How's Life in the Digital Age?

OPPORTUNITIES AND RISKS OF THE DIGITAL TRANSFORMATION FOR PEOPLE'S WELL-BEING

OECD

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OECD
BETTER POLICIES FOR BETTER LIVES

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Foreword

How's Life in the Digital Age? is the first topical report in the new *How's Life?* monograph series. *How's Life?* is the flagship publication of the OECD Better Life Initiative, which aims to promote "Better Policies for Better Lives", in line with the OECD's overarching mission. While the main *How's Life?* report is released every two years, a series of shorter monographs focusing on specific issues will now be published on a regular basis. *How's Life in the Digital Age?* documents how the ongoing digital transformation is affecting people's lives, based on the multi-dimensional framework used in *How's Life?* to monitor progress in the key dimensions of people's well-being. This report is also an input to the OECD Going Digital Initiative, which aims to describe the many facets of the digital transformation throughout a series of publications.

The report was prepared by the Household Statistics and Progress Measurement Division of the OECD Statistics and Data Directorate, with contributions from the Reform of the Public Sector Division in the Public Governance Directorate (Chapter 2). The lead author of the report was Vincent Siegerink, with contributions from Fabrice Murtin who also led the project. Marco Mira d'Ercole and Martine Durand supervised the project. Anil Alpman, Benoît Arnaud, Christopher Jacobi, Christine Le Thi, Michal Shinwell, Laura Springare, Barbara Ubaldi, Joao Vasconcelos, Benjamin Welby are gratefully acknowledged for their contributions to the analysis. Anne-Lise Faron prepared the book for publication.

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Executive Summary

How's life in the digital age?

How does the digital transformation affect people's lives and well-being? Digital technologies have radically changed the way people work, consume and communicate over a short period of time. It is necessary that statistics help understand the rapid transformation that is at stake. This first monograph of the *How's Life?* series aims to meet this need, providing a comprehensive description of digital impacts on people's life and underlining some important data gaps.

The digital transformation creates both opportunities and risks for well-being

While several OECD reports have documented the effects of digital technologies on the economy and society, this report uses the *How's Life?* well-being framework to assess how the digital transformation affects people's life as a whole. Chapter 1 provides an overview of the methodology and results described in this report. The OECD well-being framework is used to review the impacts of the digital transformation on the 11 key dimensions of people's well-being (income and wealth, jobs and earnings, housing, health status, education and skills, work-life balance, civic engagement and governance, social connections, environmental quality, personal security and subjective well-being). This chapter also looks at ICT access and use as a cross-cutting dimension of the digital transformation. A summary of a large number of existing studies highlights 39 key impacts of the digital transformation on people's well-being. The review shows that impacts can be positive as digital technologies expand the boundaries of information availability and enhance human productivity, but can also imply risks for people's well-being, ranging from cyber-bullying to the emergence of disinformation or cyber-hacking.

This report has assembled 33 indicators of key impacts of the digital transformation, including 20 indicators to monitor digital opportunities and 13 indicators to reflect digital risks. This empirical analysis can help policy-makers and concerned citizens to assess the digital situation in their country. However, empirical analysis has also to contend with important limitations, due to the lack of harmonised data and the imperfect coverage of key digital impacts. The international statistical community should invest to improve available information and to move this statistical agenda forward.

Safe digital technologies improve the life of those who have the skills to use them

For each dimension of people's well-being, Chapter 2 presents evidence on the opportunities and risks created by the digital transformation. This chapter builds on a review of a large number of scientific studies in a range of disciplines. The main insight from this review is that safe digital technologies improve the life of those who have the skills to use them. This message is two-sided. Benefiting from digital opportunities depends, first, on meeting some skills requirements, and second, on operating in safe

digital environments. On the one hand, digital technologies can improve people's life as they provide access to more information and services at a reduced cost: for instance, they simplify access to education, to health information, to consumption goods via online shopping, they cut transportation time via teleworking and improve the efficiency of energy use at home and at the city level; in sum, they make human activities more efficient. On the other hand, digital technologies entail a major inequality risk for society, as they introduce a digital divide between those who have the skills to use them and those who do not. These skills include pure digital skills but also the emotional and social skills associated with safely navigating the online world. Possessing this mix of skills, conveniently labelled as "digital literacy", is a pre-condition for people to harmoniously combine their digital and real lives, and to avoid the mental health problems associated with abuses of digital technologies. The second type of digital risks relates to safety issues such as cyber-bullying and cyber-security breaches. In a nutshell, making the digitalisation work for people's well-being would require building equal digital opportunities, widespread digital literacy and strong digital security.

Digital opportunities come naturally with broader Internet access, while digital risks are multi-faceted

Available indicators of opportunities and risks allow clustering countries and identifying their relative digital strengths and weaknesses. While understanding the drivers of opportunities and risks of the digital transformation is beyond the scope of this report, this provides a number of important insights. First, digital opportunities and risks are not correlated across countries, i.e. there is no mechanical association between the two. This implies that a successful policy framework can mitigate risks even in a digitally-rich environment. Second, digital opportunities are strongly associated with broad Internet access, which is a necessary but not sufficient condition for seizing the opportunities offered by the digital transformation. Finally, risks are very diverse in nature and it is impossible to single out a key driver. However, the prevalence of digital security incidents is a powerful predictor of risks overall, as it reflects (to some degree) the maturity of digital societies, as well as the soundness of national digital strategies.

Evidence of impacts is sparse and many topics remain contested

The conclusions drawn in this report are based on an imperfect set of indicators that do not adequately cover all life dimensions and OECD countries. In this sense, this report provides the motivation for the statistical work ahead. As the momentum on collecting complementary measures of progress persists, National Statistical Offices and other data collectors will need to design new instruments to improve the evidence on the well-being impacts of the digital transformation. Importantly, for many impacts discussed in this report, the jury is still out. Key opportunities and risks, such as the impacts of online networking sites on people's social lives, the mental health effects of extreme Internet use, or the effects of automation of jobs are still debated by researchers and analysts. This report takes stock of current evidence, but continued research will need to expand and deepen our knowledge on the many topics covered in this report.

Chapter 1. Understanding how the digital transformation affects people's well-being

How does the digital transformation affect people's life and well-being? With the Going Digital Project, the OECD has undertaken a large number of studies in order to better understand the impacts of the digital transformation on the economy and society and to derive policy recommendations. This chapter summarises the main digital issues at stake and lists the available indicators that reflect both positive and negative impacts of the digital transformation. It uses the OECD well-being framework as a tool to analyse the various impacts of the digital transformation on people's lives.

"Technology is neither good nor bad; nor is it neutral."

Melvin Kranzberg's first law of technology (Kranzberg, 1986)

Introduction

More and more people are making use of personal digital devices such as the computer and the mobile phone to access the Internet. From 2010 to 2016, the number of fixed broadband subscriptions increased by 26% in OECD countries, while mobile Internet subscriptions increased from 824.5 million to 3 864 million worldwide (OECD, 2017a). In addition to greater penetration of Internet access, new applications of digital technologies, such as the Internet of Things (IoT), big data analytics and Artificial Intelligence (AI) are becoming increasingly widespread and are exerting an influence on many aspects of people's lives. These developments have the potential to dramatically change the way people interact, live, work, or spend their leisure time today and in the future.

The impacts of the digital transformation can be felt in virtually every area of people's lives. For example, the digitalisation of job tasks requires students and workers to acquire the skills needed for a computerised work content and workplace environment. At the same time, the Internet allows for improved job matching, with people increasingly searching for jobs online. Similarly, the Internet and digital platforms are transforming our social and civic lives: they allow people to interact with each other and build communities, to obtain services from government and commercial providers more efficiently. On the other hand, digitalisation exposes people to new risks. Children may suffer from cyberbullying on social media platforms and citizens who do not possess digital skills may be disadvantaged when trying to access government services. These are just some of the opportunities and risks from the digital transformation for people's well-being.

This report is a first attempt at mapping how the digital transformation affects well-being. While previous OECD reports (OECD, 2017a; OECD 2017b) have documented the effects of digital technologies on the economy and on society (see Box 1.1), this report uses the OECD well-being framework (OECD, 2013a, 2015a) to systematically assess how the digital transformation affects people's lives. The OECD well-being framework encompasses those dimensions of people's well-being that are deemed important for living a good life, and therefore provides a valuable lens to analyse the opportunities and risks for well-being brought about by digitalisation.

Following Kranzberg's first law of technology, this report makes an explicit distinction between the opportunities and risks that the digital transformation presents for people's well-being. This distinction allows highlighting the heterogeneous nature of this transformation, based on the recognition that innovations are not intrinsically positive or negative. Rather, it acknowledges that policy-makers need to assess and monitor the various impacts of the digital transformation in order to ensure that the digital transformation ultimately comes with an improvement of people's well-being.

The analysis is supported by an extensive review of a large but scattered literature, and by a set of indicators that are currently available. Because the analysis of the digital transformation as a key phenomenon affecting people's well-being is relatively new, however, many of the relevant statistics and indicators are not currently available. The evidence presented here is therefore necessarily incomplete and preliminary; a secondary

goal of this report is therefore to assess the data gaps in measuring the well-being impacts of the digital transformation.

Box 1.1. The OECD Going Digital Project

The digital transformation's cross-cutting effects on the economy, society and individuals create new opportunities and challenges for governments and policy-makers. To support OECD Members and Partners in becoming more pro-active to unleash these opportunities and address these challenges, and to ensure the coherence of policies in the digital era, the OECD has launched the project **Going Digital: Making the Transformation Work for Growth and Well-being** (the **Going Digital project**). This project aims to help policy-makers better understand the policy implications of the digital transformation and to provide them with the tools needed to develop a whole-of-government approach to policy making in a world that is increasingly digital and data-driven. *How's Life in the Digital Age?* is one of almost 100 outputs produced by the OECD under the Going Digital project. Many of these outputs provide new insights about the implications of the digital transformation in areas ranging from productivity to tax, skills, governance and digital security.

One central tool developed by the OECD over the course of the Going Digital project is an **Integrated Policy Framework**. This framework distinguishes seven policy building blocks: 1) **access**, 2) **use**, 3) **innovation**, 4) **jobs**, 5) **trust**, 6) **society**, and 7) **market openness**. Each of the building blocks identifies several key policy areas among which co-ordination is increasingly crucial to ensure policy coherence. For example, to enhance access to digital technologies and data, policies to be co-ordinated include those affecting communications infrastructures and services, competition, investment, and regional development. Each of the framework's building block is accompanied by a set of indicators to measure countries' progress towards key objectives in the policy areas covered by the framework. Where individuals are concerned, these indicators overlap with indicators used in this report. Together, they ensure that governments and stakeholders have the evidence to shape a digital future that makes the most of the opportunities that digital transformation holds to improve people's lives, while ensuring that nobody is left behind.

Mapping the well-being impacts of the digital transformation using the OECD well-being framework

The digital transformation covers a wide range of technological, economic and societal innovations that result from digitalisation and digitisation (see Box 1.2). The origins of the digital transformation go back to the first half of the twentieth century, when the first mainframe computing machines were developed. These machines boosted the computing capacity that supported scientific advances in a wide range of fields, allowing for breakthroughs in areas such as medicine that had large impact on people's lives. Similarly, starting in the 1980s, in the early phases of personal computers, most functionalities greatly improved working environments (e.g. through text processors, information storage, calculations); and individual entertainment possibilities (e.g. games or cultural consumption on discs).

Box 1.2. OECD definition of the 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 that result in new activities or in changes to existing ones (OECD, 2018). Together, digitisation and digitalisation make up the digital transformation.

The arrival of the Internet in the early 1990s was another game-changer that led to some of the most transformative consequences of digitalisation for societal and individual well-being. Since then, a number of new technologies have arisen that shape the digital transformation in the present moment. The most important emerging technologies that contribute to current changes are:

- **The Internet** itself is considered to be the "decisive technology of the Information Age" (Castells, 2014). It is the free and open interconnection between computing devices facilitated by the Internet that bestows upon digital technologies their potential for societal transformation. These interconnections are instant, rather than time-consuming; they are global, rather than local or national; and they are often free, rather than costly. Due to its reliance on networks, the value of the Internet increases with the proliferation of its use (Zhang et al., 2015). In 2017, 3.5 billion people worldwide used the Internet, including 70% of the world's young population (ITU, 2017). The Internet is social in nature and allows for the creation of networks. Facebook, one of the most popular social media platforms, accounts for 54% of users' online time globally.
- **Mobile devices** allow individuals ubiquitous access to the Internet, revolutionizing the way people communicate, socialise, and entertain themselves through the use of a new range of applications (Lee and Lee, 2014). Smartphones, which are mobile devices that are able to perform many of the functions of a computer, are rapidly growing in the share of web page views as a proportion of the total. In 2013, 75% of Facebook users logged in to the site using a mobile device (OECD, 2016a). Smartphones have simplified the way people maintain personal relationships by allowing constant and instant access and are increasingly essential in participating in society (Lee, 2013). The degree to which smartphones are becoming a necessary element of modern life is highlighted by a recent PEW Research Center study, which found that 46% of smartphone owners say they could not live without their phone (Smith et al., 2015).
- **The Internet of Things (IoT)** is the ecosystem of digital devices and objects that optimises the use of such devices by allowing for their interconnection. It includes objects and sensors that gather data and exchange this with other devices and with humans. As a result, devices linked to the Internet of Things allow for the input of information necessary for intelligent systems to model and solve complex problems, in fields from health and medicine to traffic and logistical systems to the natural environment. According to estimations, the number of connected devices in and around people's homes in OECD countries will expand from one billion in 2016 to 14 billion by 2022 (OECD, 2015a).
- **Big data analytics** refers to the use of sophisticated techniques to analyse and understand natural or societal trends using the availability of large amounts of

new data that emerges from the digitisation of content and the monitoring of human activities (OECD, 2017a). Big data analytics exerts an impact on people's lives by improving processes and allowing for new advancements in science and medicine, government and public administration, education and business (OECD, 2015a).

- **Artificial Intelligence (AI)** or intelligent systems represent a new step in the evolution of computers that allow machines to perform human-like cognitive functions (OECD, 2017a). These systems use big data and machine learning to be able to operate independently and intelligently without human intervention. While AI is already being used today, for example in applications that learn from consumers' preferences to make suggestions, most of the promises of AI are still forthcoming. In time, AI is slated to help solve complex questions and allow for productivity and efficiency gains (OECD, 2017a). It is also the form of digital innovations that raises the most ethical concerns (see Box 1.3).
- **Blockchain** is a digital ledger that allows for secure, decentralised and disintermediated transactions of information. It relies on automated encrypting algorithms that prevent the altering of information using peer-to-peer networks that contain a copy of all historic transactions. Blockchain can therefore be applied as a secure and decentralised store of value, the documentation of legal contracts or even democratic processes such as voting.

At a *societal level*, the Internet and the innovations that came with it (e.g. open interconnections between digital devices, social media platforms) have fundamentally changed, and will continue to change the way humans interact with each other as well as the social fabric. In what is referred to as the "Network Society", networks have become the basic unit of society, and social organisations revolve around electronically processed information networks (Castells, 1996). In addition, according to some theorists, this shift is in parallel with an increased degree of networked individualism as a form of social organisation, which contrasts with traditional social structures that revolve around location-bound social groups such as the family or the community (Rainie and Wellman, 2012). Instead, society has become organised around networks that are based on shared interests, values or activities that are not constrained by geographical proximity.

These societal changes are met with equally large transformations in the structure of the *economy*. First, in the digital economy, the creation of value occurs no longer primarily in the production of goods or services, but instead is more and more concerned with the production of information and knowledge-based assets (Brynjolfsson and Kahin, 2000). Moreover, economic transactions have seen immense efficiency gains thanks to the ability to conduct trade between businesses and between businesses and consumers through electronic commerce on the Internet (OECD, 2012). And finally, new and upcoming innovations in the field of Artificial Intelligence and big data analysis have the promise to change the nature of work and potentially replace human labour.

Box 1.3. Digital transformation, well-being and ethics

The OECD well-being framework is not explicitly underpinned by normative or ethical considerations. However, in the context of the digital transformation, some have argued that a system of normative principles is necessary in order to protect individuals from potential intended or unintended negative effects. For example, in *Automating Inequality* (2018), Virginia Eubanks argues that while Big Data and machine learning may foster a more efficient functioning of criminal justice systems, they may also lead to increasing exclusion and marginalisation of the poor. Likewise, Cathy O'Neil argues in *Weapons of Math Destruction* (2016) that Big Data and machine learning have a risk of increasing social exclusion and inequalities. In 2013, a group of ex-tech workers founded the Center for Humane Technology to raise awareness about technology companies' attempt to increase people's digital addictions. In 2017, the United Nations Special Rapporteur on extreme poverty and human rights warned that digital innovations around Big Data and Artificial Intelligence would become increasingly a human rights issue, especially for minorities. The Toronto Declaration on non-discrimination in machine learning, supported by Human Rights Watch, Amnesty International, The Wikimedia Foundation and Access Now, among others, calls on stakeholders of the digital transformation to establish a set of principles that secure human rights in machine learning algorithms. Similarly, the Institute of Electrical and Electronics Engineers (IEEE) is working to develop a framework for Ethically Aligned Design (EAD) that includes human rights, well-being metrics and ethical principles as core principles.

In September of 2018, the OECD has created an expert group (AIGO) to provide guidance in scoping principles for artificial intelligence in society. The formation of the group is the latest step in the organisation's work on artificial intelligence to help governments, business, labour and the public maximise the benefits of AI and minimise its risks. The group is made up of experts from OECD member countries and think tanks, business, civil society and labour associations and other international organisations. In addition, the OECD has collaborated with the IEEE on its Global Initiative for Ethical Considerations in Autonomous and Intelligent Systems. In terms of well-being, the goal of the IEEE project on Ethically Aligned Designed (EAD) is to not only encourage their members to consider well-being outcomes in their product design, but also develop well-being metrics that allow measuring the impacts of their products on a variety of dimensions of well-being, in order to increase the knowledge base on the impacts of such innovations.

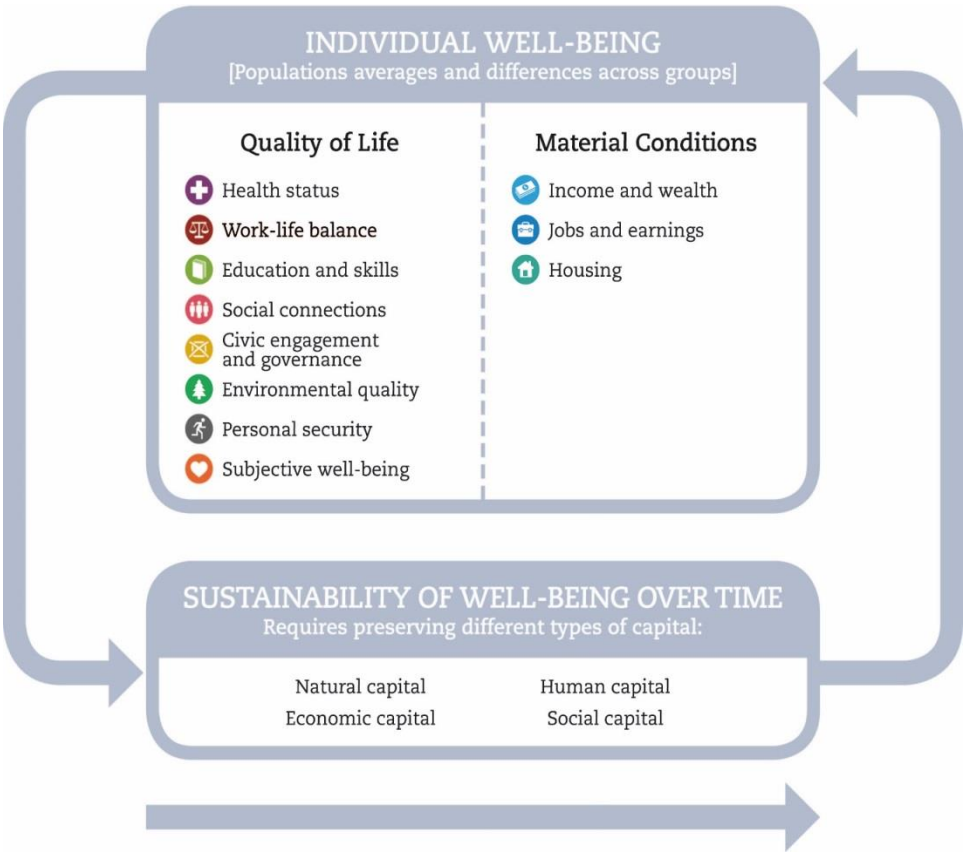
The focus of this report, however, is on *individual*, rather than economic and societal impacts of the digital transformation. Most of the opportunities or risks identified in this report are presented in terms of the direct consequences on people's lives. This means that certain important impacts of the digital transformation, such as "winner-take-all" dynamics in the economy, are generally not reflected in the indicators presented here. Because this report focuses largely on individual impacts, the Internet and personal digital devices feature prominently in the set of indicators. At times, the Internet or computers are used as a proxy for the digital transformation as a whole. For example, when estimating the impacts of the digital transformation on the quality of the working environment, the analysis relies on people who use computers or other digital devices at work. The measurement therefore does not capture how the digitalisation of entire industries, work

processes and tasks impacts people's working environment, including for those that do not even use digital devices themselves.

To assess how the digital transformation affects well-being at the individual level, this reports uses the well-being framework that the OECD has developed as part of its Better Life Initiative. This Initiative was launched in 2011 to promote a people-centred approach to policy making. As part of this initiative, the OECD developed a conceptual framework, which builds on a large body of theoretical and empirical studies in this field (Stiglitz, Sen and Fitoussi, 2009; OECD, 2011 and Boarini et al., 2012, for a review) and reflects consultation with experts from academia and governments in OECD countries. The OECD well-being framework follows a number of principles. First, it is concerned with the well-being of people rather than just economic conditions. Second, it focuses on outcomes rather than inputs or outputs, recognising that different combinations of inputs and outputs may be equally effective in delivering the same outcome. Third, it considers both objective and subjective aspects of people's life, as people's evaluations and feelings matter as much as the objective conditions in which they live. Fourth, it emphasises the need to measure the distribution of outcomes, and to identify inequalities across population groups. Finally, it also considers the long-term sustainability of well-being.

The OECD framework distinguishes between 11 dimensions of well-being today (income and wealth, jobs and earnings, housing, health status, education and skills, work-life balance, civic engagement and governance, social connections, environmental quality, personal security and subjective well-being) and four sets of resources that generate well-being in each of the dimensions mentioned above: economic capital, environmental capital, human capital and social capital. The 11 components of current well-being are outcomes that are intrinsically important to people, grouped under the two main headings of "material conditions" (i.e. economic well-being) and "quality of life" (Figure 1.1).

Figure 1.1. The OECD well-being framework



Source: OECD (2017c), *How's Life? 2017: Measuring Well-being*, OECD Publishing, Paris, https://doi.org/10.1787/how_life-2017-en.

The conceptual framework presented above has been operationalised through a dashboard of country-level indicators, published regularly in the report *How's Life? Measuring Well-Being,* that provides evidence on people's well-being for OECD countries and partner economies, and underpins the *Better Life Index*, an interactive web tool designed to engage with the public on the issue of well-being.[1]

The aspects of the digital transformation in this report sometimes go beyond the outcome indicators under each dimension of the OECD well-being framework. For this reason, this report presents a range of indicators aiming to capture the most visible impacts of digitalisation on the most salient aspects of people's life. Due to measurement limitations, "housing" is not covered by the indicators presented in this report, although some of the effects of digitalisation on housing are discussed in Chapter 2. Finally, only opportunities and risks of the digital transformation on *current* well-being are considered, although the digital transformation also affects resources for future well-being, and hence the sustainability of well-being outcomes over time.[2]

While the OECD well-being framework is not the only possible starting point for an assessment of the impacts of the digital transformation (Box 1.4), it has the advantage of comprehensively covering the most salient aspects shaping people's life, all of which are being affected, in direct or indirect ways, by the ongoing digital transformation.

Box 1.4. Alternative approaches to measuring the well-being impacts of the digital transformation

Other approaches to assessing the well-being impacts of the digital transformation may uncover different impacts or place emphasis in other areas. For example, Gluckman and Allen (2018) proposed an analytical tool to assess impacts on: institutions of the self (e.g. self-worth, self-expression, privacy), institutions of social life (e.g. social connections, education, friendships, romantic life, values and cultural expression) and institutions of civic life (e.g. politics, media consumption, governance and rule of law). Using this analytical tool, they defined five priority areas in the context of the digital transformation:

1. **Human development and early childhood learning**
2. **Mental health across the lifespan**
3. **Social inclusion (e.g. group formation and dynamics, social capital and trust)**
4. **Personal and public security**
5. **Governance**

Gluckman and Allen (2018) also identify the large policy research gaps that exist in many of these areas. Better monitoring and evaluation of these various impacts are needed in order to better understand the digital transformation and to inform public policy, which often has not sufficiently addressed these challenges.

Assessing the well-being impacts of the digital transformation

The assessment of the impacts of the digital transformation on well-being faces both practical and conceptual limitations. First, the digital transformation spans thousands of individual technological innovations and covers almost every area of people's lives. Its reach is enormous and impacts are at times very direct, at times indirect and interconnected. This makes causal analyses difficult, in particular because: 1) there is no clear counter-factual, as technologies are adopted gradually over time, and their impact cannot be tied to a particular moment or technological uptake; 2) even though the uptake of digital technologies is faster than ever before, their adoption differ across groups of people, implying heterogeneous effects across society; 3) the emergence of the digital transformation coincides with other major economic and societal changes, which makes it difficult to single out the specific role played by digitalisation. For example, while Twenge et al. (2018) has drawn attention to the fact that the introduction of the smartphone has gone hand in hand with higher teen depression and suicide rates, there is no strong evidence of a causal relationship as other factors may be at work.

In addition, there are a number of practical obstacles that impede the measurement of the digital transformation. These practical obstacles concern the ability to find relevant indicators based on timely data harmonised across OECD countries. For these reasons, the focus of this report is not on "causal" impacts but rather on identifying potential opportunities and risks associated with the digital transformation for each of the dimensions of the OECD well-being framework. Moreover, the list of opportunities and risks strives to cover the most important impacts for people's well-being, without pretending to provide a comprehensive picture of the full range of impacts of the digital

transformation. Rather, the opportunities and risks presented here should be seen as a starting point to compare how people in different countries are affected by digitalisation.

Table 1.1. Key opportunities and risks of the digital transformation for people's well-being

	Opportunities	Risks
ICT access and use	*Access to digital infrastructures* is a prerequisite to reaping the benefits of the digital transformation	There may be *inequalities of Internet usage*, even when there is equality in access
	Diversity of Internet uses brings greater benefits to individuals	
Education and skills	Students and adults need *digital skills* to participate in a digital society and economy	Emergence of a *digital skills gap* between those who do and those who do not have digital skills
	Digital resources at school can help prepare students for a digital society and economy	The adverse effects of digital resources in the classroom may reduce learning outcomes
	Online education and digital learning tools can allow for lifelong learning and new learning models	
Income and wealth	Digital skills confer a *wage premium* upon workers	
	Online consumption and the *sharing economy* have the potential to increase consumer surplus	
Jobs and earnings	*New jobs in ICT and in other sectors* become available	Digital technologies may destroy *jobs at risk of automation*
	Online job search helps job seekers find employment opportunities	The digital transformation may lead to *job polarisation*
	Workers with computer-based jobs are less subject to *job strain*	*Jobs in the digital economy may be associated with higher stress in the workplace*
Work-life balance	*Teleworking* allows people to save time and combine their work and personal lives	Constant connection to work may increase worries about work when not working
Health	Healthcare delivery becomes more efficient due to *improved communication with healthcare providers and universal health records*	Extreme use of digital technologies may be associated with *negative mental health effects*
	The *digitalisation of health technologies* has the potential to improve health outcomes	
	Health information online has the potential to improve patient experiences	
Social connections	*Increased online interactions* with friends and in social networks	*Cyberbullying* and *online harassment* can negatively impact the social experiences of children
	The Internet may help people overcome *loneliness and social exclusion*	*Discrimination against minority groups* using hate speech
Governance and civic engagement	Improved *engagement of citizens* in civic and political communities, crowed-sourced funding of specific project	Changes in how people get information may contribute to the spread of disinformation undermining trust in society and the government
	Digital technologies enhance the capacity of public authorities to *improve service delivery*	*Exclusion from digital government services* due to lack of skills
	Open data allows for improved transparency and accountability of government	
Personal security	The *uptake of blockchain-based technologies* may enhance safety of transactions and information exchange	Individuals are at risk of *data privacy violations* in various domains
		Digital security incidents may compromise people's online safety and compromise trust
Environmental quality	A *reduction in energy and resource use* can stem from improved energy efficiency of networks and de-materialisation of consumer products	Digital technologies generate rebound effects that *increase energy use*
		E-waste can increase as people consume more technological products
Housing	*Smart home technologies* can improve house management	
Subjective well-being	Overall *net benefits of Internet access for life satisfaction, affect and eudaimonia*	

The opportunities and risks identified in this report are listed in Table 1.1. This list presents 39 key impacts that are based on the evidence presented in Chapter 2. Each item in this list corresponds to a section in Chapter 2 that describes the impact and presents available indicators.

It is difficult to identify and synthesize the common patterns of the digital transformation across all dimensions of people's life. However, it is useful to simplify the complexity of the phenomenon by contrasting the efficiency gains arising from digital technologies with three different types of digital risks:

- **Digital technologies are a source of efficiency gains...**

  On the one hand, digital technologies provide a lot of information and services to people at a reduced cost: for instance, they can simplify access to education, to health information, to consumption goods via online shopping, they cut transportation time via teleworking, they improve the efficiency of energy management at home and at the city level, in sum, they make human activities more **efficient**.

- **…for those endowed with strong digital skills…**

  However, not everyone has the capacity to use digital technologies for real-life activities in an optimal way, which implies a new form of inequality, namely a digital divide that may reinforce existing forms of socio-economic inequality (Box 1.5). The **digital divide** materialises for instance in the differential usage of internet across age and socio-economic groups, and in the wage gap between high and low-digital skill workers.

- **…and digital literacy…**

  People spend more time in the digital space, which offers new ways of working, communicating and socialising that are valuable as such. On the other hand, digital life may crowd out the time spent in real-life interactions, or may create digital addiction and have other adverse effects on mental health. Making the best use of digital technologies without hampering the fundaments of human well-being requires a diverse set of cognitive and emotional skills, which can be referred to as "digital literacy". For instance, critical assessment is needed to sort out high and low-quality information, while self-control over digital involvement can prevent digital addiction.

- **…and who evolve in safe digital environments**

  As in real life, digital life raises issues such as cyber-bullying and cyber-security breaches.

Box 1.5. Inequalities and the digital divide

While the Internet has the potential to act as an equalising force, the Internet and digital technologies also carry the risk of serving as catalysts for greater inequalities of well-being. New technologies have the potential to amplify existing inequalities as they change the returns on existing forms of capital (Weber, 1978; Witte and Mannon, 2010). Economic capital (e.g. computer equipment) is needed to gain Internet access, social capital is needed to understand how to use it and engage with its content (van Deursen and van Dijk., 2014). In turn, people who have access to the Internet can generate additional economic and social capital from its use, leading to the perpetuation of inequalities. This mechanism allows for the emergence of a digital divide, which has been a concern for policy-makers since the early stages of the digital transformation (OECD, 2001).

The digital divide pertains to the "gap between individuals, households, businesses and geographic areas at different socio-economic levels with regard both to their opportunities to access information and communication technologies and to their use of the Internet for a wide variety of activities" (OECD, 2001). The digital divide can refer to both horizontal (i.e. across groups) and vertical inequalities and be related to both *access* to digital technologies and to the ability to use them (the so-called *second digital divide*). This report includes indicators that relate to both Internet use and digital skills.

The framework for well-being in the digital age used in this report takes stock of a number of fundamental inequalities that the digital transformation presents through the inclusion of indicators for specific "risks", such as inequalities of Internet use, the divide in digital skills, as well as the wage gap and job polarisation induced by differentiated impacts on labour markets. In addition, for impacts that increase horizontal inequalities, particularly by age, gender and education level, differences in exposure to opportunities and risks among these groups are highlighted.

Measuring the well-being impacts of the digital transformation

An important limitation in providing evidence on the opportunities and risks created by the digital transformation for each dimensions of well-being is the availability of relevant, internationally comparable and quality indicators. Many countries do not include technology-related variables in their standard survey vehicles. Even when relevant indicators exist at national level, the lack of internationally-agreed definitions or harmonised data collection makes cross-country comparisons difficult. In addition, many indicators are not available for all OECD countries, limiting cross-country comparability. A number of indicators presented in this report are based on large European-wide surveys, which provide a lot of information on various life dimensions, but have no or limited comparability with survey vehicles in other, non-European, countries.

There is also an issue of timeliness, which is particularly important in the case of the digital transformation, because new technologies spread at a high pace. Data on Internet access or use or on technology-related activities from even a few years ago may not be representative of the situation today. This can pose problems when comparing performance across countries For example, the latest available year for data on the number of people who look for health information online is 2014 for Australia, while it is

2016 for most other countries. Such small differences in timeliness can have large consequences for comparability given the speed at which digital innovations take place.

As a result, ensuring good country coverage has been a major challenge for the comparisons made in this report. Data used come from a number of sources, and efforts have been made to select the highest-quality data with the broadest international comparability. Data come primarily from large survey vehicles. The OECD ICT Access and Use database contains (broadly) harmonised data on a range of individual-level indicators of Internet access and use. This database is based on the OECD model survey on ICT access and usage by households and individuals, 2nd revision (OECD, 2015b), which provides a framework for the collection of cross-country data on individual and household use of digital technologies. Despite improved efforts, however, there are still differences in survey questions across countries. A number of indicators also come from the OECD Survey of Adults Skills (part of the Programme for the International Assessment of Adult Competencies, PIAAC) and the Programme for International Student Assessment (PISA). These two sources contain information about adults' and students' use of computers and digital technologies at work and at school. In addition, a number of European-wide surveys provide data for all European countries. These include Eurostat's European Statistics on Income and Living Conditions (EU-SILC) vehicle, Eurostat's model surveys on ICT usage, as well as the European Working Conditions Survey (EWCS) and the European Quality of Life Survey (EQLS), both implemented by Eurofound.

Some of the data used in this report also come from non-official sources. These sources include: the WHO's Health Behaviour in School-aged Children (HBSC) survey, implemented by an international alliance of researchers; data on self-reported exposure to disinformation collected by the Reuters Institute for the Study of Journalism in collaboration with YouGov; the Global E-Waste Monitor implemented by a consortium of organisations including the United Nations University and the International Telecommunications Union; and the Gallup World Poll.

The set of 33 selected indicators used to assess the key opportunities and risks of the digital transformation for the 11 dimensions of people's well-being is shown in Table 1.2. The selected indicators are available for most OECD countries, with a minimum coverage of 20 countries. This means that even in the case of sources with good international coverage, data are generally not available for all OECD countries. For each selected indicator, the last column of Table 1.2 indicates whether it measures a risk or an opportunity. In total, Table 1.2 includes 20 indicators of digital opportunities and 13 indicators of digital risks.

As an additional caveat, the indicators included in this set represent the *measurable* opportunities and risks of the digital transformation on well-being included in Table 1.1. They have been selected to represent wider processes for which more comprehensive data is unavailable, and as such should be considered more as "proxies" than as measuring the full set of impacts. For example, for the health dimension, the indicator "medical appointments online" is chosen to represent a range of innovations at the intersection of digitalisation and health care processes for which no other data is currently available. For a number of opportunities and risks of the digital transformation identified in the literature, it has not been possible to identify any relevant indicators. For this reason, the indicators shown in Table 1.2 should not be considered as a comprehensive measurement framework of all opportunities and risks of the digital transformation but rather, as

providing information on those well-being areas for which data is available. More details on the main data gaps and the statistical agenda ahead are provided in Chapter 3.

The available indicators of opportunities and risks of the digital transformation allow for a detailed analysis of OECD countries' relative strengths and weaknesses as well as an assessment of the way that the digital transformation impacts well-being in individual OECD countries. These two issues are examined in Chapter 3 and Chapter 4, respectively.

Table 1.2. Selected indicators of opportunities and risks of the digital transformation for various dimensions of people's well-being

Dimension		Indicator	Opportunity or Risk
ICT access and use[1]	1	Access to digital infrastructures	Opportunity
	2	Use of the Internet	Opportunity
	3	Diversity of Internet use	Opportunity
	4	Inequality of Internet uses	Risk
Education and skills	5	Digital skills	Opportunity
	6	Digital skills gap	Risk
	7	Digital resources at school	Opportunity
	8	Teacher ICT skills	Risk
	9	Online courses	Opportunity
Income and wealth	10	Wage premium associated with digital skills	Opportunity
	11	Online consumption	Opportunity
	12	Selling goods and services online	Opportunity
Jobs and earnings	13	Employment in information industries	Opportunity
	14	Online job search	Opportunity
	15	Jobs at risk of automation	Risk
	16	Lower extended job strain associated with computer-intense jobs	Opportunity
	17	Job stress associated with computer-intense jobs	Risk
Work-life balance	18	Penetration of teleworking	Opportunity
	19	Worries about work when not working associated with computer-intense jobs	Risk
Health	20	Making medical appointments online	Opportunity
	21	Accessing health information online	Opportunity
	22	Extreme Internet use among children	Risk
Social connections	23	Using online social networks	Opportunity
	24	Children experiencing cyberbullying	Risk
Governance and civic engagement	25	People expressing opinions online	Opportunity
	26	Individuals interacting with public authorities online	Opportunity
	27	Availability of open government data	Opportunity
	28	Individuals excluded from e-government services due to lack of skills	Risk
	29	Exposure to disinformation	Risk
Environmental quality	30	E-waste generated per capita	Risk
Personal security	31	Individuals experiencing cyber-security threats	Risk
	32	Individuals experiencing abuse of personal information	Risk
Subjective well-being	33	Life satisfaction gains associated with Internet access	Opportunity

Note: [1]ICT access and use is not a dimension of the OECD well-being framework per se. However, having access to digital technologies pre-conditions their possible impacts on well-being dimensions. ICT access and use has thus been added to the framework used in this monograph as a horizontal dimension.

Notes

[1] See www.oecdbetterlifeindex.org.

[2] Some of the impacts identified using the 11 dimensions of current well-being also directly or indirectly affect resources for future well-being. For example, the indicator of e-waste might also be considered to have an effect on natural capital. Similarly, the relationship between self-reported disinformation and trust in government suggests that there may be indirect effects on social capital. Human capital is also affected by a range of impacts of the digital transformation, such as through changing skills needs, potential consequences of automation on long-term unemployment and potential improvements in health outcomes.

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Chapter 2. Evidence on opportunities and risks for well-being in the digital age

This chapter provides a comprehensive review of the literature on the well-being impact of the digital transformation using the lens of the How's Life? well-being framework. For each dimension of well-being and the additional dimension of ICT access and use, the key impacts of the digital transformation are discussed and illustrated with the help of available indicators, distinguishing between opportunities and risks triggered by digital technologies. For almost all dimensions of well-being, the chapter identifies both positive and negative effects, suggesting that the digital transformation often has an ambiguous influence on people's well-being.

The statistical data for Israel are supplied by and under the responsibility of the relevant Israeli authorities. The use of such data by the OECD is without prejudice to the status of the Golan Heights, East Jerusalem and Israeli settlements in the West Bank under the terms of international law.

Introduction

The digital transformation is often described as the third defining moment in humankind's history, after the Neolithic Revolution and the Industrial Revolution (e.g. Harari, 2018). In a relatively small number of years, it has changed the way people work, consume, communicate and learn about the world. People now have a digital life and a digital identity. This chapter provides a comprehensive account of the way digital technologies have transformed people's life, in both good and bad directions, in most of its dimensions.

The chapter builds on an extensive literature review presented through the lens of the *How's Life?* well-being framework. Information is also provided on ICT access and usage, which acts as a channel through which all dimensions of people's well-being are affected by digital technologies. In addition to ICT access and usage, the eleven dimensions of well-being considered in this chapter include: education and skills, income and wealth, jobs and earnings, work-life balance, health, social connections, governance and civic engagement, personal security, environmental quality, housing and subjective well-being. Each section describes the most important opportunities and risks of the digital transformation for each dimension, illustrated by indicators when available.

This review also serves a practical purpose. By identifying the aspects of the digital transformation that are the most important for people's well-being, it provides a list of issues that *should* be measured. However, important data gaps still prevent us from capturing the full range of impacts of the digital transformation on people's life. For example, while the list of important impacts in Table 1.1 contains 39 items, only 33 indicators are currently available (Table 1.2). This implies that several important impacts of the digital transformation on people's life cannot currently be measured with comparable data.

Finally, several limitations of the analysis presented in this section should be kept in mind. First, the classification of digital impacts in terms of either risks or opportunities is not always clear-cut. For instance, having digital resources at school can constitute an opportunity to build digital education, up to a point where having too many digital resources can distract pupils from acquiring more traditional skills. In this regard, many important nuances are not reflected in the indicators used in this section. Second, the digital transformation is taking place at a very quick pace, while this review is based on evidence and indicators that are often lagging.

ICT access and usage

For people living in OECD countries, access to the Internet and a mobile device is a pre-requisite to participating in an increasingly digitalised society and economy. Personal digital devices are necessary to benefit from the opportunities offered by digitalisation in each of the dimensions important to well-being. For example, digital skills require familiarity with ICT equipment. The ability to interact with employers, medical services, family and friends is contingent on being connected to the Internet. In short, Internet access is often a key channel through which the digital transformation is impacting upon each of the dimensions of people's well-being in the digital age.

Access to digital infrastructures is a prerequisite to reaping the benefits of digital technologies

A lot of progress has been made in the dissemination of Internet access in OECD countries in the last decade. In several countries, **Internet access rates at home** are now close to 100% (Figure 2.1). In addition, over the last ten years, cross-country differences in Internet access have narrowed markedly. Lithuania, Mexico, Turkey, and a number of other countries have experienced an increase in the share of households with Internet access of 40 percentage points or more between 2005 and 2016, partially as a result of policies in favour of rural areas and disadvantaged population groups (for example by improving telecommunication infrastructures or by providing financial incentives to support usage by disadvantaged groups, OECD, 2017a). Still, on average, more than 20% of individuals living in the OECD do not have Internet access at home. This share is particularly high in Mexico, where over half of people lack Internet access at home, and also exceeds 25% in Japan, Greece, Lithuania, the United States (Box 2.1) and Israel.

Box 2.1. Internet access in the United States

Geographic factors are an important reason for the lack of home broadband access in some countries. The rural-urban divide in Internet access is particularly pronounced in the United States, where the gap in home broadband rates is about 12-13% (Whitacre, Strover and Gallardo, 2015). Wealthy and less densely populated countries such as Norway, Finland and Sweden have achieved much higher broadband access rates. One explanation for this difference is on the supply-side, as rural areas may not be sufficiently serviced by telecommunications networks. Whitacre, Strover and Gallardo (2015) find that in 2011, 13% of the American population living in rural areas had no broadband, compared to only 2% of urban Americans. Demand-side factors also play a role: African Americans and Hispanics in the United States are less aware of the availability of broadband and of the ways to gain access, even when controlling for other demographic factors such as education, income and age (Prieger and Hu, 2007). This suggests that social capital may be an important factor in explaining the digital divide and the inequalities that result from it.

Figure 2.1. Household Internet access

Percentage of households with Internet access at home, 2017 or latest year available

Note: Data on Internet access by households comes from national and European surveys on ICT access and usage by households and individuals. The latest available data refer to 2016 for Australia, Brazil, Canada, Costa Rica, Israel and Mexico; 2015 for the United States; 2012 for New Zealand; and 2009 for Japan. Earlier data refer to 2006 for Chile, France, New Zealand and Switzerland and to 2007 for the United States. For Israel and Japan measures are not strictly comparable to those of other countries due to difference in methodology. The OECD average is population-weighted.
Source: Based on OECD *ICT Access and Usage by Households and Individuals* (database), http://oe.cd/hhind.

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The diversity of Internet uses brings greater benefits to individuals

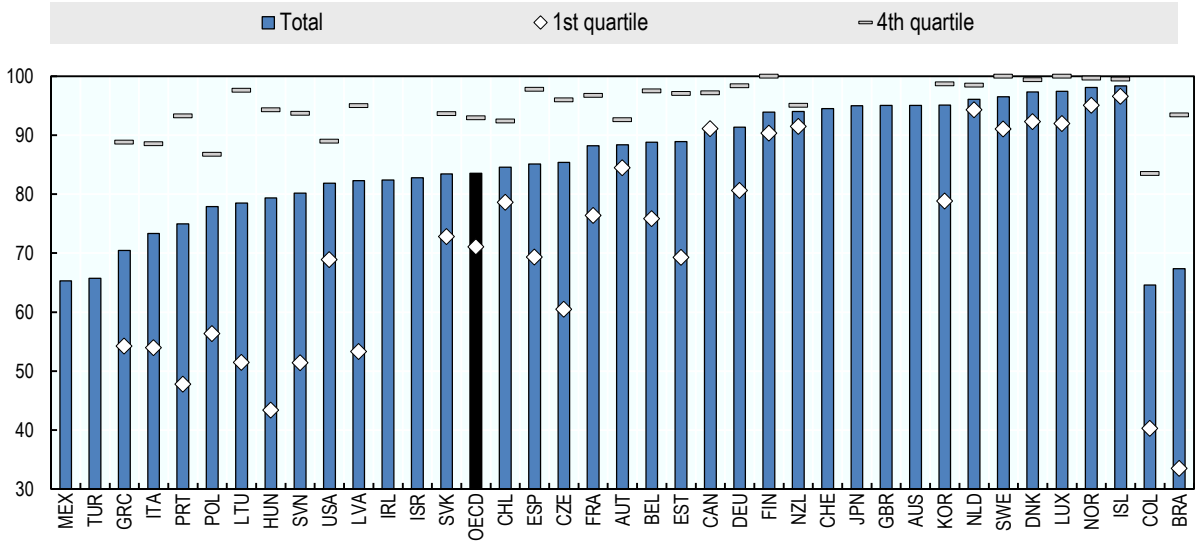
Internet access at home is not always a prerequisite to use the Internet. Mobile Internet, which becomes increasingly widespread, allows people to use the Internet without a connection in their home. Indeed, the share of **people using the Internet** is higher than the share of households who have access to the Internet. 84% of people in OECD countries have used the Internet in the last 12 months (Figure 2.2), and 72% do so every day or almost every day.[1]

Substantial variation exists in the use of the Internet among different groups, with Internet use heavily shaped by socio-economic factors (Wunnava and Leiter, 2008; Kiiski and Pohjola, 2002), particularly in OECD countries with lower rates of use. Across the OECD, Internet use rates for people in the highest income quartile are 22 percentage points higher than for people in the bottom quartile. Differences in Internet may also exist within a household: a home may have Internet access, without all members of the household using it. This is particularly relevant for differences in Internet use between men and women, which are pronounced in some OECD countries. The gender gap in Internet use is 18 percentage points in Turkey, 10 in Chile and 8 in Italy.[2]

Age is another important determinant of internet usage. While more than 95% of young people (16-24 year-olds) in OECD countries had access to Internet in 2016, among 55-74 year-olds this share is only 60%. This is a missed opportunity, since there is evidence that the Internet can play a role in achieving positive outcomes for the elderly in dimensions such as health status and social connections (Cotten et al., 2014). In Denmark, Iceland, Luxembourg, Norway and Sweden, Internet usage rates exceed 90% even among the older cohort, while in Turkey this share is only 20%.

Figure 2.2. People using the Internet, 2017 or latest year available

Individuals having used the Internet in the last 12 months, by household income quartiles



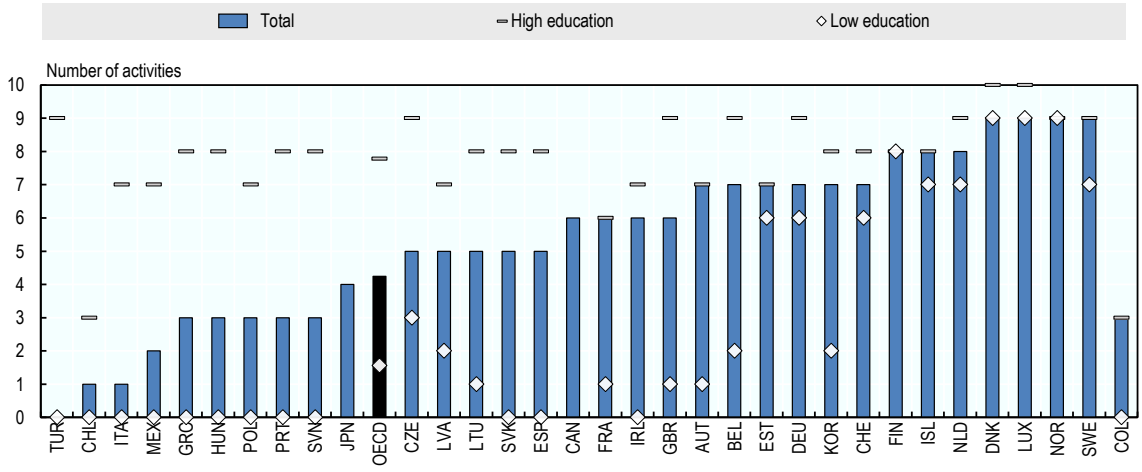
Note: For the United States, data refers to individuals having used the Internet in the last 6 months. For Israel and Mexico, the reference period is the last 3 months. For Canada and Switzerland, data refer to 2016. For Australia, Japan and New Zealand, the 2017 value was linearly extrapolated using 2012 data. These values are marked in grey. The same procedure was applied for Brazil, Italy and New Zealand for the values for the 1st and 4th quartiles.
Source: Based on OECD *ICT Access and Usage by Households and Individuals* (database), http://oe.cd/hhind.

StatLink http://dx.doi.org/10.1787/888933908438

However, data on the share of individuals having used the Internet does not capture the sophistication with which people navigate the Internet. Figure 2.3 considers the **variety of different online activities** that are used by at least 50% of people in each country, giving an indication of the depth of Internet use in different countries. Not surprisingly, people in countries with high Internet penetration rates use it for a larger range of functions. In four countries (Luxembourg and three Nordic countries), nine out of ten online activities are used by a majority of the population. The variety of uses shows that the share of the population using the Internet does not fully reflect the extent to which people use the Internet for important daily tasks. For example, in Chile and Italy, while over 70% of people have used the Internet in the last 12 months, the majority of people only use the Internet for one single activity, suggesting that the sophistication of Internet use remains limited.

Figure 2.3. Variety of uses of the Internet

Number of online activities that are used by more than 50% of total population, 2017 or latest year available



Note: The variety of uses describes the number of online activities that are taken up by a majority (50%) of the population in each country, out of a list of ten possible activities: e-mailing for private purpose; finding information about good and services; reading/ downloading software; consulting wikis; Internet banking; telephoning/video calling; playing, streaming, downloading, watching games/images/films/music; purchasing online; and visiting or interacting with public authorities websites. All activities come from the OECD ICT Information and Communication Technology database. Canada, Chile and Japan do not have data on two out of ten possible activities. Korea and Mexico miss data for one activity. Methodological differences exist for Canada, New Zealand, Japan, Korea and Mexico. The OECD average is population weighted.
Source: Based on OECD *ICT Access and Usage by Households and Individuals* (database), http://oe.cd/hhind.

StatLink http://dx.doi.org/10.1787/888933908457

There are inequalities of Internet usage even when there is equality in access

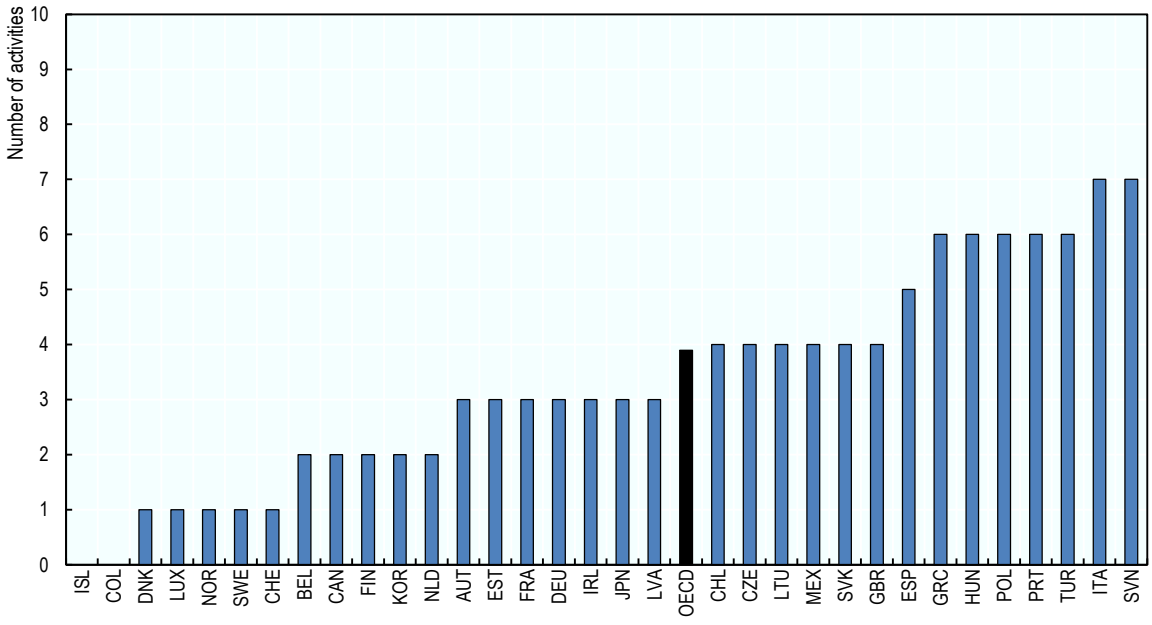
While the majority of people in OECD countries now have access to Internet, the second digital divide remains persistent (Attewell, 2001; Goldfarb and Prince, 2008). This divide in digital skills limits people's job prospects, but its implications extend to all areas of well-being. In people's daily lives, this inequality in digital skills manifests itself in the form of different abilities to use the Internet in a variety of ways. All time-saving opportunities, new ways to access information and social networking depend on people's ability to take advantage of the various possibilities provided by Internet. As Internet

access rates are very high in all OECD countries, differences in ability to use the Internet are a key factor of inequalities (OECD, 2010).

Figure 2.4 describes this second digital divide in the form of **vertical inequalities in usage of the Internet** within countries. In countries with lower Internet access and usage rates, the variety gap is lower because many of these activities have not yet been introduced on a large scale. In other countries, such as Slovenia, Italy and Portugal, there are larger gaps in the intensity at which people make use of the Internet. While some people use the Internet for a very wide range of activities, others barely use it at all. This has implications for the extent to which digital technologies can impact well-being in its different dimensions and for the inequality-enhancing effects that may emerge as a result.

Figure 2.4. Inequality in the variety of Internet uses

Difference between the number of activities that are used by fast adopters (25% of the population) and the number of activities used by a broader public (more than 50% of individuals), 2017 or latest year available



Note: Inequality in uses is the difference between number of activities that are used by fast adopters (activities that are used by just 25% of the population) and those activities that are used by a broader public (activities that are performed by more than 50% of individuals). A larger difference means a wider gap between fast adopters and the rest of the population. The activities included are the same as in the variety of Internet uses indicator (Figure 2.3). The OECD average is population-weighted.
Source: Based on OECD *ICT Access and Usage by Households and Individuals* (database), http://oe.cd/hhind.

StatLink http://dx.doi.org/10.1787/888933908476

Education is an important factor in determining differences in usage within countries, with tertiary-educated users performing on average 7.3 different activities online as opposed to 4.6 activities on average for people with a lower secondary education (OECD, 2016a). However, conditional on adoption, people from lower socio-economic backgrounds tend to use the internet more intensely than people in high-educated, high-income groups (Goldfarb and Prince, 2008). But while the former use the internet primarily for recreational and entertainment purposes, younger and more educated people

use the Internet for more productive activities such as finding jobs, getting access to health care services or engaging in political and social activities (van Deursen and van Dijk, 2014; Putnam, 2015).

Education and skills

Digital skills are essential for people to reap the benefits of digitalisation and are necessary to participate in a society that relies increasingly on digital platforms to interact with other people and with institutions. Many social and economic transactions now include some kind of digital component. Improved access to health care and government services and the ability to manage digital security and privacy risks all depend on mastering some level of digital skills (Box 2.2). In addition, the digital economy increasingly demands workers who are able to solve problems in technology-rich environments, but who also have the creative and interpersonal skills that foster success in this digital environment. Digital technologies are also transforming the learning experience itself, both in schools as well as in adult education, where opportunities to follow online courses allow people to engage in lifelong learning. However, digital skills are only an opportunity for those who have them, and so while they present an opportunity for people's well-being, the digital divide in skills also presents a risk at a societal level as the digital skills gap can perpetuate existing inequalities.

Box 2.2. What types of skills are necessary in a digital society?

Three types of skills needs have emerged in the context of the digital transformation (OECD, 2017a). First, everyone in society needs to be equipped with **ICT problem-solving skills** as well as solid literacy, numeracy and problem-solving skills in order to be able to benefit from using digital technologies in their daily life and in the workplace. This implies making investments to reduce the skills gap between students with and without digital skills (OECD, 2016b). Second, **specialised skills** are needed to ensure the realisation of the societal benefits of ICTs. The production of ICT products and services and new advances in cloud computing, big data analysis, blockchain and AI are reliant on highly specialised skills. Finally, digital technologies have sparked the demand for **additional skills that are complementary to digital technologies**, such as creative, social and emotional skills (OECD, 2015a). These skills allow people to use digital social networks without emotional or social harm and to be aware of the risks of extreme Internet use. In the workplace, interpersonal skills and leadership skills, as well as the ability to navigate and leverage the digital economy, are also becoming more important (Deming, 2017). In the context of growing automation, these human-specific skills are growing in demand.

While all three of these skills needs are important, the focus here is on the first, i.e. ICT problem-solving skills, as these skills are the most specific to the digital transformation. ICT problem-solving skills refer to the ability to navigate technology-rich environments and use the Internet in a variety of ways. Specialised skills are important for society, but an individual does not necessarily require them in his everyday life, hence they are more important for the economy at large than for individuals' well-being. Finally, while complementary skills bring advantages on the job market, as well as in navigating risks related to social connections and mental health, there are currently no adequate measures for them.

Students and adults need digital skills to participate in the digital economy and society

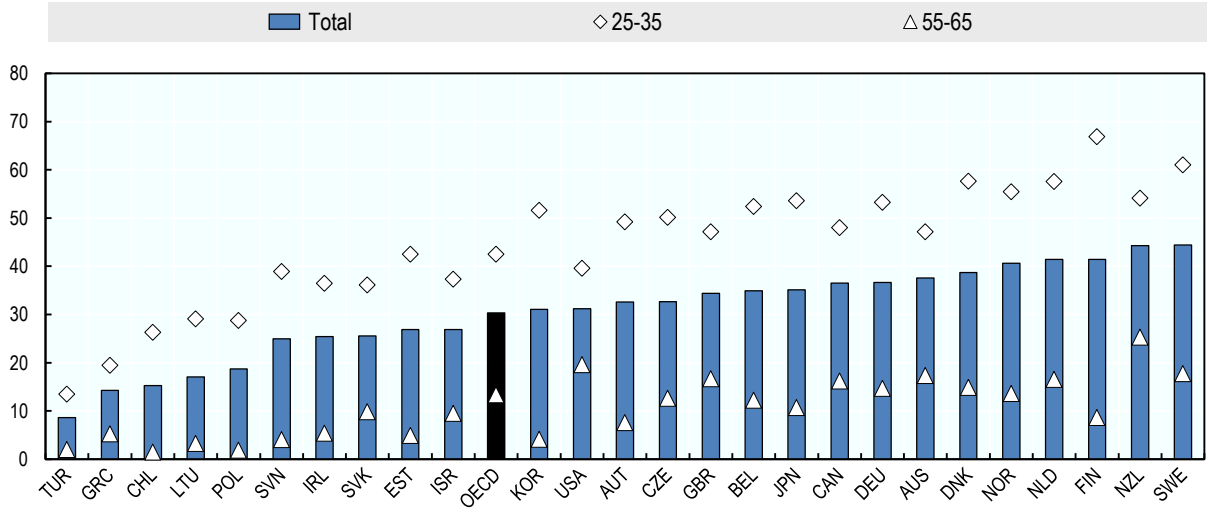
Today, digital skills are a prerequisite to fully participate in the labour market. For instance, 95% of workers of large businesses in the OECD, and 65% of those in small businesses, already use the Internet as part of their jobs (OECD, 2016b). According to Berger and Frey (2016), ICT skills are necessary in all but two occupations in the United States. At the same time, 40% of people who use simple office software at work indicate they do not have the digital skills necessary for effectively using such tools (OECD, 2017a).

In order to measure the digital skills of adults, the Programme for the International Assessment of Adult Competencies (PIAAC) includes a task-based measure of adults' abilities to solve the types of problems commonly faced in using ICTs in modern societies. This problem-solving task requires adults to use a variety of computer applications, such as e-mail, spreadsheets, word processors and websites that adults may encounter in their daily life. Scores are classified in different proficiency levels, where Level 1 denotes the capacity to only perform very basic tasks, whereas Level 2 and Level 3 denote medium and high skills. Adults scoring at Level 2 or 3 can solve problems that require the co-ordinated use of multiple applications, can evaluate the results of web searches and can manage unexpected outcomes.[3]

Figure 2.5 shows the percentage of people with a **medium or high score in problem-solving skills in technology-rich environments** (Level 2 or Level 3) across OECD countries. Sweden and New Zealand have the highest share of adults with medium or high digital skills, while in Turkey, Chile and Greece, among others, less than a quarter of people have this skill level. In all countries a significant age gap exists when it comes to digital skills. While younger generations ("digital natives") are increasingly fluent in the use of digital technologies, older people are often left behind. This has severe consequences in other dimensions of well-being, since digital skills are necessary to benefit from many of the opportunities of the digital transformation. In particular, people in the elderly population are at risk of being excluded from key services in the areas of health-care and e-government, which are increasingly reliant on digitalised systems.

Figure 2.5. Digital skills, 2012 or 2015

Share of individuals scoring at Level 2 or Level 3 in the PIAAC proficiency in problem-solving in technology-rich environments task, by age



Note: Problem solving in technology-rich environments measures adults' abilities to solve the types of problems they commonly face as ICT users in modern societies. Adults scoring at Level 2 or Level 3 can solve problems that require the co-ordinated use of several different applications, can evaluate the results of web searches, and can respond to occasional unexpected outcomes. For most countries, data refer to 2012; for Chile, Greece, Israel, Lithuania, New Zealand, Slovenia and Turkey, data refer to 2015. The OECD average is population weighted.
Source: Based on OECD (2012, 2015), *Survey of Adult Skills (PIAAC)* (database), www.oecd.org/skills/piaac/publicdataandanalysis/.

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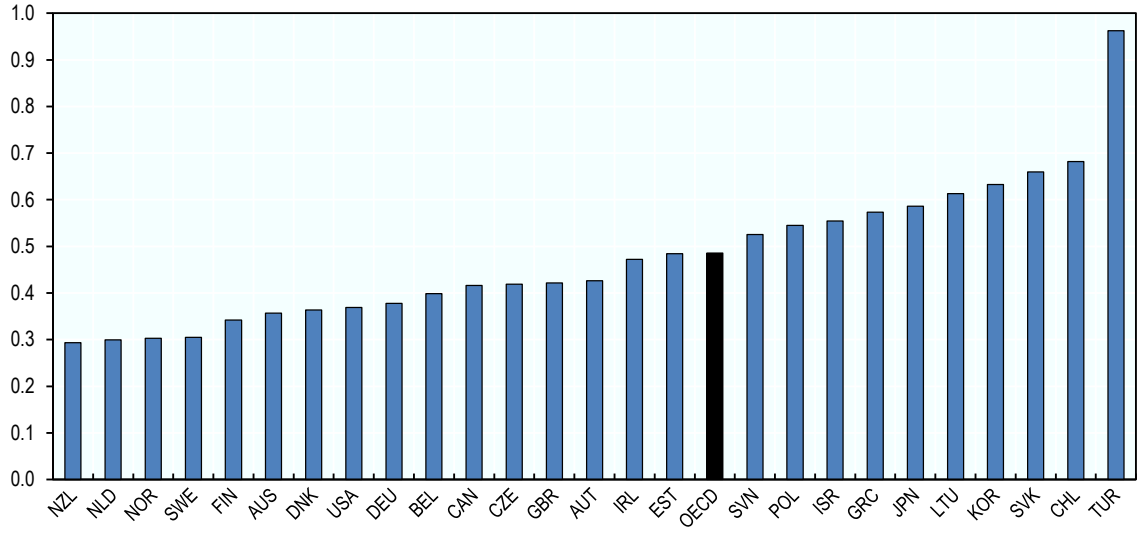
The emergence of a digital skills gap

The increasing importance of digital skills means that **inequalities in skills** have the potential to perpetuate or even worsen existing well-being inequalities. Figure 2.6 shows vertical (i.e. total) inequalities in digital skills, as measured by the coefficient of variation of the PIAAC problem-solving test score. Countries with high coefficients of variation have lower mean scores and a wider distribution, i.e. a larger gap between those with high and low scores. Turkey, Chile, the Slovak Republic and Korea record high levels of inequality in digital skills, while New-Zealand, the Netherlands and the Nordic countries display greater homogeneity in digital problem-solving scores among adults. The digital skills gap highlights the divisive potential of the digital transformation, and the extent to which the digital transformation currently manifests itself in the form of a skills gap.

Figure 2.6. Digital skills gap, 2012 or 2015

Coefficient of variation of score in problem solving in technology-rich environments assessment



Note: The digital skills gap is the ratio of the standard deviation of the Problem-solving in technology-rich environment score to the mean score of the same variable. The OECD average is population-weighted. For most countries, data refer to 2012; for Chile, Greece, Israel, Lithuania, New Zealand, Slovenia and Turkey, data is from 2015. The OECD average is population weighted.
Source: Based on OECD (2012, 2015), *Survey of Adult Skills (PIAAC)* (database), www.oecd.org/skills/piaac/publicdataandanalysis/.

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Digital resources in classrooms can help prepare students for a digital society and economy

Digital technologies can unlock new learning opportunities in the classroom by giving students access to a wider range of resources, by complementing the teacher in learning processes (computer-assisted learning) and by providing other advantages to students, such as access to motivational and informational resources associated with access to tertiary education programmes. The evidence on the advantages of ICT resources in schools remains mixed (Escueta et al., 2017). Access to technology is quite certainly beneficial to students' digital skills and provide a clear advantage to students in that area. But the effects on other learning outcomes are generally considered limited or potentially negative. Some studies find that computer-assisted learning has some positive effects, especially in science and mathematics, because it provides students with personalised learning modules that are adapted to their level. Goolsbee and Guryan (2006) also note that technologies at school may confer other benefits to students that are not measured by standardised tests.

Besides offering new pathways for learning, schools play an important role in bridging the digital divide and ensure that all children reap the benefits of technological advances. There is evidence that children from different socioeconomic backgrounds use digital technologies differently (Hargittai and Hsieh, 2013). Digital resources in the classroom can serve as an equalising force between students who do and do not have access to digital technologies at home, allowing the latter to catch up with the digital mastery of the

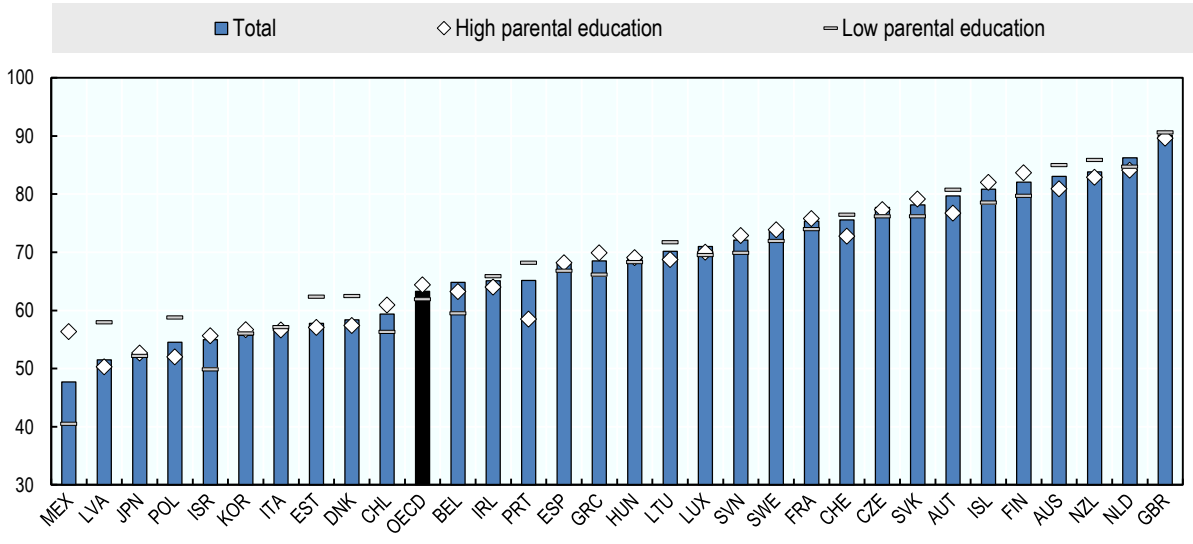
former. In addition, Banerjee et al. (2007) suggest that computer-assisted learning especially benefits schools where the quality of teaching is lower, meaning that differences in teacher quality across schools can partially be mitigated by the introduction of digital resources in the classroom.

As shown in Figure 2.7, there are important gaps between countries with widespread **digital resources at school** such as the Netherlands, New Zealand or Australia, and countries such as Mexico, Latvia or Japan where only half of the students benefit from internet-connected computers in schools (OECD, 2015b). These differences may reflect differences in financial resources across countries, but may also result from conscious choices as a result of an awareness of the risks associated with the use of technology in the classroom.

About one third of lower-secondary students in OECD countries do not use school computers connected to the Internet. In countries with a large digital divide between students with different socio-economic backgrounds differences in the penetration of digital resources at school may exacerbate these inequalities. In most OECD countries, however, parental education is not a strong determinant of students' access to digital resources at school. This suggests that access to these resources at school is not necessarily dependent on socio-economic background. However, in some countries, e.g. Mexico, students with highly educated parents are more likely to have digital resources at school than those with low-educated parents.

Figure 2.7. Digital resources at school, 2015

Share of 15-year-old students who have access to Internet connected school computers, by parental education



Note: Data refer to 15-years-old students who have access to Internet connected school computers and who use them. The OECD average is population-weighted.
Source: Based on OECD (2015), *Programme for International Student Assessment (PISA)* (database), www.oecd.org/pisa/data/.

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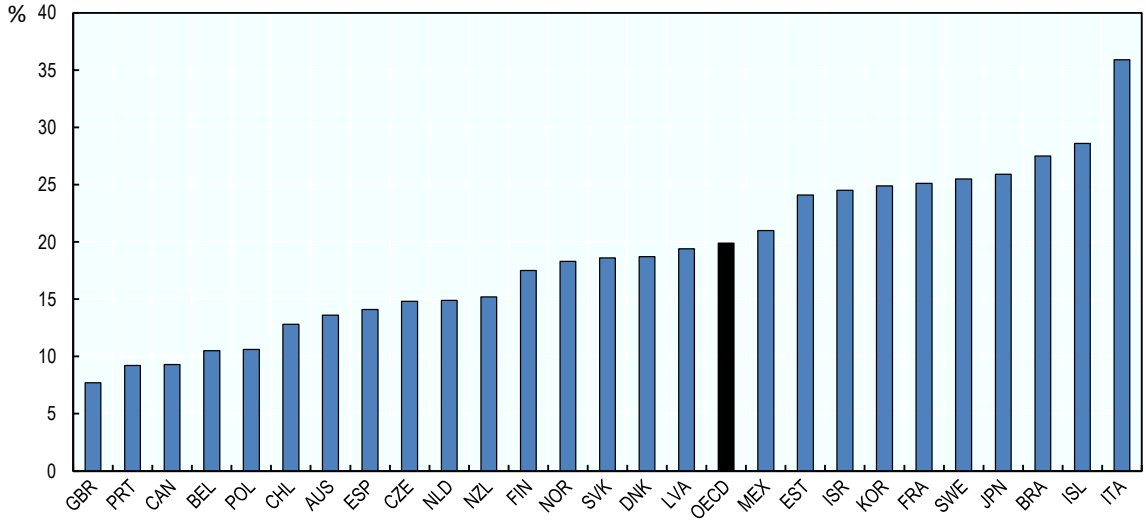
The adverse effects of digital resources in the classroom may reduce learning outcomes

Digital resources at school may also present risks for learning outcomes. The results of digital learning experiences in schools are somewhat mixed, and many studies report limited or no benefits of digital education (Bulman and Fairlie, 2016; Escueta et al., 2017). According to evidence from the Programme for International Student Assessment (PISA), while using digital resources in the classroom is beneficial for learning outcomes up to a point, too much use of digital technologies in the classroom can have negative impacts on learning outcomes (OECD, 2015b). This negative effect may be the result of greater distractions in the classroom, when students use Internet connection for chatting or playing rather than learning (McCoy, 2013). Unfortunately, no data is available on the distractive potential of digital technologies within schools.

Another way digital resources may not necessarily be conducive to improved learning outcomes relates to the lack of digital skills of teachers, which poses a constraint to computer-assisted learning. When teachers are not familiar with digital technologies, digital resources can form a distraction for both teacher and students (OECD, 2016c). On average, 20% of lower secondary education teachers in OECD countries report that their **ICT skills are insufficient** (Figure 2.8). In Italy, 36% of teachers report to have a high need to develop their ICT skills, as compared to 8% in the United Kingdom and 10% in Portugal and Canada.

Figure 2.8. ICT skills of teachers

Share of teachers reporting a high need to develop their ICT skills for teaching



Note: Data for Belgium refer to Flanders, those for Canada refer to Alberta and those for the United Kingdom refer to England.
Source: Based on OECD (2014), *Teaching and Learning International Survey (TALIS)* (database), https://stats.oecd.org/index.aspx?datasetcode=talis_2013%20.

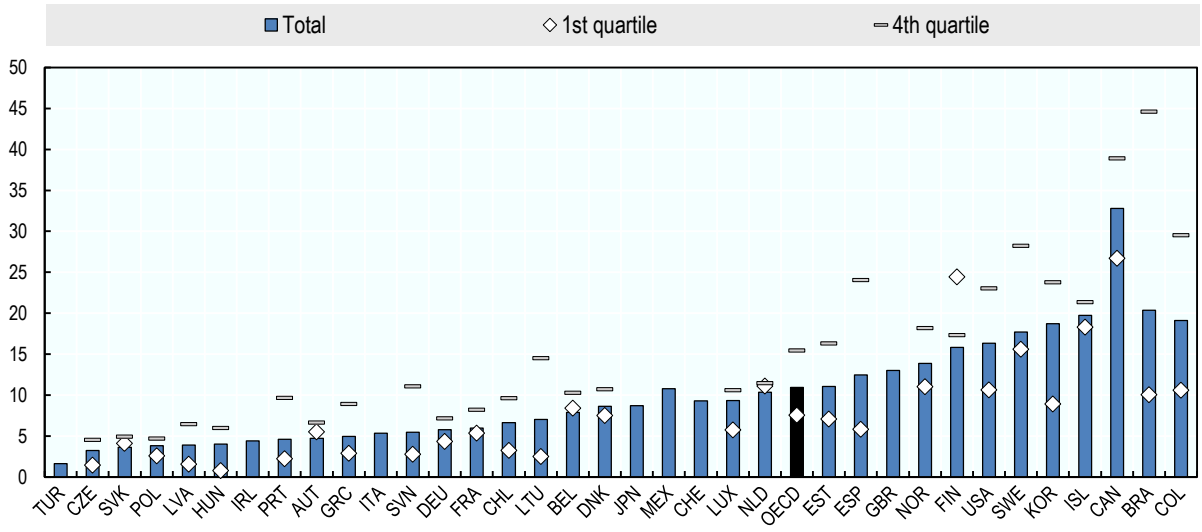
StatLink http://dx.doi.org/10.1787/888933908552

Online education and digital learning tools can support lifelong learning and new learning models

In addition to changing the educational experience at school, digital technologies have opened up new educational opportunities for all groups of the population through various e-learning platforms offering a wide range of lifelong learning opportunities. According to Kearns (2010), the Internet has engendered a "fourth generation" of distance learning, which allows for large-scale participation and higher- quality online learning. Examples of such online learning tools are Online Educational Resources (OERs), Massive Online Open Courses (MOOCs), digital learning materials, open data, etc. (OECD, 2015a). Such learning opportunities are particularly useful for workers who want to improve their skills in their current job or find a new job, and may thus improve job-to-job mobility (OECD, 2016b). Figure 2.9 shows that the **percentage of people having undertaken an online course** ranges between 20% in Canada and less than 3% in Turkey.

Figure 2.9. Online education by income quartile, 2017 or latest available year

Individuals having used the Internet for doing an online course in the last 3 months, by household income quartiles



Note: For the United States, data refers to individuals having used the Internet in the last 6 months. For Colombia, Japan and Korea the reference period is the last 12 months. There is a minor difference in methodology for Mexico. The OECD average is population-weighted.
Source: Based on OECD *ICT Access and Usage by Households and Individuals* (database), http://oe.cd/hhind.

StatLink http://dx.doi.org/10.1787/888933908571

While online learning was widely hailed as one of the democratising forces of the Internet, these expectations have not quite been met. Some observers have suggested that most successful MOOCs students are from higher socio-economic strata of the population, implying that MOOCs may increase existing educational inequalities (Escueta et al., 2017). Indeed, the share of individuals that have taken an online course in OECD countries is almost twice as high among people in the highest household income quartile than those in the lowest. The only exception to this pattern is Finland, where more low-income people use online courses.

Income and wealth

While many studies have found a positive relationship between investments in digital technologies and productivity growth (Brynjolfsson, 1993; Brynjolfsson and Hitt, 1995, 1996, 1997; Jorgenson and Stiroh, 2000), the size of this relationship varies across countries, with the United States, Korea and Japan recording higher returns of digital technologies than countries in continental Europe. GDP gains from digital technologies are essential for increasing country-wide living standards. However, what also matters for people's well-being is whether the income generated is fairly distributed. This section focuses primarily on wage gaps between workers engaged in ICT tasks and those who are not, and on the increase in the "consumer surplus" resulting from the wider consumption choices triggered by digital technologies.

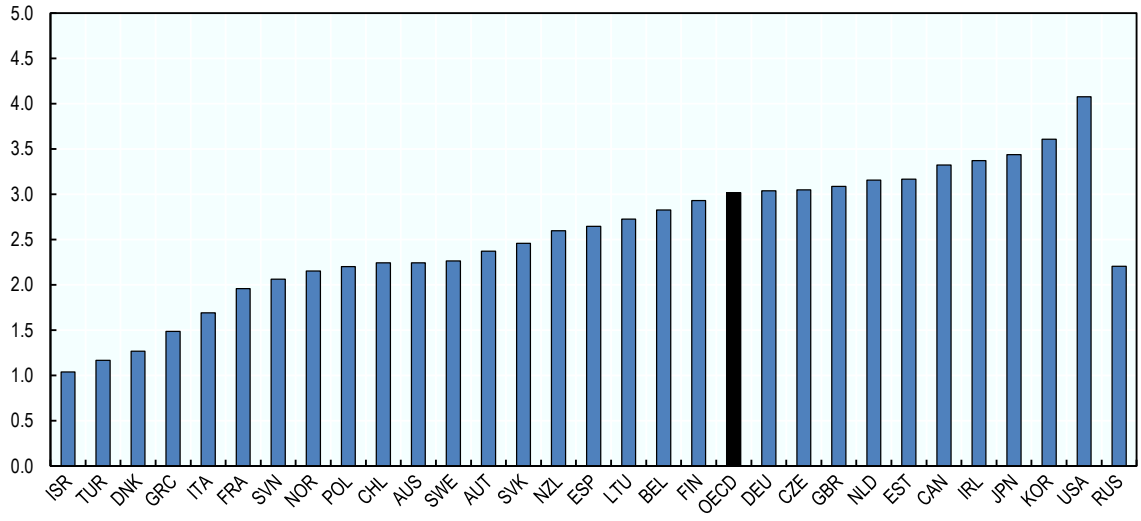
Digital skills confer a wage premium

Workers with digital skills typically earn a higher wage as a result of these competencies (Lane and Conlon, 2016; Falck, Heimisch and Wiederhold, 2016). PIAAC data show that workers who have no experience in using ICT earn 18% less per hour than those who score at Level 1 in the digital problem-solving test when controlling for individual characteristics, such as education, age and levels of numeracy and literacy skills (OECD, 2017a). Workers with higher digital skill levels (Level 2 or 3 in PIAAC) earn 26% more than those with basic skills, although part of this effect is explained by other skills and higher education: simply having digital skills is not enough to receive a wage premium, as these skills need to be put to use in order to reap the rewards (OECD, 2017a). Finally, Grundke et al. (2018) highlight the need to combine cognitive and non-cognitive skills in order to reap the monetary benefits from digitalisation.

Figure 2.10 shows the **labour market returns to ICT tasks**, which are particularly large in the United States, Korea, Japan and Ireland, amounting to around 35% when ICT task intensity increases by 100%. Compared with one additional year of education (which yields a wage-return of about 8%), a doubling of ICT task intensity is equivalent to around five additional years of education. However, much lower wage-returns are recorded in Israel, Turkey and Denmark.

Figure 2.10. Labour market returns to ICT tasks, 2012 or 2015

Percentage change in hourly wages for a 10% increase in the ICT task intensity of jobs



Note: The index of the ICT task intensity of jobs relies on exploratory factor analysis. It captures the use of ICT tasks on the job and relies on 11 items of the OECD Survey of Adult Skills (PIAAC), ranging from simple use of the Internet, to the use of Word or Excel software or a programming language. The detailed methodology is in Grundke et al. (2018). Labour market returns to task intensities are based on OLS wage regressions (Mincer equations) using data from the OECD Survey of Adult Skills (PIAAC). Estimates rely on the log of hourly wages as the dependent variable and include a number of individual-related control variables (including age, years of education, gender and the other skill measures) as well as industry of employment (dummy variables). Separate regressions are run for male and female workers. The country mean of ICT task intensity used to compute the percentage changes in wages for a 10% change in ICT task intensity refers to the country mean for male and female workers, respectively. For most countries, data refer to 2012; for Chile, Greece, Israel, Lithuania, New Zealand, Slovenia and Turkey, data refer to 2015. Values for Belgium refer to Flanders only; those for the United Kingdom refer to England and Northern Ireland. The OECD average is population weighted.
Source: Based on OECD (2012, 2015), *Survey of Adult Skills (PIAAC)* (database), www.oecd.org/skills/piaac/publicdataandanalysis/.

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Wage benefits to individuals with digital skills imply a growing cleavage between high-skilled workers and those who are struggling to keep up. Technological changes have been cited as one of the main causes behind growing income inequality and the falling labour share. According to the IMF, half of the decline in the share of national income received by workers is due to technological progress (IMF, 2017). Evidence confirms that most job losses have been among middle-skill workers in sectors such as manufacturing in favour of jobs requiring more advanced skills, with higher productivity levels and associated wages (Michaels, Natraj and van Reenen, 2014; OECD, 2017b).

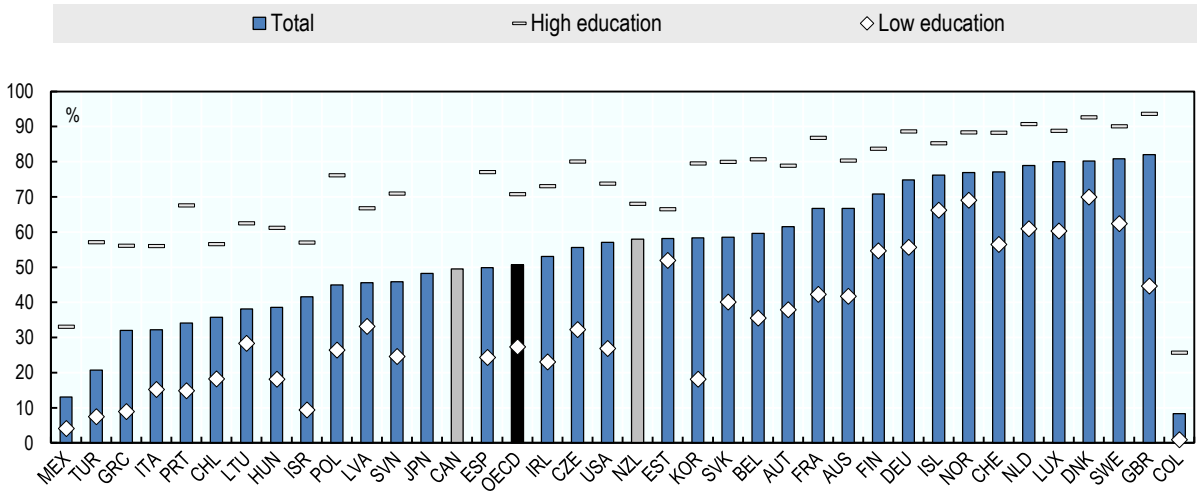
Online consumption and the sharing economy may increase consumer surplus

Digital technologies have greatly improved the ease of purchasing online products, especially entertainment products such as music, e-books, movies, TV-series, often purchased at significantly lower price than in traditional forms. Across OECD countries, 45% of individuals played or downloaded music or games online in 2014. The consumer surplus[4] gains realised by the consumption of online products like digital music, e-books and search engines have been estimated to be as high as USD 500 per person per year

(World Bank, 2016). In addition, e-commerce allows consumers to save time and access a wider range of products online. Digital markets benefit consumers through a variety of channels, from lower prices to higher quality of the goods or services consumed (OECD, 2016c). In some countries, **online consumption** is becoming part of normal daily life, with over 80% of people in the United Kingdom, Sweden and Denmark having purchased goods and services on the Internet in the past year (Figure 2.11). But the use of e-commerce services is not as widespread in other countries, and just about half of individuals across the OECD have purchased online over the year.

Figure 2.11. Online consumption by education, 2017 or latest available year

Share of individuals who have purchased online in the last 12 months



Note: The reference period is 3 months for Australia and Israel and 6 months for the United States. Minor methodological differences exist for Japan and New Zealand. Data for Australia and Israel refer to 2016; those for Japan refer to 2015, and those for Canada and New Zealand to 2012. The OECD average is population weighted.
Source: Based on OECD *ICT Access and Usage by Households and Individuals* (database), http://oe.cd/hhind.

StatLink http://dx.doi.org/10.1787/888933908609

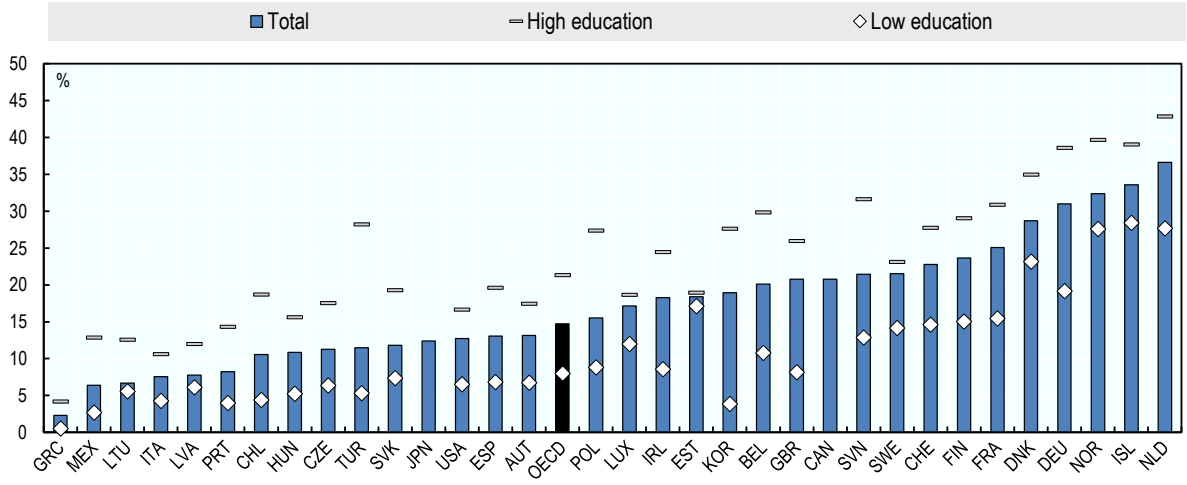
Differences in use of online websites to buy goods and services between population groups show how digital skill inequalities and socio-economic differences exclude people from reaping the benefits of the digital economy. While the United Kingdom leads the ranking in online consumption, less than half of low educated people in the country have used e-commerce services. This gap is also large in Korea, the United States and Ireland. While both digital skills and income inequalities may account for these gaps, it is clear that low educated people do find their way to online marketplaces in some countries but not in others.

The sharing economy not only allows people to increase their consumer surplus but also enables them to sell goods and services themselves. The emergence of peer-to-peer platforms such as AirBnB, Blablacar and Craigslist have transformed entire markets (Ahmad and Shreyer, 2016). Studies have shown that peer-to-peer markets can contribute positively to consumer welfare, and that these benefits are larger for consumers below the median income (Fraiberger and Sundararajan, 2017). People in the Netherlands, Iceland and Norway lead in the OECD when it comes to **selling goods and services online**

(Figure 2.12). Among Dutch people, 37% have engaged in a sale online in the last 3 months, compared with only 2% of Greeks. The opportunity to sell goods and products online appears to be used more by highly educated people, with an average gap of 14% between low and high educated people in OECD countries.

Figure 2.12. Selling goods and services using the Internet, 2017 or latest available year

Share of individuals who have sold goods or services online in the last 3 months



Note: The reference period is 6 months for the United States and 12 months for Canada, Korea and Mexico. Minor methodological differences exist for Japan. Data refer to 2016 for Japan and to 2012 for Canada. The OECD average is population weighted.
Source: Based on OECD *ICT Access and Usage by Households and Individuals* (database), http://oe.cd/hhind.

StatLink http://dx.doi.org/10.1787/888933908628

Jobs and earnings

Beyond income security, employment fulfils a number of important roles for human well-being, such as time structure, social contact, a sense of purpose, a valued social position as well as an opportunity for skill use (Jahoda, 1981; Warr, 2007). For this reason, the labour market effects of the digital transformation are among the most significant for people's well-being. The digital transformation has the potential to generate substantial changes in the composition of the labour market as jobs that require certain skillsets are replaced by a combination of technology and higher skilled labour, or even completely automated. At the same time, digitalisation yields opportunities by creating employment in new and existing industries, with greater job-to-job mobility facilitated by online job search tools. The digital economy also fundamentally changes the nature of work for many people, with fewer jobs exerting physical demands on workers but more jobs placing an emotional strain on desk-workers.

New jobs in ICT and in other sectors become available

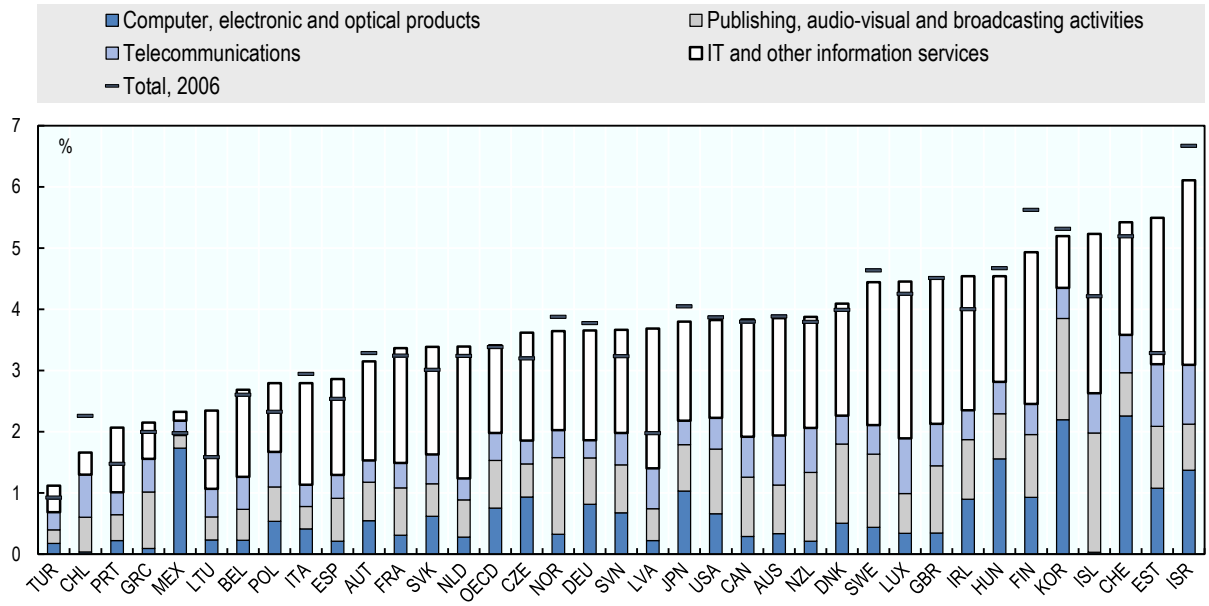
Despite fears for the automation, there is little evidence so far that technological change has led to a net loss of jobs. The emergence of digital technologies has gone in parallel with steadily rising employment rates in most OECD countries (OECD, 2017b). There are theoretical reasons for which technological progress may contribute to job creation

(Autor and Salomons, 2018). Efficiency gains and cost-savings may induce job creation within industries by expanding the market and therefore increasing demand. Increased productivity in one sector can also have positive spillovers in other sectors, if this translates into lower prices and higher demand across the economy. While these processes may imply short-term unemployment among displaced workers, they have the potential to generate economy-wide employment gains.

Estimating the economy-wide impact of digital technologies on employment is challenging, however, because the job creating effects of technological change are often indirect. **Employment in information industries** is not a proxy for the wider employment gains of the digital transformation but it gives some insight into the contribution of information industries to employment (Figure 2.13). Israel and Estonia have the largest share of workers in the ICT sector, representing 6.1% and 5.5% of the labour force, respectively. Computer, electronic and optical products industries account for substantial shares of employment in Korea, Mexico and Switzerland. Employment in information industries relative to other industries has grown strongly in Estonia, Latvia and Lithuania, where ICT-related jobs have contributed to significant job creation.

Figure 2.13. Jobs in information industries, 2016 or latest year available

Share of information industries as a percent of total employment



Note: Information industries cover the following ISIC Rev.4 Divisions: Computer, electronic and optical products (26), Publishing, audio-visual and broadcasting (58 to 60), Telecommunications (61) and IT and other information services (62, 63). Data for Japan and Luxembourg refer to 2015.
Source: OECD Structural Analysis (STAN) Databases, https://stats.oecd.org/Index.aspx?DataSetCode=STANI4_2016.

StatLink http://dx.doi.org/10.1787/888933908647

Digital technologies may destroy jobs at risk of automation

While the previous section has pointed to the lack of evidence of the negative effects of technological change on total employment so far, a number of authors have argued that ICT-based technological change will be more profound than previous instances of great

technological change. This argument is mainly supported by the observation that the labour-saving potential of digital technologies is far greater than in the case of previous technological changes (Brynjolfsson and McAfee, 2011). As a result, automation may, in the future, have much more impactful consequences on the need for human labour than it has so far. For the moment, while a shift away from manufacturing jobs has been observed, this has not translated to overall losses in employment, as middle-skill jobs have been replaced by new high-skill and low-skill jobs (OECD, 2017b).

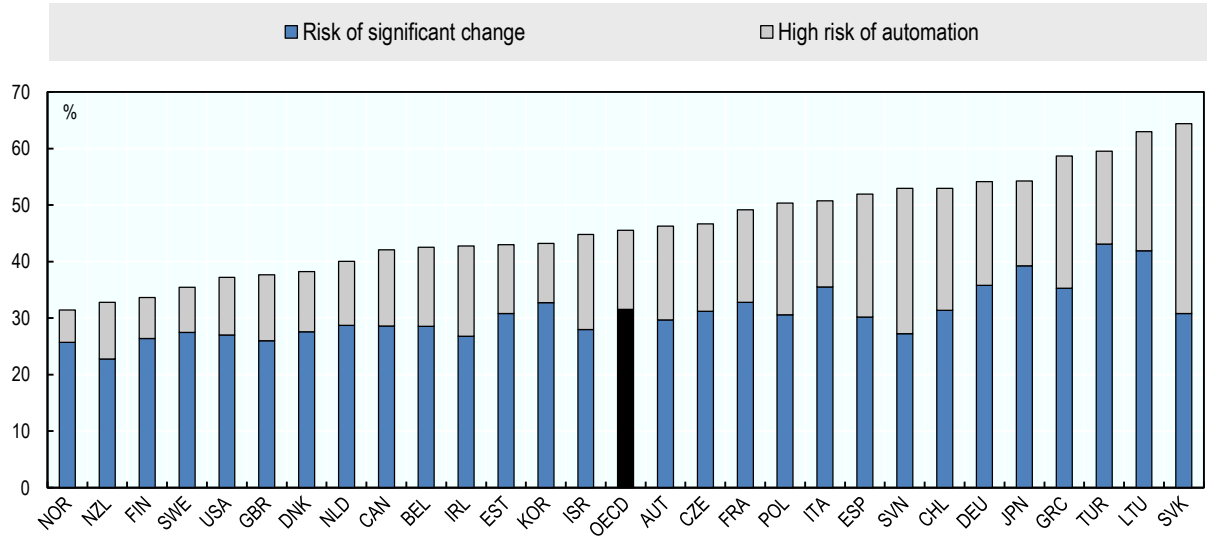
Concerns of the automation of jobs are warranted, however, at least in order to make the case for the need to invest in the most appropriate skills for the future digital economy. Thus far, estimates of the impact of automation mainly rely on expert's predictions of the types of tasks that are likely to be replaced by machines. Previous estimates by Autor, Levy and Murnane (2003) quickly proved to be too cautious: tasks that Autor et al. considered to be out of reach for machines, such as truck driving, are already being threatened by rapid advances in machine learning and AI. More recent estimates of the potential job-displacement effects of automation have looked at job tasks rather than entire job categories (Frey and Osborne, 2013). Food preparation assistants, cleaners and helpers, labourers in mining, construction, manufacturing and transport, and assemblers are the most likely to see their job tasks automated, while teaching professionals, health professionals and personal care workers are among the least likely to lose their job to a machine. Similarly, Schwab (2016) and Susskind and Susskind (2015) consider that the work of lawyers, financial analysts, journalists, doctors or librarians could be partially or totally automated. Schwab (2016) emphasises that algorithms made available by AI are able to successfully replace human actions, even creative ones. The author presents the example of automated narrative generation, in which algorithms can conceive written texts for particular types of audience.

While Frey and Osborne (2013) predicted that almost half of all jobs in the United States may be automated in the next 10 or 20 years, their estimates may be overblown as they did not consider the variety of tasks that workers may perform, as well as differences between specific jobs based on their various tasks. Looking at specific jobs and the tasks performed, more conservative estimates suggest that about 14% of jobs across the OECD are likely to be automated (Arntz, Gregory, and Zierahn, 2016; Nedelkoska and Quintini, 2018). Even though these estimates depend on a number of assumptions about the automation of various job tasks, they highlight which countries' labour markets are vulnerable to the risks of automation.

According to these estimates, **the risk of job automation** is relatively low in Norway, New Zealand, Finland and the United States and is highest in Slovakia, Lithuania and Turkey (Figure 2.14). The variation among countries is even wider when considering only jobs that are classified as "at high risk of automation" (those with a probability of being replaced by machines of 70% or more). While in Norway, Finland and Sweden, only 5-10% of jobs are at high risk of automation, this value is around 34% in the Slovak Republic and between 20 and 30% in Greece, Lithuania, Slovenia and Spain.

Figure 2.14. Jobs at risk of automation

Percentage of jobs



Note: High risk means more than 70% probability of automation; risk of significant change means between 50 and 70% probability.
Source: Based on OECD (2012, 2015), *Survey of Adult Skills (PIAAC)* (database), www.oecd.org/skills/piaac/publicdataandanalysis/ and Nedelkoska, L. and G. Quintini (2018), "Automation, skills use and training", *OECD Social, Economic and Migration Working Papers,* No. 202, OECD Publishing, Paris, https://doi.org/10.1787/2e2f4eea-en.

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The digital transformation may lead to job polarisation

In addition to the long-run risks of digital transformation on employment in the form of automation, job polarisation poses a more immediate risk (Mazzolari and Ragusa, 2013; OECD, 2017b). Job polarisation is the outcome of higher demand for high- and low-skilled jobs associated with a decline in the demand for middle-skill jobs. Between 1980 and 2014, industries where the demand for high-educated workers grew the fastest also recorded the highest decline in the demand for middle-skill workers (Michaels, Natraj and van Reenen, 2014). On one hand, middle-skilled workers are outcompeted by high-skilled workers who are needed to operate automated production systems. On the other hand, there is an increase in the supply of jobs in low-skilled service sectors, such as food service workers, security guards, janitors and cleaners, home health aides, child care workers (Autor and Dorn, 2013). The skills needed in these jobs are more difficult to automate, as they are reliant on social interactions or the type of dexterity that is not yet available in machines. Autor and Dorn (2013) found that the number of hours worked in such service occupations among low-educated workers in the United States rose by more than 50 % from 1980 to 2005. The decline in medium-skill jobs may have a range of well-being implications, such as increasing wage inequality, short-term unemployment and lower job satisfaction for workers who have no other alternative than moving to low-skilled jobs.

There is substantial evidence that this polarisation is taking place also outside the United States. OECD studies that use a variety of national and European labour force surveys

show that middle-skill jobs are disappearing not just as a result of the shrinking manufacturing sector, but also within almost every industry (OECD, 2017b). Estimates of the extent of polarisation between 1997 and 2007 vary between 9 percentage points in Austria to 2 percentage points in Canada (OECD, 2017b). While both technological change and globalisation contribute to job polarisation, the respective roles of each of them is hard to disentangle. Recent OECD studies suggest that polarisation in the labour market is most strongly associated with the penetration of ICT within sectors, more so than factors associated with globalisation (OECD, 2017b; Breemersch, Damijan and Konings, 2017).

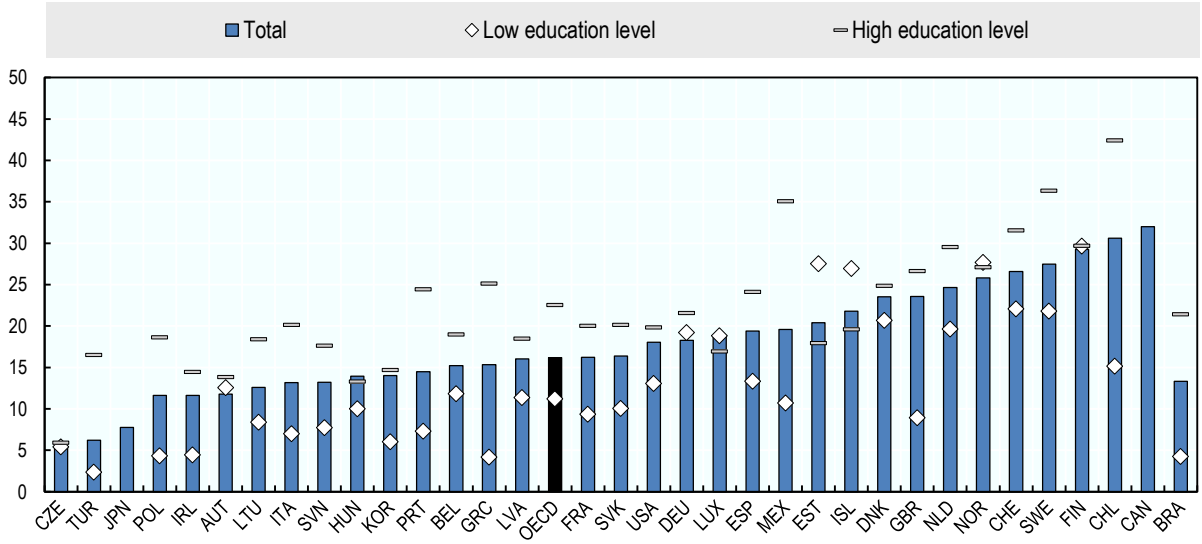
Online job search helps job seekers find employment opportunities

The Internet has significantly improved the matching process in the labour market through new platforms for job search and recruitment (Faberman and Kudlyak, 2016). While initially there was scepticism about the effects of online job search in reducing unemployment duration (Kuhn and Skuterud, 2004), many recent studies have shown a positive impact of Internet in reducing the job search process. Kuhn and Mansour (2014) found that unemployed persons who look for jobs online found work 25% faster than comparable workers who did not use the Internet. Contacting friends and relatives, sending out resumes, filling out applications and looking for advertisements were all found to be effective channels for job search through the Internet.

Online job search has grown rapidly in countries where Internet penetration is high and access costs low. In the United States, the share of young people who looked for jobs online tripled from 24% to 74% between 1998-2000 and 2008-09 (Kuhn and Mansour, 2014). Figure 2.15 shows the percentage of individuals reporting to have used the Internet to look for a job or send a job application in the last three months. Some countries where general Internet penetration is high have very low rates of online job search. For example, Japan records the third lowest share of online job searchers. One possible explanation is that lifetime employment is still very common in Japan (Sousa-Poza and Henneberger, 2004), whereas a large share of online job seekers in the United States consists of workers with an existing job who wish to change employer (Kurt and Mansour, 2014).

Figure 2.15. Online job search, 2017 or latest available year

Individuals having used the Internet to look for a job or send a job application in the last 3 months, by education level



Note: For the United States, data refers to individuals having used the Internet in the last 6 months. The reference period is 12 months for Korea. Data refer to 2016 for Brazil and to 2012 for Canada and Japan. The OECD average is population-weighted.
Source: Based on OECD *ICT Access and Usage by Households and Individuals* (database), http://oe.cd/hhind.

StatLink http://dx.doi.org/10.1787/888933908685

The relationship between online job search and education level varies across OECD countries. In most countries, online job search is more common among high-educated workers, with the OECD average share of individuals looking for jobs online twice as high among educated workers than among low-educated workers. This gap is most pronounced in Greece, Mexico and, notably, Chile, where the difference is 26%. However, in a few countries, notably Estonia, Iceland, Luxembourg and Norway, online job search is more common among low educated workers. This means that online job search may act as an equalising force in some countries more than others.

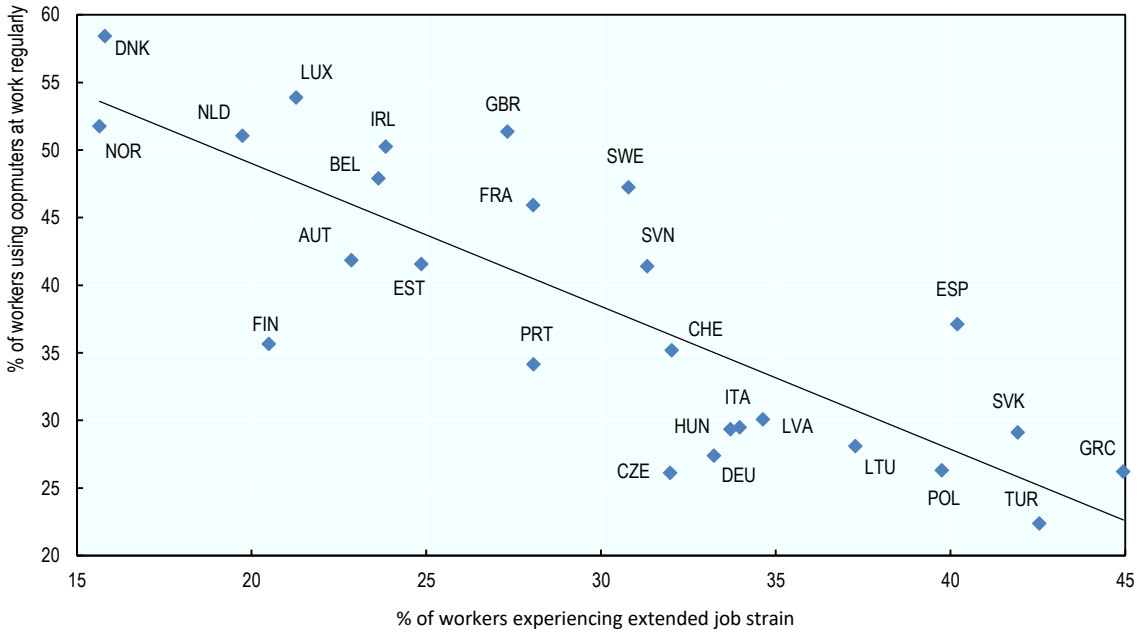
Workers with computer-based jobs are less subject to job strain

The digital economy has fundamentally changed the nature of work and people's work experience. More jobs today involve computer-based tasks, and new modes of work go hand in hand with changing social expectations around the organisation of work. Between 1995 and 2015, the proportion of workers using computers at their job increased from 40% to over 60% (Salvatori, Menon and Zwysen, 2018). These changes may have both negative and positive implications for job quality. For example, computer-based jobs may allow workers to organise their work with more flexibility (Salvatori, Menon and Zwysen, 2018), and present less physical risk factors to workers. Negative associations exist particularly in the emergence of higher emotional demands associated with an increased pace of work.

Data for European countries show that the frequent use of computers, laptops and smartphones at work is significantly and positively associated with *task discretion*, i.e. the extent to which employees feel that they can organise their work time and methods, *flexibility of working hours* and lower *physical demands*.[5] On the other hand, intense use of computers is associated with the degree to which jobs involve responding to *tight deadlines*. On balance, people who frequently use computers at work tend to experience higher quality of the working environment than those who do not.[6] This relationship also holds across countries, with countries with more computer-based jobs experiencing lower job strain (Figure 2.16).

Figure 2.16. Computer-based jobs and extended job strain

OECD countries, 2015



Note: Workers who use computers at work regularly are defined as those who use computers, laptops and smartphones at least 3/4 of the time. Extended job strain is defined as jobs where workers face more job demands than the number of job resources that they have at their disposal (with negative value indicating that a worker does not experience job strain); this measure includes a set of 6 resources and 6 demands. It is computed as the sum of job demands minus the sum of job resources, where a negative value indicates that a worker does not experience job strain. The OECD average is population weighted.
Source: OECD calculations based on European Working Conditions Survey (2015), https://beta.ukdataservice.ac.uk/datacatalogue/studies/study?id=7363&type=Data%20catalogue.

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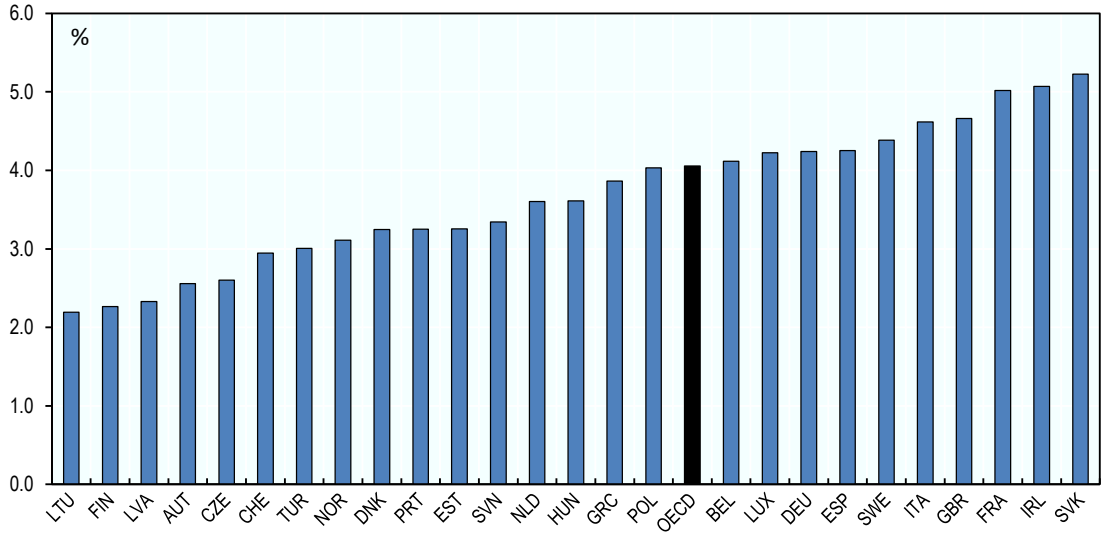
On average, across OECD European countries, computer-based jobs are associated with a 4% lower **share of workers experiencing extended job strain** (Figure 2.17). Workers in Slovakia, Ireland and France benefit particularly from reduced job strain. It should be noted that in countries where extended job strain is low, there is less scope for improvement than in countries where many workers are experiencing extended job strain.

Figure 2.17. Reduction in extended job strain, 2015

Decrease in share of workers experiencing extended job strain associated with having a computer-based job



Note: Extended job strain is defined as jobs where workers face more job demands than the number of job resources that they have at their disposal. It is computed as the sum of (6) job demands minus the sum of (6) job resources, with negative value indicating that a worker does not experience job strain. The decrease in the share of workers is calculated using a regression that estimates the impact of computer use at work on each component of extended job strain index. (the "projected" job strain index is computed for each worker using the regression coefficient if the worker has a computer-based job). The decrease reflects the share of workers who move from experiencing job strain to not experiencing it. The OECD average is population weighted.
Source: OECD calculations based on European Working Conditions Survey (2015), https://beta.ukdataservice.ac.uk/datacatalogue/studies/study?id=7363&type=Data%20catalogue.

StatLink http://dx.doi.org/10.1787/888933908723

Jobs in the digital economy may be associated with higher stress in the workplace

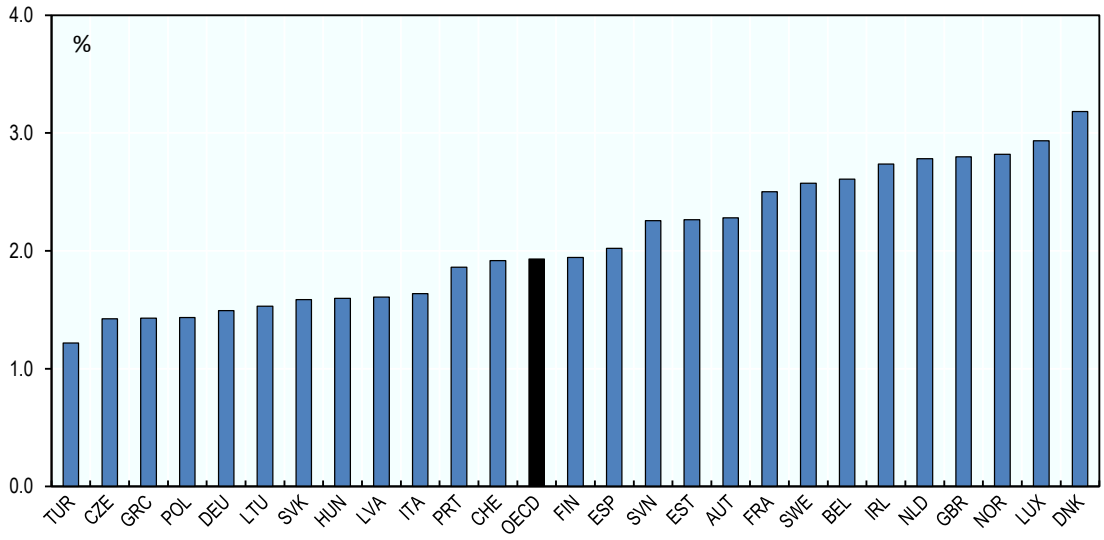
The introduction of the Internet and other digital tools in the workplace has dramatically increased the flow of information that workers have to manage. Research has documented new forms of information flows in a large range of work settings, such as investment analysis, managerial decisions, price setting, physicians' decision-making, aviation, library management and many others, and through a range of digital media, such as e-mail, intranets and push systems (Eppler and Mengis, 2004). The resulting information overload is associated with *technostress*: "a form of stress associated with individuals' attempts to deal with constantly evolving ICTs and the changing physical, social, and cognitive responses demanded by their use" (Ragu-Nathan et al, 2008; see also Brod, 1984; Arnetz and Wiholm, 1997). Information overload in the work place lowers job satisfaction and self-reported health status (Ragu-Nathan et al., 2008; Misra and Stokols, 2012). A recent study also linked perceived e-mail overload to burnout and decreased work engagement (Reinke and Chamorro-Premuzic, 2014).

An analysis of the relationship between computer use at work and **self-reported job stress** suggests that workers with digitalised jobs do experience more stress, even when controlling for earnings, skill level, and sector of employment (Figure 2.18). Because the analysis is pooled across countries, individual country-effects are computed based on the share of workers that have computer-based jobs.[7] Countries with more 'digital jobs',

therefore, by construction have a higher share of workers experiencing job stress associated with such jobs. In these countries (Norway, Luxembourg and Denmark), up to 3% more workers may experience stress at work associated with computer-based jobs. In Turkey and the Czech Republic, where few workers use computers and digital devices at work, the impact on job stress is more limited.

Figure 2.18. Job stress associated with computer-based jobs, 2015

Share of workers experiencing job stress that is associated with having computer-based jobs, European countries only



Note: The share of workers experiencing stress at work due to having a computer-based jobs is computed using OECD estimates of the effect of having a computer-based job on self-reports of job stress. The effect size is estimated using regression analysis that controls for age, gender, income and skill level, multiplied by the number of respondents in each country that frequently use computers at their job. The resulting effect size implies that people who frequently use computers in their job are 6.5% more likely to experience stress at work (significant at the $p<0.01$ level). Estimates are based on the pool of countries included in this figure. Frequently using computers refers to using computers more than half of the time at work, and experiencing job stress refers to experiencing stress either "Sometimes", "Most of the time" or "Always".
Source: OECD calculations based on European Working Conditions Survey (2015), https://beta.ukdataservice.ac.uk/datacatalogue/studies/study?id=7363&type=Data%20catalogue.

StatLink http://dx.doi.org/10.1787/888933908742

Work-life balance

Life in the digital age is faster than before the arrival of the smartphone and other tools that provide constant connectivity. People who are constantly connected complain that there are not enough hours in the day. This is somewhat paradoxical, because many applications of digital technologies aim at saving time (Wajcman, 2014): mobile technologies can aid in navigation and shorten travel times, instant messaging services allow for faster communication, and peer-to-peer services improve access to services, for example by improving their geographic reach (World Bank, 2016; OECD, 2016d). But the Internet and its applications have also increased the volume of the activities people engage in. As a result, the changing speed of life engendered by the digital transformation may have effects on people's experience of their work-life balance and indirectly on their mental health and experienced well-being.

The Internet and mobile devices have blurred previously rigid lines between work and time spent outside the workplace. Thanks to home broadband connectivity, many people are now able to work from home. Teleworking possibilities reduce commuting times and allows workers to combine work and family life more easily, especially in multi-earner households (Eurofound and ILO, 2017; Dettling, 2016). At the same time, receiving e-mails on a computer at home, or on a mobile device anywhere, allows work to protrude into the private sphere like never before. In some cases, workers are expected to be available at any time (Mazmanian and Erickson, 2014). The ability to connect from anywhere has changed the way people experience time in general, the nature of the relationship between work and home life, and people's family relations.

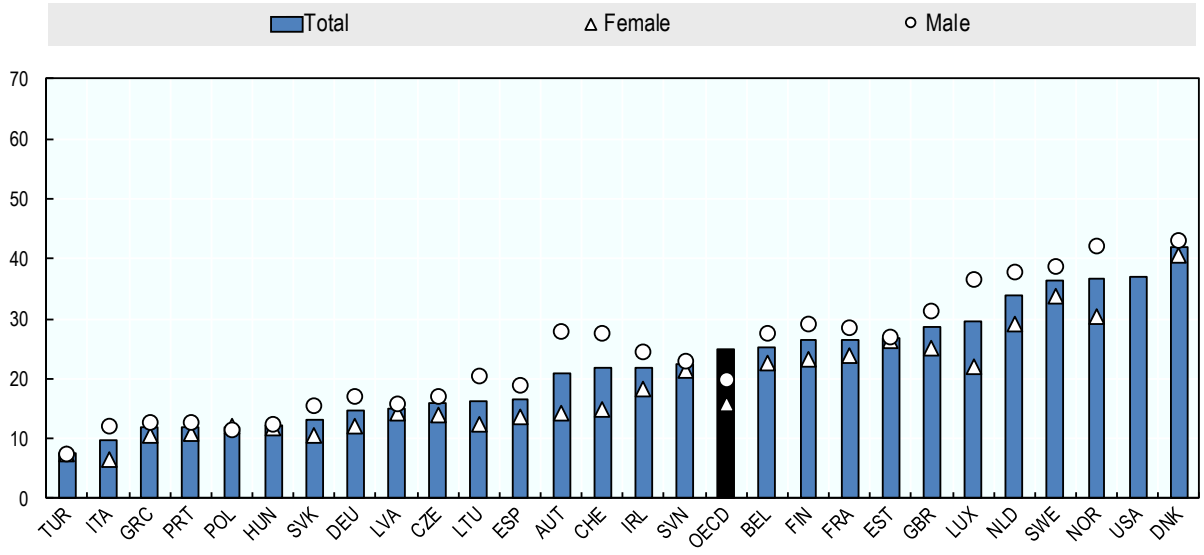
Teleworking allows people to save time and combine their work and personal lives

Teleworking, on the other hand, may present an opportunity for work-life balance as it improves time management and may reduce time spent commuting. A variety of studies have found that employees who engage in telework have higher job satisfaction (Kelliher and Anderson, 2009; Brenke, 2014). Among positive effects, teleworkers report reduced commuting times, more flexibility in organising their working time, and better overall work-life balance (Eurofound and ILO, 2017). Billari, Giuntella and Stella (2017) also found that German women who have high-speed Internet access at home are better able to attain their desired number of children, by reducing the time constraints associated with combining work and parenthood. Evidence from the American Time Use Survey shows that reductions in the time spent commuting and in home production due to Internet increase labour force participation, in particular among married women (Dettling, 2016).

Teleworking requires both technological and cultural transformations in organisations, and the scope for both of these transformations varies across countries. According to Eurofound and ILO (2017), employer attitudes are an important determinant of the penetration of teleworking. The **share of workers having teleworked at least once** is highest in Denmark and the United States, while more than 90% of people never teleworked in Italy and Turkey (Figure 2.19). Among European countries, employers are particularly open in Nordic countries (where more than one third of workers have teleworked).

Figure 2.19. Penetration of teleworking, 2015

Share of workers having teleworked at least once in their life



Note: For European countries, the share of workers having teleworked refers to workers who use ICT's at work at least 75% of the time and who report having worked outside the employer's premises at least once. For the United States, the share is based on a survey question that asks workers if they have ever worked from their home using a computer to communicate for their job. The OECD average is population-weighted.
Source: OECD calculations based on Gallup World Poll, www.gallup.com/services/170945/world-poll.aspx.

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Like other opportunities of the digital transformation, the possibility to work remotely also gives rise to new inequalities. Due to the different nature of job tasks, teleworking is almost exclusively available to high-skill knowledge workers (Billari, Giuntella and Stella, 2017). Germany ranks below OECD average in terms of teleworking penetration, which is perhaps explained by cultural factors: Brenke (2014) estimates that teleworking would be theoretically possible for about 40% of German jobs, but hypothesises that teleworking is less accepted by companies than in other countries. In some other countries, particularly Luxembourg, Austria, Switzerland and Norway, teleworking is also significantly more common among male workers than among female workers.

Constant connection to work may increase worries about work when not working

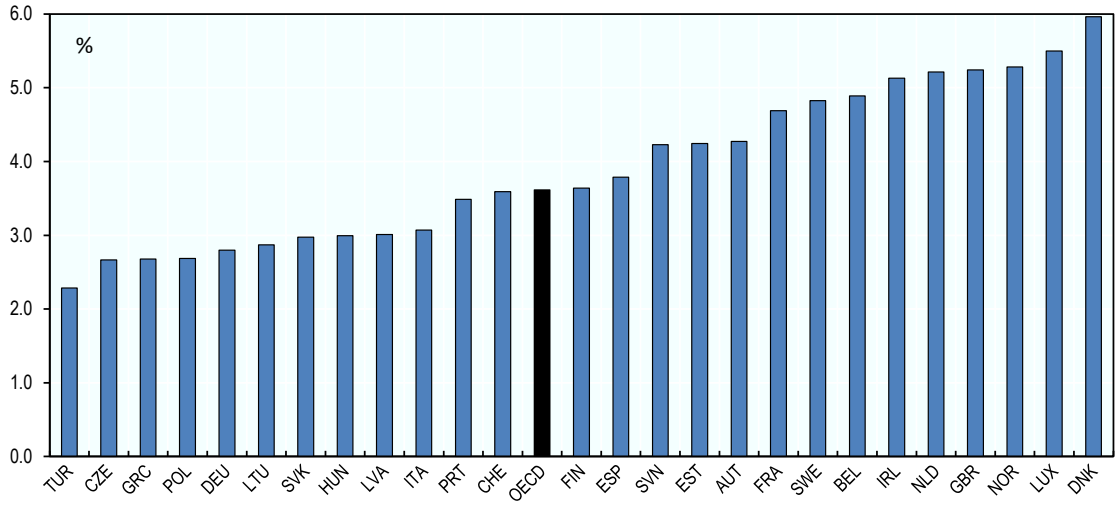
Being constantly connected to work increases risks of stress for workers. Even if the time spent at work does not change, workers may be occupied with job-related tasks even after returning home. Some studies have shown that people who check their e-mail more often experience more day-to-day stress and lower levels of positive affect (Kushlev and Dunn, 2015). A study of working adults in the United States showed that both the time spent on e-mails and the organisational expectations put on staff to monitor their e-mails after working hours lower people's satisfaction with their work-life balance (Belkin, Becker and Conroy, 2016).

Using data from the European Working Conditions Survey it is possible to get an estimate of the relationship between the frequent use of computers at work and the share of European workers who experience work-related worry at home.[8] In countries where

more workers have computer-based jobs, more workers experience **worries about work outside work time** (Figure 2.20). Those countries with more digital jobs, such as Denmark, Luxembourg and Norway are more exposed to the potential increase in worries about work after work time.

Figure 2.20. Worries about work outside work time, 2015

Share of workers experiencing worries about work outside work time that is associated with having computer-based jobs



Note: The share of workers experiencing worries about work outside work time associated with having a computer-based jobs is computed using OECD estimations of the effect size of having a computer-based job on self-reports of worries about work. The effect size is estimated using regression analysis that controls for age, gender, income, and skill level and then multiplied by the number of respondents in each country that frequently use computers at their job. The resulting effect size implies that people who frequently use computers in their job are 10.2% more likely to experience stress at work and is significant at the $p<0.01$ level. Estimates are based on the pool of countries that is included in this figure. Frequently using computers refers to using computers more than half of the time at work, and experiencing worries about work when not working refers to experiencing worries either "Sometimes", "Most of the time" or "Always".
Source: OECD calculations based on European Working Conditions Survey (2015), https://beta.ukdataservice.ac.uk/datacatalogue/studies/study?id=7363&type=Data%20catalogue.

StatLink http://dx.doi.org/10.1787/888933908780

Health

Digitalisation can affect people's health status through the emergence of new physical and mental health risks and through its impact on the health-care delivery system. Health risks associated with the digital transformations include mental health problems associated with the extreme use of digital technologies, especially among children and teenagers and the crowding out of other activities such as physical exercise. Health-care delivery is also affected by new digital technologies, such as electronic records, new treatment options, tele-care and teleconsultation. An important aspect of digitalisation concerns the production and use of medical data to improve the effectiveness and efficiency of health systems. As a caveat, the exchange and use of medical and health data must meet high data protection and data security standards, considering its sensitivity. How and where care is delivered is also affected by digital innovations, which challenges the traditional role of care providers, with implications for interactions among

care providers and between providers and patients. The effects of these changes in health-care delivery of health inequalities are potentially large, but also less well documented.

Extreme use of digital technologies may have negative mental health effects

The effects of mobile phones, video games, and the pervasiveness of ubiquitous screens on the mental health of children and teenagers have drawn significant attention in the public debate because they may present risks of addiction (James et al., 2017). Extreme Internet use, defined as children who spend more than 6 hours on the Internet outside of school, is becoming more common among children and teenagers, with time spent online by 15-year-olds increasing by about 40 minutes between 2012 and 2015 on average in the OECD (Hooft Graafland, 2018). Rosen, Carrier and Cheever (2013) found that the iGeneration members (the generation grown up in an environment where technology is ubiquitous) check their social media accounts on average every 15 minutes. While video games used to be the primary source of extreme use of digital technologies, the smartphone has extended this risk to a wider range of applications. A recent study found that 39% of 18- to 29-year-olds in the United States are online "almost constantly" (Pew Research Center, 2018a).

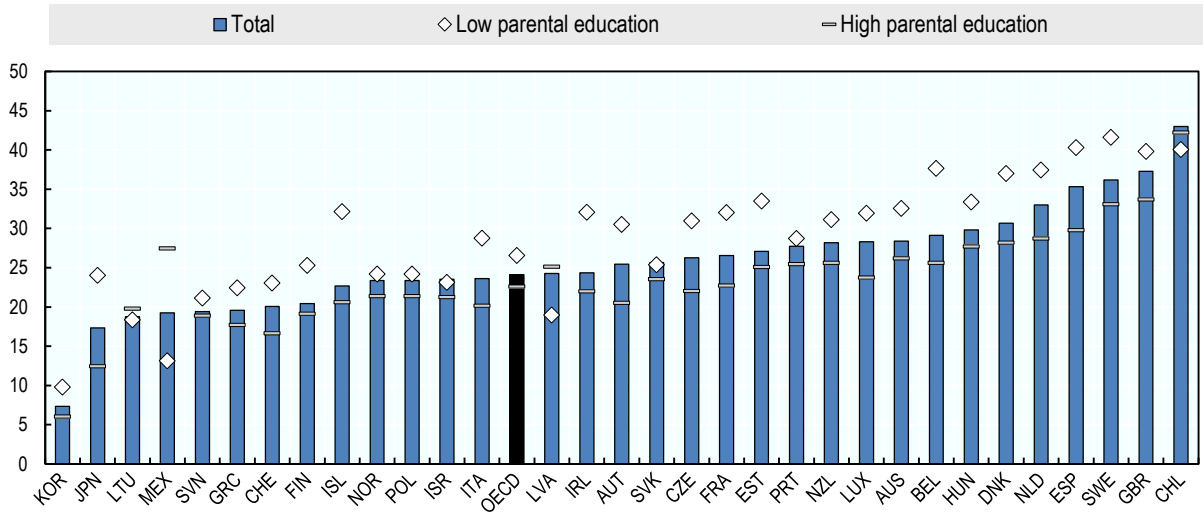
Research suggests that the Internet triggers neurological processes similar to other addictive substances and activities, i.e. experiences of short-term pleasure in the brain's "reward center" (Cash et al., 2012). This area releases a combination of dopamine, opiates and other neurochemicals when activated, a mechanism that can be compromised over time due to the deterioration of associated receptors, requiring even more stimulation to get a similar response. Children and teenagers, for biological reasons, are more susceptible to addiction because their brain is still in development. For example, a study among 14-year-olds in Belgium found that frequent gamers had brain abnormalities compared to other teens, potentially resulting from dopamine releases associated with video games (Kühn et al., 2011). However, other researchers warn that it is premature to approach Internet disorders from an addiction perspective as it is not clear that the behaviours of Internet users share the pathological characteristics of an addiction disorder (Kardefeldt-Winther, 2017).

There is evidence of a direct link between extreme Internet use and depression and anxiety (Kotikalapudi et al., 2012), but the nature of this relationship is disputed and is likely to be bi-directional, as people with anxiety, depression and other mental health problems are also potentially more likely to spend time online. A longitudinal study run on 3 000 children in Singapore found that extreme video game use and problems such as social phobia, attention deficit disorder, anxiety and depression often occur together and are likely to be mutually reinforcing (Gentile et al., 2011). Results from the PISA study show that extreme use of the Internet among children is associated with lower life satisfaction and school results, even when controlling for socio-economic backgrounds (OECD, 2017c). Overall, the consensus is emerging that digital technologies can provide benefits to children and teenagers up to a certain point, but that extreme use can have harmful effects (Przybylski and Weinstein, 2017).

Extreme Internet use among young people is common in OECD countries. On average, 24% of 15-year-olds spend more than 6 hours a day on the Internet on weekend days, and a figure that is as high as 43% in Chile and 37% in the United Kingdom (Figure 2.21). Culture may play a role in the extent to which children spend long periods of time online, with the lowest share of extreme users among children in Japan and Korea. The level of educational achievement of parents also seem to be associated with extreme Internet use,

with children of highly educated parents less likely to be extreme Internet users in most countries. There are a few exceptions to this – notably Chile, Latvia, Mexico and Lithuania – where extreme Internet use is more common among children with high educated parents, possibly reflecting an income effect.

Figure 2.21. Extreme Internet use of children, 2015



Note: Low parental education denotes parents whose highest attained education level is an upper secondary school degree or less. High parental education denotes households where at least one of the parents has completed a tertiary degree. The OECD average is population weighted.
Source: Based on OECD (2015), *Programme for International Student Assessment (PISA)* (database), www.oecd.org/pisa/data/.

StatLink http://dx.doi.org/10.1787/888933908799

The nature of social interactions online may also be conducive to mental health problems such as anxiety, depression, bipolar-mania and narcissism. Such problems are thought to be triggered by social comparisons made online (Sabatini and Sarracino, 2017). Social comparisons online may induce jealousy and lower self-esteem (Muise, Christofides and Desmarais, 2009; Krasnova et al., 2013; Blachnio, Przepiorka and Benvenuti, 2016). Online social media are especially conducive to sharing life experiences, which leads to a phenomenon knowns as the "fear of missing out", i.e. the "pervasive apprehension that others might be having rewarding experiences from which one is absent" (Przybylski et al., 2013). This feeling has been found to be more common among frequent users of social media (Alt, 2015). Twenge et al. (2018) report a strong increase in suicides among teenage girls in recent years and link suicide risk to frequency of social media use. However, these are only correlations and contradictory evidence exists, e.g. a decline in teenage suicide rates between 1990 and 2015 in most OECD countries (OECD, 2018a).

There is also some evidence that the use of digital technologies can have direct or indirect negative effects on various aspects of people's physical health. Use of digital technologies may crowd out activities that are important for people's health, such as physical exercise or sleep. Using historical variation in telecommunication infrastructure that affected broadband penetration, Billari, Giuntella and Stella (2018) find that broadband Internet access has a direct effect on the duration and quality of people's sleep,

as people use digital devices for entertainment while facing time constraints due to family and work commitments. Moreover, it has been found that blue light, emitted by the screens on many digital devices, may disturb people's circadian rhythms and reduce sleep quality, particularly when using digital technologies in the evening (Hatori et al., 2017).

More effective health-care delivery due to improved communication with service providers

Digital innovation may positively impact health outcomes in two ways. First, the delivery of health care is improved by more systematic development and use of electronic records and online accessibility of health care providers. Second, health care treatments are changing rapidly with the introduction of new technologies such as remote sensors, robotics, genomics and artificial intelligence (OECD, 2017d). These new technologies, as well as greater research capacity in biology and drug development are increasing the potential for improved health outcomes. However a pre-condition for these new technologies is a trustworthy and secure infrastructure.

Use of digital technologies in the health care sector has the potential to improve the delivery of care, improving patients' experience and achieving cost efficiencies. These "enabling technologies", are facilitated by process innovations, new eHealth technologies (Box 2.3), and the use of Big Data in decisions about treatments (OECD, 2017e). However, evidence of the effects of eHealth on health outcomes and the experience of health care delivery is still inconclusive (Black et al., 2011; Slev et al., 2016). While eHealth has been found to have positive effects on some aspects of the patient's experience, little or inconclusive evidence exists on the impact on treatment outcomes, although some evidence of positive effects exists with respect to self-reported health and depression among cancer patients who used e-health technology (Slev et al., 2016; Johansen et al., 2012).

Box 2.3. eHealth: Technological advances in health care

Use of digital technologies in health-care (eHealth) encompasses "the application of information and communications technologies across the whole range of functions that affect the health sector" (European Commission, 2012). This broad definition covers a number of digital applications:

Electronic health records (EHR) allow for seamless data exchange between patients, health care providers and pharmacies in order to improve operational efficiency and provide more personalized care. EHRs support both individual patients and doctors by accessing care more smoothly, but can also advance research through the use of large amounts of (anonymised) data on the effectiveness of treatments. Another aspect of EHRs is ePrescribing, which aims to exchange accurate, understandable and error-free prescription information between doctors, patients and pharmacists (Cooke et al., 2010).

Telehealth and mobile health solutions (mHealth) have a wide range of functions, from making online appointments, to accessing health information and communicating with health professionals online, to connecting patients in peer-support groups. Telehealth can also be used to monitor chronic conditions remotely, personalize treatment, and make treatment adjustments without the need to go to the hospital (McKinsey, 2014).

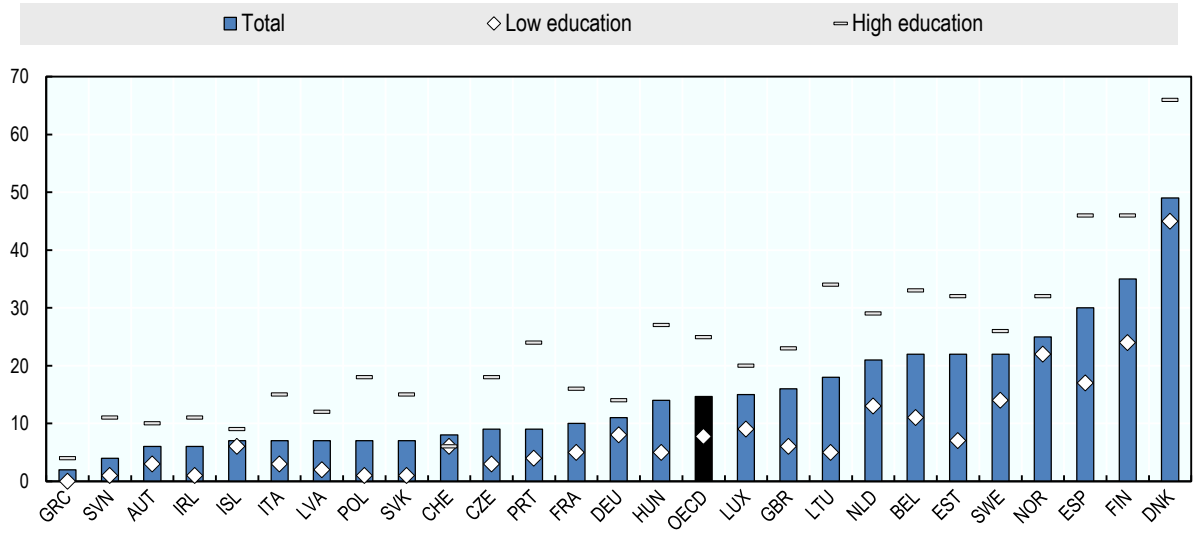
Wearable devices and sensors are increasingly using digital communication tools to send and receive data in order to provide targeted care. These innovations include both the incorporation of already existing technologies, such as pacemakers, into the Internet of Things, as well as new health monitoring devices such as wearable watches that record continuous information on patients' vital health signs.

Together, eHealth technologies serve the multiple goals of improving the patient's experience, increasing the efficiency of the health care system, freeing up time for doctors and care providers to improve patients' health outcomes, and helping physicians make better clinical decisions using new diagnosis and treatment tools supported by large amounts of new data and intelligent systems that can perform more sophisticated analyses and overcome biases.

Unfortunately, very few indicators are currently available to measure the benefits people get from digital-related process innovations in health care. An imperfect proxy indicator is the share of people who make medical appointments online. Web-based medical appointment systems have a number of positive impacts, including improving patient satisfaction, reducing no-shows and wait times (Zhao et al., 2017). Data on the **share of individuals who make medical appointments online** is available for some European countries (Figure 2.22). While in Austria and Iceland very few people make medical appointments online relative to the extent of Internet access in the population, in Spain, Finland and Denmark especially this figure is much higher. Still, in all countries for which data is available, only a minority of people makes medical appointments online.

Figure 2.22. Medical appointments online, 2016 or latest available year

Individuals having used the Internet to make an appointment with a medical practitioner in the last 3 months, by education level



Note: Data refer to the share of people making an appointment with a practitioner through websites of hospitals and health care centres and excludes e-mail. Data for Iceland and Switzerland refer to 2014. The OECD average is population-weighted.
Source: OECD calculations based on Eurostat (2017), *Digital Economy and Society* (database), http://ec.europa.eu/eurostat/web/digital-economy-andsociety/data/comprehensive-database.

StatLink http://dx.doi.org/10.1787/888933908818

Besides improving the patient experience and generating potential for more sophisticated analyses of health data for the benefit of improved treatments, eHealth can reduce health care costs by achieving administrative efficiencies and improve outcomes by reducing wasteful spending due to over-diagnosis and unnecessary treatments (OECD, 2017f). However, implementation of eHealth systems comes at a cost, and the transition from analogue to electronic health records may be burdensome to the health sector as innovations encounter financial, legal, social and ethical barriers to implementation (Ross et al., 2016).

Digitalisation of health technologies can contribute to better health outcomes

Digital technologies can also help improve health outcomes through breakthroughs in research and treatment options facilitated by new monitoring systems and by the use of Big Data and AI (Box 2.4). For example, the deployment of advanced genome sequencing techniques using embedded data-mining algorithms reduced the costs of generating human genome sequences from USD 1 million to USD 1 000 in five years (OECD, 2016a). These discoveries may lead to new and improved treatment options in the future. Analytics also can help drug and device developers identify how patients respond to treatments in more sophisticated ways (McKinsey, 2014). Such advances are facilitated by enormous improvements in computing capacity in combination of new analytical tools that the digital transformation enables.

The direct effects of such digital applications on health outcomes are difficult to estimate. Some studies have evaluated how innovation in medicine in general (beyond just digital

innovation) has impacted objective health indicators, such as life expectancy. Cutler and McClellan (2001) found positive effects in the treatment of heart attacks, low birth weight infants, cataracts and breast cancer. According to a study from the US President's Council of Advisors on Science and Technology (2012), medical innovations have added 5 years of life expectancy between 1980 and 2010. Others have argued that more expenditure on medical innovations does not necessarily lead to improved outcomes in many areas, and point to the high opportunity cost of health care spending that could be used in other areas important for well-being (Berndt, Fisher and Rajendrababu, 2003; Lichtenberg, 2004). Because of the complexity in estimating the direct effect of digital technologies on health outcomes, no explicit measure is presented here.

Box 2.4. How Big Data are transforming healthcare: From eHealth to iHealth

In health-care, several types of data sets are available and can be linked to each other: hospital inpatient data, information from cancer and mortality registers, prescription data, information on primary care and long-term care provision, patient outcomes and diabetes data files. Another example concerns the data generated by patients through mobile applications, which can improve knowledge about patient health status, disease progression and level of function. Combining different data sets can improve acute care analytics and predict the risk of re-admission at hospital or forthcoming complications. Moreover, better and linked data can also help planning infrastructure and workforce needs, predict demand fluctuations and help assessing the efficacy of expensive technologies.

Together, the increased availability of data allows for a progression from eHealth to intelligent health, or **iHealth** (Berrouiget et al., 2018). iHealth employs Big Data and intelligent systems to make smarter and more efficient decisions at the individual or population level. In the United States, Kaiser Permanente used 15 years of maternal and neonatal data to develop a risk-stratification tool that detects sepsis in neonates, and leads to a reduction in antibiotic administration within 24 hours following birth. Combating the spread of antimicrobial resistance through spatial detection is facilitated by big data analysis (Vong et al., 2017). As an example, the US FDA assesses medical technology risks using a very large database (about 178 million people), while hundreds of clinical registries on diseases and interventions have been linked in Denmark (Schmidt et al., 2015).

Health information online can improve patient experiences

Increased availability of health information online is one of the most direct ways in which the digital transformation impacts people's health experience. Many different platforms provide individuals with access to information about diseases, educate patients with treatment options and aid in decision-making, provide support for physical and emotional problems and allow for peer support (Slev et al., 2016).

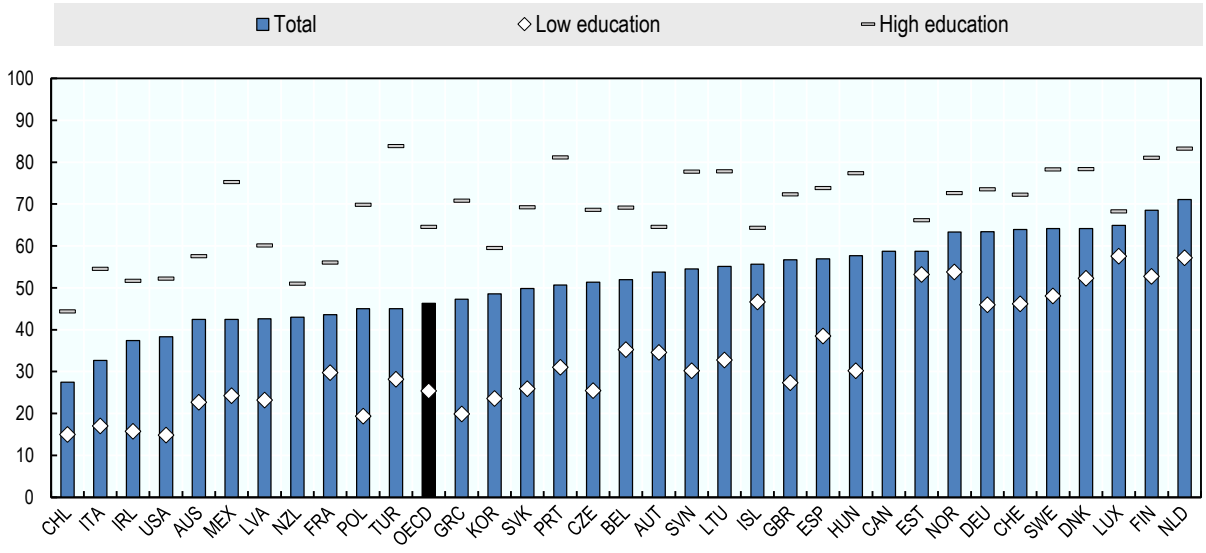
There is mixed evidence of the health and well-being impacts of these new sources of health information. Bessiere et al. (2010) found that looking for health information online is associated with depression, potentially due to poorly conducted self-diagnoses. Another hypothesis is that (unmoderated) peer platforms may increase mental health problems as they can spread wrong information. Other studies have found evidence of positive benefits from internet support groups on depression symptoms in cancer patients and

survivors (Gysels and Higginson, 2007), people with AIDS (Mo and Coulson, 2010), Parkinson's disease (Attard and Coulson, 2012), and diabetes (van Dam et al., 2005). Hong, Pena-Purcell and Ory (2012) found no effects of online cancer support on self-reported health, but positive effects on self-reported quality of life.

There are large differences between countries in the **share of people who use the Internet to seek health information** (Figure 2.23). Across the OECD, 45% of Internet users look for health information online. In a number of countries, led by the Netherlands, Luxembourg and the Nordic countries, more than half of users employ the Internet as a source of health information. Use of online health information is, in many OECD countries, strongly affected by the education level of individuals. On average, the share of people with high education accessing health information online is more than double the share of those with little or no education. As a result, potential health benefits remain concentrated in this segment of the population.

Figure 2.23. Use of online health information, 2017 or latest year available

Individuals having used the Internet to seek health information in the last 3 months, by education level



Note: Small differences in question wording exist for Australia and Canada. For the United States, data refers to individuals having used the Internet for seeking health information in the last 6 months. The reference period is 12 months for Canada, Colombia, Korea and New Zealand. Data for Australia and Brazil refer to 2016, those for the United States refer to 2015, and those for Canada and New Zealand to 2012; these values are marked in grey. The OECD average is population-weighted.
Source: Based on OECD *ICT Access and Usage by Households and Individuals* (database), http://oe.cd/hhind.

StatLink http://dx.doi.org/10.1787/888933908837

Social connections

The Internet and the smartphone have fundamentally changed the way people interact with each other. As with the arrival of previous technologies such as the television or the telephone, the effect of digital technologies on social connections has been the subject of significant debate. Putnam (2000) attributed part of the decline of social capital in the United States to an increase in time spent watching television. Several early studies noted that Internet use was associated with higher self-reported loneliness (Kraut et al., 1998;

Hamburger and Ben-Artzi, 2000; Morahan-Martin and Schumacher, 2003). Since then, this causal relationship has been questioned, and new evidence has emerged that the Internet role in changing social connections may be more positive.

Increased online interactions among friends and social networks

Two competing hypotheses exist to describe the effect of the Internet on human interactions. On the one hand, some researchers have argued that the Internet *displaces* social interactions from the real to the virtual world (Kraut et al., 1998; Nie and Erbring, 2002; Nie and Hillygus, 2002). An early study in the United States used a longitudinal sample of first-time computer users to show that the use of Internet crowded out family time and offline social interactions (Kraut et al., 1998).[9] The two causal pathways identified by the study were, first, a displacement of social activity, with less frequent offline contact and, second, a displacement of strong ties, with strong relationships offline replaced with more superficial ones online. Dienlin, Masur and Trepte (2017) also show that mobile devices have removed pretexts for offline encounters: where people used to meet in person for sharing photos, planning events or gossiping, such functions are now moved to the virtual world.

The competing hypothesis is that the Internet *reinforces* offline relationships and that computer-mediated communication increases offline contact and social capital (Shklovski, Kraut and Rainie (2006); Boase et al., 2006; Johnston et al., 2011; Burke, Marlow and Lento, 2010). By increasing the overall volume of communication, online communication also facilitates increases face-to-face interactions (Dienlin, Masur and Trepte, 2017). In this sense, the rise of the Internet has commonalities with the arrival of the telephone, which greatly enhanced social connections (Fischer, 1992). Various studies have supported this conclusion. A study of 1 210 Dutch adolescents found that those who spent more time using instant messengers also spend more time in face-to-face interactions (Valkenburg and Peter, 2007). A positive effect of social network use on face-to-face interactions was also found in a longitudinal study using a nationally representative sample of the German population (Dienlin, Masur and Trepte, 2017).

One way through which the Internet may enhance bridging social capital is through the formation of online communities (see, however, the discussion of disinformation and "echo chambers" further below). By connecting people with a shared interest, regardless of demographic characteristics or geographic location, the Internet allows forging of new bonds and creating new groups of association. This pattern, while destructing previously existing social networks, allows for the formation of new circles of individuals sharing various commonalities (Rainie and Wellman, 2012). For example, online weight-loss support groups allow individuals to encourage each other in achieving a shared goal (Hwang, Ottenbacher and Green, 2010). Such networks may complement real-life networks. After 9/11, Dutta-Bergman (2006) found that people who engaged in support groups online were also more involved in support communities offline.

The opportunity to create bridging social capital extends to new face-to-face encounters between individuals. The Internet emulates the "strangers on the train" phenomenon, where the transient nature of the environment allows individuals who do not know each other to feel more comfortable in engaging in conversation (Bargh and McKenna, 2004). This does not mean that these encounters remain offline. According to data from the US "How Couples Meet and Stay Together Survey", the Internet is displacing traditional venues for meeting partners, such as the neighbourhood, the friends-circle and the workplace (Rosenfeld and Thomas, 2012). People with Internet access in the United

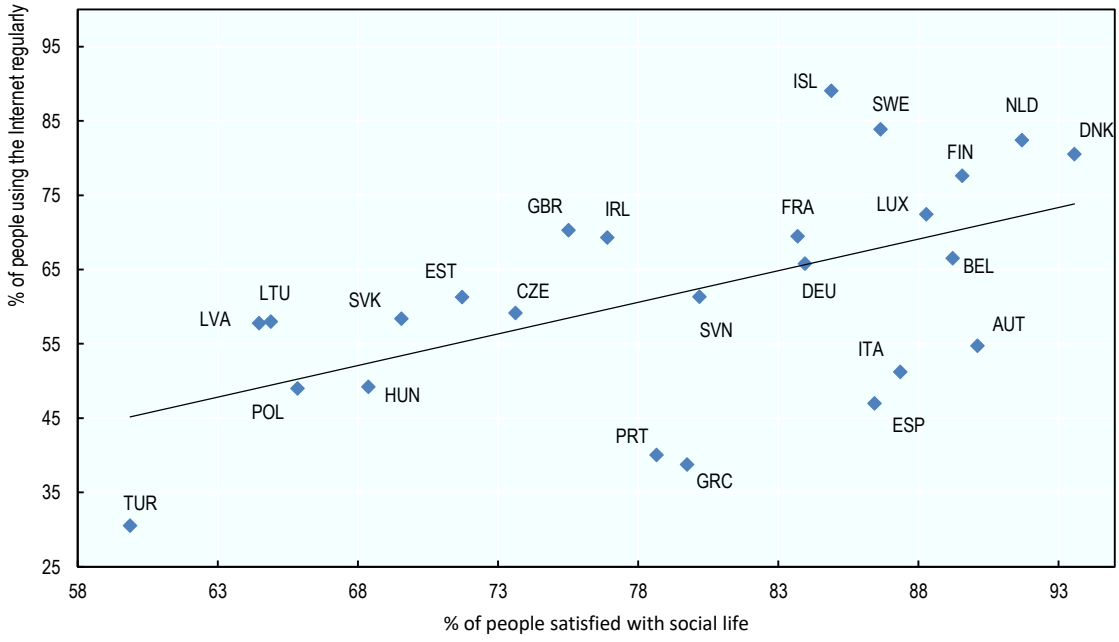
States were found to be more likely to have a romantic partner than people without Internet access, suggesting that more people may partner thanks to new ways of finding someone online (Rosenfeld and Thomas, 2012).

The proliferation of mobile devices, coupled with Internet may reduce some of the displacement risks of the computer, as smartphone-mediated communication can take place while commuting, cooking, or being at work. Individuals' use of social applications on mobile devices increase social capital, particularly among the younger generation (Cho, 2015). For example, in a study of Israeli students, Whatsapp was found to strengthen social capital by allowing students to keep in touch with their existing contacts (Aharony, 2015). On the other hand, a study based on the Italian Multipurpose survey showed that the smartphone can interfere with the quality of real life interactions (Rotondi, Stanca and Tomasuolo, 2017). Using natural field experiments Misra et al. (2014) showed that people rated conversations through traditional devices as significantly superior than those based on a smartphone.

Despite the mixed insights from the literature, substantial evidence supports the idea that online social contact does complement offline interactions, especially when considering the active use of social networks (Howard, Rainie and Jones, 2001; Valkenburg and Peter, 2007; Johnston et al., 2011; Aharony, 2015; Dienlin, Masur and Trepte, 2017). In addition, in European countries, data from the European Quality of Life Survey highlight a moderately strong cross-country correlation between frequent internet use and people's satisfaction with their social life (Figure 2.24). When distinguishing between daily and weekly users, the benefits of Internet use are greater for daily users than for weekly users.

Figure 2.24. Internet use and satisfaction with social life

OECD countries, 2012



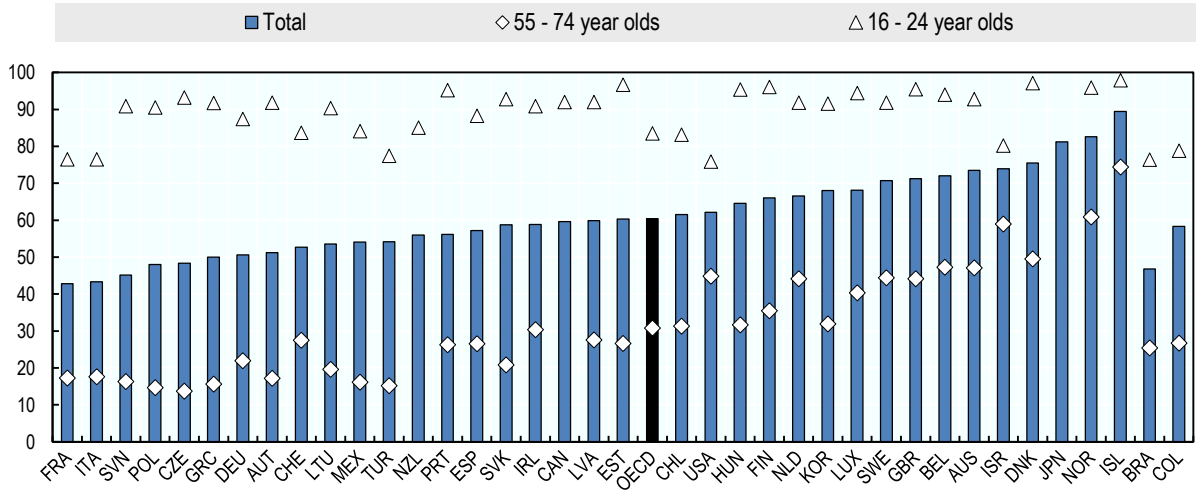
Note: People who use the Internet at least once a week, and share of people in each country who rate their social life to be higher than 5 on a scale from 1 to 10.
Source: OECD calculations based on wave 3 of the European Quality of Life Survey (2012), www.eurofound.europa.eu/surveys/europeanquality-of-life-surveys.

StatLink http://dx.doi.org/10.1787/888933908856

The benefits of the Internet for social connections are most likely the result of online social activity. Figure 2.25 shows the **percentage of Internet users who have accessed social network sites** within the last three months. Social network usage among Internet users is highest in Iceland, where almost 90% of users have accessed a social network site in the last three months, and is lowest in France, where only slightly over 40% of users did so. Age is a strong predictor of social network use. While 84% of young people (aged 16-24) in the OECD use online networking sites, the same share among 55-74 year-olds is just 31%.

Figure 2.25. Use of online social networking sites, 2017 or latest available year

Share of individuals accessing social networking sites in the last three months



Note: Data refer to 2016 for Australia, Israel and Japan, and to 2012 for Canada and New Zealand. Data for Australia, Israel, Japan, Korea, New Zealand and the United States are not strictly comparable to those for other countries due to differences in reference periods (the last 12 months in the case of Australia, Canada, Japan, Korea and New Zealand; the last 6 months in the United States). The OECD average is population-weighted.
Source: Based on OECD *ICT Access and Usage by Households and Individuals* (database), http://oe.cd/hhind.

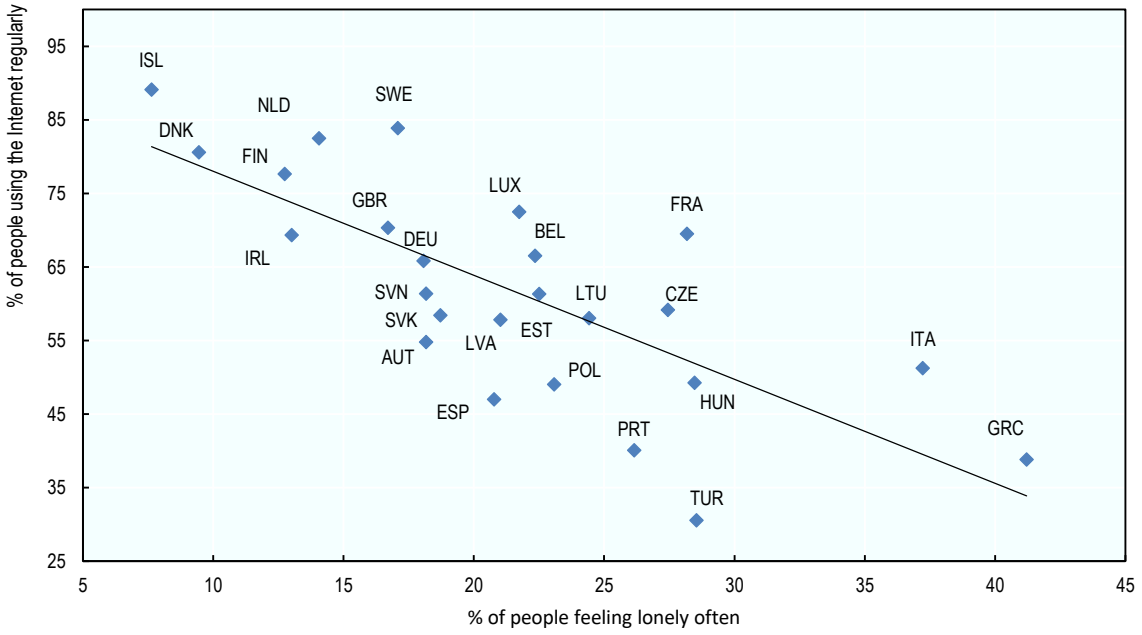
StatLink http://dx.doi.org/10.1787/888933908875

The Internet may help people overcome loneliness and social exclusion

Kraut et al. (1998) suggest that people with good pre-existing social skills will particularly benefit from online social networks, whereas those with limited social skills may only feel more excluded. By contrast, Hamburger and Ben-Artzi (2000) argue that introvert people actually benefit more from the Internet as it removes some of the barriers of traditional social interactions. Across countries, there is a strong inverse cross-country relationship between Internet use and loneliness, with people living in countries with higher levels of Internet penetration experiencing lower levels of loneliness (Figure 2.26).

One area that should be highlighted is in the potential decrease in loneliness among older adults who use digital technologies. Social isolation is a major and growing problem for the elderly, as a result of higher life expectancy in old age, lower number of offspring, and patterns of living. A growing body of evidence points to the beneficial role that the Internet and online social networks can play to overcome loneliness among the elderly. Feelings of loneliness also have detrimental effects on their health outcomes, for example in relation to dementia (Holwerda et al., 2012). The Internet can also help combating social exclusion for marginalised groups, as the anonymous nature of online interactions can help reduce the barriers to finding people with similar experiences (McKenna, Green and Gleason, 2002).[10]

Figure 2.26. Internet use and self-reported loneliness



Note: People using the Internet at least once a week, and share of people reporting to feel lonely more than "some of the time".
Source: OECD calculations based on wave 3 of the European Quality of Life Survey (2012), www.eurofound.europa.eu/surveys/europeanquality-of-life-surveys.

StatLink http://dx.doi.org/10.1787/888933908894

Discrimination against minority groups using hate speech

On the other hand, social media platforms and other online fora also provide a space for negative social interactions given the comparatively lower barrier to participation than in the case for real life interactions. Because of the Internet's anonymous or detached nature, people may engage in negative social behaviour more easily than in real life. Online harassment, discrimination against some population groups, or even criminal offences can be facilitated by social media platforms and may be as, if not more, harmful as offline. Little data exists on the prevalence of these types of harmful online behaviours across countries (see next section on Governance and civic participation). As regards discrimination, an analysis based on machine learning of 19 million tweets in the United Kingdom identified almost 5 million cases of misogyny during the four-year period of the study (Ditch the Label, 2016).

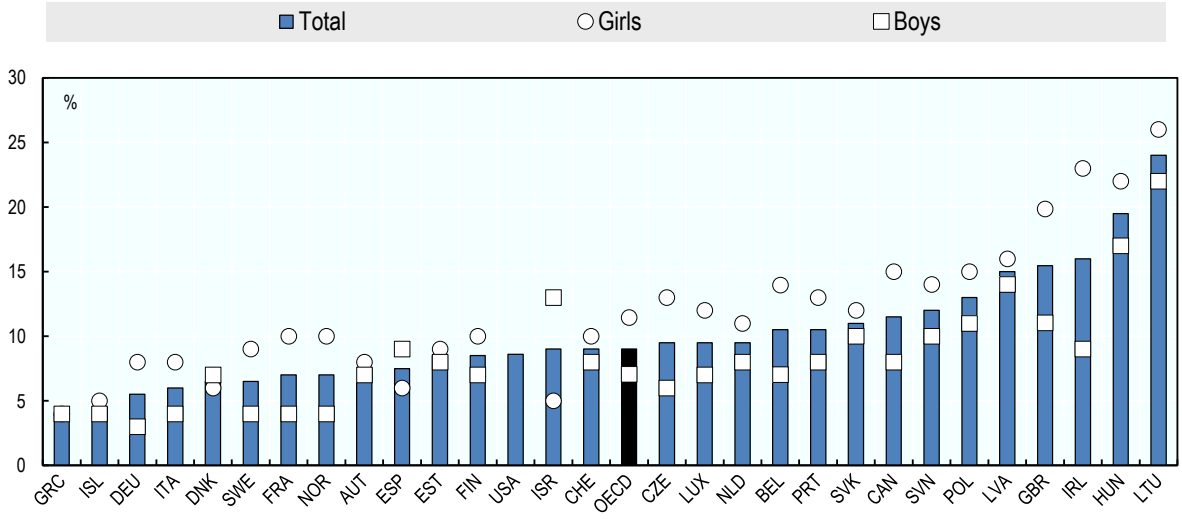
Cyberbullying and online harassment can negatively impact the social experiences of children

Bullying can have detrimental consequences for children's mental health and subjective well-being and can, in extreme cases, lead to suicide (Juvonen and Graham, 2014). Cyberbullying can be more harmful than traditional forms of bullying because the reach of humiliation is expanded to a large audience online, and because words and images can remain online indefinitely (Nixon, 2014). The link between cyberbullying and mental health problems has been extensively documented (Elgar et al., 2014; Mirsky and Omar, 2015; Lindert, 2017).

Measuring the prevalence of cyberbullying is difficult. Most surveys rely on self-reported information, which face inherent problems as victims may not be willing or able to report. Figure 2.27 presents the latest data on **children experiencing cyberbullying** from the Health Behaviour in School-Aged Children (HBSC) survey. Although this is the best source of data on this phenomenon, these data may underestimate cyberbullying rates if children do not feel comfortable answering survey questions in the school environment.[11] On average, 9% of 15-year-olds reports having experienced cyberbullying at least once in their life, with girls reporting victimisation more often than boys in all countries except in Denmark, Israel and Spain. Cyberbullying is particularly prevalent in a number of Eastern European countries and in Ireland and the United Kingdom. Conversely, children in Greece, Iceland and Germany report relatively few instances of cyberbullying.

Figure 2.27. Children experiencing cyberbullying, 2014 or latest available year

Share of 15-year-olds who report to have been bullied through online messages at least once in their life



Note: Percentage of girls and boys aged 15 who report that they have been cyberbullied by messages at least once in their life. For the United States, self-reported cyberbullying covers a wider range of experiences, including being the subject of hurtful information online, experiencing private information shared online, and cyberbullying while gaming. Data refer to 2013 for the United States. Data for the United Kingdom is a population-weighted average from England, Scotland and Wales. Data for Belgium is a population-weighted average from Flanders and Wallonia. The OECD average is population-weighted.
Source: OECD calculations based on Health Behaviour in School-Aged Children Study (2014), www.hbsc.org/news/index.aspx?ni=3473 and the United States School Crime Supplement of the National Crime Victimization Survey (2013), www.icpsr.umich.edu/icpsrweb/NACJD/studies/34980.

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Governance and civic engagement

New avenues for information and communication online are changing the way that individuals and governments express themselves and communicate with each other, receive and disseminate information and interact in the provision and uptake of public services. The consequences of these changes are complex: while people's expression of their political opinions online is a form of increased engagement in democratic and political processes, it may also increase polarisation of political views, spread

misinformation and compromise people's trust in institutions. At the same time, increased transparency of the government through open data may contribute to accountability and trust. The Internet has also opened up new ways for governments to provide services to citizens through e-government and digital government.

Increased engagement of citizens in civic and political communities

A healthy political system requires a public sphere that allows people to express their opinions, challenge the government, and engage in policy-making processes. This public sphere can serve as a place for deliberation or exchange of ideas as well as a venue for interest groups to exert influence over the political system (Grömping, 2014). The digital transformation has extended the public sphere by allowing people to express themselves politically and engage in political communities online, both on social media as well as on dedicated platforms (e.g. forwarding e-mails, sharing opinions about politics and current events, engaging with politicians on social media pages, joining collective actions online; Di Gennaro and Dutton, 2006). The Internet has been instrumental in capturing the attention of formerly disengaged voters, as witnessed for example in both Barrack Obama and Donald Trump's presidential campaigns as well as in political parties on all sides of the spectrum in Italy, Brazil, Israel and other countries (Heaney, Newman and Sylvester, 2011; Campante, Durante and Sobbrio, 2013).

In principle, the extension of citizens' engagement in societal and political communities online is an opportunity of the digital transformation. Online engagement can draw more people into the political debate, as it requires fewer resources to participate and removes traditional barriers. The idea that online exposure to political debates increases political engagement finds support in studies that have found positive associations between the online exposure to political discussions and offline political participation (Gil de Zúñiga, Molyneux and Zheng, 2014). The Internet also allows people to exert pressure on political processes through online petition platforms such as Change.org[12] or Avaaz[13] as well as through government-backed political participation platforms such as DemocracyOS[14] in Argentina (Mancini, 2015). Conversely, it has also been suggested that online political engagement may crowd out traditional forms of political participation (Christensen, 2011).

Minority groups may particularly benefit from opportunities to express their voices online. The Internet has allowed people from all walks of life not only to get news online but also to create content, motivated by a human need for self-expression (Krishnamurthy and Dou, 2008). According to traditional social psychology, people engage in protest to express grievances stemming from relative deprivation, frustration or perceived injustice (Berkowitz, 1972; Gurr, 1971; Lind and Tyler, 1988), and the Internet may serve as an exhaust to express these emotions and engender change. For example, both the #MeToo movement and the Black Lives Matter movement in the US had a strong online component. According to a large study on social media activism conducted by the Pew Research Center, over half of black social media users in the United States considered social media as personally important for expressing their political views (Pew Research Center, 2018b). In France, the Yellow Vests movement has emerged and diffused on the internet.

While there may be personal psychological benefits to political engagement online, the idea that online action has positive real world outcomes is disputed. While the Arab Spring was often cited as an example of the democratising power of the Internet (Wheeler, 2006), subsequent events in the Arab World engendered more scepticism on

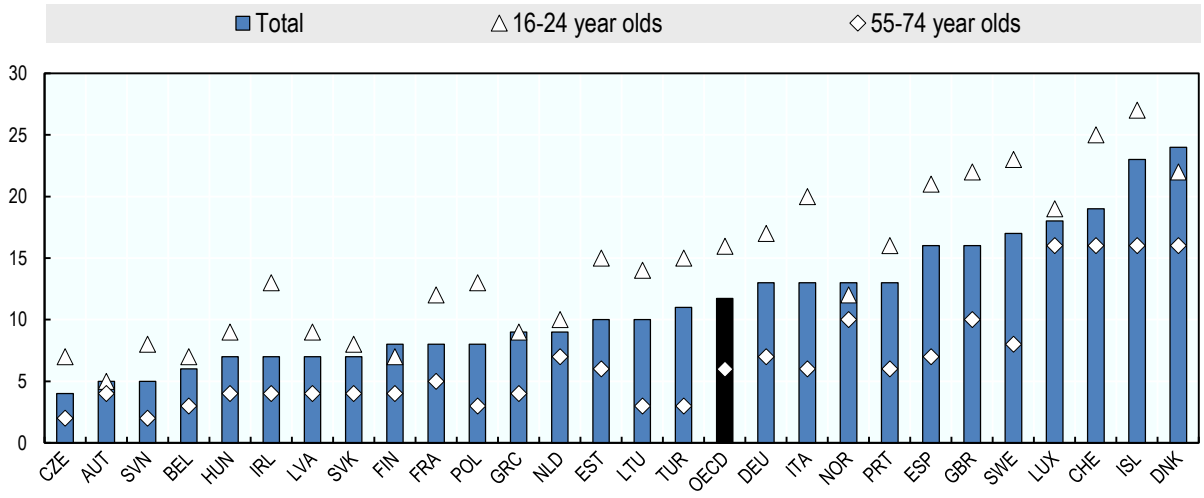
the role of online platforms in empowering people. While historically, social movements were characterised by offline organisation, social media make it possible for individuals to rally around a particular cause in an ad hoc, bottom-up way before making their voice heard "in real-life". For example, the April 2018 strikes of teachers across several US states built momentum through Facebook, giving citizens agency in their relationship between themselves and with the state (Slocum, Hathaway and Bernstein, 2018).

One often-cited drawback of the Internet is that the online platforms may act as echo chambers that limit people's exposure to alternative views. This would inhibit the Internet's capacity as a place of deliberation in the public sphere, and lead to increased political polarisation. Such views rely on the finding that people rarely seek out information that opposes their own and that their online interactions may filter information that corresponds to their views (e.g. Grömping, 2014). But recent studies that consider multiple media outlets (as opposed to single-platform studies) have suggested that most people are not in echo chambers, and that the majority actually uses the Internet to broaden their horizon (Dubois and Blank, 2018). It is also tempting to ascribe the increasing popularity of populists to social media and new campaign strategies facilitated by the Internet. But critics point out that the causes of populism are much more complex than that, and that online campaigning strategies are used across the political spectrum, not just by populist parties (Postill, 2018). More research is actually needed to untangle the complex relationships between the use of digital technologies and the formation of political views.

The issue of political engagement online is complex and the role of digital technologies in transforming political processes cannot be easily compared across countries. It is possible, however, to consider the extent to which **people engage in civic and political discussions online**. Comparable data on the online expression of political opinions exists for several European countries. In all these countries, the share of individuals using the Internet for posting opinions on civic or political issues is less than a quarter of the population (Figure 2.28). Online engagement is most common in Denmark, Iceland and Luxembourg, with fewest people active in online political discussions in the Czech Republic, Austria and Slovenia. Young people are substantially more engaged in political discussions online than the older generation, suggesting that different pockets of the population may engage with political issues in different ways.

Figure 2.28. People expressing political opinions online, 2017

Share of individuals posting opinions on civic or political issues online in the last three months



Note: Share of individuals posting opinions on civic or political issues via blogs, social networks, etc. in the last three months.
Source: OECD calculations based on Eurostat (2017), *Digital Economy and Society* (database), http://ec.europa.eu/eurostat/web/digital-economy-andsociety/data/comprehensive-database.

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Changes in information channels and the spread of disinformation may lower people's trust in others and in the government

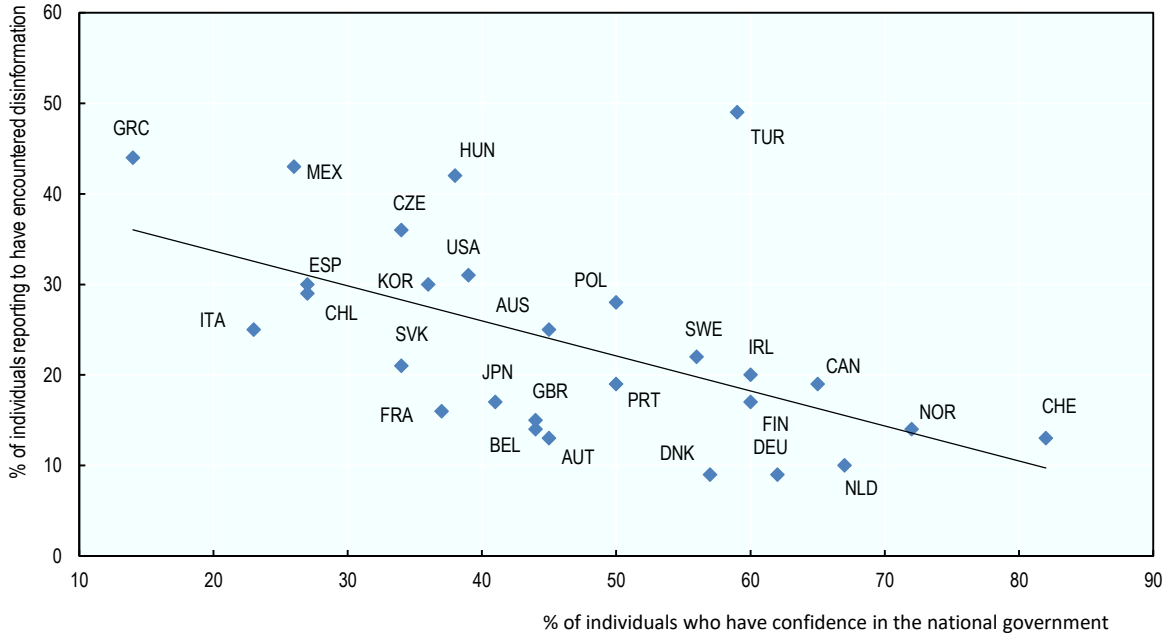
The Internet and social media have not only changed the way people express themselves, but also how they access information about societal and political issues. According to a recent survey, 38% of individuals in OECD countries used Facebook as a source of news in the previous week (Newman et al., 2018). In several countries, the digital transformation and changes in how people get information have coincided with a sharp decline in people's trust in traditional media and the government. The strongest evidence of this decline occurred in the United States, where trust in the media fell from 72% in 1976 to around 50% at the turn of the century, and to 32% in 2016. Meanwhile, people's trust in the federal government in the United States is at an all-time low of 18% in 2017 (Pew Research Center, 2017). This pattern does not hold, however, for all OECD countries, and the mechanisms through which new sources of information (and disinformation) impact trust in institutions are still poorly understood.

The Internet's disruptive force in the relations between the public, the media and the government is likely to be significant. Contrary to traditional media such as newspapers and the television, the Internet allows information to be instantly updated at low cost (Best and Krueger, 2005). Lazer et al. (2018) point out that this has disrupted the role of media as providers of objective and balance information that emerged in response to the widespread use of propaganda during the First World War. While the Internet harbours an opportunity for democracy (by enabling outsiders to challenge existing political norms and give a voice to people that were previously underrepresented), it also challenges the will and ability of voters to base their political judgments on facts, as opposed to false or overly simplistic messages, which Internet tends to spread (Persily, 2017).

One widely discussed medium through which this occurs is the spread of (unintentional) misinformation and (intentional) disinformation.[15] Disinformation is effective because humans are inherently ineffective at recognizing deception and show confirmation bias (Rubin et al., 2015). The combined uptake of social media and low trust in traditional media create in some countries an optimal environment for disinformation to spread (World Economic Forum, 2013). However, the impact of disinformation on democratic outcomes has not been proven. Persily (2017) points out that the observation that disinformation exists does not prove its impact, and that almost no research exists on the long run impact of disinformation. Alcott and Gentzkow (2017) calculated that for disinformation to have swayed the most recent US presidential election, a single deceptive article would need to have the same effect as 36 television ads, which is indicative of the continued dominance of the television as a source of information.

It is equally unclear whether the Internet and disinformation are (partially) responsible for declining levels for trust in institutions in some countries. One study found that the consumption of news from online sources is associated with higher trust in government, but information from social media is associated with lower trust (Ceron, 2015). In addition, while trust in government has declined over time in some countries, this is not the case for all OECD countries, and many have seen recent rebounds of trust in government recently (OECD, 2017f). There does seem to be a relationship, however, between the level of exposure to disinformation and trust in government across countries (Figure 2.29). Self-reported experiences of disinformation are higher in countries where trust in government is lower. It is unclear whether this negative relationship is the result of lower trust due to disinformation, of respondents in less trusting countries being more aware of disinformation sources, or perhaps of deeper institutional and societal factors that steer countries to different equilibria of good governance, trust and resilience against disinformation.

Figure 2.29. Self-reported exposure to disinformation and confidence in the government



Note: Share of individuals who report having come across stories that are completely made-up for political or commercial reasons in the last week.
Source: Reuters Institute Digital News Report, Reuters Institute for the Study of Journalism, http://media.digitalnewsreport.org/wp-content/uploads/2018/06/digital-news-report-2018.pdf?x89475 (accessed on 6 November 2018).

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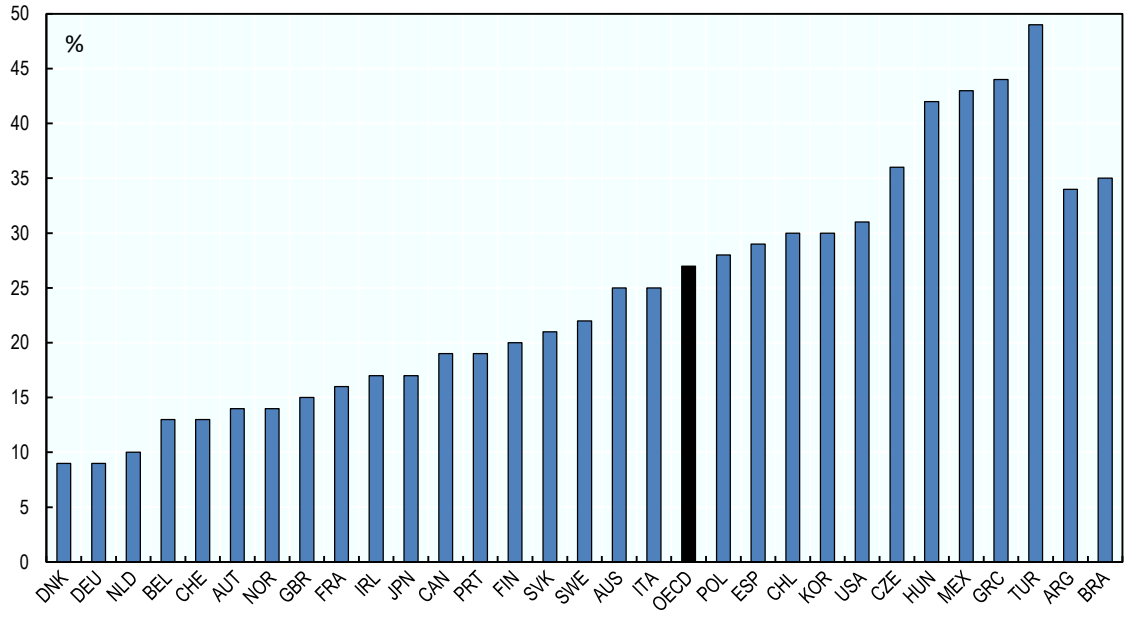
Variation in **self-reported exposure to disinformation** among OECD countries is surprisingly high, with more than a third of people indicating to have been exposed to disinformation in Greece, Mexico and Hungary, as opposed to less than 10% in Denmark, Germany and the Netherlands (Figure 2.30). This variation suggests that societal and political factors may be more conducive to the spread of disinformation. It should also be noted that the measurement of self-reported disinformation is contingent on the assumption that people's ability to identify disinformation is equal across countries. Indeed, it is possible that people are more likely to self-report experiences of disinformation in countries with lower levels of trust in traditional media. If this is the case, self-reported exposure to disinformation may represent an environment of distrust in information sources, rather than the spread of actual misinformation per se.

Figure 2.30. Self-reported exposure to disinformation, 2018

Share of individuals who say they were exposed to completely made-up news in the last week



Note: Share of individuals who report having come across stories that are completely made-up for political or commercial reasons in the last week. The OECD average is population-weighted.
Source: *Reuters Institute Digital News Report*, Reuters Institute for the Study of Journalism, http://media.digitalnewsreport.org/wp-content/uploads/2018/06/digital-news-report-2018.pdf?x89475 (accessed on 6 November 2018).

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Open data allows for improved transparency and accountability of government

One way in which the digital transformation can mitigate potential declines in people's trust in institutions is by encouraging greater openness of governments to share information that was previously hidden from the public eye. One of the most significant contributions of the digital transformation in the experience of government is through information on government processes and decisions disseminated via government websites. By opening up data on expenditures, actions and outcomes, governments can increase transparency and support greater accountability of their decisions. Beyond strengthening the interaction between government and citizens, digital technologies can also move countries towards an "open state", where the "executive, legislature, judiciary, independent public institutions, and all levels of government" work towards an open government culture (OECD, 2017g; Box 2.5), thereby strengthening trust in public institutions and reinforcing civic engagement.

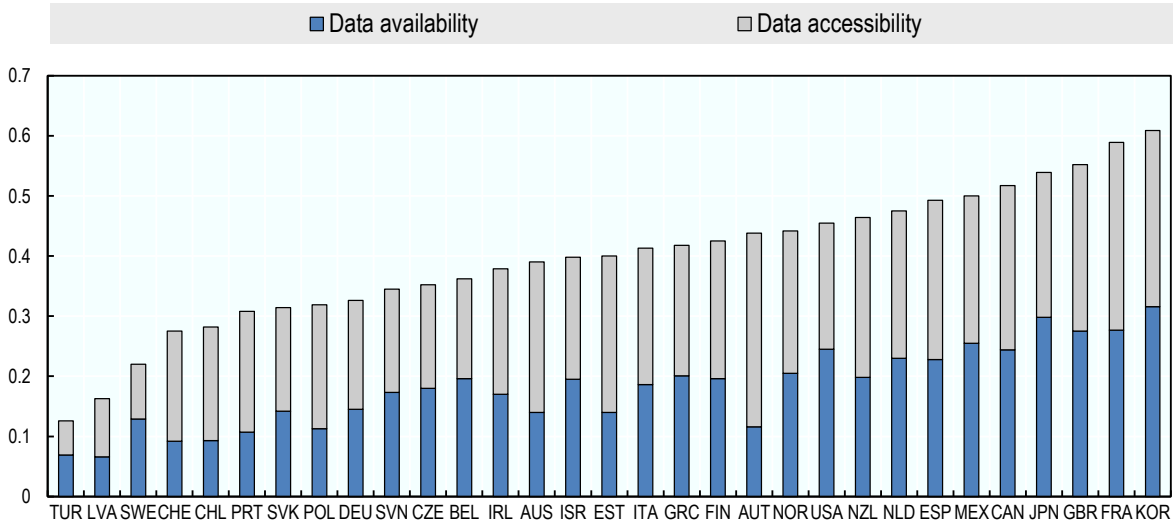
Box 2.5. The OECD Recommendation on Open Government

Digital technologies enable governments to renew their interaction with citizens to an extent and a scale impossible beforehand. The digital era may also encourage a renewal of democracy that puts direct approaches and deliberation at its heart. Online platforms allow governments to interact with citizens from all corners of the country and to publish government information, creating new possibilities for stakeholder participation and transparency. In this sense, governments are moving to what the **OECD Recommendation on Open Government** calls a "culture of governance that promotes the principles of transparency, integrity, accountability and stakeholder participation in support of democracy and inclusive growth" (OECD, 2017g). By adopting an open government culture, civic engagement is put at the heart of government's interaction with their citizens, thereby enhancing their well-being. Large-scale online consultations on legislation and rule-making are now a common feature in OECD countries. Citizens may also be called upon to provide their views on investment decisions in their communities through participatory budgeting projects, empowering them to be actors in their communities' developments.

The OECD OURdata Index assesses governments' efforts to implement **open data** in the three critical areas: openness, usefulness, and re-usability of government open data (Figure 2.31). The index is based on responses provided by public officials in member countries on government efforts to ensure that public sector data are available and accessible to citizens, and to spur a greater re-use of this data (Ubaldi, 2013). Among countries for which data is available, Korea, France and Japan seem to perform particularly well in providing access to open government data to citizens. The Korean government has taken a number of initiatives to improve access to open data by passing national laws on open data and organising specific events to help citizens make use of available data.

Figure 2.31. Open government, 2017

OURdata Index scores in the dimensions of data availability and accessibility



Note: The OURdata Index assesses governments' efforts to implement open data. "Data availability" and "Data accessibility" are two out of three dimensions of the composite OECD OURdata index (1 = max), which also includes "Government support to the reuse" of data. "Data availability" aggregates information on the content of the open-by-default policy, stakeholder engagement for the prioritisation of data release, and availability of strategic open government data (OGD) on national portals (e.g. national election results, national public expenditures or the most recent national census). "Data accessibility" aggregates information on the availability (and implementation) of formal requirements on the publication of OGD with an open licence, in open formats (e.g. non-proprietary) and accompanied with the descriptive metadata, as well as on stakeholder engagement for data quality. Data are sourced from the OECD Survey on Open Government Data conducted in November and December 2016. Respondents were predominantly chief information officers in OECD countries. Responses represent officials' own assessments of current practices and procedures regarding OGD. Data refer to central/federal governments and exclude OGD practices at the state/local levels. Data for Hungary, Iceland and Luxembourg are not available. Denmark does not have a Central/federal data portal and is therefore not included in the figure.
Source: OECD OURdata Index on Open Government Data, www.oecd.org/gov/digital-government/open-government-data.htm.

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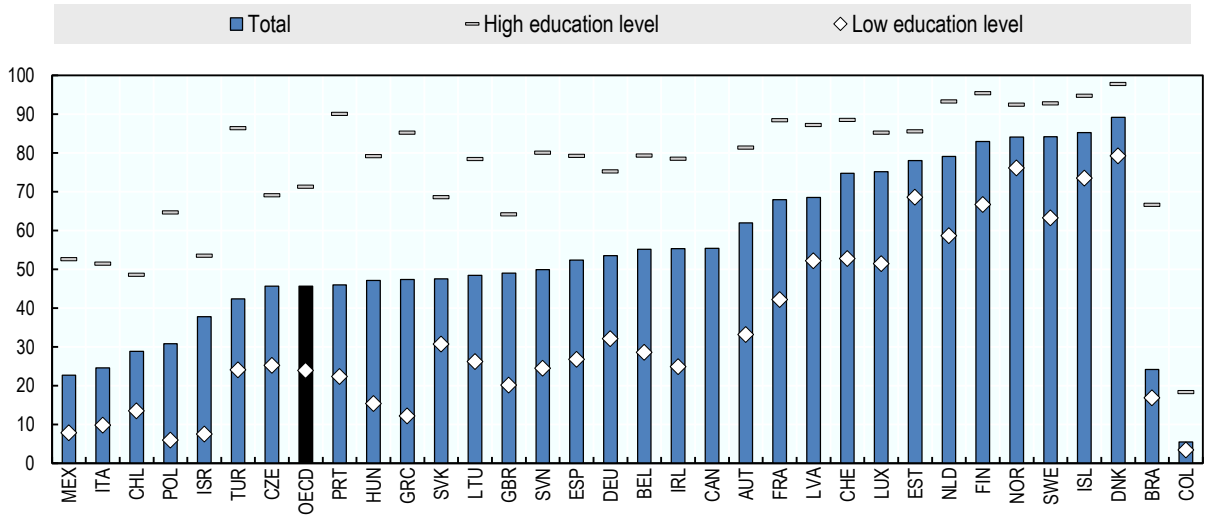
Digital technologies can improve government service delivery

Digital government strategies provide an opportunity for governments to improve the delivery of public services and foster better ties with citizens at different stages of the policy-making cycle. This is particularly important for minority groups and people who rely heavily on government support for their livelihoods, for whom improved service delivery may require access to new information, benefits, and ways to get their voices heard. In the early stages of the Internet, e-government services focused on providing specific services to citizens, ranging from the digital collection of taxes, payments of fines and dues, applications for public benefit programmes, permits and licenses, and more (Warf, 2014). Recently, governments have been implementing digital strategies in a more integrated manner in order to encourage citizen involvement (OECD, 2017g). Digital government involves a more strategic use of digital tools, using both technological and organisational innovations in government administrations in order to improve their accountability and reliability.

Use of **e-government services** has become widespread in a number of OECD countries (Figure 2.32). In the Nordic countries, the Netherlands and Estonia, at least three quarters of the population reports to interact with public authorities online. In a second group of countries (e.g. Germany, Spain and the United Kingdom), e-government services exist and are used by about half of the population. Across the OECD, 46% of individuals reported to have made use of e-government services in the past year, indicating that while e-government services are more frequently used than in the past, digitalisation of government services is still to work in process.

Figure 2.32. Use of e-government services, 2017 or latest available year

Share of individuals using the Internet for visiting or interacting with public authorities' websites in the last 12 months



Note: Data refer to 2016 for Israel and to 2012 for Canada. Results from Israel and Mexico are not strictly comparably due to differences in methodology. The OECD average is population-weighted.
Source: Based on OECD *ICT Access and Usage by Households and Individuals* (database), http://oe.cd/hhind.

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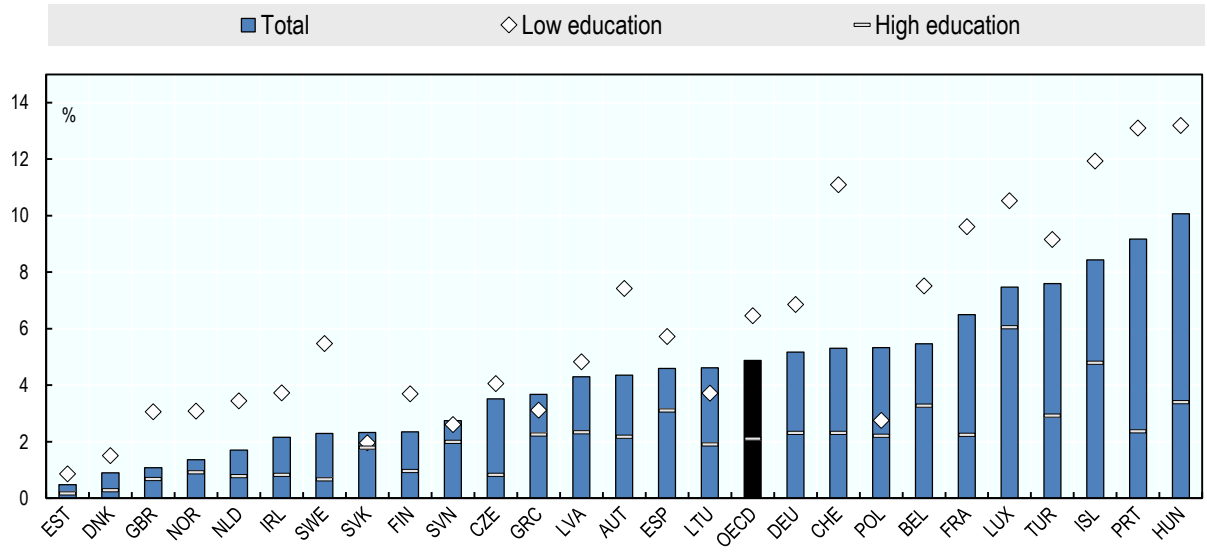
Exclusion from digital government services due to lack of skills

While digital government offers opportunities for improved service delivery and increased engagement of citizens in government processes, inequalities in digital skills inequalities pose a challenge for the fair distribution of these benefits, excluding from these digital services some of the groups that could benefit the most. For example, the Dutch Council of State recently issued a warning to the government that it risked excluding citizens from accessing certain public services if it completely replaced traditional service provision by digital government platforms. Spire (2018) has found similar results for France especially in rural areas. In addition, many governments face difficulties in successfully implementing digital government platforms. One World Bank study suggested that up to 87% of public ICT projects could be considered as failures or partial failures (World Bank, 2016). Not only does the delivery of poor quality services impede the well-being of citizens who cannot consume services but it also damages the social contract with the state, undermining the trust that might otherwise exist.

While reasons for not making use of e-government services include not having the need to, preferring the real life contact, not trusting the online service, **lack of skills is a key barrier for individuals in accessing e-government services** (Figure 2.33). In a number of European OECD countries for which this data is available, 5% of respondents did not access e-government services due to lack of skills, a share that reaches 10% in Hungary. In Estonia, a country where the government has implemented a comprehensive digital strategy, fewer than 1% of respondents indicated lacking the skills needed to use e-government services, even among people with low education. Lack of skills inhibits low educated people to access e-government services significantly more often than the more educated.

Figure 2.33. Lack of skills as a barrier to accessing e-government services, 2017

Share of individuals who did not submit forms online to public authorities due to lack of skills or knowledge in the last 12 months



Note: The OECD average is population-weighted.
Source: Based on OECD *ICT Access and Usage by Households and Individuals* (database), http://oe.cd/hhind.

StatLink http://dx.doi.org/10.1787/888933909027

Personal security

Personal (and public) security is one of the primary challenges posed by the digital transformation for individual well-being (Gluckman and Allen, 2018). In the absence of effective regulatory, legal and ethical frameworks, Internet users and organisations can be exposed to substantial economic, social, emotional and even physical risks. Trust in digital tools and applications are essential for reaping the well-being benefits of the digital transformation. This is particularly the case when it comes to the protection of personal data. While individuals are very concerned about their privacy online, they are not always able to protect their personal data adequately themselves. The increased pervasiveness of digitalisation in everyday life also means that digitally powered tools may interfere with people's physical security.

Digital security incidents may compromise people's online safety and compromise trust

Online security risks are likely to have a more indirect impact on the well-being of individuals than offline (physical) security threats. While the economic risks of online security threats are significant, the primary well-being risk of cyber-security risks is in acting as a deterrent for people to take advantage of the benefits that the digital economy offers. If people do not feel secure online, they will be more reluctant to engage in the digital economy, inhibiting this from unlocking its full potential. In other words, diminished trust may impede the effectiveness of digital solutions. According to various surveys in North America and Europe, trust and concerns about digital security are a growing concern for individuals (OECD, 2015c).

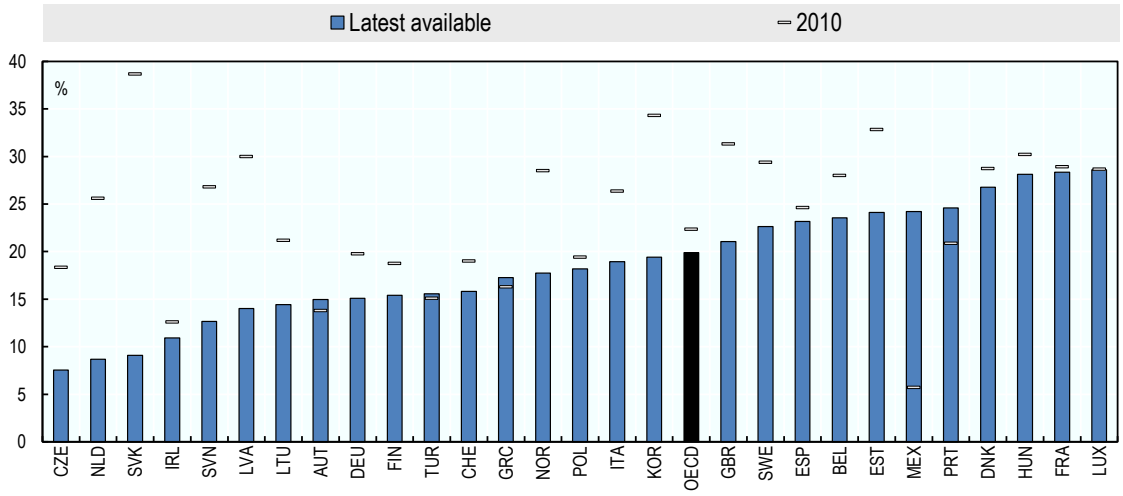
A similar trade-off takes place at the societal level, where digital opportunities are weighed against the security risks that they present. In the health-care sector threats to digital security stand in the way of taking full advantage of the benefits of digitalisation (Büschel et al., 2014). Electronic health records and digitally enabled health devices have much potential to improve health outcomes; however, their uptake partly depends on the ability of health care providers to secure new digital medical devices. While no malicious cases have been reported yet, there are concerns over the potential of cyber-security threats to essential medical devices such as automatic insulin pumps or pacemakers (OECD, 2013; Sametinger et al., 2015). The benefits of such devices for individuals thus depend on the capacity of health care providers and governments to guarantee their security.

Governments are also increasingly conscious of the necessity of securing essential infrastructures against privacy threats. Several malicious online practices have targeted governments, businesses and individuals, motivated by profit-making, activism ("hacktivism"), political goals, espionage and sabotage (OECD, 2012). In a 2014 OECD survey, governments identified such security threats as their second highest priority area in the realm of the digital economy, out of 31 possible areas (OECD, 2015c). While such cyber-attacks primarily target large organisations, individuals also face indirect consequences, which may again compromise their trust.

The measurement of cyber-security risks is challenging as online criminal activity may go unnoticed and because there is no centralised reporting mechanism for small-scale online security incidents. To measure individual experiences of cyber-security threats, self-reports remain the most reliable technique, despite possible limitations in how respondents understand these questions. In addition, high self-reports may reflect the efforts of respondents to raise awareness on cyber-security issues, rather than high prevalence of online security threats per se. Figure 2.34 shows **the share of individuals who report having experienced an online security incident** in the last three months. On average, about one in five people in OECD countries reported to have experienced a cyber-security incident, with higher shares in France, Luxembourg and Hungary. People in New Zealand, the Czech Republic and the Netherlands report the least number of incidents.

Figure 2.34. Online security incidents, 2017 or latest available year

Share of individuals who report having experienced security incidents in the last 3 months



Note: Latest available data is 2015 for all countries, except for Korea and Mexico (where latest data is 2017) and Chile and Switzerland (2014). For Korea, data refer to experience of online security threats for both private and business purposes, and the reference period is 12 months. For Mexico, the following categories are considered: "virus infection", "excess of unwanted information", "fraud with information (financial, personal, etc.)" and "violation of privacy". For Switzerland the reference period is 12 months. The OECD average is population-weighted.
Source: Based on OECD *ICT Access and Usage by Households and Individuals* (database), http://oe.cd/hhind.

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Individuals are at risk of data privacy violations in various domains

One aspect of digital security that is particularly important for individuals and that may have direct consequences for their well-being is the protection of people's personal data. Concerns about privacy online have naturally emerged from the increasing amount and diversity of personal data generated as a result of digitalisation, and of the increasing fluidity of data across geographies, organisations and systems (Büschel, 2014). Surveys indicate that this is a main concern for individuals in most OECD countries. A large majority of Europeans, according to a Eurobarometer poll, are worried that their personal information is not kept secure by websites, and 85% of them think that the risk of becoming a victim of cybercrime is increasing (European Commission, 2016). Similarly, 91% of Americans think that consumers have lost control of their personal information and data (OECD, 2015c).

Data privacy concerns stem from various forms of abuse of personal data, including national identity data (see Box 2.6), which occur both outside and within the law. The past years have seen multiple cases where personal data of large numbers of individuals were exposed as a result of a malicious attack, poor data security, or accidental publication of user data. Such data breaches have become increasingly prevalent, with the UK government estimating that 81% of large British organisations suffered a security breach in 2014 (UK Department for Business Innovation and Skills, 2014), and the Canadian Office of the Privacy Commissioner reporting that the number of data breaches more than doubled during the 2013-14 fiscal year (OECD, 2017h).

However, these breaches of data are not the only reason why people are growing increasingly concerned about the security of their personal data. The improved capacity of companies to use big data analytics to make predictions about people's preferences and behaviour can lead to psychological, emotional, economic or social harm to individuals (Kshetri, 2014). As an example, Facebook Likes have been shown to predict personal characteristics such as sexual orientation, ethnicity, religious and political views, personality traits, intelligence, happiness and potential addictions (Kshetri, 2014; Crawford and Schultz, 2013). Such "predictive privacy harm", if used for the wrong reasons, can carry significant risk for people's physical safety and mental health, contributing to people's growing unease about the potential abuse of their personal data.

Box 2.6. Digital identity

People's digital identity is one of the areas where the tension between government's concerns about security and citizen's privacy is most obvious. Governments often needs simple means of confirming the identity of a citizen, and in many countries this has led to the establishment of a central database of citizen's information. As the digital transformation allows the delivery of increasingly sophisticated and secure services that remove the need for face-to-face interaction, these databases have become common in many countries. However, they are also an attractive target for criminals.

In India, the national ID database Aadhaar, contains biometric identity data for more than 1.1 billion citizens. Anyone in the database can use their data, or thumbprint, to access private services like bank accounts or companies like Amazon; whilst membership is optional, those who are not enrolled cannot access basic government services. Despite repeated criticism about vulnerabilities of the platform, and an inadequate approach to information security, the Indian government has so far failed to enact legislation to protect the data of its citizens (Dixon, 2017).

Within the European Union, the electronic IDentification, Authentication and trust Services (eIDAS) regulation provide standards to enable interoperability of identity. This model enables the reuse of an identity verified according to one government's approach in accessing a service provided in another country, thereby supporting freedom of movement across the Union.

Digitalisation and inter-connection of national identity databases present a well-being trade-off for citizens who lack trust in the security of their private data. When government services become exclusively available to citizens who have a digital identity, this compromises people's feelings of online security or exclude them from important government services.

While privacy concerns are well-founded in the light of big data breaches and potential privacy harm, the extent of people's worries has been challenged by the observation of a paradox between the concerns that they indicate in survey questions and their online behaviour. This privacy paradox has been illustrated by empirical evidence showing that individuals are often willing to sell personal information for relatively small rewards (Kokolakis, 2017). One study has found that Internet users value items of their browsing history at about EUR 7, much less than they value offline personal information such as age and address (Carrascal et al., 2013). People generally felt positive about their personal information being used to improve services, but negative at the idea that this information might be sold by service providers.

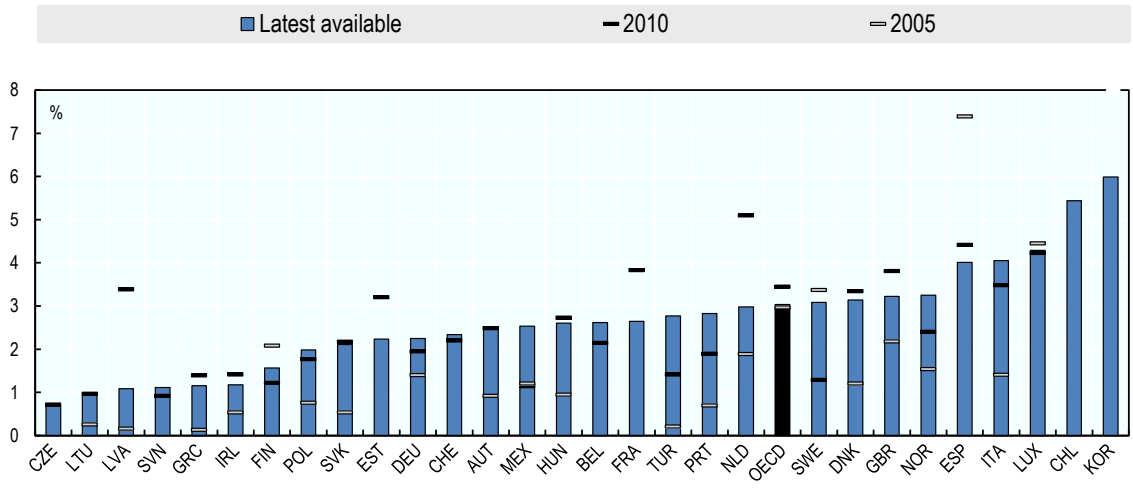
Privacy preferences also show a large heterogeneity across countries, age groups, and over time. Cultural norms may also affect the degree to which people value privacy across countries (Ardichvili et al., 2006). For example, East Asians are more careful about disclosing sensitive personal information than Westerners (Lin et al., 2013). People in more individualistic societies (such as the United States) have also been found to have lower privacy preferences than people in more collectivistic ones (such as Germany; Bellman et al, 2004). Moreover, privacy preferences are likely to change over time, with the generation of digital natives having different preferences for sharing information than older generations (Elahi, 2009).

Data-driven innovation has also increased the risk that privacy breaches could inflict economic, psychological and social harm to individuals. At the same time, the speed of the digital transformation and the rise of Big Data (together with a lagged regulatory response) do not allow strong conclusions on the well-being impacts of privacy concerns. While some researchers have argued that privacy concerns could diminish in the future, others have made the case that survey results on privacy concerns show "an undervaluation of privacy as a social value" (Hallinan, Friedewald and McCarthy, 2012). Given the incomplete understanding of self-reports, this section focuses on cross-country measures on privacy violations experienced by individuals.

Figure 2.35 shows that **personal experiences of abuse of private information,** as measured by self-reported violations, is relatively rare in most OECD countries: on average, 3% of individuals, report having experienced an online privacy infringement incident, with higher shares (above 5%) in Korea and Chile. These self-reported measures inform about the prevalence of digital security incidents, but not on their severity.

Figure 2.35. Online privacy abuses, 2017 or latest available year

Share of individuals who report having experienced an abuse of private information on the Internet in the last 3 months



Note: Latest available data is from 2015 for all countries, except Korea and Mexico (2017), and Chile and Switzerland (2014). Prevalence of privacy abuses was much higher in the past in Korea (17% in 2010 and 18% in 2005. For Mexico, data refers to "fraud with information (financial, personal, etc.)" online. Korean data include both private and business purposes; the reference period is 12 months. The OECD average is population-weighted.
Source: Based on OECD *ICT Access and Usage by Households and Individuals* (database), http://oe.cd/hhind.

StatLink http://dx.doi.org/10.1787/888933909065

Blockchain may enhance the safety of transactions and information exchange

While the digitalisation of information exchange in areas like health, government and economic interactions can pose threats to individuals' security and privacy, technologies themselves offer potential solutions to improve digital security. One emerging technology that could improve security gains in the future is Blockchain (i.e. distributed ledger technologies), a decentralised database of information allowing networks of actors to safely conduct transactions and exchange information between each other, without the risk of corruption of data. This is because evolutions of the data are available to all blocks of the chain, and each transaction is recorded and must be approved by every node in the network. In addition, the encryption of the data makes any infringements of personal data highly unlikely. The benefits of these technologies can have numerous different applications. For example, blockchain technologies have already been used to record ownership of land parcels, in public procurement processes and even in ensuring the integrity of election processes. Finally, blockchain has been at the core of crypto-currencies, which have proved to be useful already for cross-border payments, and may have a utility for cross-machine payments in the internet of things. On the other hand, crypto-currencies have also been used for criminal purposes such as money laundering and tax evasion.

Environmental quality

The environmental impact of the digital transformation can take a number of forms, both positive and negative. From a measurement perspective, estimating this impact is challenging for several reasons. Establishing a link between digital technologies and environmental outcomes such as air pollution is difficult, given the many different contributing factors to such outcomes. This section therefore focuses on impacts that relate to the use of resources in human consumption and production systems that have a negative environmental impact. This assessment is informed by a large body of literature that suggests that the production and consumption of technological products and the associated resources that are required to power these processes both have a substantial ecological impact and contribute to observed changes in the climate system (Cook et al., 2016; IPCC, 2013).

Higher energy efficiency and de-materialisation of consumer products can lower energy and resource use

The impacts of digital technologies on the environment can be classified in three ways (Berkhout and Hertin, 2004). First, direct impacts of the increased use of digital technologies refer mostly to the increased use of resources associated with the production and consumption of digital products and are therefore mostly negative. Second, indirect effects stem from the improved efficiency and de-materialisation of technological, but also on the demand effects associated with falling prices and the proliferation of ICT devices used in daily life. Finally, the digital transformation may induce structural societal and behavioural effects that result from fundamental changes in society and the economy. This section presents evidence mainly on the direct and indirect effects of the digital transformation, suggesting that the current and predicted impacts of the digital transformation are likely to weigh more heavily on the environment than its effects in relieving existing pressures.

Digitalisation of production processes and consumer goods allows for substantial efficiency gains. Modern production systems rely on a variety of digitally-enabled

technologies such as electronic sensors, microprocessors, optimising algorithms that reduce resource costs between 1 and 2% per year (Berkhout and Hertin, 2004). Similarly, Computer Assisted Design has brought about large efficiency gains since the 1990s, for example by reducing the use of aluminium in drink cans by about 50% (Berkhout and Hertin, 2004). More recently, improved analytics facilitated by Big Data have allowed efficiency gains in organisational processes (Bengtsson and Agerfalk, 2011). Other emerging technologies, such as 3D printing and industrial robots, which both rely heavily on advanced intelligent systems, are projected to generate further resource efficiency gains (IEA, 2017).

Efficiency gains also take place in the consumption of goods and of energy by consumers. The heating, lighting and powering of residential and commercial buildings uses up over two-thirds of all electricity used in industrialised countries, and smarter systems powered by sensors allow for reductions in this area (Berkhout and Hertin, 2004). The digital transformation has also led to the de-materialisation of parts of the entertainment industry as consumption of music, books and films increasingly rest on virtual media. Another example of de-materialisation due to digital technology is the replacement of a large range of individual products, such as the digital camera, radio, music player, calculator, flash light and the telephone by the smartphone. Transport is another area where energy efficiency gains are expected in the future as a result of the uptake of automated, connected, electric and shared (ACES) mobility (IEA, 2017). Such technologies could reduce energy usage by improved navigation and driving efficiencies.

Digital technologies generate rebound effects that increase energy use

However, it is unclear whether the *relative* efficiency gains in resource use described above more than offset the impact of *absolute* increases in the demand for new and existing products. Starting with the former, digital technologies simply involve the creation of a range of new producer and consumer products that require physical and energy resources. Between 2006 and 2016, the number of Americans that owned multiple ICT devices has grown from 73% to 95% (Baldé et al., 2017). ICT products consist of a large number of components, from micro-chips, semiconductors and circuit boards to liquid crystal displays and batteries. A typical personal computer may contain 1 500 to 2 000 components sourced from around the world (Berkhout and Hertin, 2004).

The expansion of the Internet of Things and of the networks and data centres that support it also lead to growing energy demands, with estimates of this increase depending on scope and underlying assumptions. Osburg and Lohrmann (2017) estimate that ICT-related power consumption will increase in Germany from 59.6 TWh in 2010 to over 90 TWh in 2020. Others have calculated that the electricity consumed by digital devices is growing more than twice as fast than global electricity demand (van Heddeghem et al., 2014) and that globally, ICT electricity consumption will rise to 21% of total consumption in 2030, a four-fold absolute rise since 2010 (Andrae and Edler, 2015). Blockchain is also increasing electricity demand; the computing power for encryption associated with the Bitcoin network (blockchain's most well-known application) now approaches the electricity consumption of Ireland (De Vries, 2018).

In addition, energy and resource savings associated to the consumption of immaterial goods are likely to increase demand for material (technology) products. This rebound effect results from lower resource prices due to greater efficiency and new demand stimulated by the better management of time, money, labour and infrastructure (Berkhout and Hertin, 2004). For example, projections of the impacts of ACES mobility vary from a

45% decrease in road transportation energy demand to a doubling of demand, depending on the indirect demand side effects that allow private travellers to spend more time in their car as a result of increased comfort and reduced driver burden (Wadud, MacKenzie and Leiby, 2016). Another example that illustrates the complexity of understanding the environmental impacts of digital technologies are e-books, where environmental gains depend on the quantity of paper books replaced by an electronic model, the duration of use of the device, and other factors (Gensch, Prakash and Hilbert, 2017).

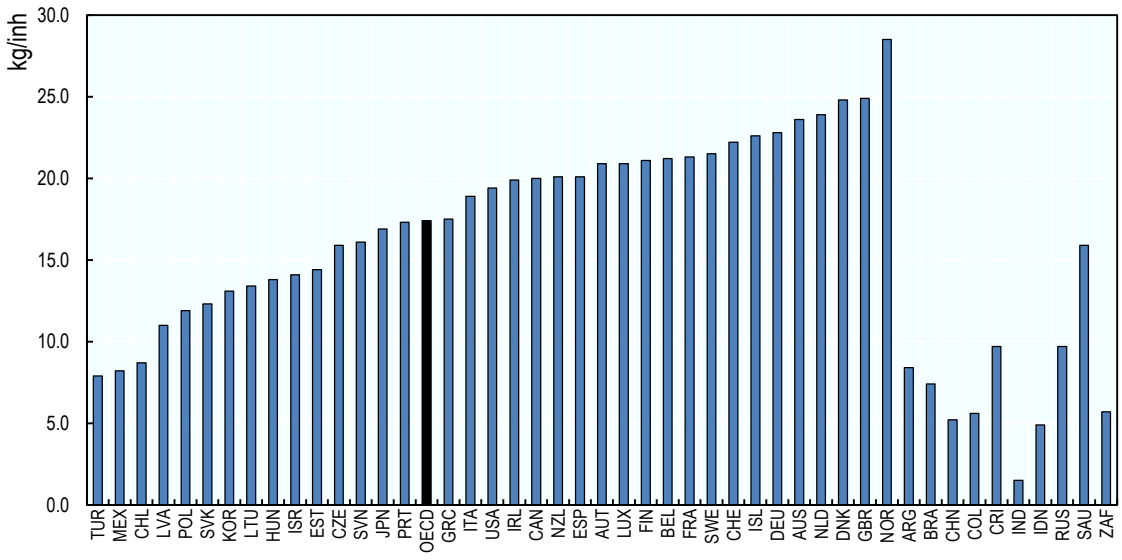
Increased waste of electronic products

Electronic waste or e-waste is one measurable impact of the digital transformation in the dimension of Environmental Quality. While smartphones have now replaced a previous generation of digital cameras, calculators and other electronics, this advantage is reduced by the larger number of digital devices that are used by individuals, businesses and governments, and by the rate at which digital devices are replaced. The environmental impact of producing digital equipment is significant, and is much higher than the cost of its use – the manufacturing of a smartphone accounts for 73% of its carbon emissions (Greenpeace, 2017). Osburg and Lohrmann (2017) estimate that replacing an electric device with a device that is 10% more efficient will offset the environmental impact from the new device only after 33-89 years. However, the average replacement cycle of smartphones is estimated at about 21.6 months per device in the US and 20.4 months in a number of European countries (Kantar Worldpanel, 2016).

These consumption patterns represent a substantial environmental burden. The Global E-Waste Monitor collects data on **e-waste generated per capita** across countries (Figure 2.36). Globally, e-waste has increased over time in absolute numbers as well as per capita, and this trend is projected to continue. In 2016, 44.7m metric tonnes of e-waste were generated with only 20% of all e-waste being collected and recycled (Baldé et al., 2017). Available data suggests that e-waste generation is highest in the United Kingdom, Denmark and the Netherlands, where individuals produce almost 25kg of e-waste per person per year. In Turkey, Mexico and Chile, e-waste generation is below 10kg. The partnership behind the Global E-Waste Monitor also notes the poor quality of official statistics on e-waste and calls for improved international harmonisation on this front.

Figure 2.36. E-waste generated per capita, 2017

E-waste in kg per inhabitant



Note: E-waste generated per inhabitant per country. E-waste refers to waste generated by the following product types: temperature exchange equipment; screen and monitors; lamps; small equipment; and small IT and telecommunication equipment. The OECD average is population-weighted.
Source: Baldé, C. et al. (2017), "The global e-waste monitor 2017: Quantities, flows and resources, international telecommunication union", United Nations University (UNU), International Telecommunication Union (ITU) & International Solid Waste Association (ISWA), Bonn/Geneva/Vienna, www.itu.int/en/ITU-D/Climate-Change/Documents/GEM%202017/Global-E-waste%20Monitor%202017%20.pdf (accessed on 20 July 2018).

StatLink http://dx.doi.org/10.1787/888933909084

Housing

Housing is important for well-being to meet basic human needs such as shelter from bad weather and to provide people with security and privacy. In addition, poor housing conditions, whether due to overcrowding or in the form of health hazards due to poor building standards, can be detrimental for people's health and mental well-being (Balestra and Sultan, 2013). The digital transformation can do little to improve or detract from the function of housing in facilitating these needs. However, smart home appliances can increase the efficiency of people's home management, contribute to energy savings and comfort in the home. It is arguable, however, that some of these functions are not essential for people's well-being, and that the contribution of digital technologies to better housing conditions remains to be analysed.

Smart Home Technologies can improve house management

The Internet of Things (IoT) technology is expected to change people's life at home through the interconnection of familiar appliances (e.g. washing machines, television, sound systems) that are made "smarter" through the inclusion of sensors and other AI softwares. The diffusion of this technology is still in its infancy and related data is not

available yet, which is why no indicators of the impacts of digitalisation on housing are included in Table 1.2.

OECD (2018b) outlines the key benefits and risks associated with IoT in the "smart home". Benefits for users include: 1) smart residential systems are more convenient as some household tasks can be automated; 2) they improve energy efficiency as they are able to cut on unnecessary energy consumption (e.g. at night); 3) they provide enhanced home security and safety regarding physical threats; 4) and they allow for a high degree of customisation as devices respond to user preferences. On the other hand, IoT devices raise some risks for smart home residents, such as data privacy, cybersecurity threats, limited interoperability, the need for lifetime product support, complex supply chains, liability regimes, and product safety.

Subjective well-being

Digital technologies have transformed people's lives in every dimension, but have they all contributed to a better life in the eyes of people themselves? This section discusses the positive and negative associations between digital technologies, in particular the Internet, and the life satisfaction component of subjective well-being (Box 2.7). The empirical evidence suggests that people with access to the Internet enjoy a higher life satisfaction than people without access to the Internet, even when controlling for income and education. The results presented in this section, however, should be interpreted with caution: positive associations are based on cross-sectional data and do not imply a causal relationship between digital technology use and subjective well-being, even if the empirical framework controls for a significant number of individual characteristics such as income, education, age, gender and labour force status. In particular, these results do not claim that well-being has increased as a result of the emergence of digital technologies. Rather, they show evidence that people who are more digitally connected report higher levels of life satisfaction.

Internet access is associated with higher life satisfaction

It is difficult to assess the long-term impact of the Internet and digital technologies on life satisfaction due to the lack of long-term panel data that includes variables on Internet access and use. However, a number of studies have attempted to estimate this relationship using cross-sectional data (Dolan, Peasgood and White, 2008; Kavetsos and Koutroumpis, 2013; Graham and Nikolova, 2012; Lohmann, 2015). These studies find a consistently positive relationship between internet use and life satisfaction at the individual level. Most of these studies look at the relationship between life satisfaction and Internet access or use variables. Penard, Poussing and Suire (2013) expanded the Luxembourg European Values Survey with more detailed questions on the frequency of Internet use, finding a generally positive relationship between Internet use and life satisfaction, and no difference in the positive effect between heavy and light users of the Internet.

Box 2.7. Subjective well-being measures and the digital transformation

To better understand the potential effects of digital technologies on subjective well-being, it is important to distinguish between three components of subjective well-being: *life satisfaction*, an evaluation that people make of their life as a whole, *affect*, a term used to describe people's emotional states (positive and negative) at a point in time, and *Eudaimonia*, which refers to people's ability to reach their potential and their assessment of the meaning and purpose of their life (OECD, 2013).

Life satisfaction

Life satisfaction is a measure of people's satisfaction with their life as a whole. It is closely related to the economist's concept of utility, but affected by the way people recall life experiences. It is a useful measure to compare experienced quality of life between different population groups or across countries. A body of research has shown that most differences in life satisfaction between nations are explained by differences in objective life conditions, such as health outcomes, education, personal relationships and income (Diener, Inglehart and Tay, 2013).

Affect

Affect captures the joys and sorrows of day-to-day life and is most closely related to what people may describe as happiness at a given moment in time. Positive and negative affect measure how people experience live at a given moment, rather than how they remember it. Differently from life satisfaction, affect is a multi-dimensional measure and has at least two distinct dimensions: positive and negative.

Eudaimonia

Eudaimonic well-being refers to people's psychological flourishing and the extent to which they can attain a degree of self-actualization. This is the least studied component of subjective well-being, and few studies have explored the relationship between Internet access and eudaimonic well-being. Eudaimonic well-being is less well understood than the other components; it is not clear, for example, whether it is a uni-dimensional concept or represents a range of related concepts (OECD, 2013).

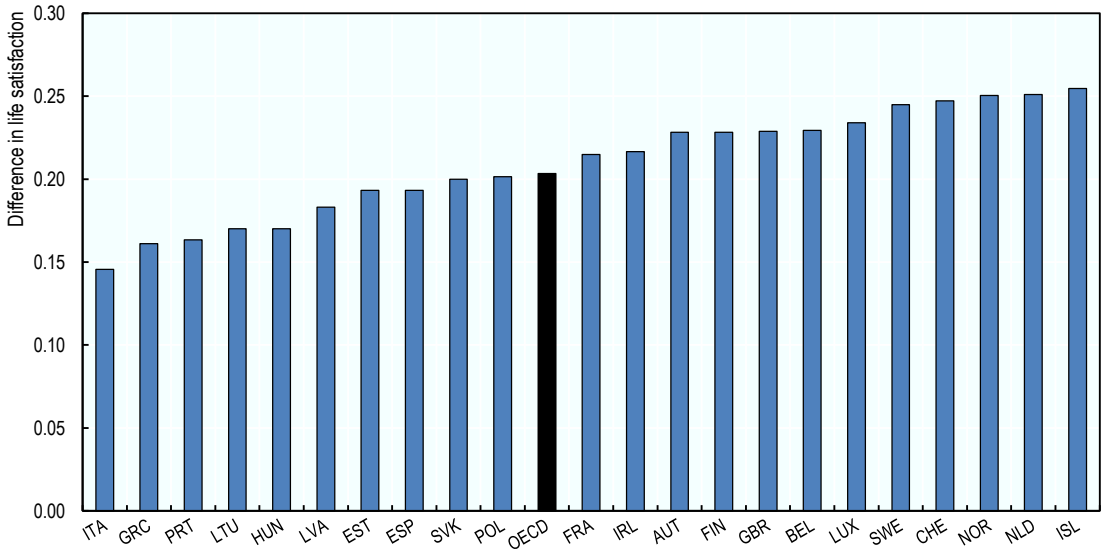
In these studies, multiple pathways are described through which Internet access may affect life satisfaction. Newly accessible goods and services providing indirect and direct benefits are a potential reason for which the Internet may increase life satisfaction (Hong, 2007; Penard, Poussing and Suire., 2013). The benefits of social networking sites on social relationships are another often mentioned potential source of increased life satisfaction (Valenzuela, Park and Kee, 2009; Pittmann and Reich, 2016; Apaolaza et al., 2013). Chan (2015) shows that voice and online communication on mobile phones also have positive associations with subjective well-being through increased bonding and bridging social capital. Finally, there may be indirect pathways through which the Internet would increase subjective well: increased flexibility of work, improved access to medical and governmental services, the ability to find romantic relationships online, or opportunities of gain new knowledge and skills through online courses.

An analysis using microdata from the 2013 EU-SILC Well-being module suggests a positive relationship between Internet use and life satisfaction in European countries, consistent with findings from previous studies. The EU-SILC Well-being module

includes a self-reported question on Internet access alongside measures of subjective well-being and a large range of demographic covariates, which allow estimation of the **life satisfaction gains associated with Internet access**. A full explanation of the empirical strategy and results is in Annex 2.A. The analysis shows that people with Internet access report a life satisfaction 0.28 points higher (on a 0-10 scale) than those who lack access to the Internet. Figure 2.37 reports the effect on life satisfaction when the population moves from zero to the current level of Internet access. By construction, countries with the highest number of self-reported Internet connections, such as Iceland, the Netherlands or Norway, rank highest in terms of life satisfaction benefit.[16, 17]

Figure 2.37. Potential gain in life satisfaction due to Internet access, 2013

Estimated increase on the life satisfaction scale by country, European countries only



Note: Life satisfaction gains are calculated based on the coefficient of Internet access on life satisfaction multiplied by the number of people who report to have Internet access in each country. See Annex for more information.
Source: OECD calculations based on EU-SILC (2013), http://ec.europa.eu/eurostat/web/income-and-living-conditions/overview.

StatLink http://dx.doi.org/10.1787/888933909103

Notes

[1] Data is from 2017 or latest available year. Average does not include Australia, New Zealand and the United States. The OECD average is population weighted. Source: OECD Information and Communication Technology database, 2017.

[2] These figures are for 2017. Source: OECD Information and Communication Technology database.

[3] Scores for the problem-solving proficiency in technology-rich environments task are classified in four levels: Below Level 1 through Level 3. In addition to these four proficiency levels, there are three additional categories (no computer experience, failed ICT core and opted out) for those

adults who were unable to demonstrate their proficiency in this area due to a lack of basic computer skills needed to complete the assessment.

[4] The consumer surplus refers to the difference between the price that consumers are willing to pay for a specific product and the actual price they pay for the product.

[5] The results for task discretion are in line with those of Salvatori, Menon and Zwysen (2018).

[6] The extended job strain index (OECD, 2017i) is a composite measures of the quality of the working environment that considers a larger number of job resources and job demands (6) compared to the index included in other OECD reports (3).

[7] Importantly, this means that the indicator of job stress associated with computer-based jobs does not reflect any potential cross-country variation in the extent to which computer-based jobs increase job stress. It is conceivable that in some countries, computer-based jobs have a higher impact on job stress than others due to workplace policies and cultural factors. These differences are not taken into consideration in this indicator.

[8] Similar to the indicator on job stress, this means that the indicator of worries about work when not working associated with computer-based jobs does not reflect any potential cross-country variation in the extent to which computer-based jobs increase worries outside work hours. It is conceivable that in some countries, computer-based jobs have a higher impact on worries about work when not working than others due to workplace policies and cultural factors. These differences are not taken into consideration in this indicator.

[9] In the case of the television, a large body of research also supports the displacement hypothesis that television crowds out social interactions (Kraut et al., 1998; Putnam, 2000; Frey, Benesch and Stutzer, 2007; Bruni and Stanca, 2008). This effect is particularly strong for individuals with low levels of self-control over their own behaviour and for people who watch excessive amounts of television (Frey, Benesch and Stutzer, 2007). Not only does the television depress the frequency of social interactions, but it also has significantly negative effect on life satisfaction (Bruni and Stanca, 2008).

[10] For example, McKenna and Bargh (1998) found that finding support online increases the possibility of coming out in real life for homosexuals.

[11] The KidsOnline survey is another survey that focuses on children's online behaviour; it includes a confidential section that is filled out at the parental home, which may be a safer space to self-report bullying. However, this survey is currently only available for EU countries and therefore has limited comparability.

[12] Change.org, www.change.org (accessed on 31 January 2019).

[13] Avaaz: the world in action, https://avaaz.org/page/en/ (accessed on 31 January 2019).

[14] DemocracyOS: change the tool, Democracia en Red, http://democracyos.org/ (accessed on 31 January 2019).

[15] Disinformation is defined as all forms of false, inaccurate, or misleading information designed, presented and promoted to intentionally cause public harm or for profit (European Commission, 2018).

[16] This figure therefore does not show cross-country variation in the strength of the association between life satisfaction and Internet use. The reported variation across countries only reflects differences in Internet access. Since Internet is consistently found to be associated with higher levels of life satisfaction, this figure reflects an illustration of the life satisfaction gains associated with Internet access.

[17] Several authors have suggested that Internet access may provide the greatest benefits in life satisfaction at the lower end of the income distribution (Graham and Nikolova, 2012; Penard, Poussing and Suire, 2013). An interaction term between the logarithm of household income and the access to Internet variable in the model confirms that the relationship is stronger at the lower end of the income distribution and diminishes with increasing income. This finding has different interpretations. Thanks to the Internet, people with lower incomes may benefit from services that were previously inaccessible to them, which is not the case to the same extent for people in higher incomes, who had access to such services even without Internet. However, it is also possible, as mentioned above, that Internet access does reflect an uncaptured income or wealth effect.

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Annex 2.A. **Internet access and life satisfaction**

The European Statistics on Income and Living Conditions (EU-SILC) instrument contains detailed data on living conditions for participating European countries. The 2013 Well-being Module includes a set of self-reported well-being questions alongside a question on Internet access. Similar to other large survey vehicles, the Internet-related question is not very detailed and in this case does not specify whether the individual uses the Internet, let alone the frequency of use. Internet access is therefore considered a proxy for Internet use, where the potential causal pathways of Internet use on subjective well-being run through any of the dimensions discussed in this paper, from changes in social connections to increased transparency of government to access to education, etc. The overall direction of the effect of Internet access is therefore a product of the relative weight of different negative and positive effects of Internet use on life satisfaction.

To estimate the effects of Internet access on life satisfaction, a standard model of the determinants of life satisfaction is used (Frey and Stutzer, 2005; Helliwell, 2008; Dolan, Peasgood and White, 2008), where Internet access is used as the explanatory variable of interest alongside a set of demographic characteristics as well as country-fixed effects to control for country-level variance in terms of living standards as well as potential cultural determinants of life satisfaction responses (Boarini et al., 2012). This approach does not differ substantially from other studies into the relationship between life satisfaction and Internet access or use (Graham and Nikolova, 2012; Lohmann, 2015). Conceptually, the nature of the life satisfaction variable lends itself best to an ordered probit model. However, Ferrer-i-Carbonell and Frijters (2004) show that coefficients estimated with ordinary least squares (OLS) are very similar and the following model builds upon standard practice that utilises OLS for life satisfaction regressions in order to support the ease of interpretation (Boarini et al. 2012). Therefore, the satisfaction of life scale from 0 (Not at all satisfied) to 10 (Completely satisfied) is used as explanatory variable.

$$Life\ satisfaction_{ic} = \alpha + \beta\ Internet\ connection_i + X_i + \mu_c + \varepsilon_{ic}$$

where the index *ic* denotes a respondent *i* in country *c*, *Internet connection* is a dummy variable that denotes whether the respondent has access to the Internet at home, X_i is a set of individual characteristics including age, gender, marital status, employment status, income and education. Finally μ_c captures country-fixed effects for the countries included.

The risk of overestimating the effect of Internet use on life satisfaction in this model stems from the possibility that having an Internet connection is strongly correlated with other material life conditions that are not captured by household income, such as individual or household assets that facilitate the capability of getting Internet access. For this reason, X_i also includes a measure of financial satisfaction in order to further account for individual differences in material well-being. This way, any effect of Internet access is closer to the actual effect of having and using the access, rather than the ability to acquire it.

Results from the regression are shown in Annex Table 2.A.1. The coefficient of Internet access is positive and significant, indicating that the overall effect of being able to access the Internet on life satisfaction is in fact positive. For all other variables, results are in line with formerly found relationships between life satisfaction and demographic characteristics (Dolan, Peasgood and White, 2008). Column (2) shows that the inclusion of financial satisfaction indeed lowers the estimated effect of Internet access, and this second estimate is used to calculate the country-specific effects. The share of life evaluation that is explained by the model is in line with general outcomes of happiness or life evaluation regressions. Senik (2014) notes that the typical share of happiness explained by observable variables in terms of the R^2 of an OLS estimate is around 10%. The model that includes financial satisfaction has a substantially higher R^2, which is likely partially a result of a shared method variance bias resulting from the similarity in the two questions.

In addition to estimating the effect of Internet access on life satisfaction, interaction variables are included to consider the effect for key demographic groups. These regressions are presented in columns (3-6). Internet access appears to be particularly beneficial for the more vulnerable social groups. The higher people's income, the less benefit they draw from Internet access and the same counts for young people and the highly educated. These are important findings, because they suggest that Internet access may be inequality-reducing than inequality-inducing in a variety of ways. Conversely, women do benefit less from Internet access than men.

Annex Table 2.A.1. Regression results: Internet access and life satisfaction

	(1)	(2)	(3)	(4)	(5)	(6)
	Life satisfaction	Life satisfaction	Life satisfaction	Life satisfaction	Life satisfaction	Life satisfaction
Internet access	0.551***	0.277***	1.108***	0.318***	0.247***	0.279***
	(0.06)	(0.03)	(0.36)	(0.02)	(0.04)	(0.03)
Internet access*log income			-0.089**			
			(0.04)			
Internet access*female				-0.074*		
				(0.04)		
Internet access*old					0.063	
					(0.04)	
Internet access*young					-0.049**	
					(0.02)	
Internet access*low education						0.007
						(0.02)
Internet access*high education						-0.060*
						(0.03)
Log income	0.417***	-0.066***	-0.003	-0.067***	-0.066***	-0.066***
	(0.03)	(0.02)	(0.03)	(0.02)	(0.02)	(0.02)
Age	-0.102***	-0.049***	-0.048***	-0.049***	-0.054***	-0.049***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Age^2	0.001***	0.000***	0.000***	0.000***	0.000***	0.000***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Female	0.122***	0.089***	0.088***	0.144***	0.090***	0.089***
	(0.03)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Married	0.452***	0.319***	0.319***	0.319***	0.318***	0.319***
	(0.05)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)
Separated, divorced or widowed	-0.176***	-0.012	-0.012	-0.015	-0.010	-0.011
	(0.04)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
Unemployed	-0.560***	-0.113***	-0.111***	-0.110***	-0.114***	-0.113***
	(0.08)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)
Retired	0.407***	0.225***	0.224***	0.231***	0.220***	0.224***
	(0.11)	(0.06)	(0.06)	(0.05)	(0.05)	(0.06)
Employed	0.369***	0.226***	0.226***	0.227***	0.232***	0.226***
	(0.09)	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)
Low education	-0.095**	-0.029	-0.030	-0.030	-0.029	-0.032
	(0.04)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
High education	0.146***	0.008	0.014	0.008	0.009	0.063*
	(0.02)	(0.01)	(0.01)	(0.01)	(0.01)	(0.04)
Financial satisfaction		0.481***	0.481***	0.481***	0.480***	0.481***
		(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Country fixed effects	(yes)	(yes)	(yes)	(yes)	(yes)	(yes)
N	242 530	242 530	242 530	242 530	242 530	242 530
R^2	0.159	0.400	0.400	0.400	0.400	0.400

Note: Standard errors in parentheses. *=p<0.10, **=p<0.05, ***=p<0.01. Results obtained using an ordinary least squares regression with robust standard errors clustered by country and survey weights (but not population weights).
Source: OECD calculations based on EU-SILC (2013), http://ec.europa.eu/eurostat/web/income-and-living-conditions/overview.

Finally, the coefficient on Internet access is used to estimate the life satisfaction benefit of Internet access in each country based on the number of people with Internet access as reported in EU-SILC, using the following calculation:

$$Life\ satisfaction\ benefit_c = \beta\ Internet\ connection_i * \sum Internet\ connection_{ic}$$

This estimation of added life satisfaction due to Internet access by country represents the gains in life satisfaction associated with people having access to the Internet (Annex Table 2.A.2). This estimate is somewhat artificial as it compares the life satisfaction benefit of having Internet access between two different groups, rather than between the same group before and after having access. However, it does point to the potential net positive effects that may result from having Internet access and to the importance of policies that bridge the digital divide and ensure that everyone has the possibility to access the Internet.

Annex Table 2.A.2. Life satisfaction gains associated with Internet access for selected countries

Country	Self-reported Internet access	Life satisfaction gains associated with Internet access
Austria	0.82	0.23
Belgium	0.83	0.23
Estonia	0.77	0.21
Finland	0.82	0.23
France	0.77	0.21
Greece	0.58	0.16
Hungary	0.61	0.17
Ireland	0.78	0.22
Iceland	0.92	0.25
Italy	0.52	0.15
Luxembourg	0.84	0.23
Latvia	0.66	0.18
Netherlands	0.90	0.25
Norway	0.90	0.25
Poland	0.73	0.20
Portugal	0.59	0.16
Spain	0.70	0.19
Sweden	0.88	0.24
Switzerland	0.89	0.25
United Kingdom	0.82	0.23

Note: Calculations are made using survey weights.
Source: OECD calculations based on EU-SILC (2013), http://ec.europa.eu/eurostat/web/income-and-living-conditions/overview.

Chapter 3. Comparing well-being in the digital age across OECD countries

This chapter combines the indicators presented in the previous chapter into two synthetic indices of digital risks and digital opportunities. These indices are found to be non-correlated with each other, implying that increased digital opportunities are not necessarily associated to higher digital risks. Digital opportunities are found to be highly correlated with access to ICT, which suggests that providing broad access is a necessary but not a sufficient condition to create opportunities. While digital risks are diverse in nature, the prevalence of digital security incidents is a powerful predictor of other digital risks, as countries' digital maturity and digital strategies can reduce all digital risks while increasing digital security. As analysis based on available indicators is limited due to the lack of harmonised data, this chapter also discuss the statistical agenda going forward.

The statistical data for Israel are supplied by and under the responsibility of the relevant Israeli authorities. The use of such data by the OECD is without prejudice to the status of the Golan Heights, East Jerusalem and Israeli settlements in the West Bank under the terms of international law.

Introduction

The previous chapter exposed the opportunities and risks of the digital transformation in each dimension of people's well-being. While taking stock of all available evidence is a necessary first step, it is useful to synthesise existing information in order to identify countries' strengths and weaknesses in order to inform an adequate policy response. One way to prepare for policy prioritisation and intervention is to draw some international comparison on the extent of digital opportunities and risks. Some countries are able to benefit from the opportunities brought about by the digital transformation, while managing to mitigate its risks. Other countries have embraced the opportunities but also face high risks, and some other countries neither enjoy the opportunities nor face the risks. The analysis starts by building logical clusters of countries, before discussing the underlying dynamics that might contribute to different equilibria.

In practice, this chapter combines the various indicators presented in the preceding chapter to build two synthetic indicators of digital opportunities and risks, which are then used to map countries along these two axes. A first notable result is the complete lack of any cross-country correlation (i.e. 0.00) between overall opportunities and risks. This implies that embracing the opportunities of the digital transformation is not inescapably associated with being exposed to risks. Similarly, countries that have been exposed to few of the opportunities of the digital transformation may still be exposed to high risks.

As a second step, the chapter reviews some of the factors that prominently represent, and partly explain, overall digital opportunities and risks. Opportunities of the digital transformation are found to be highly correlated with Internet access, which suggests that providing broad access is a necessary condition for creating digital opportunities. However, providing access to digital technologies is not a sufficient condition for reaping the benefits of the digital transformation, as individuals also require the right economic, regulatory and cultural conditions to benefit from access.

While the opportunities of the digital transformation are strongly correlated with Internet access, this is not the case for risks. Risks of the digital transformation occur regardless of the degree of digitalisation of the country and seem to depend on other factors. This partially reflects the diversity of risks that the digital transformation brings about. Each risk of the digital transformation is subject to a range of enabling or inhibiting factors. The share of population having experienced digital security incidents is the indicator that most strongly correlates with the overall index of risks of the digital transformation. When trying to explain some of the driving factors of countries' performance, the roles of framing conditions and cultural factors are important. A detailed examination of a country's relative performance is provided in Chapter 4 through the presentation of specific country profiles.

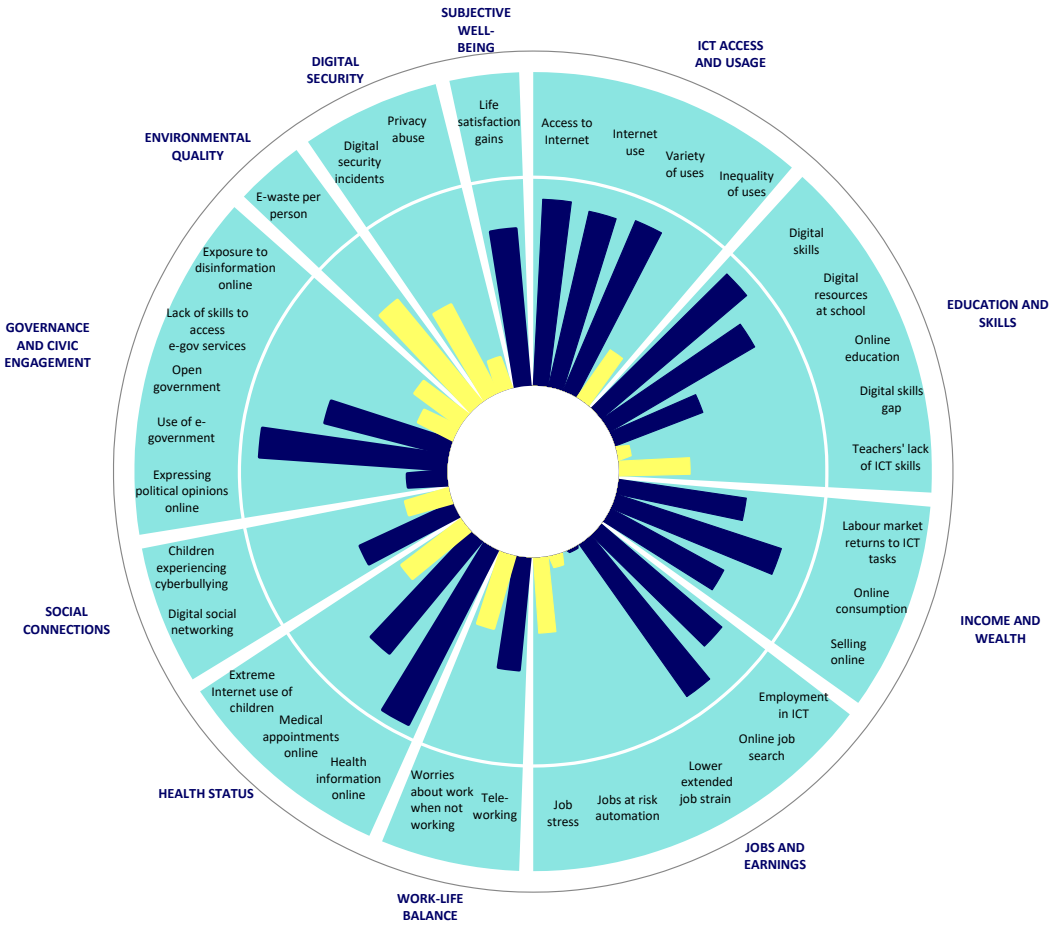
A final, and perhaps most important, finding is that international comparisons are inhibited by a lack of harmonised indicators, so that a strong effort from the statistical community is warranted in the future. The chapter highlights current issues and lays out a concreate statistical agenda going forward.

Evaluating individual country performance

Chapter 2 has presented 33 indicators of opportunities and risks of the digital transformation in the 11 dimensions of well-being and the additional dimension of ICT access and use. While it is important to compare country performance in each of these

dimensions, the large number of indicators makes it hard to synthesise exactly how individual countries are performing across the board. For this reason, one of the key outputs of this report are the digital well-being wheels presented in Chapter 4 for individual countries. These wheels present the performance of an individual country across the 33 indicators relative to other OECD countries. The digital well-being wheel presents opportunities in dark blue and risks in yellow, with longer bars denoting either higher opportunities or higher risks. The first inner circle corresponds to the minimum outcome observed among OECD countries, while the second inner circle corresponds to the maximal outcome. The digital well-being wheel is shown in Figure 3.1 below for Finland. It shows that people in Finland reap a lot of the benefits of digitalisation and are relatively protected from its risks.

Figure 3.1. The digital well-being wheel in Finland



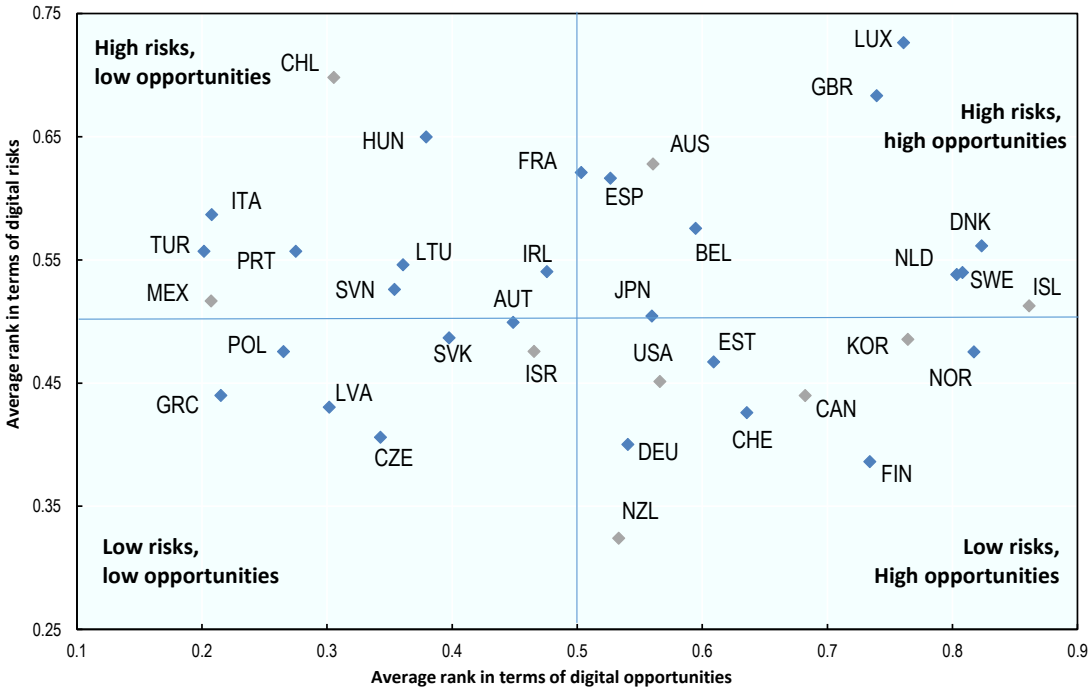
StatLink http://dx.doi.org/10.1787/888933909122

Comparing opportunities and risks across countries

In order to understand countries' relative opportunities and risks related to the digital transformation, a synthetic indicator of digital opportunities is constructed by aggregating the 20 normalised indicators of opportunities across the dimensions discussed in Chapter 2 (ICT access and usage, education and skills, income, consumption and wealth, jobs, work-

life balance, health, social connections, governance and civic engagement, and subjective well-being). For each indicator, countries are scored according to their comparative performance (0 when in the bottom third of all OECD countries, 0.5 when in the middle third of OECD countries, 1 when in the top third of OECD countries). Missing data values are excluded, and ranks are renormalized between 0 and 1 to avoid distortions in case of data gaps. The resulting synthetic index of digital opportunities is calculated as the average score across 20 indicators. A similar procedure is conducted for the synthetic index of digital risks, which encompasses 13 risk indicators across the same dimensions (ICT access and usage, education and skills, jobs, work-life balance, health, social connections, governance and civic engagement, environmental quality and digital security).

Figure 3.2. Comparative analysis of digital risks and digital opportunities across countries



Note: Risks of the digital transformation encompass 13 indicators across 9 dimensions: ICT access and usage, education and skills, jobs, work-life balance, health status, social connections, civic engagement and governance, environmental quality and digital security. Opportunities of the digital transformation are measured through 20 indicators across 9 dimensions: ICT access and usage, education and skills, income, consumption and wealth, jobs, work-life balance, health status, social connections, governance and civic engagement, and subjective well-being. For each indicator, countries are ranked according to their comparative performance such that the country with the lowest values has a score of 0 and the country with the highest outcome has a score of 100. Scores are averaged within dimensions, before then being averaged across dimensions. Missing data values are excluded from each country's score, thus scores may be heavily under- or over-estimated in the case of large data gaps. Countries with more than 10 missing indicators are marked in grey instead of blue.

StatLink http://dx.doi.org/10.1787/888933909141

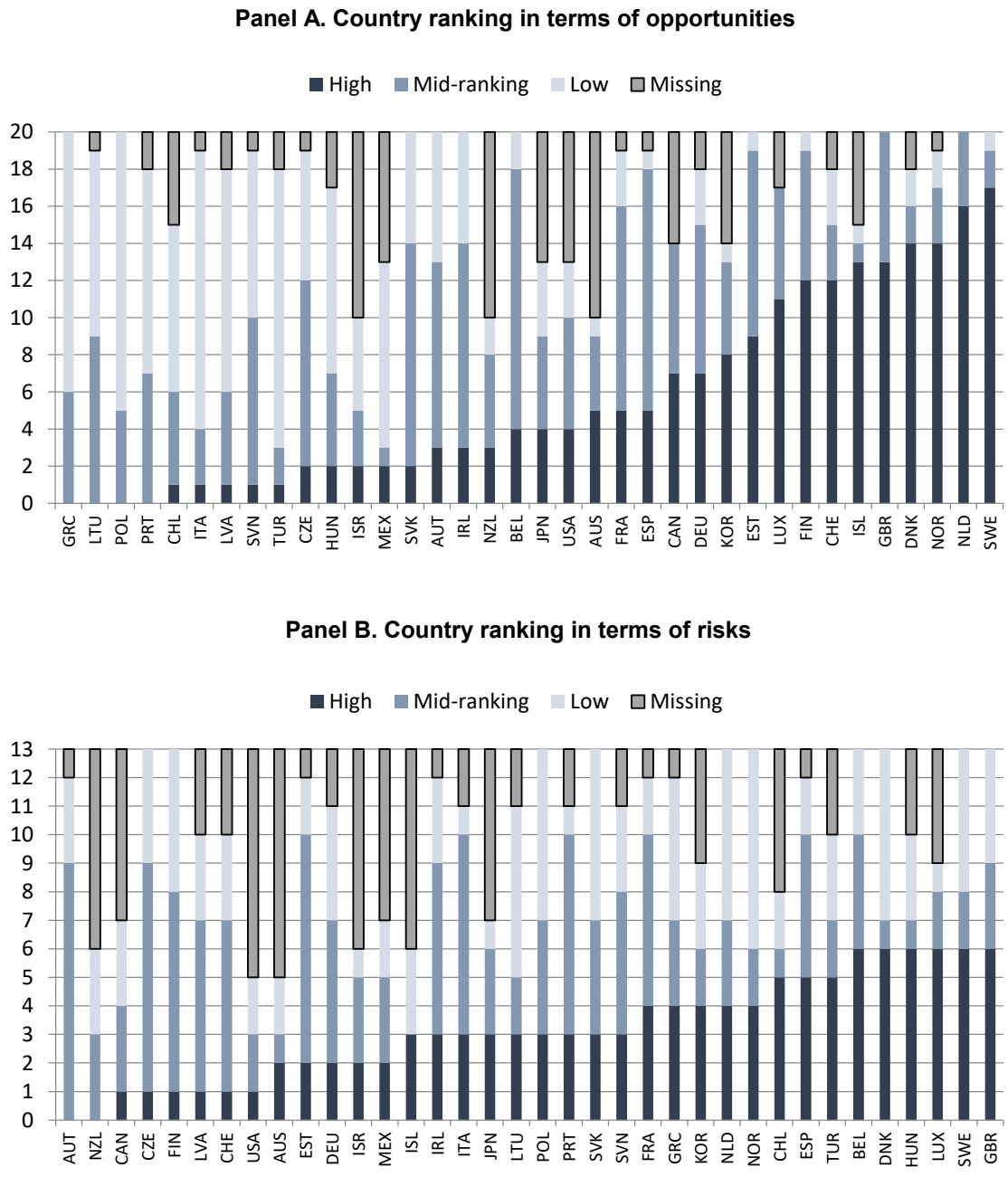
Figure 3.2 depicts the results and maps countries in the dual space of opportunities and risks of the digital transformation. First, it is striking that there is a zero cross-country correlation between digital opportunities and risks (the correlation is actually equal to 0.00). The figure also shows that a number of countries located in the upper-right

quadrant (e.g. Luxembourg, the United Kingdom and, to a lesser extent, Denmark, Sweden and the Netherlands) enjoy high opportunities while at the same time facing high risks. On the contrary, countries such as Greece, Latvia and the Czech Republic benefit less from the opportunities of the digital transformation relative to other countries but also face fewer risks.

However, there are also countries that combine low opportunities with high risks. Countries in the upper left quadrant of Figure 3.2 (notably Chile, Italy and Hungary) have embraced few of the opportunities of the digital transformation, but are exposed to high risks. Other countries in the lower right quadrant (e.g. Finland, Norway, Korea, Canada and Switzerland) combine high opportunities from the digital transformation while avoiding a number of its risks.

Figure 3.3 provides further details on countries' performance and adds information about the number of missing indicators in each area. The highest scores in opportunities (Panel A) are generally in countries with the highest levels of Internet penetration: the Nordic countries, Luxembourg, the Netherlands and the United Kingdom. In these countries, there is a low divide in Internet access and use among different population groups. Many people have access to the services offered by the digital transformation and make use of them. However, there are differences in the ability of these digitally advanced countries to mitigate the risks of the digital transformation. Panel B shows, for instance, that in Sweden and Denmark, high opportunities go together with high risks, while Finland has low risks when it comes to the production of e-waste, the share of children experiencing cyber-bullying or abuses of personal information.

Figure 3.3. Country relative position in terms of opportunities and risks from the digital transformation



Note: These figures show the number of indicators in which the country ranks in the top, mid or bottom third across all available countries. Missing indicators are marked in grey.

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Figure 3.4, Panel A confirms the instrumental importance of Internet access for reaping opportunities for well-being in the digital age. There is a large and significant correlation (0.77) between the average rank in terms of overall digital opportunities and the share of

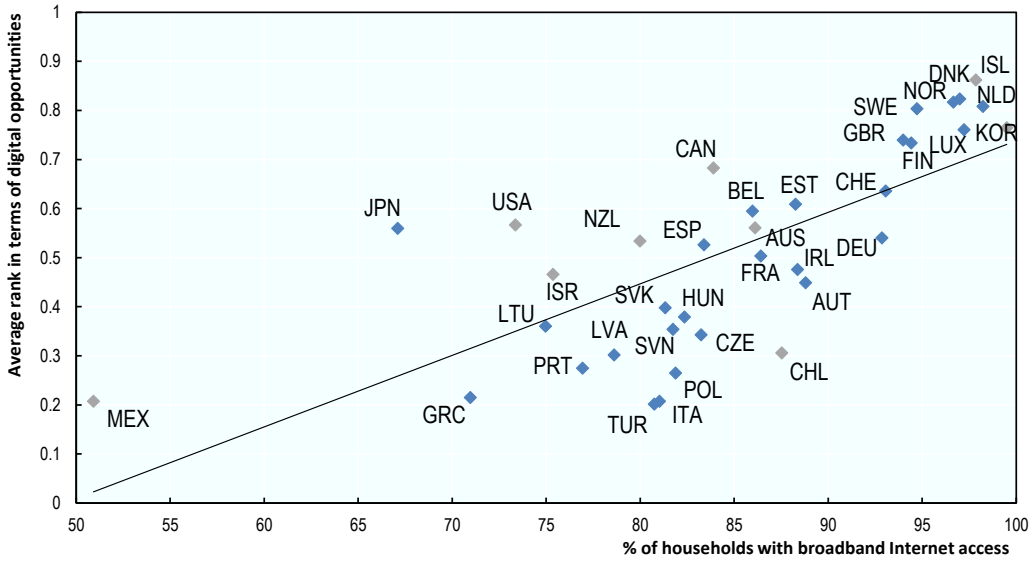
households with broadband Internet access. The eight leading countries in terms of digital opportunities are also the leaders in terms of broadband Internet diffusion among households. Risks of the digital transformation are harder to characterise as they are diverse. First, there is a low correlation (0.16) between digital risks and ICT access, suggesting that Internet diffusion does not mechanically brings about higher risks. Second, the strongest cross-country correlation (0.68) is observed between risks of the digital transformation and cyber-insecurity, measured as the percentage of people having experienced digital security incidents over the last 3 months. This suggests that the indicator of cyber-insecurity captures other important digital risks, possibly reflecting the overall digital maturity of each country as well as of the scope and effectiveness of national digital strategies.

Government policy certainly plays a role in determining countries' uptake of digital technologies and the mitigation of potential adverse effects. National digital strategies (NDS) have been implemented by the large majority of OECD country governments with the primary goals of strengthening e-government services, developing ICT infrastructure, promoting ICT skills and strengthening digital security (OECD, 2017). These strategies may have a variety of objectives, with many countries considering effects on GDP growth, productivity and competitiveness, but only a few explicitly considering the importance of the strategy to advance quality of life and well-being (with the exception of the NDS of Estonia, Lithuania, the Netherlands and Turkey).

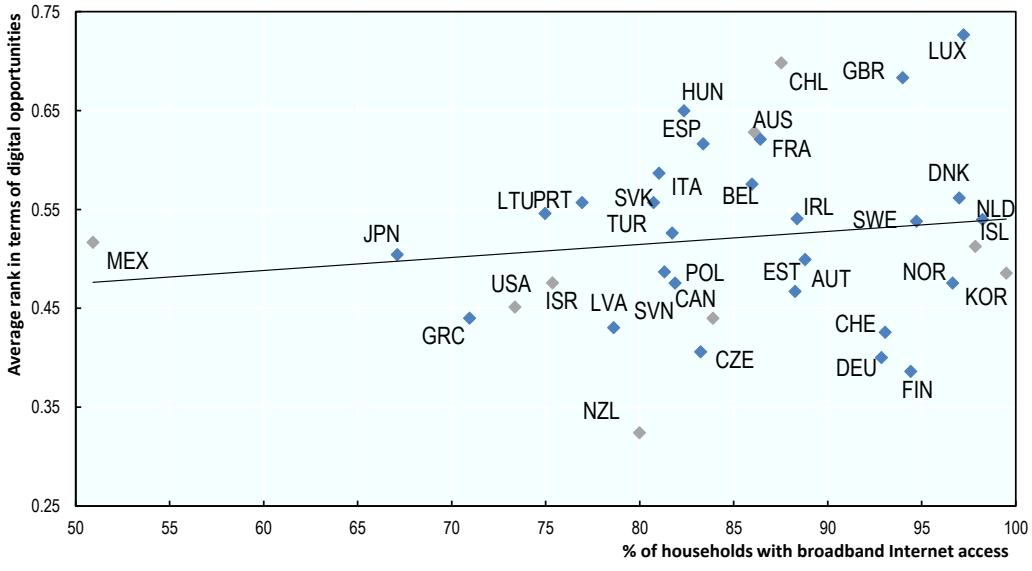
Among the named priorities in countries' national strategies, there is substantial variation in the degree to which NDS's cover the mitigation of key potential well-being risks (OECD, 2015a). Most national strategies focus on facilitation ICT access and use, supporting e-government services, and mitigating security risks. However, many opportunities and risks are not covered by a large number of countries. For example, advancing the inclusion of elderly and disadvantaged group is a named objective in the NDS of only four countries, and developing a sound regulatory approach for digital environments appears in three. This means that some of the key adverse effects the digital transformation, for example the sources and consequences of extreme use or the spread of misinformation online, may not be addressed. These differences in policy and regulatory approaches, alongside other cultural, economic and political factors, may explain the different paths that countries take with respect to reaping the benefits and mitigating the risks of the digital transformation. Culture is another explanation of the observed cross-country differences in digital opportunities and risks, as it is a strong determinant of a country's predisposition for innovation and technological change (Herbig and Dunphy, 1998).

Figure 3.4. Association between digital opportunities and risks and specific indicators

Panel A. ICT access and digital opportunities



Panel B. Online security incidents and digital risks



Note: Digital risks encompass 13 indicators across 9 dimension: ICT access and usage, education and skills, jobs, work-life balance, health status, social connections, civic engagement and government, environmental quality and digital security. Digital opportunities are measured through 20 indicators across 9 dimensions: ICT access and usage, education and skills, income, consumption and wealth, jobs, work-life balance, health status, social connections, governance and civic engagement, and subjective well-being. Countries with more than 10 missing indicators are marked in grey instead of blue.
Source: For both households with broadband Internet access and individuals experiencing online security incidents, the source is OECD *ICT Access and Usage by Households and Individuals* (database), http://oe.cd/hhind.

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These various factors are likely to affect not only the emergence of technological innovations inside a country but also the extent to which people in these countries are open to embracing new technologies and adopt innovations. In 2015, the OECD compiled data on people's perceptions of the benefits of science and technology from the Eurobarometer and a variety of national sources (OECD, 2015a). While the indicator is experimental due to the variety of sources used, the variation between attitudes towards technology is striking. In Estonia, the Netherlands and Luxembourg, positive attitudes are dominant, with over 80% of people agreeing that science and technology have a positive effect. In other European countries, i.e. the Czech Republic, Italy and Hungary, this value ranges between 60 and 70%. Yet, it is unclear whether more positive attitudes result in a higher uptake of technologies or rather the other way around.

One major limitation of the present analysis is the number of missing indicators in some countries. As discussed previously, country coverage is severely limited for some indicators; in 4 countries, at least 15 indicators out of 33 are missing. However, Figure 3.3 shows no strong association between the number of missing indicators by country and their relative performance: for instance, both the top three and the bottom three performing countries in terms of opportunities have a complete set of indicators (Panel A). In any case, specific measurement efforts would be needed to fill these data gaps in the future.

The statistical agenda ahead

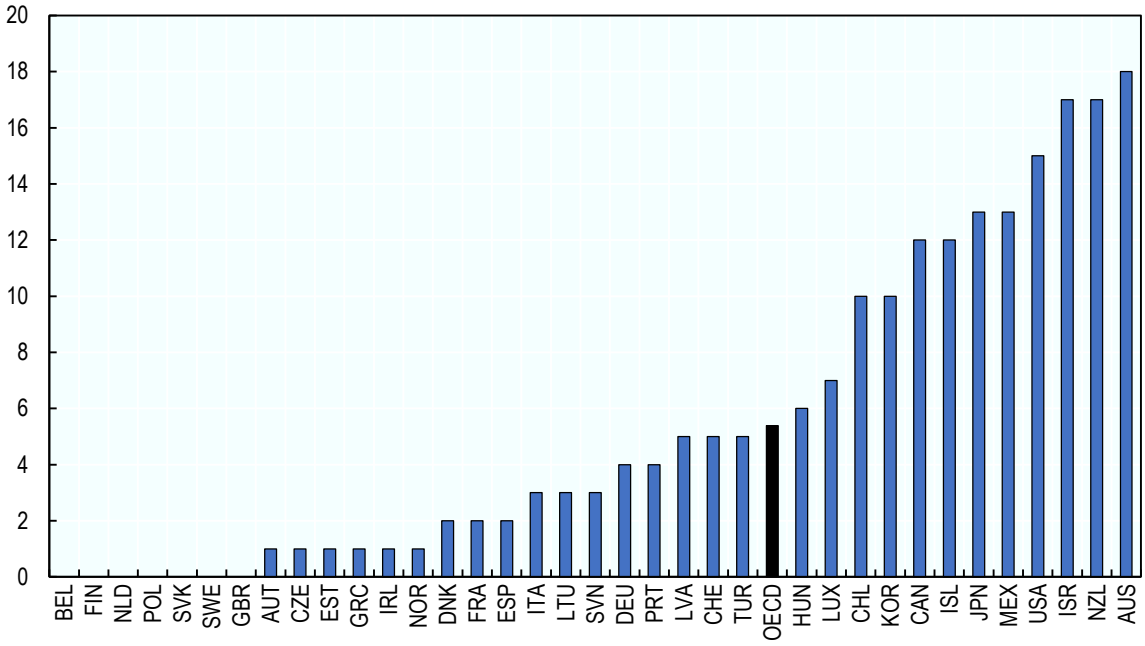
Due to the pace of the digital transformation, governments, industry and civil society alike struggle to identify the nature of the impacts of digitalisation on people's lives (Gluckman and Allen, 2018). Currently, the understanding of many well-being impacts of the digital transformation, such as those on mental health, social connections and subjective well-being, remains limited to small-scale studies often focused on a specific country or population group. Because of the recent nature of these technologies, National Statistical Offices (NSOs) may not have yet integrate measures of the use of such technologies and its impacts into relevant data collections. This section reviews the measurement challenges discussed throughout this report and suggests priorities for the statistical agenda ahead. Existing data gaps are first recalled, covering both gaps in the set of indicators presented in this publication and indicators that were not included due to lack of quality data. Based on this assessment, suggestions are made to improve the evidence base on the impacts of the digital transformation on people's well-being. It is incumbent upon the research community, governments, academic institutions and civil society organisations, to advance knowledge on the well-being impacts of the digital transformation.

Data gaps

Evidence on the impacts of the digital transformation in each dimension of well-being has been gathered in this report, but available indicators are often available for only a subset of countries. The country coverage of indicators used in this report is heavily unbalanced, with a few countries lacking data for a large number of indicators (Figure 3.5). The countries with the largest number of missing data are Australia, New Zealand, Israel and the United States. Absence of data limits comparison of opportunities and risks presented above.

Figure 3.5. Missing data by country

Number of indicators included in the digital well-being wheel that are missing for each country



Note: The total number of indicators in the digital well-being wheel (see Chapter 4) is 33.

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One reason for the imbalance of indicators is the lack of harmonisation similar to the one that has taken place at the European level to collect data on the access and use of digital technologies, mostly through Eurostat's model questionnaire on ICT usage in households and individuals. This survey is closely aligned with the OECD model survey on ICT access and usage by households and individuals (OECD, 2015b), and is therefore a reliable source for a number of indicators included here. In addition, other European-wide surveys, such as the EWCS and the EU-SILC, provide additional evidence on the relationship between computer use and job quality, or Internet access and subjective well-being.

While most OECD countries have a dedicated ICT survey to measure the use of digital technologies of households and individuals, differences remain in the extent to which countries use harmonised survey questions. A number of indicators in this report rely on information of the use of specific online activities, such as expressing opinions online or accessing online health information. In the countries with large data gaps, a number of ICT use questions are not included in these surveys, giving rise to missing indicators in a number of dimensions. Besides ICT access and usage surveys and large European-wide surveys, this publication relies heavily on data from other international survey instruments such as the PIAAC, PISA and TALIS surveys implemented by the OECD's Directorate for Education and Skills. Some countries have opted out of participation in parts of these surveys, resulting in missing data. For example, France, Italy and Spain did not participate in the problem-solving in technology-rich environments assessment that is

used to measure digital skills in PIAAC. Because this data is used for both the digital skills and the digital skills gap indicators, these countries are missing data points.

The indicators used in this report to construct the digital well-being wheels presented in Chapter 4 have been closely examined, with a detailed quality review included in the Annex to this chapter, which lays out the main statistical issues for each indicator, and suggests future improvements.

Furthermore, a number of opportunities and risks of the digital transformation that were identified as important in Table 1.1 and discussed in Chapter 2 do not feature in the digital well-being wheel due to lack of data availability. These impacts have been documented through qualitative descriptions or country-specific studies, but their measurement has not been incorporated in international survey vehicles. A list of these indicators is shown in Table 3.1.

The proposed indicators in this table fall into a number of categories. First are indicators of how people spend their time. Because extreme use of mobile devices has only been a concern recently, surveys have so far insufficiently focused on the amount of time that people spend on mobile devices. Similarly, it remains unclear how digital technologies have affected people's habits and whether other activities have been crowded out by the use of digital technologies. Second are indicators of new technologies and online activities that have not been included in survey vehicles. Examples are exposure to disinformation, use of digital health monitoring tools, and self-reported victimisation of hate speech online. Finally, a third group of indicators relate to the causal effect of the digital transformation on various well-being outcomes. This is the case for indicators of digital technology use on mental health and subjective well-being, as well as those measuring the effects of automation and computer-based jobs on labour market polarisation. These are the most challenging, because they require collecting longitudinal data in to study effects on individuals over time. Concrete actions that data producers, notably National Statistical Offices (NSOs), can take in order to fill the missing gaps are suggested below.

Table 3.1. Types of opportunities and risks currently not covered by indicators

Dimension	Proposed indicator	Main issue	Survey type	Feasibility
CT access and use	Frequency of use of mobile devices	Include harmonised question on frequency of mobile phone use and Internet use in ICT access and use surveys	ICT surveys	High
Jobs and earnings	ICT-driven jobs in other sectors	Include task-based and industry (ISIC) covariates in one survey vehicle to monitor the proportion of ICT-driven jobs by sector	Labour force surveys, PIAAC	High
	Extent of job polarisation driven by digital skills and job automation	Longitudinal data on job tasks, computer use at work and digital skills in labour market surveys would be necessary in order to estimate these effects	Labour force surveys, PIAAC	Medium
Work-life balance	Time spent in transportation associated with telework	Information on Internet use in time use surveys; harmonisation across time use surveys	Time use surveys	Medium
	Time spent on childcare responsibilities associated with telework	Information on Internet use in time use surveys; harmonisation across time use surveys	Time use surveys	Medium
Health	Diffusion of health monitoring tools	Inclusion of appropriate survey questions in national health surveys or ICT access and use surveys; harmonisation across health surveys	Health surveys, ICT surveys	High
	Mental health effects of digital devices on adults	Include covariates of self-reported health and subjective well-being in ICT surveys; include improved covariates of ICT use in General Social Surveys with well-being outcome variables; longitudinal data is needed to assess causality	GSS, Health, ICT surveys	Medium
	Crowding out of healthy behaviour	Information on Internet use in time use surveys; harmonisation across time use surveys	Time use surveys	High
Social connections	Reduced frequency of offline contact	Information on Internet use in time use surveys; harmonisation across time use surveys	Time use surveys	High
	Hate speech and online harassment	Introduction of an appropriate and standardised survey question in national victimisation survey; or use of web-scraping and machine learning to count instances online	Victimisation surveys or innovative techniques	High/ Medium
Civic engagement and governance	Exposure to disinformation online	Inclusion of appropriate survey questions in ICT surveys	ICT surveys	High
Personal security	Physical injury associated with automated technology	Introduction of an appropriate survey question in national victimisation surveys	Victimisation surveys	High
Environmental quality	Net carbon footprint of digital activities and technologies	Very difficult to estimate the direct effect of the various factors impacting energy use affected by digital technologies	Energy accounts	Low
	Reduced personal automobile mileage associated with digital vehicle sharing options	Very difficult to estimate the direct effect of changes in behavioural patterns and the rise of vehicle platforms and demand changes in automobile mileage	Household consumption surveys	Low
Housing	Diffusion of Smart Home Technologies	Introduction of an appropriate survey question in household consumption surveys	Household consumption surveys	High
Subjective well-being	Causal effect of Internet use on subjective well-being	Longitudinal studies and improved covariates associated with subjective well-being and ICT access and use are necessary to improve evidence.	ICT surveys, General social surveys	Medium

Improving statistical vehicles

Suggestions on the design of statistical vehicles are made below in order to improve the coverage and comparability of multiple indicators at the same time. These suggestions concern the harmonisation of ICT surveys that could be tied to the OECD model survey, the inclusion of subjective well-being questions into ICT surveys, time use surveys, and the construction of longitudinal data.

Using the OECD model survey to improve comparability

A major step to improve understanding of the impact of the digital transformation lies in the harmonisation of ICT access and use data across countries. The OECD model survey on ICT access and usage by households and individuals (OECD, 2015b) is an attempt to standardize survey questions related to ICT access and use across countries in order to align measures. This tool contains a number of questions that form the basis of indicators included in this report, particularly on specific online activities as well as on exposure to data privacy and online security incidents. However, a number of further improvements would be desirable.

Currently, the partial adoption of the model survey by NSOs limits comparison of opportunities and risks in a number of specific domains, such as health and governance and civic engagement. While some countries measure the access and usage of ICTs by households and individuals using stand-alone surveys, others include dedicated ICT modules in existing household surveys, which limits the number of questions that can be included in the survey. In addition, two indicators of Internet access and use in this report rely on a large set of questions on a variety of Internet uses. This is important, because the variety of activities that people perform reflects the depth of their usage of the Internet. With the second digital divide increasingly driven by differences in skills, it is vital to monitor the uptake of a range of online activities of different groups in the population, as this may be a source of exclusion and inequality in the future.

A specific issue for the harmonisation of indicators pertains to the recall period of questions based on the model survey. For activities performed on the Internet, the model survey suggests a recall period of 3 months (with a few exceptions, notably for online consumption, due to possible seasonality differences, and for e-government, because needs to access government services may be less frequent). Some countries, however, use recall periods of 12 months or unspecified, limiting comparability. The model survey also suggest reference periods for questions on the frequency of uses (of computers, mobile phones, etc.), but here too there are differences among countries. Better alignment of reference periods would improve comparability. The second revision of the OECD model survey provides a more detailed account of methodological differences in how countries measure ICT access and use by households and individuals.

Beyond harmonisation, the model survey needs to be reviewed in a timely manner in order to keep up with the rapid pace of the digital transformation. Emerging trends, such as experiences of misinformation and new online activities, are not well reflected in the OECD model survey. In addition, the model survey has to keep up with changes in the frequency and intensity of use of digital devices. For some demographic groups, mobile phone use has become so intense that “several times a day” may not suffice as the most frequent response option, as more and more people are online all the time. Similarly, the highest response option for daily use of mobile phone, “more than one hour”, does not allow identifying extreme users. In the same vein, at a time where 26% of US adults are

online "Almost constantly", it would be useful to have more granular response options, beyond the "daily" option currently included in the Eurostat questionnaire.

Finally, in order to facilitate the monitoring of ICT use trends, regular data collections are imperative for cross-country comparisons. Currently, for some indicators included in this report, the most recent data for some countries refer to 2012 or earlier, which may be too far in the past to make relevant comparisons.

Improving existing surveys with covariates of subjective well-being

For a large part, the data in this report come from ICT surveys targeting households and individuals or other large household survey vehicles. A key problem with these data sources is that they are not designed to assess the relationship between digital transformation and people's well-being. As a result, while observations can be made about trends over time and between groups in the uptake of certain digital activities, these surveys do not allow establishing a link between use of these activities and well-being impacts. This is especially the case for indicators of subjective well-being.

There is sufficient evidence to believe that use of personal digital devices and specific online activities may have a strong influence on people's mental health, feelings of achievement, and life satisfaction. Surveys in ICT use should include a core set of questions on subjective well-being to better understand its relationship with the exposure to these digital innovations.

Time use surveys can shed light on the effects of digital technologies

Time use surveys (TUS) may provide new insights into the effects of using digital devices. TUS are particularly useful to shed light on the well-being effects of the digital transformation because they can track how this may change the way people work and spend their time, and whether digital activities may crowd out exercise or sleep. Unfortunately, there are as many varieties of time use surveys as there are countries having implemented them. Table 3.2 reviews digital variables across ten selected national time use surveys. The most common variable across these surveys is the digital equipment of the dwelling, which is included in seven surveys. All surveys ask about the use of digital technologies, but in a non-comparable way: some ask about daily duration of usage (two out of ten), others about the frequency of use (three out of ten), while the remaining five use a categorical "yes/no" question regarding technology use. Table 3.2 also shows that only two surveys, in France and the United States, allow assessing subjective well-being during digital activities. Such information is key in evaluating how people experience these activities.

Table 3.2. Digital variables included in selected time use surveys

	Digital activity	Affects measured during some activities
Canada	Socialising or communicating, using technology (versus in person) Duration – use of technology Number of text messages sent per day	No
Denmark	Digital equipment in the dwelling Frequency of usage – computer Duration on Internet Internet activities: bank, shopping, information, e-mails Teleworking Computer use for work at home Internet use for work at home	No
Finland	Digital equipment in the dwelling Frequency – computer use for leisure, by activity Frequency – use of Internet, by activity Social network user	No
France	Digital equipment in the dwelling Frequency of usage – Internet Use of Internet, by activity	Yes
Germany	Media use Use of computer/smartphone Programming/repair computer or smartphone Information obtained via computer/smartphone Communication via computer/smartphone Other activities via computer/smartphone	No
Italy	Digital equipment in the dwelling Teleworking Job search on Internet	No
Mexico	Digital equipment in the dwelling Use of mass media	No
Turkey	Digital equipment in the dwelling Computing activities, by type Use of Internet, by activity Training in computing	No
United Kingdom	Digital equipment in the dwelling Household management using the Internet, by activity Computing activities, by type	No
United States	Household management using the Internet, by activity Computer use, by purpose (leisure, volunteering) Online shopping	Yes

Collecting more longitudinal data to understand causal effects

The lack of longitudinal data prevents establishing causal linkages between use of digital technologies and effects on people's well-being. Examples are plenty, from estimating the effects on job quality of computer use, to measuring the effects of digital devices on social connections, (teenage) mental health and subjective well-being. Currently, analysis of the relationship between use of digital technologies and potential outcomes is reliant on cross-sectional data that neglect potential selection bias and endogeneity problems. The lack of robust evidence has sparked a lively academic debate in some areas, notably in understanding the impacts of the digital transformation on mental health. Ideally, longitudinal data of ICT use in combination with appropriate subjective well-being variables would be the best way to understand the well-being impacts of new technologies. For cost and logistical reasons, longitudinal data is not common for large-

scale household surveys, and certainly not for ICT use surveys. A broad research consortium involving NSOs and academics could expand the evidence base on the causal effects of the introduction of new technologies on well-being.

Leveraging innovative technologies to monitor new online trends

Finally, digital innovations themselves offer a response to some of the measurement challenges raised in this report, in particular for indicators of misinformation, hate speech, cyber security violations and cyberbullying. Innovations in the field of big data analysis based on machine learning strategies may in the future allow measuring the intensity of these phenomena in different countries. For example, Amador et al. (2017) created a model to recognize disinformation on Twitter in the context of the 2016 US general election. Google is developing algorithms to detect hate speech on its websites. More work could take place under the umbrella of the OECD Smart Data Strategy, an organisation-wide initiative aimed at expanding the evidence base using new methods of collecting, processing and analysing data. Along with National Statistical Offices, the OECD intends to explore the ways in which machine learning and other big data analysis tools can be used in monitoring some of the opportunities and risks of the digital transformation, providing evidence in a variety of well-being domains.

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Annex 3.A. **Quality assessment of available indicators used in this report**

Annex Table 3.A.1. Detailed quality assessment of indicators

Dimension		Indicator	Quality	Harmoni-sation	Country coverage	Timeli-ness	Key measurement issue	Possible solutions	Feasibility of improvement
ICT access and use	1	Access to digital infrastructures		■		■	Some methodological differences; some data is outdated		High
	2	Individuals using the Internet		■	■	■	Some methodological differences; some data is outdated	Improve alignment in questions in order to improve cross-country comparison	High
	3	Variety of uses of the Internet		■	■	■	Activities measured differ across country; new activities (e.g. teleworking) are not reflected in ICT access and usage surveys	Improve alignment in questions in order to improve cross-country comparison; ensure question relevance by including new online activities	High
	4	Inequality of Internet uses		■	■	■	Same as no. 3	Same as no. 3	High
Education and skills	5	Digital skills			■	■	Lack of country coverage, long interval between surveys	More regular tests can improve in the monitoring of digital skills	High
	6	Digital skills gap			■	■	Same as no. 5	Same as no. 5	High
	7	Digital resources at school	■	■		■	The measure only considers availability of digital resources, not what they are used for, nor does it consider other types of e-learning devices.	An improved measure would consider the use of computer-based learning tools, rather than access to computers, per se.	High
	8	Teachers' lack of ICT skills	■		■	■	Because the measure is based on self-defined skills needs it is not an objective measure of teachers' skills across countries	A standardised test on teacher skills would provide a more reliable measure	Medium
	9	Online courses	■	■		■	Different timeframes specified across countries; does not consider a wider range of e-learning tools such as mobile applications, Youtube videos, etc.	A wider definition of online courses, harmonised definition and harmonised timeframe	High
Income, consumption and wealth	10	Wage premium associated with digital skills			■		Lack of country coverage, long interval between surveys		High
	11	Online consumption		■	■	■	Does not consider the frequency of online purchases by individuals, which is important as online consumption becomes more widespread	An improved measure may ask for frequency of online shopping	High
	12	Selling online		■	■	■	Some methodological differences; some data is outdated	Improve alignment in questions in order to improve cross-country comparison	High
Jobs	13	Employment in information industries	■			■	Employment in information industries as classified in this measure does not indicate the degree of digitalisation of jobs in these industries; moreover, this indicator does not capture job creation associated with the digital transformation in other	An additional measure of highly digital jobs in other sectors would reflect employment in digital jobs better; in addition, regular measurement can help to assess the growth in employment	Medium

Dimension		Indicator	Quality	Harmoni-sation	Country coverage	Timeli-ness	Key measurement issue	Possible solutions	Feasibility of improvement
							sectors; some data is outdated	over time in the ICT sector	
	14	People using the Internet when looking for a job					Some methodological differences; some data is outdated	An alternative measure might consider online job search among unemployed people; alignment question timeframe in order to improve cross-country comparison	High
	15	Mean job automatibility					Probabilities of automation are based on current technological possibilities; it does not consider future innovations that may lead to further automation	It is virtually impossible to predict which jobs survive in the future; the current measures provides a good sense of which jobs are more at risk and in which countries	Low
	16	Reduction in extended job strain associated with computer-based jobs					The measure only considers the difference extended job strain between workers with computer-based jobs and those who do not have computer-based jobs, so no causality can be established	Time series data is necessary to better analyse the effects of computer-based and 'digital' jobs and job quality	Medium
	17	Job stress associated with computer-based jobs					The measure only considers the difference in job stress between workers with computer-based jobs and those who do not have computer-based jobs, so no causality can be established	Time series data is necessary to better analyse the effects of computer-based and 'digital' jobs and job stress	Medium
Work-life balance	18	Penetration of teleworking					Lack of harmonisation in survey question across countries; some data is outdated	Align question reference timeframe in order to allow cross-country comparisons	High
	19	Increased worries about work when not working					The measure only considers the difference in worries about work between workers with computer-based jobs and those who do not have computer-based jobs, so no causality can be established	Time series data is necessary to better analyse the effects of computer-based and 'digital' jobs and worries about work when not working	Medium
Health	20	Making medical appointments online					There are many more e-health services, notably the use of Electronic Health Records, that better represent digitalisation in patient-provider interactions	Better data on the use of Electronic Health Records among service providers	High
	21	Accessing health information online					Methodologies are not strictly comparable for certain countries (Australia, Canada, New Zealand and the United States); some data is outdated	Align question reference timeframe in order to allow cross-country comparisons	High
	22	Digital addiction among children					The current measure does not capture a pathological digital addiction	Self-reported diagnoses of digital addiction may be unreliable, but better survey measures of pathological digital addiction may be included in (children's) health surveys	Medium

Dimension		Indicator	Quality	Harmoni-sation	Country coverage	Timeli-ness	Key measurement issue	Possible solutions	Feasibility of improvement
Social connections	23	Using online social networks		■		■	Methodological differences exist for Australia, Israel, Japan, Korea, New Zealand and the United States, particularly in the reference period; this measure would particularly benefit from the inclusion of subjective well-being covariates	Align question timeframe in order to allow cross-country comparisons	High
	24	Children experiencing cyberbullying	■		■	■	Self-reports are problematic, both in a school- and home-setting, because children may not be comfortable to admit victimisation in the presence of others	A home-setting may be a safer environment for self-report measures, but the KidsOnline survey currently has limited geographic reach; it is hard to conceive of a better measure than self-reported victimisation	Low
Governance and civic engagement	25	People expressing opinions online	■	■	■		Measure is not sensitive to intensity or frequency of online civic or political engagement; lack of harmonisation limits comparability across countries	Besides self-report data innovative techniques like web-scraping can help in measuring online civic and political engagement	High
	26	Individuals interacting with public authorities online	■	■		■	The current measure does not consider the quality of the e-government experience; methodological differences in certain countries (Israel, Mexico) limit comparability	Improved measures may consider citizen's satisfaction with e-government services	High
	27	Availability of open government data		■			Potential challenges in comparing countries' efforts. For more information, see Ubaldi (2013).		
	28	Individuals excluded from e-government services due to lack of skills			■		Lack of geographic coverage outside of Europe		High
	29	Individuals experiencing disinformation	■		■		No official data on self-reported disinformation exists; in addition, self-reports may be affected by the ability to recognise disinformation and by mistrust in information in general	Besides including self-reported questions in survey vehicles, innovative techniques using web-scraping and machine learning may be developed in the future to measure the prevalence of misinformation	High
Environmental quality	30	E-waste generated per capita	■	■			Countries' efforts in measuring e-waste vary substantially, see detailed information in Baldé (2017)		Medium
Security	31	Individuals experiencing cyber-security events	■	■		■	Self-reported measures may not be the best way to measure cyber-security as it does not provide insight into the type or significance of cyber-security events; methodological differences exist across countries; some data is outdated	Innovative techniques may help track and record cyber-security incidents using machine learning and big data analysis in the future	Medium

Dimension		Indicator	Quality	Harmoni-sation	Country coverage	Timeli-ness	Key measurement issue	Possible solutions	Feasibility of improvement
	32	Individuals experiencing abuse of personal information	■	■		■	Like with cyber-security events, improved measures may be developed thanks to digital innovations; methodological differences exist across countries and some data is outdated	Innovative techniques may help track and record online privacy incidents using machine learning and big data analysis in the future; better alignment of questions across countries	Medium
Subjective well-being	33	Life satisfaction gains from Internet access	■	■	■	■	Current analysis is based on cross-sectional data and only distinguishes differences in life satisfaction between people who do and do not have Internet access; lack of geographic coverage outside of Europe; Internet access does not reflect Internet use.	Longitudinal data would be necessary to understand causal impacts; more detailed covariates on the intensity and frequency of Internet use is necessary to understand impacts of use and extreme use	Medium

Note: The four columns of quality, harmonisation, country coverage, and timeliness are marked when an indicator faces limitations in each of these areas. Quality refers to the relevance, validity and accuracy of the indicator; harmonisation refers to the degree to which the indicator is measured in a consistent way across countries; country coverage refers to whether the indicator is available for all OECD countries; and finally, timeliness concerns the availability of recent data for the indicator.

Chapter 4. Country profiles

The indicators described in the previous chapter are used in this chapter to evaluate the progress of individual countries in seizing the opportunities of the digital transformation and in mitigating its risks. This chapter presents a country profile of each OECD country, identifying differences in countries' progress when it comes to navigating the benefits and risks of the digital age. Due to data limitations, these profiles only assess countries' comparative strengths and weaknesses based on average measures, without considering inequalities in achievements in certain opportunities and risks as well as changes over time.

Reader's guide to the country profiles

The digital well-being wheel is a graphical depiction of OECD countries' performance in seizing the opportunities and mitigating risks of the digital transformation. The wheel presents, for each country, the available indicators on the opportunities and risks associated with the digital transformation for each dimension of well-being, showing opportunities in dark blue and risks in yellow. The indicators are normalised to show a country's relative situation compared to other OECD countries. Indicators are presented in such a way that longer bars mean either higher opportunities or higher risks, depending on the colour of the bar. For opportunities (in dark blue) longer bars indicate more positive outcomes, whereas for risks (in yellow), longer bars indicate more negative outcomes. When an indicator is missing, the relevant segment of the wheel is shaded in white.

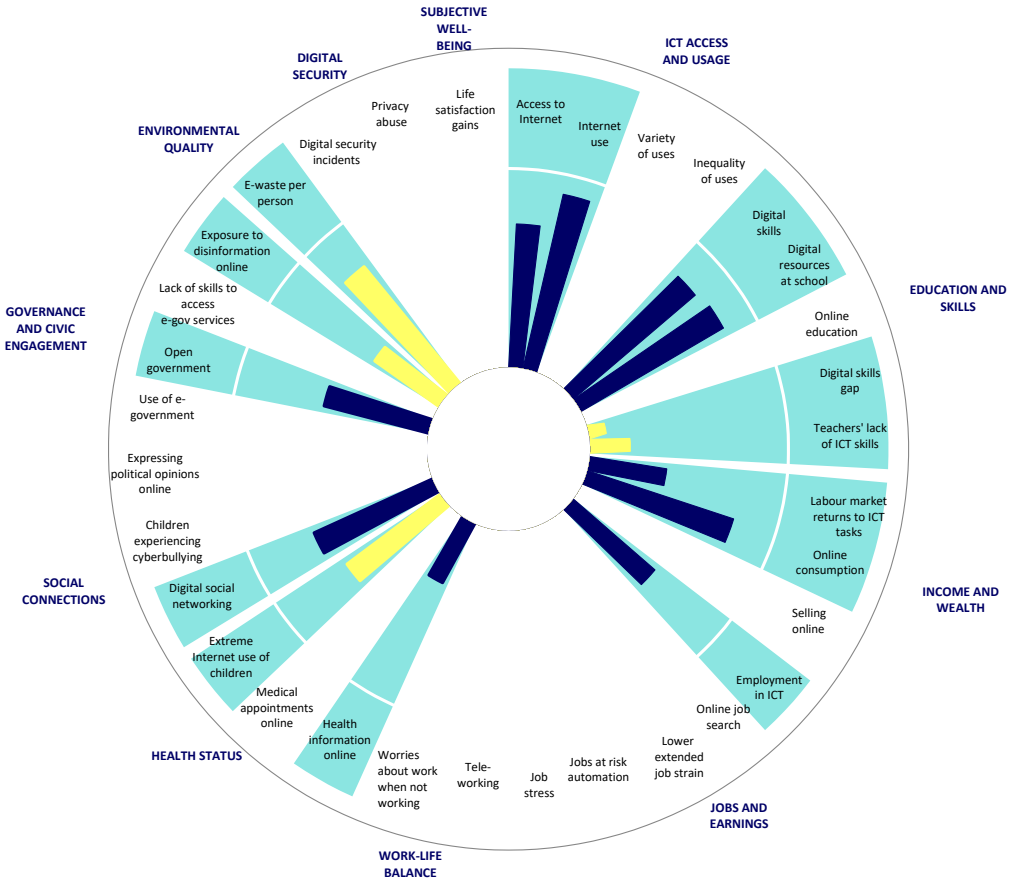
The following pages present the digital well-being wheel for all OECD countries excluding Colombia, which (at the time of writing) was still on the access track to formal membership.

The statistical data for Israel are supplied by and under the responsibility of the relevant Israeli authorities. The use of such data by the OECD is without prejudice to the status of the Golan Heights, East Jerusalem and Israeli settlements in the West Bank under the terms of international law.

How's life in the digital age in Australia?

Compared to other OECD countries, Australia benefits substantially from the opportunities offered by the digital transformation, with high performance in the dimension of **education and skills** as well as high levels of **Internet access** and **use**. The share of people with digital skills in Australia is one of the highest in the OECD, and these skills are evenly distributed across the population. In addition, relatively few **teachers** in Australia report a **lack of ICT skills**. At the same time, people in Australia produce a high level of **e-waste per person** (23.6 kg per inhabitant). Children in Australia also face risks from the digital transformation, with 28% **using the Internet for more than 6 hours** on a weekend day. The assessment of benefits from the digital transformation in Australia should be interpreted with caution due to the unavailability of information on opportunities and risks in several domains such as work-life balance, jobs and earnings, digital security and subjective well-being.

Figure 4.1. The digital well-being wheel in Australia



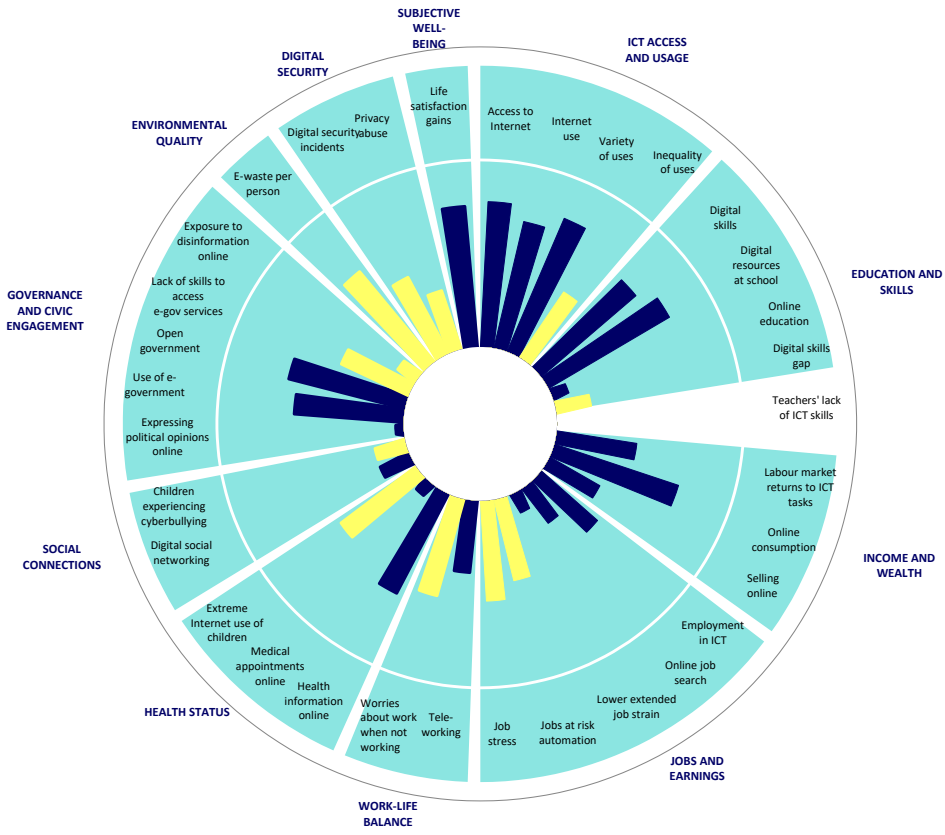
Note: This wheel depicts **Australia**'s relative performance in terms of key opportunities and risks in the context of the digital transformation. The centre of the wheel corresponds to the lowest outcome observed across all OECD countries, while the outer circle corresponds to the highest outcome. For opportunities (in dark blue) longer bars indicate better outcomes, whereas for risks (in yellow), longer bars indicate worse outcomes. If data are missing for any given indicator, the relevant segment of the circle is shaded in white.

StatLink http://dx.doi.org/10.1787/888933909217

How's life in the digital age in Austria?

In general, Austria is moderately exposed to both the opportunities and risks of the digital transformation, compared to other OECD countries. People in Austria have high rates of access to **broadband Internet** and make use of a wide **variety of online activities** (7 out of a list of 10 online activities are used by more than 50% of the population)**. The inequality of uses of the Internet** is a bit below the OECD average, meaning that the benefit from internet uses is fairly widespread across the population. In addition, the availability of **digital resources at school** is high, and people in Austria have relatively high levels of **digital skills**. On the other hand, few people in Austria make use of **online education**, with only 5% of people having followed an online course in the last 3 months. The level of **online consumption** as well as that of **open government** stand above the average while the level of **employment in ICT** is below the average. Finally, the scores of opportunity (**digital social networking**) and risk (**children experiencing cyberbullying**) from the **social connection** domain are below the average.

Figure 4.2. The digital well-being wheel in Austria



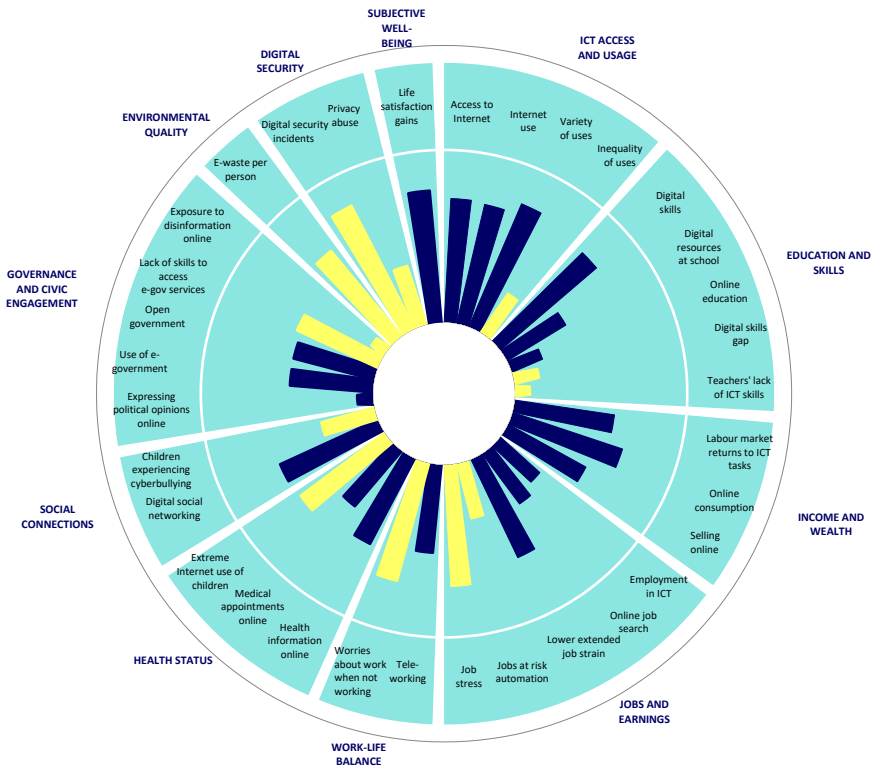
Note: This wheel depicts **Austria**'s relative performance in terms of key opportunities and risks in the context of the digital transformation. The centre of the wheel corresponds to the lowest outcome observed across all OECD countries, while the outer circle corresponds to the highest outcome. For opportunities (in dark blue) longer bars indicate better outcomes, whereas for risks (in yellow), longer bars indicate worse outcomes. If data are missing for any given indicator, the relevant segment of the circle is shaded in white.

StatLink http://dx.doi.org/10.1787/888933909236

How's life in the digital age in Belgium?

Compared to other OECD countries, Belgium benefits from the opportunities of the digital transformation, but is also relatively heavily exposed to its risks. People in Belgium make use of large **variety of Internet uses**, including in specific dimensions, such **digital social networking** and **online consumption.** Belgium also ranks relatively high when it comes to **digital skills**, and the **digital skills gap** is one of the smallest of the OECD. **Exposure to disinformation** is relatively uncommon in Belgium, with 13% of people reporting having encountered disinformation in the last week, well below the OECD average. At the same time, **online political and civic engagement** is comparatively low: only 6% of individuals report having uploaded such posts in the last 3 months. There are several domains in which Belgium is particularly exposed to the risk of the digital transformation. Workers in Belgium are at relatively high risk of **job stress** and **worries about work when not working** due to having computer-based jobs. In addition, the level of **extreme Internet use of children** is above the OECD average. The environment is another domain where Belgium is exposed to risks, with a relatively high level of **e-waste per person.**

Figure 4.3. The digital well-being wheel in Belgium



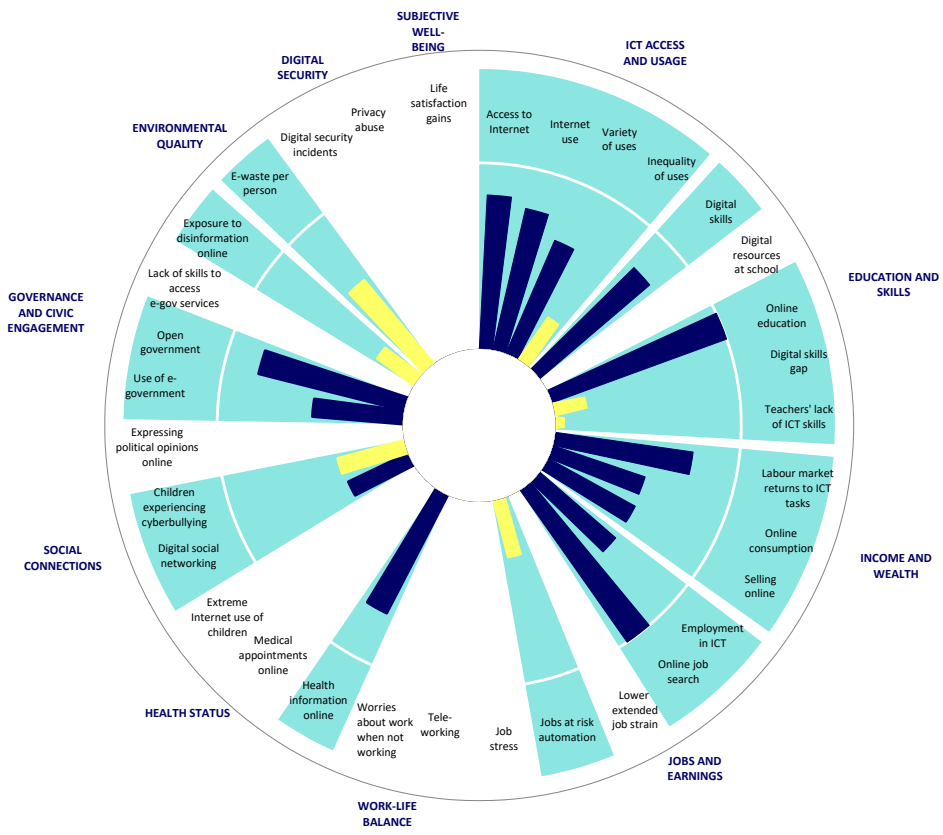
Note: This wheel depicts **Belgium**'s relative performance in terms of key opportunities and risks in the context of the digital transformation. The centre of the wheel corresponds to the lowest outcome observed across all OECD countries, while the outer circle corresponds to the highest outcome. For opportunities (in dark blue) longer bars indicate better outcomes, whereas for risks (in yellow), longer bars indicate worse outcomes. If data are missing for any given indicator, the relevant segment of the circle is shaded in white.

StatLink http://dx.doi.org/10.1787/888933909255

How's life in the digital age in Canada?

Compared to other OECD countries, Canada benefits to a large degree from the opportunities offered by the digital transformation while being exposed to relatively low risks. People in Canada make high use of a **variety of Internet activities**. More people in Canada make use of the Internet for **online education** and **finding and applying for jobs** than in any other OECD country. In addition, Canada's level of **digital skills** is well above the OECD average, with a relatively low accompanying **digital skills gap**, and few **teachers reporting to lack ICT skills** to perform their job (9%). Some other key risks of the digital transformation are relatively contained in Canada. **Self-reported exposure to disinformation**, at 19% is almost half that of its larger southern neighbour. In addition, the share of children reporting to be exposed to **cyberbullying** is lower than the OECD average. The assessment of benefits from the digital transformation in Canada should be interpreted with caution due to the unavailability of information on the Canada's performance in several domains such as work-life balance, digital security and subjective well-being.

Figure 4.4. The digital well-being wheel in Canada



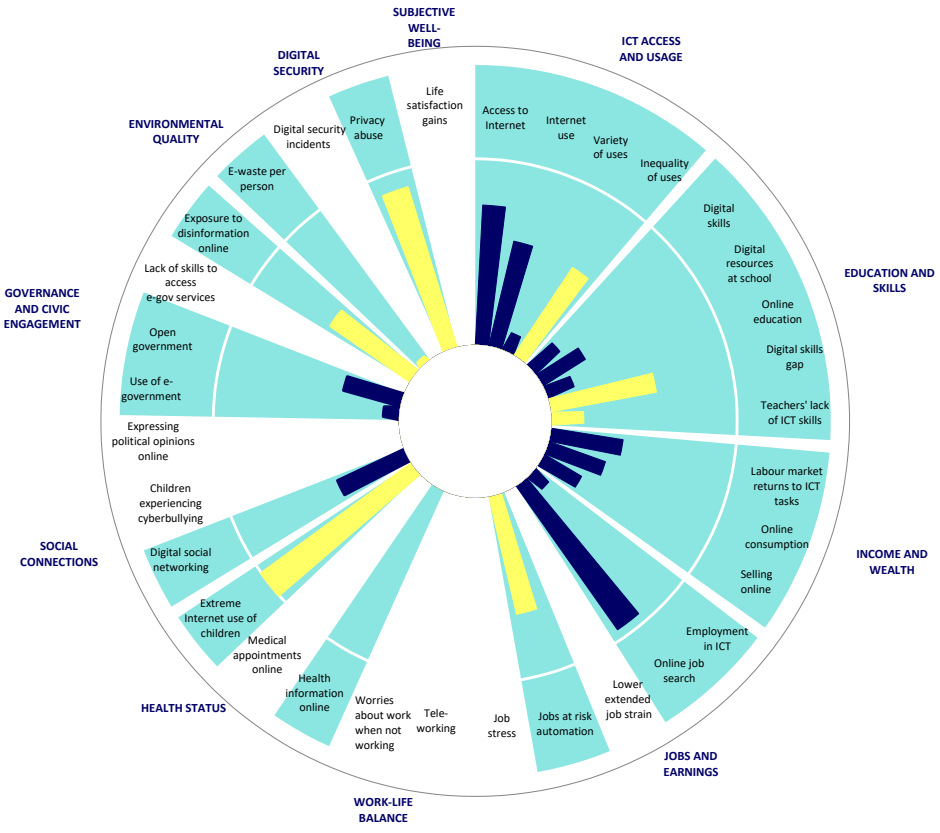
Note: This wheel depicts **Canada**'s relative performance in terms of key opportunities and risks in the context of the digital transformation. The centre of the wheel corresponds to the lowest outcome observed across all OECD countries, while the outer circle corresponds to the highest outcome. For opportunities (in dark blue) longer bars indicate better outcomes, whereas for risks (in yellow), longer bars indicate worse outcomes. If data are missing for any given indicator, the relevant segment of the circle is shaded in white.

StatLink http://dx.doi.org/10.1787/888933909274

How's life in the digital age in Chile?

Unfortunately, a large number of indicators of opportunities and risks of the digital transformation are missing for Chile, limiting a comprehensive assessment of impacts. Relative to other OECD countries, Chile faces high exposure to risks of the digital transformation and limited performance in terms of opportunities. **Access to internet** has increased substantially over the past decade, and is now above the OECD average at 87.5%. However, the **variety of uses** of the Internet is limited and the level of **inequality of uses of the Internet** is above the OECD average. One of the major areas where Chile lags behind is in the area of **digital skills** and education. Few students in Chile have access to **digital resources at school** and the share of people making use of **online education** is relatively low. The share of people **using the Internet for finding and applying for jobs** in Chile is higher than in other OECD countries, however. At the same time, Chile is exposed to a key risk in the area of employment as it faces a relatively high level of **jobs at risk of automation**. In addition, 43% of children make **extreme use of the Internet**, which is higher than in any other OECD country.

Figure 4.5. The digital well-being wheel in Chile



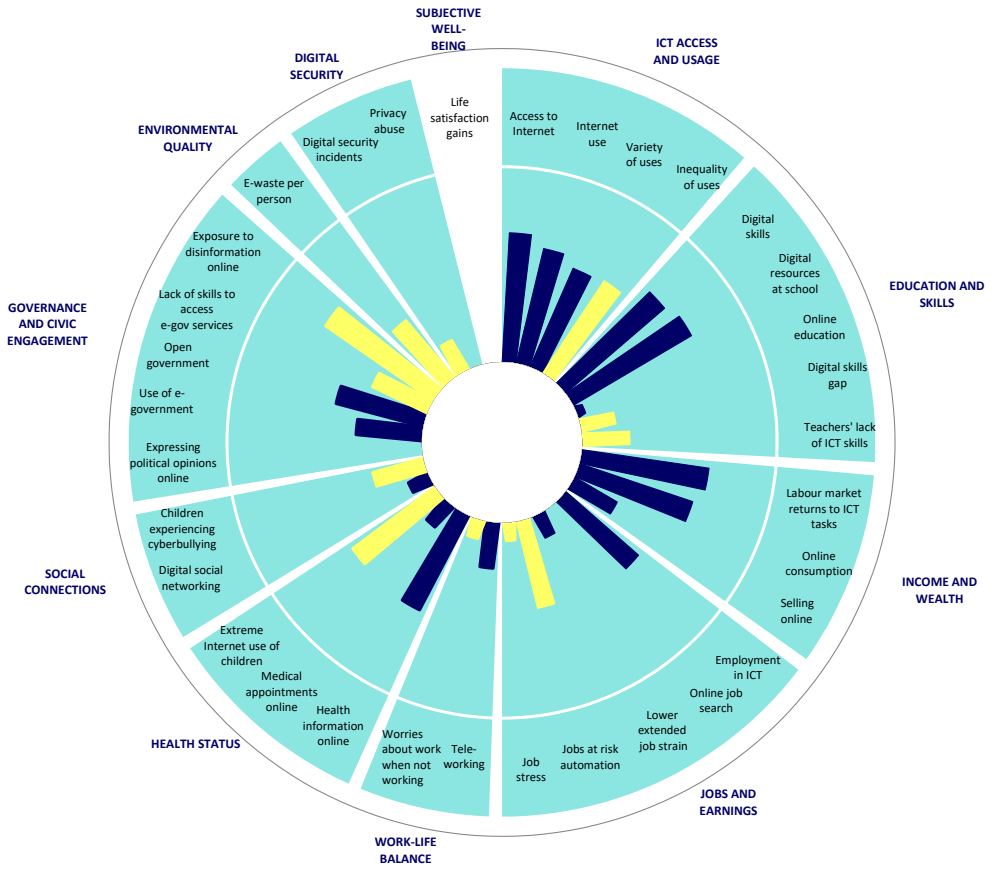
Note: This wheel depicts **Chile**'s relative performance in terms of key opportunities and risks in the context of the digital transformation. The centre of the wheel corresponds to the lowest outcome observed across all OECD countries, while the outer circle corresponds to the highest outcome. For opportunities (in dark blue) longer bars indicate better outcomes, whereas for risks (in yellow), longer bars indicate worse outcomes. If data are missing for any given indicator, the relevant segment of the circle is shaded in white.

StatLink http://dx.doi.org/10.1787/888933909293

How's life in the digital age in the Czech Republic?

Relative to other OECD countries, the performance of the Czech Republic is characterised by low risks but also low opportunities. The **access to Internet** has improved substantially over the past decade, and is now above the OECD average at 83.2%. However, there is a comparatively high level of inequality of uses, meaning that while some groups make use of a large **variety of Internet uses**, the majority of the population makes use of only a few activities. The Czech Republic performs relatively poorly in terms of **online job search** with the lowest share of individuals having used the Internet for searching a job (5.4%). The country is exposed to the risks of digital transformation to a limited extent, although it has one of the highest rates of **exposure to disinformation** (36%) while the rate of people **expressing political opinions online** is the lowest among OECD countries. The share of people having followed **courses online** is also low, but the Czech Republic performs relatively well in **digital resources at school,** with 77.7% of students having access to Internet connected school computers.

Figure 4.6. The digital well-being wheel in the Czech Republic



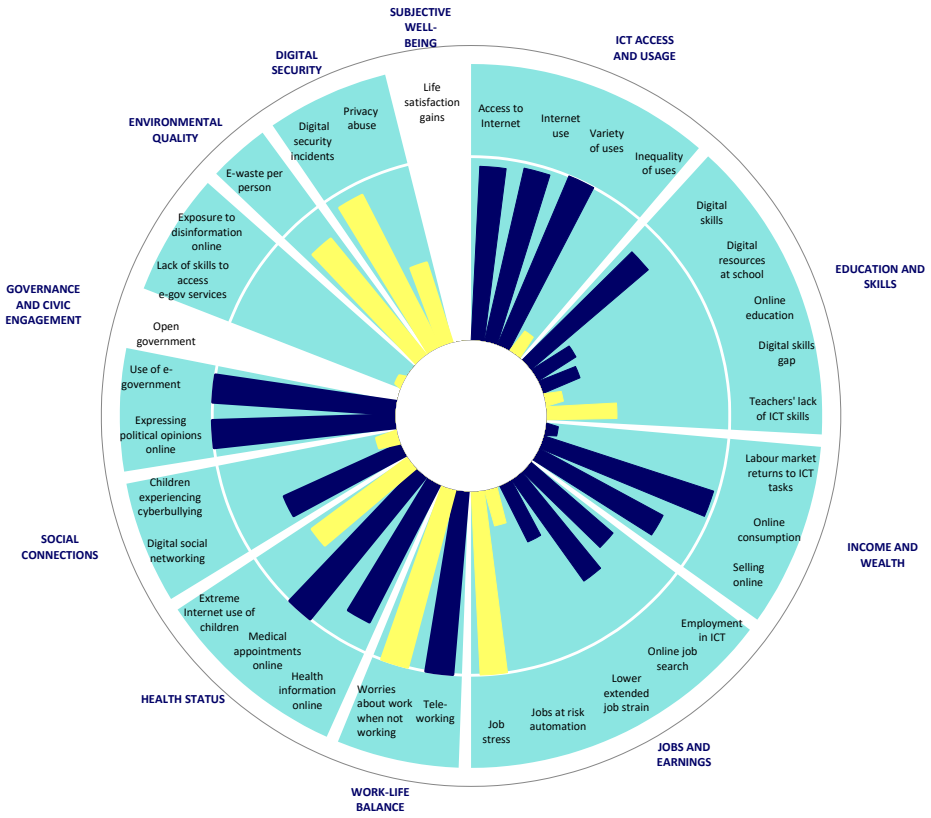
Note: This wheel depicts **Czech Republic**'s relative performance in terms of key opportunities and risks in the context of the digital transformation. The centre of the wheel corresponds to the lowest outcome observed across all OECD countries, while the outer circle corresponds to the highest outcome. For opportunities (in dark blue) longer bars indicate better outcomes, whereas for risks (in yellow), longer bars indicate worse outcomes. If data are missing for any given indicator, the relevant segment of the circle is shaded in white.

StatLink http://dx.doi.org/10.1787/888933909312

How's life in the digital age in Denmark?

People in Denmark benefit to a large extent from the opportunities of the digital transformation, but are also exposed to high risks. A very large share of the Danish population benefits from the possibilities offered by the Internet: **access and use of the Internet** are in the top tier of the OECD. Nine out of a list of ten online activities are used by a majority of the population, which is the highest level of **variety of Internet uses** in the OECD. The high degree of digitalisation of daily life is reflected in other domains, such as governance and civic engagement, where Denmark ranks as the top country in terms of people **using e-government services** and **expressing political opinions online**. In addition, the level of **jobs at risk of automation** is below the OECD average. However, as a result of the high share of workers with computer-based jobs, Denmark faces a significant risk of **job stress** and **worries about working when not working** associated with computer-based jobs. On the other hand, Denmark also reports the highest share of people who **telework** (42%), which may bring substantial, benefits in the area of work-life balance as well.

Figure 4.7. The digital well-being wheel in Denmark



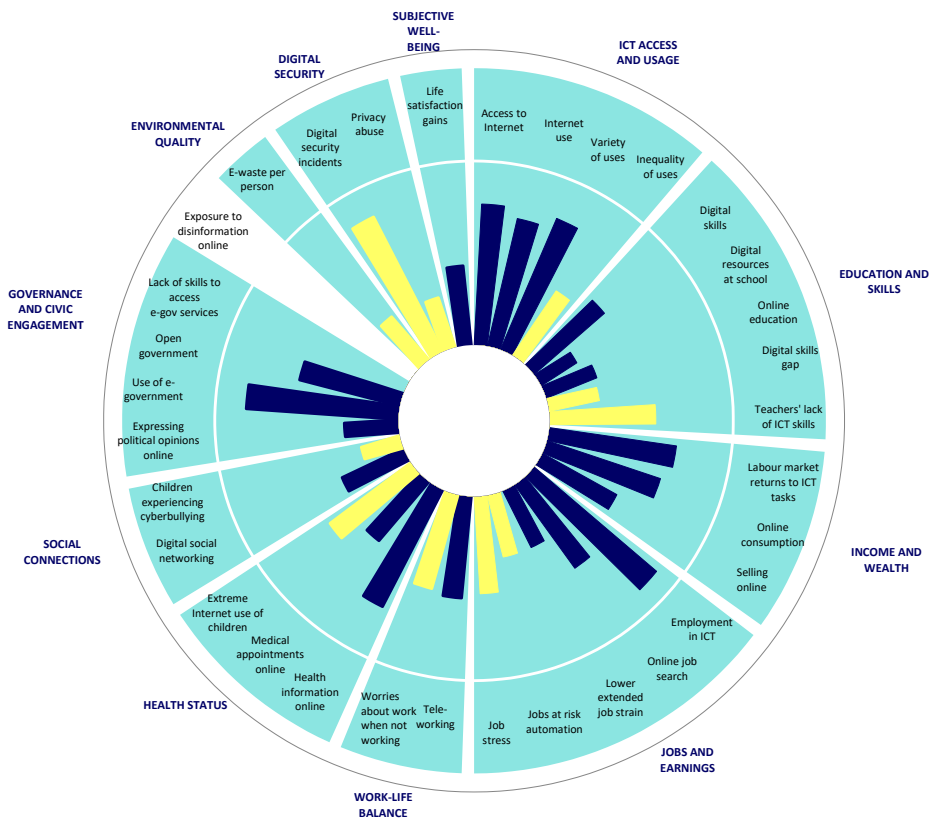
Note: This wheel depicts **Denmark**'s relative performance in terms of key opportunities and risks in the context of the digital transformation. The centre of the wheel corresponds to the lowest outcome observed across all OECD countries, while the outer circle corresponds to the highest outcome. For opportunities (in dark blue) longer bars indicate better outcomes, whereas for risks (in yellow), longer bars indicate worse outcomes. If data are missing for any given indicator, the relevant segment of the circle is shaded in white.

StatLink http://dx.doi.org/10.1787/888933909331

How's life in the digital age in Estonia?

Estonia belongs to the group of countries with a relatively high performance in opportunities and low risks, as compared to the OECD average. People in Estonia have high levels of **access to the internet** and use it for a large range of purposes, for instance to get access to **health information online**. The government has embraced a strong e-government strategy, which is not impeded by **lack of skills to use e-government services,** as Estonia ranks first in this regard. The labour market provides substantial **returns to ICT skills,** and **employment in information industries** as a share of total employment is the second largest among OECD countries. There is still scope for improvement, as about one fourth of Estonian people report having experienced **digital security incidents** (versus 19% on average among the OECD) and 24% of **teachers report lacking ICT skills**, as compared to 20% on average among OECD countries. While the share of **extreme Internet users** among children is slightly above the average, Estonia records fairly low levels of **cyberbullying**, especially compared to the other two Baltic States, where this problem is more prevalent.

Figure 4.8. The digital well-being wheel in Estonia



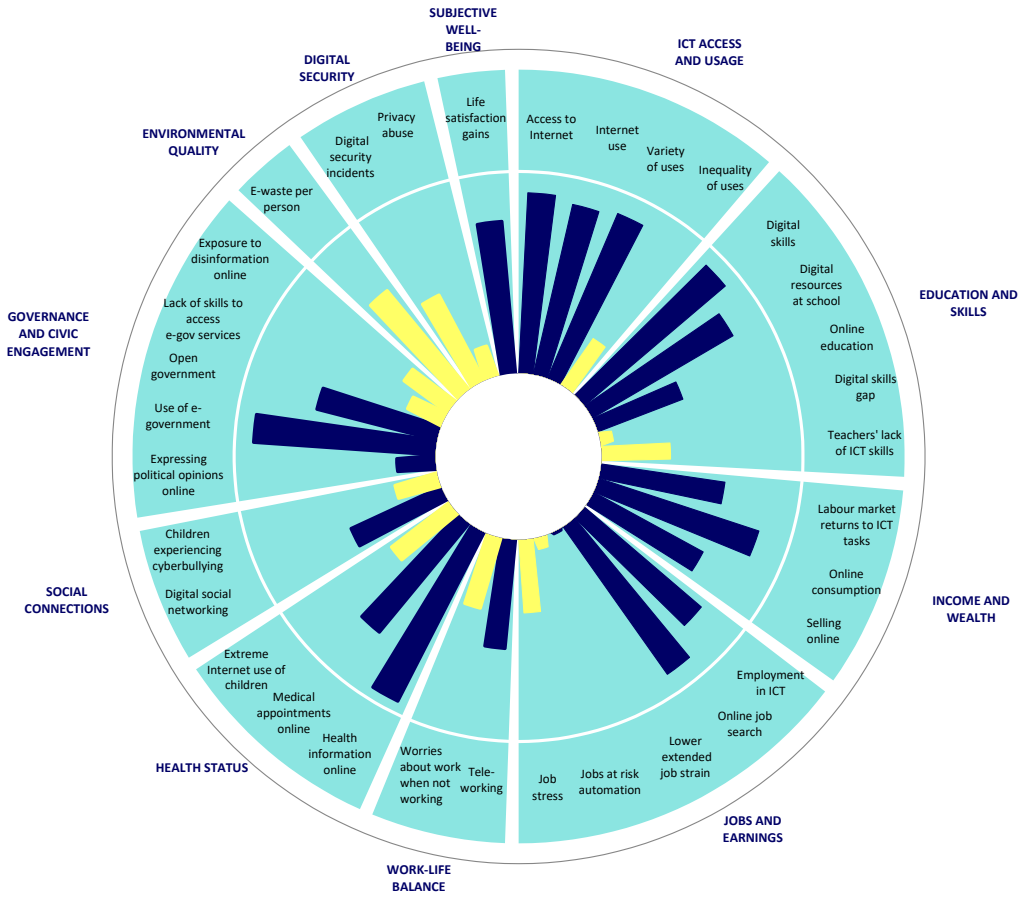
Note: This wheel depicts **Estonia**'s relative performance in terms of key opportunities and risks in the context of the digital transformation. The centre of the wheel corresponds to the lowest outcome observed across all OECD countries, while the outer circle corresponds to the highest outcome. For opportunities (in dark blue) longer bars indicate better outcomes, whereas for risks (in yellow), longer bars indicate worse outcomes. If data are missing for any given indicator, the relevant segment of the circle is shaded in white.

StatLink http://dx.doi.org/10.1787/888933909350

How's life in the digital age in Finland?

Finland enjoys many of the opportunities and benefits of the digital transformation, relative to other OECD countries. **Access and use of the Internet** and the **variety of activities** that people use the Internet for is high compared to other countries, and **life satisfaction gains** are relatively high. At the same time, the level of **inequality of uses of the Internet** is low relative to OECD countries. At 5.6% of employment, information industries **contribute significantly to employment** in Finland, digital skills are digital resources in education are high and few jobs are at risk of automation relative to OECD countries, but related **job strain** is at the OECD average, and digitalisation is **not reducing job strain** in Finland. People in Finland use the internet at high rates for consumption, to search for jobs, use e-government and seek health information, but less for social networking, relative to OECD countries. At 21kg e-waste per inhabitant, Finland is above the OECD average in pollution from electronic waste.

Figure 4.9. The digital well-being wheel in Finland



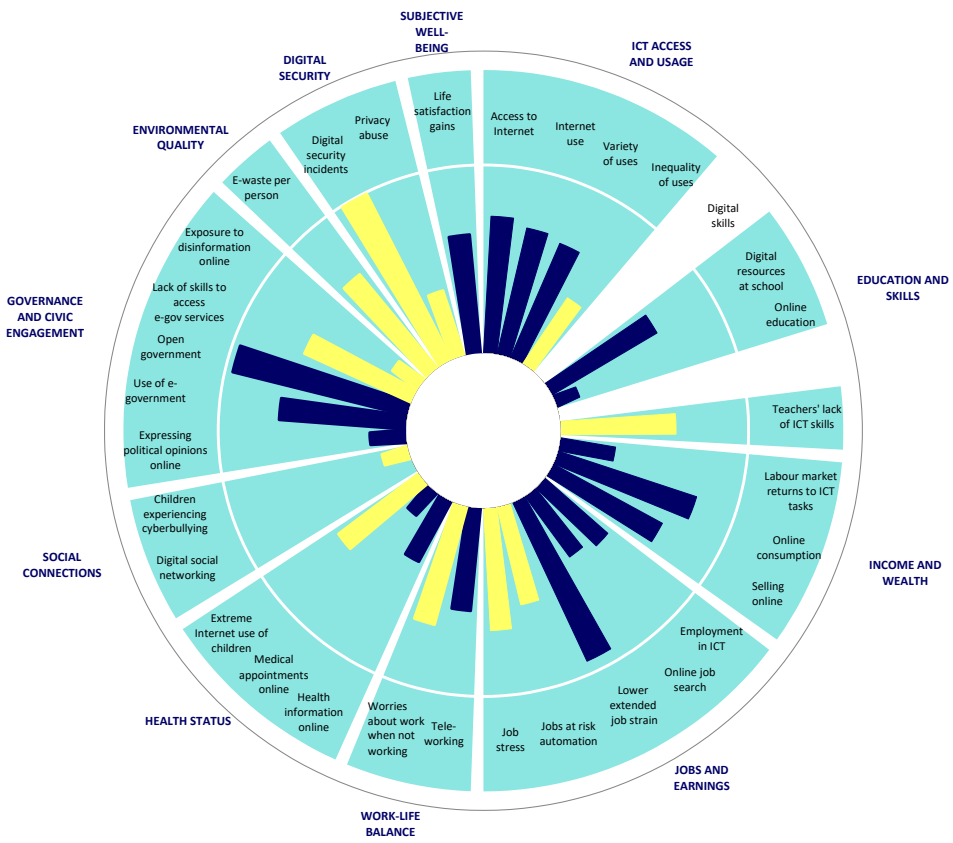
Note: This wheel depicts **Finland**'s relative performance in terms of key opportunities and risks in the context of the digital transformation. The centre of the wheel corresponds to the lowest outcome observed across all OECD countries, while the outer circle corresponds to the highest outcome. For opportunities (in dark blue) longer bars indicate better outcomes, whereas for risks (in yellow), longer bars indicate worse outcomes. If data are missing for any given indicator, the relevant segment of the circle is shaded in white.

StatLink http://dx.doi.org/10.1787/888933909369

How's life in the digital age in France?

France benefits in some ways from the digital transformation, but it is also more exposed to digital risks relative to other OECD countries. 28% of people in France report having experienced **online security incidents**, one of the highest rates in the OECD, and extreme use of the Internet by children is higher than the OECD average. While **schools are equipped** with digital resources, teachers report **lacking necessary ICT skills** more often than in the OECD on average. **Internet use and access,** and the **variety of activities** that people use the Internet for is higher than in other countries but the level of **inequality of uses of the Internet** is close to the OECD average. France ranks as one of the highest in the OECD for **government data availability and accessibility**, according to the *OURdata Index*. In France, the **life satisfaction gains** from using the Internet are slightly higher than the OECD average due to a relatively high share of Internet users, and there is **lower job strain** associated with computer use, but the high share of computer-based workers relative to other OECD countries is associated with a higher risk of **worries about work outside of work hours**.

Figure 4.10. The digital well-being wheel in France



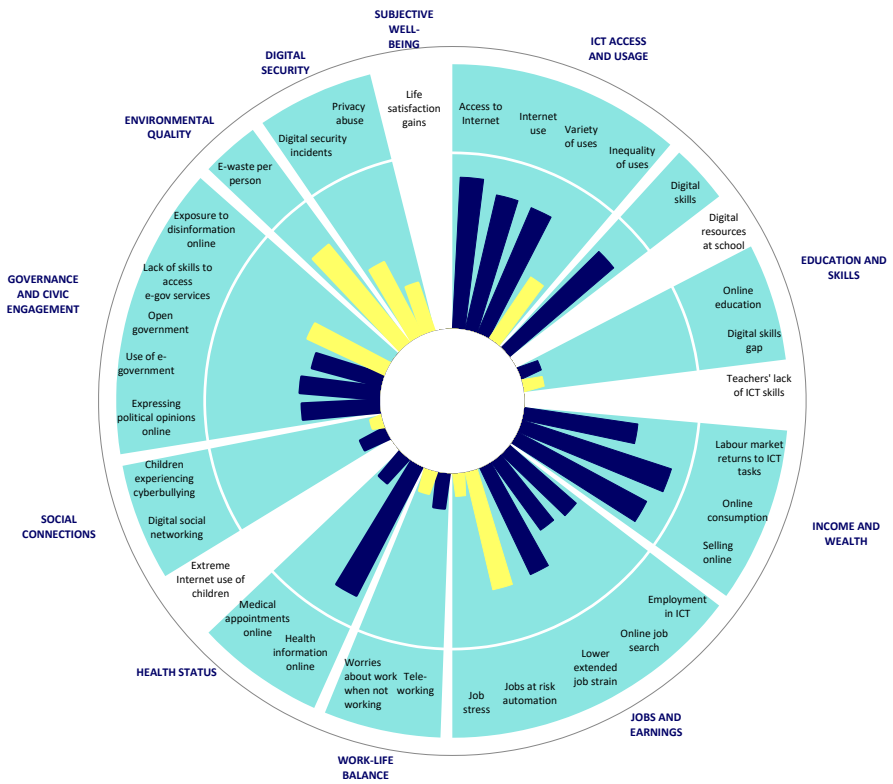
Note: This wheel depicts **France**'s relative performance in terms of key opportunities and risks in the context of the digital transformation. The centre of the wheel corresponds to the lowest outcome observed across all OECD countries, while the outer circle corresponds to the highest outcome. For opportunities (in dark blue) longer bars indicate better outcomes, whereas for risks (in yellow), longer bars indicate worse outcomes. If data are missing for any given indicator, the relevant segment of the circle is shaded in white.

StatLink http://dx.doi.org/10.1787/888933909388

How's life in the digital age in Germany?

In general, Germany performs relatively well across the different well-being dimensions in the context of the digital age, as it reaps more opportunities than the average OECD country and is subject to fewer risks. The **share of people who use the Internet** and the **variety of activities** that people use the Internet for is high compared to other OECD countries. German adults are in the top tier when it comes to **digital skills**, with 37% of people scoring at an intermediate level in problem-solving in technology-rich environments, which comes with a low **digital skills gap**. By contrast, Germany is facing high risk of **job automation,** with a total of 54.2% of jobs at risk of automation. The relatively low share of workers with computer-based jobs does limit the job stress and **worries about work when not working** associated with digital jobs. The **exposure to disinformation** is one of the lowest in OECD countries (9%). At the same time, the number of people reporting that they could not **access e-government services due to lack of skills** is slightly above the OECD average. In addition, efforts to **open government data** in Germany are limited compared to other countries, according to the OECD OURdata Index.

Figure 4.11. The digital well-being wheel in Germany



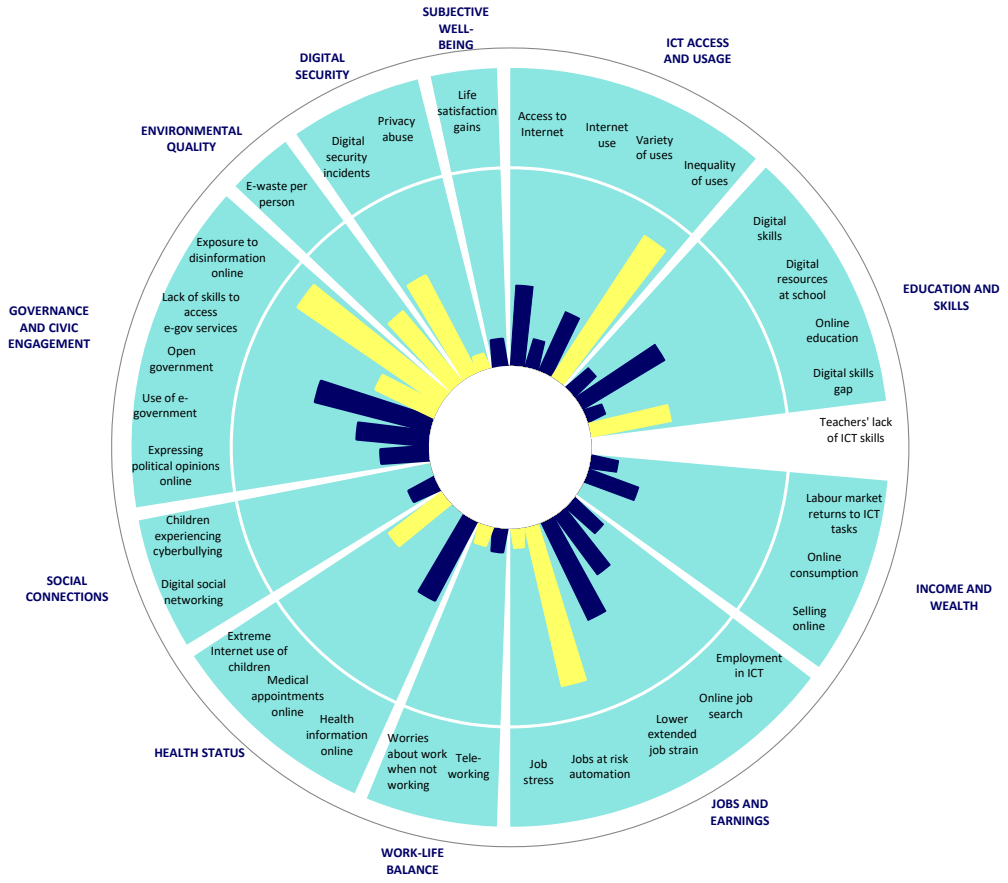
Note: This wheel depicts **Germany**'s relative performance in terms of key opportunities and risks in the context of the digital transformation. The centre of the wheel corresponds to the lowest outcome observed across all OECD countries, while the outer circle corresponds to the highest outcome. For opportunities (in dark blue) longer bars indicate better outcomes, whereas for risks (in yellow), longer bars indicate worse outcomes. If data are missing for any given indicator, the relevant segment of the circle is shaded in white.

StatLink http://dx.doi.org/10.1787/888933909407

How's life in the digital age in Greece?

The digital transformation entails more risks than benefits in Greece, relative to other OECD countries. **Internet access and use**, as well as the **variety of activities** that people use the Internet for is low compared to other countries. At the same time, the level of **inequality of uses of the Internet** is among the highest of OECD countries. In the job market, **information industries** do not add significantly to **employment**, and **many jobs are at risk of automation** relative to OECD countries. However, due to the low share of computer-based jobs, few people report **worries about work outside of work hours**. **Digital skills** of the adult population are among the lowest in the OECD, and students in Greece have access to **fewer digital resources** at schools, but only 4% of students report experiencing **cyberbullying**, the lowest rate in the OECD. While people in Greece do not use the Internet much for **consumption**, **e-government**, or **job search**, they do report comparatively high **exposure to disinformation online**.

Figure 4.12. The digital well-being wheel in Greece



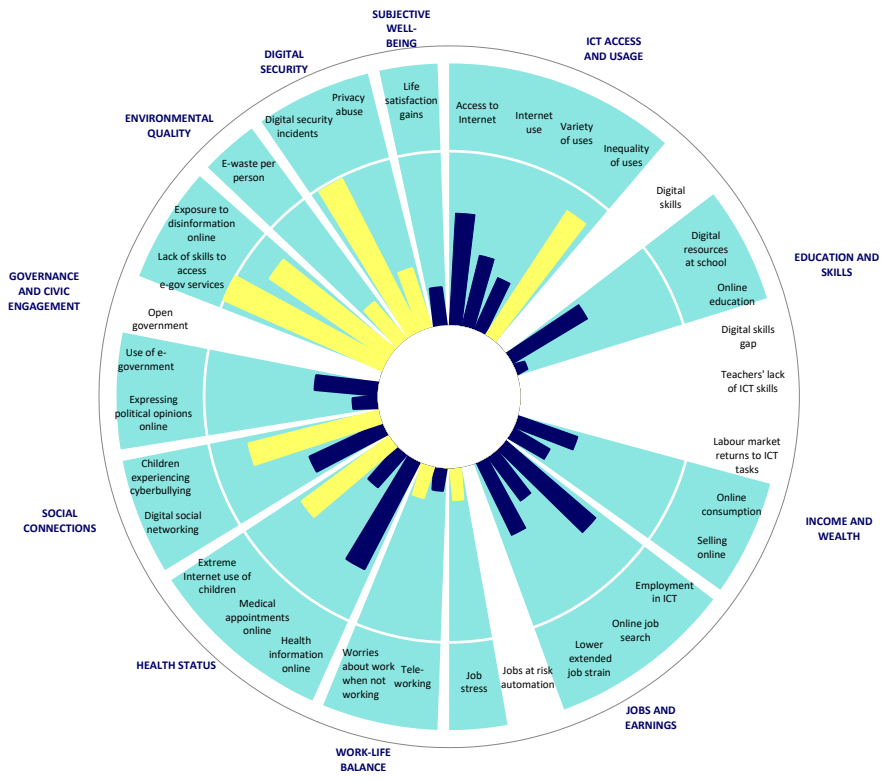
Note: This wheel depicts **Greece**'s relative performance in terms of key opportunities and risks in the context of the digital transformation. The centre of the wheel corresponds to the lowest outcome observed across all OECD countries, while the outer circle corresponds to the highest outcome. For opportunities (in dark blue) longer bars indicate better outcomes, whereas for risks (in yellow), longer bars indicate worse outcomes. If data are missing for any given indicator, the relevant segment of the circle is shaded in white.

StatLink http://dx.doi.org/10.1787/888933909426

How's life in the digital age in Hungary?

Compared to other OECD countries, Hungary is highly exposed to the risks of the digital transformation, while only experiencing limited benefits from its opportunities. Hungary has a very high level of **inequality of Internet uses**. Despite limited **use of Internet**, Hungary is in the top three of OECD countries in the share of people reporting **digital security incidents**. While there is no data on **digital skills,** Hungary is the country with the highest share of people reporting **lack of skills** as a reason not to use **e-government services**. However, national data show that 29% of Hungarian people have submitted completed forms to public authorities' websites, which is in line with the EU average. The Internet is not widely used for key economic activities such as **online consumption** and **finding jobs online**, although the **share of information industries in employment** is well above the OECD average. While comparatively few people use the Internet to **express political opinions**, many people report having been **exposed to disinformation**. Furthermore, children are particularly affected by online risks: the share of **extreme Internet users** among children is above the OECD average and Hungary ranks second in terms of children reporting **cyberbullying**.

Figure 4.13. The digital well-being wheel in Hungary



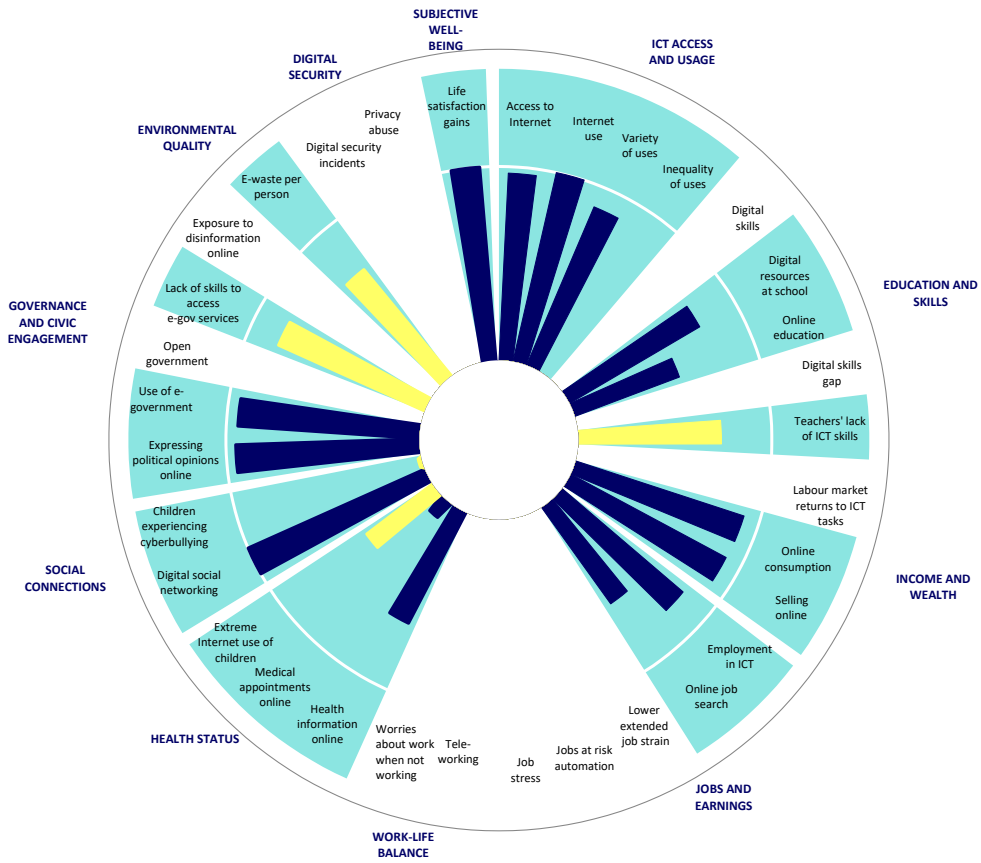
Note: This wheel depicts **Hungary**'s relative performance in terms of key opportunities and risks in the context of the digital transformation. The centre of the wheel corresponds to the lowest outcome observed across all OECD countries, while the outer circle corresponds to the highest outcome. For opportunities (in dark blue) longer bars indicate better outcomes, whereas for risks (in yellow), longer bars indicate worse outcomes. If data are missing for any given indicator, the relevant segment of the circle is shaded in white.

StatLink http://dx.doi.org/10.1787/888933909445

How's life in the digital age in Iceland?

Overall, Iceland is a country that benefits highly from the opportunities provided by the internet while having only average exposure to the risks. Iceland ranks third among OECD countries in **Internet access** and first in **Internet use**. The country ranks first in the use of **online social networking sites**, and it ranks second in the **expression of political opinions online**, the **selling of goods and services** using the Internet, and the **use of e-government services**. Because of high levels of Internet access, the associated **life satisfaction gains** are very high compared to other countries. Despite the high use of internet in Iceland, the share of **children using the Internet more than 6 hours on a weekend day** is lower than the OECD average and the share of children experiencing **cyberbullying** in Iceland is among the lowest in the OECD. However, people in Iceland do sometimes feel limited by their ICT skills, with almost 30% of the teachers reporting a high need to develop **ICT skills for teaching**, and 8.4% of the population report lacking skills to access e-government services.

Figure 4.14. The digital well-being wheel in Iceland



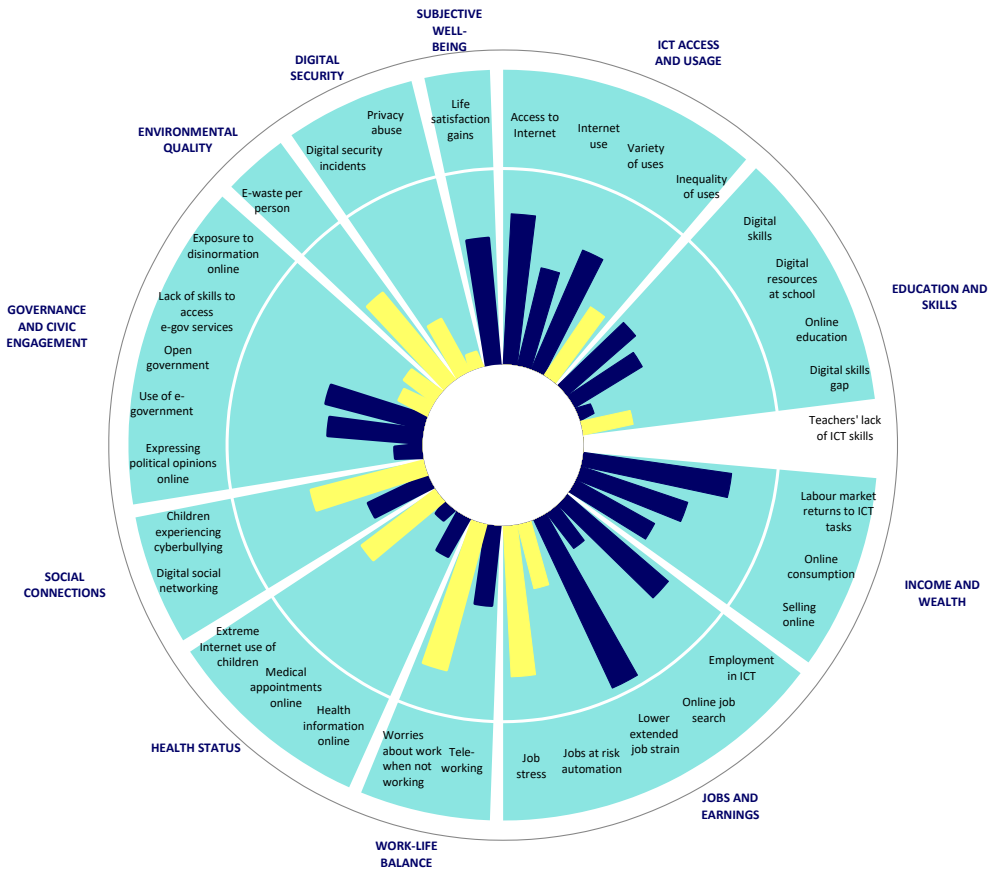
Note: This wheel depicts **Iceland**'s relative performance in terms of key opportunities and risks in the context of the digital transformation. The centre of the wheel corresponds to the lowest outcome observed across all OECD countries, while the outer circle corresponds to the highest outcome. For opportunities (in dark blue) longer bars indicate better outcomes, whereas for risks (in yellow), longer bars indicate worse outcomes. If data are missing for any given indicator, the relevant segment of the circle is shaded in white.

StatLink http://dx.doi.org/10.1787/888933909464

How's life in the digital age in Ireland?

Ireland shows average performance both in exposure to the risks of the digital transformation as well as in the extent to which it reaps the benefits. While **Internet access** is above the OECD average, **Internet use** is slightly below, as are adult **digital skills**. At the same time, **digital security risks** are low, and very few people in Ireland report having been **exposed to disinformation**. Irish 15-year-olds report incidents of **cyberbullying** at comparatively high rates and are more likely to **use the Internet for extreme use**, but students have less **access to digital resources** than in most OECD countries, and only 4.4% of people report using **online education** over the past 3 months – well below the OECD average. In Ireland, information industries contribute significantly to employment with a **4% of total employment**, higher than the OECD average, but the share of computer-based jobs is also associated with higher rates of **job stress** and **worries about work outside of work hours** than in other OECD countries, although also benefit a fair amount from **lower extended job strain**.

Figure 4.15. The digital well-being wheel in Ireland



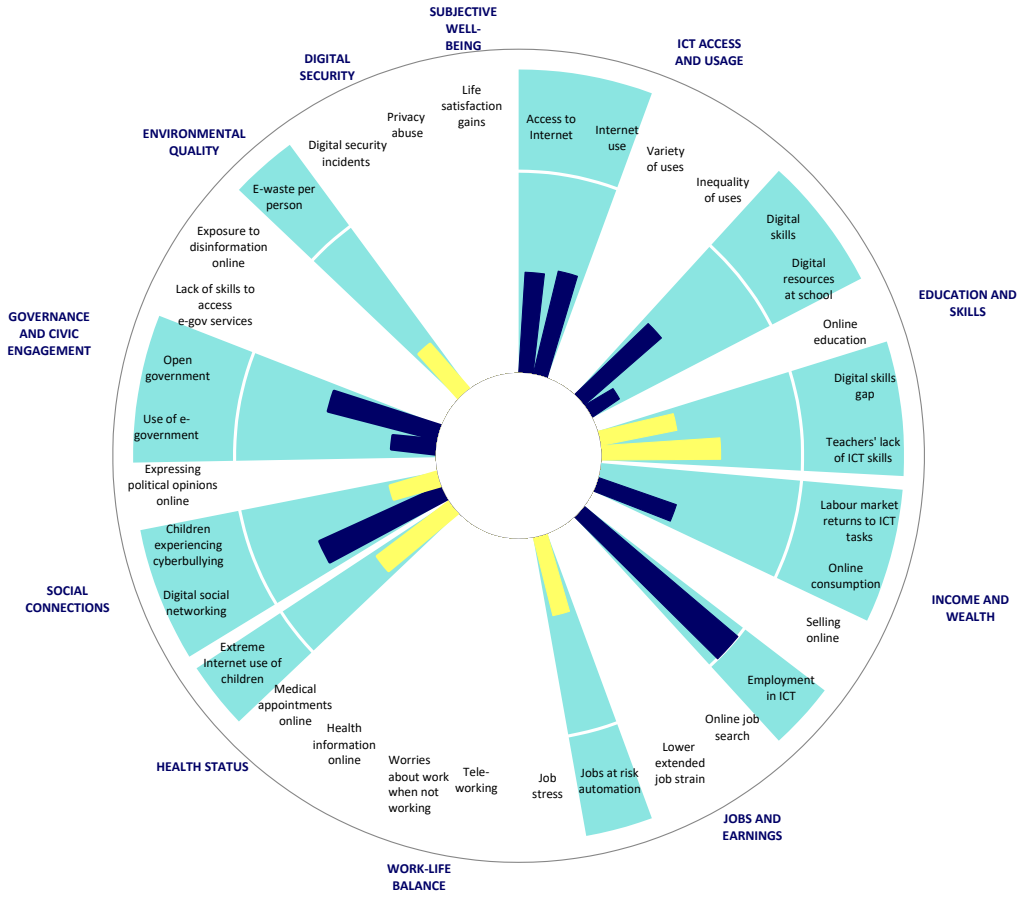
Note: This wheel depicts **Ireland**'s relative performance in terms of key opportunities and risks in the context of the digital transformation. The centre of the wheel corresponds to the lowest outcome observed across all OECD countries, while the outer circle corresponds to the highest outcome. For opportunities (in dark blue) longer bars indicate better outcomes, whereas for risks (in yellow), longer bars indicate worse outcomes. If data are missing for any given indicator, the relevant segment of the circle is shaded in white.

StatLink http://dx.doi.org/10.1787/888933909483

How's life in the digital age in Israel?

Unfortunately, data limitations prevent a comprehensive analysis of the opportunities and risks of the digital transformation in Israel. Available indicators suggest that Israel's performance in opportunities and risks is relatively mixed. Israel stands out in **employment in information industries**, with the highest share recorded across the OECD. Despite this, the **labour market returns to ICT tasks** are very low. In addition, both **Internet access** and **use of the Internet** are slightly below the OECD average: 75% of households in Israel have a broadband Internet connection, compared to an average of 78%. In schools, too, the availability of **digital resources** is below the OECD average, with 55% of students reporting having access and using Internet connected school computers. Israel performs relatively well in the area of social connections, with 74% of people **using online social networking sites**, and less than average rates of children exposed to cyberbullying.

Figure 4.16. The digital well-being wheel in Israel



Note: This wheel depicts **Israel**'s relative performance in terms of key opportunities and risks in the context of the digital transformation. The centre of the wheel corresponds to the lowest outcome observed across all OECD countries, while the outer circle corresponds to the highest outcome. For opportunities (in dark blue) longer bars indicate better outcomes, whereas for risks (in yellow), longer bars indicate worse outcomes. If data are missing for any given indicator, the relevant segment of the circle is shaded in white.

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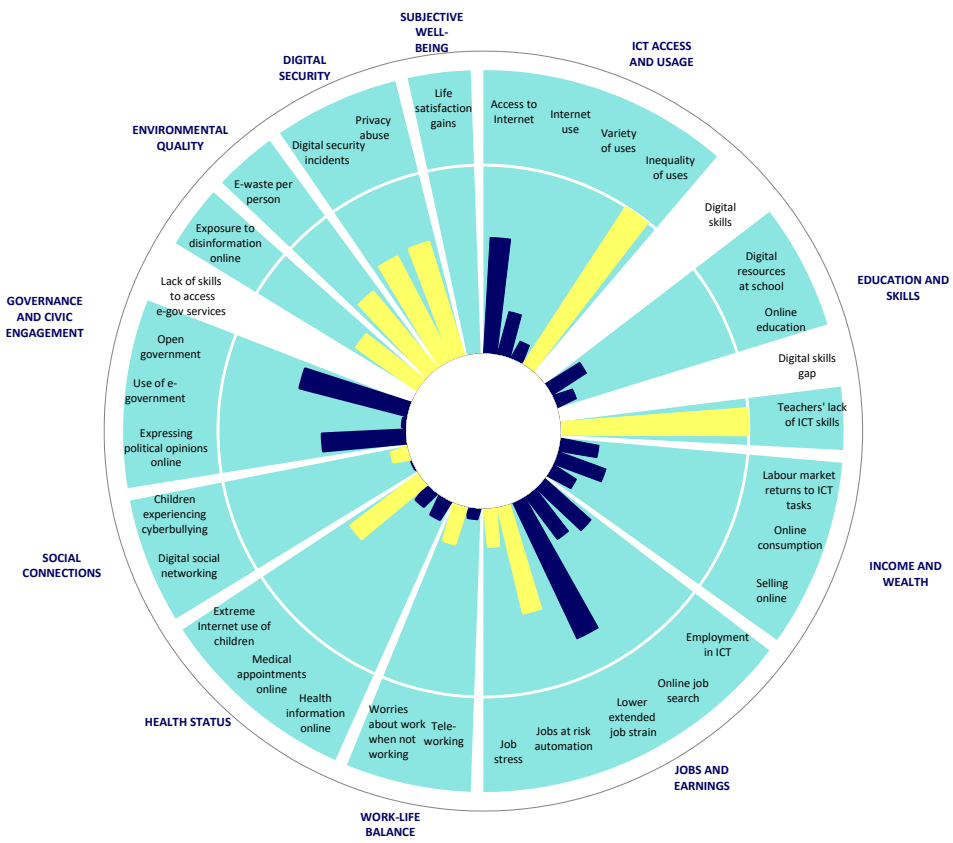
How's life in the digital age in Italy?

Italy is more exposed to the risks of the digital transformation than it reaps the benefits, relative to other OECD countries. **Internet use** and the **variety of activities** that people use the Internet for is low compared to other countries. At the same time, the level of **inequality of uses of the Internet** is among the highest of OECD countries, meaning that while a small group of people use the Internet for a broad range of activities, the majority of people has not benefited from a large variety of online uses. Because relatively few people use the Internet compared to other OECD countries, the **life satisfaction gains** from having access to the Internet are comparatively small. People in Italy have benefited a fair amount from **lower extended job strain** due to computer-based jobs, but information industries **contribute relatively little to overall employment** and an estimated 15% of jobs are at **high risk of automation**, which is above the OECD average. Italy is exposed to a few other key risks of the digital transformation, most notably a widely reported **lack of ICT skills among teachers**, with 36% of teachers indicating a high need to develop their ICT skills.

Figure 4.17. The digital well-being wheel in Italy



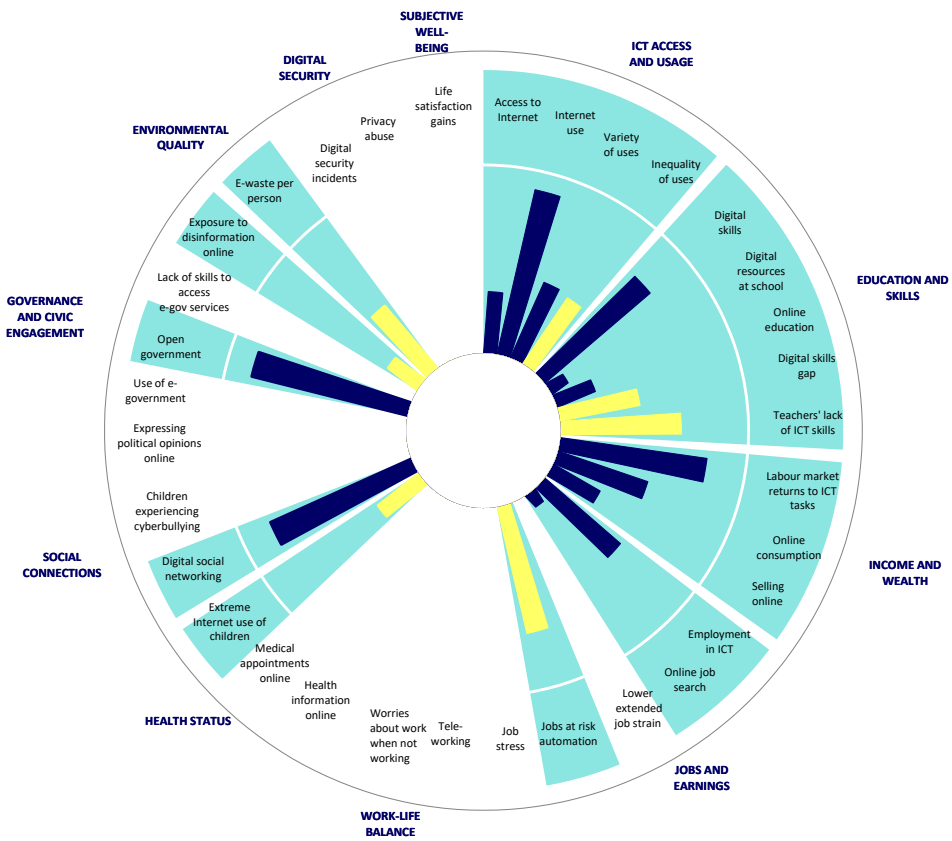
Note: This wheel depicts **Italy**'s relative performance in terms of key opportunities and risks in the context of the digital transformation. The centre of the wheel corresponds to the lowest outcome observed across all OECD countries, while the outer circle corresponds to the highest outcome. For opportunities (in dark blue) longer bars indicate better outcomes, whereas for risks (in yellow), longer bars indicate worse outcomes. If data are missing for any given indicator, the relevant segment of the circle is shaded in white.

StatLink http://dx.doi.org/10.1787/888933909521

How's life in the digital age in Japan?

Unfortunately, data limitations prevent a comprehensive analysis of the opportunities and risks of the digital transformation in Japan. Overall, Japan's performance in terms of opportunities and risks of the digital transformation is mixed. Figures for **ICT access** are relatively low compared to other OECD countries, which may partially be explained by differences in methodology. The share of people **using the Internet**, however, is well above the OECD average, at 95%. **Digital skills** in Japan are relatively high, with 35% of people scoring at an intermediate level of skills, compared to 30% on average in the OECD. The return on these skills in Japan is substantial: the **labour market returns to ICT tasks** are the third highest in the OECD. At the same time, Japan's labour market is relatively exposed to **job automation**, with 39% of jobs estimated to be at risk. In the area of governance and civic engagement, Japan scores very high in the availability and accessibility of **open government data**, according to the OECD OURdata Index. Moreover, 17% of people in Japan report having **encountered disinformation** in the past week, which is well below the OECD average of 27%.

Figure 4.18. The digital well-being wheel in Japan



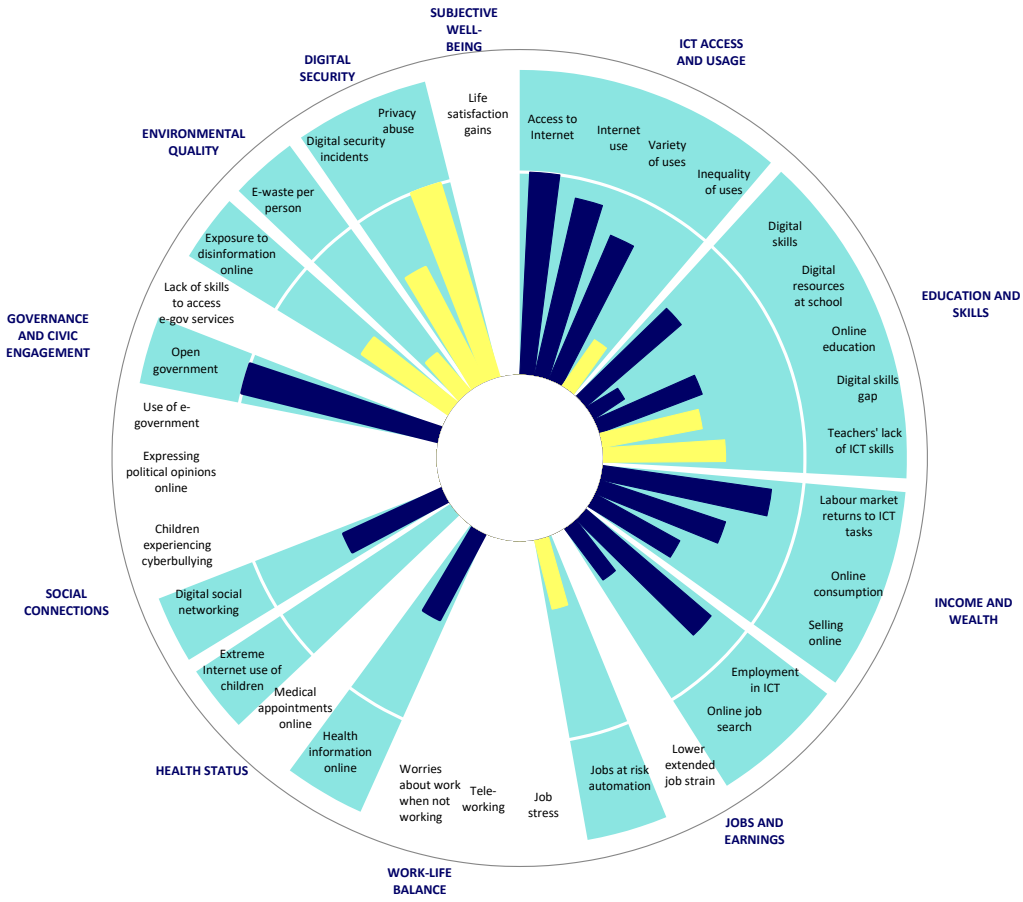
Note: This wheel depicts **Japan**'s relative performance in terms of key opportunities and risks in the context of the digital transformation. The centre of the wheel corresponds to the lowest outcome observed across all OECD countries, while the outer circle corresponds to the highest outcome. For opportunities (in dark blue) longer bars indicate better outcomes, whereas for risks (in yellow), longer bars indicate worse outcomes. If data are missing for any given indicator, the relevant segment of the circle is shaded in white.

StatLink http://dx.doi.org/10.1787/888933909540

How's life in the digital age in Korea?

A number of indicators of the digital well-being wheel are missing for Korea, particularly in the dimensions of Governance and Civic Engagement and Work-Life Balance. Korea has the **highest level of broadband Internet access** in the OECD (99.5%). A large **variety of Internet activities** are used by a majority of the population and these uses are evenly distributed across the population, relative to other OECD countries. Korea also boasts a relatively high share of **jobs in information industries**. In Korea, 10.4% of jobs are at **high risk of automation**, which is just below the OECD average. In comparison with other OECD countries, Korea produces a small amount of **electronic waste**. Key risks of the digital transformation for Korea are in the dimension of security, with 6% of Koreans having experienced an **incident of privacy abuse** online, the highest share inside the OECD. Furthermore, relatively few Korean students have access to **digital resources at school**, and a comparatively high share of teachers report **lacking sufficient ICT skills** to use such resources.

Figure 4.19. The digital well-being wheel in Korea



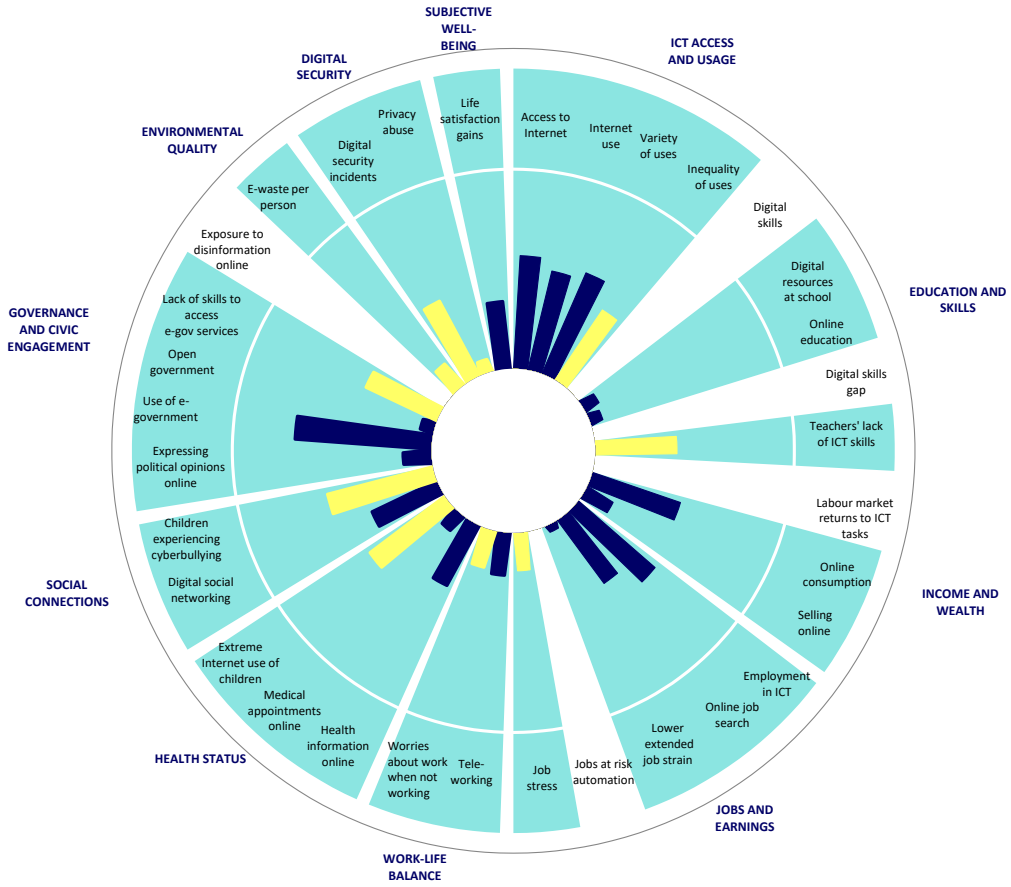
Note: This wheel depicts **Korea**'s relative performance in terms of key opportunities and risks in the context of the digital transformation. The centre of the wheel corresponds to the lowest outcome observed across all OECD countries, while the outer circle corresponds to the highest outcome. For opportunities (in dark blue) longer bars indicate better outcomes, whereas for risks (in yellow), longer bars indicate worse outcomes. If data are missing for any given indicator, the relevant segment of the circle is shaded in white.

StatLink http://dx.doi.org/10.1787/888933909559

How's life in the digital age in Latvia?

Latvia's exposure to both the opportunities and risks of the digital transformation is below the OECD average, which reflects the country's limited degree of digitalisation relative to other OECD countries. Almost 80% of households in Latvia now have **Internet access at home**, which is just above the OECD average. However, 82% of individuals in Latvia report having **used the internet** in the last 12 months, which is slightly below the OECD average. Only 7% of people in Latvia use the Internet to **express political opinions online**, and an equal figure uses it for **medical appointments** – both are below the OECD average. The major risks associated with internet in Latvia are those that affect children, 24% of which are identified as **extreme Internet users,** and **cyberbullying** is more common in Latvia than it is in most other OECD countries, just like in neighbouring Lithuania. The main opportunity of the digital age that stands out in Latvia is in the use of e-**government services**, which are used by 69% of people.

Figure 4.20. The digital well-being wheel in Latvia



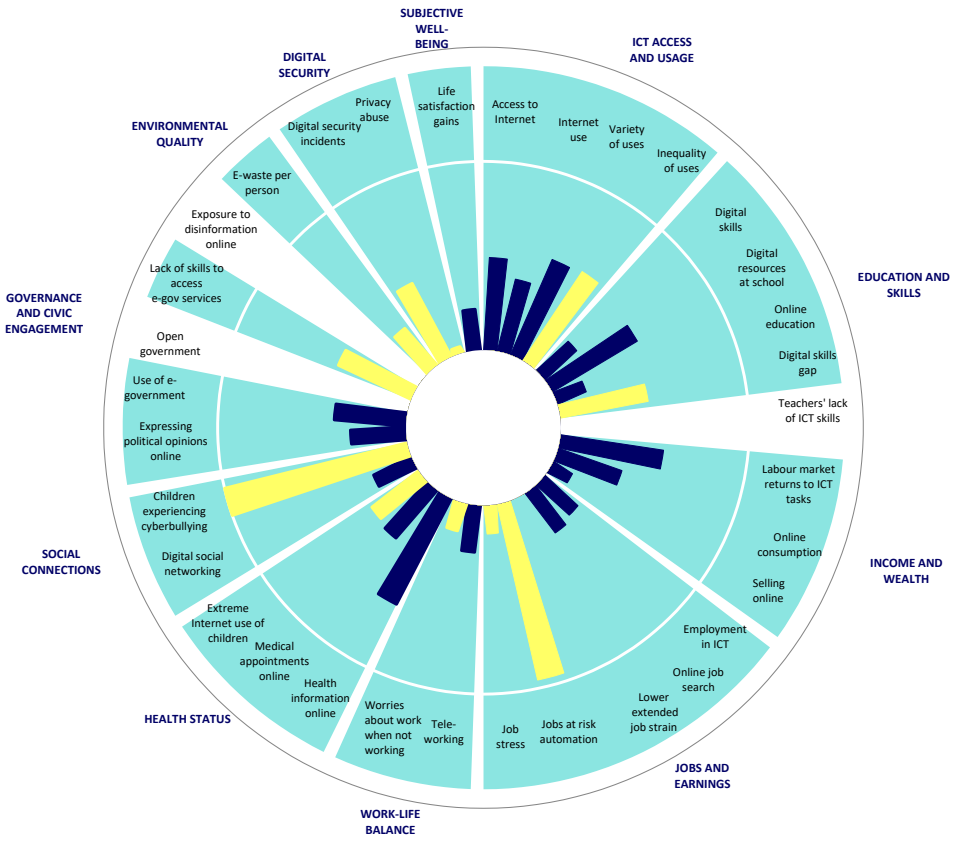
Note: This wheel depicts **Latvia**'s relative performance in terms of key opportunities and risks in the context of the digital transformation. The centre of the wheel corresponds to the lowest outcome observed across all OECD countries, while the outer circle corresponds to the highest outcome. For opportunities (in dark blue) longer bars indicate better outcomes, whereas for risks (in yellow), longer bars indicate worse outcomes. If data are missing for any given indicator, the relevant segment of the circle is shaded in white.

StatLink http://dx.doi.org/10.1787/888933909578

How's life in the digital age in Lithuania?

Overall, Lithuania's exposure to the risks of the digital transformation is relatively high compared to the degree to which it reaps the benefits. In general, Lithuania's exposure to the digital transformation remains limited, with relatively low levels of Internet access and internet use. The share of households with **broadband Internet access** remains well below the OECD average at 75%, although this is a substantial increase with respect to the 2005 level. Lithuania's performance in **digital skills** is low compared to other OECD countries: only 17% of adults score at an intermediate level in the PIAAC problem-solving test. At the same time, people in Lithuania are exposed to some key risks. The share of **jobs at risk of automation** is the second highest in the OECD at an estimated 42%. In addition, Lithuania has a higher share of children reporting to be the victim of **cyberbullying** than any other OECD country. In other dimensions such as work-life balance, the digital transformation has had relatively little impact compared to other countries: both opportunities from **teleworking** and risks of **worries about working associated** with computer-based jobs are limited.

Figure 4.21. The digital well-being wheel in Lithuania



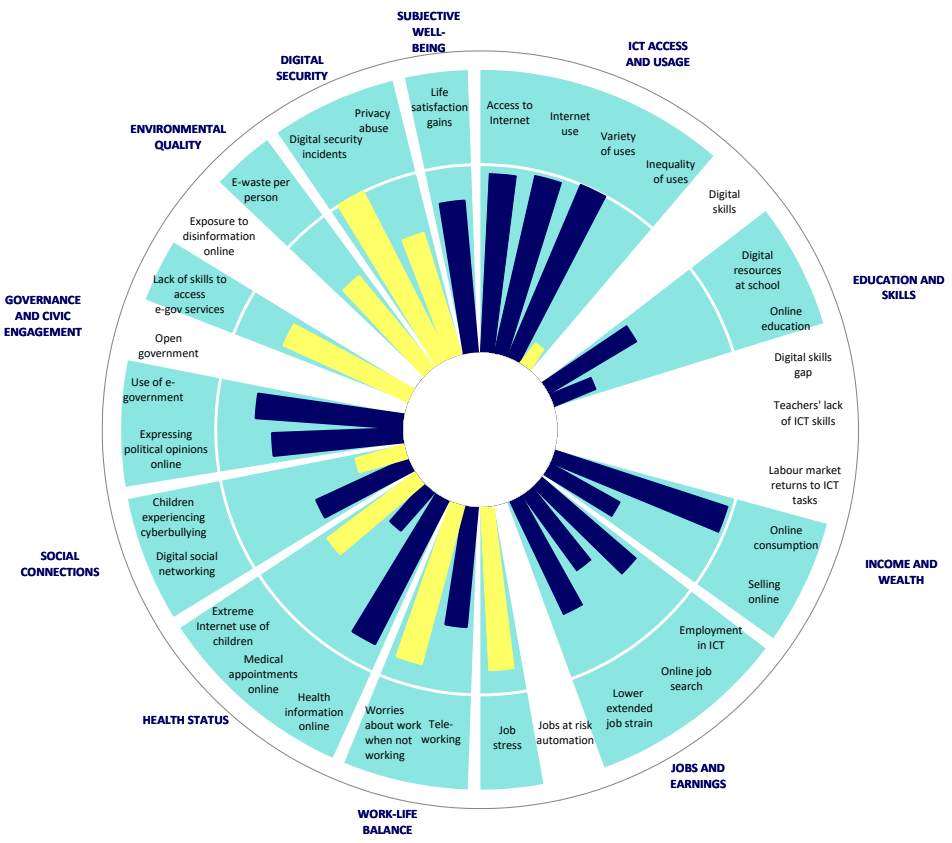
Note: This wheel depicts **Lithuania**'s relative performance in terms of key opportunities and risks in the context of the digital transformation. The centre of the wheel corresponds to the lowest outcome observed across all OECD countries, while the outer circle corresponds to the highest outcome. For opportunities (in dark blue) longer bars indicate better outcomes, whereas for risks (in yellow), longer bars indicate worse outcomes. If data are missing for any given indicator, the relevant segment of the circle is shaded in white.

StatLink http://dx.doi.org/10.1787/888933909597

How's life in the digital age in Luxembourg?

Compared to other OECD countries, Luxembourg benefits highly from the opportunities offered by the Internet but is also exposed to substantial risks. In Luxembourg, the levels of **Internet access**, **Internet use**, and **variety of uses** of the Internet are among the highest in the OECD. Compared to other OECD countries, a large share of the population in Luxembourg uses the Internet in a range of dimensions, such as for the purpose of **online consumption** and finding **health information online**. These benefits are also relatively equally distributed across the population. On the other hand, the data show that Luxembourg is highly exposed to risks in the dimension of digital security; it ranks first in the share of people reporting **online security incidents** among OECD countries. Because of the large share of workers with computer-based jobs, Luxembourg is particularly exposed to the adverse effects of **job stress** and **worries about work when not working**. Luxembourg is also above the OECD average with respect to the share of people who **lack** the **skills to access e-government services** and in terms of e-waste per person.

Figure 4.22. The digital well-being wheel in Luxembourg



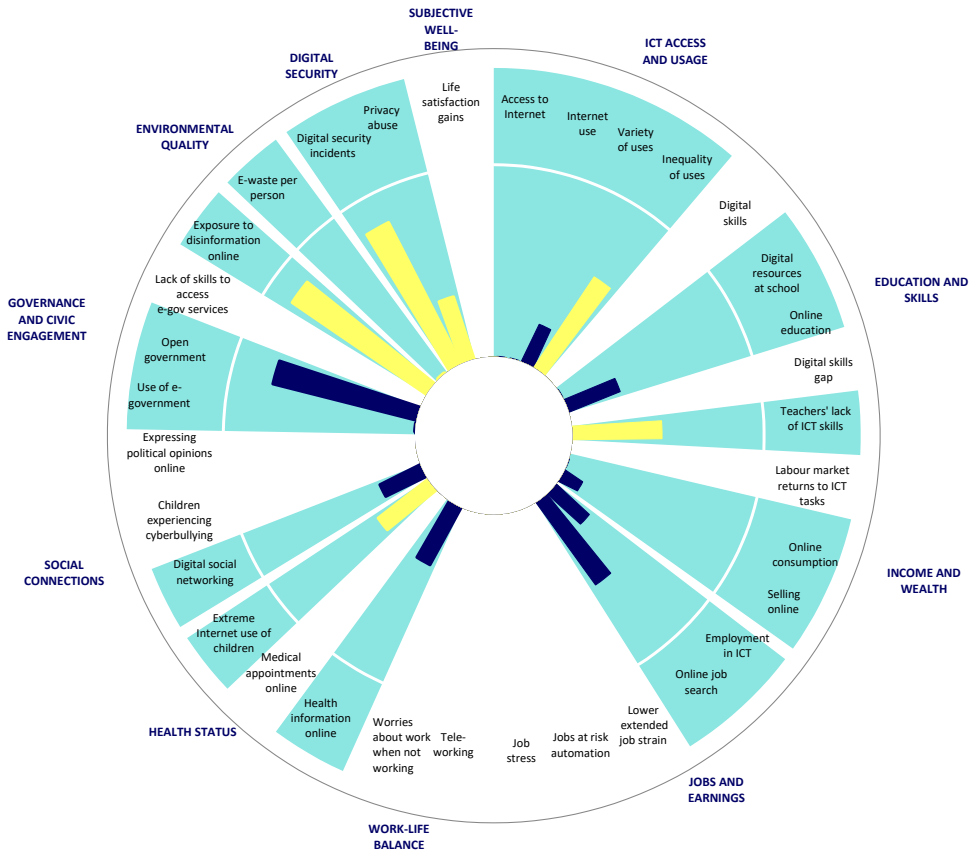
Note: This wheel depicts **Luxembourg**'s relative performance in terms of key opportunities and risks in the context of the digital transformation. The centre of the wheel corresponds to the lowest outcome observed across all OECD countries, while the outer circle corresponds to the highest outcome. For opportunities (in dark blue) longer bars indicate better outcomes, whereas for risks (in yellow), longer bars indicate worse outcomes. If data are missing for any given indicator, the relevant segment of the circle is shaded in white.

StatLink http://dx.doi.org/10.1787/888933909616

How's life in the digital age in Mexico?

Unfortunately, a large number of indicators are missing for Mexico, limiting a comprehensive assessment of impacts. Where data exists, evidence suggests that people in Mexico benefit from the opportunities of the digital transformation to a limited degree, whereas a number of risks are present. Access to Internet remains limited in Mexico, which has the lowest share of **households connected to broadband Internet**, at 51%, as well as the lowest **share of Internet users**. In addition, fewer Mexican students have access to **digital resources at school** than in any other OECD country. Key online activities, such as **online education** or **searching for health information online** are not widely leveraged, compared to other OECD countries. In addition, Mexico is relatively exposed to the spread of **disinformation online**: 43% of Mexicans report having experienced this in the past week – the third highest share across the OECD. At the same time, Mexico has made strides to publish **open government data** and ranks in the top tier in this area.

Figure 4.23. The digital well-being wheel in Mexico



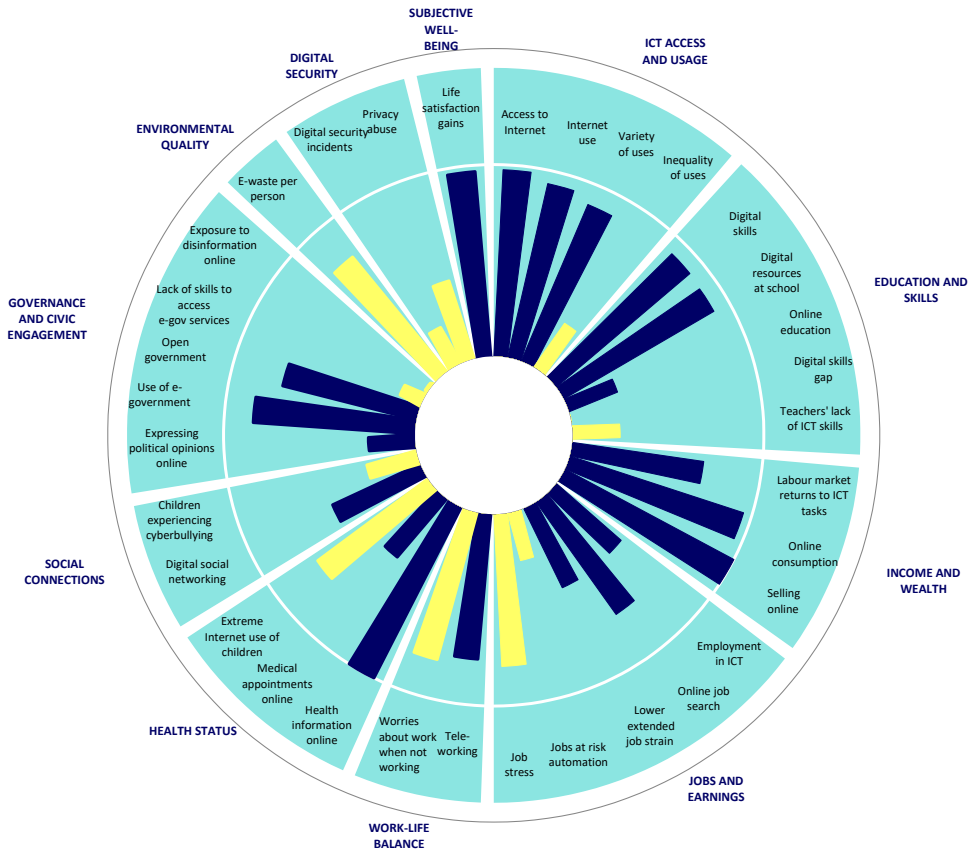
Note: This wheel depicts **Mexico**'s relative performance in terms of key opportunities and risks in the context of the digital transformation. The centre of the wheel corresponds to the lowest outcome observed across all OECD countries, while the outer circle corresponds to the highest outcome. For opportunities (in dark blue) longer bars indicate better outcomes, whereas for risks (in yellow), longer bars indicate worse outcomes. If data are missing for any given indicator, the relevant segment of the circle is shaded in white.

StatLink http://dx.doi.org/10.1787/888933909635

How's life in the digital age in the Netherlands?

People in the Netherlands benefit substantially from the opportunities offered by the digital transformation compared to other OECD countries, yet they are also exposed to a few key risks. **Access to Internet and Internet use**, both in terms of the share of users and the variety of online **activities** that people participate in are high compared to other OECD countries. People in the Netherlands have relatively **high levels of digital skills**, and these skills are relatively equally distributed across the population. This allows high levels of participation in key online activities in various well-being dimensions, and 37% of Dutch people engage in the **online sale of goods and services**, more than in any other OECD country. They are also among the most avid **tele-workers** in the OECD. However, the high prevalence of computer-based jobs also means that a relatively large share of workers experience **job stress** and **worries about work outside of work time**. In addition, children in the Netherlands are relatively prone to extreme use of the Internet, with 33% of children using the Internet for more than six hours on a typical weekend day.

Figure 4.24. The digital well-being wheel in the Netherlands



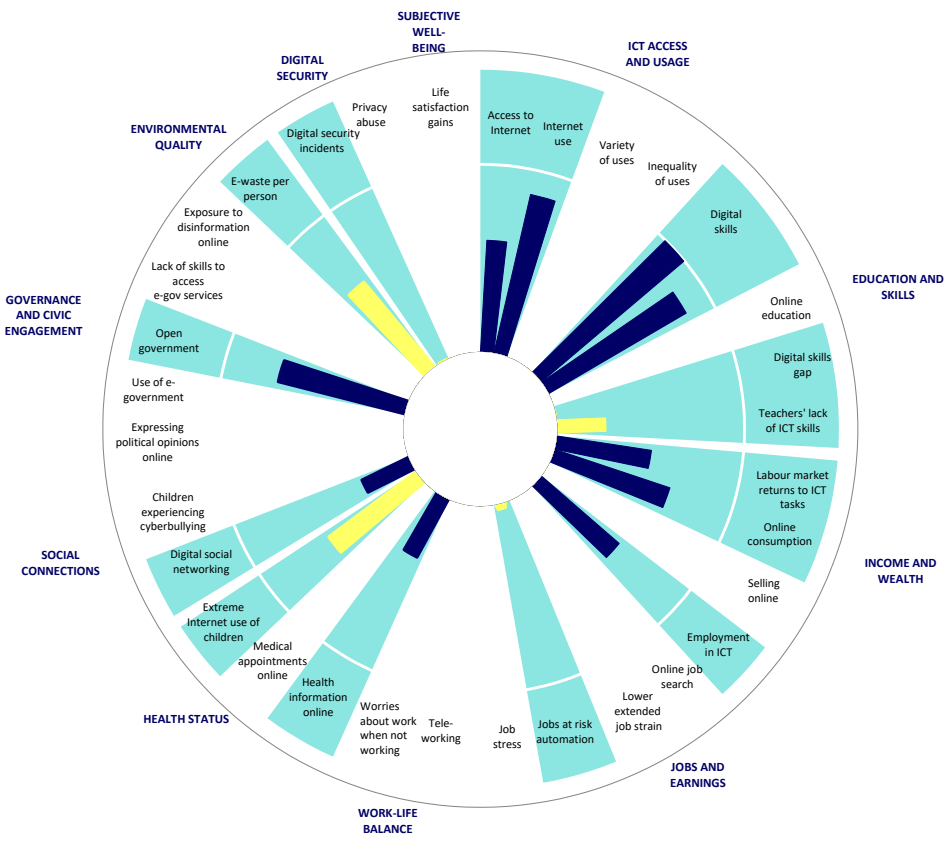
Note: This wheel depicts the **Netherlands**' relative performance in terms of key opportunities and risks in the context of the digital transformation. The centre of the wheel corresponds to the lowest outcome observed across all OECD countries, while the outer circle corresponds to the highest outcome. For opportunities (in dark blue) longer bars indicate better outcomes, whereas for risks (in yellow), longer bars indicate worse outcomes. If data are missing for any given indicator, the relevant segment of the circle is shaded in white.

StatLink http://dx.doi.org/10.1787/888933909654

How's life in the digital age in New Zealand?

Unfortunately, a large number of indicators of opportunities and risks of the digital transformation are missing for New Zealand, limiting a comprehensive assessment of impacts, particularly for risks of the digital transformation. Where data is available, however, evidence suggests that people in New Zealand have high access to some of the opportunities of the digital transformation, but are also exposed to some risks. **Internet use** in New Zealand is widespread and the **share of people with digital skills** is among the highest in the OECD, while **inequalities in digital skills** are very low. In addition, many students have access to **digital resources in the classroom**, relative to other OECD countries. However, children in New Zealand are also exposed to the risks of the digital transformation, with 28% of 15-year-olds **spending more than 6 hours on the Internet** on a weekend day. People in New Zealand are less affected by some other risks. New Zealand has the second lowest **share of jobs at risk of automation** in the OECD and relatively few people have experienced **digital security risks**, although data for this last indicator is less recent than for other OECD countries.

Figure 4.25. The digital well-being wheel in New Zealand



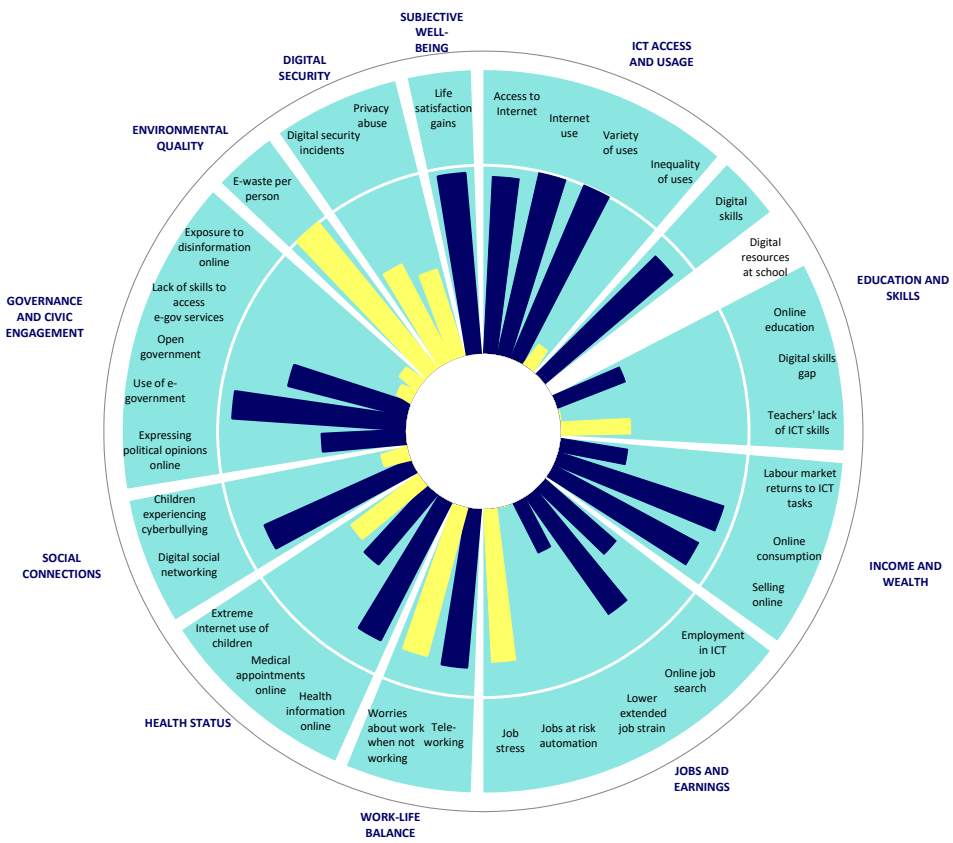
Note: This wheel depicts **New Zealand**'s relative performance in terms of key opportunities and risks in the context of the digital transformation. The centre of the wheel corresponds to the lowest outcome observed across all OECD countries, while the outer circle corresponds to the highest outcome. For opportunities (in dark blue) longer bars indicate better outcomes, whereas for risks (in yellow), longer bars indicate worse outcomes. If data are missing for any given indicator, the relevant segment of the circle is shaded in white.

StatLink http://dx.doi.org/10.1787/888933909673

How's life in the digital age in Norway?

Relative to other OECD countries, Norway performs well in benefiting from the opportunities of the digital transformation, but it is also exposed to some key risks. Norway is in the top tier of countries when it comes to **ICT access and use** and simultaneously displays very low **inequality of uses** of the Internet. In addition, people in Norway have a very high level of **digital skills**, while the **digital skills gap** belongs to the lowest in the OECD. Norwegians make prolific use of the various opportunities provided by the Internet in a number of dimensions. 84% of Norwegians make use of **e-government services** and 37% of Norwegians have engaged in **teleworking** - the third highest share in the OECD. Compared to other countries, there are few children reporting to have experienced **cyberbullying**. Nonetheless, the predominance of digital activities in Norway has also generated the highest level of **e-waste** per person in any OECD country, at 28.5 kg per inhabitant. As a result of the share of workers with computer-based jobs, Norwegians are particularly exposed to the risks of **job stress** and **worries about work outside work time** that are associated with working in the digital economy.

Figure 4.26. The digital well-being wheel in Norway



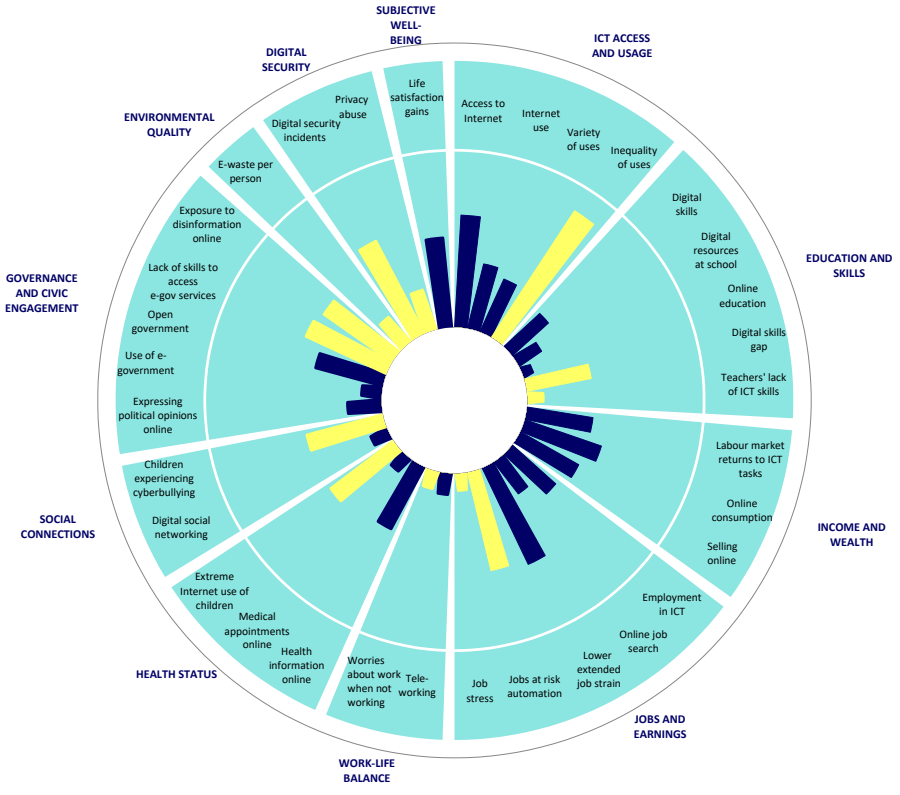
Note: This wheel depicts **Norway**'s relative performance in terms of key opportunities and risks in the context of the digital transformation. The centre of the wheel corresponds to the lowest outcome observed across all OECD countries, while the outer circle corresponds to the highest outcome. For opportunities (in dark blue) longer bars indicate better outcomes, whereas for risks (in yellow), longer bars indicate worse outcomes. If data are missing for any given indicator, the relevant segment of the circle is shaded in white.

StatLink http://dx.doi.org/10.1787/888933909692

How's life in the digital age in Poland?

In general, Poland has mixed performance in reaping the benefits of the digital transformation, but is also somewhat less exposed to the risks, compared to other OECD countries. The rate of **access to the Internet** in Poland (77.6% of households are connected to broadband Internet according to national sources) has increased substantially since 2005 (when the share was only 30.4%), and is now slightly above the OECD average. However, the **share of people using the Internet** remains low, the **variety of uses** of the Internet is limited, and there is substantial **inequality of uses** of the Internet. Despite the fact that **teachers** do not consider themselves to **lack ICT skills**, people in Poland have relatively low levels of **digital skills** and there are few **digital resources** in Polish schools. The share of jobs at risk of automation, at 50.4%, is high compared to other OECD countries. Due to the relatively low share of workers with computer-based jobs, the negative impacts of associated **job stress** and **worries about work when not working** are more contained than in other countries. In addition, the prevalence of other adverse effects, such as **exposure to disinformation online** or **extreme internet use of children** (23.4%) are below the OECD mean.

Figure 4.27. The digital well-being wheel in Poland



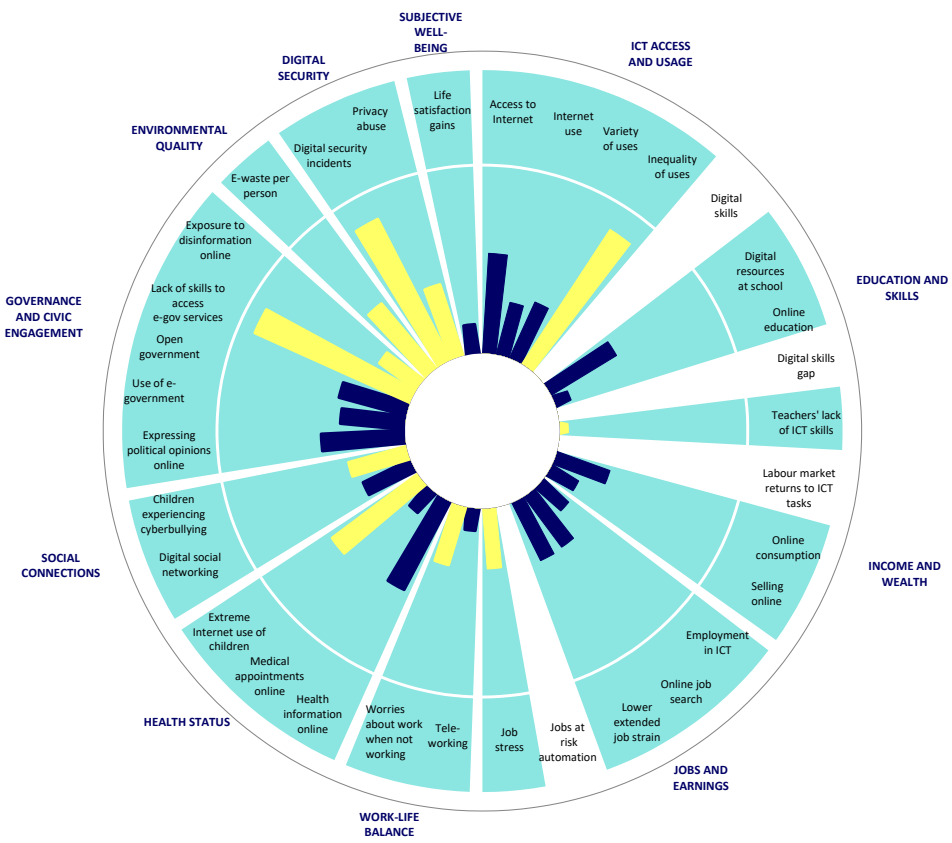
Note: This wheel depicts **Poland**'s relative performance in terms of key opportunities and risks in the context of the digital transformation. The centre of the wheel corresponds to the lowest outcome observed across all OECD countries, while the outer circle corresponds to the highest outcome. For opportunities (in dark blue) longer bars indicate better outcomes, whereas for risks (in yellow), longer bars indicate worse outcomes. If data are missing for any given indicator, the relevant segment of the circle is shaded in white.

StatLink http://dx.doi.org/10.1787/888933909711

How's life in the digital age in Portugal?

Relative to other OECD countries, Portugal has a relatively high level of exposure to the risks of the digital transformation, while having only marginally benefitted from its opportunities. **Internet access** (76.9% of households have a broadband Internet connection) is slightly below the OECD average, but it has more than doubled since 2005 (when the share was 31.5%). **Internet use** and the **variety of uses** are relatively limited while there is a very high level of **inequality of uses** of the Internet in Portugal, meaning that although a minority of the population uses the Internet for a large range of activities, the majority of the population uses the Internet for very few purposes. Likewise, people do not use the Internet much for **online consumption**, **online selling** or **job search**, suggesting that the momentum of income and wealth generation through digital activities is weak. In comparison to other OECD countries, many Portuguese people report **lacking skills to access e-government services** and they report high levels of **digital security incidents**. In contrast, the Portuguese score above the OECD average when it comes to seeking **health information online** and in expressing **political opinions online**.

Figure 4.28. The digital well-being wheel in Portugal



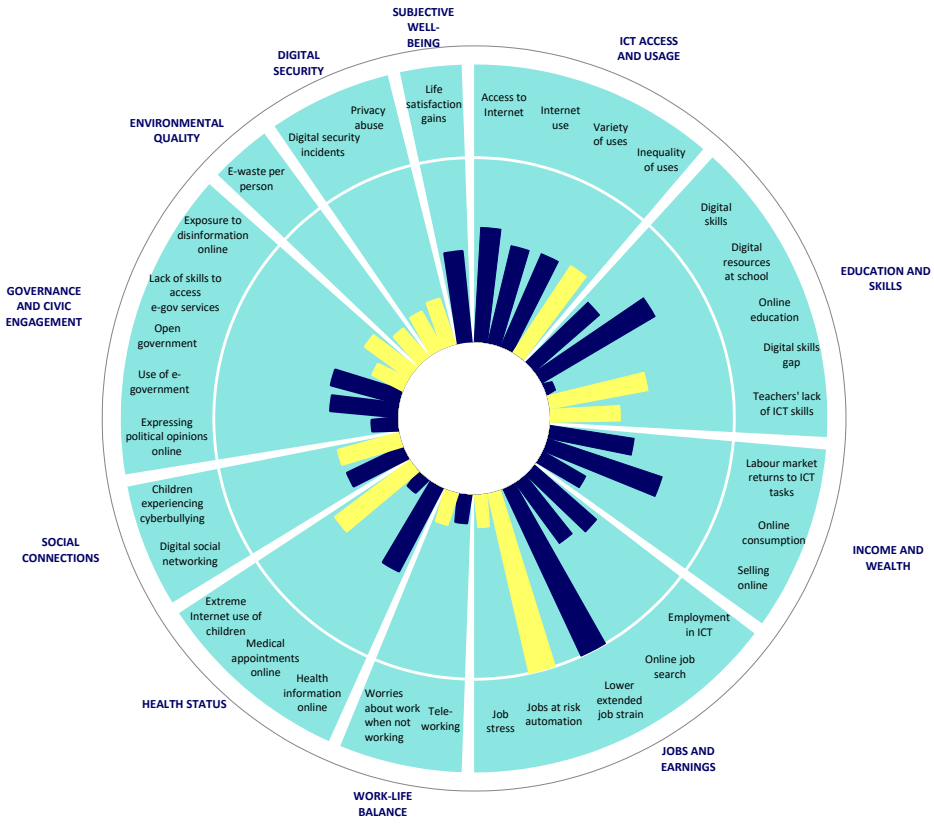
Note: This wheel depicts **Portugal**'s relative performance in terms of key opportunities and risks in the context of the digital transformation. The centre of the wheel corresponds to the lowest outcome observed across all OECD countries, while the outer circle corresponds to the highest outcome. For opportunities (in dark blue) longer bars indicate better outcomes, whereas for risks (in yellow), longer bars indicate worse outcomes. If data are missing for any given indicator, the relevant segment of the circle is shaded in white.

StatLink http://dx.doi.org/10.1787/888933909730

How's life in the digital age in Slovakia?

Compared to other OECD countries, Slovakia's exposure to the opportunities and risks of the digital transformation is mixed. At 64.4%, Slovakia's share of **jobs at risk of automation** is the highest across all OECD countries. At the same time, Slovakia benefits more from a decrease in **extended job strain associated with computer-based jobs** than any other OECD country, potentially because of reduced physical demands. In most other areas, however, Slovakia report below average scores, meaning that it is protected from risks but also reaps relatively few opportunities. People in Slovakia are less engaged online in the political and social spheres, with only 7% of people **expressing political opinions online**. At the same time, important risks in the areas of digital security and governance and civic engagement are relatively contained. **Online consumption** and **health information** sought **online** are slightly above the OECD average. In terms of **access to the Internet**, which is now at 81.3%, Slovakia has experienced enormous gains from 23.0% in 2005. The **use**, **variety of use** and **inequality of use** of the Internet is at average levels of OECD countries, and associated **life satisfaction gains** are moderate.

Figure 4.29. The digital well-being wheel in Slovakia



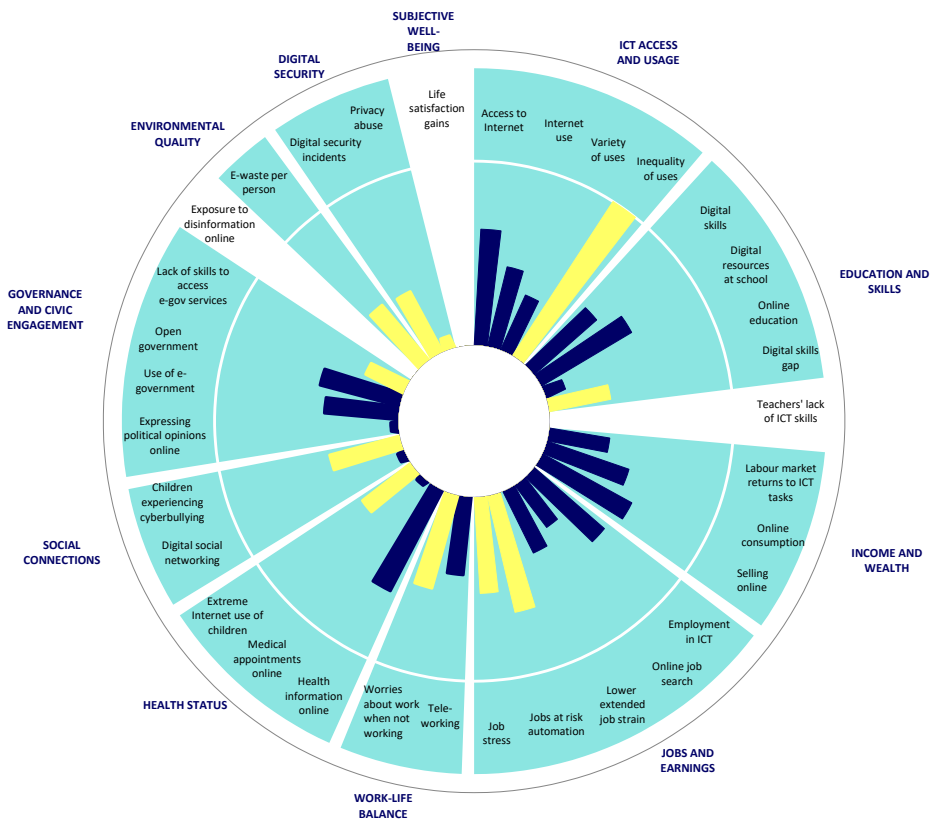
Note: This wheel depicts **Slovakia's** relative performance in terms of key opportunities and risks in the context of the digital transformation. The centre of the wheel corresponds to the lowest outcome observed across all OECD countries, while the outer circle corresponds to the highest outcome. For opportunities (in dark blue) longer bars indicate better outcomes, whereas for risks (in yellow), longer bars indicate worse outcomes. If data are missing for any given indicator, the relevant segment of the circle is shaded in white.

StatLink http://dx.doi.org/10.1787/888933909749

How's life in the digital age in Slovenia?

Slovenia's performance in opportunities and risks of the digital transformation is mixed. 81.7% of the population have **access to the Internet**, but the levels of **Internet use** and the **variety of uses of the Internet** are relatively low. Slovenia has one of highest levels of **inequality of uses of the Internet** among all OECD countries, meaning that a small portion of the population makes use of a large range of different online activities, but the majority of people only use a few key activities. Key online activities in the dimensions of health and social connections are not widely used, with 45% of people having used **online social networking sites** in the last three months. Overall, **digital skills** are around average OECD levels and 72% of students have access to **digital resources at school,** which is higher than the OECD average. However, the share of people who make use of **online courses** is relatively low. Given that many online activities are not widely taken up, **privacy abuses** and **digital security incidents** are relatively rare. Nonetheless, **cyberbullying** is more common in Slovenia than in other countries, with 10% of children reporting having been a victim.

Figure 4.30. The digital well-being wheel in Slovenia



Note: This wheel depicts **Slovenia**'s relative performance in terms of key opportunities and risks in the context of the digital transformation. The centre of the wheel corresponds to the lowest outcome observed across all OECD countries, while the outer circle corresponds to the highest outcome. For opportunities (in dark blue) longer bars indicate better outcomes, whereas for risks (in yellow), longer bars indicate worse outcomes. If data are missing for any given indicator, the relevant segment of the circle is shaded in white.

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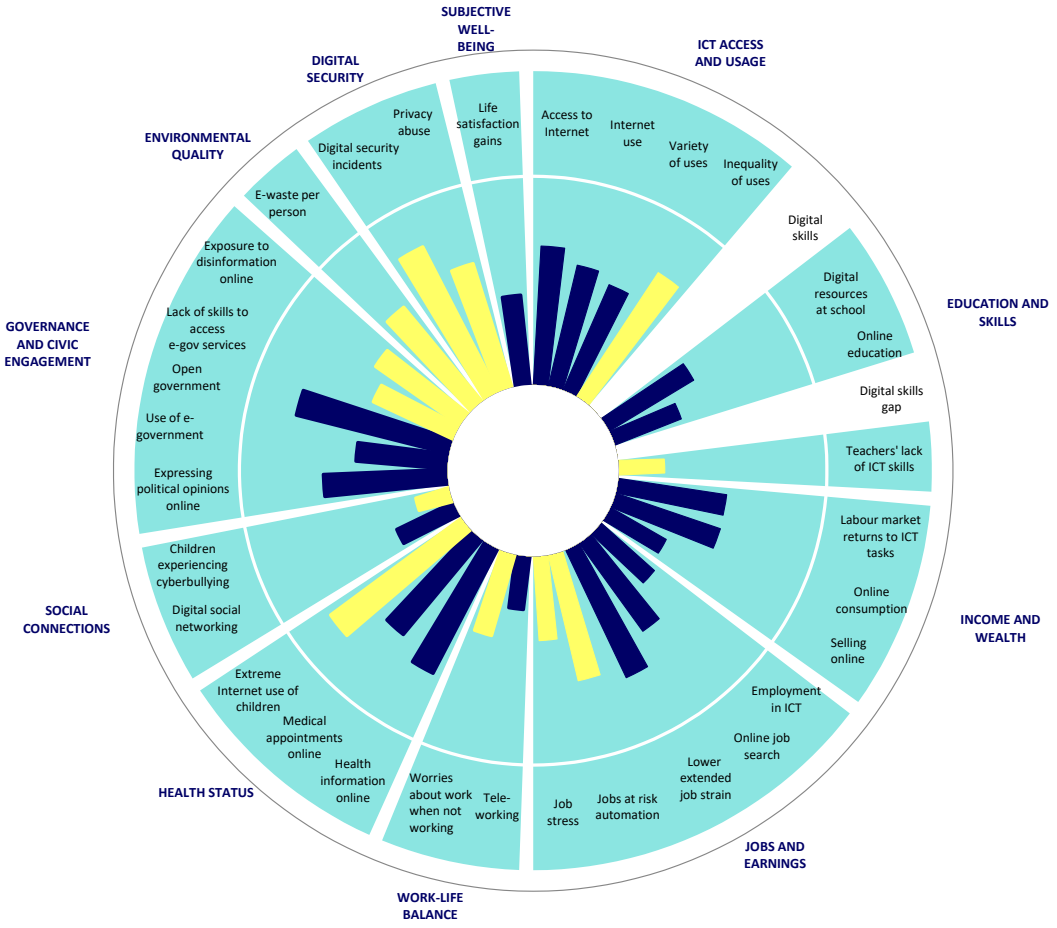
How's life in the digital age in Spain?

Overall, Spain belongs to the group of countries that enjoy more digital opportunities but also face more risks than the OECD average. The share of people **using the Internet** and the **variety of activities** that people use the Internet for are slightly above the OECD average. Spain performs relatively poorly in the share of **employment in information industries** and faces a relatively high **risk of job automation**, with 52% of jobs estimated to be at risk. In addition, the **labour market returns to ICT** tasks are below the OECD average. On the other hand, a relatively high share of people in Spain make use of online health services such as **making medical appointments online**, and efforts to **open government data** are considered to be advanced compared to other countries, according to the OECD OURdata Index.

Figure 4.31. The digital well-being wheel in Spain



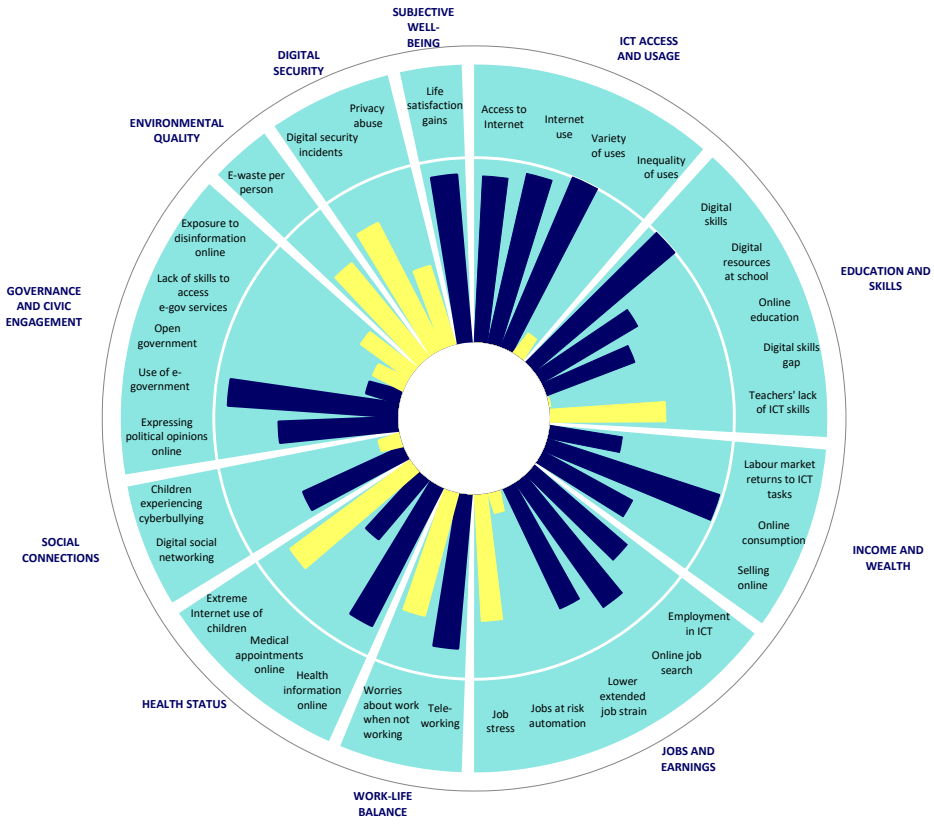
Note: This wheel depicts **Spain**'s relative performance in terms of key opportunities and risks in the context of the digital transformation. The centre of the wheel corresponds to the lowest outcome observed across all OECD countries, while the outer circle corresponds to the highest outcome. For opportunities (in dark blue) longer bars indicate better outcomes, whereas for risks (in yellow), longer bars indicate worse outcomes. If data are missing for any given indicator, the relevant segment of the circle is shaded in white.

StatLink http://dx.doi.org/10.1787/888933909787

How's life in the digital age in Sweden?

Overall, Sweden is a high performer when it comes to embracing the opportunities of the digital transformation, while its exposure to risks is average, relative to other OECD countries. Sweden has high rates of ICT access and use, and has the highest performance in terms of **variety of Internet uses**, meaning that a large range of online activities are used by a majority of the population. In addition, the share of people with intermediate **digital skills** is the highest in the OECD, while the **digital skills gap** is very low. Sweden scores particularly high in the use of e-**government services**, which are taken up by 84% of people, almost double the OECD average. **Teleworking** is also common in comparison to other countries: 36% of workers have done so at least once. At the same time, the high share of workers with computer-based jobs means that workers are more exposed to the risks of **job stress** and **worries about work when not working** than in the OECD on average. Moreover, 36% of Swedish 15-year-olds are **extreme Internet users**, which is the third highest share in the OECD. The prevalence of **cyberbullying**, however, is relatively low.

Figure 4.32. The digital well-being wheel in Sweden



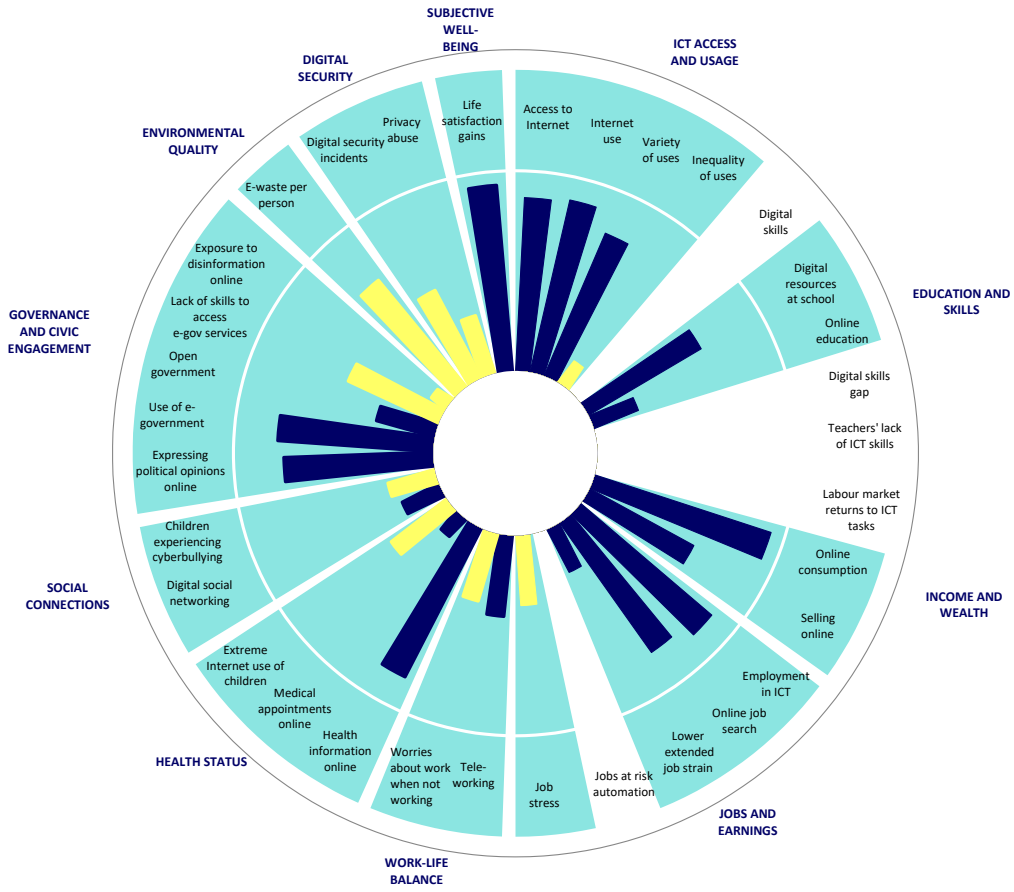
Note: This wheel depicts **Sweden**'s relative performance in terms of key opportunities and risks in the context of the digital transformation. The centre of the wheel corresponds to the lowest outcome observed across all OECD countries, while the outer circle corresponds to the highest outcome. For opportunities (in dark blue) longer bars indicate better outcomes, whereas for risks (in yellow), longer bars indicate worse outcomes. If data are missing for any given indicator, the relevant segment of the circle is shaded in white.

StatLink http://dx.doi.org/10.1787/888933909806

How's life in the digital age in Switzerland?

Compared to other OECD countries, people in Switzerland report high benefits from the digital transformation thanks to widespread use of a **variety of online activities**. In many domains, Switzerland boasts high shares of people engaging in online activities, such as in **purchasing goods and services online**, **expressing political opinions** and the **use of e-government services**. **Internet access** (93.1%) and **use** (94.5%) levels are indeed among the highest in OECD and are combined with a relatively low degree of **inequality of uses** within the population. By contrast, the use of **online education** services stands below the OECD average, as is the case for **online social networking**. Due to the relatively low share of people with computer-based jobs, the negative impacts of **job stress** and **worries about work when not working** are limited. The share of children reporting having been **cyberbullied** is below the OECD average, as is the share of **extreme Internet users** among children. The digital transformation is associated with the generation of **E-waste**, which, at 23.6kg per inhabitant, stands above the OECD average.

Figure 4.33. The digital well-being wheel in Switzerland



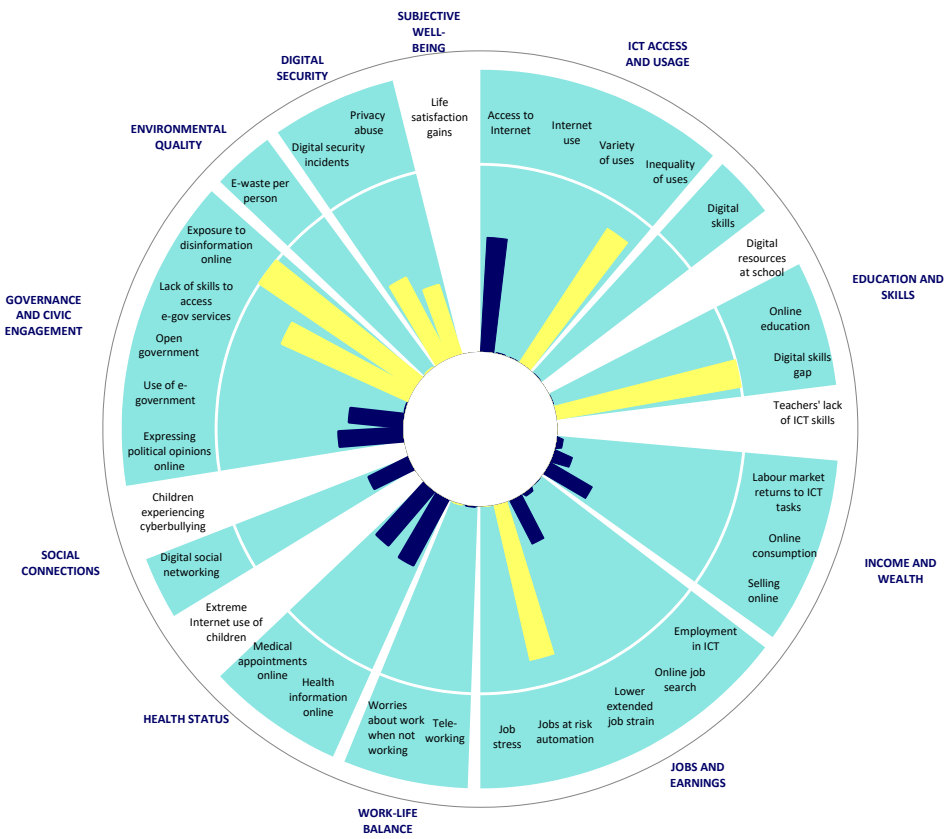
Note: This wheel depicts **Switzerland**'s relative performance in terms of key opportunities and risks in the context of the digital transformation. The centre of the wheel corresponds to the lowest outcome observed across all OECD countries, while the outer circle corresponds to the highest outcome. For opportunities (in dark blue) longer bars indicate better outcomes, whereas for risks (in yellow), longer bars indicate worse outcomes. If data are missing for any given indicator, the relevant segment of the circle is shaded in white.

StatLink http://dx.doi.org/10.1787/888933909825

How's life in the digital age in Turkey?

Compared to other OECD countries, Turkey has been exposed to limited opportunities of the digital transformation, while experiencing relatively high risks. While **Internet access** rates are slightly above the OECD average, a relatively high share of people do not use the Internet, with 65% of the population having **used the Internet** in the last 12 months, compared to an OECD average of 84%. The **inequality of Internet uses** is very high, which means that while a small minority has embraced a wide range of the possibilities offered by the Internet, a majority of people does not use the Internet at all or for limited activities. In addition, the level of **digital skills** is substantially lower than in the rest of the OECD. Turkey's limited performance in the realm of opportunities is accompanied by a high exposure to some risks. 43% of **jobs** in Turkey are **at risk of automation**, which is the third highest share in the OECD. In addition, more people in Turkey than in any other country reported having been **exposed to disinformation online** (note that this survey only covers Turkey's online population). However, thanks to the limited spread of digital technologies, Turkey produces the least amount of **e-waste** in the OECD.

Figure 4.34. The digital well-being wheel in Turkey



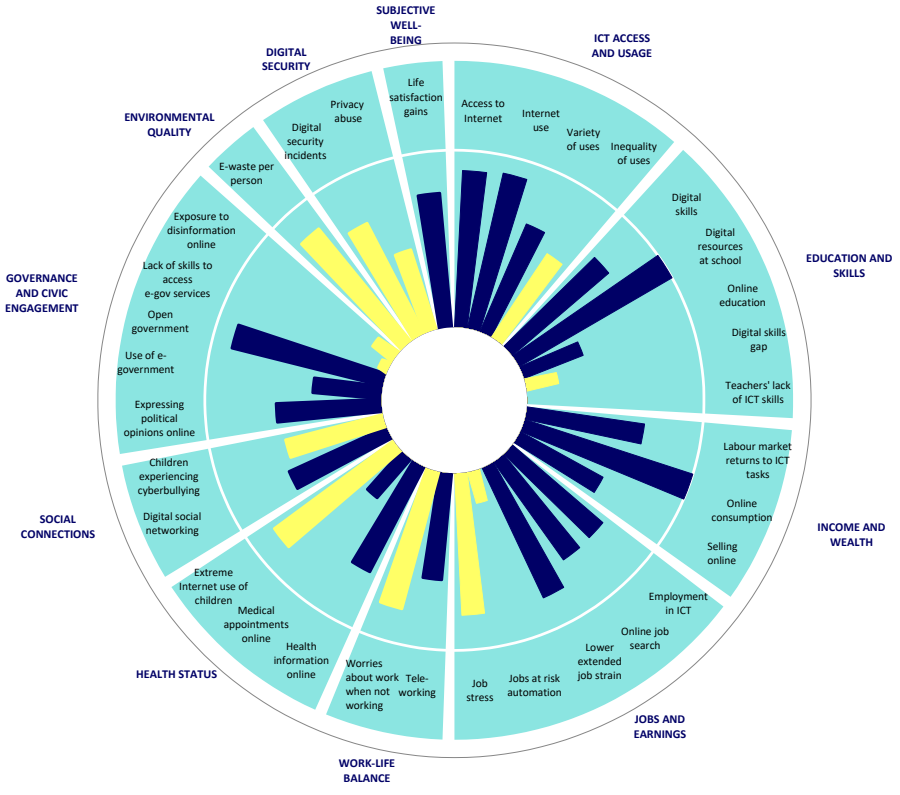
Note: This wheel depicts **Turkey**'s relative performance in terms of key opportunities and risks in the context of the digital transformation. The centre of the wheel corresponds to the lowest outcome observed across all OECD countries, while the outer circle corresponds to the highest outcome. For opportunities (in dark blue) longer bars indicate better outcomes, whereas for risks (in yellow), longer bars indicate worse outcomes. If data are missing for any given indicator, the relevant segment of the circle is shaded in white.

StatLink http://dx.doi.org/10.1787/888933909844

How's life in the digital age in the United Kingdom?

Overall, the United Kingdom has fully embraced the opportunities of the digital transformation, but it is also highly exposed to the risks, relative to other OECD countries. The United Kingdom performs in the top tier when it comes to **access to Internet** and **Internet use**. It has the highest rate of access to **digital resources in the classroom**, with 90% of students using digital resources, compared to an OECD average of 63%. People in the United Kingdom also make use of **online consumption services** more than in any other OECD country. **Employment in information industries** is relatively high, and the **labour market returns to ICT** skills are above the OECD average. The United Kingdom's openness to digital transformation has also led to an exposure to risks. The high share of workers with computer-based jobs gives rise to the pitfalls of **job stress** and **worries about work when not working**. The level of **inequality of uses** is relatively high, which means that not everyone makes full use of the breadth of possible online activities. In addition, the risks for children are substantial, with 37% of **extreme Internet users** among 15-year-olds, the second highest share in the OECD.

Figure 4.35. The digital well-being wheel in the United Kingdom



Note: This wheel depicts the **United Kingdom**'s relative performance in terms of key opportunities and risks in the context of the digital transformation. The centre of the wheel corresponds to the lowest outcome observed across all OECD countries, while the outer circle corresponds to the highest outcome. For opportunities (in dark blue) longer bars indicate better outcomes, whereas for risks (in yellow), longer bars indicate worse outcomes. If data are missing for any given indicator, the relevant segment of the circle is shaded in white.

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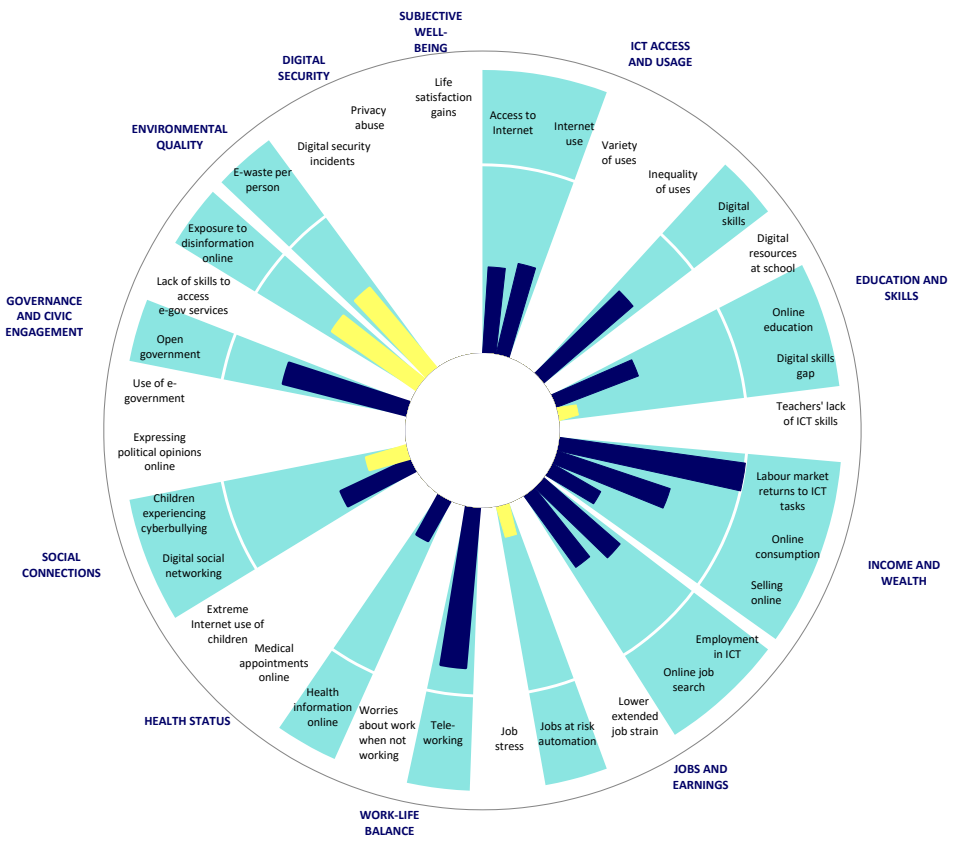
How's life in the digital age in the United States?

Unfortunately, data limitations prevent a comprehensive analysis of the opportunities and risks of the digital transformation in the United States. In particular, data on a number of key digital risks is missing, making it difficult to assess to what extent people in the United States are exposed to the well-being risks of the digital transformation. In general, the United States has average outcomes in attaining key opportunities of the digital transformation. The United States boasts the **highest returns to ICT tasks** in the OECD, reflecting the high potential income gains of digital skills. While the share of the population with **digital skills** is around the average, the **digital skills gap** is comparatively small. The United States also faces a relatively low risk of job automation, with 10.2% of jobs estimated to be at a **high risk of automation**. However, **Internet access** and **use** in the United States falls behind most other OECD countries. More than a quarter of households do not have **broadband Internet access**, the fourth lowest share across the OECD. In addition, **exposure to disinformation** is relatively high, and 31% of Americans reports having encountered disinformation in the past week.

Figure 4.36. The digital well-being wheel in the United States



Note: This wheel depicts the **United States**' relative performance in terms of key opportunities and risks in the context of the digital transformation. The centre of the wheel corresponds to the lowest outcome observed across all OECD countries, while the outer circle corresponds to the highest outcome. For opportunities (in dark blue) longer bars indicate better outcomes, whereas for risks (in yellow), longer bars indicate worse outcomes. If data are missing for any given indicator, the relevant segment of the circle is shaded in white.

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How's Life in the Digital Age?

OPPORTUNITIES AND RISKS OF THE DIGITAL TRANSFORMATION FOR PEOPLE'S WELL-BEING

This report documents how the ongoing digital transformation is affecting people's lives across the 11 key dimensions that make up the How's Life? Well-being Framework (Income and wealth, Jobs and earnings, Housing, Health status, Education and skills, Work-life balance, Civic engagement and governance, Social connections, Environmental quality, Personal security, and Subjective well-being). A summary of existing studies highlights 39 key impacts of the digital transformation on people's well-being. The review shows that these impacts can be positive as digital technologies expand the boundaries of information availability and enhance human productivity, but can also imply risks for people's well-being, ranging from cyber-bullying to the emergence of disinformation or cyber-hacking. In sum, making digitalisation work for people's well-being would require building equal digital opportunities, widespread digital literacy and strong digital security. Continued research and efforts in improving statistical frameworks will be needed to expand our knowledge on the many topics covered in this report.

This publication is a contribution to the OECD Going Digital project which aims to provide policymakers with the tools they need to help their economies and societies prosper in an increasingly digital and data-driven world.

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