skills, and a strong ability to continue learning. The quality of education and training systems (starting from early childhood education) needs to improve by taking a holistic approach to skills. Relevant bodies need to adapt the catalogue of recognised occupations requiring formal training and need to adapt the curricula thereof in a flexible manner and with a long-term vision. Policies also need to enhance equity in educational opportunities for inequality to be reduced. After initial education, all workers need to be given opportunities and incentives to maintain their skills, upskill and/or reskill throughout their working lives – whether through formal or informal learning. Many of them will need to be given specific guidance how to realise life-long learning. Large numbers of workers lack the basic skills required to thrive in or simply cope with technologically-rich work environments and low-skilled workers are less likely to participate in training than high-skilled ones. The rise of new business models coupled with non-standard forms of work further compounds the challenge, since workers in such types of employment may be less likely to participate in training. Addressing the barriers to adult learning, especially for low-skilled individuals, requires working on various fronts such as increasing incentives for investments in training (e.g. personal training accounts, or lifelong training rights), developing mechanisms to allow the portability of training rights between employers so built up rights are not lost when workers change jobs, fostering motivation and removing time and other constraints. Policies to encourage employers to invest in training are also required, as the scale of the challenge goes beyond the capabilities of government alone. To facilitate this, governments can provide incentives for the private sector to invest in the development of transferable skills, build work-based learning into educational programmes, and create an environment where people have greater discretion over learning activities. Co-ordination among education and training institutions, employers, and social partners and institutions can make education and training programmes more responsive to changing needs and help target those who need learning opportunities the most (see Box 3.6). It is crucial that this includes high-quality and independent orientation and counselling on lifelong learning for all workers and unemployed over their whole career span.

- **Adapting social protection**. Adequate social protection is crucial to help workers transit smoothly between jobs, especially when they have been displaced. In a context where many countries already struggle to provide adequate social protection for workers on non-standard work contracts (e.g. temporary contracts, self-employed, on-call labour), the advent of the platform economy adds to these difficulties. An increasing number of people only work occasionally and/or have multiple jobs and income sources, with frequent transitions between dependent employment, self-employment and work-free periods. Many people do not even have all of the formal permits allowing them to formally work as and such be protected under existing rules. All this is adding to the challenges faced by existing social security systems, which are still largely predicated on the assumption of a full-time, regular, open-ended contract with a single employer. As a result of these challenges, more workers risk falling through the cracks – although the scale of the problem that lies ahead is difficult to predict at this stage. In some cases, employment regulation will need to be clarified or adapted to take into account new forms of employment. Tax and benefit systems would also need to be extended and or adapted to the new forms of work so that all workers are both provided with some minimum protection and their various sources of income are brought into the tax system. Portability of social security entitlements should be promoted to prevent the loss of benefit entitlements when workers move between jobs. And governments may also need to expand the role of non-contributory schemes so that no one is left without social protection as a result of their contract status. Several countries are experimenting with various forms of basic income schemes which, besides being simple, have the advantage of not leaving anyone without support. However, an unconditional payment to everyone at meaningful but fiscally realistic levels would require tax hikes as well as reductions in existing benefits, and would often not be an effective tool for reducing poverty. In addition, some disadvantaged groups would lose out when existing benefits are replaced by a basic income, illustrating the downsides of social protection without any form of targeting at all. A key challenge in addressing the rise in new forms of work resides in the measurement issues encountered, given that traditional sources of information on labour markets (e.g. household and labour force surveys) currently do a poor job at capturing them.

- **Future-proofing labour market regulation and labour standards**. Maintaining and improving labour market performance in the future world of work will also require a fresh look at existing labour market regulations to ensure that they still are fit for purpose. These include employment protection legislation, minimum wage laws, working time regulations and regulations to safeguard occupational health and safety. As digital transformation may further promote the diffusion of non-standard forms of work, this may result in reduced job security for many workers. Many might not be protected at all by the standard rules for hiring and firing applying to open-ended contracts. Oftentimes, less strict rules apply (e.g. in cases of temporary employment, temporary work agency work or dependent self-employment) while in others, workers are excluded from employment protection legislation altogether (e.g. the self-employed). For some of the emerging new forms of work, it is not even clear what the status of workers is, who the employer is, and what rules should apply to them. It will therefore be critical for countries

to examine their legal frameworks to determine whether they need to be updated and/or adjusted to remain fit for purpose. Countries should also think about how existing regulations can be better enforced in the face of disruptive business models, and what complementary legal and regulatory measures can help. Finally, labour market regulation and tax policy should be scrutinised to ensure neutrality between various forms of work and to avoid regulatory arbitrage, resulting in employers and workers choosing non-standard contracts solely to circumvent taxes and regulations on regular contracts.

- **Fostering social dialogue**. Anticipating future challenges and opportunities, finding solutions, managing change proactively, and shaping the future world of work can be achieved more easily and effectively if employers, workers and their representatives work closely together with governments in a spirit of co-operation and mutual trust. However, since the 1980s, the process of collective representation and negotiation has been challenged in the OECD union membership declined from 30% to 17% and the proportion of workers covered by collective agreements went down from 45% to 33%. Going forward it will be important to understand how to promote workers' representation in a world where flexible forms of employment become more common, as union membership is usually very low among non-standard workers. The new forms of work add to the challenge of organising worker voice since individuals are increasingly working alone, separated by geography, language and legal status or simple lack of the necessary information. Alternative forms of worker organisation are emerging and such developments should be welcomed. However, there are limits to what alternative labour movements can achieve, and there is still value in collective bargaining, both for workers and employers. This is why alternative labour movements are better seen as complements to labour unions. In addition, unions can and do reach out to non-standard workers, and social dialogue can help regulate new forms of work. But government intervention is needed to develop a favourable regulatory environment. In particular, revisions of both competition and labour law may be needed. In some cases there are important regulatory challenges to overcome (e.g. in many countries independent workers cannot unionise since this would be considered forming a cartel. Where appropriate, governments should also tackle the misclassification of workers so that they have access to the channels of workers' voice they are entitled to. At the same time, social dialogue can help in finding firm-level solutions in using technology to foster high performing work practices.

- **Prioritising resources.** The implementation of a people-driven "adaptation agenda" that relies heavily on skills development, life-long learning, support for worker deployment and improved social protection will require resources in an era when public budgets are under tremendous pressure. Governments will need to realign spending to support these new initiatives and improve the efficiency of government services and the effectiveness of the initiatives put in place. The adoption of new digital tools (see Box 3.2) could help improve public sector efficiency and help deliver better services. New forms of public-private partnerships will also help to deliver the adaptation agenda for the digital age.

4.2. Harnessing digital transformation for firms

The productivity slowdown: laggard firms and stalling diffusion

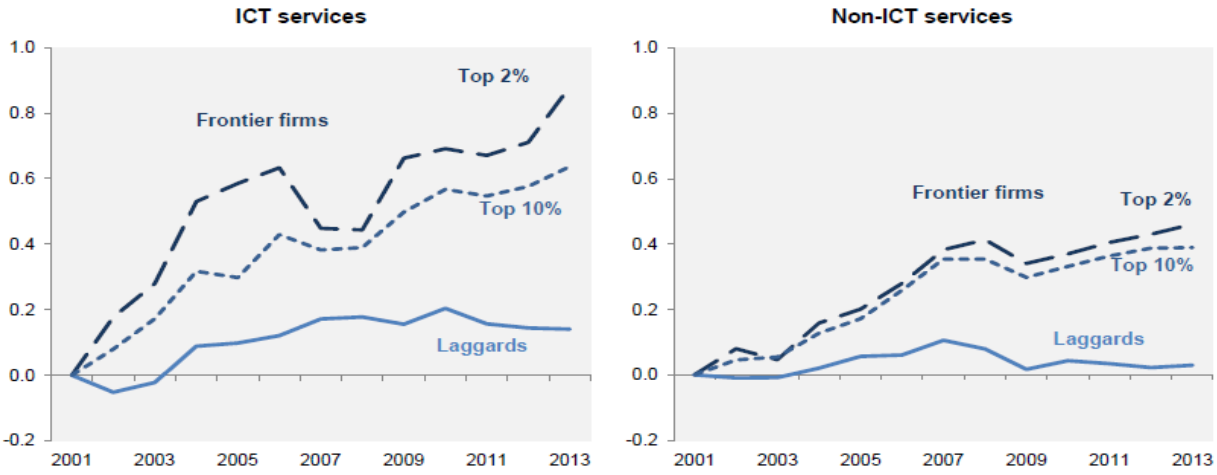
87. Digital transformation of our economies holds the promise of improving productivity performance by enabling innovation and reducing the costs of a range of business processes (Goldfarb and Tucker, 2017). But despite the rapid rise of digital technologies starting in the mid-1990's, aggregate productivity growth has slowed over the past decade or so, sparking a lively debate about the potential for digital technologies to boost productivity. Today, as in the 1980s, when Nobel-prize winner Robert Solow famously quipped: "we see computers everywhere but in the productivity statistics" there is again a paradox of rapid technological change and stagnating productivity growth. There are several possible factors that may contribute to this paradox (including inadequate measurement, see Box 3.4), that provide clues to possible avenues for policy action that could strengthen future productivity growth based on digital transformation.

88. First, there are still important differences in digital transformation across industries that affect the overall state of digital transformation, and thus its impacts on productivity (see also McKinsey Global Institute, 2018). Recent OECD analysis shows that some sectors are less advanced than others in terms of the pace of digital transformation (Calvino et al., 2018; OECD, 2017b). For example, even if new technologies are being integrated here too, agriculture, mining and real estate still rank in the bottom part of the distribution on digital intensity across all available indicators. Conversely, telecom and IT services rank consistently at the top of the distribution. Other sectors display a large heterogeneity, suggesting that they are only engaged in some aspects of digital transformation. Importantly, some of the most digitally advanced sectors in the economy - such as telecom and IT services - have a relatively small weight in the economy, limiting their impact on aggregate productivity growth. Conversely, some sectors that are - on average - less advanced in the digital transformation, such as health services, education, construction and real estate, have a relatively large weight in the economy.

89. Looking behind the aggregate and sectoral statistics, micro-level studies reveal that the aggregate productivity slowdown masks a widening performance gap between more productive and less productive firms, especially in ICT-intensive sectors (Andrews, Criscuolo and Gal, 2016; Figure 4.3). This divergence is not just driven by frontier firms pushing the productivity frontier out, but also by the stagnating productivity of laggard firms related to the limited capabilities of, or lack of incentives for, such firms to adopt best practices. Together, these signs illustrate that the main source of the productivity slowdown is not so much a slowing of innovation by the most globally advanced firms, but uneven uptake and diffusion of these innovations throughout the economy (OECD, 2015a). This could also be because we are at the cusp of a new technological wave where only a few front-runners have mastered the new opportunities and this know-how has not yet been codified for easy dissemination and adoption.

Figure 4.3. The divergence in multi-factor productivity growth

ICT vs. non-ICT services sector

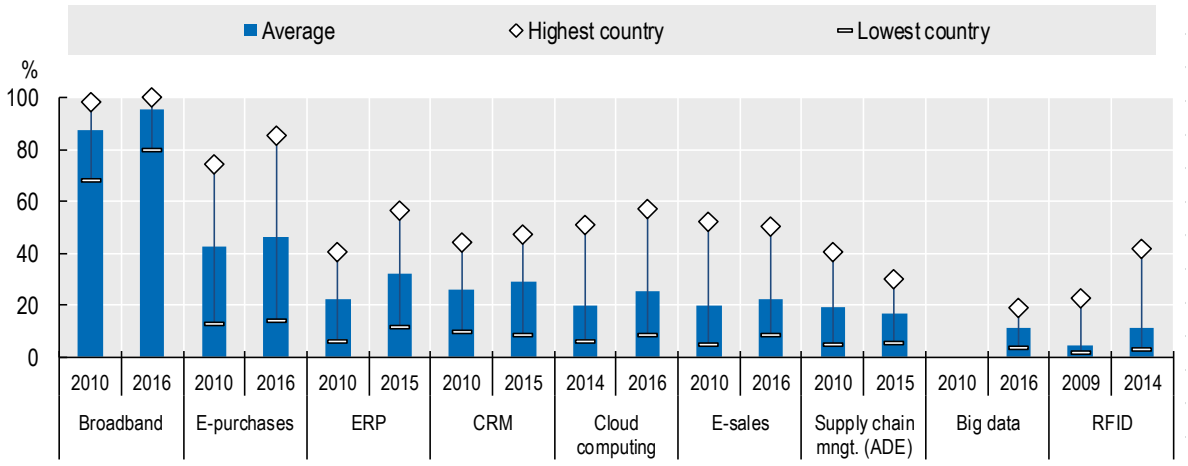


Source: Andrews, D. C. Criscuolo and P. Gal (2016), "The Best versus the Rest: The Global Productivity Slowdown, Divergence across Firms and the Role of Public Policy", OECD Productivity Working Papers, No. 5

90. In either case, OECD data show that the diffusion of digital technologies across OECD countries is far from complete. While most firms now have access to high-speed broadband networks, more advanced, productivity-enhancing digital tools and applications, such as enterprise resource planning systems or big data analytics, have diffused to far fewer firms in OECD countries (Figure 4.4). Moreover, significant cross-country differences emerge – even amongst the most advanced economies – raising important questions about why some countries are more successful at adopting digital technologies than others.

Figure 4.4. Diffusion of selected ICT tools and activities in firms, 2010 and 2016

As a percentage of enterprises with 10 or more persons employed



Note: The upper and lower bar denote the minimum and maximum average value across countries. ERP refers to enterprise resource planning, CRM to customer relationship management, RFID to radio frequency identification.

Source: OECD (2017b), OECD Science, Technology and Industry Scoreboard 2017.

91. The diffusion of so-called "general-purpose technologies" like digital technologies typically follows an S-shaped curve where technologies are initially only adopted by some leading firms and later diffuse to all firms, as they become more established, prices fall and markets grow. Consequently, there is a significant gap between what can currently be implemented from a technical point of view (and what may be implemented by frontier firms) and what is currently being implemented by firms on average.

92. The history of technological change also demonstrates that the successful implementation of new technologies involves much trial and error, and that it takes time to reorganise production processes, introduce new business models, and provide workers and management with new skills. Digital transformation is not just about the diffusion of technology, but increasingly about the complementary investments that firms need to make into skills, organisational changes, process innovation, new systems and new business models (Haskel and Westlake, 2017). Some recent research suggests that the scale and complexity of these complementary investments is growing, which may make digital transformation particularly difficult for non-frontier firms, such as traditional SMEs (Brynjolfsson, et al., 2017). During this process of adjustment and experimentation, productivity growth may be low and can even turn negative (Brynjolfsson et al, 2017).

93. On a positive note, the slow diffusion of digital technologies and the related processes across firms and industries in OECD countries suggests that its impacts on productivity are likely to emerge in the years to come, as digital intensity in firms and sectors increases further and the economy adjusts (Van Ark, et al., 2016). This might also be affected by the current business cycle - as firms in several OECD countries are starting to incur labour and skills shortages, they will increasingly look for digital tools to help enhance their productivity performance. Moreover, the pick-up in demand may help spur investment and strengthen technology diffusion (McKinsey Global Institute, 2018).

94. In particular, digital technologies offer new opportunities for SMEs to participate in the global economy, innovate, scale-up and enhance productivity. Digital transformation facilitates the emergence of "born global" small firms, and SMEs' access to customers in local and international markets, with Internet platforms increasing the supply of products and services and allowing trades that otherwise would not happen. Big Data and data analytics enable SMEs to better understand the processes within the firm, the needs of their clients and partners, and the overall business environment. The use of digital technologies can also ease SMEs' access to skills and talent, such as through better job recruitment sites, and the outsourcing of key business functions, all of which can help improve performance. It can also facilitate access to a range of financing instruments and the development of innovative solutions to address information asymmetries and collateral shortages.

95. However, SMEs face particular challenges in the adoption and effective use of ICT, particularly in the case of productivity-enhancing applications and in the access to high-speed broadband networks. The adoption lag of SMEs is mainly due to a lack of key capabilities, e.g. human resources and management expertise, lack of investment in complementary assets and unavailability of access to high-speed broadband networks in small towns and rural areas. For instance, lack of investment in in-house innovation and organisational capabilities limits the capacity of SMEs to take full advantage of new

technologies to enhance data analytics, engage in e-commerce, or increase participation in knowledge networks. Furthermore, SMEs face specific challenges in managing digital security and privacy risks, mainly due to lack of awareness, resources and expertise to assess and manage risk effectively.

96. Enabling SMEs and entrepreneurs to fully harness digital transformation can help ensure growth is inclusive, as well as boost productivity and competitiveness, as these firms find new niches in global value chains. Comprehensive national digital strategies that take into account SMEs, policies that facilitate access to finance, knowledge networks and skills, including the development of management skills for the digital economy, and SME engagement with competency centres and/or technology extension services, can be helpful for SMEs. National digital security strategies can also help address the specific needs of SMEs by providing them with practical guidance and the appropriate incentives to adopting good practices.

The role of structural factors for digital adoption

97. A second factor limiting the impacts of digital technologies on productivity is the slow pace of structural change and resource re-allocation in OECD economies. Digital transformation of firms involves a process of search and experimentation with new technologies and business models, where some firms succeed and grow and others fail and exit (OECD, 2004). Countries with a business environment that enables this process may be better able to seize the benefits from digital transformation than countries where such changes are more difficult and slow to occur.

98. New OECD research shows that the diffusion of selected digital technologies is typically more advanced in sectors where firm turnover (i.e. entry and exit) is higher (Calvino and Criscuolo, 2018). This is consistent with the idea that new entrants: *i*) possess a comparative advantage in commercializing new technologies (Henderson, 1993); *ii*) place indirect pressure on incumbent firms to adopt new technologies; and *iii*) can more fully reach their potential when they have sufficient space to grow, which is accommodated by the exit of inefficient firms. Moreover, digital adoption will be facilitated by efficient resource allocation, since a firm's incentives to experiment with uncertain/risky digital technologies will be shaped by its perceived ability to rapidly scale-up operations in event of success, and rapidly scale-down operations and potentially exit the market at low cost in the event of failure (Andrews and Criscuolo, 2013). From this perspective, harnessing digital transformation for firms places an added premium on policies that foster business dynamism and efficient resource reallocation. This is a challenge in many OECD countries against the backdrop of declining business dynamism (Criscuolo, Gal and Menon, 2014) and rising resource misallocation (Adalet McGowan et al., 2017a; Berlingieri, Blanchenay and Criscuolo, 2017) that has been observed in many OECD countries over the past decade.

99. A range of policies can incentivise greater digital adoption through experimentation either by increasing competitive pressures or by lowering the costs of reallocation. This includes insolvency regimes that do not inhibit corporate restructuring and do not excessively punish entrepreneurial failure. For example, reforming insolvency regimes to the least stringent levels in the OECD is associated with a 3-10% increase in the share of firms adopting cloud computing in industries highly dependent on external finance relative to those less dependent on such finance (Figure 4.5., panel A). At the

same time, access by entrepreneurs to appropriate forms of finance, such as venture capital financing, together with corporate tax regimes that do not excessively favour debt over equity financing, are also associated with higher digital adoption rates.

100. Any policy incentivising the uptake of digital technologies, however, requires adequate infrastructure. Yet, many regions and localities in OECD countries remain badly connected to modern high-speed broadband networks, resulting in large inter-regional gaps. For example, indicators on the percentage of households with a broadband internet connection show gaps of up to 48 percentage points between the most and the least connected regions in the OECD (OECD, 2016a). This gap also affects SMEs, which are often the main contributors to the local economy in small towns and rural areas. Fully benefiting from the opportunities linked to digital transformation will require that all individuals, businesses and governments have reliable and affordable access to digital networks and services (see also Section 3.2). In some more remote or less-densely populated regions this might require proactive approaches by the government, often in the context of national broadband strategies, and co-investment when commercial players assess there is insufficient demand for them to invest (OECD, 2017g).

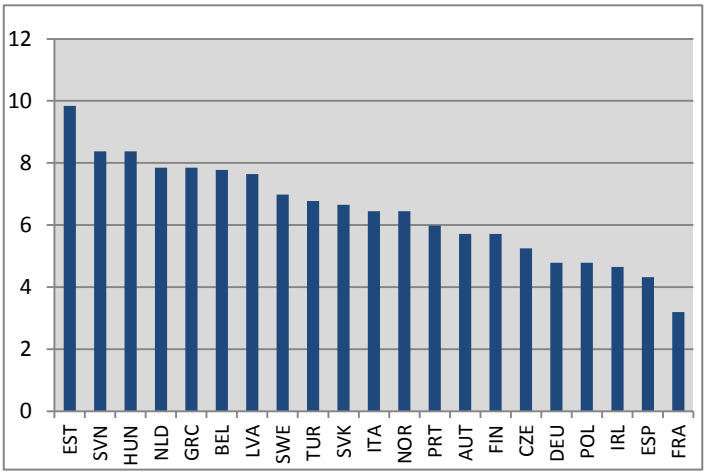
101. Importantly, the transition of an economy based on tangibles to one based on intangibles (or ideas) can only succeed if firms have access to the right set of *capabilities.* For example, qualified firm management that takes the decisions to invest and guides the adoption process has been identified as a key capability (see Bloom et al., 2012; Pellegrino and Zingales, 2014). Firm-level practices related to workers, including their participation in training and consultations, or their flexibility in working hours, are also important in this context. As illustrated by Figure 4.5, panel B, the differential impact of increasing the share of firms with high performance work practices (HPWP)[3] to best practices is associated with a increases, ranging from less than 1% to over 10%, in the share of firms adopting CRM systems in knowledge-intensive industries relative to industries with a low knowledge intensity. Second, as discussed in Section 4.1, worker's skills matter, including providing them with opportunities to continuously develop their skills in order to keep pace with the fast-changing technological landscape; and ensuring people's skills are allocated to their most productive uses. Structural variables proxying the quality of managerial capital, the general level of (ICT) skills, and the efficiency of human capital allocation are therefore associated with disproportionately higher digital adoption in knowledge intensive sectors, relative to other sectors. In addition, the ability to manage digital security and privacy risks, also contributes to a more effective use of digital technologies (see Box 3.5).

[3] HPWP measures the share of workers receiving bonuses (bonus), having participated in training over the previous year (training) or enjoying flexibility in working hours (flexible working hours). The index is based on data from the OECD Survey of Adult Skills (PIAAC) (OECD, 2017i)

Figure 4.5. Structural factors and digital adoption

A: Increase in Cloud Computing adoption rates from improving Insolvency Regime efficiency to the sample optimum

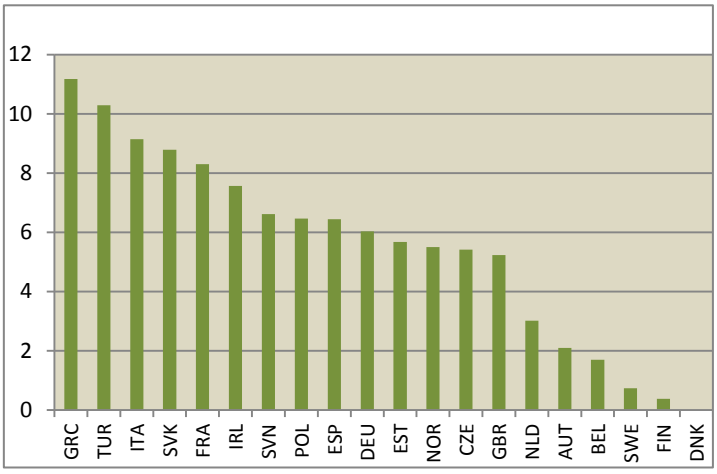
Differential impact between industries with high and low external financial dependency (in percent)



Note: Financial dependency refers to industry level dependence on external finance (Rajan & Zingales, 1998). Insolvency Regimes efficiency is based on the aggregate indicator in Adalet McGowan et al. (2017b).

B: Increase in CRM systems adoption rates from increasing the share of firms with high performance work practices (HPWP)

Differential impact between industries with high and low knowledge intensity (in percent)



Note: Knowledge intensity refers to the average share of persons with tertiary education by sectors. HPWP refers to the share of jobs with *high* HPWP, i.e. above the top 25th percentile of the pooled distribution (average 2012 & 2015).

Digital transformation and business dynamism

102. Recent OECD work has pointed to a slowdown in business dynamism in OECD economies, which has slowed down the necessary reallocation of resources across the economy. For example, the share of non-viable old firms has been increasing in many OECD countries, particularly since the financial crisis, while the productivity of the latter group of firms has been falling rapidly relative to "viable" old firms, as well as younger firms in general (Adalet McGowan, et al, 2017a; Berlingieri et al, 2017). The growing amount of resources trapped in unproductive firms and the slowdown in reform efforts to tackle regulations that impede product market competition (Adalet McGowan et al., 2017b) have also contributed to the slowdown in structural change. To explore the role of business dynamism for digital transformation in more detail, new evidence from the OECD's Going Digital project explores three different aspects of business dynamics and how it has been affected by the ongoing digital transformation: i.e. business dynamics; mark-ups; and mergers and acquisitions (M&As).

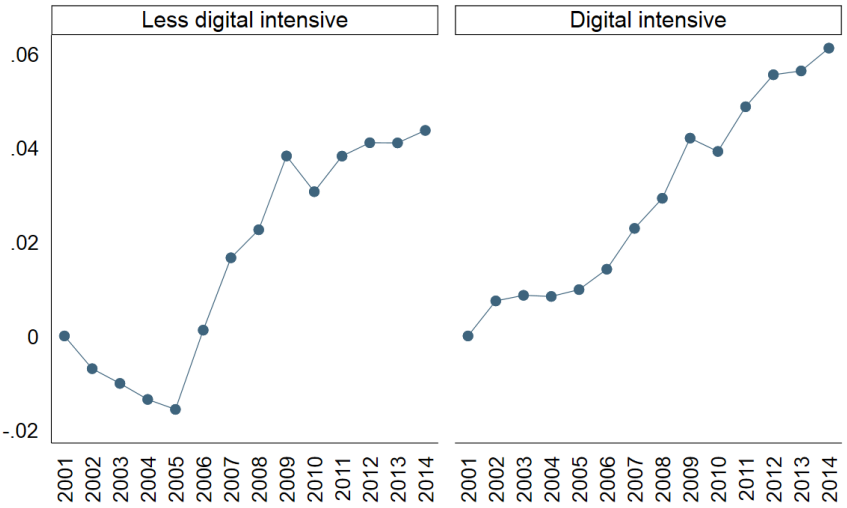
- **Business dynamics**: Research examining the association between business dynamism (measured by the churning rate) and selected measures of digital intensity (Calvino and Criscuolo, 2017) points to the existence of a positive role of digital transformation for business dynamics. This is in line with the idea that digital transformation lowers barriers to entry and facilitates reallocation. It also

suggests that the more digital sectors are those that are more dynamic (i.e. with higher rates of entry, higher churning and higher post-entry growth). On the other hand, the results also show that indicators on the automation of tasks and the share of turnover from e-commerce are negatively associated with business dynamism. These results might reflect the role of high fixed costs and the importance of networks with customers and suppliers and data which might represent a barrier for new firms. They might also point to the potential the fact that growth of firms in highly automated sectors might not always involve the direct creation of new jobs.

- **Mark-ups**: Digital technologies are also transforming the way firms produce, scale up and compete. They allow firms to leverage ever larger networks of consumers, access multiple geographical and product markets almost instantaneously, and exploit increasing returns to scale from intangible assets. Yet, as discussed above, the largest productivity benefits have thus far mainly been accrued by some, often large, firms. At the same time, the lower costs of production, easier penetration of several markets and higher intensity in knowledge assets, allows digital companies to scale up faster and more easily, and generate increasing returns to scale, thus potentially making the entry of new players in the market more difficult. This dynamic may be stronger in digital rather than less digital intensive industries, as the former are typically characterised by network effects, economies of scope in data collection and analysis, and, as a result, high and increasing levels of price and product differentiation (OECD, 2015b). In this context, new OECD work (Calligaris et al., 2018) explores mark-ups, i.e. the wedge between the price a firm charges for its output on the market and the cost the firm incurs to produce one extra unit of output. The study estimates mark-ups at the firm level for a large sample of companies across 26 OECD and non-OECD countries, for the period 2001-2014. It finds that mark-ups have been increasing over the period, on average across firms and countries, but especially in firms at the top of the mark-up distribution. Furthermore, the results suggest that mark-ups are higher in digital-intensive sectors than in less-digitally intensive sectors, other firm characteristics being equal, with the difference increasing over time (see Figure 4.6).

- **Mergers and acquisitions**: Finally, new exploratory research also points to changes in M&A activity, especially in certain digital industries (Bajgar et al. 2018). Both the number and value of global M&As have been steadily increasing in recent years, and digital sectors have played an important role in this rise. Two industries with a particularly large increase in the number of M&As between 2005 and 2016 are data processing and software publishing, with a very large increase in acquisitions of data processing start-ups. This is increasingly driven by acquirers which themselves operate in data processing, and has become increasingly concentrated, with the top 1% acquirers accounting for about 70% of the total deal value in 2016. In addition, the importance of corporate ventures and development capital in data processing has been increasing and is much higher than in other digital and non-digital sectors.

Figure 4.6. Mark-up growth in digital intensive vs less digital intensive sectors, 2001-2014



Note: The distinction between digital intensive sectors (resp. less digital intensive sectors) rank above (resp. below) the median sector by digital intensity, as calculated jointly over all indicators of digitalisation in Calvino et al. 2018 . This graph fixes the ranking of sectors to the initial period (2001-03), and shows only mark-ups estimated assuming a Cobb-Douglas production function.

Source: OECD estimates based on Orbis® data.

The role of competition policy

103. While the changes in business dynamism, the growth of mark-ups (in particular in digitally-intensive sectors) and the growth in mergers and acquisitions are not necessarily a cause of concern as they may be inherent to the nature of digital transformation, they do point to important changes in the competitive environment linked to digital transformation that need to be further examined and considered by policy makers. Globalisation can only bring its full benefits if competition is fair in a well-functioning market. Some barriers remain, for instance different regulatory frameworks across countries can make it difficult and costly for companies to expand internationally. Policy makers - in particular those responsible for competition - will need to continue monitoring these developments to ensure competition.

104. More broadly, in the fast-moving reality of digital transformation, existing regulatory frameworks designed for traditional products and services may need to be reviewed in light of digital transformation. In some cases, existing regulatory frameworks may even prevent or slow down the development of new digital products and services. For example, in some sectors, cross-border sales are still negligible, which may seem puzzling given the growing scope for digital technologies to enable cross-border trade[4]. Conversely, new policy measures might be needed to enable digital transformation. The need for regulatory structures to evolve over time, taking account of technical conditions

[4] One example is the financial sector, as reported by a 2016 study for the European Commission, see https://ec.europa.eu/info/system/files/study-digitalisation-01072016_en.pdf.

and policy priorities, is well-recognised, as is the need for regulations to be driven by evidence and for enforcement to be non-discriminatory. The OECD has previously developed a methodology to help evaluate policies for ensuring regulations can achieve the economic benefits of competition, the *Competition Assessment Toolkit*.[5]

105. A recent qualitative survey of regulations by the OECD found that existing regulatory frameworks designed for traditional products and services may not be suitable for a global digital economy (Figure 4.7), in particular in sectors such as transport, accommodation and finance. In some cases, they may even prevent or slow down the development of new digital products and services. Conversely, new policy measures might be needed to enable digital transformation.[6]

106. The platform - or sharing - economy is at the centre of the debate on competition, digital transformation and regulation. While many countries are considering changes to applicable legislation in the accommodation, financial and transport sectors (see Figure 4.7), e-commerce, healthcare, professional services and electricity are among the other sectors where regulatory changes are sometimes deemed necessary in light of digital transformation. In these cases, legislation was sometimes drafted at a time when some products or services did not exist, with a number of potential implications. For instance, it may not be clear whether the new products and services fall under the existing legislation or the legislation may include requirements that are harder for new economic operators to comply with.

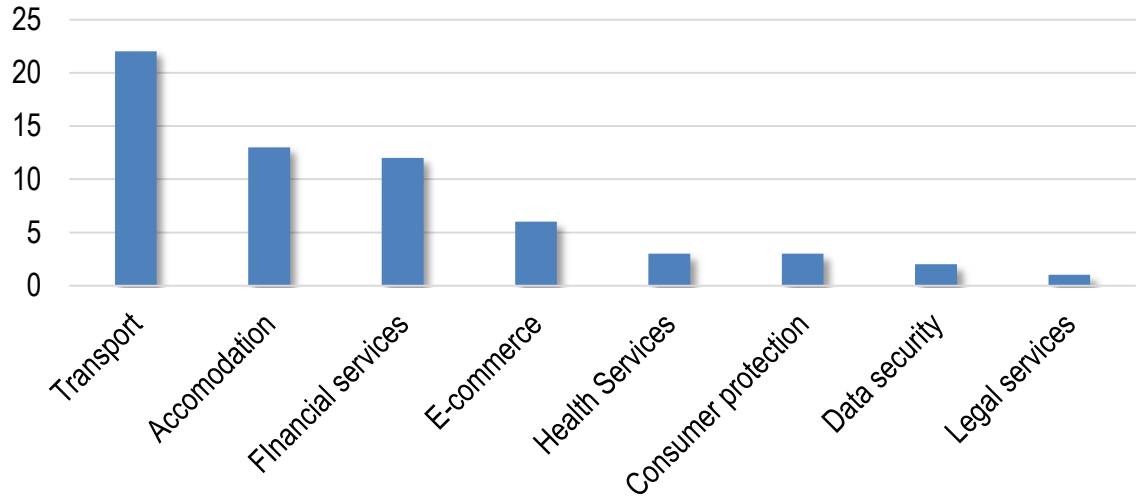
107. Another development, related to the platform economy, is that the regulation of economic activities often is not directly applicable to transactions between private individuals, or if applicable, treats private individuals in the same way as large enterprises. One survey response noted that some traditional business models at risk of displacement by innovation have lobbied domestic regulators for "adoption of regulations that can stop or delay such innovations." Clearly, digital transformation is changing the world faster than many rules and regulations have evolved. Governments could benefit from mechanisms to periodically review their regulatory frameworks and, where appropriate, update them to ensure that they are well-suited to the increasingly digitalised world.

108. One way that existing policy frameworks can be adapted to a digital environment is through "regulatory sandboxes" (see Box 3.8). Regulatory sandboxes provide a limited regulatory waiver or flexibility, usually explicitly to facilitate experimentation and testing. The limits are usually in terms of geographic space, duration or sector, and are negotiated or enabled by regulatory authorities to facilitate market-testing, experimentation and innovation (OECD 2017f).

[5]The Competition Assessment Toolkit is available in 17 languages at: http://www.oecd.org/daf/competition/assessment-toolkit.htm.

[6] See DAF/COMP/WP2/WD(2017)2. To date, about 30 countries have submitted responses to the OECD questionnaire in addition to companies via BIAC.

Figure 4.7. Number of countries mentioning given sector in survey responses



Source: OECD competition survey, see DAF/COMP/WP2/WD(2017)2.

109. Moving beyond the regulation of specific sectors, relevant developments have been identified in other areas such as data protection and consumer protection. Horizontal legislation is an enabler of online transactions and contributes to building trust in the digital environment. In some cases, amendments to existing legislation may be necessary (e.g. consumer protection and data protection); in other cases, additional regulations may need to be issued to regulate new areas enabling digital transactions, e.g. digital signatures. As part of its regular collection of information on regulatory barriers to competition (in 2013 and underway in 2018), the OECD has been monitoring the status of regulation in some of these areas, in particular data protection, online users' tracking, portability of data, and protection of online purchases.

110. Many competition authorities actively engage in advocacy activities in their jurisdictions and have over time recommended specific changes to their countries' regulations. More generally, digital transformation has implications that go beyond product market regulation or enabling legislation, including for competition law enforcement. An OECD hearing in June 2017 suggested that existing principles answer the key questions that arise in the context of platforms, for example on determining the market boundaries and assessing market power, provided that small but important adjustments are made to the techniques used in the analysis.

111. The most important of these adjustments is to account for network effects, taking into account the fact that platforms are often more attractive to users on one side when they successfully recruit users on another side. Competition law enforcers should give particularly careful consideration to allegedly exclusionary conduct in platform markets. Some features of the digital sector, such as economies of scale and scope and network effects, can favour the emergence of dominant firms. While care should be taken not to confuse market gains by more competitive companies and abuse of dominant positions,

there is evidence that economies of scale may be a greater challenge for maintaining competition than previously realised.

112. The increasing use of pricing algorithms can potentially enhance competition or, on occasion, could increase the risks of collusion (OECD, 2017l). Pricing algorithms may create a new mechanism for achieving outcomes comparable to those of explicit collusion, and with equally harmful consumer impacts as from explicit collusion, without involving operational interventions by humans. There are few known cases so far so the extent of this potential problem is not yet clear. But the concept of algorithm-facilitated cartels raises new enforcement challenges, and potential prosecution may depend on jurisdictions having an operational definition of "agreement between competitors" that is appropriately broad.

113. Competition authorities are taking action against situations involving improper conduct or undue extension of market power. As enforcement challenges may cross borders, enhanced co-operation among competition authorities will be increasingly important, including by reinforcing information-sharing and investigation assistance.

Policies to strengthen future productivity growth

114. For policy makers, a number of points emerge from the discussion above. First, digital transformation is already having impacts on productivity in individual firms - and also in specific industries. Second, further and larger impacts are likely to emerge as digital transformation evolves and new technologies, business models and practices diffuse to more firms and industries. Third, ensuring that the largest possible impacts emerge can benefit from pro-active policy action, all of which will also support productivity growth more generally. Key actions include:

- *Strengthening national and international technology and knowledge diffusion*. As discussed in detail in OECD (2015a), advanced technology and knowledge often comes from abroad, as it is developed in scientific institutions and global frontier firms. Openness to foreign technology and knowledge is therefore essential to benefit from digital transformation, and requires openness to trade, investment, and international mobility of the highly skilled. Moreover, strengthening knowledge diffusion within the economy is important and can benefit from further policy action, e.g. as regards the wider use of technology extension services, improvements in science-industry linkages and stronger mobility of human resources within the economy. Protection of intellectual property rights is also important in this context.

- *Fostering investment in tangible and intangible capital, notably skills*. With investment levels remaining low across most OECD countries, policies that can strengthen investment in tangible and intangible capital are crucial to increase the adoption of digital technologies, strengthen the necessary complementary knowledge and enhance the absorptive capabilities of firms, managers and workers. Investment in skills (firm-specific and otherwise) of both workers and managers is particularly important in this context.

- *Enabling SMEs to harness digital transformation*. SMEs' adoption of digital technologies and uptake of productivity-enhancing practices is particularly

important to ensuring that productivity growth is inclusive and that emerging entrepreneurial opportunities are seized. Comprehensive national digital strategies that take into account SMEs, policies that facilitate access to finance, high-speed connectivity, knowledge network and skills, including management skills, and SME engagement with competency centres and/or technology extension services can be particularly helpful for SMEs.

- *Facilitating the necessary structural change in the economy*. Policies that facilitate structural change through the entry, growth and exit of firms are important to support the introduction of new, digital-intensive business models, and replace old and obsolete business models. Policies in OECD countries often implicitly or explicitly favour incumbents, and do not always enable the experimentation with new ideas, technologies and business models that underpins the success of innovative firms, be they large or small. Policies which (unwittingly) constrain the entry and growth of new firms can also slow down structural change. Moreover, policy should also avoid trapping resources in inefficient firms, e.g. through bankruptcy laws that do not excessively penalise failure.

- *Strengthening structural reform to support digital transformation*. In many sectors of the economy, successful digital transformation will require changes to existing institutions, regulations and markets, as new technologies enable the emergence of new business models and innovative firms, as well as new ways of delivering public and private services. To unlock the potential of digital transformation, further structural reforms will eventually be required in many areas, including financial services, health services and education services, as well as the public sector itself. Regulatory changes may also be necessary to ensure appropriate protection of consumers in online transactions, in particular when these involve the disclosure of personal data. Consumers' take-up of new and innovative products, as well as e-commerce transactions, may be slowed down by a lack of adequate protection. Similarly regulation of data ownership and data portability will have to be such as to ensure that the accumulation of data from incumbents does not create barriers to entry for new-comers, thus slowing down innovation and reducing competition.

- *Ensuring effective competition*. Finally, policy makers will need to ensure that market competition is effective by providing competition authorities with rules and tools can address the new challenges posed by the digital economy, where these prove to be necessary, and that co-operation across national competition agencies is enhanced to address competition issues that are increasingly transnational in scope or involve global firms.

- *Investing in innovation to drive the productivity frontier*: Finally, firms and governments will also need to continue investing in innovation to further develop digital and other technologies that can move the global productivity frontier. This includes ensuring sufficient investment in basic research that is key to developing the seeds for future innovation and that has underpinned most of the technologies that drive the current digital transformation (OECD, 2015a; 2015b). Ensuring the

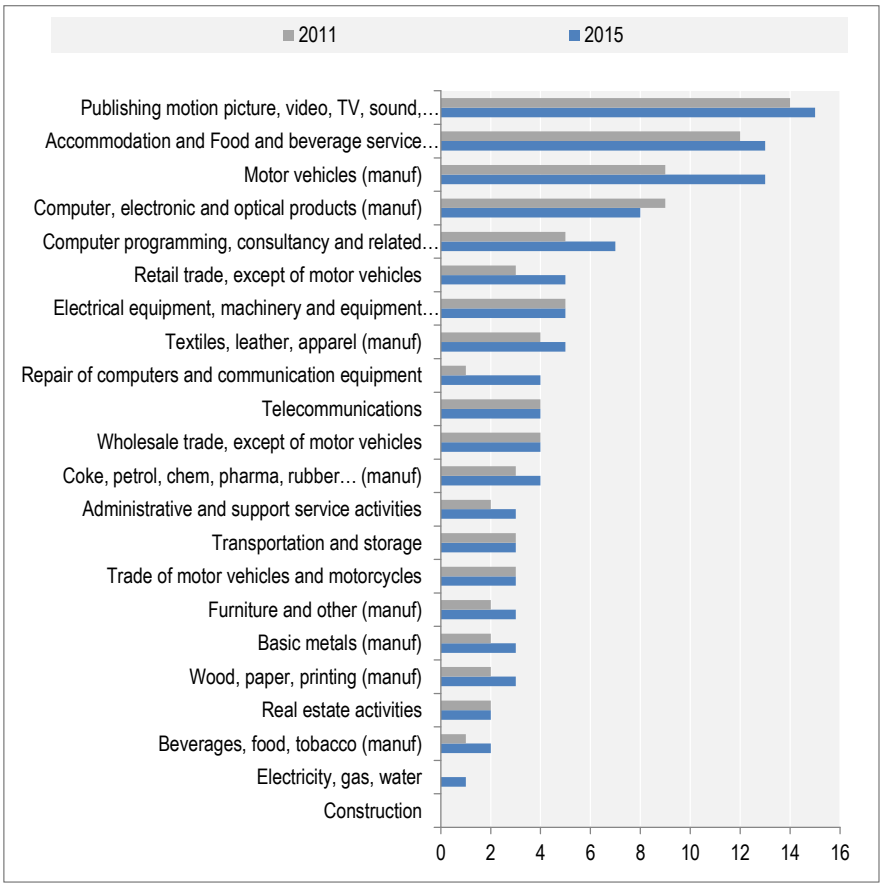
impacts of such investment will also require efforts to foster diffusion across the economy, including by strengthening the knowledge exchange between science and business.

4.3. Fostering trade and market openness in the digital economy

115. Digital transformation has significantly reduced the cost of engaging in international trade; facilitated the co-ordination of global value chains; helped diffuse ideas and technologies across borders; and connected greater numbers of businesses and consumers globally, pushing out the digital trade frontier. A growing number of enterprises, across both manufacturing and services sectors, are engaging in cross-border electronic sales (Figure 4.8). But there are differences across countries, which underscores the importance of unlocking the potential of e-commerce - and digital trade more generally - in a range of countries.

Figure 4.8. Enterprises engaged in cross-border electronic sales (2011-2015)

As a percentage of enterprises in each sector



Note: Values are averages across sectors for EU-28 countries. They show the share of enterprises having done electronic sales to other EU countries and the rest of the world.
Source: Eurostat, Digital Economy and Society Statistics.

116. Digital transformation has allowed trade to take place through digital means entirely (e.g. digitally delivered cloud-computing services), and enabled more traditional trade (e.g. goods and services trade via on-line platforms). But while it has never been easier to engage in trade, digital trade has amplified the importance of some trade measures (e.g. trade facilitation for cross-border online purchases) and given rise to new issues with trade impacts (e.g. cross-border flows of data) (OECD, 2017h).

117. Digital transformation has also spurred the development of path-breaking innovations – like artificial intelligence or cloud computing – helping firms, especially SMEs, access IT services with little upfront investment or scale up IT functions in response to rapid changes in demand.

118. As digital transformation progresses, governments are facing new regulatory challenges, not just in managing issues arising from digital transformation, but also in ensuring that the opportunities and benefits from digital trade can be realised and shared inclusively. One particular question around which there has been a great deal of discussion is whether current trade rules adequately address new developments arising from trade in the digital age. Indeed, existing multilateral trade rules were negotiated when digital trade was in its infancy and, even if conceived to be technologically neutral, questions arise over whether they might require clarifications to reflect new forms of, and issues raised by, digital trade.

119. Trade rules are traditionally predicated on identifying whether products are goods or services and the borders they cross, but new business models and the global nature of the Internet blur these distinctions. Firms can flexibly service markets from different locations. Moreover, the products they now sell bundle goods with services (as is the case of a smart home speaker connected to a voice-controlled intelligent personal assistant). This makes it increasingly difficult to identify the particular trade rules that apply to specific transactions.

120. A better understanding of the factors that shape market access and openness in the digital era is needed. First, by looking at openness to trade in goods, services and digital connectivity in a more holistic way. Second, by identifying how different types of measures, whether new or old, raise new issues for digital trade.

Moving towards a more holistic approach to market openness

121. Market openness creates a business-friendly environment that allows "foreign suppliers to compete in national markets without encountering discriminatory, excessively burdensome or restrictive conditions" (OECD, 2010). It helps firms, domestic and foreign, reap the benefits of trade and contributes to economic growth (Romalis, 2007). However, the rise of new business models, while enabling greater trade, also makes ensuring market openness more complex.

122. Indeed, innovative business models – like matching services, logistical support and secure payment systems – are providing solutions that enable firms to sell their products online, reducing some of the complexity of trade in the digital era. Others make local or offline activities part of their business model in order to profitably sell new types of products. Moreover, firms increasingly rely on digital technologies not just in the production stages and the delivery of goods and services, but also as a means of connecting different, and geographically dispersed, actors. Digital transformation allows

firms to draw on data from users to better respond to consumer preferences, better target services and connect and customise production processes globally.

123. Yet these changes, coupled with the greater bundling of goods and services enabled by digital transformation, challenge traditional market openness distinctions between goods and services. Not only do these now have to be considered jointly, but a greater focus on openness to information transfers and digital connectivity is also needed.

124. Market openness in the 21st century therefore needs to be approached more holistically. For example, Internet access may be a necessary but it is not a sufficient condition for digitally enabled trade in goods to flourish. If logistics services in the receiving (or delivering) country are costly due to service trade restrictions increasing prices, or if goods are held up at the border by cumbersome procedures, then the benefits of digital transformation may not materialise. Platform-enabled trade transactions might be curtailed or might not take place at all.

125. Open trade and investment regimes can create new avenues to rapidly upgrade technologies and skills, and increase specialisation. Market openness is a critical framework condition to enable the digital transformation to flourish. The bundling of goods and services and the rise of new technology-driven products and markets raises issues related to the classification of new types of products and services, and highlights the need to ensure market access for both the good and the bundled or embedded service. Growing interconnectedness and a greater demand for just-in-time delivery also means that trade needs to be faster and more reliable more than ever, underscoring the need for more efficient trade facilitation. At the same time, data form an integral part of international production processes. Data are an asset that can be traded, a means to deliver services and co-ordinate global value chains and an enabler of trade facilitation.

126. In this interconnected world, the benefits of digital transformation for trade are contingent on a combination of factors. Within the firm, investment in information and communication technologies (ICT) such as big data is associated with higher productivity, but only for firms that adopt new organisational processes or have access to workers with adequate skills. Reaping these benefits also requires market openness. New technologies are often made available through international trade, and access to international markets for both inputs and outputs is necessary for scaling production and increasing competitiveness. Indeed, successful 'born global' firms combine both adoption of new technologies and access to global markets.

127. At the same time, a better understanding and mapping of how traditional issues in market openness, such as trade facilitation, may have new consequences in the context of digitally enabled trade; or how market openness in the digital era might be conditioned by new issues, such as having internationally interoperable e-payment systems, can give policy-makers a better overview of the factors that help countries maximise the benefits from digital trade.

Measures affecting digital trade

128. The nature of the measures that affect how modern firms engage in digital trade is varied, some relate to accessing and using digital networks or supporting digital services; others are old trade issues with new consequences; and some are new measures which raise new issues.

Measures affecting access to and use of digital networks

129. A cross-cutting issue affecting any firm seeking to engage in digital trade relates to access and the use of digital networks. Issues range from the quality of physical infrastructure to regulatory matters. While some issues are not the direct purview of trade policy, they affect the ability of firms to engage in digital trade. The physical infrastructure or the cables and wires that underpin the transfer of information between countries underpin digital connectivity. Access to this infrastructure, through market openness ensuring competitive telecommunications markets, conditions the cost of participation in digital trade. In this respect, restrictions on the cross border supply of telecommunication services is a trade-related horizontal measure affecting the ability of firms to engage in digital trade, irrespective of whether a firm is producing a good or a service.

Old measures, new issues

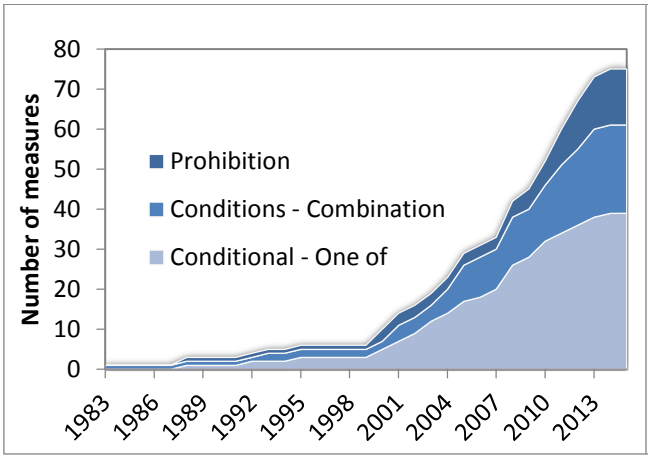
130. Digital trade can also change or amplify the importance of "old" issues. For instance, trade in low value goods ordered on-line is still subject to traditional physical connectivity constraints. However, since trade costs can represent a sizeable share of the value of small consignments, how fast and at what cost a physical good can clear a border is especially important for this type of trade. At the same time, growing trade in digitally ordered parcels poses new challenges for customs authorities and other border agencies. These relate to growing workloads and the need to adapt clearance processes and risk management. These may, in turn, affect at-the-border costs, including for larger shipments. They may also relate to revenue issues related tariffs or collection of VAT. At the same time, an increasing volume of digitally-ordered parcels exacerbates “old” issues related to border enforcement of counterfeit goods.

New measures, new issues

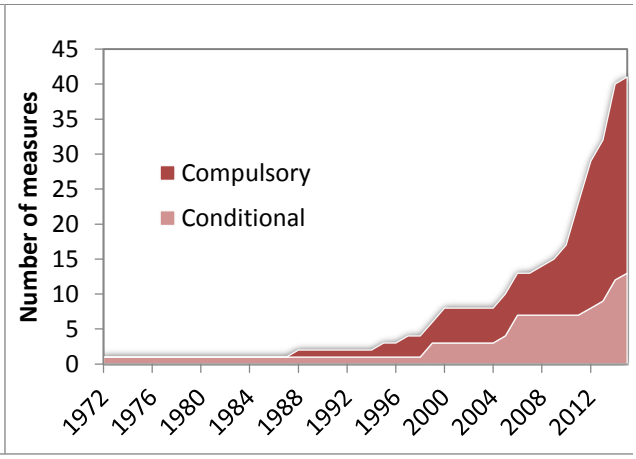
131. Digital transformation also raises new issues such as those related to e-payments, or interoperability, but perhaps the most important, and controversial, relates to cross-border data flows. Data underpin digital transformation and impact the trade environment: as an integral part of production, an asset that can themselves be traded, a means to deliver services and co-ordinate global value chains, and an enabler of trade facilitation. But the growing volume of data exchanged across borders has amplified concerns about digital security, the protection of privacy, and audit and regulatory reach. As a result, governments are increasingly seeking to regulate the cross-border transfers of data, or requiring that data be stored locally (Figure 4.9).

Figure 4.9. Stock of identified data measures

a. cross-border transfer restrictions



b. local storage requirements



Source: OECD estimates based on OECD 2016e.

132. The implications of these measures are not well understood and have led to a polarised debate. On the one hand, there are concerns about the impact that the emerging measures[7] may have on business activity and on the ability to benefit from digital trade; on the other hand, there are concerns about ensuring public policy objectives, such as the protection of privacy. The challenge is to find the balance that enables these key objectives to be met while preserving the significant economic and trade benefits flowing from data-enabled trade. To support this dialogue it will be important to better understand the nature and composition of data flows that are highly heterogeneous, ranging from data associated with engineering to logistics to more sensitive financial and customer data and mixing personal and non-personal data. Each may require a different approach and policy framework.

International co-operation is essential to meet market openness challenges in the digital age

133. Many digital infrastructures such as the Internet were born global. They offer new opportunities for scale, particularly for SMEs and businesses in developing economies, but they raise key challenges for domestic and international policy in a world where borders and regulatory differences between countries remain.

134. International trading relationships are governed by bilateral, regional, and multilateral trade and investment agreements, which play an essential complementary role to, and can help anchor and underpin, domestic structural reforms. Action in multilateral fora is of particular importance in promoting the mutual interests of countries in terms of trade liberalisation, building confidence between firms and the societies in which they operate on the widest possible global basis.

[7] A preliminary catalogue of such emerging measures can be found in OECD 2016e (Annex A).

135. Many trade-related aspects of digital transformation appear largely covered under agreements forged at the World Trade Organisation (WTO). WTO agreements are technologically neutral, so disciplines pertaining to trade in goods under the General Agreement on Tariffs and Trade (GATT), or trade in services under GATS, apply equally in the online and offline worlds. Hence a wide range of WTO agreements are considered relevant to trade in a digital world, including the Agreement on Trade-Related Aspects of Intellectual Property Rights, the Agreement on Technical Barriers to Trade, the Information Technology Agreement and its recently concluded expansion, and the Trade Facilitation Agreement. Yet with rapid changes in technology, there is a discussion among WTO members about whether there is a need to update or clarify existing rules and commitments.

136. E-commerce was introduced as early as 1998 into the agenda of global trade policy making through the work programme on e-commerce launched by the WTO (WTO, 1998). While progress has been slow, at the 11th Ministerial Conference in Buenos Aires, Members agreed to continue work under the current work programme and "maintain the current practice of not imposing customs duties on electronic transmissions" until the next Ministerial (WTO, 2017a). A group of 71 Members further agreed to "initiate exploratory work together toward future WTO negotiations on trade-related aspects of electronic commerce" (WTO2017b).

137. At the same time, trade agreements – multilateral, plurilateral and bilateral – can offer some useful insights into facilitating exchanges across countries with different domestic policy settings, reflecting different cultural and political contexts. In trade agreements, combining the benefits of trade with countries' right to regulate has rested on requirements that: i) domestic measures are transparent; ii) the same measures are applied to everyone in the same way (i.e., that they are non-discriminatory); and iii) that in achieving their public policy objectives, countries do not use measures that restrict trade more than is necessary to achieve the objective.

138. In this context, it is worth noting that international discussions on digital trade in the G7 and G20 are ongoing. At the Ise-Shima Summit in 2016, G7 leaders reaffirmed the free flow of information as a fundamental principle to promote the global economy and development and to ensure a fair and equal access to the cyberspace for all actors of digital economy while, at the same time, reaffirming "the importance of respecting and promoting privacy, data protection and cybersecurity." The G20 leaders Declaration in 2017 also echoed support to the free flow of information while respecting applicable legal frameworks for privacy, data protection and intellectual property rights in 2017.

139. Reaping the benefits of digital trade will increasingly require international dialogue on approaches that ensure the interoperability of differing regulatory regimes, whether for data or other transversal issues. While it is premature to define what this type of dialogue might look like, and indeed, in which fora this is to be carried out, it must include developed and developing countries and be multi stakeholder, involving, for example, the business community, competition authorities, the Internet technical community, trade unions, and civil society in the policy-making process.

4.4. Well-being in the digital age

140. Digital transformation does not only affect growth, jobs and trade, but also people's and society's overall well-being. Like any technology that has been developed in history, digital transformation presents opportunities and challenges, benefits and risks. But the high speed of change due to digital transformation, and its scale and scope (see Section 2.1.2) imply that virtually every aspect of people's lives is being affected by digital transformation. Governments are taking note. For example, The Digital Charter is the UK's response: a rolling programme of work to agree norms and rules for the online world and put them into practice. Its core purpose is to make the internet work for everyone – for citizens, businesses and society as a whole.

141. While technology by itself can be neutral, what affects the outcome is how it is used which policy can affect. Policy needs to help shape the transformation to ensure that the benefits and opportunities emerge and are accessed equally, and challenges and risks are addressed. This has prompted public debates and ethical considerations on the desirable conditions under which digital transformation would operate in a beneficial way (Box 4.1).

Box 4.1. Prioritising people's well-being in the digital age

The Stiglitz-Sen-Fitoussi Commission (Stiglitz, et al. 2009) has emphasised that economic growth was a means to enhance people's well-being and not an ends in itself. Likewise, digital transformation should not only bring about progress via intelligent and autonomous technologies, but also operate in conformity with human values, in particular fairness, to enhance people's well-being. Several organisations including the European Union and the Institute of Electrical and Electronics Engineers (IEEE) have launched a global initiative to develop a guiding ethical framework for the design, production and use of digital technologies, based on the principles of human dignity and human rights, equality, justice, non-discrimination and social responsibility. Ethical codes of conduct as well as licenses for designers and users of digital technologies will likely emerge in the future alongside new legislation, in order to make digital transformation 'ethical by design'.

Understanding how digital transformation affects people's well-being

142. The OECD's Well-being Framework provides a good starting point to examine the impacts of digital transformation on people's well-being because of its multidimensional nature.[8] Based on this framework, the impacts of digital transformation

[8] The OECD Well-being framework, which is described in the OECD *How's Life?* publication (OECD, 2013, 2015, 2017), underpins the OECD *Better Life Index*, a communication tool that allow users to build an overall index of average well-being in various countries, based on the importance that they attribute to different dimensions. Based on a literature review of the key

on the following well-being dimensions can be explored: *income and wealth, jobs and earnings, housing conditions, health status, work-life balance, education and skills, social connections, civic engagement and governance, environmental quality, personal security* and *subjective well-being*. This section also examines how *ICT access and usage* impacts on well-being in a cross-cutting way, thus encompassing 12 fundamental dimensions through which digital technologies may affect people's lives. In line with the OECD Well-being Framework, the discussion considers both average outcomes as well as inequalities in outcomes, which is of crucial importance as digital transformation may give rise to a digital divide, leading to increasing inequalities in skills, jobs and earnings, among others.

143. A key insight drawn from the work is that digital transformation presents both opportunities and risks for the different dimensions of well-being. Digital transformations may have both positive and negative impacts, and there may be heterogeneous effects across population groups, depending for instance on age, gender or skill-set. This variegated picture is observed among each dimension of well-being. For instance, tele-working may allow workers to spend less time commuting and allow for more leisure time (Harpaz, 2002), but constant connectedness may also result in more job stress at home. As regards social connections, social networks may decrease loneliness among the elderly (Cotten, 2013), but these networks are currently also associated with less face-to-face socialisation as well as with cyberbullying and depression among the young (Hamm et al. 2015).

144. Some of the key impacts of digital transformation on well-being are summarised in Table 4.1, which describes both opportunities and risks for each dimension of well-being. The selection of a key impact is based on the criteria that it concerns people's well-being and that it involves an important transformation or phenomenon, linked to digital transformation. For each impact, the table indicates whether an indicator to measure that impact is available or whether new data needs to be collected. Thus, the table encompasses both existing measures that can be used to monitor the well-being impacts of digital transformation under current data limitations, as well as a list of data gaps that will need to be addressed in the future.

145. When examining the key impacts of digital transformation across all dimensions of well-being, some common patterns can be highlighted. First, digital transformations can increase people's productivity when, for instance, digital skills complement other skills, thus enhancing labour inputs, or when health technologies improve health outcomes. Second, digital transformations can lower the transaction cost of some human activities and increase the consumer surplus when they are undertaken though a digital interface. This concerns many online activities such as education, consumption, job search, health or care information, social interaction or the use of government services. Some of these effects have inequality-reducing effects, for example in allowing access to (free) educational and training opportunities or by improving the dissemination of job offers through postings online. On the other hand, digital transformations can have negative impacts, such as digital distractions at school, risk of job automation (see

determinants of people's well-being, a dashboard of indicators describes both material conditions and quality of life of people across 11 key dimensions of well-being.

Section 4.1), increased job stress or worry, digital addictions or burn-outs (Young, 2009), cyberbullying, digital security incidents or increased e-waste. Finally, digital transformation can also have negative impacts on inequality, which are linked to the dispersion of digital skills as well as growing wage inequality and job polarisation; to citizens' exclusion due to the unequal access or usage of digital technologies; or to the use of emerging technologies in public service delivery.

146. In addition to measurement constraints, the review of digital impacts on well-being is bounded by some fundamental limitations. The novel and constantly changing nature of digital transformation poses some challenges for identifying its main effects. Many digital transformations are very recent, and no consensus still exists on the nature of their impacts. For example in the area of the mental health, some studies have shown that excessive use of social media may lead to an increase in depressive symptoms and even suicide (Twenge et al., 2017). However, such studies have also been criticised for not making strong causal claims, and more research is needed to firmly demonstrate any causal link between the use of social media and mental health. Where possible, the framework presented in Table 4.1 is based on the best evidence of *current* impacts of existing technologies.

Table 4.1. A brief review of key potential impacts of digital transformation on people's well-being

	Opportunities	Risks
Education and skills	Students and adults need **digital skills, digital literacy, and computational thinking** to participate in a digital society and economy	Emergence of a **digital divide in skills** between those who do and those who do not have digital skills
	Digital educational resources at school help prepare students for a digital society and economy	Negative side effects of digital resources at school, such as **digital distractions and deskilling**, may reduce learning outcomes
	Online education and digital learning tools allow for lifelong learning and new learning models	Constant ***re-skilling of workers*** becomes necessary to keep up with fast-changing digital technologies
Income, consumption and wealth	Individuals can use digital skills as a complement to other skills to increase productivity and benefit from a **wage premium**	The gap between workers with high and low digital skills drives **wage inequality**
	Online consumption, **online financial services** and the platform (or sharing) economy have the potential to increase consumer's surplus	
Employment	**New jobs in ICT** and ***across all sectors*** become available	***Job polarisation*** has increased demand for high- and low-skilled jobs, and decreased demand for middle-skilled jobs
	Online job search helps job seekers find employment opportunities	Digital technologies may destroy **jobs at risk of automation**
	Individuals who use digital technologies have **higher job quality** due to lower physical demands, increased task discretion and self-realisation	At the same time, **negative job quality effects** can arise from increased job stress and emotional demands
Work-life balance	**Teleworking** allows people to spend less time in transit and allows for an improved gender balance by ***sharing childcare responsibilities***	Constant connectedness may increase **worry about work when not working**
Health	People benefit from better health outcomes thanks to **improved communication with health care services**, available **online health information**, ***universal Electronic Health Records,*** new ***health monitoring tools*** and ***digital health technologies***	Digital technologies may yield **digital addiction among children** and other ***negative (mental) health effects***
Community	**Increased online interactions** among friends and social networks	**Cyberbullying** and online harassment
		Unstable social support due to ***less frequent real interactions***
Governance and civic engagement	**Increased online engagement** of citizens in societal and political debates	***Discrimination against minority groups and women*** using hate speech
	Citizens have **access to open government data**, which increases accountability and public sector integrity	People's trust in institutions may be challenged by higher exposure as well as by ***fake news***
	Digital technologies help public authorities engage diverse groups in ***open and inclusive public service design and policy making***	Governments may discriminate against ***citizens who do not have access to digital public platforms***
	Improved satisfaction of public administration efficiency thanks to ***new digital skills of civil servants***	***Unfair treatment*** linked to the use of emerging technologies in public service delivery, raising ethical issues
	Citizens are consumers and prosumers of news	***Media consumption becomes algorithm-led***, decreasing the diversity and polarising the opinions on issues

Security	The ***uptake of blockchain-based technologies*** may enhance safety of transactions and information exchange	**Digital security incidents** (including identity theft) may compromise people's online safety
		Individuals are at risk of **data privacy violations** in various domains (health, consumption, e-government)
	Secure electronic identification, authentication, encoding and e-signatures promote security in the on-line environment	***New challenges for physical security*** brought by automation (e.g. driverless vehicles) and ***hacking of Internet of Things-enabled systems*** (energy, transportation)
		Increased number and diversity of ***organisations holding personal data***. (public and private)
Environment	***A reduction in energy consumption and carbon emissions*** resulting from improved operational and energy efficiency in transportation, buildings, and industry.	***Increase in energy/material use and electronic waste*** from growing consumer demand for connected devices with relatively short lifespans.
		Increase in energy use to power digital infrastructure and services (i.e. data centres and data transmission networks) and to maintain network connectivity of devices (i.e. standby power).
		Emerging sources of energy demand such as cryptocurrencies and other blockchain applications.
	Individuals can use internet-based shared transport options (***car-share, bike share, carpool)***	Autonomous vehicles could induce rebound effects and ***increase travel activity, energy use, and congestion***, while reducing mass transit use.
Housing	Households using ***Smart Home Technologies*** can improve house management	Connected homes could be vulnerable to digital security attacks.
Subjective well-being	**Increase in life satisfaction** due to having internet access	***Financial satisfaction*** may be reduced due to wider social comparisons.
	Increase in job satisfaction due to computer use at work	
ICT Access and use	**Access to digital infrastructures** is a prerequisite to reap the benefits of digital technologies	There may be **digital divides in usage**, even when there is equality in access.
	Use of a **variety of different online activities** allows the greatest benefits of the Internet to individuals	

Note: * Indicators highlighted in **bold and underlined** denote data is available for a large number of countries, indicators in ***italics*** denote a data gap

Measuring the impact of digital transformation on people's well-being

147. The potential impacts identified in Table 4.1 can be used in support of policy making as they: i) can help identify countries' comparative digital risks and opportunities; ii) provide an overall perspective of digital risks and opportunities when the corresponding indicators are presented together. The available indicators for the different dimensions of well-being are reported in Table 4.2 and measurement issues are discussed in Box 4.2. As already mentioned the set of indicators is intended to evolve as new data become available and as further societal impacts occur as a result of digital transformation.

Box 4.2. Measurement issues

Based on current data availability, 31 indicators are used to measure the impact of digital technologies on people's well-being. For 7 OECD countries (Belgium, Estonia, Finland, Netherlands, Poland, Sweden and United Kingdom) all indicators are available. For 10 OECD countries (Australia, Canada, Chile, Iceland, Israel, Japan, Korea, Mexico, New Zealand and the United States) more than 10 indicators are not available. On average across OECD countries, around 6 indicators are not available. Key data gaps for digital well-being include jobs at risk of automation (not available for 13 countries), job strain (10 countries), people expressing political opinions online (10 countries) and life satisfaction gains from having internet access (15 countries). For the analysis of digital risks and opportunities, missing scores are derived, by country, using the aggregated indicators of Income and Education from the Better Life Index as predictors.

Given the above data limitations, a number of dimensions are poorly covered in the cross-country analysis. Observed gaps in the fields of Governance and Civic Engagement, Environment and Housing requires further statistical work. The key data issues identified are: i) comprehensiveness: limited data availability within dimensions (unbalanced dimensions, e.g. Environment); ii) coverage: data sources are often limited to European countries, with limited coverage for most non-European countries; iii) timeliness: indicators are not collected on a regular basis (for 6 indicators, data is from 2012/2013; for 8 indicators data from 2015); iv) harmonisation: in many cases, data exist in many countries, but differences in methodology prevent the construction of comparable indicators (e.g. proportion of individuals teleworking).

Table 4.2. Indicators used to measure the impact of digital transformation on people's well-being

Education and skills	Digital skills; Digital skills gap; Digital resources at school; Digital distractions at school; Online education
Income, consumption and wealth	Wage premium to digital skills; Wage gap due to digital skills; use of online purchase of consumption goods and financial services
Employment	Employment in ICT sector; Jobs at risk of automation; People using Internet when looking for a job; impact on job strain of digital technologies
Work-life balance	Teleworking; Worrying about work when not working
Health	Digital addiction of children; Accessing health information online; Making medical appointments online
Community	Using online social networks; Children experiencing cyberbullying
Governance and Civic Engagement	Expressing political opinions online; Use of e-government; Open government (data availability, accessibility and re-use)
Environmental quality	E-waste per person
Digital security	Experienced digital security incidents; Experienced abuse of private information
Subjective well-being	Life satisfaction gains from having internet access[9]
ICT Access and Usage	Access to digital infrastructure; Diffusion of online activities;[10] Inequality of uses
	* The dimension of ***Housing*** is included into the framework presented in Table 4.1 but the lack of relevant data prevents its inclusion in the set of indicators included in Table 4.2.

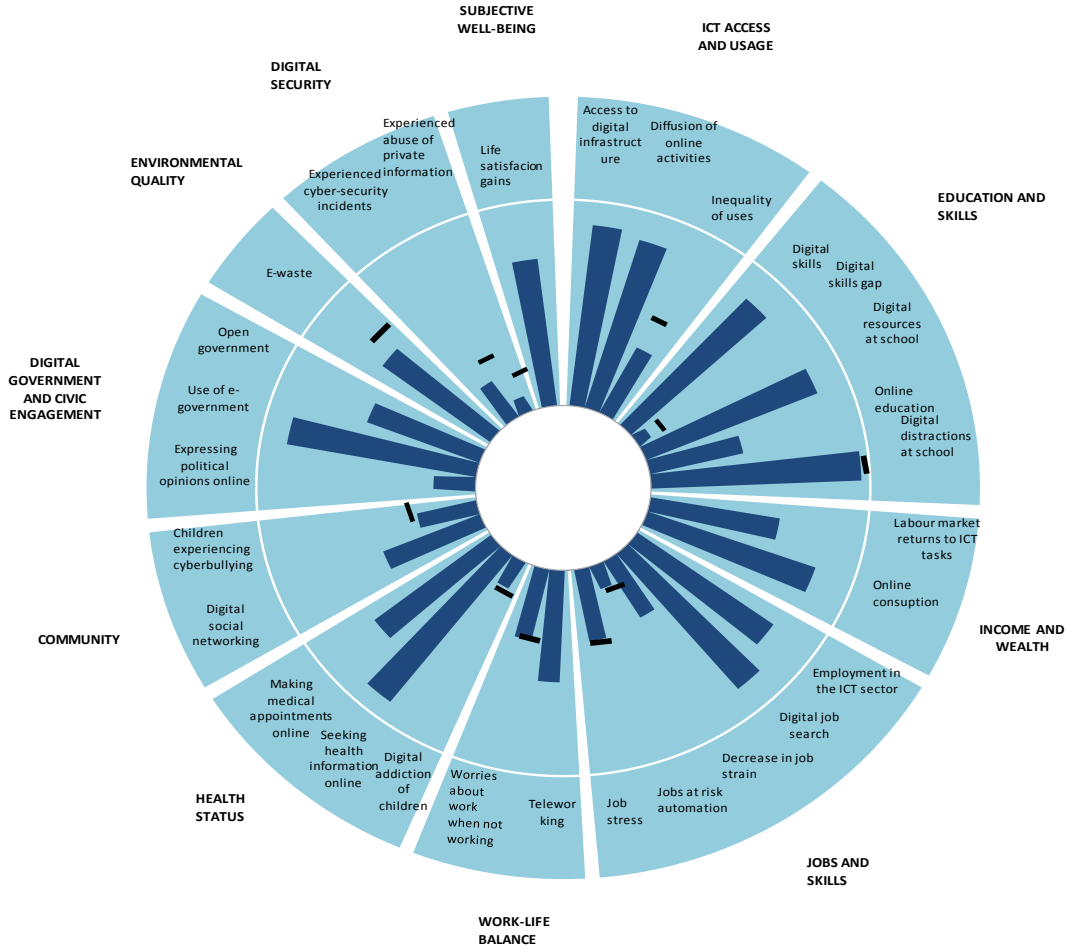
Notes: The definitions of the indicators are included in Annex II.

[9] The life satisfaction indicator is based on regression analysis of the effect of internet access on life satisfaction and job satisfaction respectively, controlling for a range of other explanatory variables and individual characteristics.

[10] This indicator refers to the average number of different online activities that the majority of individuals engage in in a given country. The indicator features a list of eleven possible different online activities, such as online banking, accessing e-government services, and entertainment.

148. Figure 4.10 depicts a 'Digital Well-being Wheel' similar to the OECD well-being wheel included in the How's Life? publication (OECD, 2017d). The Digital Well-being shows for example that, compared to other OECD countries, Finland scores relatively high in terms of seizing digital opportunities such as the penetration of online services (education, banking, consumption, health), and relatively well in mitigating certain digital risks such as safeguarding jobs subject to automation or managing data privacy issues.

Figure 4.10. Well-being in the digital age - the example of Finland



Note: The centre of the wheel corresponds to the lowest outcome observed across all OECD countries, while the outer circle corresponds to the highest outcome. The wheel describes both positive impacts (i.e. opportunities) and negative ones (i.e. risks), for which the scale has been inverted to ease interpretation (i.e. a low score constituting a good outcome).

149. Analysis of risks and opportunities of digital transformation at the national level points to a wide heterogeneity: for example, Denmark, the United Kingdom, Canada and the United States, which benefit from higher opportunities, also face higher risks, while conversely Chile, Mexico and the Slovak Republic record both lower risks and smaller opportunities. Some digitally-advanced countries such as Estonia, Korea and Finland combine high digital opportunities and low risks, while others lag in terms of access to ICTs and have not yet capitalised on opportunities that digital transformation present for individual well-being, although they still face some risks.

150. Aggregating the available information across all dimensions of well-being can mask some different situations across dimensions. For example, correlations between indicators of digital risks and opportunities within each dimension of well-being find a particularly high correlation for two dimensions of well-being, namely work-life balance and health. In the first case, this may be because tele-connectedness allows for more flexibility in the organisation of work and private life, at the cost of an increased worry about work when not working. In the second case, digital technologies many involve benefits from health monitoring but they also pose a risk of digital addiction among children (and adults). A zero or a negative correlation is found for all other dimensions of well-being, suggesting that there is little correlation between digital risks and opportunities for people's well-being.

151. The review of key digital impacts on people's well-being and the findings presented above underscores once more that policy should aim at reducing risks while enhancing opportunities. However, designing appropriate policies becomes increasingly complicated as the digital transformation of economies and societies involves a radical change in how people live, work and interact. Growing pressures to compete with machines in the workplace; the use of algorithms and digital platforms enabling patient-managed healthcare and more efficient service delivery, but also related ethical risks and privacy concerns; the impacts of automation on adolescents' development and human relations, are just some examples of how the new digital context affects the drivers of individuals' well-being.

152. These issues are in many cases still uncharted territory for policy-makers. Better mapping and understanding these changes in society will be important to develop appropriate policy responses. Moreover, digital transformation itself opens the ground for new ways of conducting and designing policies through more user-driven approaches as discussed below.

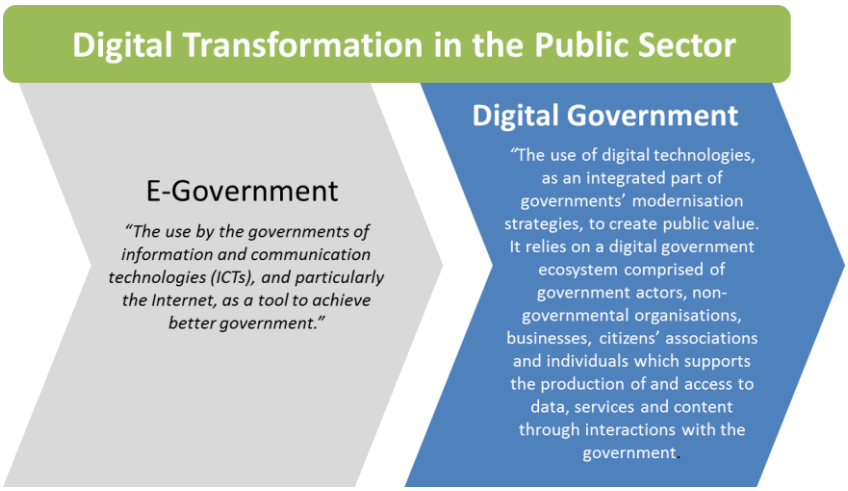
Digital government: towards a digital transformation of public sectors that increases value for individuals

153. Even though digital technologies and data exchanges are rapidly increasing across the public sector with the intent to better respond to changing people's expectations brought about by the digital transformation underway, digital technologies are not transformative in and of themselves. In order to capture the benefits that they offer to better serve societies and increase well-being, a full shift towards people-driven digital government is critical. The Recommendation of the Council on Digital Government Strategies [C(2014)88] calls for this fundamental paradigm shift from an e-government approach to Digital Government (Figure 4.11). This requires the integration of digital technologies into decision-making processes, and in the shaping of overarching strategies

and agendas, for public sector reforms and public service delivery. In a nutshell, it is no longer about transferring on-line (i.e. digitising) existing processes and services, it is about taking advantage of the opportunities provided by digital technologies and data to redesign those processes and services (i.e. digitalising) letting the change be driven by people's needs and preferences. This people-driven approach provides a unique opportunity to link decisions on technology use and deployment across the public sector with better results in terms of individual well-being.

154. However, this shift towards digital government has significant implications and consequences for governments. First, guaranteeing that digital technologies are not applied to traditional structures and procedures by simply updating them to digital formats, but that they are leveraged to rethink and reorganise government processes, procedures and services in ways that are digital by design and place people's perspectives at the core. For example, decentralised online services coupled with blockchain technology would allow for a much more direct participation in the political process. This leads to the second requirement which is the need to move away from top-down assumptions about citizens and businesses' needs and to foster greater openness and public engagement to bring people into the design, development, delivery and monitoring of public policies and services (citizen-driven approaches). Third, moving to digital government involves the establishment of organisational and governance frameworks to further collaborations with internal and external stakeholders to improve the delivery of better policies and services by letting the needs of the users drive decisions on services. Digital government can thus not only lead to a better capacity to anticipate and understand the evolving needs of people's well-being in an overall context of digital transformation, but also to a more effective use of technology to address them, *i.e.* the essence of a public sector that is capable of striking a balance between the opportunities and risks of digital transformation for people's well-being.

Figure 4.11. From e-government to digital government



155. Failure to enact a shift towards Digital Government by adapting public sector capacities, workflows, business processes, methodologies and frameworks to a new and changing environment, exposes governments to important risks and shortcomings, such as dissatisfaction with public services and a subsequent decrease of public trust in governments' capacity to increase people's well-being in the digital age.

156. One way in which the public sector can contribute to well-being is by providing opportunities for public value creation. Rather than acting as a monopoly provider of public services, digital government serves as a platform for users to collaborate with one another and with third party providers, enabled by open government data. Strategic and sustainable open government data frameworks are already being implemented by a number of countries (e.g. Korea, France, Japan, Mexico Spain and United Kingdom) to foster people's empowerment by enabling them to take more informed personal decisions or to participate directly in policy-making processes and public service delivery. This helps to increase trust in the public sector, and also provides opportunities for data-driven policies as shown by initiatives such as *Retos Publicos* and Open Data 100 in Mexico, 18F in the United States and Develop Italia in Italy (OECD, 2017j). Hence, open government data is a prime example of how the strategic use of technologies in the public sector lowers transaction costs for individuals and increases public sector efficiency. These more collaborative-oriented policy approaches enable governments to involve and place people at the core of the design, implementation, delivery and monitoring of policies and services, leading to more personalised, needs-based and tailored responses (Box 4.3).

Box 4.3. Examples of how the citizen-driven approach impacts individual well-being

There are an increasing number of digital government examples that demonstrate how a people-driven approach, where citizens and businesses determine their own needs and work to address them in partnership with governments, enable the benefits of digital transformation and mitigate risks (OECD, 2016b). For example, Mexico demonstrates how useful and relevant open data can be for crisis management and to develop solutions driven by collaboration with citizens, expanding beyond the government's viewpoint. When a major earthquake hit Mexico City in September 2017, Mexico used its experience with the 2015 hurricane to improve how aid was provided by the various public entities, notably by using new technologies and data to inform and target, rather than disrupt, rescue efforts (OECD, 2016c and 2018c). Open data was used to manage the crisis by collaborating with people to achieve the following goals: create a map informing users of damaged buildings, collection centres and available hostels; publish open data on hospitals, municipalities in extraordinary situations; structural evaluation of the earthquake to ensure citizens remain as informed as possible; collaborate with civil society to maximize the effective use of open data to manage the crisis; and develop a resilience map based on inputs provided by the citizens.

The OpenSolarMap example from France shows how the government has leveraged crowdsourcing and data analytics to adopt a people-driven approach to the identification of environment-related policy measures - such as solar panels and rooftop vegetation distribution in cities - to mitigate the effects of pollution. Citizens were engaged to classify rooftops in an open geographic database; citizen-produced data were used to teach a machine learning algorithm to perform a similar analysis on 48 million referenced rooftops by the French Land Registry Office. Consequently, the combination of peoples contributions and the use of analytical techniques and technology were essential to generate data of sufficient quality and at a large enough scale to improve policymaking that are driven by people's needs. Beyond the benefit of crowdsourced analysis to the government, involving people increases their awareness and engagement about environmental risks and how they can work with government to help mitigate those risks.

Designers Italia, a national innovation project launched in June 2017 by the Agency for Digital Italy (AgID) and the Digital Transformation Team - is meant to strengthen the role of citizens in the development of public services. Designers Italia calls upon the world of services designers, both inside and outside the public administration to strengthen the role of design thinking in the planning of digital public services with the aim to design services driven by citizens' needs. The project seeks to collaborate with service designers to: include people's point of view in the process of designing and choosing technologies for public digital services; understand citizens' needs across a complexity of situations, needs, and moods in which they live while interacting with the PA; help people understand the new digital tools and give them ways to familiarize themselves with the changes. This is critical not only to secure a use of technology to design services that better respond to people's needs, but also to avoid creating new forms of digital divides and make technology simpler, through a process of continuous improvement.

Conclusions on well-being in the digital age

157. Given the horizontal nature of public sector digital transformation, efforts to move towards digital government affect all aspects of service delivery and policy making, and as a result have direct implications for all the dimensions of the Well-Being Framework. The potential of digital technologies in terms of efficiency, connectedness, convenience and personalisation supports substantive changes in well-being dimensions such as consumption and wealth, work-life balance and subjective well-being. Digital government strategies are powerful tools to secure a coherent evolution towards a use of technology across the whole public sector that fosters a citizen-driven approach. Placing people at the core of the design and delivery of policies and services, enabling new mechanisms for engagement and collaboration in policy making and service delivery, and making access and use of digital services more relevant and simple, is an imperative for the public sectors to fully seize the opportunities offered by digital transformation to impact people's and society's overall well-being.

158. Digital technologies can help increase engagement in societal and political communities as well as foster open government and transparency, which can increase accountability and public sector integrity. New technologies also have an impact on issues such as political campaigning, hate speech and fake news, which potentially affect social cohesion and trust. Governments can help address these issues through Digital Government strategies that can sustain more open and collaborative approaches, able to foster the positive effects of digital transformation (Ubaldi, 2013), while help addressing some potential negative implications for governments, e.g. the risk of further marginalisation due to more entrenched political views, increased opportunities to circumvent policies and regulations in a platform-based economy possibly affecting public safety and the provision of equal opportunities.

5. Conclusions on Going Digital in a Multilateral World

159. The Going Digital project has begun to identify and analyse some of the key policy issues facing policy makers in the digital age. Policy making under uncertainty requires a consideration of several possible future scenarios, including the various uncertainties that underpin them, to ensure that policies put in place today remain resilient to the changes to follow. While the project is not yet complete, insights are emerging in a range of areas.

160. It is clear that digital transformation affects all aspects of the economy and society in complex and interrelated ways, challenging existing policies in many areas. As a result, silos of all types are disintegrating, and hard borders are becoming less relevant. This means that stronger co-operation and collaboration domestically are critical, as well as a re-think about how policy is developed and implemented.

161. In particular, a flexible, forward-looking and integrated policy framework that cuts across policy silos is essential to ensuring a coherent and cohesive whole-of-government approach to fully realise the potential of digital transformation and address its challenges. To support policy making in the digital age, better measurement of digital transformation and its impacts is critical, including in areas such as national accounts, data and data flows, citizen trust, and digital trade. Such data may not necessarily come from traditional statistical sources.

162. Governments – at the local, regional and national levels – have an opportunity to be remade by digital transformation as they use digital technologies to improve efficiency and targeting, enable innovative policy design and rigorous impact evaluation, and expand citizen and stakeholder engagement.

163. At the same time, the Internet cuts across national borders and changes conventional notions of location, distance, and jurisdiction, requiring stronger international and multi-stakeholder co-operation which are critical factors in effective and multilateral action in many areas. For example, digital transformation offers both opportunities to tax administrations (e.g. to increase efficiency and raise tax compliance) as well as challenges (e.g. the use of distributed ledger technologies and crypto-currencies for illicit purposes), requiring now more than ever co-operation and co-ordination across jurisdictions.

164. Data have been identified as a foundational driver of digital transformation as well as an enabler. Data analytics, data-driven innovation, and other data-intensive activities, including machine learning and AI, benefit from open and interconnected information systems and networks that enable efficient, flexible and cheap data flows among potentially unlimited actors. Enhancing access to data can maximise the social and economic value of data, provided that all stakeholders have sufficient evidence to assess the possible trade-offs of data utilisation.

165. Data are also essential for trade and investment. Reaping the benefits of digital trade requires international dialogue on regulatory approaches that ensure the interoperability of differing regulatory regimes, for data or other transversal issues. Emerging measures impacting cross-border data flows raise concerns for business activity and the ability to benefit from digital trade; on the other hand, important public policy

objectives, such as the protection of privacy, security and IPRs, must be taken into account.

166. A people-driven and inclusive approach to policy making is essential, as also highlighted in the OECD's work on Inclusive Growth. If we lose sight of the individual and the need for all individuals to be engaged and benefit from digital transformation, the transformation cannot be positive and inclusive. Ensuring connectivity and affordable access for all, as well as the protection of individual's privacy and consumer rights, are key elements of an inclusive and people-driven approach.

167. Addressing the impacts of the digital transformation on jobs and skills is also key to an inclusive and people-driven outcome. Effective social dialogue should be combined with innovative approaches to addressing worker transition should be encouraged, including the use of technology to identify needed skills or to link skills to available opportunities, and PPPs to develop new initiatives to facilitate worker transition. More data are also needed to enable development of more effective policy approaches (for example, a better understanding of the challenges involved in worker redeployment, life-long training, and longitudinal data on skills/jobs development).

168. New OECD estimates suggest that on average 14% of jobs are at a high risk of automation in the next 15-20 years. Another 31% of jobs are at risk of significant change in terms of task content as a result of automation. However, new jobs will be created too, and there is no evidence that, to date, technological change has been associated with net job losses overall.

169. But new jobs are not the same as those that are lost and polarisation in the labour market is a concern. High-skilled workers have thus far tended to benefit relatively more from technological change, while the share of employment in middle-skilled jobs has decreased. Going forward, low-skilled workers are most at risk of losing their jobs and being left behind.

170. Ensuring a smooth and fair transition for all workers requires a comprehensive package of co-ordinated policies, including facilitating worker redeployment, investing in skills, education and training, providing social protection and adequate employment protection to all forms of work strengthening social protection, forward looking labour market regulation, fostering social dialogue, and prioritising resources that can support the transition process.

171. While assuring the transition for workers, digital divides by age, education, gender, income, degree of disability, and geography persist across and within countries and must be reduced. Addressing these divides, e.g. by broadband policies aimed at providing affordable access and services to all, is crucial to ensuring an inclusive transformation.

172. The impacts of digital transformation on well-being must also be better understood and measured. Digital transformation may have both positive and negative impacts, and there may be heterogeneous effects across population groups, depending on age, gender, income level or skill-set. Placing people at the core of the design and delivery of policies and services, enabling new mechanisms for engagement and collaboration in policy making and service delivery, and making access and use of digital

services more relevant and simple, is an imperative to fully seize the opportunities offered by digital transformation to improve people's well-being.

173. Policy makers can also help translate digital transformation into growth and productivity. Technologies – in particular frontier technologies – and related business models and organisational practices aren't diffusing as well as they need to. The diffusion of digital technologies is more advanced in sectors in which firm dynamism is higher. Harnessing digital transformation for firms requires policies that foster business dynamism and efficient resource reallocation, strengthening technology and knowledge diffusion, fostering investment in tangible and intangible capital, helping SMEs engage with digital transformation, facilitating structural adjustment to enable the growth of digitally-intensive firms, and ensuring sound competition.

174. Digital transformation enables firms to improve market intelligence and access global markets and knowledge networks at relatively low cost, opening up new opportunities that require complementary investments in organisational changes, process innovation, new systems and new business models (as well as skills). The scale and complexity of these complementary investments is growing, which makes digital transformation difficult for firms lacking key capabilities, such as traditional SMEs. Comprehensive national digital strategies that take into account SMEs (including by providing them with practical guidance and incentives to adopt good practices), policies that facilitate access to finance, knowledge networks and skills, and SME engagement with competency centres and/or technology extension services, can be helpful.

175. As all sectors of the economy go digital, it is essential to encourage good digital security risk management practices by taking into account cross-border and cross-sector interdependencies and fostering trust with and among private operators to enable information sharing about threats, vulnerabilities and incidents, including for SMEs. To do so, responsibilities for digital security must be shared among individuals, business and governments.

176. As digital transformation progresses, individuals are increasing asking what personal data is stored, how it is subsequently used and whether they can access their data, on the job and at home. Technological advances can help increase trust through "privacy by design" processes whereby privacy preferences are embedded or coded in technologies from the start. For example, encryption can play an important role for privacy as mobile devices and the IoT expand.

177. At the same time, privacy in an increasingly data-driven economy requires a multifaceted strategy, reflecting a whole-of-society vision, and supported at the highest levels of government. Such strategies need to strike the right balance between the social and economic benefits of enhanced reuse and sharing of data and analytics, and individuals' and organisations' concerns about such openness, including the protection of privacy and intellectual property rights. Co-ordinated privacy strategies at the national level would enhance privacy protection in an increasingly data-driven environment.

178. The competitive environment is changing in digitally-intensive sectors. For example, mark-ups – the wedge between the price a firm charges for its output on the market and the cost the firm incurs to produce one extra unit of output – have been increasing on average across firms and countries, especially for firms at the top of the

mark-up distribution and those in digital-intensive sectors. Mergers and acquisitions are growing too, in particular in digitally-intensive sectors.

179. These changes may not necessarily be a source of concern, as they may be inherent to the nature of digital transformation, but they should be further examined and considered by policy makers. For instance, competition frameworks designed for traditional products may not be suitable for a global digital economy. Governments may also need to enhance co-operation across national competition agencies to address competition issues that are increasingly transnational in scope or involve global firms.

180. Looking ahead, it is clear that we need to climb out of our policy silos and reach across them to better understand how digital transformation is reshaping our lives, how we can exploit it, and how we can help those in danger of being left behind. Using the multi-stakeholder model that has served us so well, it is important to be creative and bold in making digital transformation work for all people and for the economy. Together, governments and stakeholders must shape a common digital future that makes the most of the immense opportunities that digital transformation holds to improve people's lives and boost economic growth, while ensuring that nobody is left behind.

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Annex I: Going Digital State of Play[11]

The Going Digital project leverages the unique capacity of the OECD to bring together a wide range of policy communities with strong multi-stakeholder engagement to collectively identify the opportunities and address the challenges our economies and societies face in a digital world.[12] The Going Digital project builds on three pillars:

- Pillar 1 (***horizontal activities***): Development of an integrated policy framework for making the digital transformation work for growth and well-being and other activities that are relevant across all policy areas, including several key collaborative projects[13] and analysis of core aspects ("vectors") of digital transformation and what this implies for policy.

- Pillar 2 (***Committee-specific work***): Analysis of various facets of digital transformation being undertaken in specific policy domains. This work is carried out within the scope of each respective Committee's PWB for 2017-18.

- Pillar 3 (***cross-cutting activities***): Modules focusing on key cross-cutting issues. This pillar is meant to enable a "deep dive" into specific issues relevant to some (but not all) policy areas to gain key insights into some of the big challenges of the digital era that are at the intersection of more than one policy area[14].

The project will generate a broad range of outputs, including over 80 reports, workshops and other activities related to analysis of digital transformation in specific policy domains, as well as reports and other activities that arise from unique collaborations across and between Directorates. Specific synthetic outputs include reports to the OECD Ministerial Council Meetings in 2017 and 2018, and a comprehensive synthesis report that will be presented at a high-level closing conference. "Beyond the book" outputs involve national roundtables, one or more possible OECD Council Recommendations, the integrated policy framework, the development of a Going Digital toolkit that would provide tools and good practices for the digital age.

[11] The latest Going Digital State of Play report provides a detailed update on the implementation of the Going Digital project [DSTI/CDEP/GD(2018)1].

[12] The 14 core Committees participating in the Going Digital project include: the Competition Committee, the Committee on Consumer Policy, the Committee on Digital Economy Policy (lead Committee), the Committee on Industry, Innovation and Entrepreneurship, the Insurance and Private Pensions Committee, the Committee on Financial Markets, the Committee on Fiscal Affairs, the Committee on Scientific and Technological Policy, the Committee on Statistics and Statistics Policy, the Economic Policy Committee, the Education Policy Committee, the Employment, Labour and Social Affairs Committee, the Public Governance Committee, and the Trade Committee.

[13] Collaborative projects include: (i) foresight scenarios, (ii) use of digital technologies to improve policy design, implementation, monitoring and evaluation, and (iii) digital security and resilience in essential sectors.

[14] Cross-cutting modules include the impact of the digital transformation on : (i) jobs and skills, (ii) productivity, competition and market openness, (iii) well-being, and (iv) measurement.

Annex II: Indicators of well-being

Label	Indicator	Unit of measurement	Year	Country Coverage	Source
ICT Access and Usage	Access to digital infrastructures	Percentage of households with Internet access at home	2017 or latest available year	OECD 35	OECD Information and Communication Technology database
	Average use of different internet services	Number of activities linked to the majority of users (threshold 50 %)	2017 or latest available year	OECD 31	OECD Information and Communication Technology database
	Inequality of uses	The difference between the number of activities that is performed by more than 25 percent of individuals and the number of activities performed by more than 75 percent of individuals	2017 or latest available year	OECD 32	OECD Information and Communication Technology database
Education and skills	Digital skills	Percentage of adults who score above Level 2 in problem-solving in technology-rich environments	~ 2012	OECD 25	OECD Survey of Adult Skills (PIAAC)
	Digital skills gap	Coefficient of variation in digital skills	~ 2012	OECD 25	OECD Survey of Adult Skills (PIAAC)
	Digital resources in education	Percentage of students aged 15 who report that they are using Internet connected computer in school	2015	OECD 30	OECD Programme on International Students Assessment (PISA)
	Digital distractions	Percentage of students who are using digital devices, such as smart phones, tablets, computers and laptops, for chatting online at least once a week	2015	OECD 30	OECD Programme on International Students Assessment (PISA)

	Online education	Percentage of individuals who have used the Internet, in the past 3 months, for doing an online course (in any subject)	2017 or latest available year	OECD 33	OECD Information and Communication Technology database
Income, consumption and wealth	Labour market returns to ICT tasks	Percentage change in hourly wages for an increase in ICT task intensity by 10% (at the country mean)	~ 2012	OECD 28	Calculation by Grundke et al. (2017) based on data from OECD Survey of Adult Skills (PIAAC)
	Online consumption	Percentage of individuals who have used the Internet, in the past 12 months, for purchasing goods and services online	2017 or latest available year	OECD 35	OECD Information and Communication Technology database
Employment	Employment in the ICT sector	Employment in the ICT sector and subs-sectors, as a percentage of total employment	2015	OECD 32	OECD Digital Economy Outlook 2017; STAN: OECD Structural Analysis Statistics (database)
	Mean job automatability	Probability of automation for the mean job	~ 2012	OECD 22	Calculation by Scarpetta et al. (forthcoming) based on data from OECD Survey of Adult Skills (PIAAC)
	Digital job search	Percentage of individuals who have used Internet, in the past three months, for looking for a job or sending a job application	2017 or latest available year	OECD 32	OECD Information and Communication Technology database
	Job strain	Decrease in job strain associated with computer-intense jobs	2015	OECD 25	European Working Conditions Survey (EWCS) 2015
	Job stress	Increase in job stress associated with computer-intense jobs	2015	OECD 25	European Working Conditions Survey (EWCS) 2015

Work-life balance	Tele-working	Percentage of workers having teleworked at least once	2015	OECD 27	European Working Conditions Survey (EWCS) 2015
	Worries about work when not working	Increase in people worrying about work when not working due to having computer-based jobs	2015	OECD 25	European Working Conditions Survey (EWCS) 2015
Health status	Digital addiction of children	Percentage of students (aged 15) who report that they feel really bad when Internet not available	2015	OECD 30	OECD Programme on International Students Assessment (PISA)
	Accessing health information online	Percentage of individuals who have used Internet, in the past three months, for seeking health information	2017 or latest available year	OECD 31	OECD Information and Communication Technology database
	Making medical appointments online	Percentage of Internet users making an appointment with a practitioner via a websites	2016	OECD 26	Eurostat Information Society Statistics database
Community	Using online social networks	Percentage of individuals who have used Internet, in the past three months, for accessing social networking sites	2017 or latest available year	OECD 35	OECD Information and Communication Technology database
	Children experiencing cyberbullying	Proportion of young people who have been cyberbullied by messages at least once	~ 2014	OECD 28	Health Behaviour in School-aged Children (HBSC) study
Civic engagement and governance	People expressing political opinions online	Percentage of individuals who have used Internet, in the past three months, for posting opinions on civic or political issues via websites	2017	OECD 25	Eurostat Information Society Statistics database

	Individuals interacting with public authorities online	Percentage of individuals who have used Internet, in the past three months, for visiting or interacting with public authorities websites	2016 or latest available year	OECD 31	OECD Information and Communication Technology database
	Open government data availability and data accessibility	OURdata Index, data availability, data accessibility and government support for data re-use	2017	OECD 31	OECD Governance at a Glance - edition 2017 database
Environmental quality	E-waste	E-waste generated per inhabitant	2016	OECD 34	The Global E-waste Monitor *
Digital security	Individuals experiencing cyber-security events	Percentage of individuals who have used Internet, in the past three months, and have experienced security incidents	2016 or latest available year	OECD 28	OECD Information and Communication Technology database
	Individuals experiencing abuse of private information	Percentage of individuals who have used Internet, in the past three months, and who have experienced abuse of personal information or privacy violations	2015 or latest available year	OECD 30	OECD Information and Communication Technology database
Subjective well-being	Life satisfaction	The effect of internet access on life satisfaction	2013	OECD 20	European Union Statistics on Income and Living Conditions (EU SILC) survey 2013

* Baldé, C.P., Forti V., Gray, V., Kuehr, R., Stegmann,P. : The Global E-waste Monitor – 2017, United Nations University (UNU), International Telecommunication Union (ITU) & International Solid Waste Association (ISWA), Bonn/Geneva/Vienna.

Annex III. Going Digital: Analytical Deliverables since the Inception of the Project

Pillar 1

- Analysis of how digital technologies can be used for better public policies [DSTI/CIIE(2017)20].
- Development of an integrated policy framework, underpinned by Committee responses to the preliminary integrated policy framework questionnaire [DSTI/CDEP/GD(2017)9].
- Identification of a set of "vectors" of digital transformation to help policymakers understand the core aspects of the digital transformation and the implications for policy [DSTI/CDEP/GD(2017)4/REV1].
- Exploration of policy issues related to digital security and resilience in critical infrastructure and essential services, such as energy, transport, finance and essential government services.
- Elaboration of a set of Going Digital Foresight Scenarios [DSTI/CDEP/GD(2017)10], underpinned by a series of OECD-wide and external workshops.

Pillar 2

- Examination of the possible impacts of AI and how the OECD may help develop a human-centred approach to its development and application.
- Examination of the possible impacts of digital connectivity for trade logistic chains, including cross-border shipping and delivery [http://www.oecd-ilibrary.org/content/chapter/aid_glance-2017-6-en]
- Exploration of access to new data sources for statistics, and the underlying business models and incentives for the corporate sector [STD/DOC(2017)6]
- Elaboration of how to bridge the rural digital divide [DSTI/CDEP/CISP(2017)1/REV2]
- Exploration of business models for sustainable research data repositories [DSTI/STP/GSF(2017)1/REV1/FINAL]
- Examination of potential mismeasurement in GDP and productivity growth of the digital economy in the post-crisis slowdown [STD/CSSP(2017)4/ANN1]
- Analysis of consumer protection enforcement in a global digital marketplace [DSTI/CP(2017)10/REV1]
- Elaboration of consumers policy in the smart home [DSTI/CP(2017)8/REV1]
- Analysis of the co-ordination and support of international research data networks [DSTI/STP/GSF(2017)5/FINAL]
- Examination and documentation of evolutions and emerging opportunities and challenges in the digital economy [http://dx.doi.org/10.1787/9789264276284-en]
- Exploration of the impacts of digital platforms for facilitating access to research infrastructures [DSTI/STP/GSF(2017)4/FINAL]

- Development of a framework for analysis for digital trade [TAD/TC/WP(2017)4/FINAL]
- Exploration of the impacts of digitalisation and energy [https://dx.doi.org/10.1787/9789264286276-en]
- Exploration and enhancement of the role of insurance in cyber risk management [https://dx.doi.org/10.1787/9789264282148-en]
- Analysis of how financial education and consumer protection can be ensured for all in the digital age [http://www.oecd.org/finance/g20-oecd-report-on-ensuring-financial-education-and-consumer-protection-for-all-in-the-digital-age.htm]
- Exploration of entrepreneurship in 2017 [http://dx.doi.org/10.1787/entrepreneur_aag-2017-en]
- Exploration of the future of work for women [http://www.oecd.org/employment/Going-Digital-the-Future-of-Work-for-Women.pdf]
- Analysis of how technology and globalisation are transforming the labour market [https://dx.doi.org/10.1787/empl_outlook-2017-7-en]
- Analysis of how behavioural insights can be used to improve online disclosures with [DSTI/CP(2017)9/REV1]
- Exploration of the possible impacts of industrial robotics on the global organisation of production [DSTI/CIIE(2017)14]
- Analysis of tax challenges arising from digitalisation [http://www.oecd.org/tax/tax-challenges-arising-from-digitalisation-interim-report-9789264293083-en.htm]
- Examination of how to manage the transition to driverless road freight transport [https://www.itf-oecd.org/sites/default/files/docs/managing-transition-driverless-road-freight-transport.pdf]
- Identification and elaboration of a set of OECD productivity indicators in 2017 [http://dx.doi.org/10.1787/pdtvy-2017-en]
- Exploration of policy issues related to open research agenda setting [DSTI/STP/GSF(2017)3/FINAL]
- Examination of the possible impacts of 'robo advice' for pensions [http://www.oecd.org/pensions/Robo-Advice-for-Pensions-2017.pdf]
- Analysis of how the digital transformation affects science, innovation, the economy, and the way people work and live [http://dx.doi.org/10.1787/9789264268821-en]
- Analysis of how to support an effective cyber insurance market, a report for the G7 Presidency [DAF/AS/WD(2017)17]
- Examination of the potential for FinTech to transform the way pensions operate and how governments are supporting its development [https://www.oecd.org/finance/Technology-and-Pensions-2017.pdf]
- Exploration of possible impacts of technology and innovation in the insurance sector [http://www.oecd.org/finance/Technology-and-innovation-in-the-insurance-sector.pdf]
- Exploration of possible implications of the digital economy for the investment policy community [DAF/INV/WD(2017)14]
- Examination of the evolving role of satellite networks in rural and remote broadband access [DSTI/CDEP/CISP(2016)5/REV2]

- Report of a survey of consumer trust of peer platform markets [DSTI/CP(2017)5/REV1]
- Examination of evolutions of open government strategies and objectives [https://dx.doi.org/10.1787/gov_glance-2017-en]
- Elaboration of considerations for the application of the G20/OECD high-level principles on financial consumer protection to digital and alternative financial services [DAF/CMF/FCP/RD(2017)2]
- Exploration of the impacts of top R&D investors and their industrial property strategies in the digital economy [www.oecd.org/sti/world-top-rd-investors.pdf]
- Examination of the skills needed for a digital world [https://www.oecd.org/els/emp/Skills-for-a-Digital-World.pdf]

Pillar 3

- Development of a taxonomy of digitally-intensive sectors [DSTI/CIIE/WPIA(2017)2] to support analytical modelling as well as work to assess how to best measure the digital economy in the SNA.
- Exploration of the impacts of digital transformation on business dynamism [DSTI/CIIE(2017)17] and a workshop to further investigate regulations that restrict competition in light of digitalisation.
- Exploration of the impacts of algorithms and collusion, and policy issues related to competition in the digital age [DAF/COMP(2017)4]

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