CESI
ALL WORKERS COUNT

DIWORK
DIGITALISING PUBLIC SERVICES
Making it work for citizens, business and workers

RESEARCH IN THE FRAMEWORK OF CESI'S PROJECT "DIWORK - DIGITALISING PUBLIC SERVICES: MAKING IT WORK FOR CITIZENS, BUSINESS AND WORKERS"

FINAL REPORT:

EDUCATION AND TRAINING SECTOR

2022

VISIONARY ANALYTICS

Co-funded by the European Union

List of Abbreviations

ADS	**Automated Decision Support –** the process that involves the use of data, machines and algorithms to make decisions and automatically provide solutions to repetitive management problems. The process involves processing data from databases, text, social media, sensors, images, speech via computer software, algorithms, machine learning, natural language processing, robotics, artificial intelligence and augmented intelligence.
AI	**Artificial Intelligence –** software that is developed with one or more of the techniques and approaches (such as machine-learning, logic- and knowledge-based approaches, some statistical approaches), and can, for a given set of human-defined objectives, generate outputs such as content, predictions, recommendations, or decisions influencing the environments they interact with.
ANPE	**National Association of Teachers in Spain** (ES: ANPE Sindicato Independiente); CESI member organisation.
AR	**Augmented Reality –** interactive experience of a real-world environment where the objects that reside in the real world are enhanced by computer-generated perceptual information.
BLC	**German Federation of Food Chemists in Public Service** (DE: Bundesverband der Lebensmittelchemiker/-innen im öffentlichen Dienst); CESI member organisation.
CPD	**Continuous Professional Development –** long-term career development, learning activities for professionals to periodically develop and enhance their abilities required for their job.
CSEN	**French Trade Union Confederation of National Education** (FR: Confédération Syndicale de l'Education Nationale); CESI member organisation.
CSIF	**Spanish Central Independent and Public Employees' Trade Union** (ES: Central Sindical Independiente y de Funcionarios); CESI member organisation.
DBB	**German Civil Service Federation** (DE: Beamtenbund und Tarifunion); CESI member organisation.
DESI	**The Digital Economy and Society Index –** a summary of indicators on Europe's digital performance, coordinated by European Commission.
EC	**European Commission**
EFTA	**European Free Trade Association**
EHR	**Electronic Health Record–** electronic version of a patient's medical history that is maintained by the provider of healthcare services and include all of the key administrative clinical data relevant for persons care, including demographics, progress notes, medications, etc.
EI	**Education International-** a global union federation of teachers' trade unions which has 401 member organisations in 172 countries.
EMPL	**European Parliament's Committee on Employment and Social Affairs**
EP	**European Parliament**
ERP	**Enterprise Resource Planning**
EU	**European Union** (EU-27)
EUPAN	**European Public Administration Network**
EUROFEDOP	**European Federation of Public Services Employees**; CESI member organisation.
FAQ	**Frequently Asked Questions**
FCG/GPF	**Austrian trade union of postal and telecommunications employees** (DE: Die Gewerkschaft der Post- und Fernmeldebediensteten)

FWA	**Flexible Working Arrangements –** work environment and schedules that do not have normal constraints of a traditional job, allowing employees to choose particular hours of work, as well as work location.
GDP	**Gross Domestic Product**
GDPR	**General Data Protection Regulation**
GIS	**Geographic Information System –** a system that creates, manages, analyses, maps all types of data. It is used to make maps that communicate, perform analysis, share information, and solve problems.
GP	**General Practitioner –** a medical doctor who treats all common medical conditions, refers patients to hospitals and other medical services for urgent and specialist care, and provides preventive care and health education to patients of all ages.
GPS	**Global Positioning System –** a satellite-based radio navigation system that allows land, sea and airborne users to determine their exact position.
HE	**Higher Education**
HEI	**Higher Education Institution –** organisations providing higher, postsecondary, tertiary, and/or third-level education, e.g., universities, research universities, specialised higher schools, colleges, professional schools.
HIE	**Health information exchange –** the mobilisation of healthcare information electronically across organisations within a region, community, or hospital system, allowing health professionals and patients to access and securely share medical information
HR	**Human Resources**
ICT	**Information and Communication Technology–** computers and other digital technologies that aid individuals or institutions in handling or using information
ID	**Identification –** an official document proving a person's identity
ILO	**International Labour Organization**
IMCO	**European Parliament Committee on the Internal Market and Consumer Protection**
IoT	**Internet of Things –** the network of physical objects that are embedded with sensors, software and other technologies for the purpose of connecting and exchanging data with other devices and systems over the Internet.
ISCED	**The International Standard Classification of Education –** the reference international classification for organising education programmes and related qualifications by levels and fields. ISCED 1 refers to primary education, ISCED 2- lower secondary education, ISCED 3- upper secondary education.
IT	**Information Technology –** computers, elaborate networks, computer software, and other digital or electronic devices that are used to help attain an efficient method for the management of information.
JRC	**Joint Research Centre –** the European Commission's science and knowledge service.
LAN	**Local Area Network –** a series of computers linked together to form a network within a limited area (e.g., a school, university campus, office).
LMS	**Learning Management System –** a software application or web-based technology used to plan, implement and assess a specific learning process. It is used to administer, document, track, report, automate, deliver educational courses, training programs, learning and development programs (e.g., Moodle, Edmodo, Blackboard, etc.).
MEP	**Member of European Parliament**
MKKSZ	**Hungarian Civil Servants and Public Employees Trade Union** (HR: Magyar Köztisztviselők, Közalkalmazottak és Közszolgálati Dolgozók Szakszervezete); CESI member organisation.
ML	**Machine Learning –** the use and development of computer systems that are able to learn and adapt without following explicit instructions, by using algorithms and statistical models to analyse and draw inferences from patterns in data.

MOOC	**Massive Open Online Course –** an online course made available over the internet aimed at unlimited participation and open access; a model for delivering learning content online to anyone who wants to take a course.
MS	**Member State** of the European Union
NGO	**Non-Governmental Organisation**
NLP	**Natural Language Processing –** the ability of a computer program to understand and respond (with text or speech of their own) to human language as it is spoken and written (text and voice).
OECD	**Organisation for Economic Co-operation and Development**
OSH	**Occupational Safety and Health**
PA	**Public Administration –** civil employed by a government department or agency for public sector undertakings
PHR	**Personal Health Record –** a collection of health-related information that can be generated by healthcare providers (e.g., physicians, hospitals, pharmacies) but is controlled by the patient.
RFID	**Radio-frequency identification –** a form of wireless communication that uses electromagnetic fields to automatically identify and track tags attached to objects.
RJPS	**General Trade Union of the Republic of Lithuania** (LT: Respublikinė Jungtinė Profesinė Sąjunga); CESI member organisation.
RPA	**Robotic Process Automation –** technology based on software robots or on artificial intelligence that emulate human actions interacting with digital systems and software, and automating the repetitive processes usually conducted by humans.
RRF	**Recovery and Resilience Facility –** a temporary recovery instrument coordinated by European Commission, aimed to help Member States to implement reforms and investments to recover from the coronavirus pandemic.
SATSE	**Spanish Trade Union of Nursing Professionals** (ES: Sindicato de Enfermería); CESI member organisation.
SDG	**Sustainable Development Goals**
SDMCG	**Montenegrin Trade Union of Physicians** (ME: Sindikat Doktora Medicine Crne Gore); CESI member organisation.
SLFS	**Serbian trade union of Doctors and Pharmacists** (SR: Sindikat lekara i farmaceuta Srbije); CESI member organisation.
SPELC	**French free catholic education professional trade union federation** (FR: Syndicat Professionnel de l'Enseignment Libre Catholique); CESI member organisation.
STEM	**Science, technology, engineering and mathematics**
UK	**United Kingdom**
UN	**United Nations**
UNI	**UNI Global Union –** global union federation for the skills and services sectors, gathering national and regional trade unions in 150 countries representing 20 million workers.
USA	**United States of America**
USLIP	**Romanian Free Trade Union in Pre-University Education** (RO: Uniunii Sindicatelor Libere din Învățământul Preuniversitar (USLIP) Iaşi); CESI member organisation.
USP	**Universal service provider –** in postal sector – a public or private entity providing a universal service or parts thereof within a country, not specifying whether required by license, authorization or another legal instrument.

VET	**Vocational Education and Training –** training in skills and teaching of knowledge required in particular occupations or more broadly on the labour market.
VLE	**Virtual Learning Environment –** educational technology, a set of teaching and learning tools, a virtual classroom that allows students and teachers to communicate online, providing class information, learning materials and assignments via the Web.
VPN	**Virtual Private Network –** an encrypted connection over the Internet from a device to a network, creating a secure, private network to ensure that sensitive data is safely transmitted.
VR	**Virtual Reality –** an experience where the user's visual and auditory senses are cut off from the real world.
WEF	**World Economic Forum**
WZZ	**Polish Free Trade Union "Forum – Education"** (PL: Wolny Związek Zawodowy "Forum – Oświata"); CESI member organisation.

Table of contents

Introduction

This study was commissioned by the European Confederation of Independent Trade unions (CESI) and carried out by Visionary Analytics. CESI connects 40 national and 4 European trade union organisations, who collectively represent over 5 million employees, mostly in the four sectors of central government, regional and local administration, education and training, healthcare, and postal services.[1] Responding to the increasing importance of digitalisation of the public sector, further accelerated by the COVID-19 pandemic, CESI finds it necessary to support its members in their efforts to understand and address digital transformation of work. To this end, this report aims to provide CESI members with a better understanding of the key developments of digitalisation in their sectors, and their implications for workers they represent.

Chapter 1 begins with an overview of **digitalisation trends** in the public sector, and the associated benefits and risks. Firstly, the chapter shows how the nature of the digital transformation itself has evolved over time to enable a better understanding on what is happening today. Next, the report overviews the drivers behind digitalisation today, showing that digitalisation is a way for public sector organisations to better respond to citizens' needs by benefiting from new technological developments. The chapter also overviews the overall risks associated with digitalisation of the public sector.

Chapter 2 looks at the **barriers** to digitalisation and **the role of trade unions in addressing them**. Greater focus is given to two barriers that are especially important for trade unions. The first section shows how **workers' attitudes** can impact the process of digitalisation, explaining that workers' resistance to digitalisation can act as a key barrier and suggesting how trade unions could shape workers' attitudes. The second section addresses the barrier of **digital skills gap**, explaining that digital skills have become an essential prerequisite for successfully participating in the labour market and that the demand for digital skills is likely to only increase. The section encourages trade unions to steer their efforts towards strengthening and consolidating digital skills of workers they represent.

Chapter 3 is an overview of how **work organisation** has changed due to digitalisation. Namely, it sheds more light on the effects of teleworking, automation, creation of new jobs, new forms of worker management and changes in human-machine interaction. It shows trade unions how workers can benefit from these developments, but also raises awareness about the associated risks, including on their occupational health and safety (OSH) and working conditions.

Chapter 4 provides a **sectorial view** and allows the readers to gain a deeper understanding on what digitalisation means for the education and training sector:

- The chapter starts with an overview of key developments specific to the sector. In order to streamline the information, only developments that are more important for workers are discussed. It allows the readers to understand what exactly is happening in workplaces and to grasp the extent of digitalisation in the sector.
- It is followed by an overview of the opportunities of digitalisation in the sector. Digitalisation has the potential to bring multiple positive outcomes for employers, citizens, workers and society in general. The section explains that these potential positive effects drive digitalisation further.
- The third part of the chapter presents the specific barriers and risks of digitalisation in the sector. Specific attention is paid to two barriers that trade unions can have most impact on, namely, workers' attitudes and digital skills gap. The first part of subsection looks at how workers in the sector approach digitalisation by evaluating their attitudes towards it. The second part of the subsection explains what kind of digital skills are in demand and shows that workers in the sector lack competences that are expected to be required of them in a digital age. The last part of the subsection focuses on trade union responses, discussing the role that trade unions can play in addressing the barriers to digitalisation and supporting workers. In addition, it overviews the attitudes of CESI members from the sector

[1] In addition, large shares of CESI's affiliates are also employed in security and justice, defence and transport sectors.

at hand towards digitalisation. This allows trade unions to compare the way they approach digitalisation with the attitudes of their peer- organisations.
- The last part of the chapter presents key positive and negative effects of digitalisation on work organisation. It allows trade unions to gain a better understanding on how workers they represent can benefit from digital technologies (e.g., it can mean their work is less physically straining, they perform their tasks more efficiently, they are more satisfied with their jobs, they have more autonomy, etc.). Moreover, it also sheds light how digitalisation can make workers' working conditions worse (e.g., by expanding their working time, subjecting them to constant performance monitoring), and induce poor health outcomes (e.g., high levels of stress and anxiety, physical health problems, etc.).

Chapter 5 overviews the **key EU initiatives** that cover the topic of digitalisation (especially in the public sector) and its impact on workers. The chapter is useful for trade unions to understand the political importance of digital transition and to be informed about the key policy developments of consequence to them and the workers they represent.

The report ends with practical **recommendations** for CESI members on the ways they can effectively support workers in the times of digital transformation of work. In addition to the recommendations, trade unions can draw inspiration and advice from **good practice examples** in blue boxes that they can find throughout the report. These good practices present exemplary actions and efforts of CESI members and other trade unions (as well as workplaces) that seek to actively address the challenges and reap the benefits of digitalisation. Similarly, green boxes contain **practical examples** on how digital tools are applied in workplaces. These examples illustrate the ways that digitalisation manifests itself in public sector.

The report is complemented by **Annexes I-III** that focus on **defence, security and justice**, and **transport sectors** respectively. These chapters summarise the results of the survey and interviews with CESI members from respective sectors. **Annexes IV and V** provide additional information on the applications of **specific digital tools in the education and training and health** sectors respectively. Finally, **Annex VI** presents **methodological information** and **Annex VII** provides **the list of literature** used in the report that readers can consult for further information.

The assignment was very comprehensive in its scope; therefore, **each chapter can be read as a stand-alone piece of information**. Readers can for example use this report to only gain an understanding of the drivers, benefits and risks of digitalisation of the public sector, to understand the implications of digitalisation, to zoom in on the developments in a particular sector, or to learn about key legislative or financial initiatives.

The report is based on the following data:
- **Data from academic and grey literature** (including reports by international organisations, European Union agencies, private consultancy companies) and statistical data from OECD, Eurostat, relevant national and international surveys.
- Statistical data and comments from the **survey of CESI members**. The survey was tailored for 6 focal sectors and contained questions that would help to understand trade unions' attitudes towards digitalisation, including the perceived effect it has on their workers and their working conditions. The survey was carried out in September-December of 2021. Invitations were sent out to 42 CESI members. Twenty out of 42 CESI members (47%) provided complete answers to the survey. The sectorial distribution of responses is as follows: 12 for central government, local and regional administrations sector; 10 for education and training sector; 7 for health services sector; 1 for postal services sector; 3 for defence sector, and 3 for security sector.
- Information gathered through **interviews with CESI members**. Throughout November 2021-January 2022 7 interviews[2] were carried out with representatives of CESI member organisations. Interviewees were selected based on the good practices identified through their survey responses and guidance of CESI.

[2] Out of which 2 provided written answers.

1. Digitalisation trends

1.1. From e-Government to Digital Government

Key takeaway:

- The public sector has started adopting ICT in the 1990s with the goal to increase efficiency of specific tasks. Public sector is now moving towards a much more holistic approach to digitalisation. Importantly, this shift implies a change of working practices in public sector.

Enthusiasm to introduce new digital technologies within the public sector already existed throughout the 1990s. With the dawn of the digital age, bureaucratic and slow public sector institutions became less capable to meet the expectation of citizens to receive more effective, efficient and better public services. Therefore, the public sector resorted to the adoption of ICT that could transform organisational structures, documents, service provision, policy and governance systems with a view to meet these needs of citizens.[3] It is expected that digitalisation can make public sector institutions more cost-efficient, effective and transparent in service delivery, making the service provision more citizen-centric, as well as supporting public decision-making, improving trust in government and eventually contributing to better quality of life for citizens.[4]

The public sector went through several stages of digitalisation.[5] The first critical shift occurred between 1990s and early 2000s as the public sector went through a transition from traditional (face-to-face, bureaucracy-oriented) service provision to **eGovernment,** with the main goal of increasing efficiency of specific tasks by adopting ICT tools. Paper transactions were to be replaced by the application of World Wide Web technology, service provision was to take place online, and governments set up websites and IT systems within public administrations. Government web portals provided information for citizens, enabled service providers to receive requests by users (e.g., make a doctor's appointment), and store data (e.g., health records, information on students' performance, etc.). Since the late 2000s the public sector has been undergoing a shift from eGovernment initiatives to **Digital Government**, which goes beyond the use of ICT tools to merely improve efficiency of certain tasks. Digital Government refers to open, smart and transformed government, fostering participation of and collaboration with citizens, by facilitating interaction with them. It is also a "smart" government that uses open and big data, administrative and business process management innovations, Internet of Things (IoT), blockchain, and Artificial Intelligence (AI) to make better decisions and optimise resources.[6] It is a transformed and citizen-driven government, the goal of which is to meet the needs and expectations of citizens, business and other stakeholders, making exchanges interactive, accessible and personalised.[7]

Today digitalisation aims to address the growing need for a holistic approach rather than work in vertical silos. Governments are therefore moving from targeted e-government projects towards a 'whole-of-government' approach, which means that all government services are provided in a more integrated way and facilitated by digital technologies. The shift goes beyond digitalisation of services and includes improving internal processes, structures and

[3] Barcevičius, E., Cibaitė, G., Codagnone, C., Gineikytė, V., Klimavičiūtė, L., Liva, G., Matulevič, L., Misuraca, G., Vanini, I., 2019. Exploring Digital Government transformation in the EU - Analysis of the state of the art and review of literature. Joint Research Centre. Luxembourg: Publications Office of the European Union, 10.

[4] Williams, M., & Valayer, C., 2018. "Digital Government Benchmark. Study on Digital Government Transformation." DG Joint Research Centre, European Commission; Barcevičius et al., 2019; Dunleavy, P., Margetts, H., Bastow, S., Tinkler, J., 2005. "New Public Management Is Dead—Long Live Digital-Era Governance", *Journal of Public Administration Research and Theory 16(3),* 478.

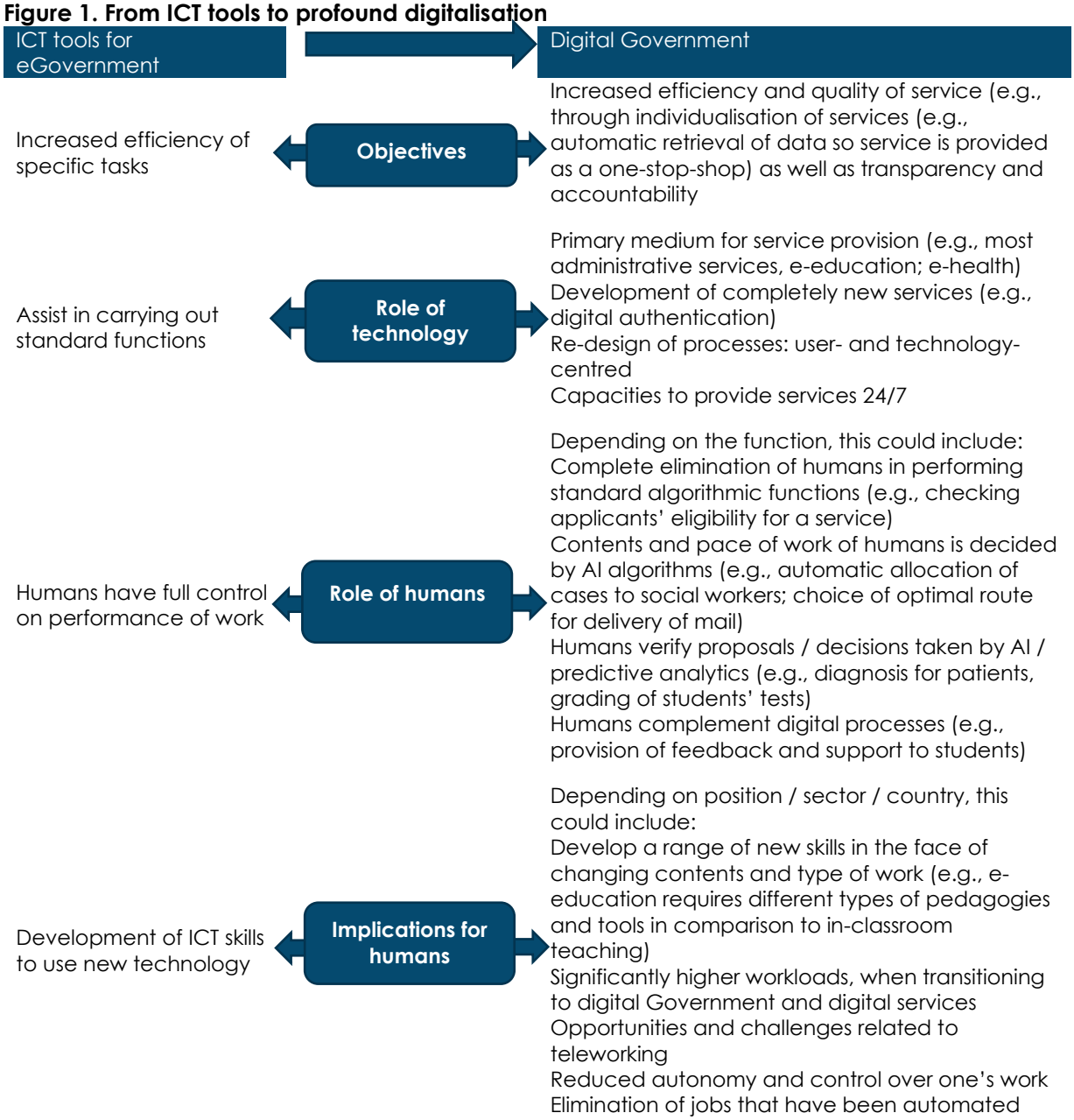
[5] See Barcevičius et al., 2019, 10-11 for the following account.

[6] *Internet of Things (IoT)* refers to the network of physical objects that are embedded with sensors, software and other technologies for the purpose of connecting and exchanging data with other devices and systems over the Internet. *Blockchain* is a digitally distributed, decentralized and often public ledge that exists across a network and consists of records called blocks; these blocks record transactions across many computers which cannot be altered easily after they are created.

[7] Viderity, 2018. "The Future of Digital Government". *Viderity.* Available: http://viderity.com/2018/10/09/the-future-of-digital-government/

working practices in public administration.[8] The characteristics of transformation from e-government to Digital Government are illustrated in Figure 1.

Figure 1. From ICT tools to profound digitalisation

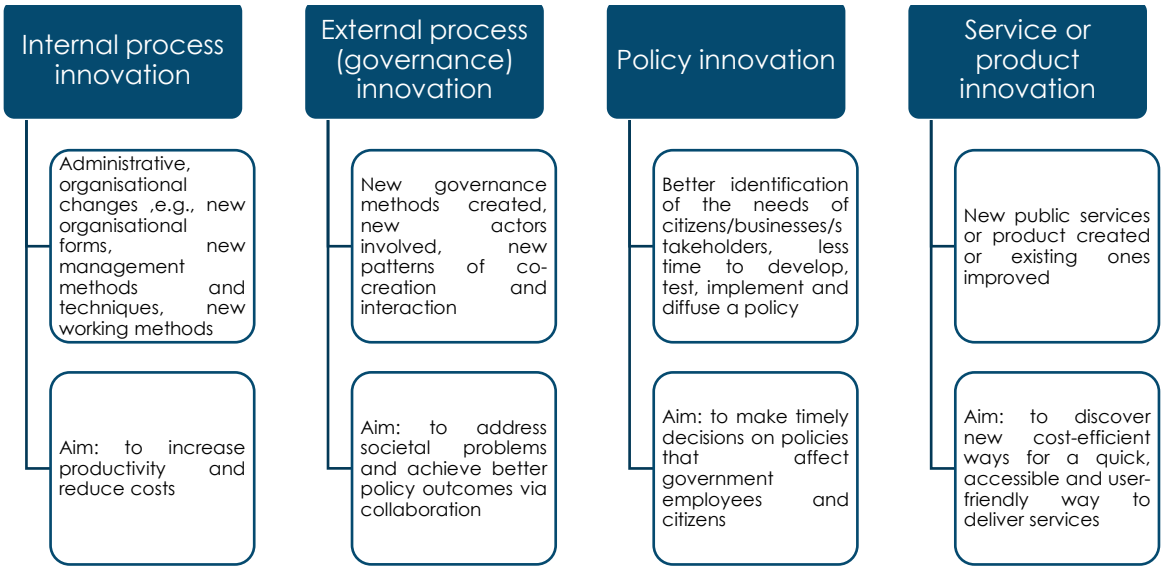


Source: Visionary Analytics, based on a synthesis of multiple sources.

There are generally four types of government innovations enabled by digital technologies: internal process, external process, policy and service or product innovation (see Figure 2). As this study focuses on the impact of digitalisation on workers, internal process innovation appears to be the most important. Therefore, only the most important internal process innovations will be discussed in the following chapters.

[8] Janowski, T., 2015. "From electronic governance to policydriven electronic governance- evolution of technology use in government". In *Communication and Technology*, Layne, K., and Lee, J., 2001. Developing fully functional E-government: A four stage model. *Government Information Quarterly*18(2), 122-136.

Figure 2. Types of digital innovations in government



Source: JRC, 2019: 20

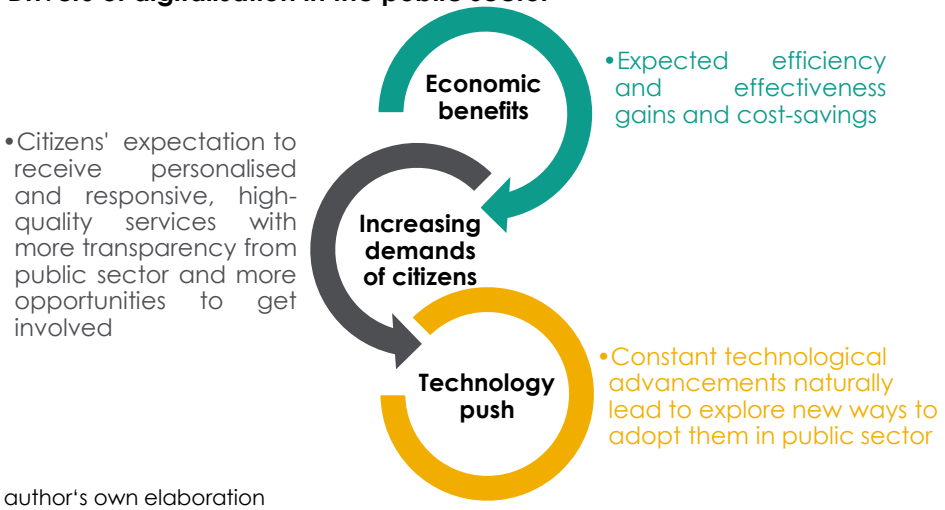
1.2. Drivers of digitalisation in public sector

Key takeaways:

- Public sector digitalisation is driven by the expected economic benefits (i.e., improvement in the efficiency and effectiveness of service delivery, cost savings), the need to respond to citizens' demands (i.e., offer personalised and responsive services and more transparency), as well as new technological advancements (i.e., artificial intelligence, robotics, Internet of Things, geo-spatial data, blockchain, virtual reality, etc.).
- International institutions see digital transformation as a way to make public services more accessible, efficient and of higher quality, in addition to improving working conditions, reducing OSH risks and improving work-life balance.
- The COVID-19 pandemic has significantly accelerated digitalisation trends in central governments, local and regional administrations, education and training sector, health services, and postal services. Lockdowns and limited face-to-face interactions highlighted the importance of organisations and workers being able to provide digital services and maintain a functioning economy during a crisis.

Digitalisation in the public sector is driven by strong external drivers (see Figure 3). These drivers allow to understand the importance and inevitability of digitalisation.

Figure 3. Drivers of digitalisation in the public sector



Source: author's own elaboration

Expected economic benefits is a key driver of digitalisation of the public services. Public sector institutions seek to improve their service delivery to be more efficient (e.g., provide services faster) and effective (e.g., reduce human error and improve accuracy), as well as to increase cost savings (e.g., reducing labour costs via automation).[9]

Digitalisation is also driven by the push to keep up with the private sector and the demands of citizens. Innovation in the private sector is centred on improving the experience of customers (e.g., Netflix suggesting content based on user history and ratings, Amazon reducing the purchase process to one-click), who have become accustomed to simple digital services, personalisation, and feedback in real time. Such constant development and adoption of digital technologies by individuals and businesses puts pressure on public administration to follow suit.[10] Personalised and responsive services offered by private sector has increased citizens' demands to receive the same high-quality services from the public sector. Indeed, one of the expected benefits of digitalisation of public sector is increased user satisfaction, more accessible and higher-quality public services. In addition to better services, citizens also want more transparency from public sector and expect to be more involved in decision-making. More interactions with citizens, one of the characteristics of digitalisation, can improve transparency, accountability, trust and legitimacy of governments. However, public services have not caught up with this yet. In a 2015 study on digitalisation of the public sector, 70% of surveyed officials, leaders and experts believed they were behind the private sector.[11]

Technology push also drives digitalisation of the public sector. The public sector is currently focused largely on the application of technologies that fall within the concept of Artificial Intelligence (AI, including machine learning (ML) and predictive analytics), robotics (including collaborative robotics and chatbots), IoT, geo-spatial data, blockchain and open government data, cloud solutions.[12] Other digital innovations that are applied in public sector organisations are Virtual Reality (VR), Augmented Reality (AR) applications, 3D and 4D printing, bio printing, autonomous vehicles such as drones, to name a few (see Box 1). Figure 4 summarises key technological innovations and their application in the public sector.

[9] Barcevičius et al., 2019, 55.

[10] Lemke, F., Ehrhardt,K., Popelyshyn, O., 2021. "Support and Resistance of Public Officials Towards Current eGovernment Initiatives – A Case Study on Ukraine and Germany." *dms – der moderne staat – Zeitschrift für Public Policy, Recht und Management,* 14(1).

[11] Deloitte, 2015. The journey to government's digital transformation. Deloitte University Press. https://www2.deloitte.com/content/dam/insights/us/articles/digital-transformation-in-government/DUP_1081_Journey-to-govt-digital-future_MASTER.pdf

[12] Tuomi, I., 2018. The Impact of Artificial Intelligence on Learning, Teaching, and Education. Luxembourg: Publications office of the European Union; Barcevičius et al., 2019, 21.

Figure 4. Key digital technology developments utilised in the public sector

Predictive and behavioural analytics
Based on AI, predictive and behavioural analytics are applied in public sector with a hope to improve resource management, provide faster and better service delivery, and allow governments to predict problems before they occur, facilitating better problem-solving. Predictive analytics are used in policing, defence, transportation, education and health sectors, to name a few. They also have great potential for use in policy-making by government agencies in order to assess problems more precisely and come up with clear policy measures to address them.

Robotic process automation (RPA)
Process automation technology based on software robots or AI, used in digital government to automate government operations (e.g., entering data into systems, communicating with citizens), with an expectation to reduce human errors, cut operational costs and let civil servants focus on higher-value tasks. In the public sector, RPA is mostly associated with chatbots, conversational bots and intelligent agents that replace traditional ways of communicating with public sector institutions. In some countries and public services (e.g., healthcare), this has been advanced by deploying physical robotics to assist civil servants with service provision.

Internet of Things (IoT)
IoT describes the network of physical objects that are embedded with sensors, software and other technologies for the purpose of connecting and exchanging data with other devices and systems over the Internet. IoT has great potential to benefit public sector by informing it about major trends. IoT can improve planning and forecasting, make enforcement of regulation more efficient, empower citizens, improve government transparency, reduce costs, improve efficiency, effectiveness and flexibility of service provision, to name a few. Nevertheless, its application in public sector is not sufficiently studied yet.

Data-based innovations
Geo-spatial and location data provides geographic and location information of different data objects that can help governments to provide better location-based services and make better complex policy decisions (i.e., understand specific challenges faced by different communities in the country). Governments have also opened up their data and made it available to all via **Open Government Data (OGD**) initiatives to foster transparency, accountability and citizen engagement. In relation to that, public organisations are increasingly using **Application Programming Interfaces (APIs),** which allow them to share data across the public sector and with citizens and businesses.

Blockchain
Blockchain is a digitally distributed, decentralised ledger that exists across a network and consists of records called blocks which record transactions across many computers, allowing the participants to verify and audit transactions independently. It can be used to perform tasks of registration, identification, verification, and authentification of digital transactions. Extension of blockchain application can reasonably be expected in healthcare and central government administrations, local and regional administrations. Reduced errors, costs, increased transparency and trust of government data and transactions are examples of benefits public sector.

Source: author's own elaboration based on multiple sources.

Box 1. AI applications in the public sector

Artificial Intelligence (AI) refers to any machinery devices that can observe their environment, learn and take intelligent action based on the information they have and their experience.[13] For this they need data (which is abundant in the digital age) and the rules on how to use it.

Public sector is data-intensive, and the adoption of AI to process this data is expected to improve decision and policy making. A study mapping AI applications in the public sector found 85 different AI-implementations across European countries.[14] Most AI applications are used in general public services and are not linked to any specific policy area. AI is used to support re-design of internal service delivery processes, as well as policy-making mechanisms and to improve quality and engagement

[13] Barcevičius et al., 2019, 21.
[14] Misuraca, G., van Noordt, C. Boukli, A., 2020. "The use of AI in public services: results from a preliminary mapping across the EU." In *Proceedings of the 13th International Conference on Theory and Practice of Electronic Governance. Athens*, 2020, 90-99. New York: Association for Computing Machinery.

with citizens. 15 Most common types of AI used in public administration in Europe are natural language processing (NLP) (29%), pattern recognition (25%), image recognition (20%), unclassified (16%), robotics (6%), robotic process automation (4%).[16] Moreover, 16% of AI implementations in the public sector in the EU were unclassified, i.e., it was not clear what kind of AI-technology was used.

NLP technologies, the most common application of AI in public administration can be illustrated as the use of chatbots which provide information about various administrative procedures or automatic translations of documents or the transcription of political debates using speech recognition.[17] Other studies show that AI application in public sector ranges from AI predicting the award prices for projects, AI used for medical diagnosis and treatment, to AI used to transform government's workforce.[18] The current adoption of AI in public sector remains at early stages as it is mostly used to automate processes and for predictive analytics.[19] It is used to answer questions, fill out and search documents, deal with routing requests, translation and drafting of documents.

Most of the AI initiatives in the public administration in the EU are implemented with the aim to increase efficiency (49%) and only a few are aimed at improving inclusion of service delivery to make organisations more open to the public. Generally, application of AI in government is expected to solve such governmental problems as resource allocation, managing large datasets and diverse data, shortages of experts/specialists, performing procedural routine processes, scenario building and prediction, customer relation management.[20] For example, chatbots are expected to improve user-centricity of services by delivering support, information and simplifying service provision.[21] Similarly, ML is expected to improve transparency of eGovernment services by estimating the duration of the service delivery.[22]

Source: Misuraca, G., van Noordt, C., Boukli, A., 2020; Barcevičius et al., 2019.

International institutions are encouraging the digital transformation of public sector (e.g., United Nations, the Organization for Economic Cooperation and Development, the European Commission), which see it as a way for public services to become more accessible, efficient and of higher quality. Those promoting digitalisation in public services also believe that it can improve working conditions, reduce OSH risks and improve work-life balance.[23] International organisations perceive and promote digitalisation of central government and administration as the only way to modernise government.[24]

Most recently, in order to facilitate a successful digital transformation of Europe, as well as a transition towards a climate neutral, circular and resilient economy, the European Commission (EC) has adopted an EU digital strategy *'A Europe fit for the digital age'* which sets out targets related to digitalisation to be achieved until 2030.[25] One of the four focus areas and goals of the strategy is digitalisation of public services, as the EU aims to ensure that 1) 100% of key public services are provided online, 2) 100% of citizens have access to medical records and 3) 80% of citizens use digital identity.[26] According to the EC, effective e-government can lead to more efficiency and savings for governments, businesses and citizens, as well as increasing transparency and openness.[27] The EC ran a *public consultation on a set of European Digital Principles* in May-September 2021 in order to develop the principles for designing digital rules

[15] Misuraca, G., van Noordt, C., 2020. Overview of the use and impact of AI in public services in the EU. Luxembourg: Publications Office of the European Union.
[16] Misuraca, G., van Noordt, C., 2020.
[17] Misuraca, G., van Noordt, C., 2020.
[18] Barcevičius et al., 2019, 23.
[19] Tinholt, D., Carrara, W., & van der Linden, N., 2017. Unleashing the potential of Artificial Intelligence in the Public Sector. Capgemini Consulting.
[20] Mehr, H., 2017. Artificial Intelligence for Citizen Services and Government. *Harvard Ash Center for Democratic Governance and Innovation.*
[21] Capgemini, DG CNECT, IDC, Politecnico di Milano, Sogeti, 2020. eGovernment Benchmark 2020. European Commission. Luxembourg: Publications Office of the European Union, 37.
[22] Capgemini et al., 2020, 37.
[23] Voss, E., Rego, E., 2019. Digitalisation and Public Services: a Labour Perspective. Public Services International.
[24] Voss, E., Rego, E. 2019
[25] European Commission. "Europe's Digital Decade: digital targets for 2030". https://ec.europa.eu/info/strategy/priorities-2019-2024/europe-fit-digital-age/europes-digital-decade-digital-targets-2030_en
[26] Other three priorities of the strategy evolve around 1) skills, i.e., ensuring that at least 80% of population has necessary skills to thrive in the digital age, and cultivating 20 million ICT specialists,2) digital transformation of private sector business, i.e., achieving the targets of 75% of EU companies using Cloud/AI/Big Data, and more than 90% of SMEs to reach at least a basic level of digital intensity, as well as growing scale ups and financing double EU Unicorns, 3) Secure and sustainable digital infrastructures, i.e., providing gigabit for everyone and 5G connection everywhere, doubling EU share in global production of semiconductors, producing 10 000 climate neutral highly secure edge nodes, and develop first computer with quantum acceleration.
[27] European Commission, 2020a. Digital Economy and Society Index (DESI) 2020. Thematic chapters.

and regulations of digitalisation. The results of the consultation are feeding into EC's proposal for a joint interinstitutional declaration on digital rights and principles which would be signed by EC, EP and the Council.[28] In addition, the EU has established a new funding programme *'Digital Europe' (DIGITAL)* and allocated €7.5 billion to fund digital transformation of businesses, citizens and public administrations.[29] The European Parliament has also been focusing on the topic of digitalisation of public services (most recently, the EP organised a public hearing of experts on costs and benefits of digital public administration in December 2021[30]). See Chapter 5 for a more detailed overview of key EU initiatives on digitalisation of the public sector.

Other international institutions that are paying more attention to digital transformation include the OECD, which adopted a *Recommendation on Digital Government Strategies (2014)*[31] to support the development and implementation of digital government strategies that bring governments closer to citizens and businesses. The OECD has also developed a *Digital Government Toolkit* where good practices on innovative, transparent and efficient public sector digitalisation are presented. [32] As part of the 2030 Agenda for Sustainable Development and the Sustainable Development Goals, the United Nations are embracing the spread of ICT to advance and transform public institutions and their service delivery capabilities.[33] The UN advocates for digitalisation of the public sector as it is deemed important for reaching Sustainable Development Goal (SDG) 16 on promoting peaceful and inclusive societies, providing justice for all and building effective, accountable and inclusive institutions. For this reason, every two years the UN conducts an *E-Government Survey* to assess global and regional e-government development, as well as a *research on Open Government Data*, among other initiatives.

The digitalisation was further intensified by the COVID-19 pandemic in an unexpected and rapid way. Out of 230 million jobs in EU-27 and the UK, 59 million (26%) of jobs were found to be at risk because of the pandemic, as workers faced reduced hours or pay, furloughs or permanent layoffs.[34] 24 million (40%) of those jobs at risk from COVID-19 were also found to be at risk of displacement from automation, showing a large overlap between jobs at risk due to the pandemic in the short term and jobs displaced by automation in the longer term.[35] These jobs include wholesale and retail, accommodation and food services, and jobs in construction sector.

As an essential part of the economy, the public sector was especially affected by the health crisis-induced lockdowns. The global crisis not only required the public sector to continue functioning at the same pace, but to provide services in a different manner, adapting to an unprecedented situation while trying to avoid any disruption of services. It showcased the importance of governments providing information and services to citizens online in order to ensure the continuation of governmental activities in times of crisis. Regarding the health sector, researchers and practitioners stress that the pandemic has put employers in health sector in a situation where they had to complete years of anticipated digital transformation in a few weeks.[36] Similarly for the education and training sector, the crisis has highlighted the necessity of digital skills when educators needed to effectively use digital solutions for distance learning.[37]

---

[28] European Commission, 2021. "Consultation results: European express strong support for proposed digital rights and principle." https://digital-strategy.ec.europa.eu/en/consultation-results-europeans-express-strong-support-proposed-digital-rights-and-principles

[29] European Commission. "The Digital Europe Programme". https://digital-strategy.ec.europa.eu/en/activities/digital-programme

[30] European Parliament Committee on the Internal Market and Consumer Protection, 2021. "Digital public administration in covid-19 era". https://www.europarl.europa.eu/committees/en/digital-public-administration-in-covid-1/product-details/20211208CHE09825

[31] OECD, Public Governance and Territorial Development Directorate, 2014. Recommendation of the Council on Digital Government Strategies.

[32] OECD. "OECD Digital Government Toolkit". https://www.oecd.org/governance/digital-government/toolkit/

[33] United Nations. "Digital Government". https://publicadministration.un.org/en/ict4d

[34] McKinsey Global Institute, 2020a. The future of work in Europe. Discussion Paper.

[35] McKinsey Global Institute, 2020a.

[36] McKinsey Global Institute, 2020b. McKinsey Quarterly. https://www.mckinsey.com/business-functions/strategy-and-corporate-finance/our-insights/five-fifty-the-quickening; Cornerstone, 2020. A License to Skills: Embracing the Reskilling Revolution. https://hr.cornerstoneondemand.com/reskilling-revolution

[37] European Commission, 2020a.

Teleworking was introduced as the main way of work during the crisis, which meant that the public sector had resorted to using digital tools for continuing providing their services. Switching to telework was a shift which highlighted the importance of the digital skills necessary for the future. Changes to work organisation induced by the pandemic confirmed that public sector workers can work remotely. These changes are likely here to stay, highlighting the need for the public sector to invest in technological infrastructure to support them in the long run. According to a Cornerstone survey of 500 business leaders and 1 000 employees across the globe carried out at the very beginning of the COVID-19 pandemic in 2020, 76% of employees believed the challenges their organisation was facing due to the crisis will significantly alter their work and experiences in the future; 88% of HR leaders and 91% of non-HR executives share the same belief. Indeed, Member States had dedicated around 40% of the budget for digital investments available from the EU Recovery and Resilience Facility to foster the digital transformation of public services (see Chapter 5).[38]

1.3. Risks of digitalisation in public sector

Key takeaway:

- Some of the key risks related to digitalisation of the public sector are job losses for some workers, and risks of technological bias and discrimination, as well as issues related to accountability for the technologies introduced and threats to data privacy.

Researchers stress that some research overestimates or over-emphasizes the positives of digital transformation.[39] In any case, it is important to acknowledge that digitalisation can also bring negative effects to all stakeholders involved.

Technology, especially algorithms, can be biased and discriminative.[42] As an example, these risks have been relevant for a long time for operations in police departments, where algorithms have been proven to be flawed and biased, e.g., making incorrect facial recognition matches or physical characteristics matches. However, algorithms are increasingly more often used for other purposes such as recruitment in various sectors.[43] With algorithmic recruitment comes the risk for certain groups of labour force (e.g., women, black people) to be discriminated against and excluded from the recruitment process.[44] In addition, AI is also used for worker management practices, such as performance monitoring and evaluation, where it can also disadvantage certain employees. Policies and interventions designed based on biased predictions and suggestions can have discriminatory consequences.

For example, some speech recognition systems have been proven to discriminate against African Americans, when these systems were deployed to evaluate workers' performance in customer service jobs.[40] Moreover, governments are using Automated Decisions Systems (ADS) to identify policy target groups (e.g., predict the likelihood of children in danger), which can disregard important nuances and skew results to the disadvantage of the most vulnerable populations.[41]

There is a growing accountability gap between public and private sectors in terms of who is responsible for how new technologies work and their effects on citizens and workers. As private companies often have a lead in digitalisation, they are consulted or even leading digitalisation efforts in governments.

An illustration of accountability gap comes from a private company "CityTec", which manages smart city projects across the Netherlands, collecting data on residents, which they refuse to share with municipalities because it is "*competition-sensitive information*".[45]

Increasingly more citizen data is fed into multiple digital systems that help public sector organisations to enhance their service delivery. This causes data privacy concerns and risks of personal information being mined and used for private purposes.[46] Multiple cases of leak of populations' data or failure to ensure confidentiality of personal data have occurred in the public sector, underlining the importance of adequate security and safety systems to ensure that digitalisation does not invade peoples' private lives.[47]

More risks on workers in the education and training sector are discussed in Chapter 4.

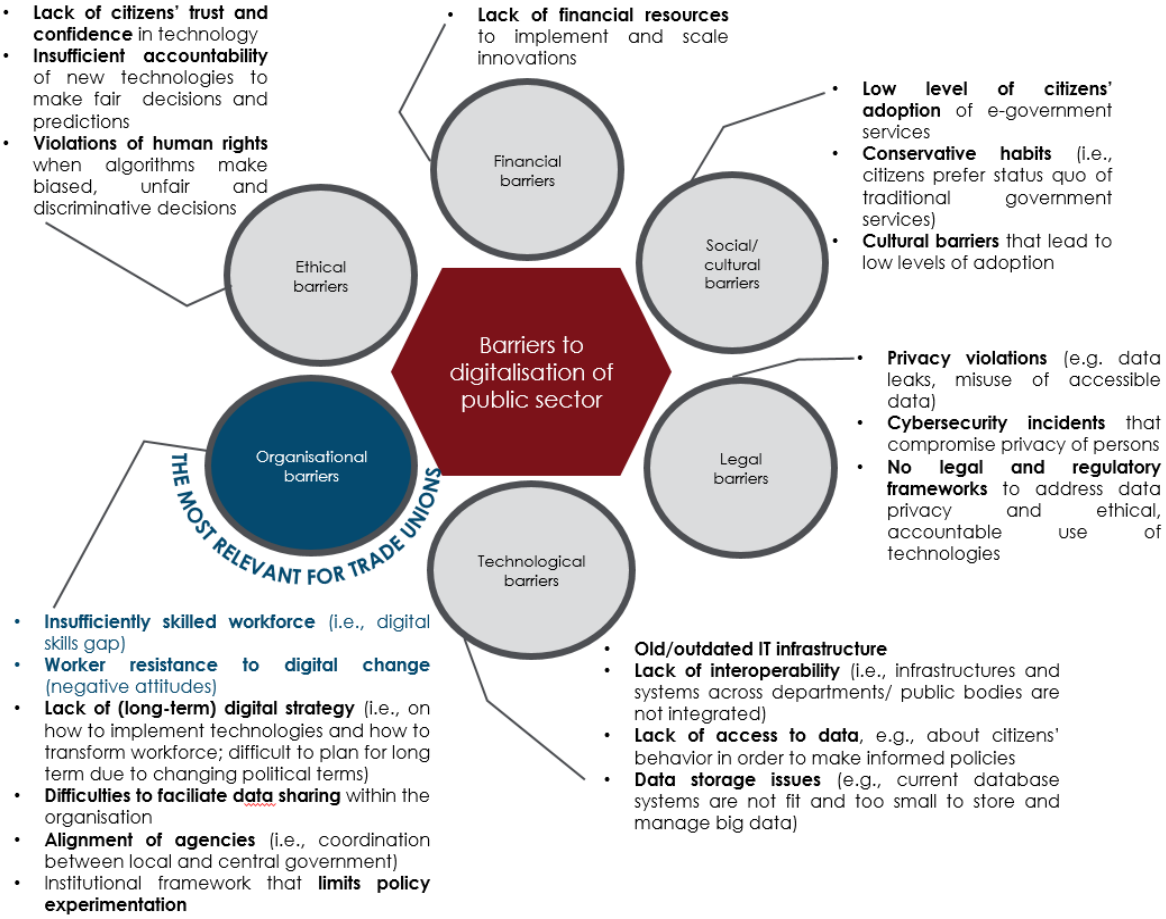
2. Barriers to digitalisation in public sector and remedies

The public sector has not caught up with the potential of digitalisation yet. In a 2015 study on digitalisation of the public sector, 70% of surveyed officials, leaders and experts believed they were behind the private sector. [48] Digitalisation occurs differently in the public sector as compared to the private sector, because it includes political ideas, ambitions and interventions that aim to fundamentally reshape organisations.[49] Therefore, **public sector encounters multiple obstacles that hinder its digitalisation** (see Figure 5).

Barriers that are of the most relevance to trade unions relate to workers' capacities and attitude towards digitalisation. While trade unions have limited capacity to impact such barriers as lack of technological equipment or lack of financial resources, they can impact workers' attitudes and their readiness for digitalisation. Hence, the following two subsections discuss the selected two barriers, namely workers' attitudes and digital skills gap in greater detail. In addition, the subsections explain how trade unions can respond to these challenges and support workers.

[38] Capgemini, DG CNECT, IDC, Politecnico di Milano, Sogeti, 2021. eGovernment Benchmark 2021. Entering a New Digital Government Era, 7.
[39] Fischer, C., Heuberger, M., & Heine, M., 2021. The impact of digitalization in the public sector: A systematic literature review. *der moderne staat - dms: Zeitschrift für Public Policy, Recht und Management*, *14(1);* Barcevičius et al., 2019.
[40] Koenecke, A. et al., 2020. Racial disparities in automated speech recognition. *PNAS*, 117(4), 7684-7689.
[41] Barcevičius et al., 2019, 51.
[42] Pencheva, I., Esteve, M., & Mikhaylov, S. J., 2018. Big Data and AI–A transformational shift for government: So, what next for research?. *Public Policy and Administration*, 35(1), 24-44.
[43] Brione, P., 2020. My boss the algorithm: An ethical look at algorithms in the workplace. ACAS; Vedapradha, R., Hariharan, R. Shivakami, R., 2019. Artificial Intelligence: A Technological Prototype in Recruitment. *Journal of Service Science and Management*, 12(3), 382-390; Fernández-Martínez, C., Fernández, A., 2020. AI and recruiting software: Ethical and legal implications. *Paladyn, Journal of Behavioral Robotics*, 11(1), 199-216.
[44] Dastin, J., 2018. "Amazon scraps secret AI recruiting tool that showed bias against women". *Reuters,* October 8, 2018. https://www.reuters.com/article/us-amazon-com-jobs-automation-insight/amazon-scraps-secret-ai-recruiting-tool-that-showed-bias-against-women-idUSKCN1MK08G; Feloni, R., 2017. "I tried the software that uses AI to scan job applicants for companies like Goldman Sachs and Unilever before meeting them — and it's not as creepy as it sounds." *Business Insider*, August 23, 2017. https://www.businessinsider.com/hirevue-ai-powered-job-interview-platform-2017-8
[45] Naafs, S., 2018. "'Living laboratories': the Dutch cities amassing data on oblivious residents." *The Guardian*, March 1, 2018. https://www.theguardian.com/cities/2018/mar/01/smart-cities-data-privacy-eindhoven-utrecht
[46] Scassa, T. 2014. Privacy and open government. *Future Internet 6(2)*, 397-413.
[47] Hillenius, G., 2017. "Following security breach, Sweden shores up outsourcing rules." *Joinup*, August 2, 2017. https://joinup.ec.europa.eu/collection/egovernment/news/following-security-breach-sw ; Monteiro, M. A., 2019. "First GDPR fine in Portugal issued against hospital for three violations." *IAPP*, January 3, 2019. https://iapp.org/news/a/first-gdpr-fine-in-portugal-issued-against-hospital-for-three-violations/
[48] Deloitte, 2015.
[49] Plesner, U., Justesen, L., Glerup, C., 2018. The Transformation of Work in Digitized Public Sector Organizations. *Journal of Organizational Change Management,* 31(5), 1176-1190.

Figure 5. Barriers to digitalisation of public sector



Source: Barcevičius, E., et al., 2019; 57; Riedel, 2021; Lemke et al., 2021; UN, 2020; Ostroff, 2006.

2.1. Workers' attitudes

Key takeaways:

- Amongst the key barriers to digitalisation, much attention is paid on workers' resistance and negative attitudes towards digital change. Workers may resist digitalisation because of the belief that their organisations are not prepared for it, fear of change, or lack of involvement in the process of change.
- A few CESI members noted that workers fear digitalisation and would like to avoid it, that they believe that their organisations are not ready for digital change (especially in the education and training sector), or that they feel like they do not have a choice in and influence over how their work is being transformed (especially in health sector). However, these negative sentiments do not seem to be widespread and the attitudes of workers towards digitalisation are rather positive to the most part.
- Digitalisation requires a long-term vision and plan on behalf of employers, who should have a clear purpose for the change and strategies to help workers to adapt to the change. Such approach should be promoted and supported by trade unions as well in order to prepare workers for digital change.
- Trade unions can shape workers' attitudes towards digitalisation in order to help them cope better with the change. For this trade unions need to be aware of the drivers and purpose of digitalisation as well as potential benefits for workers, and share this knowledge with workers.

2.1.1. Workers' resistance to digitalisation

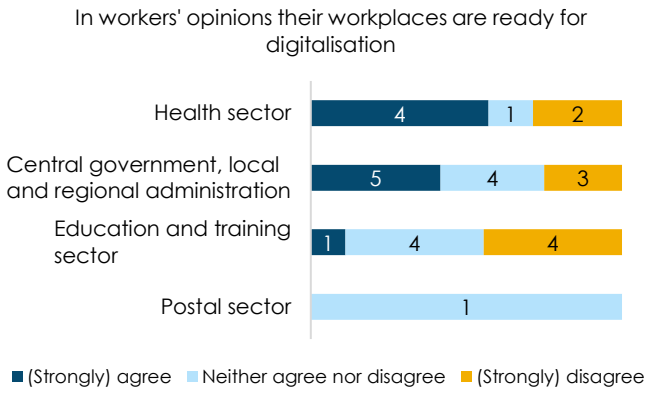
A foundational barrier to digitalisation of the public sector is workers' resistance.[50] Firstly, **civil servants may resist organisational changes because they do not think their organisations are**

[50] Hofmann, S., Ogonek, N., 2018. Different but still the same? How public and private sector organisations deal with new digital competences. *Electronic Journal of e-Government*, 16(2), 127-135; Visionary Analytics, 2020. CESI members' survey on digitalisation in public sector

ready for it. [51] Managers have a central role in this regard, as organisational readiness is mostly associated with their dedication to change and ability to get employee buy-in for structural changes. [52] Workers perceive their organisation as not ready for changes if managers do not provide sufficient communication and if they experience adverse repercussions of the change.[53] To this end, it is important that managers and middle management convey the importance of digital change and create accommodating environment to prevent negative attitudes of public sector workers.[54]

In terms of organisational readiness, CESI members believe that workers in healthcare and central, local and regional administrations tend to think that their workplaces are ready for digitalisation (see Figure 6). However, four out of nine trade unions indicated that in workers' opinion workplaces in the education and training sector are not ready for digitalisation. In addition, organisational unpreparedness has been chosen as one of the key barriers to addressing changing work organisation practices by high shares of trade unions from different sectors (see Figure 7).

Figure 6. Workers' perception of organisational readiness for digitalisation in the public sector, according to CESI members



Source: Visionary Analytics, 2021. DiWork survey on digital transformation of public sector. N= 12 for central government, local and regional administrations, N=9 for education and training sector, N=7 for health sector, N=1 for postal sector.

Figure 7. CESI members' perception of organisational readiness for digitalisation in the public sector

Source: Visionary Analytics, 2021. DiWork survey on digital transformation of public sector. N= 12 for central government, local and regional administrations, N=8 for education and training sector, N=6 for health sector.

Secondly, **workers resist digitalisation because they fear organisational change**. Research has shown that civil servants are more risk averse towards any organisational change.[55] The fear of change can stem from habits, fear of the unknown, fear of negative economic impact, or seeing only adverse outcomes of the change.[56] There is legal uncertainty workers have to face when dealing with digital documents (e.g., when an employee has to decide if an e-mail can be considered as an official document).[57] This is related to workers' fear of radical transparency enabled by digital technologies which allows to trace who is responsible for mistakes, fear of making the wrong decision and ultimately fear of losing their job. Although a few of CESI members agree that workers fear digitalisation and would like to avoid it, most of them disagree, suggesting that the responding trade unions do not think that workers they represent resist digitalisation out of fear (see Figure 8).

[51] Armenakis A., Harris, S.G., Mossholder, K.W.,1993. Creating readiness for organizational change. *Human relations*, 46(6), 681-703 ; Cinite, I., Duxbury, L. E., Higgins, C., 2009. Measurement of perceived organizational readiness for change in the public sector. *British Journal of Management*, 20(2), 265-277.
[52] Cinite et al. 2009
[53] Cinite et al.,2009
[54] Lemke et al., 2021
[55] Wirtz, B. W., Pistoia, A., Ullrich, S., Göttel, V., 2016. Business models: Origin, development and future research perspectives. *Long range planning*, 49(1), 36-54; Dur, R., Zoutenbier, R., 2015. Intrinsic motivations of public sector employees: Evidence for Germany. *German Economic Review*, 16(3), 343-366.
[56] Kotter, J.P., Schlesinger, L.A., 2008, Choosing strategies for change, *Harvard Business Review*, 86(7),130-139.
[57] Hoffman, S., Ogonek, N. 2018.

Figure 8. Fear of digitalisation among public sector workers according to CESI members

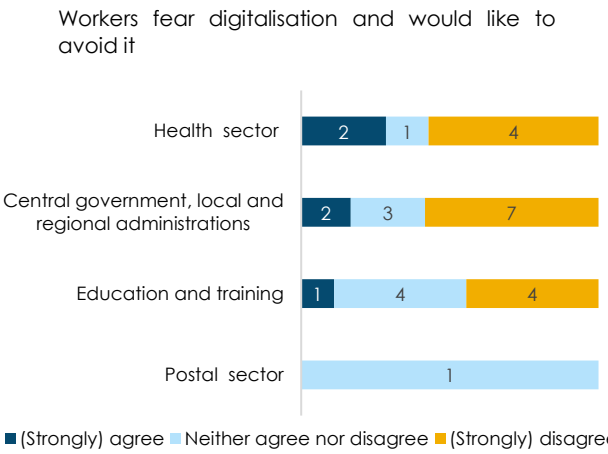
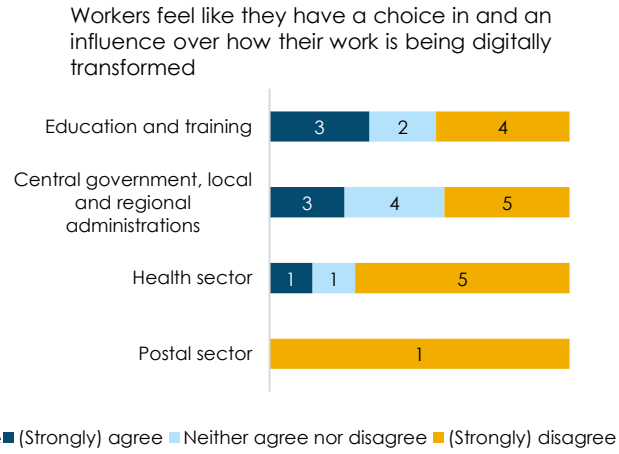


Figure 9.Workers' involvement in the process of digitalisation according to CESI members



Source: Visionary Analytics, 2021. DiWork survey on digital transformation of public sector. N= 12 for central government, local and regional administrations, N=9 for education and training sector, N=7 for health sector, N=1 for postal sector.

Thirdly, **workers are not sufficiently involved in the process of digitalisation, which makes them more likely to resist it**. Digital transition requires not only engagement from employees but also a participatory approach, which would enable and encourage workers to be active participants in the change.[58] Workers or their representatives are rarely consulted when it comes to introducing new digital tools or systems in their workplaces. This can make workers feel like they have no choice in the matter and can in no way influence the process of digitalisation. Research has shown that compared to workers from other sectors, civil servants are less confident that their employers would involve them in decisions about introduction of new technology.[59] Indeed, most of the CESI members representing workers from the health sector believe that employees feel like they do not have a choice in and an influence over how their work is being digitally transformed (see Figure 9). Trade unions remain more positive when it comes to workers' involvement in and influence over digitalisation in the education and training sector, as well as central, regional, and local administrations.

Nevertheless, public servants do not always resist digitalisation. The survey of German and Ukrainian public sector officials showed that 93% of respondents were willing to contribute to the digital initiatives at their workplace.[60] The results of the CESI members' survey also reveal that workers in the public sector hold rather positive attitudes towards digitalisation. Figure 8 shows that most of the CESI members believe that workers do not fear digitalisation, and, on the contrary, are eager to take part in it (see Figure 10). An exception can be seen in the central government, local and regional administration sector, where seven out of twelve trade unions indicate that workers they represent are not personally invested in driving digital transformation.

2.1.2. Remedies to negative workers' attitudes towards digitalisation

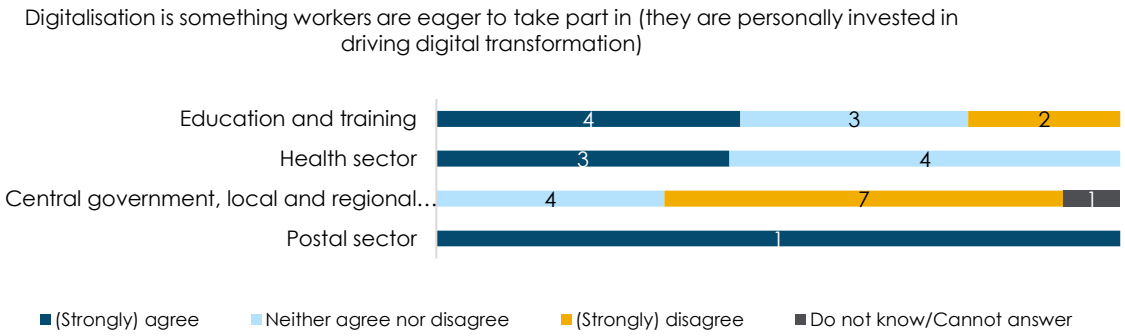
To counter workers' resistance as the foundational barrier to digitalisation of the public sector it is essential to **support a change of the organisational culture**.[61] Digital transformation cannot be approached in a vacuum, as a standalone process that can be facilitated by simply investing in digital tools and implementing various digital systems in organisations. It is necessary to approach digitalisation with regard to its impact on the whole organisation (especially

[58] Gupta, S., 2018. Organizational Barriers to Digital Transformation. KTH Royal Institute of Technology School of iNdustrial Engineering and Managemnt.
[59] For example, in the recent survey of the public service workers in the UK, even 73% of them indicated that they are not sure if their employer would involve them in decisions about introduction of new technology. Source: https://prospect.org.uk/news/technology-can-be-beneficial-to-the-civil-service-but-not-if-we-forget-about-the-humans-involved/
[60] Lemke et al. 2021.
[61] OECD. Digital talent for a transformative public sector culture. https://www.oecd-ilibrary.org/sites/245a6748-en/index.html?itemId=/content/component/245a6748-en

workers) rather than focusing on how it makes operations and service provision more efficient.[62]

To this end, in order to facilitate a successful digital transformation, employers in the public sector must approach digitalisation as a change that requires a long-term vision and plan. The clear purpose would explain the necessity of digitalisation for workers, which would then be less likely to resist change. Moreover, employers should have a strategy on how to help workers adapt to this change, including supporting their skills development and ensuring safe and healthy work conditions. Organisational shift should be guided by professionals with strong leaderships and change management skills, who would "nurture a culture of experimentation, curiosity and learning from failure".[63]

Figure 10. Workers' willingness to take part in digitalisation process, as seen by CESI members



Source: Visionary Analytics, 2021. DiWork survey on digital transformation of public sector. N= 12 for central government, local and regional administrations, N=9 for education and training sector, N=7 for health sector, N=1 for postal sector.

Trade unions can also shape workers' attitudes to digital change. Among other factors, workers' attitude towards digital change depends on whether they are informed about the purpose of digitalising their work practices, whether they are consulted on the implementation of digital tools and if they are aware of the benefits it can bring them. To this end, trade unions can do the following to shape workers' attitudes:

- Be aware about what drives digitalisation and share this knowledge with workers. It is important that trade unions and workers understand that digitalisation is an inevitable process driven by technology push as well as increasing citizen expectations and expected economic benefits (see Chapter 1.2).
- Encourage employers to put in place digitalisation strategy, which would explain to workers the purpose of digitalisation and include measures on how to support them through organisational change.
- Be aware and raise awareness among workers of the potential benefits that digital change can bring to them (e.g., see Chapter 3). It is important that workers see evidence on what digitalisation means for their work in practical terms. Understanding that digital tools can help them in their daily tasks can shift workers' attitude from negative to positive. Nevertheless, it is as important to be aware of the potential disadvantages of digitalisation for workers, so as to avoid creating an impression that digitalisation is an inherently positive development and overlooking important risks.

2.2. Digital skills

Besides workers' attitudes, another important barrier to digitalisation is their **lack of digital skills.**

Key takeaways:

- Structural transformations of the labour market due to digitalisation increases the demand for digital skills, including specific hard skills (e.g., programming, ability to solve technical problems), as well as soft skills (e.g., non-cognitive, interpersonal, self-leadership skills).

[62] Logical Design Solutions, 2019. Organizational Change: A Crucial Component of Digital Transformation.https://www.lds.com/pov/organizational-change-crucial-component-digital-transformation/

[63] OECD, 2020. The OECD Framework for digital talent and skills in the public sector. OECD Working Papers on Public Governance No. 45, 20.

- Demand for medium-skilled workers is decreasing and higher-skilled jobs experience most gains. Workers with higher levels of skills are more secure in the digitalised labour market, with higher likelihood of employment and higher levels of income.
- Almost half (42%) of EU27 and the UK citizens, and 34% of workers lack at least basic digital skills. Older people, those with lower levels of education, retired or inactive are less digitally literate. Countries in Southern Europe and Central and Eastern Europe demonstrate lower levels of digital literacy. Public sector is doing rather well in terms of basic digital literacy as most workers (77%) have at least basic digital skills. However, the above-discussed trends indicate that basic digital skills are certainly not enough for successful adaptation to the future of work.
- Changing skills requirements have multiple implications on workers: workers might find themselves in need to develop new or different skills, and some of their current skills might become obsolete.
- Public sector workers are usually offered traditional offline training that cover judicial topics, specific programmes and procedures, soft skill development, and basic IT tools. However, these efforts are not sufficient.
- Generally, workers should be aware of digital technologies and the specific need for digital skills in their works, as well as given access to training. Trade unions can contribute to closing the digital gap by building partnerships, raising awareness and facilitating training opportunities.

2.2.1. Digital skills are a combination of technical and creative skills

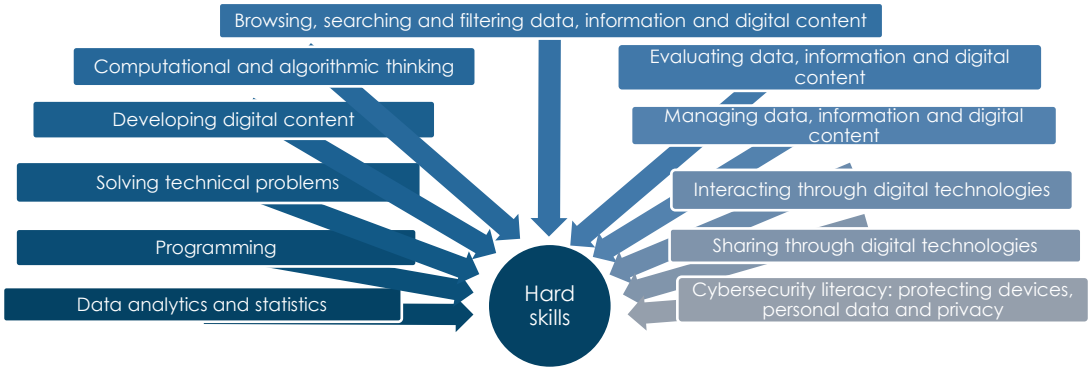
The labour market is undergoing structural transformations driven by digitalisation.[64] Digital transformation is redesigning existing jobs, processes of service provision, creating new means to provide services and creating new services and jobs altogether (see Chapter 3). Such change is significantly transforming the demand for skills that workers must have to participate in the labour market. Reconfiguration of jobs makes some skills obsolete and highlights the importance of others.[65] The set of certain skills required for the future of work are referred to as "digital competence", "digital skills" or "new skills". Highlighting the importance of these skills, the European Commission names digital skills as the backbone of the digital society.[66]

Due to the dynamic and constant technological and societal change, and different research interests and aims, different terms have been used over time to define the skills that will be in high demand due to digitalisation.[67] These terms include computer or ICT literacy, digital competence, information literacy, digital literacy, e-skills including ICT-user skills, ICT-practitioner skills, e-business or e-leadership skills, among many.[68] Despite the variability of terms, they usually cover very similar sets of abilities that are deemed necessary for the future of work. They include two sets of skills: **1) hard skills** or technological/technical/ICT skills, cognitive skills and STEM knowledge**, and 2) soft skills,** or non-cognitive skills.

At the beginning of the 4th Industrial evolution, defining the skills for the future of work meant focusing mainly on the demand for "hard" skills and STEM knowledge, stressing the ability of workers to conduct data analytics and program.[69] The key factor behind this reasoning was the fact that at first digitalisation (particularly computerization and automation) was largely confined to routine tasks.[70]

[64] Berger, T., Frey, C.B., 2016. Digitalization, jobs and convergence in Europe: strategies for closing the skills gap. European Commission.
[65] Warhurst, C., Hunt, W., 2019. The digitalisation of future work and employment: Possible impact and policy response. JRC Working Papers Series on Labour, Education and Technology. No. 2019/05, European Commission, Joint Research Centre (JRC).
[66] European Commission, 2020a.
[67] Curtarelli, M., Gualtieri, V., Jannati, M.S., Donlevy, V., 2016. ICT for work: Digital skills in the workplace. European Commission, 16.
[68] See Frailon, J., Schulz, W., Ainley, J., 2013. International Computer and Information Literacy Study; European Council, 2018. Recommendation on key competences for lifelong learning (2018/C 189/01); The European E-Skills Forum, 2004. E-skills for Europe: Towards 2010 and Beyond. Brussels: European Commission.
[69] Cornerstone, 2020.
[70] Acemoglu, D., and Autor, D., 2011. Skills, tasks and technologies: Implications for employment and earnings. *Handbook of Labor Economics* 4.

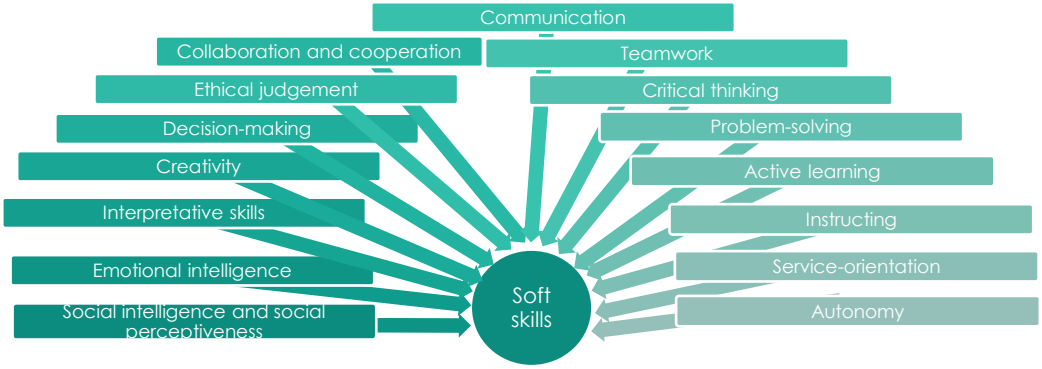
Figure 11. Examples of hard skills in demand



Source: based on Dondi, M., Klier, J., Panier, F., and Schubert, J., 2021; Carretero Gomez, S., Vuorikari, R. and Punie, Y., 2017.

However, more recently non-routine tasks have been transformed into well-defined problems that could be automated using NLP, pattern recognition and machine perception technologies.[71] In this context where technologies are able to solve STEM problems without the assistance of human workers, researchers highlight that workers need more than "hard" technical ICT or STEM knowledge.[72] Therefore, the discourse on the skills needed for the digital age workforce has shifted from focusing on solely "hard" skills **towards a mix of hard and soft skills, and a convergence of technical and creative ability**.[73]

Figure 12. Examples of soft skills in demand



Source: based on JRC, 2019; WEF 2018; Baldwin, 2019; Frey and Osborn, 2013; Voss and Rego, 2019, OECD 2018

Soft skills are interpersonal characteristics related to personality, temperament, attitude and intuition rather than acquiring knowledge, making them more difficult for algorithms to internalise (see Figure 12).[74] These skills are related to integrity and motivation, and enable a person to interact effectively with others. Since machines cannot yet substitute jobs that require to simultaneously use a wide range of skills and address unpredictable scenarios[75], workers with strong unique human capacities who can anticipate changes, be resilient, and flexible are the safest in an increasingly digitised labour market.

Examples of key soft skills include the following:

- ***Creativity*** refers to workers' ability to develop innovative ways to solve a problem, come up with unusual clever ideas on a given topic, knowledge of theory and techniques needed to compose, produce, perform works of music, dance, visual arts, drama and sculpture.[76]
- ***Social intelligence*** (including social perceptiveness, negotiation, persuasion, assisting and caring for others) is also in demand, as workers need to be able to bring people together and reconcile differences, persuade others to change their minds or behaviour, provide personal assistance, medical attention, emotional support, other personal care to co-workers, customers or patients.[77]
- ***Social perceptiveness*** is important for workers to be aware of others' reactions and understanding why they react as they do.[78]

- ***Critical thinking*** is necessary to identify the strengths and weaknesses of alternative solutions, conclusions or approaches to problems. [79]
- ***Active learning*** is an important skill to understand the implications of new information for current and future problem-solving and decision-making. [80]
- Workers also need certain skills that would enable them not to only conduct their work tasks, but to *manage their own workloads* in healthy and safe manner.[81] They will need to be ***self-reliant, flexible, adaptable, resilient, culturally sensitive*** and *competent to work across multiple disciplines*, as well as have *interpersonal skills* for collaborating virtually.[82]

Employees and employers alike acknowledge the importance of both hard and soft skills. Employers surveyed in the Cornerstone study reported their wish to develop employee skills in STEM areas and provide them with technical training, but they also prioritise development of such soft skills as leadership, seek to improve learning in the flow of work and social learning.[83] These goals reaffirm employers' wish to develop skills related to technology (46%), leadership (43%), communication (35%), data analysis (30%), and mental and emotional health (27%). Employers rate workers' ability to adapt to change and being able to learn as equally important as being able to use a computer.[84] This all suggests that non-cognitive (soft) skills are as important to employers for the future of work as are advanced numeracy, literacy and technical skills.[85]

2.2.2. Increasing demand for digital skills

Since the beginning of the 4th Industrial Revolution, research on the requirements for the workforce in the future of work had suggested that work activities and therefore skill requirements for workers will be significantly different.[86] As digital technologies modify job content and work organisation, employers need workers that have digital skills (both hard and soft skills) to respond to these changes.[87] Growth of employment in knowledge-intensive sectors dictates that demand for digital skills is increasing.[88]

Around 90% of occupations in Europe require at least some kind of digital skills.[89] The most required skills in all occupations (especially for high- and medium-skilled jobs) are basic digital skills (i.e., using a word processor, creating a spreadsheet, searching for, collecting and processing information using ICT, communicating through ICT using email, social media, video calls).[90] 90% of employers reported that such occupations as professionals, technicians, clerical

[71] Berger, T. and Frey, C.B., 2016.
[72] Hunnius, S., Paulowitsch, B. and Schuppan, T. 2015. "Does E-government Education Meet Compe-tency Requirements? An Analysis of the German University System from International Perspective", in Bui, T.X. and Sprague, R.H. (Eds.), 48th Hawaii International Conference on System Sciences (HICSS), HI, USA, IEEE, Piscataway, NJ; Cordella, A. and Tempini, N., 2015. E-government and organizational change: Reappraising the role of ICT and bureaucracy in public service delivery. *Government Information Quarterly (32)3*; Hartley, J. 2017. The Uses of Digital Literacy. New York, NY: Routledge; Deloitte, 2018. 2018 Deloitte and The Manufacturing Institute skills gap and future of work study.
[73] Cornerstone, 2020, 2.
[74] Servoz. M., 2019. The future of work? Work of the future! On how artificial intelligence, robotics and automation are transforming jobs and the economy in Europe. European Commission, 62; ACT, 2014. Cognitive and noncognitive skills. https://www.act.org/content/dam/act/unsecured/documents/WK-Brief-KeyFacts-CognitiveandNoncognitiveSkills.pdf
[75] Gonzalez Vazquez, I., et al., 2019. The changing nature of work and skills in the digital age. Luxembourg: Publications Office of the European Union; Harari, Y. N., 2018. *21 Lessons for the 21st Century*. Israel: Spiegel & Grau, Jonathan Cape.
[76] Frey, C. B., and Osborne, M. A., 2013. The Future of Employment: How Susceptible are Jobs to Computerization?, Oxford Martin Programme on Technology and Employment,.
[77] Frey, C. and Osborner, M.A, 2013, 30-31.
[78] OECD, 2018. Based on O*NET26.1 Database https://www.onetcenter.org/database.html#individual-files
[79] OECD, 2018. Based on O*NET26.1 Database.
[80] OECD, 2018. Based on O*NET26.1 Database.
[81] EU-OSHA, 2018. Foresight on new and emerging occupational safety and health risks associated with digitalisation by 2025. Luxembourg: Publications Office of the European Union, 63.
[82] EU-OSHA 2018, 63.
[83] Cornerstone, 2020.
[84] Gonzalez Vazquez, I., et al., 2019, 42-43 based on Cedefop's Skills Online Vacancy Analysis Tool for Europe (Skills-OVATE)
[85] Gonzalez Vazquez, I., et al., 2019, 42.
[86] Rotarori, D. Lee, E.J., Sleeva, S., 2020. The evolution of the workforce during the fourth industrial revolution. *Human Resource Development International,* 24(1), 92-103; Berger, T., Frey, C.B., 2016; Hüsing, T., Korte, W.B, Dashja, E., 2015. E-skills and e-leadership skills 2020. Trends and forecasts for the European ICT professional and digital leadership labour market. Empirical Working Paper.
[87] Gonzalez Vazquez, I., et al., 2019, 29.
[88] McKinsey, 2020a.
[89] Servoz, M. 2019, 17; Curtarelli, M., et al., 2016; ET 2020 Working Group on Vocational Education And Training (VET), 2020. Innovation and Digitalisation: eight insights for pioneering new approaches, 23.
[90] Curtarelli, M., et al. 2016, 8.

workers, skilled agricultural workers were required to have at least basic digital skills. While advanced digital skills were less required, they were most in demand for professionals and technicians (advanced digital skills refer to using software for design, calculation or simulation, programming and using computer numerical control machines and robots.[91] Such estimates suggest that digital skills have become transversal skills and they are required of every worker.[92]

The phenomenon of "hollowing out" of the labour market further increases the demand for digital skills:[93] In recent years in most advanced economies, *employment has grown in knowledge-intensive sectors*, such as telecommunications, financial services, real estate, education, human health and social work, where workers require *a higher level of digital skills* (i.e., a combination of use of ICT and non-cognitive skills such as communication and teamwork)[94]. At the same time employment has *declined in agriculture and manufacturing sectors,* where workers perform *manual, low-skills tasks, with no need for digital skills* and/or social interaction and emotional capacities[95]. Looking to the future, generally, activities requiring mainly physical and manual skills (e.g., craft and technician skills, fine motor skills) will decline by 18% by 2030 across Europe, while activities requiring basic cognitive skills (e.g., basic literacy and numeracy, basic data input/processing) will decline even by 28%.[96] Similarly to low-skill occupations, middle-skills and middle-wage employment is eroding as well, as growth of such lower middle-skill occupations as bank tellers has stagnated.[97]

Possession of digital skills leads to higher likelihood of employment, pointing toward the importance of these skills. Workers lacking basic digital skills are more vulnerable and encounter difficulties in finding jobs. Technological change is skill-biased, reducing the demand for unskilled labour compared to skilled labour.[98] Some of the largest employment sectors in Europe are also those the most at risk of job losses due to automation (e.g., manufacturing, administration and support services, distributive trades).[99] This means that large proportions of workers are vulnerable in the face of digitalisation if they do not possess skills that could help them find employment in other sectors. According to McKinsey, having 'self-leadership' skills correlates with higher likelihood of employment as those proficient in adaptability, coping with uncertainty, synthesizing messages, and achievement orientation are more likely to be employed in the digital age.[100]

Digital skills are also linked with better income prospects. Lack of digital literacy severely impairs wage prospects.[101] Workforce lacking digital skills is at greater risk of unemployment and poverty.[102] Conversely, the probability to have a high-paying job is greatest for workers who perform non-routine tasks requiring non-cognitive skills and also use of ICT.[103] According to McKinsey, the four abilities and behaviours most strongly linked to high incomes were "work-plan development", "asking the right questions", "self-confidence", and "organisational awareness", signalling the importance of different skills across different categories (not only hard skills).[104] These findings correspond with the fact that one commonality between the best-paid young professionals is that they are employed in jobs where the use of non-cognitive

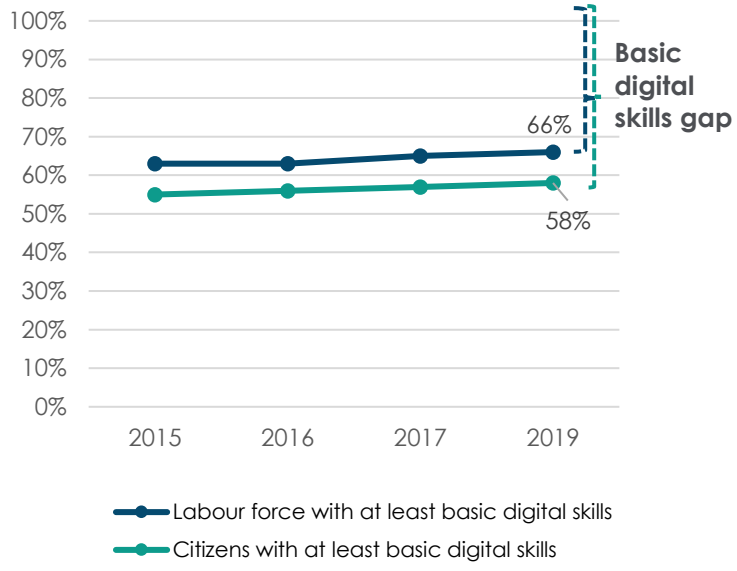
[91] Curtarelli, M., et al. 2016, 7.
[92] Curtarelli, M., et al. 2016, 5.
[93] EU-OSHA 2018, 24; Smit, S., Tacke, Lund, S., Manyika, J., 2020. The future of work in Europe Automation, workforce transitions, and the shifting geography of employment. The McKinsey Global Institute.
[94] Smit, S. et al., 2020; Gonzalez Vazquez, I., et al., 2019, 29-31.
[95] Gonzalez Vazquez, I., et al., 2019, 29.
[96] Smit, S. et al., 2020, 23.
[97] Smit, S. et al., 2020, 9.
[98] Pastore, F., Gausas, S., Styczynka, I. et al., 2019. EU and ILO: Shaping the Future of Work. Policy Department for Economic, Scientific and Quality of Life Policies Directorate-General for Internal Policies.
[99] EU-OSHA, 2018, 24.
[100] Dondi, M., Klier, J., Panier, F., and Schubert, J., 2021. Defining the skills citizens will need in the future world of work. McKinsey & Company.
[101] Falck, O., Heimisch, A., Wiederhold, S., 2016. Returns to ICT Skills. IEB Working Paper N. 2016/05; Lane, M., Conlon, G., 2016. The Impact of Literacy, Numeracy and Computer Skills on Earnings and Employment Outcomes. OECD Education Working Papers No. 129.
[102] ESF Transnational Platform, 2018. https://ec.europa.eu/european-social-fund-plus/en/transnational-cooperation-platform
[103] Gonzalez Vazquez, I., et al., 2019, 29.
[104] Dondi, M., et al., 2021.

(soft) skills (i.e., problem solving, communication, team working and planning/organisation) is considered important.[105]

2.2.3. Digital skills gap

Knowledge and skills is one of the pre-conditions determining workers' readiness for digital transformation. **Today, still a large part of the citizens and workers in the EU lacks at least basic digital skills,** despite the fact that most jobs require such skills.[106] That is one of the key barriers to digitalisation. According to the European Commission's Digital Scoreboard, the share of EU27 and the UK citizens who have basic or above basic overall digital skills increased from 55% in 2015 to only 58% in 2019.[107] These increases are relatively small and signal that in 2019 still a large part (42%) of EU citizens did not have basic digital skills. More specifically, in terms of workers, around 34% of the active labour force (employed and unemployed) of EU-27 and the UK lacked basic digital skills (see Figure 13).

Figure 13. Basic digital skills in the EU27 and the UK (2019)



Source: European Commission, Digital Scoreboard.

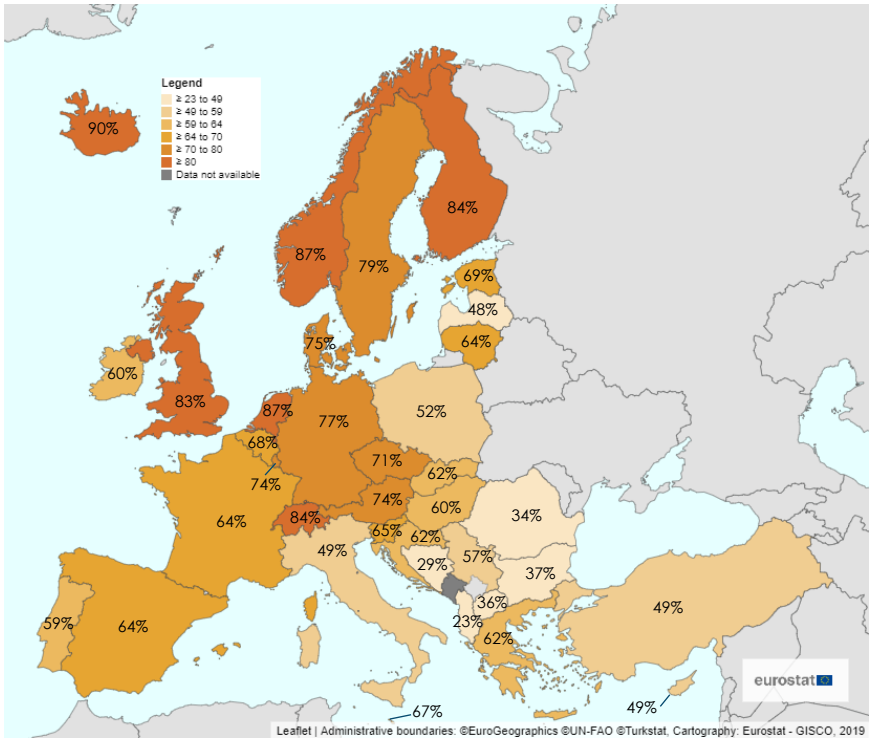
The following briefly discusses a few key trends related to the lack of digital skills in Europe:

- 61 million of adults in Europe have poor literacy and numeracy skills, which hinder their chances of being digitally literate and successfully integrated in the labour market.[108]
- The level of skills possessed by European workers strongly depends on socio-demographic factors. Research shows that digital proficiency is lower among older people.[109] In 2019, 82% of people aged 16-24, 66% of people aged 25-54, and 35% of people aged 55-74 had at least basic digital skills in EU27 + UK, showing a decrease in digital proficiency with age.[110]
- Individuals that attained higher levels of formal education are more likely to have at least basic digital skills than those with lower levels of education.[111] In 2019, the share of individuals in EU-27 + UK with higher levels of formal education that had at least basic digital skills was 84%, while the number stood at 32% for those with no or low formal education.[112]
- According to DESI in 2014-2017, Southern Europe and Central and Eastern Europe were behind the Western and Norther Europe in terms of share of workers with digital skills (see Figure 14)·. This trend remains true for both basic and more advanced digital skills, and for labour force and citizens generally, according to Eurostat data from 2019.

[105] Gonzalez Vazquez, I., et al., 2019, 41 based on Cedefop's European Skills and Jobs Survey, 2016.
[106] European Commission. Digital Economy and Society Index (DESI) 2020 Questions and Answers. https://ec.europa.eu/commission/presscorner/detail/en/qanda_20_1022
[107] https://ec.europa.eu/eurostat/databrowser/view/isoc_sk_dskl_i/default/table?lang=en In broad terms, an individual has a basic level of skills when he/she is able to perform at least one activity in at least one in four skills areas of DigComp (i.e., information skills, communication skills, problem solving skills, software skills or digital content creation skills). An individual has above basic level of digital skills when he/she can perform more than one activity in all four skills areas. For more detailed explanation please see: https://ec.europa.eu/eurostat/cache/metadata/en/tepsr_sp410_esmsip2.htm
[108] Servoz, M., 2019, 69-70.
[109] Dondi, M., et al., 2021; DESI, 2020; Curtarelli et al. 2016, 9.
[110] Eurostat. Individuals' level of digital skills (until 2019). https://tinyurl.com/yppusrwh
[111] Dondi, M., et al., 2021; DESI, 2020;
[112] Eurostat. Individuals' level of digital skills (until 2019).

The share of public sector workers with basic digital skills is higher than the European average, which means that **the public sector has a narrower digital skills gap in comparison to other sectors** considered in the Eurostat's estimations. Statistics from 2019 show that 77% of workers in public administration, defence, education, human health or social work activities in EU27 and the UK had at least basic digital skills: 32% had basic digital skills, and 42% had an above basic level of digital skills.[113] For comparison, the share of workers with at least basic digital skills in the business services (private sector) is only 2 percentage points higher (79%).[114] Other sectors that report more workers who have digital skills are real estate activities (80%), financial or insurance sector (88%) and information and communication (92%). On the other hand, multiple sectors have less digitally proficient workers than the public sector, namely, mining or quarrying, manufacturing, or other industry (60% of workers have at least basic digital skills), wholesale, retail trade, transport, accommodation, or food services (58%), construction (49%), forestry or fishing (30%). A more precise analysis of the kind of skills workers have in the public administration, defence, education, human health or social work activities (sectors in the focus of this study) reveals that workers are more proficient in information skills, communication skills and problem-solving skills than in software skills.[115]

Figure 14. Active labour force with at least basic digital skills (2019)



Source: Eurostat (2019). Available at: https://tinyurl.com/3bnr7j8t

Although the effects of digitalisation on workers' skills may be multi-directional, all of them lead to a digital skills gap. Workers might find themselves in need to develop higher skills (upskilling), or different types of skills (reskilling), and some of their current skills might become unnecessary or obsolete (deskilling) (see Box 2).

Box 2. Examples of how changing skills needs may affect workers' skills in multiple directions

- **Deskilling** occurs because the knowledge required to perform some of the tasks in a job is embodied within technology or technology itself performs these tasks. For example, postal workers equipped with digital routers no longer need to know the neighbourhood or plan their routes, AI-based computer, perform an increasing number of diagnostic tests in healthcare, and matching algorithms tend to increasingly successfully "allocate" unemployed to vacancies or further learning.
- **Upskilling** is associated with the need to develop, manage, and operate advanced digital technologies. Design and continuous improvements in the digital systems requires broad understanding of the processes of service provision, key quality parameters, potential bottlenecks, etc. – this span significantly beyond narrowly conceived digital skills. Operation of digital technologies, likewise, may require broad set of skills and knowledge. For example, doctors validating AI-based diagnoses in addition to relevant medical knowledge, need to understand how the algorithm functions, so that they could identify potential biases or errors in the generated diagnoses.

[113] Eurostat. Individuals' level of digital skills (until 2019).
[114] Eurostat. Individuals' level of digital skills (until 2019).
[115] 88% of EU-27 and the UK had above basic information skills, 78%- above basic communication skills, 75%- above basic problem solving skills, but only 56% had above basic software skills. Source: Eurostat. Individuals' level of digital skills (until 2019).

- **Reskilling** is needed when workers need to perform tasks different from those they did before (as a result of automation and changes in occupation). As routine tasks are increasingly automated and performed by computers, workers increasingly need social skills in order to carry out tasks that are beyond the reach of computer.

Source: author's own elaboration based on Acemoglu, D. and Autor, D., 2010. Skills, Tasks and Technologies: Implications for Employment and Earnings, NBER Working Paper No. 16082; Martinaitis, Ž., Christenko, A., Antanavičius J., 2020. Upskilling, deskilling, or polarisation? Evidence on change in skills in Europe, *Work, Employment and Society* (35)3.

The speed at which workers are expected to renew their skills has intensified. Estimates suggest that decades ago workers needed to update their skills every 10 to 15 years, while now they must upskill and then reskill at least every decade.[116] For certain groups of workers, who experience a rapid change of the knowledge required to perform their job, this process needs to be continuous and regular – monthly or bi-weekly (e.g. professionals in STEM-related industries, health professionals and technicians, teachers).[117] McKinsey estimates that by 2030, around 21 million (or 9%) of workers in EU-27, the UK and Switzerland will need to change their occupations because their current roles will not exist.[118] At the same time, almost five times as many workers (94 million or 40% of the workforce in the EU27, the UK and Switzerland in 2018) might not need to change their occupations but will need to acquire new skills, as one fifth of their current activities could be handled with the help of technology. This need for workers to adapt their skill sets to the changing labour market has resulted in what some call a 'reskilling revolution', where the skills gap should be closed through lifelong learning and upskilling, deeming skills development as one of the most critical priorities for the next decade.[119]

2.2.4. Remedies to the digital skills gap

Equipping society (and the labour force) with digital skills remains one of the greatest challenges of digitalisation. The special Eurobarometer survey from September-October 2021 revealed that difficulty in learning new digital skills is a top concern for 26% of the surveyed.[120] 77% of workplaces in EU that reported they are aware of the digital skills gap in their workplace had not taken any actions to address it, according to data from 2015.[121] In addition, constantly evolving technology makes it difficult to predict what kind of specific skills workers will need in the future, making it more difficult to develop these skills.[122] In the face of job automation and creation of new jobs that involve new activities, initial education and further training of workers play a paramount role. Research highlights the importance of addressing the digital skills gap by transforming education systems so that they focus on developing transversal skills rather than preparing people for specific jobs.[123]

Lifelong learning becomes essential for workers to keep up with digitalisation. Most of the workforce are no longer students learning in education institutions, which are the primary facilitators of learning. Therefore, continuous adult learning is important to ensure that the workforce is ready for digital transformation. Older people are less likely to be proficient in digital skills, which illustrates the need for and importance of adult learning. ILO has prioritized the recognition of universal entitlement to lifelong learning for people to acquire skills, upskill and reskill throughout their life course.[124]

Employees mostly acknowledge the need for upskilling or reskilling, creating the demand for training. For example, in 2020, 72% of the respondents of the public sector employees in Ukraine and Germany indicated they saw the need to improve their technical skills and learn new

[116] Kasriel, S., 2017. "Skill, re-skill and re-skill again. How to keep up with the future of work." *World Economic Forum,* July 31, 2017. https://www.weforum.org/agenda/2017/07/skill-reskill-prepare-for-future-of-work/

[117] Cornerstone, 2020; McGuinness, S., Pouliakas, K., Redmond, P., 2021. Skills-displacing technological change and its impact on jobs: challenging technological alarmism? *Economics of Innovation and New Technology*, 1-23.

[118] Smit, S. et al., 2020, 30.

[119] World Economic Forum, 2020. "The Reskilling Revolution: Better Skills, Better Jobs, Better Education for a Billion People by 2030." January 22, 2020. https://www.weforum.org/press/2020/01/the-reskilling-revolution-better-skills-better-jobs-better-education-for-a-billion-people-by-2030; Cornerstone, 2020.

[120] Misheva, G., 2021. Eurobarometer 2021: the difficulty of learning new digital skills is a top concern for Europeans. https://digital-skills-jobs.europa.eu/en/latest/news/eurobarometer-2021-difficulty-learning-new-digital-skills-top-concern-europeans

[121] Curtarelli, M., et al. 2016, 8.

[122] Servoz, M., 2019, 43.

[123] Servoz, M., 2019, 57.

[124] International Labour Organization (ILO), 2021. Shaping skills and lifelong learning for the future of work. International Labour Conference 109th Session.

processes.[125] In the Cornerstone study, 20% of 1,000 surveyed employees from around the world expressed concern that their role in the next few years will be filled by more qualified candidates, and 21% indicated that their role will become too digitally technical and they will not be able to keep up with the requirements. Employers also report that a rather large share of workers are not prepared to respond to the increasing demand for digital skills. For example, 15% of employers in a European Commission study from 2016 reported that some of their employees are not fully capable to use digital technologies at work.[126] However, despite the apparent demand for skill development, as of 2020, only around 20% of enterprises in the EU-27 provided ICT training to their employees, the share ranging from 7% in Romania to 38% in Finland.[127]

There is a myriad of ways workplaces can address digital skills gap. Out of the 12% workplaces in the European Digital Skills Survey that had taken any action to do so, most addressed the digital skills gap by training (on-the-job training & development programmes, as well as external training).[128] In the public sector, workers obtain digital skills by participating in traditional offline trainings and rarely in e-learning.[129] Most of the trainings in the public sector cover judicial topics, specific programmes and procedures, soft skill-related trainings and training on basic IT tools such as Microsoft Office. Public sector employees follow traditional training and then teach their peers on the job. According to a Cornerstone study from 2020, the most popular avenues for skills development chosen by workplaces is the use of learning management systems (LMS) and workshops and instructor-led training (however, those are less popular in Europe as compared to North America or Asia). Additional ways employers prioritise skills development include investing in external consultants, expanding Learning and Development staff (i.e., team members that aim to support workers' personal and professional development, especially popular in Europe), and implementing mentorship programs.

One of the most important obstacles to addressing the digital skills gap is difficulties in forecasting what kind of skills will be required for future jobs. Rapid advancements of technology make it hard to predict what activities workers can be expected to do in the future. Identification of emerging new skill needs is key to the reskilling revolution. Currently, according to the Cornerstone (2020) study, employees identify which skills they need for their current jobs or jobs they are applying to by asking their managers (46% of respondents), using career resources (43%), reading job descriptions (38%), and consulting colleagues (29%). However, it is more difficult to understand what kind of skills workers will need for the future jobs that do not exist yet. The technology itself can serve in this regard, as ML and AI technologies can spot patterns from large amounts of data and therefore predict the skills of the future.[130]

LinkedIn's Economic Graph, a digital representation of the global economy based on all the data in LinkedIn is an example of how technology can be used to predict the skills of the future. It spots trends such as talent migration, hiring rates, in-demand skills by region.

Trade unions can contribute to addressing the changing skills needs by: [131]

- Raising awareness on digital technologies and the need for digital skills.
- Promoting access to training, e.g., disseminating information about existing training initiatives and how to access them. That is where trade unions and other professional associations can play an essential role.
- Facilitating training. Trade unions can organise training on the use of specific software or hardware tools implemented in workplaces.
- Building multi-stakeholder partnerships based on effective social dialogue to increase the availability of digital skills. An exemplary type of partnership could be between educators

[125] Lemke et al., 2021.
[126] Curtarelli, M., et al. 2016,
[127] Eurostat, N/A. Enterprises that provided training to develop/upgrade ICT skills of their personnel. https://ec.europa.eu/eurostat/databrowser/bookmark/74967b58-05a9-4a0c-b514-01f59e0fd33a?lang=en
[128] Curtarelli, M., et al. 2016,
[129] Hoffman, S. & Ogonek, N., 2018.
[130] Servoz, M., 2019, 59
[131] Curtarelli et al 2016, 9-11.

and employers aiming to design career-relevant curricula.[132] Trade unions are important agents that can contribute to the development of the schemes to develop skills and train workers that would be relevant for workers, would meet their needs and would be in line with vocational programmes and qualifications.[133]

Box 3. Good practices of addressing digital skills gap in public sector

- **The Portugal Digital Skills and Jobs Coalition** is preparing a nationwide program which will develop digital skills of approximately 100 thousand teachers in the country.[134] In addition, it has implemented a program to create and teach courses in the areas of Information, Communication and Electronic Technologies (TICE) in Public Administration (PA) to promote use of technologies in all public bodies in order to modernise central, local and regional government administrations.[135] These courses were on the introduction to artificial intelligence, and innovation and big data.
- In Luxembourg, the **National Institute of Public Administration (INAP)** acts as a partner of the administrations and services of the central government and municipalities in terms of initial and continuing professional training. Its actions are aimed to facilitate systematic development of the professional skills of public officials. Since 2018 INAP is offering hundreds of continuing education courses and seminars to public officials working in national and local administrations. Its' most recent initiative is the Digital leadership program which targeted senior officials in the public service.[136] They were given the opportunity to follow different programs (a business, technology and creativity), be introduced to relevant digital subjects and receive personalised coaching.

Source: https://www.incode2030.gov.pt/atividades/educacao; https://www.incode2030.gov.pt/destaque/ina-promove-novos-cursos-e-learning-no-ambito-da-formacao-tice-na-ap-do-incode2030; https://inap.gouvernement.lu/fr/actualites.gouvernement%2Bfr%2Bactualites%2Btoutes_actualites%2Bcommuniques%2B2021%2B09-septembre%2B20-digital-academy.html

3. Implications of digitalisation on work organisation

At the early stages of digitalisation, the most important implication for workers was the need to develop ICT skills to be able to conduct processes and provide services using ICT devices. Those processes and services themselves remained largely the same. However, with the emergence of Digital Government, new processes to provide public services were designed, including new management methods and techniques and new working methods which had a wider range of implications for workers. However, up to date there is insufficient research on the implications digitalisation has for workers in the public sector, as most of the studies are theoretical, and focusing mostly on the impact of digitalisation on governments in a broad sense, and especially citizens. Moreover, most of these studies focus on the positive implications of digitalisation, pointing to the importance to raise awareness about the possible risks that digitalisation can bring, especially for workers, who are in the middle of the change.

A key implication of digitalisation for workers is related to how technology replaces manual labour and drives work organisation changes. Work organisation refers to division of labour, coordination, and control of work. More specifically, it entails questions such as how work is divided into job tasks, how tasks are bundled into jobs and assignments, what are the interdependencies between workers, how work is coordinated and controlled, organised and managed within companies in terms of designing work processes, allocating responsibilities and tasks, scheduling work, setting work pace, rules and procedures and decision-making processes.[137] Digitalisation transforms how work is organised as adoption of ICT changes the equipment, tools and technical systems used to organise, manage and deliver products and/or services.[138] Such transformations mean that workers experience changes in their work environments.

[132] McKinsey 2020a, 40.
[133] Curtarelli et al 2016, 10.
[134] Portugal INCoDe. Education and Professional training. https://www.incode2030.gov.pt/atividades/educacao
[135] Portugal INCoDe, 2020. INA PROMOVE NOVOS CURSOS E-LEARNING NO ÂMBITO DA "FORMAÇÃO TICE NA AP" DO INCODE.2030. https://www.incode2030.gov.pt/destaque/ina-promove-novos-cursos-e-learning-no-ambito-da-formacao-tice-na-ap-do-incode2030
[136] The Luxembourg Government National Institute of Public Administration. 2021. Digital Academy: a first hackathon for senior positions in the Civil Service https://inap.gouvernement.lu/fr/actualites.gouvernement%2Bfr%2Bactualites%2Btoutes_actualites%2Bcommuniques%2B2021%2B09-septembre%2B20-digital-academy.html
[137] Eurofound, 2022. Work organisation. https://www.eurofound.europa.eu/topic/work-organisation
[138] EU-OSHA, 2018, 46.

In this chapter four key trends in work organisation due to digitalisation are discussed, namely 1) flexible working arrangements, 2) automation, 3) new forms of worker management, and 4) changes in machine-human interaction. In addition, the implications of these changes on working conditions, including occupational safety and health (OSH) of workers are overviewed in each sub-section.

Key takeaways:

- The main opportunities that digitalisation offers for workers across all sectors include working time reduction, increased work autonomy, new forms of collaboration and cooperation between workers & machines, and better ergonomics. On the other hand, digitalisation also poses the risk working-time extension, increased surveillance, competition and inequalities between workers. In addition, while digitalisation can create new jobs and job functions, on the other hand it can also destruct existing jobs due to automation.
- The prevalence of workers using flexible working arrangements (e.g., telework) is increasing, especially because of the pandemic, although they remain less popular in the public sector. Depending on how well it is implemented, telework can either increase or decrease workers' OSH protection, make them either more or less autonomous, reduce or increase levels of stress, result in better or worse work-life balance.
- Around 22% of jobs in Europe (including the UK and Switzerland) could be automated by 2030. Jobs most at risk are those consisting of manual tasks, highlighting the importance of soft skills for future-proof jobs. In the public sector, postal and courier activities are the most likely to be automated, health sector employees are expected to be affected less, and the education sector is the least likely to be automated. Automation can lead to job loss, cause psychosocial risks related to the fear of job loss, and may lead to deskilling. However, it also creates new jobs (e.g., open data coordinators, data scientists, professionals providing technical support, workers able to explain and supervise the outcomes of digital systems), allows better service provision, and reduces the risk of arduous and dangerous work.
- New forms of worker management expose workers to increased levels of surveillance and monitoring. It can improve OSH protection, work efficiency and result in fairer work organisation, although it has the risk of intensifying work, invading workers' privacy, stripping them of autonomy, increasing levels of stress, and exposing them to discrimination.
- Digitalisation has changed the dynamics of machine-human interaction, where workers are no longer controllers of digital devices, but are also supervising their work. This can make workers feel less valued and increase the risk of social isolation due to de-personalisation of work.

3.1. Flexible working arrangements

The broader use of ICT in the economy leads to new flexible working arrangements (FWAs) and new forms of employment that alter traditional work organisation and patterns of work. FWAs have emerged in Europe since 2000 and have become increasingly important over time.[139] These new forms can be characterized by irregular provision of work, unconventional working space and time patterns.[140] There are nine new forms of employment identified by Eurofound, ICT-based mobile work (or telework) being the most predominant one in European labour market, as well as the most relevant for the public sector. [141] It is worth mentioning that another form of employment, platform work, has experienced a tremendous growth in recent years and is a focus of policymakers and researchers.[142] However, considering the nature of occupations in the public sector, it can be assumed that growth of platform work is a less relevant development for workers in this sector.

A subcategory of remote working, **telework** refers to work carried out remotely while using personal electronic devices.[143] According to JRC calculations, in 2019 around 11% of

[139] Eurofound and the International Labour Office, 2017. Working anytime, anywhere: The effects on the world of work. Luxembourg: Publications Office of the European Union, and Geneva: the International Labour Office.
[140] Eurofound, 2015. New forms of employment. Luxembourg: Publications Office of the European Union
[141] New forms of employment are: employee sharing, job sharing, voucher-based work, interim management, casual work, platform work, portfolio work and ICT-based mobile work. Source: Eurofound, 2015. New forms of employment https://www.eurofound.europa.eu/publications/report/2015/working-conditions-labour-market/new-forms-of-employment
[142] European Commission, 2018. Flash Eurobarometer 467: The use of the collaborative economy. http://data.europa.eu/euodp/en/data/dataset/S2184_467_ENG.; Gonzalez Vazquez, I., et al., 2019.
[143] Sostero M., Milasi S., Hurley J., Fernández-Macías E., Bisello M., 2020. Teleworkability and the COVID-19 crisis: a new digital divide?, JRC Working Papers Series on Labour, Education and Technology No. 2020/05. Seville: European Commission, 7.

employees (excluding self-employed) in EU-27 were working from home at least *occasionally*, an increase from less than 8% in 2008. [144] 3.2% of them worked from home *usually*, a share that has not significantly changed since 2008.[145] The average share of all workers working from home in the EU is relatively higher than 11% (19% of the workforce in 2015[146]) because teleworking is more popular among self-employed, who are not included in JRC calculations and less relevant for the public sector too. The share of teleworking employees ranged from 2% to 35% across different EU MS in 2019: it was more common in Northern and Western Europe and less common in Southern and Eastern Europe (see Figure 16).[147]

Figure 15. Prevalence of telework by occupation in EU-27, 2018

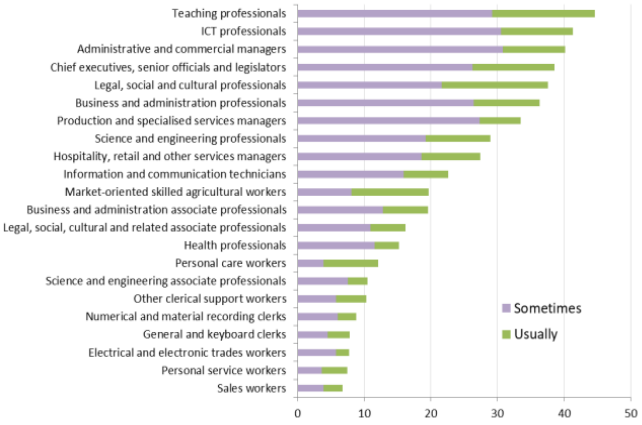
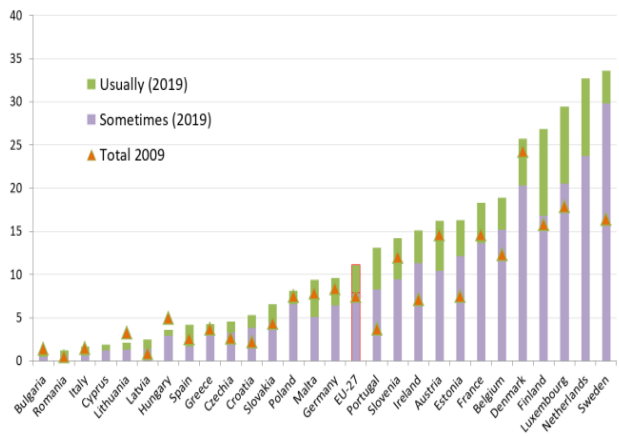


Figure 16. Prevalence of telework across EU MS

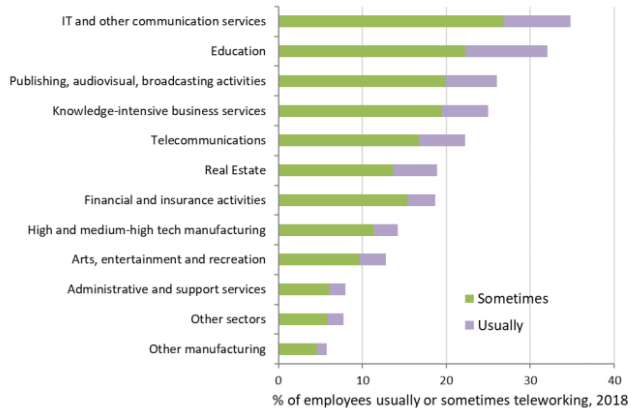


Source : Sostero, M. et al. 2020. Teleworkability and the COVID-19 crisis : a new digital divide ? JRC Working Papers Series on Labour, Education and Technology No. 2020/05. Seville: European Commission.

Telework has spiked due to the COVID-19 pandemic as 40% of those working in the EU-27 started to telework full time – almost three times as many as before the pandemic.[148] The share of employees regularly working from home increased anywhere from 3-5% to a third or more at the EU level.[149] Importantly, employees more than the self-employed experienced the largest increase in teleworking because of the pandemic and are more likely to experience long-lasting changes to their work organisation.[150] This is important considering that most of the workforce in the public sector are dependent employees and not self-employed. Looking forward, the number of teleworkers and therefore the importance of flexible working arrangements is expected to increase as it is predicted that 73% of any organisation's departments will have remote workers by 2028.[151]

[144] Sostero, M., et al., 2020, 8. Based on EU-LFS and matching the results of EWCS 2015.
[145] Sostero, M., et al., 2020, 8.
[146] Eurofound and the International Labour Office, 2017.
[147] Eurofound, 2020. Living, working and COVID-19. COVID-19 series, Publications Office of the European Union, Luxembourg, 7.
[148] Eurofound, 2020, 7-8.
[149] Sostero, M. et al., 2020, 5-6.
[150] Sostero, M. et al., 2020, 5.
[151] Dragomir, S., 2020. The Ultimate List of Remote Work Statistics. Small bizgenius 2020 Edition.

Figure 17. Prevalence of telework by sector in EU-27, 2018



Source: Sostero et. al. 2020: 11-12

Sector-wise, in EU-27 in 2018 the prevalence of telework was highest in IT and other communication services (i.e., Computer Programming, Consultancy and Related Activities-Information Service Activities) (around 35% of the employees in the sector teleworking), and education sector (32%) (see Figure 17). The high levels of teleworking in the education sector are unexpected considering that teaching is largely place-dependent occupation. However, they could be explained by the fact that teachers grade the papers and prepare for classes at home. In terms of occupations, teaching professionals, ICT professionals, administrative and commercial managers have teleworked the most in EU-27 in 2018.[152] On the other side of the spectrum, teleworking was least prominent among personal service workers and sales workers (see Figure 15).

The amount of telework among sectors and occupations is impacted by their "teleworkability". It is estimated that around 36% of employment in the EU is currently teleworkable and the ultimate determinant of teleworkability is the lack of physical handling tasks.[153] This means that teleworking is naturally more prevalent in high-skilled, white-collar occupations (e.g., professionals and managers), whereas low-paid blue-collar workers are exempt from the chance to telework and therefore from any labour market advantages related to it (discussed below). However, only 13% of employment in Europe can be carried out remotely with a minimal loss of quality, whereas for 24% of such teleworkable occupations require social interactions and thus cannot be fully conducted remotely.[154] Besides the high levels of teleworking in the education sector, other public service sectors do not seem to be so prone to teleworking: administrative and support services sector, and occupations of health professionals, clerical support workers, general and keyboard clerks exemplify significantly lower teleworking levels compared to other sectors and occupations as seen in Figure 15 and Figure 17.

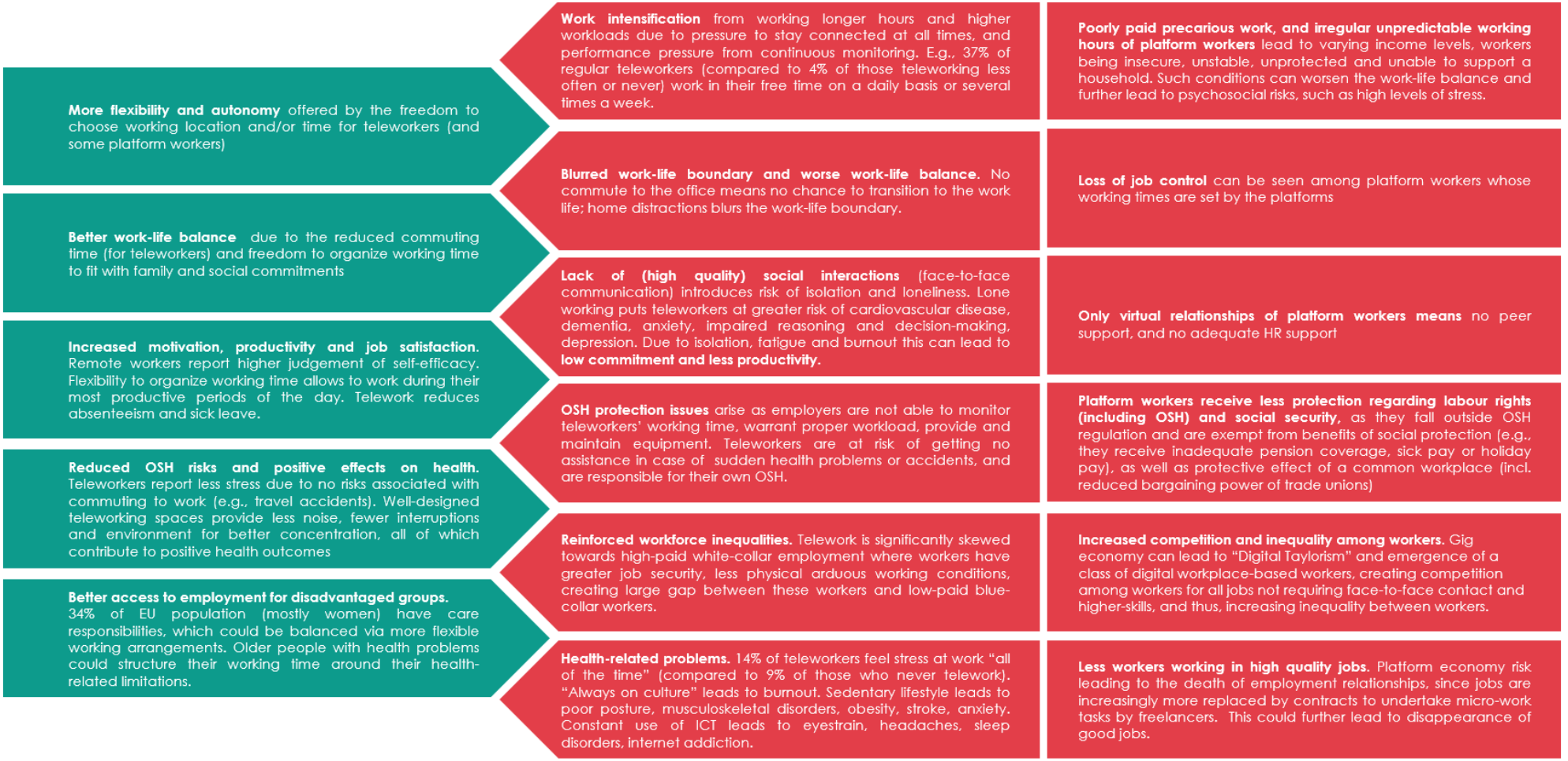
There are a lot of challenges in implementing telework in the public sector. [155] Teleworking in the public sector is not easy to implement considering the many security and privacy concerns. A challenge is to connect trusting devices that teleworkers could work with to a government network. Furthermore, telework requires various ICT tools, technology, servers and various equipment, and the public sector might face financial difficulties to set up such IT infrastructure. In addition, challenges related to implementing regulation to legislate telework in the public sector is a significant obstacle. Importantly, outbreak of the COVID-19 was an important factor that removed (at least partially or temporarily) some of these barriers that prevented workers (including those in the public sector) to telework before the pandemic.[156]

Telework has the potential to be beneficial and disadvantageous depending on how well it is facilitated. To prove the case in point, Eurofound and ILO study on telework has shown that same individuals experienced both positive and negative effects of teleworking on their work-life balance, for example.[157] Similarly, although teleworkers report higher levels of stress, they also appreciate the positive effect telework has on their health.[158] Such dichotomies make it difficult to arrive at a solid conclusion on whether telework has more positive and negative

[152] Sostero, M. et al., 2020, 11-12.
[153] Sostero, M. et al., 2020
[154] Sostero, M. et al., 2020
[155] Fraij, J., Aburumman, N., 2021. How Does Telework Act As A Solution To The Public Sector In The Time Of Pandemic?. *Network Intelligence Studies*, 9(17), 13-24.
[156] Sostero, M. et al., 2020, 5.
[157] Eurofound and the International Labour Office, 2017.
[158] Sostero, M. et al., 2020, 20.

implications for workers. It also highlights the importance of ensuring that the practice of telework is implemented in an adequate way to maximise the positive effects and minimise the potential risks, both discussed below and outlined in Figure 18.

Figure 18. Key implications of flexible working arrangements on workers



Source: author's own elaboration based on multiple sources.[159]

[159] Eurofound and ILO, 2017; Caillier,J. B., 2011. The Impact of Teleworking on Work Motivation in a U.S. Federal Government Agency. *The American Review of Public Administration 42(4)*; Butler, E.S,, Asgeim, C., Rebstock Williams, S., 2007. Does telecommuting improve productivity? Communications of the ACM 50(4): 101-103.; Cohen, S., Janicki-Deverts, D., Miller, G.E. 2007; Uglanova, E. and Dettmers, J., 2018; Tavares, A.I. 2017; Sostero et al 2020: 19-20; Eurofound, 2020; EU-OSHA, 2018: 7,48, 49, 55, 58, 59, 61; Mandl, I. et al., 2015; Messenger, J. 2017; Greer T. & Payne, S. C. 2014. Overcoming telework challenges: Outcomes of successful telework strategies. *The Psychologist-Manager Journal 17(2)*; Nygren, K. G., 2012; Fariweather, N. B.1999; Suh, A. and Lee, J. 2017; Ruth, S. and Chaudhry, I. 2009; Voss, E., Rego, E. 2019; OECD, 2016; Montreuil, S. and Lippel,K., 2003; Eurostat, 2018; Vanajan, A., Bültmann, U., Henkens, K., 2020; Shin, B. Sheng, O. R. L., Higa, K. El Sawy, O., 2000; Konradt, U. et al., 2003; Weinert, C. Laumer,S. Maier, C. & Weitzel, T., 2016; Knowledge at Work, 2017; Eurofound 2017 update of EWCS; Horton, J. et al., 2018; WHO, 2022; Adams-Prassl, A., Boneva, T., Golin M. and Rauh C. 2020. Inequality in the Impact of the Coronavirus Shock: Evidence from Real Time Surveys. ZA DP No. 13183; Broughton et al., 2018. The experiences of individuals in the gig economy; Lethbridge, 2015; European Parliament, 2016; Eurofound, 2019; Valenduc, G., Vendramin, P. 2016; ILO, 2016; Warhurst and Unt, 2019; Wright, A.D., 2015.

3.2. Automation of tasks and jobs

Automation is one of the key features of the 4th Industrial Revolution. Technological advancements allow technologies to replace workers in conducting their tasks or even their whole jobs, making the work processes increasingly more complex, interconnected and autonomous so that they can self-organise, self-learn and self-maintain.[160] Around 20% of jobs in Europe can be expected to be automated in the future, most of them being routine jobs that consist of physical manual tasks.

Different approaches to measuring the extent of expected automation offer a wide range of estimates on how many jobs are likely to be automated in the future. The pioneering study of automation of jobs predicted that almost half (47%) of jobs in advanced economies will be automated. [161] More recent studies had also arrived at similar conclusions.[162] However, there are studies suggesting that only a relatively small share (around 10%-15%) of jobs will be automated and thus eliminated.[163] In terms of Europe, in their survey of over a thousand local economies across EU-27, the UK and Switzerland in 2020, **McKinsey estimated that by 2030, 22% of current work activities (equivalent to 53 million jobs) could be automated.[164]**

Routine jobs that can be defined by a mathematical equation and consist of physical manual tasks remain the most at risk of being automated.[165] Besides consisting of routine tasks, these jobs usually demand less specific, transversal and interpersonal skills, as well as less training, and can also be characterised by a higher worker-machine interaction.[166] This has caused fears of job loss among medium- or lower-skilled workers employed in routine occupations, e.g., transport, building, craft, trade, plant and machine operators, clerical jobs, sales and market services, food preparation jobs, elementary or personal service occupations.[167]

However, multiple studies have demonstrated that the **negative impact of automation is exaggerated**.[168] Research suggests that occupational attributes that most estimates associate with a greater risk of automation (i.e., routine and repetitive tasks) only have a weak link to actual changes and warn to approach projections of massive job destruction with scepticism.[169] Moreover, it should be considered that jobs are rarely automated at their entirety. While routine tasks within jobs can be more prone to automation, the share of whole jobs that can be fully substituted by technological devices is low: by one estimate, only about 9% of jobs across 21 OECD countries have at least 70% of tasks that could be fully automated. [170] Other estimations suggest that only around 9% of the workforce in EU27, the UK and Switzerland will need to change occupations because their current roles will no longer be needed.[171] To take this argument further, evidence in facts suggests that in the long-run digitalisation will create as many as or even more jobs than it destroys. [172] In 2018, the World Economic Forum (WEF) has reported that the ratio between newly created jobs and displaced jobs is increasing: WEF estimated that between 2018 and 2022 digitalisation will create 133

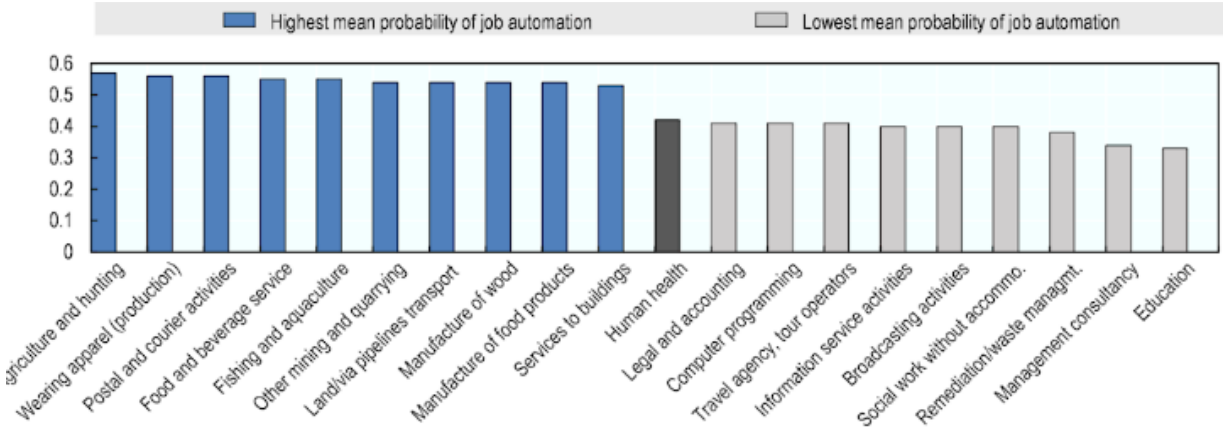
[160] EU-OSHA 2018, 46.
[161] Frey and Osborne, 2013, 2017.
[162] Manyika, J., Lund, S., Chui, M. Bughin, J., Woetzel, J., Batra, P., Ko, R., Sanghvi, S., 2017. Jobs lost, jobs gained: What the future of work will mean for jobs, skills, and wages. McKinsey Global Institute. https://www.mckinsey.com/featured-insights/future-of-work/jobs-lost-jobs-gained-what-the-future-of-work-will-mean-for-jobs-skills-and-wages
[163] See Pastore, F. et al., 2019, 71; Arntz, M., Greogry, T., Zierahn, U., 2017. Revisiting the risk of automation. *Economics Letters 159* ; Nedelkoska, L. and Quintini G., 2018. Automation, skills use and training. OECD Social, Employment and Migration Working Papers; Pouliakas, K., 2018. Automation risk in the EU labour market. A skill-needs approach. European Centre for the Development of Vocational Training, University of Aberdeen business School and IZA.
[164] McKinsey, 2020a.
[165] Pugliano, J., 2017. *The Robots are Coming. A Human's Survival Guide to Profiting in the Age of Automation*. Berkeley: Ulysses Press.
[166] Nedelkoska, L., Quintini, G., 2018, 49
[167] McGuiness et al., 2021.
[168] Van Reenen, J., 1997. Employment and Technological Innovation: Evidence from U.K. Manufacturing Firms. *Journal of Labor Economics*, 15(2); Vivarelli, M., 2015. Innovation and employment. *Iza World of Labor 154;* Van Roy, V., Vértesy, D., Vivarelli, M., 2018. Technology and employment: Mass unemployment or job creation? Empirical evidence from European patenting firms. *Research Policy 47(9)*.
[169] Freeman, R. B., Ganguli, I., and Handel,M. J., 2020. Within Occupation Changes Dominate Changes in What Workers Do: A Shift-Share Decomposition, 2005-2015. AEA Papers and Proceeding.
[170] Arntz, M., et al., 2017.
[171] McKinsey 2020a, 30.
[172] WEF, 2018. The Future of Jobs Report 2018. https://www3.weforum.org/docs/WEF_Future_of_Jobs_2018.pdf; Pastore, F. et al., 2019; WEF, 2020. The future of Jobs Report 2020. https://www.weforum.org/reports/the-future-of-jobs-report-2020

million new jobs and destroy 75 million.[173] By 2022 a share of new roles in jobs is expected to increase to 27%.

Evidence suggests that **occupations where workers have high degrees of social interaction, creativity, problem-solving and caring for others are least likely to be automated.**[174] This once again highlights the importance of workers developing soft skills that would give them advantage and higher likelihood of staying in the labour market. Nevertheless, the capabilities of robots are expanding, suggesting that virtually no occupation will remain unaffected by automation.[175] Robots are already undertaking cognitive mental tasks,[176] and some speculate they will be able to perform tasks that are now exclusive to humans, such as social tasks that involve empathy (e.g., caring for elderly people).[177]

Some of the most likely-to-be automated sectors concern public sector workers (see Figure 19). Fast evolving digitalisation of the postal sector is already evident. Postal sector and namely sorters as an occupation are highly likely to be undoubtedly affected by technological replacement.[178] Generally, the most likely to be replaced in the public sector are administrative and operative roles (this includes administrative jobs as well as physical jobs such as hospital porters).[179] It is predicted that the replacement of these jobs will occur by 2030.[180] On the other end of the spectrum, interactive, frontline and cognitive roles (e.g., health professionals, administrative managers, teachers, social service workers, police officers) are among the less affected groups.[181] It can be expected that some of their routine tasks, but not whole jobs will be replaced. Although they might not need to change occupations, even in these less affected sectors and occupations workers will need to adapt to changing nature of their tasks: many of administrative tasks, including handling of standard cases or invoicing, that are prevalent in the public administration can be easily automated.[182] **Due to rapid technology**

Figure 19. Jobs most and least likely to be automated



Source: OECD, 2018. Automation, skills use and training. https://www.oecd-ilibrary.org/employment/automation-skills-use-and-training_2e2f4eea-en

development, it is difficult to predict what jobs will be created by digitalisation. A significant proportion of people entering the workforce by 2025 will be working in jobs that do not exist as of now.[183] About 30% of new jobs created in the USA over the past 30 years did not exist or were not fully developed at that time,[184] including such occupations as app developer, social

[173] WEF, 2018.
[174] OECD, 2018, 49.
[175] Muro, M., Maxim, R., Whiton, J., 2019. Automation and Artificial Intelligence: How machines are affecting people and places. Brookings; EU-OSHA 2018, 46.
[176] Manyika, J., et al., 2017; OECD 2018.
[177] Foster, M., 2018. "Aging Japan: Robots may have role in future of elder care". Reuters. https://www.reuters.com/article/us-japan-ageing-robots-widerimage-idUSKBN1H33AB
[178] Warhurst and Hunt 2019.
[179]Deloitte, 2017. The State of the State: Government through business lenses. https://www2.deloitte.com/content/dam/Deloitte/uk/Documents/public-sector/deloitte-uk-government-through-talent-lenses.pdf
[180] Deloitte, 2017.
[181] Deloitte, 2017.
[182] Voss, E., Rego, E., 2019.
[183] EU-OSHA, 2018, 23.
[184] Manyika, J., et al., 2017.

media manager, drone operator, search engine optimisation consultant, web developers, user experience designers, including Airbnb hosts, Uber drivers, social media influencers and stars.[185] Nevertheless, despite difficulties in forecasting, some emerging important functions of workers can be predicted:

- The labour market will need "*trainers*" who will manage large amounts of data and design algorithms to train AI systems. It will also need "*explainers*", workers able to interpret the outcomes of AI systems, and "*architects*" responsible for organising AI systems and recognising opportunities for AI adoption. "*Ethicists*" will be necessary to set guidelines and ensure that AI systems are accountable and ethically just.[186]
- The expansion in industrial robotics implies that manufacturing firms will need professionals that could provide robotics support services, namely *programmers and specialists in robot maintenance*.
- The demand for *data professionals* (e.g., data scientists) is constantly growing due to the need for professionals that can manage and elaborate large amounts of data available. By 2025 data professionals are expected to account for 4% of EU-28 employment, the share which was already 3.5% in 2017.[187]
- Some other examples of new jobs include *cybersecurity specialists*, *network experts, computer engineers*, *data stewards*, *open data coordinators*, *big data analysts* (see Figure 20).

Figure 20. Examples of jobs emerging due to digitalisation in different industries

Source: based on World Economic Forum, 2020. Jobs of Tomorrow. Mapping Opportunity in the New Economy. *Note: The emergence of new professions reflects the adoption of new technologies, which gives rise to green economy jobs, roles at the forefront of the data and AI economy, and roles in engineering, cloud computing and product development. It also reflects the importance of human interaction in digital economy.*

Figure 21 below outlines the key positive and negative implications of automation on workers. The key to maximising the positive implications and minimising the risks associated with automation, is to ensure that workers trust and accept technologies. To this end researchers highlight the importance of **adaptive automation**, which can ensure that the speed of the processes of robots are adapted to the speed of human-workers working with them.[188]

[185] WEF, 2020. Jobs of Tomorrow Mapping Opportunity in the New Economy. https://www3.weforum.org/docs/WEF_Jobs_of_Tomorrow_2020.pdf ; McKinsey, 2020a, 22.
[186] Wilson, H. J., Daugherty, P., and Bianzino, N., 2017. The jobs that artificial intelligence will create. *MIT Sloan Management Review*, 58(4), 14.
[187] JRC, 2019.
[188] EU-OSHA 2018, 51.

Figure 21. Key implications of automation on workers

Source: author's own elaboration based on multiple sources.[189]

3.3. New forms of worker management

New forms of worker management occur whereby workers are put under tight ICT-enabled surveillance and monitoring. Worker management has been on the rise since teleworking and rapid transformation of work environment following the outbreak of COVID-19 pandemic, which have led to a global spike in usage of dedicated electronic monitoring software.[190]

Building-up on decades-long monitoring of employees' on-site activities via timesheets, **employers have started to resort to sophisticated electronic monitoring packages.** Increasingly digitalised ways to manage workers include use of people analytics (e.g., digitalised profiling) in human resources (HR) management, use of big data and algorithmic distribution of work, using sensory and other monitoring devices to track wellness and productivity, analyse tone and sentiment, using gathered data to make work-related decisions (who to hire, fire, or promote, what kind of tasks should be assigned to whom, which group of people work best together, etc.).

[189] OECD, 2018; Perez, C. & Martín, F., 2018. "Digitalisation and Artificial Intelligence: the New Face of the retail banking sector. Evidence from France and Spain" Working Papers halshs-01884121, HAL; McKinsey 2020a: 18, 30; EU-OSHA, 2018, 47-51, 60, 64 ; Servoz, M., 2019, 75; Levy, F., and Murmane, R, J., 2004. *The New Division of Labor: How Computers Are Creating the New Jobs Market*; Muñoz-de-Bustillo, R., Grande, R. and Fernández-Macías, E., 2016. Innovation and Job Quality. An Initial Exploration, QUINNE Working Paper WP5-1-2016; Freeman, R.B., et al., 2020; McGuiness et al., 2021, 5; Nygren, K. G., 2012. Narratives of ICT and Organizational Change in Public Administration. *Gender Work and Organization 19(6)* 623-624; Steijn, W. M. P., Luiijf, E., van der Beek, D., 2016. Emergent risk to workplace safety as a result of the use of robots in the work place. TNO R11488; World Government Summit, & Kinetic CS, 2018. From automation to AI government strategic considerations.

[190] Morrison, S., 2020. "Just because you're working from home doesn't mean your boss isn't watching you". Vox. https://www.vox.com/recode/2020/4/2/21195584/coronavirus-remote-work-from-home-employee-monitoring

Algorithmic HR management enables employers to provide feedback to workers and allocate tasks without human interference.[191] This is facilitated by worker-related data collected by digital devices. Through monitoring such worker activity as their location, working pace and time, internet sites visited, keystrokes, absence/presence at the desk, social media activity, any physical activity, digital devices and software gather not only data related to worker performance, but also highly sensitive personal data. This data is coordinated and overseen by computer algorithms and software that can create a synthetic measure of employees' everyday performance.

For example, wearables, sensors, GPS, webcams, bionics and exoskeletons, various software are used to monitor (and enhance) worker performance. Specifically, alongside the widespread websites blocking and control of e-mail and phone calls history, modern software (e.g., ActiveTrak, Hivedesk, Time Doctor, Work Examiner, EmpMonitor, Workpuls, Hubstaff, Desktime, Teramind) allows employers to track keystrokes, file transfers, time spent on specific activities, email content, phone logs, and on-screen content via regular screenshots (up to 1 screenshot every 5 seconds).

Uptake of new forms of worker management in Europe has been growing as part of digitalisation process and has been further catalysed by the COVID-19 pandemic. For example, 47% of public sector workers in Germany reported that digitalisation resulted in increased levels of surveillance and control of their work.[192] Global demand for worker monitoring software increased by 80% in March 2020 compared with pre-pandemic times,[193] and the search term 'remote employee monitoring' peaked around the beginning of the pandemic according to Google trends.[194] Sales of monitoring products provided by companies such as Hubstaff, Awareness Technologies or Teramind have tripled,[195] while Enaible was getting four times as many inquiries about their software since the pandemic.[196] Such tools like Sneek, a screen capturing software, which takes webcam shots of employees every five minutes has gained prominence due to the pandemic.[197] New forms of worker management can have multi-directional implications for workers, depending on its purpose and the ways it is facilitated (see Figure 22).

[191] Lee, M., K., Kusbit, D., Metsky, E., Dabbish, L. A., 2015. Working with Machines : The Impact of Algorithmic and Data-Driven Management on Human Workers. Proceedings of the 33rd Annual ACM Conference on Human Factors in Computing Systems.
[192] DGB, NRW, 2018. Digitization in the public sector - effects from the perspective of employees (2018 survey) https://nrw.dgb.de/archiv/++co++5fb3a472-cd37-11e8-a27c-52540088cada
[193] Migliano, S., O'Donnell, C., 2020. "Employee Surveillance Software Demand up 56% Since Pandemic Started". TOP10VPN.
[194] Eurofound, 2020.
[195] Allyn, B., 2020. "Your Boss is Watching You: Work-From-Home Boom Leads To More Surveillance". NPR https://www.npr.org/2020/05/13/854014403/your-boss-is-watching-you-work-from-home-boom-leads-to-more-surveillance ; Dreyfuss, J., 2020. "Here's how employers are using tech tools to keep a close watch on their remote workers". CNBC. https://www.cnbc.com/2020/06/24/new-tech-tools-employers-are-using-to-keep-watch-on-remote-workers.html
[196] Heaven, W., D. 2020. "This startup is using AI to give workers a "productivity score. MIT Technology Review. https://www.technologyreview.com/2020/06/04/1002671/startup-ai-workers-productivity-score-bias-machine-learning-business-covid/
[197] Holmes, A., 2020. "Employees at home are being photographed every 5 minutes by an always-on video service to ensure they're actually working — and the service is seeing a rapid expansion since the coronavirus outbreak". Business Insider. https://www.businessinsider.com/work-from-home-sneek-webcam-picture-5-minutes-monitor-video-2020-3 ; Harwell, D., 2020. "Managers turn to surveillance software, always-on webcams to ensure employees are (really) working from home". The Washington Post. https://www.washingtonpost.com/technology/2020/04/30/work-from-home-surveillance/

Figure 22. Key implications of new forms of worker management on workers

Source: EU-OSHA 2018: 6-7, 47, 49, 50-51, 54-56, 58, 62; Martin and Freeman, 2003; Knowledge at Work 2017; Bezek and Britton, 2001; Yerby, 2013; Mandl, I. et al., 2015; Messenger et al., 2017; HSE 2017; Voss and Rego, 2019; EU-OSHA, 2020; ETUI, 2017; Stein et al., 2016; Moore 2018; Jeske and Santuzzi, 2015; Akhtar and Moore, 2016.

3.4. Changes in machine-human interaction

Digitalisation means new forms of collaboration and cooperation between workers and machines. The rapid development of technological tools in the mid-20th century caused changes in machine-human interaction.[198] Before the pace of digitalisation increased, new equipment was designed in a way that a human would be able to control it, putting them in a clear position of power. However, since then machines are being modelled like humans and used to automate tasks that would normally be done by them, **changing human position from that of controller to supervisor.**

Human workers are working in an ever-close proximity with digital technologies. Due to the constantly evolving technologies such as speech and image recognition, emotion detection, the registration of eye movement and gestures, machines can register user behaviour increasingly more precisely,[199] making it possible for humans and machines to work together. Human-machine co-working is expected to develop further, as robots will be equipped with self-optimising algorithms which allow them to learn from their human colleagues.[200] Robots can be expected to be used in such sectors as healthcare, defence, customer-facing jobs, including services and administration,[201] to name a few examples related to the public sector.

Humans can interface with machines remotely via ICT. Human-machine interfaces are real-time, interactive, direct and immersive.[202] They are expected to advance even further, allowing human-machine interaction to increasingly resemble human face-to-face communication (e.g., enabling machines to use voice and gestures). [203] In addition, some workers in countries like Sweden or Estonia had already taken the human-machine interface further by getting microchip implants, which allow them to access workplaces or security-restricted areas more easily.[204]

Such proximity in human-machine relationship requires **new techniques to protect workers' OSH,** as workers and machines are no longer working in separate rooms without interaction. Employers therefore will need to adopt sensors, vision systems, soft, rounded edges, reduced speeds and force as measures to ensure worker protection.[205]

Key implications of new dynamics between machines and humans are presented in Figure 23. It is important that workers understand these capabilities and limitations of the machines they are working with. Therefore, employers are responsible for devising new working methods for employees to work with robots and other machines that would be safe and beneficial. [206]

[198] Mario Nardo, D. Forino, T. Murino, 2020. The evolution of man-machine interaction: the role of human in Industry 4.0 paradigm. *Production & Manufacturing Research*, 8(1), 20-34.
[199] EU-OSHA 2018, 46.
[200] EU-OSHA, 2018, 46.
[201] EU-OSHA 2018 46.
[202] EU-OSHA 2018, 50.
[203] EU-OSHA, 2018, 46.
[204] Bas-Wohlert, C., 2018. "Microchips get under the skin of technophile Swedes", *PhysOrg*, May 13, 2018. https://phys.org/news/2018-05-microchips-skin-technophile-swedes.html ; Savage, M., 2018. "Thousands Of Swedes Are Inserting Microchips Under Their Skin". *NPR*. October 22, 2018. https://www.npr.org/2018/10/22/658808705/thousands-of-swedes-are-inserting-microchips-under-their-skin?t=1636905448073 ; Siibak, A., & Otsus, M., 2020. "You either love it immediately, or you hate it". Reflections and experiences of Estonian employees with microchip implants. *AoIR Selected Papers of Internet Research*, *2020*.
[205] Boagey, R., 2016. 'Hand in hand', *Professional Engineering*. http://www.imeche.org/news/news-article/hand-in-hand
[206] Servoz, M., 2019, 75.

Figure 23. Key implications of changing machine-human interaction for workers

Source: EU-OSHA, 2018: 7, 47-50, 56, 59; Nygren, K.G., 2012; Elmore,T., 2014.

4. Education and training

This chapter addresses digitalisation and its implications for the workforce in the education and training sector, i.e., primary, secondary, tertiary education and vocational education and training (VET). The education sector should reflect the needs of current society and economy and respond to major changes in the modern world, including the overarching use of digital tools. To respond to the needs of the digital world, the use of technology for teaching and learning is advocated as a way to enhance learning experiences and prepare students for the digital future of work.[207] This is especially relevant considering the current mismatch between skills that students acquire in schools and skills necessary for the labour market.[208]

Technology can redefine who learns and who educates, how educators and learners communicate, and transform learning content and resources, spaces and costs.[209] Teachers are expected to contribute to the digital transformation of education by using ICT for teaching and learning.[210] In this mission to reform education, teachers play a critical role as educational innovations will only enter the classroom if teachers know them, are willing to introduce them and know how to do that.[211]

4.1. Digital evolution in education and training sector

Key takeaways:

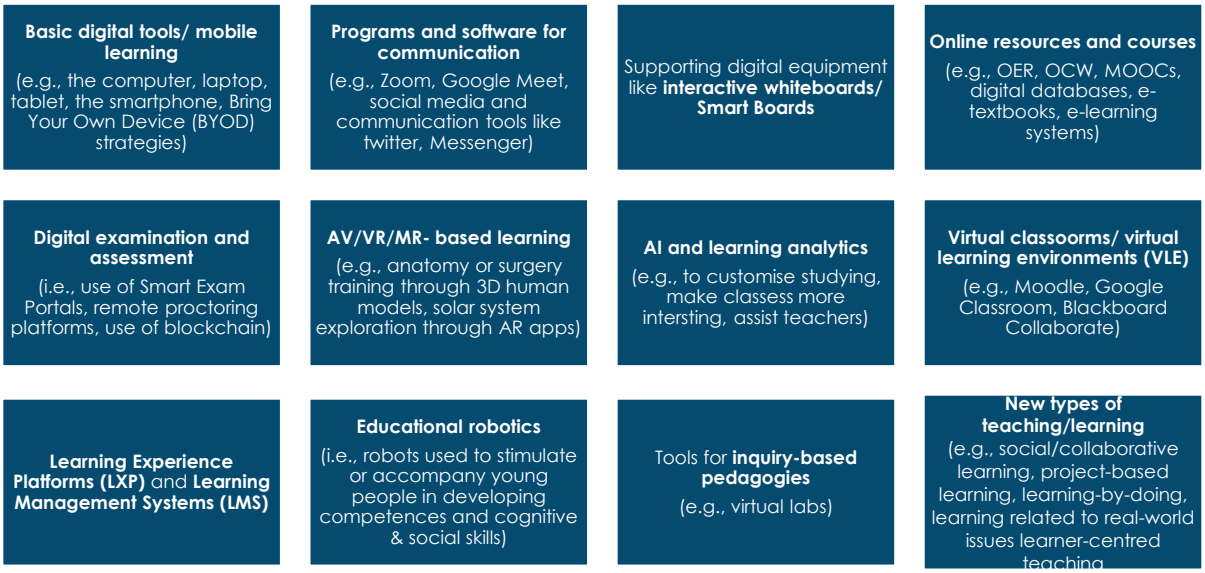
- Digitalisation of the education and training sector refers to the changing teaching practices, which are becoming increasingly more personalised, interactive and immersive with the help of digital tools used by teachers.
- Uptake of digitalisation in education and training shows upward trends as more teachers are using ICT in class, to prepare for class, to create digital content and to communicate with students, parents and other teachers.
- The pandemic set off rapid digitalisation of the sector with most education and training institutions struggling to adapt to the remote education provision. The crisis has exposed weaknesses in digital infrastructure of many schools as well as unpreparedness of teachers.

4.1.1. Key digitalisation trends

Digitalisation of the education and training sector refers to integration of digital technology in education processes with a view to efficiently achieve learning outcomes.[212] More precisely, it refers to pedagogical use of digital technology in schools. Modern technologies which allow greater access to educational content and facilitate collaborative learning and teaching complement traditional ways of teaching in the classroom. A wide variety of devices and ways they can be applied in practice for teaching and learning are available and in use. Figure 24 represents key developments in digitalising education and training (see Annex IV for a more detailed overview of digital tools used in education).

[207] Davies, R. S.,West, R. E. 2013. Technology integration in schools. *In Handbook of research on educational communications and technology.* New York: Springer, 841-853.
[208] Deloitte & Ipsos, 2019. 2nd Survey of Schools: ICT in Education
[209] ET 2020 Working Group, 26. For example, the use of technology in education and training means that new groups of people have access to education, anyone can post videos with educational material to global audiences using social media, teachers and learners can collaborate more through digital platforms, learning is personalised, customised, feedback is real-time, more detailed and accurate, media is used to promote skills, previously inaccessible knowledge is made available, learning anytime and anywhere is possible, virtual learning environment occur, day-to-day costs of accessing education are lower.
[210] Davies, R.S., and West, R.E., 2013.
[211] Braun, A., März, A., Mertens, F., Nisser, A., 2020. Rethinking education in the digital age. European Parliament, 21.
[212] ET 2020 Working Group, 23

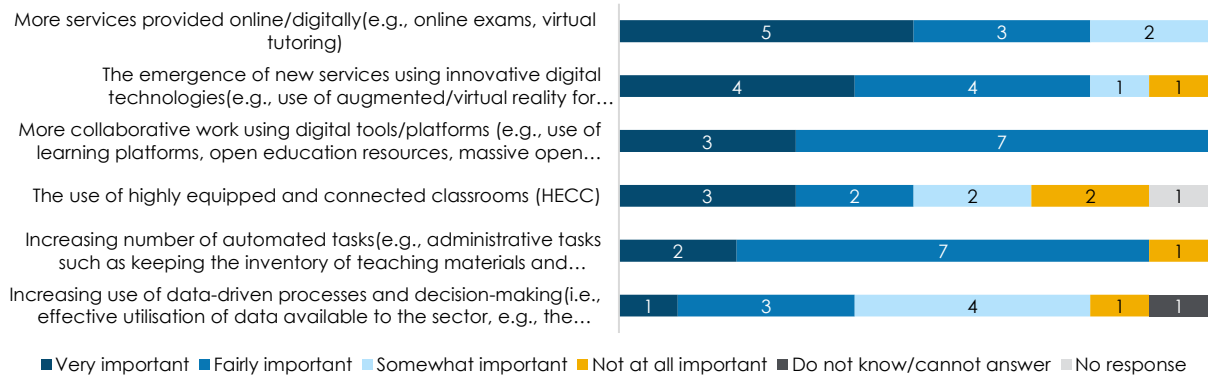
Figure 24. Digitalisation developments in the education and training sector



Source: author's own elaboration based on multiple sources.[213]

In evaluating the digitalisation trends of the sector, surveyed CESI members revealed that the most important trend is *increasing number of services that are provided online or in a digital way* (see Figure 25). Examples of these services include online exams, virtual tutoring and virtual classes. *New services based on the use of innovative technologies* such as AR/VR, blockchain, AI, robotics was also highlighted, as well as the tendency of *more collaborative work* as teachers use videoconferencing tools, learning platforms, open education resources and other tools to communicate more and share resources, facilitating greater knowledge sharing.

Figure 25. Importance of trends in the education and training sector as reported by CESI members



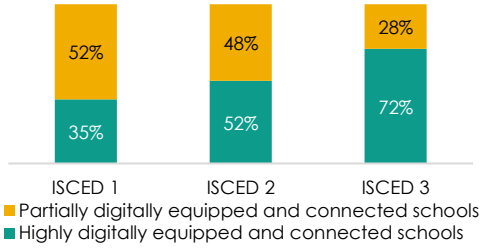
Source: Visionary Analytics, 2021. CESI members' survey on digitalisation of the public sector. N=10

[213] Hariharan, V., 2021. "Digital Transformation in Education: Trends & Strategies". *Leadsquared*, July 13, 2021. https://www.leadsquared.com/digital-transformation-in-education-trends-strategies/ ; Alimisis, D., 2013. Educational robotics: Open questions and new challenges. *Themes in Science and Technology Education*, 6(1), 63-71; Coclough, C. 2020. Teaching with Tech: the role of education unions in shaping the future. Education International, 24, 43; ET 2020 Working Group; European Commission, 2013; JRC, 2021: 12; Hazelkorn, E. and Edwards, J., 2019. Skills and Smart Specialisation: The role of Vocational Education and Training in Smart Specialisation Strategies. Luxembourg: Publications Office of the European Union; Petty, B., 2018. "4 Tools for a Flipped Classroom". *Edutopia*, July 23, 2018. https://www.edutopia.org/article/4-tools-flipped-classroom ; Littlejohn, A., Margaryan, A., 2014. Technology-enhanced professional learning. In *International handbook of research in professional and practice-based learning.* Dordrecht: Springer, 1187-1212.

4.1.2. Take-up of ICT for teaching

Since 2010 the status quo in digital education in Europe has changed as EU MS had used Structural Funds to invest large amounts into digital education and especially digital infrastructure.[214] As a consequence, the digital infrastructure of schools has developed significantly since then, with the ratio between digital devices and number of learners dropping, more schools having reliable internet connection and digital teaching aids such as interactive whiteboards, and the use of ICT for teaching in schools increasing. [215] European education systems are mostly digitalised, with teachers having access to the Internet and computer in their workplaces and using digital technologies in teaching and learning.[216] However, although since 2011 all EU countries had adopted strategies for using digital technology in education, large differences remain among countries and the impact of digital technology changing educational practices is less evident than expected.[217] Therefore, despite upwards trends in the use of ICT for teaching, **the full potential of digital technologies for learning and teaching has not been reached**.[218]

Figure 26. The share of European students at digitally equipped and connected schools



Source: Deloitte and Ipsos, 20192nd Survey of Schools: 38-39

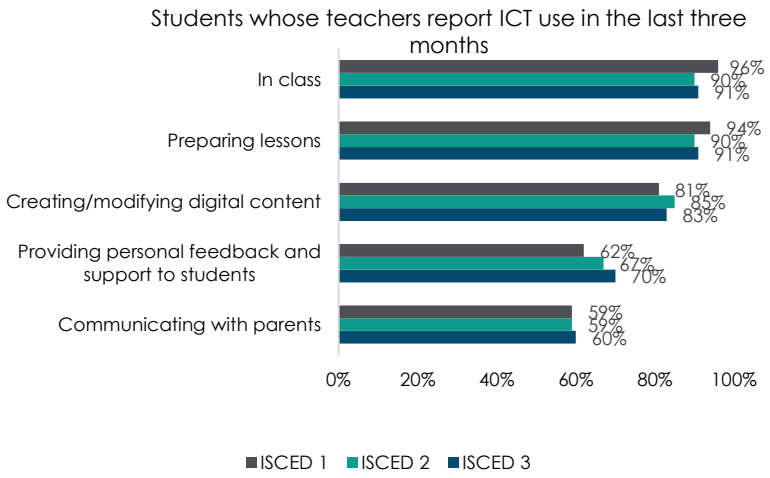
In terms of primary and secondary education, more than half of students from lower (ISCED 2) and upper secondary (ISCED 3) schools in Europe attend highly digitally equipped schools, the share dropping to 35% for primary school students (ISCED 1) (see Figure 26).[219] This means that a lot of secondary schools in Europe provide high numbers of fully operational digital equipment (i.e., computers and interactive whiteboards) for students, have fast Internet speed, a public school website, email addresses for more than half of students and teachers, a student data management system, a virtual learning environment (VLE), a platform for online school-home communication and a local area network (LAN). Most of these schools are in Nordic countries (e.g., Estonia, Denmark, Sweden, Norway, Finland and Iceland). However, providing high-speed Internet connection remains the key struggle for European schools, since less than 1 out of 5 students attend schools with access to high-speed Internet. Availability of interactive whiteboards remains rather limited too, as on average 56 ISCED 1 students use one board. The availability is even worse in ISCED 2 and 3, where respectively 109 and 166 students share one interactive whiteboard.

A large majority of students in Europe are taught by teachers who have more than 6 years of experience in using computers and the Internet at school.[220] However, despite teachers' extensive experience, prior to the pandemic teachers did not use digital technologies intensively, i.e., only 19% in ISCED 1, 15% in ISCED 2, and 30% in ISCED 3 students were taught by teachers who use ICT in more than 75% of their lessons. Nevertheless, most of students had teachers that used digital technologies in at 25-50% of their lessons.[221] Another study shows that most teachers have experience and are familiar with ICT, as more than two thirds of them had at least five years of experience using ICT during lessons or in preparing lessons. [222] However, only less than half of

[214] European Commission, 2020. Education and Training Monitor 2020, 11.
[215] Conrads, J., Rasmussen, M., Winters, N., Geniet, A., Langer, L., 2017. Digital Education Policies in Europe and Beyond. JRC. Luxembourg: Publications Office of the European Union; OECD, 2019. Measuring Innovation in Education.
[216] Coclough, C. 2020. Teaching with Tech: the role of education unions in shaping the future. Education International, 18-22.
[217] European Commission, 2018. Communication on the Digital Education Action Plan. https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52018SC0012&qid=1516868529548&from=DE
[218] OECD, 2016. Innovating Education and Educating for Innovation. The Power of Digital Technologies and Skills. Paris: OECD Publishing. Retrieved October 01, 2016 from http://dx.doi.org/10.1787/9789264265097-en
[219] Deloitte & Ipsos, 2019, 38-40
[220] 75% in ISCED 1, 70% in ISCED 2 and 80% in ISCED 3
[221] Deloitte & Ipsos, 2019, 46
[222] Fraillon, J. et al. 2019. Preparding for life in a Digital World: 178-179. IEA International Computer and Information Literacy study conducted in 2018 in 12 countries. viewcontent.cgi (acer.edu.au)

teachers reported using ICT every day for teaching, pointing to the lack of digital competence and training on ICT (see Section 4.3.2).[223]

Figure 27. Teachers' use of ICT for different functions



Source: Deloitte and Ipsos, 2019. 2nd Survey of Schools: ICT in Education. Luxembourg: Publications Office of the European Union: 53

Teachers use ICT in various activities in the teaching process (see Figure 27). The most common function teachers use ICT for is in class.[224] Almost all students are taught by teachers that use ICT to prepare lessons, including browsing for material to be used in lessons, browsing to prepare lessons, preparing tasks for students using Word for example. Teachers also use ICT for creating/modifying digital content (e.g., preparing presentations online, creating digital resources) and providing feedback to and communicating with students. More than half of students in Europe attend schools where teachers use ICT for providing personal feedback and support, and where communication via emails and apps between teachers and students is rather frequent. Similarly, around 60% of students have teachers who use digital technologies to communicate with parents.

Digitalisation trends are similar in the tertiary education, where digital technologies were being adopted decades ago to different extents among and within higher education systems.[225] Already in 2014 European higher education institutions (HEIs) demonstrated a much higher uptake of blended learning and online degree courses than expected.[226] At that time, European universities started to create systematic and strategic approaches to digitalisation of HE. Since then, the process of digitalisation has rapidly progressed, and the discourse shifted not on whether technologies should be used for education but how and to what extent they should be used. As of 2020, a survey of 368 European HEIs showed that all were using ICT for teaching and learning and half of them using it widely, most (75%) in the form of blended learning. [227] HEIs had also significantly increased their use of MOOCs (36% of the surveyed institutions offer MOOCs), and there is a growing trend towards digital assessments but the number of HEIs using digital credentials or badges remains low.[228] However, often the actual use of digital technologies in HEIs is limited, e.g., studies report that only some instructors in HEIs rarely used LMS, using them mostly to post syllabi, distribute course materials and assignments, keep gradebooks.[229] With a view to the future, almost all (95%) of HEIs surveyed indicated that they see digitalisation as a strategic priority.[230]

VET also has great potential for innovation and digitalisation, which has been overlooked and only starting to be tapped into more recently.[231] VET invites the use of basic technological devices such as laptops, interactive whiteboards, digital video cameras, and more recently the use of online

[223] Fraillon et al. 2019, 178-179
[224] Deloitte& Ipsos, 2019, 53.
[225] OECD, 2020b. Digitalisation today: Benefits and risks for teaching and learning. Digitalisation Webinar One. https://www.oecd.org/education/higher-education-policy/Digitalisation-today-webinar-key-messages.pdf
[226] Gaebel, M., Zhang, T., Stoeber, H. & Morrisroe, A. 2021. Digitally enhanced learning and teaching in European higher education institutions. European University Association absl.
[227] Gaebel, M., Zhang, et al., 2021.
[228] Gaebel, M., Zhang, et al., 2021.
[229] OECD, 2020b
[230] Gaebel, M., Zhang, et al., 2021.
[231] Edward, J. and Hazelkorn, E. 2019. Skills and smart specialisation. Seville, Joint Research Centrre.

tools and resources, as well as 5G, AI, learning analytics, VR solutions. For example, video-based teaching and learning or flight simulations are the traditional examples of experiential learning facilitated by digitalisation in VET.[232] Although the data on what type of digital technologies are used in education and training in VET are in short supply, current average VET school contains a mix of digital technologies that teachers and trainers use in different ways.[233] The first-order innovations, such as blogs, wikis, social networking sites, VLEs, laptops, notebooks, interactive whiteboards, web apps, digital cameras, e-learning and digital portfolios are very widespread and used in many technology-rich learning environments. Meanwhile, second-order innovations, such as AR, simulations, digital games, console games, remote-response systems, mobile/handheld computing, programming applications, handheld projectors and electronic books are used at a less frequent rate in VET currently.[234] Less disruptive technologies that have less effect on teaching and learning are more common than those with the potential for more radical change.

The COVID-19 pandemic had disrupted the education and training sector, but also highlighted its great potential for innovation.[235] The outbreak of COVID-19 had commenced the largest remote teaching experiment in history as the in-person instruction was prohibited and almost all compulsory education and VET institutions were completely closed at least during the first wave of the pandemic.[236] The crisis is seen as a game changer for the way technology is used in education and training[237]:

- *All educational processes had to be organised and implemented in a completely virtual environment*.[238] The EdTech industry that facilitates digital education through creating e-classrooms, VR or interactive modules, education apps, conferencing tools, online learning software has experienced significant boom during the pandemic. [239] Majority of education systems globally had started to use systems to monitor learners' involvement in the class, online meeting spaces, educator-parent connection tools, mind mapping cooperation, learners assessment systems, video classes, online courses, learning platforms (e.g., Moodle), electronic textbooks and many others. [240] For example, the use of virtual classrooms (e.g., Blackboard Collaborate) increased by 3600% in March 2020, and by 9000% by the end of September 2020 in OECD countries.[241] Comprehensive e-learning systems and websites were launched by Ministries in some countries, and several MS had increased their investment in digitalisation projects and move to online and blended learning thanks to the pandemic.[242]
- *This shift to digital learning greatly affected education personnel.* Educators from HEIs reported that crisis had forced teaching staff to do "things they would have declared as impossible a few weeks before" in terms of digitally enhanced learning and teaching.[243] As stressed by CESI members, the pedagogical relationship has become exclusively digital overnight, exposing

[232] ET 2020 Working Group, 2020, 46, 50.
[233] ET 2020 Working Group, 2020, 51, 69.
[234] ET 2020 Working Group, 2020, 70.
[235] European Commission, nd. Digital Education Action Plan (2021-2027). https://ec.europa.eu/education/education-in-the-eu/digital-education-action-plan_en ; European Commission, 2021. Education and Training Monitor 2021. Executive Summary: 3.
[236] Liu-Kai, C., Dorn, E., Sarakatsannis, J. and Wiesinger, A. 2021. "Teacher survey: Learning loss is global—and significant". McKinsey; The Guardian, 2020. "How do coronavirus containment measures vary across Europe?" March 16, 2020. Retrieved from https://www.theguardian.com/world/2020/mar/12/how-do-coronaviruscontainment-measures-vary-across-eu; Van der Graaf, L., et al., 2021, 43; JRC, 2021. What did we learn from schooling practices during the COVID-19 lockdown? Publications Office of the European Union, Luxembourg, 7.
[237] European Commission, 2020. Education and Training Monitor 2020, 3. 95% of respondents to the public consultation on the Digital Education Action Plan see the COVID-19 pandemic as a game changer.
[238] ET 2020 Working Group: 23; Education and Training Monitor 2020: 11
[239] Van der Graaf, et al, 2021: 23; Dolan, M., 2020. "Big funds circle EdTech as post-pandemic mega-trend". Reuters, September 25, 2020; BusinessWire, 2021. "Europe EdTech and Smart Classroom Market Forecast to 2027: Coming Together of Latest Technologies for Enhanced Learning - ResearchAndMarkets.com", March 3, 2021 https://www.businesswire.com/news/home/20210303005431/en/Europe-EdTech-and-Smart-Classroom-Market-Forecast-to-2027-Coming-Together-of-Latest-Technologies-for-Enhanced-Learning---ResearchAndMarkets.com
[240] Coclough, C. 2020: 9, 14; European Data Portal. 2020. Education during COVID-19; moving towards e-learning. June 22, 2020. Retrieved from https://www.europeandataportal.eu/en/impact-studies/covid-19/educationduring-covid-19-moving-towards-e-learning;
[241] OECD, 2020b.
[242] European Commission, 2021. Education and Training Monitor 2021. Executive Summary: 4
[243] Gaebel, M., et al., 2021.

many weaknesses of education system.[244] The sector was underprepared for the drastic shift as teachers had to use digital platforms they were not familiar with, they lacked training and adequate resources, having to use their own digital tools for teaching.[245] VET institutions had faced even more challenges than compulsory general education institutions, as key characteristics of VET education – focus on practical training and networking – are nearly impossible without face-to-face interactions.[246]

- *Educators experienced negative effects of digital teaching during the pandemic*. The majority of teachers in eight countries surveyed in 2021 reported that remote learning is a poor substitute for classroom learning, as the instruction of their effectiveness declined, especially in public sector, where teachers lack access to learning tools.[247] Besides decline in their work effectiveness, teachers were also exposed to health and safety concerns in cases when they were expected to remain in schools for the children of essential workers during lockdowns, sometimes with no personal protective equipment. The situation also gave rise to psychosocial issues of such as feelings of abandonments and loneliness during the lockdown.[248] The unpreparedness of education systems exposed educators to increased workload and working hours, leading to overworking and high levels of stress.[249] Finally, increased use of digital technologies underlined the privacy and cyberbullying concerns among workers (see Box 6Box 6).

As a follow-up to the developments, in almost all MS the Recovery and Resilience Facility (RRF) that supports recovery from the coronavirus crisis is expected to boost digital transformation of education, including the development of digital skills of the workforce, as well as development of digital infrastructure and digital teaching resources.[250] For example, in Italy the RRF will be used to fund a project transforming 100 000 classrooms into flexible and connected learning environments, and in Austria 80 000 pupils per year will receive digital equipment.

4.2. Opportunities of digitalisation in education and training sector

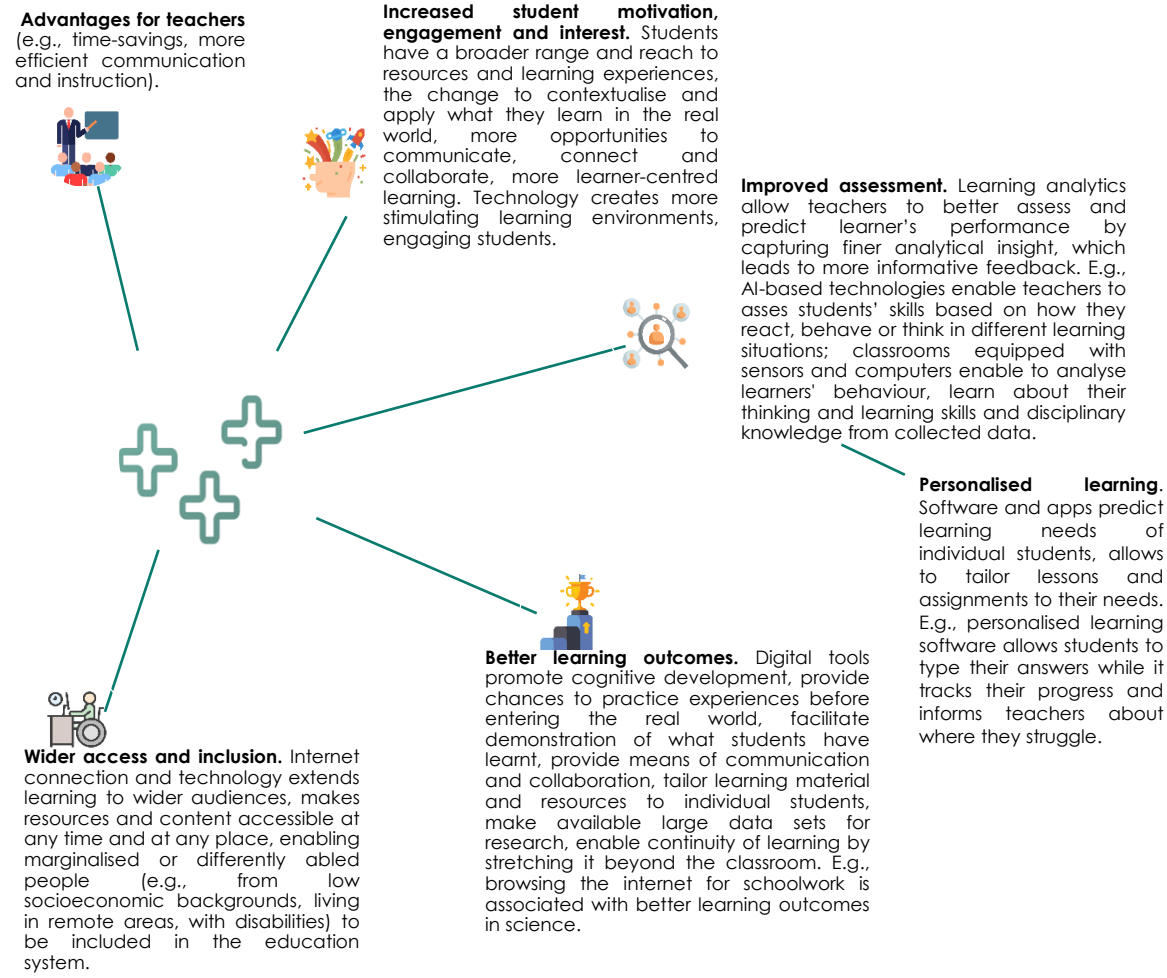
Key takeaway:

- Digital transformation of education and training sector has the potential to benefit students (e.g., increase their motivation and engagement), educators (e.g., more efficient communication and instruction) and economic systems (e.g., wider access and inclusion to education).

Digitalisation of the education and training sector can be beneficial to students, educators and for general development of economic systems (Figure 28). As highlighted in the CESI Manifesto for the Teaching Profession, digitalisation has the potential to transform methods of learning.[251] Research shows that when ICT is appropriately integrated into the curriculum, it enhances the depth and breadth of the teaching and learning processes.[252] ICT is capable to provide easy-to-access, dynamic, proactive, comprehensive, innovative and stimulating teaching-learning environment.[253] Digitalisation can also be beneficial for teachers, making their daily tasks less time-consuming and more efficient (see Section 4.4 for a more detailed overview).

[244] Visionary Analytics, 2021. CESI Members' survey on digitalisation of the public sector
[245] Visionary Analytics, 2021. CESI Members' survey on digitalisation of the public sector
[246] Van der Graaf, L. et al., 2021, 44.
[247] McKinsey Li-Kai Chen, Emma Dorn, Jimmy Sarakatsannis, and Anna Wiesinger (2021). Countries covered: Australia, Canada, China, France, Germany, Japan, the UK, and the US.
[248] JRC, 2021, 13.
[249] Visionary Analytics, 2021. CESI Members' survey on digitalisation of the public sector
[250] European Commission, 2021. Education and Training Monitor 2021. Executive Summary, 4-5, 7.
[251] CESI, 2018. Manifesto for the Teaching Profession: Horizon 2025, 6.
[252] Razak, N.A., Alakrash, H., Sahboun, Y.S., 2018. English Language Teachers' Readiness for The Application of Technology Towards Fourth Industrial Revolution Demands. *Jurnal Teknologi Maklumat dan Multimedia Asia-Pasifik 7(2-2): 89-98.*
[253] Arnseth, O.E., and Hatlevik, H.C,, 2012. ICT, Teaching and Leadership: How do Teachers Experience the Importance of ICT-Supportive School Leaders*?, Nordic Journal of Digital Literacy,* 1, 55-69.; Ghavifekr, S. & Rosdy, W.A.W., 2015. "Teaching and learning with technology: Effectiveness of ICT integration in schools." *International Journal of Research in Education and Science (IJRES)*, 1(2), 175-191.

Figure 28.Opportunities of digitalisation in education and training sector



Source: author's own elaboration based on multiple sources[254]

4.3. Barriers to digitalisation and remedies: what can trade unions do?

Key takeaways:

- Mostly cited barriers to digitalisation of education and training sector include lack of equipment and financial resources to acquire it, risk of digital exclusion and inequalities among students, risk of worse learning outcomes, health problems for students and teachers, data privacy and security issues, as well as workers' resistance and lack of digital skills.
- Openness to innovation amongst teachers is lower in many European countries that in other parts of the world, but generally teachers hold positive attitudes towards digitalisation. CESI members believe that workers in the sector perceive digitalisation as bringing more opportunities than risks.
- It is essential that teachers, as the key facilitators of digitalisation of teaching, have digital competence. Teachers should be able to identify, choose and effectively use digital resources and tools, solve technical problems, as well as develop soft skills of students and deal with ethical questions.

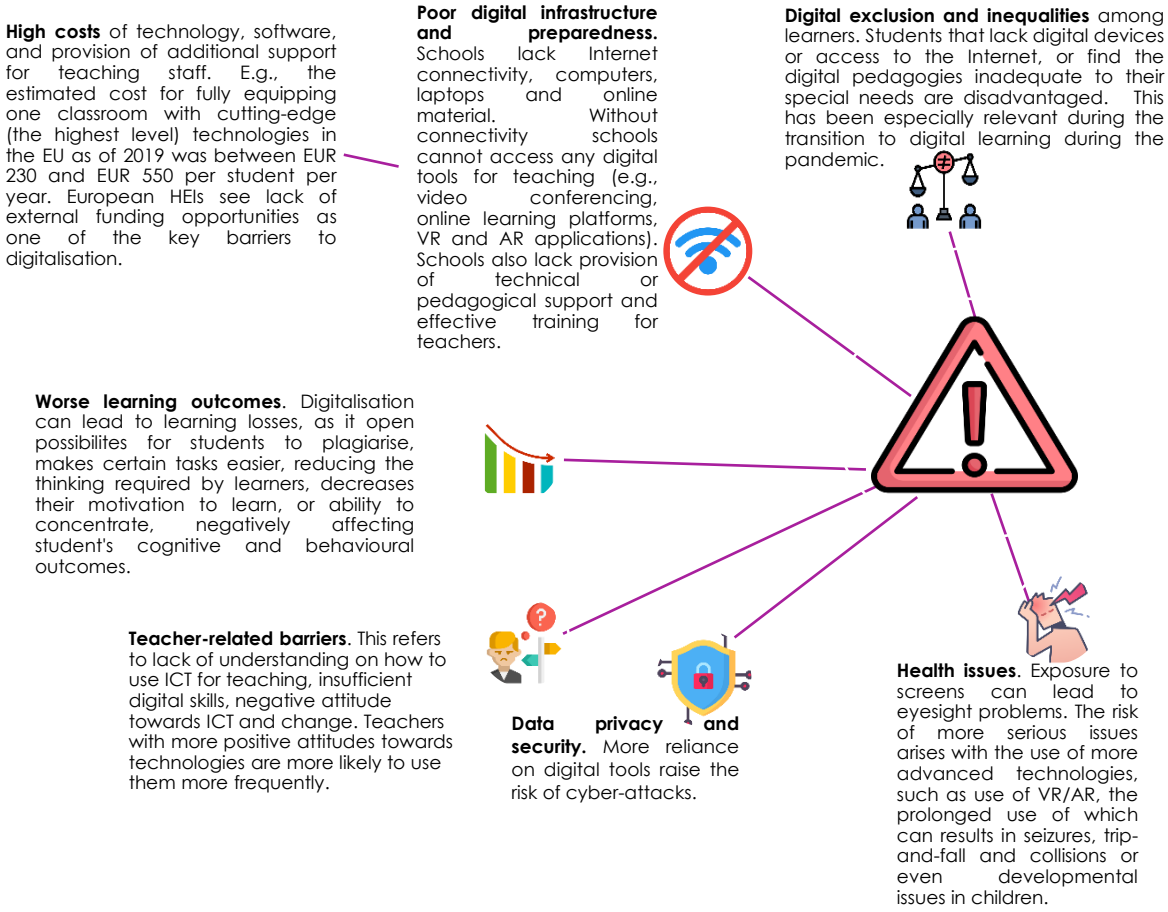
[254] Deloitte & Ipsos, 2019, OECD, 2020. ICT resources in school education: What do we know from OECD work? Draft; Abduraheem, MP and Joseph, Joni. C., 2019. "Recent Trends in Higher Education, Induced by Digitalisation." Research Guru, 13(1), 540-544; JRC, 2021; Van der Graaf, et al, 2021; Rapanta, C. et al., 2020. Online University Teaching During and After the Covid-19 Crisis: Refocusing Teacher Presence and Learning Activity. Postdigital Science and Education 2.; Voss, E., Rego, E. 2019; Hooda, M. and Rana,C. 2020; Vivek Hariharan, 2021. Digital Transformation in Education: Trends & Strategies; Tuzun, H., Soylu, M.Y., Yilmaz, T.K., Inal, Y., 2009. The effects of computer games on primary school students' achievement and motivation in geography learning. *Computers & Education 52(1)* ; Rodrigues, M. and Biagi, F. 2017. Digital technologies and learning outcomes of students from low socio-economic background: An Analysis of PISA 2015. JRC. Icons retrieved from Flaticon.com

However, high shares of teachers across all education levels are not well-equipped to use ICT in teaching. They show a high need for training to obtain ICT skills.

- Five out of nine CESI members believe that digitalisation will bring more opportunities than risks in the sector. Trade unions can develop policy, carry out research, and establish dedicated structures/bodies to address digitalisation matters in the sector, as well as offer courses/workshops on the governance of digital technologies in education. Trade unions could facilitate training of teachers by identifying skills needs, developing training programmes, and being more involved in social dialogue related to the digital skills of workers.

However, despite the potential benefits that these opportunities can bring to teaching and learning, many barriers to the uptake of ICT remain (see Figure 29). Lack of equipment, followed by pedagogy-related obstacles (i.e., insufficient digital skills and understanding on how to use digital technologies for teaching), and attitude-related obstacles (i.e., lack of interest of teachers and resistance of teachers) are among the important barriers to digitalisation by teachers.[255] The latter two are discussed in more detail below.

Figure 29. Barriers to the digitalisation of the education and training sector



Source: author's own elaboration based on multiple sources[256]

[255] Deloitte & Ipsos, 2019: 48-49

[256] Van der Graaf, et al, 2021, 35; Brecko, B., Kampylis, P., Punie, Y., 2014. Mainstreaming ICT enabled Innovation in Education and Training in Europe: Policy actions for sustainability, scalability and impact at system level, JRC83502; European Commission, 2020. Education and

4.3.1. Workers' attitudes

Teachers' beliefs and attitudes towards ICT in teaching and learning are prerequisite for a successful digitalisation of teaching.[257] Besides digital competences and digital confidence teachers must also have a positive mind-set towards new technologies in general in order to successfully integrate digital technology into education.[258] Researchers note that educators do not have to be fully conversant with technologies to use them in a way that improves the teaching and learning experience, but they have to be open to innovative pedagogies and to understand how these technologies can benefit their work.[259]

On one hand, studies show that openness to innovation amongst teachers is lower in many European countries that in other parts of the world.[260] On average only 35.9% of lower secondary teachers in the EU identify investing in ICT to be of high importance.[261] Educators, especially those from older generations may resist change, especially when it comes to difficulties understanding which innovations are 'good' or 'bad'.[262] This points to the need for support to educators to adapt to digitalisation, including continuing professional development and school strategies on the use of ICT. Sometimes teachers do not believe that technology can add any substantial benefits, disengaging from the process of digitalisation.[263] Teachers can also develop negative attitudes towards digitalisation when it disrupts their work or affects them in a negative way (see Section 4.3.1). Research concludes that teachers' belief in using technology is essential for them to effectively transform classes and integrate ICT.[264]

On the other hand, teachers' attitude towards the use of ICT in teaching remains generally positive. Large majority of teachers in the 2nd Survey of Schools believe that the use of ICT in teaching and learning positively affects students' achievement, motivation, higher order thinking (i.e., problem solving, analysis, critical thinking) and transversal skills (i.e., learning to learn, social competences, etc.).[265] Teachers especially appreciate how ICT use positively impact students' motivation, but seems to be sceptical about its impact on transversal skills and higher order thinking skills. They are aware of the importance of digitalisation in order to prepare students for digital age and future of work, as most of them agree with the fact that ICT use is essential for that. Similarly, a vast majority of teachers surveyed in International Computer and Information literacy Study (ICILS) in

Training Monitor 2020: 29; Deloitte and Ipsos, 2019; BECTA, 2004. A Review of the Research Literature on Barriers to the Uptake of ICT by Teachers. Coventry: British Educational Communications and Technology Agency (BECTA); Eickelmann, B. 2011. Supportive and hindering factors to a sustainable implementation of ICT in schools. *Journal of Educational Research Online 3(1)*; Pelgrum, W.J., 2008. "School practices and conditions for pedagogy and ICT" in: Law, N, Pelgrum, NJ, Plomp, T (eds) Pedagogy and ICT Use in Schools Around the World: Findings from IEA–SITES 2006; Petko, D. 2012. Teachers' pedagogical beliefs and their use of digital media in classrooms: Sharpening the focus of the 'will, skill, tool' model and integrating teachers constructivist orientations. *Computers & Education 58(4*; Ghavifekr, S., Kunjappan, T., Ramasamy, L., Anthony, A., 2016. "Teaching and Learning with ICT Tools: Issues and Challenges from Teachers' Perceptions." *Malaysian Online Journal of Educational Technology*, 4(2), 38-57; EUA, 2020; European Commission DG CNECT, 2019. 2nd Survey of Schools: ICT in education, HECC model.; Gaebel, M. et al., 2021; ET 2020 Working Group, 44; Bueno, 2020; Kong, Y., Seo, Y., Silk, & Zhai, L., 2018. "Comparison of reading performance on screen and on paper: A meta-analysis." *Computers & Education,* 123, 138-149; Clinton, V., 2019. "Reading from paper compared to screens: A systematic review and meta-analysis." *Journal of Research in Reading,* 42(2), 288– 325; Delgado, P., Vargas, C., Ackerman, R. & Salmerón, L., 2018. "Don't throw away your printed books: A meta-analysis on the effects of reading media on reading comprehension." *Educational Research Review*, 25, 23-38; JRC, 2021,10; Oculus Rift Health and Safety Notice" (PDF). Retrieved 13 March 2017. https://static.oculus.com/documents/310-30023-01_Rift_HealthSafety_English.pd. Icons retrieved from Flaticon.com.

[257] Zhao, Y., Hueysham, T., Mishra, P., 2001. Teaching and elarning: Whose computer it is? Journal of Adolescent &Adult Literacy 44(4): 348-355; Davis, N., Eickelmann, B., Zaka, P. 2013. Restructuring of educational systems in the digital age from a co-evolutionary perspective. *Journal of Computer Assisted Learning 29(5)*; Donnelly, D, McGarr, O, O'Reilly, J. 2011. A framework for teachers' integration of ICT into their classroom practice. Computers & Education 57(2): 1469–1483; Badia et al., 2013; Erdogan, 2011; Ertmer, 2005; Kubiatko, 2013; Kusano et al., 2013; Oye et al., 2014; Petko, 2012

[258] European Schoolnet, 2013. Survey of Schools: ICT in Education. European Commission.

[259] European Commission/EACEA/Eurydice, 2019. *Digital Education at School in Europe*. Eurydice Report. Luxembourg: Pulblications Office of the Euroepan Union.

[260] TALIS, 2018. Chapter 2. Teaching and Learning for the Future. Online version https://www.oecd-ilibrary.org/education/talis-2018-results-volume-i_d2a4bf35-en

[261] OECD, TALIS 2018 Database from Monitor 2020: 32

[262] TALIS, 2018. Chapter 2.

[263] Howard, S., K. & Mozejko, A., 2015. "Teachers: technology, change and resistance." In Henderson, Michael & Romeo, Geoff (Eds.), *Teaching and Digital Technologies: Big Issues and Critical Questions*, 307-317. Port Melbourne, Australia: Cambridge University Press.

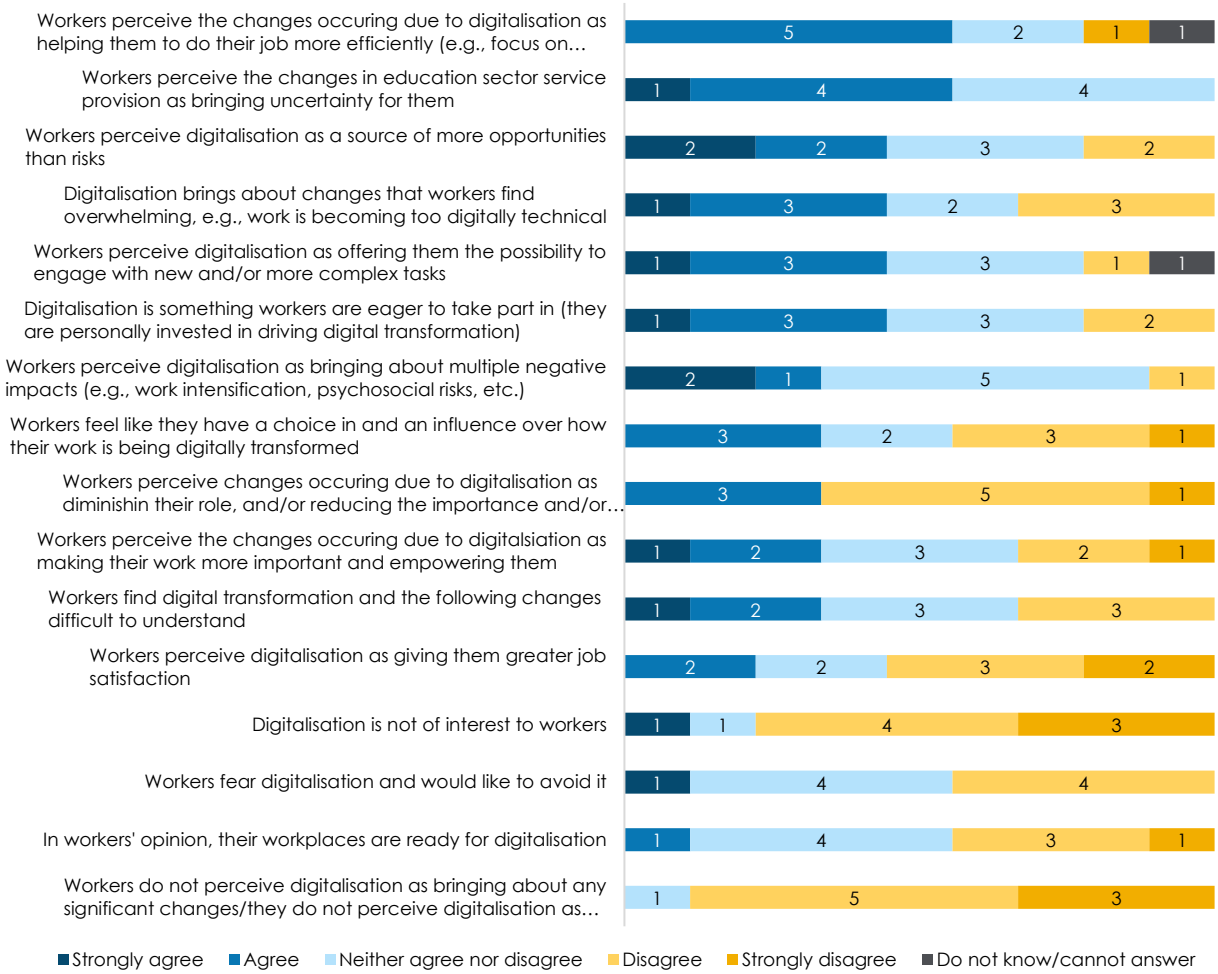
[264] Shiftlet, R., and Weilbacher, G., 2015. "Teacher Beliefs and Their Influence on Technology Use: A Case Study." *Contemporary Issues in Technology and Teacher Education,* 15(3), 368-394.

[265] Delloite & Ipsos, 2019, 109-110.

2018 recognised the multiple positive impacts of digitisation of teaching, e.g., increased student interest in learning, better access to information, and helping students to work at a level appropriate to their learning needs.[266] In higher education, a recent survey of European HEIs revealed that in more than half of surveyed HEIs (62%) staff had positive attitudes towards digitally enhanced learning and teaching, although positive attitudes were more common among students than teachers.[267]

The results of the survey of CESI members (see Figure 30) reinstates the results of previous surveys of teachers, showing that their attitudes are rather positive. Most of the trade unions indicated that workers do not fear digital transformation and are aware that the following changes affect them in significant ways. Additionality, according to trade unions workers see digitalisation as offering more opportunities than risks, e.g., workers perceive the changes due to digitalisation as helping them to do their job more efficiently, and offering opportunity to engage with new, more complex tasks. Six out of nine trade unions indicate the absence of negative attitudes among workers by disagreeing that workers believe digitalisation diminishes their role or reduces the meaningfulness of their job. Four out of nine trade unions think that workers are interested in digital transformation and are personally invested and eager to take part in it.

Figure 30. Attitudes of workers in the education sector according to CESI members



Source: Visionary Analytics, 2021. CESI Members' survey on digitalisation of the public sector, N=9.

[266] Fraillon et al., 2019, 183.
[267] Gaebel, M., et al., 2021.

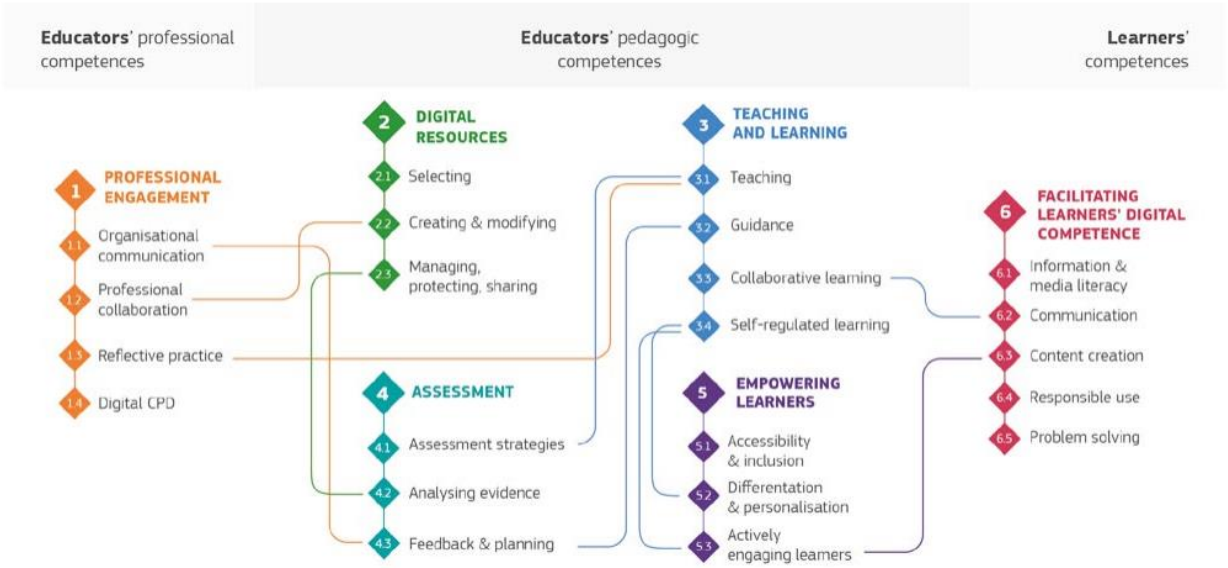
4.3.2. Digital skills

4.3.2.1. Increasing demand for digital skills

Teachers are key facilitators in the adoption of ICT in education. Teachers' confidence and attitude in using digital technologies are closely linked to how much pedagogical value the technological tool has. Therefore, as central drivers of digital transformation, educators and trainers need strong digital competences to be able to identify, choose, integrate and use available digital tools effectively and in a meaningful way in order to improve teaching and learning and to prepare students for digital society.[268]

Considering the expectations of teachers to prepare students for the future of work, Figure 31 presents an overview of the digital competences that educators need to have. It shows that due to digitalisation, workforce in the education and training sector needs a wide array of skills to fulfil several objectives. These skills range from technical, such as using digital technologies for teaching and learning, the ability to provide students with technical support, ability to select the appropriate tools in different contexts, to non-cognitive skills, such as being aware and able to address risks related to inclusion and inequality among learners or flexibility to provide anywhere-anytime learning. The demand for the soft skills has been further underlined by the COVID-19 pandemic. It showed that teachers must deal not only with digital technology but also with delicate social contexts, requiring them to be aware of the social, emotional, and affective aspects of digital technology-based education.[269]

Figure 31. Digital competence framework for educators



Source: European Commission, 2017. Digital Competence Framework for Educators (DigCompEdu) available at https://ec.europa.eu/jrc/en/digcompedu

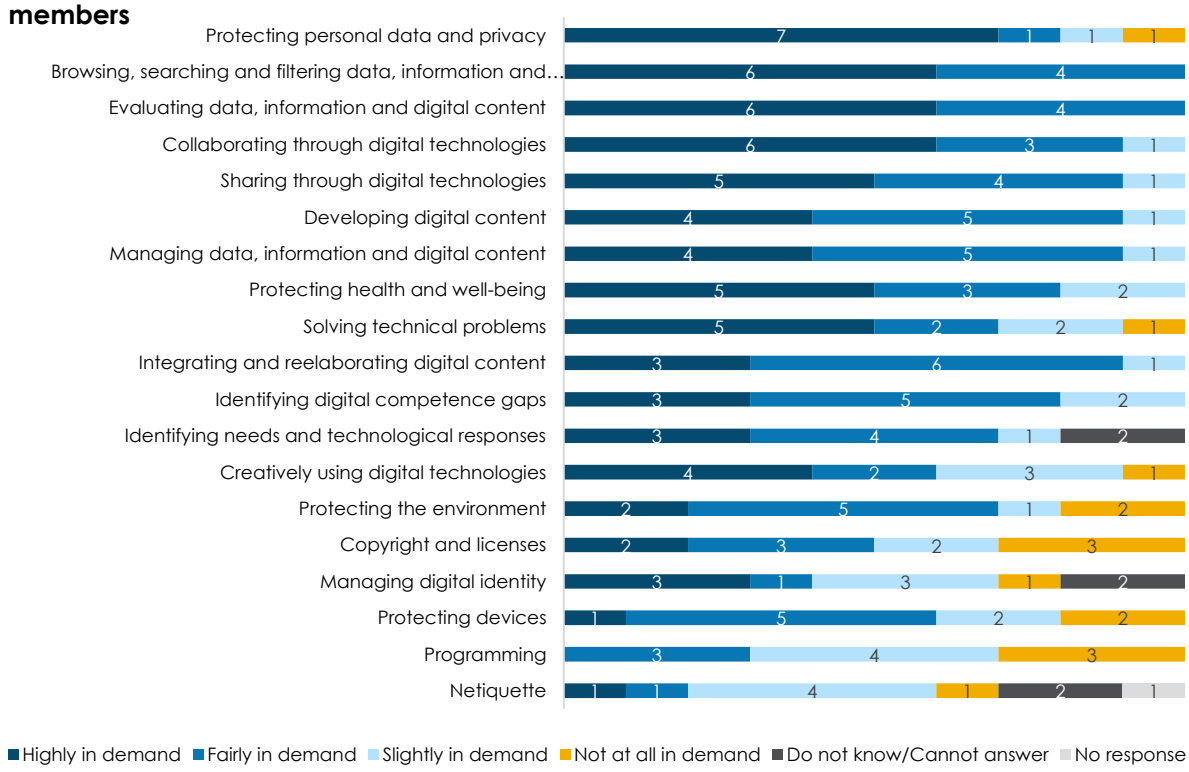
All but one CESI members believe that in the past five years the demand for *technical digital skills* (e.g., data analysis, programming) and *interpersonal skills* (e.g., role modelling, sociability,

[268] OECD, 2015: 191; Pastor, R. , Quiros, T. C. 2015. Learning and teaching technology options. European Parliament : 46-47; EP, 2020: 20; European Commission 2020. Education and Training Monitor 2020: 16; Redecker, C., 2017. European Framework for the Digital Competence of Educators: DigCompEdu; European Commission/EACEA/Eurydice, 2019.

[269] Williamson, B., Eynon, R., Potter, J., 2020. Pandemic politics, pedagogies and practices: digital technologies and distance education during the coronavirus emergency. *Learning, Media and Technology 45(2): 107-114.*

empathy, collaboration) has increased for teachers. Seven out of nine CESI members think that there is an increased need for *cognitive skills* (e.g., structured problem solving, logical reasoning, communication, adaptability) and *self-leadership skills* (e.g., self-awareness, self-directed learning, coping with uncertainty). SPELC (a CESI member) has highlighted the increasing demand for teachers to improve and change their communication skills to be able to communicate with the class in a virtual environment, as well as the ability to control students' work.[270]

Figure 32. Demand of digital competences in education and training sector according to CESI members



Source: Visionary Analytics, 2021. CESI Members' survey on digitalisation of the public sector, N=10

A skill of *protecting personal data and privacy* has been ranked as highly in demand by the most of CESI members (see Figure 32). Other highly or at least fairly in demand skills for educators include *browsing, searching, filtering, evaluating* and *managing* data, information and digital content, *collaborating and sharing* through digital technologies and developing digital content. CESI members think that the least in demand skills for educators are *programming* and *netiquette*.

4.3.2.2. Digital skills gap

Even though digital competences are considered an essential skill to teachers, a share of educators in Europe has insufficient digital competence or confidence in their abilities. In 2017, digital skills gap reported by European employers in education sector was higher than the EU-28 average.[271] In 2018 **less than 40% of educators across the EU felt ready to use digital technologies in teaching**.[272] The employers of teachers also lacked confidence in their staff's ability to effectively use digital tools in instruction (only two out of three students across OECD countries were in schools whose principals believed that their staff had the technical and pedagogical skills for the use of ICT in teaching).[273] Even when schools were well equipped with digital technologies

[270] Visionary Analytics, 2021. CESI Members' interview on digitalisation of the public sector
[271] Curtarelli et al. 2016.
[272] OECD, 2018. TALIS 2018 Results (Volume I): Teachers and School Leaders as Lifelong Learners. TALIS, OECD Publishing, Paris
[273] OECD, 2020.

during the pandemic to continue VET, teachers were not ready to create digital content or lacked skills to use them effectively.[274]

Educators were not usually working outside classrooms and for 67% of teachers the pandemic was the first time they provided distance education.[275] Teachers lacked experience and appropriate pedagogical and digital competence, preventing them from accessing and managing technologies, and facilitating remote teaching.[276] Even the younger generation teachers, those who felt tech-savvy, had robust digital skills and/or had been using digital environments for teaching, felt unprepared for when digital technologies became central for the teaching process (rather than just complementary tools).[277] Therefore, the pandemic has underlined the need for education personnel to obtain support and training in digital competence in order to carry out teaching that requires use of digital tools.[278] The lack of appropriate skills in digital technologies is an important obstacle for digitalisation as reported by educators themselves.[279] Staff training on digital skills is one of the enablers of digitalisation in the education sector. Teachers must join their profession equipped with digital skills and continue to keep up with digitalisation through continuous professional development (CPD), which would help them to update their skills, improve their digital confidence and therefore facilitate easy integration of new technologies into their work. [280] Today teachers have different opportunities to obtain digital skills (see Figure 33).

Figure 33. Opportunities for digital skills development for educators

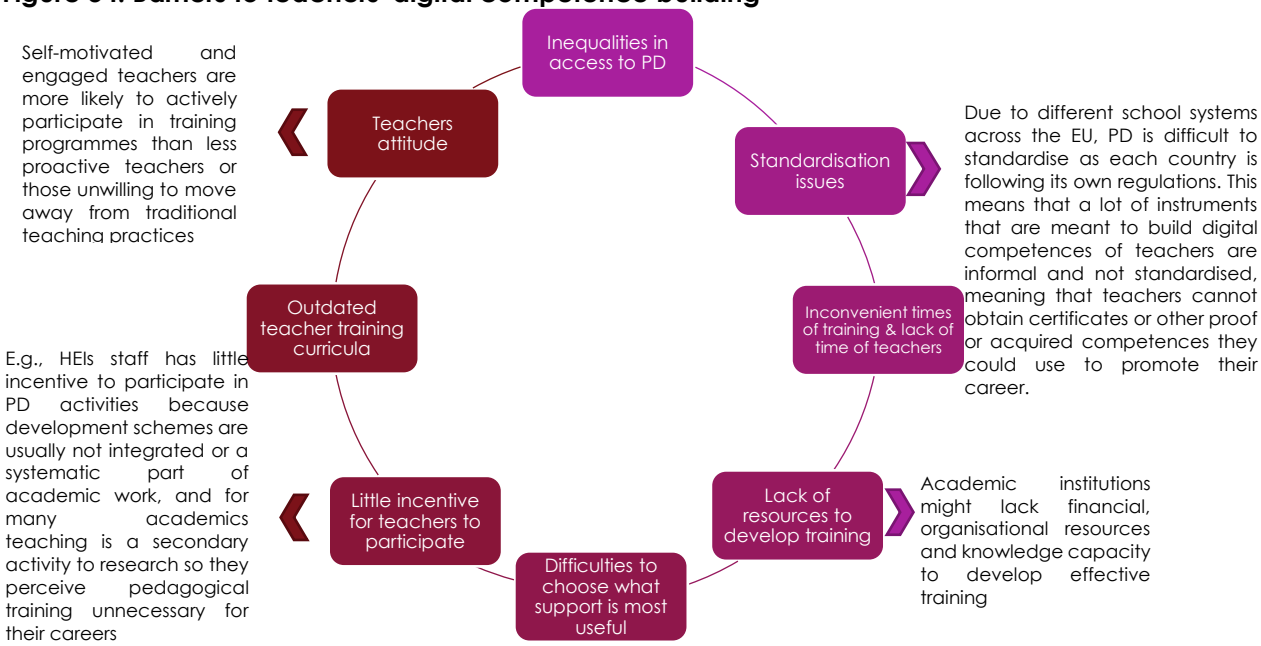
Source: European Commission's Education and Training Monitor (ed. 2019 and 2020); OECD, 2020.; Gaebel, M. et al. 2021; Deloitte & Ipsos, 2019; Ghavifekr, S. & Rosdy, W.A.W. , 2015; European Commission, EACEA/Eurydice 2019.

Development of digital capacity of teachers is hindered by multiple barriers (see Figure 34). CESI members attribute difficulties of teachers to obtain digital skills to *lack of access to training* and

[274] ET 2020 working group.
[275] Van der Graaf, L., et al., 2021, 35.
[276] Van der Graaf, L., Dunajeva, J., Siarova, H., Bankauskaite, R. 2021, Research for CULT Committee – Education and Youth in Post-COVID-19 Europe – Crisis Effects and Policy Recommendations, European Parliament, Policy Department for Structural and Cohesion Policies, Brussel, 12, 34; JRC, 2021, 14.
[277] JRC, 2021,15; König, J. Jäger-Biela, D. J. & Glutsch, N. 2020. Adapting to online teaching during COVID-19 school closure: teacher education and teacher competence effects among early career teachers in Germany. *European Journal of Teacher Education 42(4)*.
[278] European Trade Union Committee for Education, nd., What does COVID-19 mean for education personnel in Europe? https://www.csee-etuce.org/en/policy-issues/covid-19/3631-general-information
[279] Deloitte & Ipsos, 2019.
[280] OECD 2018; Deloitte & Ipsos 2019; Bocconi, S. et al. 2016. Developing Computational Thinking in Compulsory Education. JRC.; OECD, 2016.

inequality in terms of access.[281] Organisations often lack resources (e.g., time and budget) to effectively implement the training. Other bad practices in addressing changing skills needs for teachers, also highlighted by CESI members is that often courses are delivered for a very large number of users and at inconvenient times outside teachers' working hours. At the same time, teachers also refuse to participate in training if it interferes with their jobs and there are no replacement staff. This leads to teachers having to learn how to use ICT in their free personal time.

Figure 34. Barriers to teachers' digital competence building



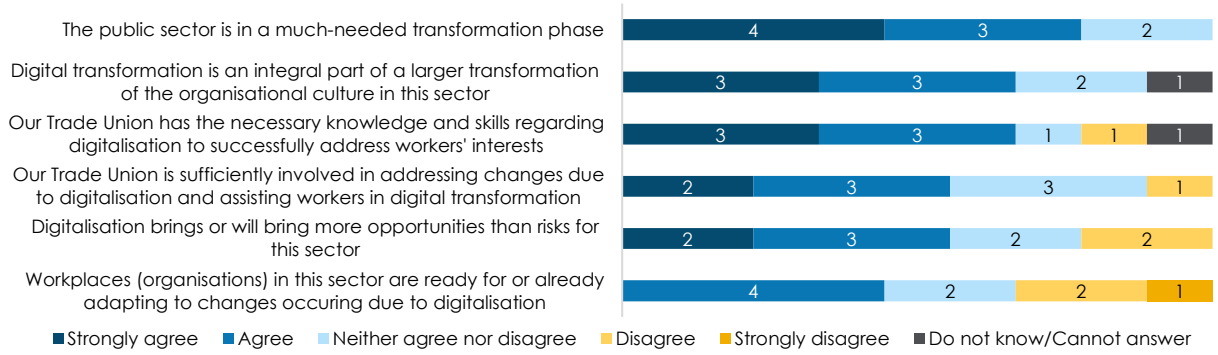
Source: EP 2020; Vuorikari 2019; Delloite & Ipsos 2019; OECD 2017; Inamorato des Santos et al. 2019; Van der Graaf, L., et al., 2021: 54; OECD, TARI 2018

4.3.3. Trade union response

The survey of EI member organisations reveals that **teachers' trade unions hold largely positive views towards digitalisation of teaching.** Most of EI member organisations seem to be in favour even of the more advanced technologies in workplaces (e.g., such as systems supporting teachers' management and administrative tasks, personalisation of learning).[282] However, certain more advanced systems such as automating students' assessments and grading received less support by European trade unions. CESI members are also more hopeful than negative about digitalisation, as five out of nine trade unions believe that digitalisation will bring more opportunities than risks (see Figure 35). Most of CESI members acknowledge that the public sector in a much-needed transformation phase and that digital transformation is an integral part of a transformation of the organisational culture. Four out of nine believe that workplaces in the sector are ready for digitalisation while three (strongly) disagree. As for the role trade unions play in the process, majority believe that they have the necessary knowledge and skills to address workers' interests and that they are sufficiently involved in assisting workers in digital transformation.

[281] Visionary Analytics, 2021. CESI Members' survey on digitalisation of the public sector
[282] Coclough, C. 2020, 44.

Figure 35. CESI members' attitudes to digital transformation in the education and training sector



Source: Visionary Analytics, 2021. CESI Members' survey on digitalisation of the public sector, N=9.

Trade unions play an important role in the digitalisation process of the education and training sector. The involvement of trade unions is important to ensure that new technologies enhance the role of the teaching profession instead of undermining it.[283] Trade unions should dedicate time and resources to better understand the potential benefits and risks of digitalisation to be able to assist educators in their adaptation to the future of work. Trade unions can develop policy, carry out research, and establish dedicated structures/bodies to address digitalisation matters in the sector, as well as offer courses/workshops on the governance of digital technologies in education.

In its resolution on the future of the teaching profession, Education International (EI, a global federation of teachers' unions) advocates for education unions to influence how technologies are implemented and what is their effect on teachers.[284] The resolution expresses the belief that the future of union work will be to "oversee and support the constant, life-long upskilling of their members that the new work environment will require". It therefore encourages trade unions to represent their members by making sure that CPD is provided on AI in order for personnel to obtain necessary skills to remain competitive in the digital world of work.

However, in the recent survey of EI member organisations, a large share of respondents from Europe (43%) indicated that they are not consulted by education authorities on what digital tools are wanted by teachers, while 40% were consulted.[285] Similar trend persisted during the pandemic, as the majority of European organisations that responded (i.e. 41%) indicated that they have not been consulted at all on the introduction of new digital technologies during the pandemic.[286] In addition, 56% of European trade unions indicated that they are not involved in assessing digital technologies (for their quality, usefulness, relevance) in addition to 19% explaining that there are no structures or processes for assessing technologies. In turn only 17% of members have been involved in assessments in such channels as through seats on Ministry advisory groups, through social dialogue, expressing their opinions in joint associations and in advisory councils. These results point to the lack of structures and processes for assessment of digital technologies and the high levels of non-involvement of trade unions. The fact that trade unions are not involved in risk assessments and are not consulted point towards lack of opportunities for teachers to raise questions or concerns related to digitalisation (e.g., work-life balance and privacy issues).

[283] Education International. 2020. Shaping the future of the teaching profession. July 17, 2020. https://www.ei-ie.org/en/item/23432:shaping-the-future-of-the-teaching-profession
[284] Education International, 2019. Resolution on: The Future of the Teaching Profession. Education International is a global union federation of teachers' trade unions which has 401 member organisations in 172 countries.
[285] Coclough, C. 2020, 40.
[286] Cuclough, C. 2020, 15.

Supporting workers in their attempts to adapt to changing skills needs in the sector should be an important part of trade unions' work (see Box 4). Eight out of ten CESI members believe that trade unions could facilitate training of teachers by *identifying skills needs and developing training programmes*, and seven believe *trade unions should be more involved in social dialogue* related to the digital skills of workers.[287] SPELC (a CESI member) explained that trade unions are essential partners in negotiations with public authorities where they should bring up the needs of personnel and contribute to the implementation of relevant training plans. Similarly, ANPE (a CESI member) noted that trade unions could encourage public administrations and private educational centres to implement a permanent training plan. Interestingly, only three out of ten CESI members think that *trade unions should raise awareness amongst workers about the opportunities offered by digitalisation*.

Box 4. Good practices of CESI members in addressing changing skills needs of teachers

French Free Catholic Education Professional trade union Federation (Syndicat Professionnel de l'Enseignment Libre Catholique (SPELC) focuses its actions on informing education and training staff through awareness raising (e.g., via written publications, emails, sharing of available resources and posting on their website). For example, SPELC website integrates the FAQ from the Ministry of Education of France, allowing workers to easily find the relevant information they seek. Having no vocation or resources to provide IT or educational resources to teachers, SPELC helps its members by regularly alerting the Ministry of Education about the difficulties that teachers encounter, especially in terms of training and lack of educational or material resources.

Romanian Free trade union in Pre-University Education (Uniunii Sindicatelor Libere din Învățământul Preuniversitar (USLIP) Iaşi) encourages its members to participate in training courses. A couple of CESI members noted that they organise the trainings themselves. For example, the French trade union Confederation of National Education (Confédération Syndicale de l'Education Nationale (CSEN) has indicated it organises social media training via videoconferences for its members. National Association of Teachers in Spain (ANPE Sindicato Independiente) constantly detects the needs of teachers in terms of training and organises training courses that are mainly provided online. ANPE explains that it has unnecessary administrative obstacles and lack of a general training plan that would provide the timetable and economic budget necessary for the training of teachers, which hinder their efforts in assisting teachers in digitalisation.

Source: Visionary Analytics, 2021. CESI Members' survey and interviews on digitalisation of the public sector.

4.4. Impact on work organisation in education and training sector

Key takeaway:

- Research on the effects of the use of ICT for teaching on teachers is scarce. The most pronounced positive implications for teachers are time savings and more efficient communication with other teachers, students and parents. Key risks of digitalisation for teachers entail work intensification, anxiety and stress, as well as loss of autonomy.

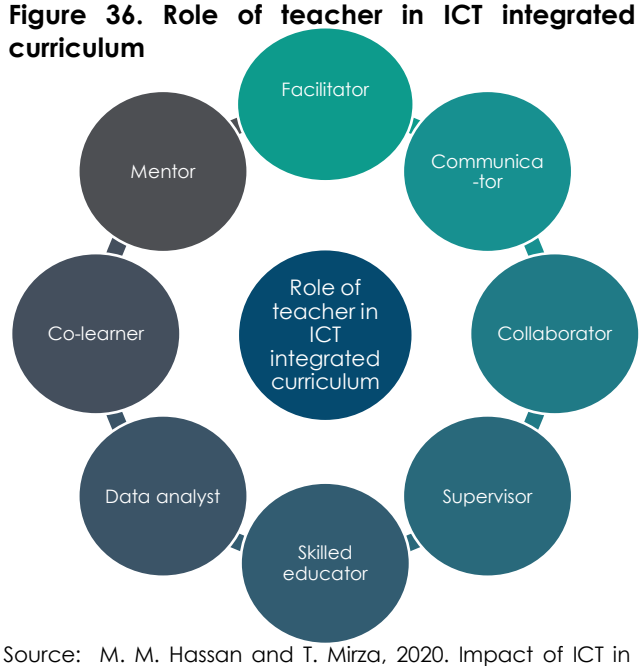
As the goal of digitalising education is to improve learning processes of students, most research focuses on how technology affects students, overlooking its effects on the work of teachers.[288] It is important to acknowledge that digitalisation changes and will continue to change how the work of educators is organised. Digitalisation implies changes to pedagogy, curricula, teaching and learning modalities and location.[289]

[287] Visionary Analytics, 2021. CESI Members' survey on digitalisation of the public sector

[288] Fernández-Batanero J.M, Román-Graván P, Reyes-Rebollo M.M., Montenegro-Rueda M., 2021. "Impact of Educational Technology on Teacher Stress and Anxiety: A Literature Review." *Int J Environ Res Public Health*, 18(2), 548.

[289] International Labour Organization, 2021. Digitalization in teaching and education in Ethiopia, Kenya, Malawi, Rwanda and the United Republic of Tanzania. Geneva: International Labour Office.

Figure 36. Role of teacher in ICT integrated curriculum



Source: M. M. Hassan and T. Mirza, 2020. Impact of ICT in changing the role of a Teacher: An Overview.

The introduction of ICT has changed the role of teachers who now engage in learner-centred, less hierarchical, and more interactive teaching and learning than before. The role of teachers has changed to include such functions as facilitator of independent learning (guiding students towards online resources), creator of digital content for instruction, a source of knowledge about ICT and its use for pedagogy, an important actor in raising students' awareness about digital citizenship, cyber bullying, hacking, copyright issues, able to differentiate between reliable and unreliable sources of information and to promote responsible use of online resources for learning (see Figure 36).[290] These changes carry along important implications for teachers and training staff.

The use of digital technologies means that certain tasks that educators used to carry out manually become automated. As underlined by the pandemic, teachers can engage in flexible working arrangements and rely on digital tools to conduct their classes from their homes rather than their usual workplaces. Furthermore, the use of digital technologies in classrooms and in virtual learning environments (VLEs) allows continuing collection, maintenance and dissemination of data and information related to teachers and their performance, exposing teachers to more monitoring and management. Lastly, digitalisation creates new tasks and occupations that not only imply the need for professionals to develop new skills but also offers jobs. The implications of these and other changes on educators and their OSH are briefly discussed in this section (Figure 37).

Figure 37. Key positive and negative effects of digitalisation on educators

Time-savings	Work intensification
Increased autonomy and academic freedom	Negative mental and physical health effects
Efficient communication and collaboration (with other teachers, students, parents)	Loss of autonomy
More efficient instruction	Less efficiency (as technologies hinder instruction and communication)
Less stress	Fear of job loss and fear of loss of authority
Job opportunities	Risks of privacy invasion, cyberbullying and online harassment

Source: author's own elaboration

4.4.1. Positive effects of digitalisation on workers

Time-savings is one of the key advantages, saving teachers' time preparing for lessons, marking students' work, conducting administrative tasks and engaging in teamwork with colleagues.[291] For example, integration of MOOCs in the lessons in HE means that educators do not need to worry about transmission of materials, but can focus on clarifying the content, addressing students' questions and discussion. This is also relevant in VET, when, for example, trainers and teachers are freed from routine activities and can focus on developing more interactive classroom activities via flipped

[290] Hassan, M., M. and Mirza, T., 2020. "Impact of ICT in changing the role of a Teacher: An Overview." Gedrag Organ Rev, 33(3), 441-449

[291] TALIS 2018

classroom techniques.[292] Automation helps not only staff responsible for administrative tasks (e.g., admissions, enrolments, student finance management), but also teachers as it can automate course assessment data handling.[293]Another example is the use of online learning material which allows teachers to avoid unnecessary replication of material saving their time.[294]Use of digital technologies in education can **increase professional autonomy and academic freedom** of educators, by freeing them up to engage in more meaningful activities as well as giving them more flexibility as to how instruct students. [295] The **efficiency of instruction** when using AR, as well as it leading to increased attention, participation and motivation of users is also recognised in the literature.[296]

Technology enables **more efficient communication and collaborative work**. Various communication venues (e.g., email, learning management systems, and social media) makes it easier for teachers to exchange information between themselves, as well as with students and their parents.[297] Teachers can enjoy more ways to meet and work with their colleagues, students, and teachers.

The use of ICT can also **relieve pressure and reduce stress of teachers**.[298] Teachers that spend a lot of time doing administrative work or grading report higher levels of stress, as opposed to those that devote more time to teaching. In this vein, the use of ICT to help teachers conduct non-teaching activities discussed above more efficiently can lead to lower levels of stress.

Digitalisation creates new responsibilities for teachers, which can lead to **job opportunities**. One example is creation of a role of learning pathway designer or coordinator, a professional who acts as a curator, planning and designing individual student learning experiences.[299] Schools are introducing similar coordinator roles for professionals who do not instruct students but work with teachers in developing learning goals, assessing student learning and ensuring coherence across learning activities. The pandemic has also resulted in job creation in digital education content and technological development.[300] However, only three out of ten CESI members indicated that new tasks and job functions are emerging in the sector, signalling that for teachers this effect is not that significant (yet).[301]

4.4.2. Negative effects of digitalisation on workers

Digitalisation has changed teachers' role adding more complexity and more functions and responsibilities to teachers' daily agendas (see Figure 36). This naturally leads to a situation where teachers' **work is more intense and demanding**.[302] Teachers' daily work includes more processes and activities, including acquiring knowledge about different devices used by students and learning how to solve any potential technical problems, protecting students from online threats, setting different tasks for different students in order to address the digital divide among students, paying more personal attention to each student, preparing detailed and clear instructions and controlling students' attention (see Box 5).[303] Six out of ten CESI members indicated that they observed the intensification of teachers' work in the past five years.[304] This

[292] ET 2020 Working Group, 46, 48 i.e., students work on material before class and use the classroom time for teacher interaction or group work to deepen the understanding
[293] Gonzalez Vazquez, I., et al., 2019, 24.
[294] ET 2020 Working Group, 2020, 51.
[295] Coclough, C, 2020, 35.
[296] ET 2020 Working Group, 2020, 64.
[297] Viberg, A. R., Frykedal, K.F and Hashemi, S.S., 2019. Teacher educators' perceptions of their profession in relation to the digitalization of society. *Journal of Praxis in Higher Education 1(1),* 98.
[298] OECD, 2020. ICT resources in school education: What do we know from OECD work?
[299] DeArmond, M., Campbell, C., Hill, P., 2018. "The Uncertain Future of Teaching". Thinking Forward: New Ideas for a New Era of Public Education.
[300] ILO, 2021,12.
[301] Visionary Analytics, 2021. CESI Members' survey on digitalisation of the public sector
[302] Coclough,C. 2020, 38.
[303] JRC, 2021. What did we learn from schooling practices during the COVID-19 lockdown? European Commission, 12-13; The Conversation, 2018. Ten reasons teachers can struggle to use technology in the classroom. August 13, 2018. https://theconversation.com/ten-reasons-teachers-can-struggle-to-use-technology-in-the-classroom-101114
[304] Visionary Analytics, 2021. CESI Members' survey on digitalisation of the public sector

contributes to a worsening work-life balance.[305] This has been especially relevant during the pandemic, as teachers' private environments became their workplaces.[306] Signalling the importance of the effect, *blurred work-life boundaries* was the only OSH implication selected as important for teachers by all CESI members.[307] In addition, seven out of ten CESI members also named *burnout* as a prominent OSH consequences for teachers. Teachers can experience burnout due to increasing demands and exhaustion.[308]

Box 5. Difficulties of digital teaching for teachers

Evidence suggests that it is difficult for teachers to keep students engaged digitally.309 SPELC explained that these difficulties to maintain a relationship with students were further highlighted during the pandemic. It is difficult for teachers to conduct remote teaching, interacting and controlling the work of 20-25 students simultaneously. Therefore, while on one hand teachers' job is easier in a way that they have a lot of supporting material for classes, on the other hand it becomes harder to conduct the classes and control the learning process. Such experiences also highlight the need for teachers to develop soft skills.

Source: Visionary Analytics, 2021. CESI Members' survey and interview on digitalisation of the public sector.

Digitalisation can have negative effects on teachers' health.[310] Teachers experience high levels of anxiety and stress due to the demands to integrate ICT in teaching, as well as improper use of technologies or avoidance to use it.[311] CESI members also highlight the *increase in work-related stress*.[312] The most pronounced reason behind teachers' stress is the demand to introduce digital technologies despite the fact that they lack technical resources, equipment or skills and training to do that. [313] In these cases, teachers feel inadequate, insecure, and incompetent which in turn leads to stress and anxiety and contributes to the bad conscience in teacher-student relations as well as to conflicts between teachers.[314] Teachers also experience fatigue as a result of having to incorporate technology in their teaching practices without proper training. [315] Constant difficulties to control students in a virtual environment and lack of social interactions when providing remote teaching can also contribute to worse mental health.[316] With the use of ICT for teaching, teachers are exposed to cyberbullying. Feelings of confusion and frustration, as well as cognitive overload, may occur occurring due to abundance of digital means that can be used.[317] In terms of physical health outcomes, overstimulation from screens and digital environment exposure can lead to not only increased anxiety levels of teachers, but eyesight problems and sleep disorders (as discussed in Chapter 3).[318]

The use of digital technologies can decrease professional autonomy.[319] Technology can jeopardise teachers' right to determine the methods of instruction.[320] Digital education means that today teachers' work can be controlled, monitored, and observed to larger extents, highlighting the risks to teachers' academic freedom. [321] For example, in the survey of Education International (a global federation of teachers' trade unions) member organisations, 43% of trade unions believe that professionals' performance is assessed using digital tools in schools.[322]

[305] Coclough, C. 2020, 38.
[306] JRC 2021, 18.
[307] Visionary Analytics 2021. CESI Members' survey on digitalisation of the public sector
[308] Freudenberger Herbert, J., 1974, "Staff Burnout." *Journal of Social Issues*, 30(1), 159-165.
[309] Van der Graaf, L., et al., 2021, 39.
[310] Coclough, C. 2020, 38.
[311] Mcilroy D., Bunting B., 2003. "Personality, behavior, and academic Achievement: Principles for educators to inculcate and students to model." *Contemp. Educ. Psychol*. 27(2), 326–337; Fernández-Batanero J.M., et al., 2021.
[312] Visionary Analytics, 2021. CESI Members' survey on digitalisation of the public sector
[313] Fernández-Batanero J.M., et al., 2021.
[314] Viberg, A.R., et al., 2019, 98; Pillay H., Goddard R., Wilss L."Well-Being, Burnout and Competence: Implications for teachers." Aust. J. Teach. Educ. 30(2), 22–33
[315] Kyriacou, C., 2003. *Antiestrés para profesores*. Barcelona: Ediciones Octaedro
[316] JRC, 2021, 18.
[317] JRC, 2021, 13-14.
[318] JRC, 2021, 19.
[319] Coclough, C. 2020, 35.
[320] BCTF, 2017. Educational technologies and teacher autonomy. Research Report https://files.eric.ed.gov/fulltext/ED586190.pdf
[321] Education International, 2020; Visionary Analytics, 2021. CESI Members' survey on digitalisation of the public sector.
[322] Coclough, C. 2020, 35-36; Education International is worlds' largest sectoral global union federation of teachers' trade unions consisting of 401 member organizations in 172 countries and territories that represents over 30 million education personnel from pre-school through university.

However, only two out of ten CESI members *indicated prevalence of data-based worker management practices* (e.g., task allocation, worker scheduling done based on data collected about workers) as an important change in work organisation.[323]

Digitalisation can hinder the work of teachers. For example, in case of a malfunctioning computer or whiteboard teachers may not be able to use the device temporarily or for a longer period of time, especially if the school provides no technical assistance. This can further exacerbate teachers' fear of equipment failure and discourage them from embracing digitalisation.[324] Digital technologies can also hinder communication between students and teachers, as usual eye contact and body language are not easily transferable to virtual environments.[325]

Digitalisation also causes **concerns about technologies (especially advanced AI) replacing teachers and leading to job loss**. [326] More generally, this is also related to the **deteriorating role and authority of teachers** since the patterns of interactions between the teacher and the student are changing.[327] This change is fostered by advanced self-learning materials, online knowledge bases, to name a few, meaning teachers are no longer the main (or at least not the only) source of information. Students can access vast amounts of information online, parts of which can conflict with what the teacher is teaching, creating tensions between students and teachers. For example, majority of university students surveyed in a study in University of Calicut indicated that they believe they can acquire more knowledge than their teachers have with the help of technology.[328] Social media platforms contribute to the decreasing authority of teachers, making students perceive teachers as friends. The changing relationship is also evident from the fact that students feel more confident than teachers in certain tasks such as coding and programming apps, programs or robots.[329] This is also related to students becoming partners or co-creators of their own learning and becoming more active participants of the process.[330]

Digitalisation of teaching can interfere with teachers' privacy and personal data.[331] The use of digital tools for teaching produces huge amounts of personal data. Teachers are encouraged to consider security of internet connections from places they are working, security of passwords in their online accounts of software and apps they use for teaching, the security and data protection of their personal phones used to communicate with parents and students, and the security of the online resources and tools that they choose for teaching.[332] Educators' privacy is also affected by increased opportunities for surveillance. For example, the European Court of Human Rights has confirmed that in the case of video surveillance systems installed in the teaching auditoriums at the University of Montenegro, the surveillance breached professors' right to privacy.[333] Related to the privacy concerns are cyber bullying and online harassment issues faced by teachers. [334] The problem has been highlighted during the remote teaching periods during the pandemic, as teachers feared being mocked by students or becoming victims of hate (see Box 6).[335]

---

[323] Visionary Analytics, 2021. CESI Members' survey on digitalisation of the public sector
[324] Türel, Y., K., and Johnson, T.E., 2012. Teachers' Belief and Use of Interactive Whiteboards for Teaching and Learning. *Educational Technology & Society 15(1).*
[325] Viberg, A.R., et al., 2019, 100.
[326] Education International, 2021. Resolution on: The Future of the Teaching Profession https://www.ei-ie.org/en/item/23043:resolution-on-the-future-of-the-teaching-profession
[327] MP, A., and Joseph, J.C., 2019. Recent Trends in Higher Education, Induced by Digitalisation. Research Guru 13(1).
[328] MP, A., and Joseph, J.C., 2019.
[329] Deloitte & Ipsos, 2019.
[330] RMIT University. The future of learning and teaching: Big changes ahead for education https://www.rmit.edu.au/study-with-us/education/discover-education/the-future-of-learning-and-teaching-big-changes-ahead-for-education
[331] Coclough, C., 2020, 38; OECD, Huang, R.H., Liu, D.J., Zhu, L.X., Chen, H.Y., Yang, J.F., Tlili, A., Fang, H.G., Wang, S.F., 2020. Personal Data and Privacy Protection in Online Learning: Guidance for Students, Teachers and Parents. Beijing: Smart Learning Institute of Beijing Normal University.
[332] Rastrick, E, 2020. "Teachers' Data Privacy While Teaching Online. Student Privacy Compass", May 6, 2020. https://studentprivacycompass.org/rastrick1/
[333] European Court of Human Rights, 2017. Antović and Mirković v. Montenegro - 70838/13.
[334] Coclough, C., 2020, 38; Centrum Cyfrowe, 2020. Edukacja zdalna w czasie pandemii. Raport z badań. April 2020.
[335] Visionary Analytics, 2021. CESI Members' survey and interviews on digitalisation of the public sector

CESI members believe that *organisational unpreparedness* followed by *difficulties to adjust OSH practices* are the key barriers to successfully addressing the changing work organisation practices.[336] Nine out of ten CESI members think that *trade unions should facilitate OSH training* to help workers adjust to digitalisation. Eight out of ten believe that trade unions can play an important role by protecting workers' well-being through *social dialogue and collective bargaining*. Half of the respondents think that they should *become more informed* about digitalisation and its impacts on workers or that they should *provide workers with tailored information* about digitalisation. One respondent suggests that trade unions should *negotiate with the public authorities on how to regulate* computer use and minimise the potential negative consequences.

The implications digitalisation has on teachers and educators are rarely addressed in collective agreements or legislation, and most often addressed through institutional (workplace) policies, pedagogical advice or guidance, and OSH provisions.[337] However, even 32% of respondents to the Education International (a federation of teachers' trade unions) member survey indicated that teachers' wellbeing in relation to digitalisation is not addressed in any of the mentioned ways.

Box 6. CESI members addressing changing work organisation practices in education and training sector

SPELC is focused on cyberbullying of teachers as one of the most important concerns, made even more relevant during the pandemic. Due to the virtual teaching practices teachers fear to be subjected to bullying and harassment by students. Virtual classrooms make it easy for students to record or picture teachers, manipulate the content of the image, audio or video, and share it on social media. SPELC addresses the issue of teachers' rights to their image by offering its members an insurance contract to protect their private life and misuse of their personal image. Members of SPELC are protected by the special insurance contract, under which the insurance company can intervene in case teachers observe that their image is misused online. The company makes the content less visible and more difficult to find (since they cannot completely delete anything from the Internet) and can proceed to sue the author of misuse. SPELC regularly brings these and other concerns of teachers to the Ministry of Education, encouraging it to put these issues on the agenda.

Other CESI members in the sector support workers via providing training. Polish Free trade union "Forum-Education" (Wolny Związek Zawodowy "Forum – Oświata" (WZZ F-O) supports its members and organises training courses on the relevant OSH regulations not only for workers but employers as well. Similarly, National Association of Teachers in Spain (ANPE Sindicato Independiente) offers its members training related to new technologies and digitalisation through online tools. The trade union also conducts interviews in the centres with the teaching staff in order to collect specific or general needs regarding the digitalisation of teachers' work.

Source: Visionary Analytics, 2021. CESI Members' survey and interviews on digitalisation of the public sector.

5. EU initiatives

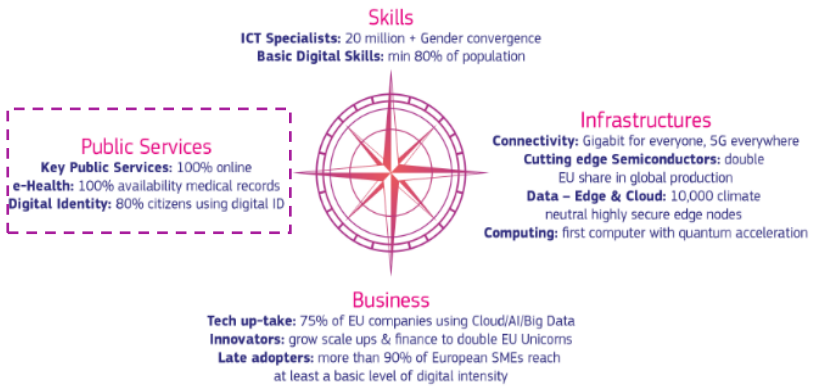
EU attributes great significance to digitalisation. Digital policies rose to the top of EU's agenda at the beginning of 2010. Currently, digitalisation is one of the key six strategic priorities of the European Commission. With the great attention paid to the topic, there is an abundance of strategies, policy papers, legislative proposals that can be relevant for workers and that trade unions should be aware of. This section starts with introducing the leading digitalisation strategy of the EU and proceeds with overviewing legislative, financial and other initiatives related to digital transformation, skills and working conditions. The focus is on the most relevant and significant developments of European Commission and European Parliament and on the four focal sectors for the study.

[336] Visionary Analytics, 2021. CESI Members' survey on digitalisation of the public sector
[337] Coclough, C., 2020, 39.

5.1. Europe fit for the Digital Age

First and foremost, one of the six key strategic priorities of the European Commission is to create **a Europe fit for the Digital Age**. To this end it has committed to make 2021-2030 **Europe's Digital Decade**, by setting digital targets to be achieved by 2030.[338] The strategy responds to the growing importance of digital technologies and associated challenges including the digital divide. The strategy commits EU to pursue a human-centric, sustainable digital society to empower citizens and businesses. Objectives of the strategy will translate into 20 new legislative and non-legislative initiatives.[339]

Figure 38. Key targets of EU's Digital Decade strategy



Source: European Commission. Europe's Digital Decade. https://digital-strategy.ec.europa.eu/en/policies/europes-digital-decade

Published in March 2021, the Communication '**Digital Compass: The European Way for the Digital Decade**' presents four targets of EU's digital strategy, one of which is digitalisation of public services (see Figure 38). In this regard, EC is focused on reducing barriers to public services and ensuring their accessibility to all. It aims to enable all citizens and business to have online access to key public services related to career, studying, family, regular business operations, moving, and seeks that at least 80% of citizens use digital ID. EC has already taken action through funding e-participation projects, standardizing electronic health records, and supporting the development of smart cities.[340]

In September 2021, the EC specified how the Digital Decade objectives should be achieved by releasing **the Policy Programme: a path to the digital decade**. The plan advocates for structured and close cooperation between the EU and MS. It sets up a governance framework based on an *annual cooperation cycle* and *introduces a mechanism to coordinate investments* between EC and MS to reach the targets of the Digital Decade. The plan also communicates EC's initiative to launch *large-scale multi-country digital projects* that would pool EU, national and private resources to address gaps in the identified critical capacities of the EU and thus help to achieve the targets. To this day the Commission's initial list of the areas of investment that multi-country projects should focus on include public administration and digital skills, as well as digital innovation hubs, 5G communications and others. To help with the set up and implementation of these projects, EC developed a new instrument called the **European Digital Infrastructure Consortium** (EDIC). The plan foresees that EC monitors and reports the progress towards achieving Digital Decade targets via annual **'Report on the state of the Digital Decade'**. Commission's work programme for 2022 expresses its commitment to follow up on the path by reaching agreements on and implementing proposals for a safe and secure internet, a European digital identity and on trustworthy AI.[341] It plans to develop projected trajectories for each target of the Path together with the MS.

As part of the Digital Decade, EC aims to define what kind of digital transformation it promotes and defends via a **joint inter-institutional solemn Declaration on Digital Rights and Principles** of

[338] European Commission. Europe fit for the Digital Age. https://ec.europa.eu/info/strategy/priorities-2019-2024/europe-fit-digital-age_en
[339] European Parliament. Legislative Train Schedule. Europe fit for the Digital Age. https://www.europarl.europa.eu/legislative-train/theme-a-europe-fit-for-the-digital-age/fiche
[340] European Commission. Digital public services and environments https://digital-strategy.ec.europa.eu/en/policies/digital-public-services
[341] European Commission, 2021. Commission work programmer 2022: Making Europe stronger together. https://ec.europa.eu/info/sites/default/files/com2021_645_en.pdf

the European Parliament, the Council, and the Commission. [342] The declaration would set a common benchmark at the European level for fundamental rights and values in the digital space, ensure that all citizens benefit from digitalisation, are skilled for the digital society and exercise their rights online and offline, guide the EU and MS in designing and enforcing coordinated policies, help monitor the perception of Europeans of the benefits of digitalisation in an annual Eurobarometer. After a public consultation in 2021, the draft of the Declaration was released on 26 January 2022 and is expected to be endorsed by the summer.[343] The Declaration refers to such rights and principles of digital transformation as placing people at its centre, supporting solidarity and inclusion, ensuring the freedom of choice online, fostering participation in the digital public space, increasing safety, security and empowerment of individuals, and promoting the sustainability of the digital future. It explicitly refers to everyone's right to access all public services online and to not be asked to provide data more often than necessary, right to digital education and skills, and right to healthy and safe working conditions and appropriate protection in the digital environment (i.e., the right to disconnect and work-life balance).

The European Strategy for Data is also a part of the Digital Decade and it aims to facilitate a free flow of non-personal data within the EU to enable citizens, businesses, researchers and public administrations to make well-informed decisions based on data.[344] According to EC, data have the potential to upgrade public services (e.g., provision of personalised medicine). The first legislative initiative adopted under the European strategy for data was the **European Data Governance Act** (drafted in November 2020 and agreement between EP and Council reached in November 2021).[345] The regulation aims to facilitate data sharing across sectors and MS, to increase trust in data sharing, strengthen mechanisms to increase data availability and overcome technical obstacles to the reuse of data. The regulation is expected to help citizens (including workers) to gain more control over their data, being able to decide who and for what purposes can access the data.[346] Complementary to this regulation, the Commission is in process of proposing another major legislative initiative, the **Data Act,** which aims to foster data sharing among businesses, and between businesses and government.[347]

The Digital Europe Programme (DIGITAL) is a first ever funding programme dedicated solely to supporting digital transformation in the EU. It has a budget of €7.5 to support projects in five key capacity areas: supercomputing (€2.2 billion), artificial intelligence (€2.1 billion), cybersecurity (€1.6 billion), advanced digital skills (€0.6 billion), and ensuring a wide use of digital technologies across the economy and society (€1.1 billion).[348] The Commission has launched the first three calls under the Programme in November 2021.[349] Other funding instruments that contribute to the modernisation of public sector are European Structural and Investment Funds (ESIF), the Connecting Europe Facility (CEF) and ISA² programmes.[350]

An important development has been the establishment of the **Recovery and Resilience Facility (RRF)** in February 2021 with the budget of €723.8 billion which is meant to support investment and reforms in MS to cope with the pandemic and prepare Europe for green and digital transitions. The Regulation requires that each MS devotes at least 20% of the allocation received from RRF to foster the digital transition. Up to October 2021, in practice the Member

[342] European Commission. Europe's Digital Decade: digital targets for 2030 https://ec.europa.eu/info/strategy/priorities-2019-2024/europe-fit-digital-age/europes-digital-decade-digital-targets-2030_en

[343] European Commission, 2022. Declaration on European Digital Rights and Principles.https://digital-strategy.ec.europa.eu/en/library/declaration-european-digital-rights-and-principles

[344] European Commission, European data strategy. https://ec.europa.eu/info/strategy/priorities-2019-2024/europe-fit-digital-age/european-data-strategy_en

[345] European Commission. European data governance act. https://digital-strategy.ec.europa.eu/en/policies/data-governance-act

[346] European Commission, 2020. Regulation on data governance-Questions and Answers https://ec.europa.eu/commission/presscorner/detail/en/QANDA_20_2103

[347] European Parliament. Legislative Train Schedule. A Europe fit for the Digital Age. https://www.europarl.europa.eu/legislative-train/theme-a-europe-fit-for-the-digital-age/file-data-act

[348] European Commission. The Digital Europe Programme https://digital-strategy.ec.europa.eu/en/activities/digital-programme

[349] Misheva,G., 2021. Commission launches first calls for proposals under the Digital Europe Programme. Digital Skills & Jobs Platform. https://digital-skills-jobs.europa.eu/en/latest/news/commission-launches-first-calls-proposals-under-digital-europe-programme

[350] European Commission. European structural and investment funds. https://ec.europa.eu/info/funding-tenders/funding-opportunities/funding-programmes/overview-funding-programmes/european-structural-and-investment-funds_en; Innovation and Network Executive Agency. "Connecting Europe Facility". https://ec.europa.eu/inea/en/connecting-europe-facility; European Commission. ISA² - Interoperability solutions for public administrations, businesses and citizens. https://ec.europa.eu/isa2/home_en

States that received funding for their Recovery and Resilience Plans (RRPs), had gone over the 20% target and averaged digital investments at 26% of their allocations.[351] **Digital investment to digital public services was the top priority area** for MS and they allocated 37% of investments to develop platforms, to give access to e-government solutions, to increase interoperability between different digital solutions, to reduce the administrative burden, to digitalise healthcare, transport and energy systems. Digitalisation of public services was followed by 20% of allocations on the digitalisation of businesses, and 17% on human capital, including facilitating online learning possibilities through digital platforms for schools and individuals or including digital skills in VET courses.

5.1.1. Initiatives related to digital transformation

This section overviews the most important and recent legislative developments in the EU (mostly EC) related to digital transformation. More precisely, it presents EU-level regulations related to the increasing collection and use of data, provision of online services and development of the artificial intelligence (AI).

The **Tallinn Ministerial Declaration on eGovernment** signed between all EU MS and EFTA countries in 2017 represented the highest level of commitment by MS to make e-government and a digitalised public sector a key to transforming societies and support the EU's four freedoms.[352] The Declaration included agreeing on the common user-centricity principles to improve user experience in accessing public services. By signing the declaration, MS pledged to implement the principles of digital-by-default, inclusiveness and accessibility, user-centricity, trustworthiness and security, interoperability, openness, and transparency of digital public services by 2022.

General Data Protection Regulation (GDPR) is fully applicable since 2018. Employees have a number of rights under GDPR important in the context of digitalisation of workplaces. GDPR provides employees the following rights:

- Information about the collection and processing of their personal data
- Access the personal data and supplementary information held about them by the data controller
- Have their personal data rectified by the data controller if the personal data they have is inaccurate or incomplete
- Have their personal data erased by the data controller
- Restrict a data controller from processing their data if they consider it is unlawful or the data is inaccurate
- Object to their personal data being processed for direct marketing, scientific or historical research
- Data portability – this allows them to get data from their employer and reuse it.

Under GDPR employers must be transparent about how they use and safeguard personal data of workers and are accountable for their data processing activities. They must inform employees about what personal data they will be collecting, how and why it will be processed, and must have either legal basis or consent for collecting personal data.

The Electronic Identification, Authentication and Trust Services (eIDAS) Regulation entered into force in September 2018 and fosters cross-border recognition of electronic identification means, important for the digitalisation of the public sector. It sets the rule for all organisations delivering public digital services in all EU member state to recognise electronic identification from all EU member states. The regulation attributed all electronic signatures, qualified digital certificated, electronic seals, timestamps and other electronic authentication mechanisms the same legal standing as authentications on paper. The EIDAS Regulation is currently under revision and is expected to be updated by introducing the **European Digital Identity system**

[351] European Commission, 2021. Digital Economy and Society Index (DESI) 2021. Thematic chapters, 11.
[352] Joinup, 2021. "About Tallinn Ministerial Declaration". https://joinup.ec.europa.eu/collection/tallinn-ministerial-declaration/about

(EUid) to secure the identification for the use of public and private online services.[353] The vote on the EUid is expected to take place in July 2022.

In 2017 the European Commission has published the revised **European Interoperability Framework (EIF)** which provided a set of recommendations for Member States on how to set up interoperable digital public services.[354] The EC has stressed that digital public services are important in order to enable citizens to interact with public administrations electronically, in a timely, effective and efficient manner. EIF was created to make sure that MS' efforts to enable these electronic interactions do not create isolated digital environments and digital fragmentation of services and data in Europe.

Cybersecurity is important for secure digital transformation of society. **The EU Cybersecurity Strategy** published in 2020 fosters resilience to cyber threats and trustworthiness of digital technologies used by citizens and businesses.[355] Among other topics the strategy covers the security of the connected objects in the workplaces. In October 2021 MEPs demanded **common EU cyber defensive capabilities,** i.e., measures and IT policy as well as improve military cyber defence coordination.[356] The EC is planning to publish a proposal for a **new European Cyber Resilience Act** in the third quarter of 2022. The aim of the act is to establish common cybersecurity standards for products.[357]

Recognising that Artificial Intelligence (AI) has great potential to benefit society and economy (e.g., through better healthcare, efficient public administration), EU has developed a comprehensive approach to AI. Multiple legislative and non-legislative initiatives of European Commission and European Parliament stress the importance of AI to be excellent and trustworthy and pays attention to how AI deployment in organisations affects workers.

- **The European Strategy on AI** (2018) named the potential benefits of AI technology for workers, including helping workers with repetitive, strenuous and dangerous tasks, assisting workers by providing more accurate information and suggesting decisions (e.g., assisting doctors with diagnosis), helping people with disabilities to join the labour market.[358] It also predicted that AI will create new jobs and tasks and while replacing others. The strategy identified the need to help workers whose jobs are most likely to be transformed or disappear by providing them with opportunities to upskilling and training.
- In 2019 the High-Level Expert Group on AI presented **Ethics Guidelines for Trustworthy Artificial Intelligence.**[359] The guidelines acknowledge that deployment of AI systems in workplaces can have significant negative effects on workers and highlights the importance to ensure that workers and their representatives are informed, consulted and participating in the process of implementing AI systems at organisations.
- These beliefs were reinstated in the **White Paper on Artificial Intelligence – A European approach to excellence and trust** published in 2020. The White Paper was the first major publication within the EU's goal of Shaping Europe's Digital Future. It sets out policy options on how to promote safe development and deployment of AI.[360] In the paper the EC expresses its opinion that AI applications used for recruitment processes or in any situations that impact workers' rights should be considered "high-risk" calling for safeguards. Moreover, it once again highlights that involvement of social partners is crucial to ensure a human-cantered approach to AI at work. The White Paper was accompanied by a

[353] European Parliament. Legislative Train Schedule. Revision of the eIDAS Regulation- European Digital Idenityty (EUID). https://www.europarl.europa.eu/legislative-train/theme-a-europe-fit-for-the-digital-age/file-eid

[354] European Commission, 2017. New European Interoperability Framework Promoting seamless services and data flows for European public administrations. Luxembourg: Publications Office of the European Union, https://ec.europa.eu/isa2/sites/default/files/eif_brochure_final.pdf

[355] European Commission. The Cybersecurity Strategy.https://digital-strategy.ec.europa.eu/en/policies/cybersecurity-strategy

[356]European Parliament, 2021. "MEPs demand common EU cyber defensive capabilities" News. https://www.europarl.europa.eu/news/en/press-room/20210930IPR13930/meps-demand-common-eu-cyber-defensive-capabilities

[357]European Parliament. Legislative Train Schedule. The New European Cyber Resilience Act. https://www.europarl.europa.eu/legislative-train/theme-a-europe-fit-for-the-digital-age/file-european-cyber-resilience-act/12-2021

[358] European Commission, 2018. Communication from the Commission "Artificial Intelligence for Europe". https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=COM%3A2018%3A237%3AFIN

[359] European Commission, 2019. Ethics guidelines for trustworthy AI. https://digital-strategy.ec.europa.eu/en/library/ethics-guidelines-trustworthy-ai

[360] European Commission, 2020. White Paper on Artificial Intelligence a European approach to excellence and trust. https://ec.europa.eu/info/sites/default/files/commission-white-paper-artificial-intelligence-feb2020_en.pdf

'**Report on the safety and liability implications of Artificial Intelligence, the Internet of Things and robotics'** which concluded that current product safety legislation has gaps that must be addressed.[361]

- European Parliament has set up a Special Committee on Artificial Intelligence in a Digital Age, which analyses the impact of AI on the EU economy.[362] In October 2020 MEPs adopted **several legislative and own-initiative reports** that outlined how the EU could regulate AI. Legislative initiatives focused on 1) ethical aspects of AI, robotics, and related technologies (including how it should be human-centric, safe, transparent, with safeguards against bias and discrimination) and 2) civil liability regime for AI (including liability when AI causes damage on health, physical integrity, or property of users).[363] EC's response to these initiatives was the proposal for regulation of AI (discussed below). MEPs had also proposed guidelines for the use of AI in military, justice and health, as well as education, culture and the audiovisual sector (see below), and more recently drawn attention to the secure and fair use of AI by the police.[364] The ongoing initiatives of MEPs include **the report on AI in a Digital Age** which will be put to a vote, followed by a plenary debate and vote in May 2022.[365] The draft of the report presented in November 2021 revealed that EU should focus on fostering the enormous potential of AI.
- EU renewed its approach to AI in 2021. Firstly, it updated the **Coordinated Plan on AI** first published in 2018.[366] The Plan focuses on strong collaboration between EC and MS in accelerating development of AI that is human-centric, sustainable, secure, inclusive, and trustworthy. Secondly, and most importantly, in April 2021 the European Commission proposed first-ever **proposal for an AI Regulation (Artificial Intelligence Act).**[367] The proposal names AI technology used for employment, workers management and access to self-employment as high risk and thus subject to strict obligations before they can be put on the market. The Regulation would be an important safeguard for workers against the negative implications of AI usage in their workplaces. The proposal is currently discussed by the Council and EP, which is preparing its position on the proposed regulation to come out in 2022.[368] The anticipated position will contain recommendation on the ways to deal with the challenges in deploying the technology. The Regulation could enter into force in the second half of 2022 in a transitional period and would become applicable in the second half of 2024.[369]

On top of that the Commission has also proposed **legal initiative on EU rules to address liability issues** related to new technologies, and a **revision of sectoral safety legislation** (e.g., Machinery Regulation, General Product Safety Directive). Both of these initiatives are expected to contribute to building trustworthy new technologies that do not negative affect their users, including workers.

---

[361] European Commission, 2020. Commission Report on safety and liability implications of AI, the Internet of Things and Robotics https://ec.europa.eu/info/publications/commission-report-safety-and-liability-implications-ai-internet-things-and-robotics-0_en

[362] European Parliament. Special Committee on Artificial Intelligence in a Digital Age https://www.europarl.europa.eu/committees/en/aida/home/highlights

[363] European Parliament, 2020. "Parliament leads the way on first set of EU rules for Artificial Intelligence", News. https://www.europarl.europa.eu/news/en/press-room/20201016IPR89544/parliament-leads-the-way-on-first-set-of-eu-rules-for-artificial-intelligence

[364] European Parliament, 2020. AI rules: what the European Parliament wants https://www.europarl.europa.eu/news/en/headlines/society/20201015STO89417/ai-rules-what-the-european-parliament-wants; European Parliament, 2021."Use of artificial intelligence by the police: MEPs oppose mass surveillance", News. https://www.europarl.europa.eu/news/en/press-room/20210930IPR13925/use-of-artificial-intelligence-by-the-police-meps-oppose-mass-surveillance

[365] European Parliament Legislative Observatory. 2020/2266 (INI(Report on Artificial Intelligence in a Digital Age. https://oeil.secure.europarl.europa.eu/oeil/popups/ficheprocedure.do?reference=2020/2266(INI)&l=en

[366] European Commission, 2018. "Member States and Commission to work together to boost artificial intelligence "made in Europe"https://ec.europa.eu/commission/presscorner/detail/en/IP_18_6689; European Commission, Coordinated Plan on Artificial Intelligence 2021 Review 2021. https://digital-strategy.ec.europa.eu/en/policies/plan-ai

[367] European Commission, 2021. Proposal for a regulation of the European Parliament and of the Council laying down harmonized rules on Artificial Intelligence (Artificial Intelligence Act) and amending certain Union Legislative Acts. https://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1623335154975&uri=CELEX%3A52021PC0206

[368] European Parliament. Legislative Train Schedule. Proposal for a regulation on a European Approach for Artificial Intelligence https://www.europarl.europa.eu/legislative-train/theme-a-europe-fit-for-the-digital-age/file-regulation-on-artificial-intelligence

[369] European Commission. Regulatory framework proposal on artificial intelligence. https://digital-strategy.ec.europa.eu/en/policies/regulatory-framework-ai

In May 2021 the European Parliament adopted a **resolution on shaping the digital future of Europe,** which calls on the EC to boost its efforts in dealing with challenges of digital transition.[370] The report focuses on AI as the key driver of digital transformation and encourages EC to address such issues as lack of digital skills and connectivity.

EU is also promoting the application of Internet of Things (IoT) and the use of data in governments. In 2015 it launched the **Alliance for Internet of Things Innovation** (AIOTI) to support the growth of European IoT ecosystem.[371] In 2016 EC published a staff working document on '**Advancing the Internet of Things in Europe'**[372].

5.1.2. Initiatives on digital skills

European Commission acknowledges the need to address the problem of skills mismatch due to digitalisation in the EU labour market. Building on the ten actions of the New Skills Agenda (adopted in 2016 to help workers acquire necessary digital skills) in 2020 the European Commission has launched the **new European Skills Agenda**. It is a five-year plan to help individuals and businesses develop more and better skills. The target set by the EC is 70% of adults to have basic digital skills by 2025.[373] The European Skills Agenda includes 12 actions grouped in four categories, one of which is to ensure that people have the right skills for jobs. The group includes six actions: strengthening skills intelligence, EU support for strategic national upskilling action, Proposal for a Council Recommendation on vocational education and training (VET), rolling out the European Universities Initiative and upskilling scientists, skills to support the twin transitions, increasing STEM graduates and fostering entrepreneurial and transversal skills, skills for life.

As part of the European Skills Agenda, in November 2020, the EC has launched **the Pact for skills** to encourage skills development in Europe.[374] The Pact invites public and private organisations to join their efforts in upskilling and reskilling Europeans. Signatories of the Pact commit to support upskilling and reskilling, and the Pact provides signatories with support to find partners, with webinars, updates on EU policies and instruments, best practices, guidance, and resources.

Digital Skills & Jobs/ Platform was launched in May 2021 and became the main gateway to information on digital skills in Europe, providing access to relevant news, events, training and research on skills and digital competences.[375]

In 2021 the EP adopted a **resolution on the European Skills Agenda**, calling for MS to invest more to close the digital skills gap by prioritising retraining and learning new skills in their COVID-19 recovery and resilience plans.[376] It also called for EU to devote a much bigger part of the budget for the European Skills Agenda.

The European Pillar of Social Rights Action Plan has set the target of 60% of all adults taking part in training every year by 2030. To support MS in achieving this goal, in December 2021 the EC had adopted two proposals related to improving upskilling opportunities for Europeans.[377] These proposals were EC's response to the pandemic-accelerated need for reskilling and upskilling, as well as to current situation where Europeans rarely participate in regular learning after their initial education and training because they lack financial resources or time, or are not aware of the upskilling or reskilling opportunities. The following is proposed:

---

[370] European Parliament "MEPs want more support for digital innovation and AI applications ". News https://www.europarl.europa.eu/news/en/press-room/20210517IPR04133/meps-want-more-support-for-digital-innovation-and-ai-applications

[371] Alliance for Internet of Things Innovation https://aioti.eu/

[372] European Commission, 2016. Staff Working Document: Advancing the Internet of Things in Europe https://digital-strategy.ec.europa.eu/en/library/staff-working-document-advancing-internet-things-europe

[373] European Commission, Digital skills and jobs. https://digital-strategy.ec.europa.eu/en/policies/digital-skills-and-jobs

[374] European Commission. Pact for Skills https://ec.europa.eu/social/main.jsp?catId=1517&langId=en

[375] Digital Skills and Jobs Platform https://digital-skills-jobs.europa.eu/en

[376] European Parliament, 2021. "Put digital skills at the heart of education and training policies " News. https://www.europarl.europa.eu/news/en/press-room/20210204IPR97127/put-digital-skills-at-the-heart-of-education-and-training-policies

[377]European Commission, 2021. "Commission takes action to improve lifelong learning and employability" https://ec.europa.eu/commission/presscorner/detail/en/ip_21_6476

- **Individual Learning Accounts (ILA)** proposal aims to address key bottlenecks that prevent people from accessing training, i.e., motivation, time and funding. ILAs are defined as virtual skills wallets for every person of working age, giving them a budget to spend on training to improve their skills and employability.[378] The EC proposed for MS and social partners to set up ILA and provide training entitlement for all adults of working age, to define a list of labour-market relevant and quality-assured training that would be eligible for funding from ILA and accessible through a digital registry (e.g., a mobile device), and to offer opportunities of career guidance and validation of previously acquired skills together with paid training leave. National authorities would be responsible to ensure adequate annual provision of individual training entitlements, which could be accumulated by peopled and used throughout their career.
- In the second proposal, the EC aims to establish a common definition, standards and recognition for **micro-credentials**, which are used to certify learning outcomes of small learning experiences (e.g., a short course of training).[379] Micro-credentials allow people to develop their skills in a flexible and targeted way. EC wants to ensure these credentials are of high quality and transparent, so that more people would use them for skills development.

The European Digital Competence Framework (DigComp) has been under one more revision since January 2021. The updated version of DigComp has been published in early 2022 and takes into account Artificial Intelligence, the Internet of Things, datafication, teleworking, among other digital developments.[380]

According to the European Commission work programme for 2022, the EC will propose further **measures to facilitate and promote digital skills in schools and higher education**.[381]

5.1.3. Initiatives on working conditions, workers' safety and health

Two key OSH Legislations at least partly related to the use of ICT for work in the EU are **Directive 89/391/EEC (the Framework Directive)**[382] **and Directive 90/270/EEC on display screen equipment**.[383] The Framework Directive mentions that employers should keep themselves informed about the dangers of deploying the latest technology advancements, and should ensure that workers and/or workers' representatives are consulted when planning and introducing new technologies in order to ensure better OSH protection. Employers are also obliged to ensure that each worker receives adequate safety and health training when any new technologies are introduced, when new work equipment is introduced or changes. The Directive on display screen equipment lays down minimum safety and health requirement for work with display screens, explaining that it can introduce risks of eyesight, physical problems and problems of mental stress and obliging employers to perform an analysis of workstations, ensure they are safe to use, inform workers on all aspects of safety and health and provide them with training. Workers are also entitled to an eye and eyesight test before commencing display screen work and at regular interval afterwards.

In 2021 the Commission adopted the new OSH strategy via the communication '**EU strategic framework on health and safety at work 2021-2027 – Occupational safety and health in a changing world of work**'.[384] One of the missions of the strategy is to make workplaces fit for digital transition. To this end the strategy foresees a **review of the Workplaces Directive and the**

[378] European Commission. Adult skills - Individual Learning Accounts: a tool to improve access to training . https://ec.europa.eu/info/law/better-regulation/have-your-say/initiatives/12876-Adult-skills-Individual-Learning-Accounts-a-tool-to-improve-access-to-training_en

[379] European Commission, 2021. "Commission takes action to improve lifelong learning and employability" https://ec.europa.eu/commission/presscorner/detail/en/ip_21_6476

[380] European Commission, 2022. "Digital Competences Framework (DigComp 2.2) update published" https://ec.europa.eu/social/main.jsp?langId=en&catId=89&newsId=10193&furtherNews=yes

[381] European Commission, 2021. Communication on Commission work programme 2022: making Europe stronger together.

[382] Council Directive of 12 June 1989 on the introduction of measures to encourage improvements in the safety and health of workers at work https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:01989L0391-20081211

[383] Council Directive 90/270/EEC of 29 May 1990 on the minimum safety and health requirements for work with display screen equipment https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:31990L0270

[384] European Commission, 2021. Communication on EU strategic framework on health and safety at work 2021-2027 Occupational safety and health in a changing world of work. https://eur-lex.europa.eu/legal-content/EN/ALL/?uri=COM:2021:0323:FIN

Display Screen Equipment Directive, as well as an EU-level **initiative related to mental health at work**. Other two priorities of the strategy relate to improving prevention of accidents and illnesses and getting prepared for any potential future health crises.

Digital transformation enables workers to work from anywhere at any time, which can potentially bring about negative health outcomes, intensifying work, increasing levels of stress and anxiety, as well as leading to sleep disorders and musculoskeletal disorders (see Chapter 3). In 2020, the EMPL committee in the EP initiated legislative proposal for the '**right to disconnect'.**[385] The proposal set minimum requirements on the use of digital tools for professional purposes outside working time, addressing workers' rights to fair working conditions. It also advocated establishing minimum requirements for remote working and clarifying working conditions, hours and rest periods. The proposal emphasized the significant role of social partners for the implementation of the right to disconnect. The legislative initiative passed the vote in the Parliament in January 2021, calling for EC to propose a law. In March 2021 the EC foresaw a follow-up on the proposal after it assesses the existing practices related to the right to disconnect. The foreseen **implementation report of the Working Time Directive** that will be published in 2022 is going to shed more light on the implications of remote work on working time and can be significant for the future of the right to disconnect.[386] **Council conclusions on telework** of June 2021 called on MS to recognise the benefits and risks of telework, paying more attention on the OSH, including working time.[387]

The closest measures that come to workers' right to disconnect in the EU are:

- **Working Time Directive** (setting the minimum daily and weekly rest periods essential for workers' health and safety)[388]
- Principles 9 (work-life balance) and 10 (healthy, safe and well-adapted work environment and data protection) of the **European Pillar of Social Rights[389],**
- **Directive on work-life balance for parents and carers** that entered into force in July 2019.[390]

According to the European Commission work programme for 2022, the Commission will follow up on the **implementation of the European Pillar of Social Rights** action plan in order to ensure that European workers can enjoy better balance in their lives and have fair working conditions.[391]

Importantly for trade unions, the Commission has plans to publish a **Communication to strengthen the social dialogue** at EU and national level, supporting the key role of social partners in digital transitions. [392]

5.2. Sector-specific EU initiatives: education and training sector

In 2021, the EU renewed **the Digital Education Action Plan (2021-2027)** to support sustainable and effective adaptation of education and training systems to the digital age. It aims to foster the development of a high-performing digital education ecosystem and enhance digital skills and competences for the digital transformation.[393] The Digital Education Action Plan was also

[385]European Parliament. Legislative Train Schedule. The right to Disconnect. https://www.europarl.europa.eu/legislative-train/theme-a-europe-fit-for-the-digital-age/file-al-legislative-proposal-to-the-commission-on-the-right-to-disconnect/12-2021

[386] European Parliament. Legislative Train Schedule. The right to Disconnect.

[387] Council of the European Union, 2021. Council conclusions on telework. https://data.consilium.europa.eu/doc/document/ST-9747-2021-INIT/en/pdf

[388] European Commission. European employment strategy, Working conditions https://ec.europa.eu/social/main.jsp?catId=706&langId=en&intPageId=205

[389] European Commission. European Pillar of Social Rights: Building a fairer and more inclusive European Union https://ec.europa.eu/info/strategy/priorities-2019-2024/economy-works-people/jobs-growth-and-investment/european-pillar-social-rights_en

[390] Directive (EU) 2019/1158 of the European Parliament and of the Council of 20 June 2019 on work-life balance for parents and carers and repealing Council Directive 2010/18/EUhttps://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A32019L1158

[391] European Commission, 2021. Communication on Commission work programme 2022: Making Europe stronger together

[392] European Commission, 2021. Communication on Commission work programme 2022: Making Europe stronger together

[393] European Commission. European Education Area https://ec.europa.eu/education/education-in-the-eu/digital-education-action-plan_en

affected by the pandemic and is calling for stronger cooperation at the European level to learn from the crisis and adapt education and training systems to better fit the digital age.[394]

On 19 May 2021, Parliament adopted a **resolution on the use of AI in education, culture and the audiovisual sector**. [395] The resolution calls for AI technologies to be regulated and trained to prevent gender, social or cultural bias and protect diversity. Focusing on education, the resolution stresses that teachers should always be able to correct decisions taken by the AI (especially in terms of student selection and evaluation), and that they need to be trained to use AI in education.

The European Commission's **renewed agenda for higher education** (adopted in 2017) fosters development of pedagogical and curriculum design skills of HE teachers, doctoral candidates and postdoctoral graduates. It highlights the need for systematic investment in educators' CPD.

In its working programme for 2022, the European Commission expresses its intent to present the EU strategy for universities and propose ways for a deeper and more sustainable transnational cooperation in higher education, together with **initiatives to improve digital in school and higher education**. [396]

[394] European Commission 2020. Digital Education Action Plan 2021-2027 https://ec.europa.eu/education/sites/default/files/document-library-docs/deapcommunication-sept2020_en.pd

[395] European Parliament, 2021. "MEPs call for an ethical framework to ensure artificial intelligence respects EU values "News. https://www.europarl.europa.eu/news/en/press-room/20210517IPR04135/meps-call-for-an-ethical-framework-to-ensure-ai-respects-eu-values

[396] European Commission, 2021. Communication on Commission work programme 2022: Making Europe stronger together.

6. Conclusions and recommendations

Digital transformation of workplaces in the public sector is a development which has great potential to help workers. However, the potential risks are not insignificant and need to be mitigated with care. In this light, it is essential that, as the representatives of workers, trade unions are active in supporting them through the digital transition. The findings of our study shed light on a few recommendations for trade unions, which CESI members can draw inspiration from.

1. The very purpose of trade unions is to protect the interests and wellbeing of workers through maintaining and improving their working conditions. Digitalisation is one of the most important current developments that has been proven to have significant impact on workers, having the potential to improve and to worsen working conditions. Workers' interests need to be taken into account when adopting digital tools in workplaces and their working conditions should not deteriorate due to digitalisation. Therefore, it is important for trade unions to put digitalisation on their agendas, realising that it is a relevant and important development that they can shape and support workers through. While most CESI members attribute a lot of importance to digitalisation and the ways they can support workers, trade unions should **acknowledge that they can and should play a key role in the process of digitalisation**.

Pay more attention to digitalisation by approaching it as a key development that affects workers and required trade union involvement.

Draw inspiration from the examples in which trade unions adopt an active stance in providing support and advocating for workers' interests in the context of digitalisation. A number of such examples had been provided in this study as well.

2. Public sector is undergoing a digital transformation which was further accelerated by the COVID-19 pandemic. Currently among the most widespread technological innovations adopted in the public sector are Artificial Intelligence, robotics, data-based innovations, Internet of Things and blockchain. The use of these technologies in public sector brings important changes to how work is organised; it affects how workers conduct their tasks on a daily basis, and how likely they are to remain active participants of the labour market. In the environment of increasingly growing demands of citizens, public sectors' search for ways to make services more economically beneficial, and constant technological developments, digitalisation of the public sector is only likely to advance further and affect workers in more different ways. To this end, first and foremost **trade unions should be aware about the current and foreseeable key developments of digitalisation and how these developments affect workers in practice.**

Conduct surveys of workers or organise discussions where they could share their experiences with using digital tools for work, and how it impacts them daily. This would allow trade unions to hear a first-hand experience and learn more about how digitalisation of workplaces look in practice. Such discussions could also involve employers.

Make an effort to identify and follow relevant research on digitalisation and its impacts on workers, e.g., European Commission's eGovernment benchmark, thematic ILO, JRC, Eurofound, other studies. This study can provide a useful starting point to identify the most relevant research, which also includes studies that are predicting future trends.

3. For digitalisation to be a process which benefits all stakeholders, it requires an environment where workers hold positive attitudes towards the change, are willing to support and embrace it. However, quite often workers find digitalisation overwhelming, changes as difficult to understand and bringing them uncertainty. Workers' attitudes are informed not only by their previous experience with technology, their levels of digital skills, but also awareness and proof of the actual benefits of change. Hence, lack of information and clear strategy on how digitalisation happens and what it means for workers can foster negative attitudes, leaving workers with no clarity. While employers are the key stakeholders in supporting organisational change and leading workers through digitalisation, **trade unions can shape workers' attitudes** as well, especially by informing workers about what kind of positive and negative impacts they can expect.

Through discussions identify information needs of workers, i.e., what kind of information they lack or would be interested in (e.g., statistics of the spread of teleworking, upcoming trends and new technological advancements, legislative initiatives that affect their work, how they can benefit from digitalisation and what disadvantages they can expect, etc.)

Organise awareness-raising campaigns to provide workers (especially those unaware about the potential of digitalisation) with the most relevant information on digitalisation and its impacts. This can range from simply sharing the link to relevant studies, news articles, blog posts via email or social media, to producing and sharing periodical newsletters, where the most relevant information is summarized in an easy-to-read way.

4. As digitalisation affects them on a daily basis, workers should be consulted on the implementation of new technology and changes in work organisation. To this end, as worker representatives, trade unions should protect workers' right to information, consultation and participation and seek to represent workers' needs regarding digital tools and how they will be applied. To this end trade unions **be active in consultations and negotiations on the implementation of new technologies in workplaces.**

Highlight to employers the importance of a fair digitalisation process which requires participation of workers. If needed, actively encourage employers to set up consultations with worker representatives before they plan adopting digital tools.

Gather workers' opinions/views on digitalisation or use of a specific tool before the consultation, and actively participate in consultations and/or negotiations with employers representing those views.

Assess whether new digital tools planning to be developed/implemented benefit workers and respond to their needs, what are the potential risks and whether there are mitigation strategies in place.

5. The topic of digitalisation is high on the agenda of policymakers at the national and EU levels. Policymakers periodically organise consultations inviting stakeholders to express their views on digitalisation and related regulations. Participation in public consultations is an effective way for trade unions to indirectly shape the future regulations and rules by communicating the needs and concerns of their members. Trade unions should **not miss a chance to contribute to policymaking** by participating in these stakeholders' consultations.

Stay informed about the ongoing and planned public stakeholders' consultations set up by national and EU-level policymaker: follow news on the policymakers' websites, social media or through networks with other trade unions.

Actively seek to participate in available public stakeholders' consultations and contribute by providing practical insights and representing the real workers' attitudes and needs.

Advocate for greater/new regulations when workers recognise the need to update, change or complement the existing rules or laws that are outdated/insufficient (e.g., on telework). This can be done through discussion with employers, ministries, and other regulatory bodies.

6. Lack of digital skills is a major barrier to digitalisation. It prevents workers from enjoying the benefits of digital tools and instead makes their work more complex. Workers lack opportunities to develop digital skills. To this end, trade unions should **make an effort to narrow the digital skills gap**.

- Advocate for facilitation of training for workers on the necessary digital skills and the use of specific digital tools before/while they are set up in workplaces. Encourage employers to provide workers with training opportunities that are accessible (i.e., at convenient time and place, not expensive) and relevant (i.e., tailored to specific needs of individual workers/worker groups).
- Make an effort to identify (e.g., through surveys of workers or employers) or learn through published research about what kind of skills are and will be needed for workers in the future.
- Allocate part of trade union resources to organise training on digital skills, e.g., train in-house staff to provide these trainings or hire external professionals and organise periodical training sessions to update digital skills or one-off trainings on the use of specific software.

7. Public sector is lagging behind the private sector in terms of digitalisation. Trade unions that represent **workers from private and public sector can facilitate knowledge exchange** between two groups of workers. Workers in the private sector are more likely to already have experience and knowledge on how it affects their day-to-day job, skills and working conditions. Using this knowledge and applying it to the public sector can help prepare public sector workforce for digitalisation.

- Organise workshops or discussions between workers in the trade union from different sectors and industries to facilitate dialogue on digitalisation.

8. There is a wide variety of available regulatory, financial, and informational instruments developed by European organisations, think thanks, social partners on digitalisation and its effects on labour market. The regulatory instruments inform about the values of digitalisation which should not be overlooked or breached by employers when adopting digital tools in workplaces. The financial instruments provide opportunities to get funding for digital skills development or digitalisation itself. Informational instruments can be useful for following the latest research, news on the topic and accessing good practices. Trade unions should make **use of the wide variety of available instruments** that can support workers.

- Consult existing national and EU-level regulatory instruments (e.g., White Paper on AI, Declaration of Digital Principles) to be aware about the values of digitalisation that employers should respect in digitalising workplaces. If need be, use these instruments to advocate for workers' interests through social dialogue and collective bargaining.
- Be aware of and use informational instruments (e.g., Digital Skills and Jobs Platform) to find relevant up-to-date information related to digitalisation, as well as good practices to draw inspiration from.
- Be aware of, use and encourage employers to use available financial instruments that fund development of workers' skills or development of digital tools that would support workers.