CEDEFOP
European Centre
for the Development
of Vocational Training

BRIEFING NOTE

ARTIFICIAL OR HUMAN INTELLIGENCE?

Digitalisation and the future of jobs and skills: opportunities and risks

Did you know that artificial intelligence-based methods of image recognition – such as scanning X-rays for evidence of cancer or other diseases – have reduced the scope of error from 29% to less than 3% in the past seven years? Can you imagine how much such predictive capabilities would allow a physician to improve efficiency in his/her diagnoses?

THE FOURTH INDUSTRIAL REVOLUTION

Most of us will recently have come across some manifestation of AI applications, be it virtual assistants on our smartphones, speaking to chatbots, translating foreign languages online, or unknowingly being targeted by specific adverts and media content ([1]). The physician using the novel image recognition machine will recently have learned how to use it or, more precisely, how to interact with it, each playing their part in the diagnosis.

In fact, the 4th Industrial Revolution (or Industry 4.0) is here, and already disrupting the world of work. Cedefop's first European skills and jobs survey (ESJS) found that 43% of adult workers across the EU saw the technologies they use change in the past five years, while 47% saw changes in their working methods or practices. With forecasts predicting that nearly half of all jobs in advanced economies may potentially be automated, it is no surprise that a 2017 Eurobarometer survey revealed that 72% of EU citizens fear that robots and AI may 'steal people's jobs'.

However, many scientists see fears of robots and machines breeding a jobless future as exaggerated, arguing that previous industrial revolutions caused this kind of 'alarmism' too. While no prediction about the future can be definitive, it seems reasonable to expect that both work and learning will increasingly be shaped by automation and AI applications in a wide range of industries. This includes education, health care, transport and manufacturing.

FIGURE 1. **POLICIES FOR DIGITAL AND OTHER KEY SKILLS IN THE EU-28+**

In the past four years (2015-18), most EU Member State training policy initiatives were geared towards providing people in initial and continuous VET with digital skills. Such policies had the highest rate of full-scale implementation and government regulation.

([1]) The Oxford Dictionary defines artificial intelligence (AI) as the theory and development of computer systems able to perform tasks normally requiring human intelligence, such as visual perception, speech recognition, decision-making, and translation between languages (2017). AI may affect economy and society by being a general purpose technology, lowering the cost and increasing the predictive capability of decision-makers in complex, unstructured environments.

DRIVERS OF CHANGE

This time is different

There are several reasons why current technological progress differs from the past. Innovation cycles are faster. Firms can engage in rapid product prototyping and marketing. Many organisations are less dependent on a core workforce, as they can draw on the power of the crowd and online (platform) labour. The digital world also allows for fast upscaling of 'digital innovators' in winner-take-all markets.

New technologies have usually translated into cheaper and better products, creating higher demand from consumers and more jobs. However, in recent decades the link between higher productivity and labour's income share has been severed in most EU countries. This time around, technological progress may exacerbate income inequalities.

The demographic crunch also threatens societies' ability to adapt to the changing skill demands of future labour markets; for instance, it is usually more difficult for mid-career workers to upskill and change jobs than for their younger counterparts.

And while past technological breakthroughs tended to replace low-skilled, routine work, today many high-skilled tasks, including in the health, legal, finance and education industries, can be performed faster and better by machines than humans.

How technology affects labour markets

Despite these differences from previous industrial transformations, evidence to date on the impact of robots on employment is mixed. Some studies point to a positive (or neutral) net employment balance associated with technology (especially research and development and product innovation) and some forms of automation. While US research has found a significant negative effect of robot adoption, evidence from Germany and other advanced economies points to positive job creation spillovers across industries, albeit with distributional consequences for wages and work hours for workers of different age and skill level.

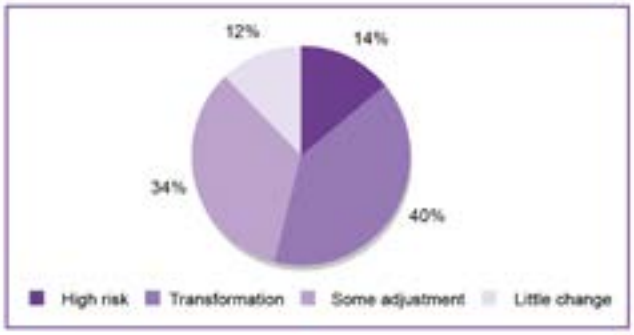
Of most concern, however, is that job creation through innovation seems to have run out of steam: instead of creating new jobs or tasks, commercial innovations using AI, such as industrial robots, are increasingly displacing labour.

IMPACT OF AUTOMATION

Obsolete jobs and skills, changing tasks

Building on ESJS data, recent research suggests that only 14% of EU jobs face a high risk of automation, with most related tasks substituted by machine learning algorithms (Figure 2). This includes assemblers, operators of stationary plant and machines, electrical and electronic trades workers, but also drivers and mobile plant operators. For approximately 18 million EU workers (8% of jobs), according to ESJS data, the risk is severe, as their employers fail to provide compensatory training, further exacerbating their vulnerability.

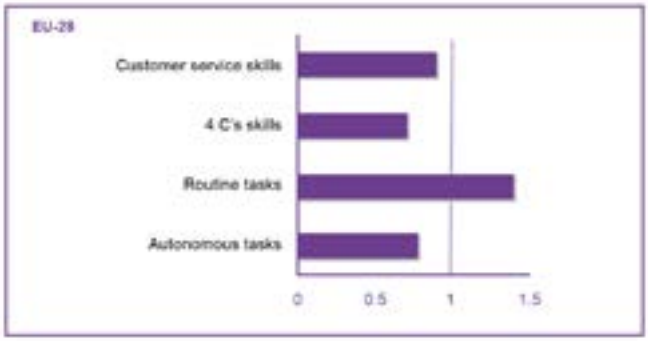
FIGURE 2. **SHARE OF EU JOBS AT RISK OF AUTOMATION**



NB: Automation risk classes defined as: High risk = 70%; Transformation = between 50-70%; Some adjustment = 30-50%; Little change = automation risk < 30%
Source: Pouliakas (2018).

However, AI and automation do not necessarily destroy jobs, but transform them: for four in 10 EU jobs some tasks will be automated, demanding new skill needs to complement AI technologies. ESJS analysis shows that the jobs most likely to be transformed by automation typically rely on routine tasks. Jobs demanding worker autonomy, planning, teamwork, communication and customer-service skills are expected to resist automation better.

FIGURE 3. **JOB SKILLS/TASKS PRONE TO AUTOMATION**



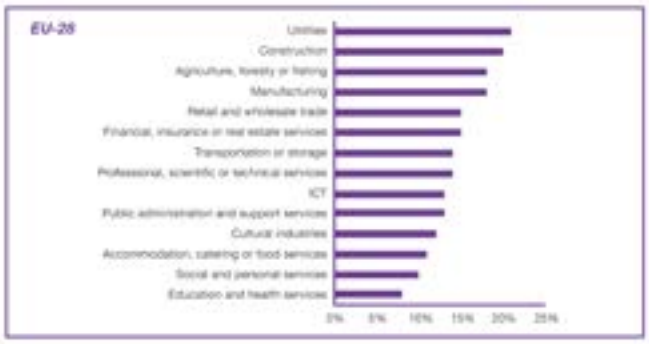
NB: 4Cs: communication, cooperation, creativity, critical thinking.
Source: Pouliakas (2018).

Polarisation and automation

Workers in jobs with high automation probability suffer significant negative labour market consequences. Many fear they will lose their jobs (job separation); this impacts on their job satisfaction. Employees in highly automatable jobs, predominantly lower-educated workers, also receive about 3.5% lower hourly wages than those with similar sets of skills in lower-risk jobs.

The impact of automation is generally felt unequally in different segments of society. People with gaps in digital and transversal skills, working in medium- or low-skill occupations, are prone to a higher automation risk than their better educated peers. The same holds for workers in elementary occupations, crafts/trades, and plant and machine operators. In contrast, this risk is lower for managers and professionals and those employed in social and personal services, education, health and cultural industries (Figure 4).

FIGURE 4. **PERCENTAGE OF EU WORKERS AT HIGH RISK OF AUTOMATION, BY INDUSTRY**



Source: Pouliakas (2018).

TECHNOLOGICAL SKILLS OBSOLESCENCE AND TRAINING

For lower-skilled workers the introduction of automating technologies at work may require a long period of hardship and adaptation until they acquire new skills to cope with new tasks or find a new job.

But technological change, and the skills obsolescence it brings, affects all workers; on average 16% of EU workers – 28% in Estonia – fear that digitalisation will render their skills outdated. Higher-qualified workers faced with technological skills obsolescence often express job dissatisfaction and fear of job insecurity. However, analysis based on ESJS data reveals,that they are more likely to undergo upskilling and on-the-job learning to cope with new tasks and skills complexity than workers whose jobs have not been affected by changing technologies. There is little evidence that technological advances inevitably cause adult worker deskilling. In any case, policy-makers should be wary of the fact that advancing technologies reinforce higher skill demand and training, widening the digital divide and putting low-skilled workers at further disadvantage.

NEW FORMS OF WORK – NEW WAYS TO LEARN

Technological change and digitalisation not only affect what work new jobs entail and what people will have to learn, but also how people will work and learn, both at their workplace and outside.

Cedefop's CrowdLearn study: sneak preview

To gather evidence on a lesser known aspect of digitalisation – the growing number of people earning some or all of their income from work mediated by online labour platforms – Cedefop has been looking at the skill needs and learning practices of so-called crowd-workers. While crowd-work currently represents only a small part of the overall European labour market (with estimates ranging from 2% to 11% of EU adults), it is one of the most debated (global) labour market trends.

BOX 1. **CEDEFOP'S CROWDLEARN STUDY**

Cedefop's CrowdLearn study, carried out between January 2018 and December 2019, looks into the following research questions: What skills do crowd-workers develop through their work and with what learning processes, individual and social? Are there differences in learning and skill development practices between crowd-workers? Do platform markets promote effective skill development and utilisation of crowd-workers' skills? What about recognition/validation and portability of crowd-workers' skills and credentials? What policies can improve skill development and matching of crowd-workers? Final results of the study will be published in early 2020.

Source: www.cedefop.europa.eu/en/events-and-projects/projects/digitalisation-and-future-work

Cedefop's CrowdLearn study addresses these questions via a combination of qualitative and quantitative research. Although still in progress, the study has revealed a first typology of the most typical skills developed by individuals through crowd-work (Table 1).

The findings show that individuals' skill formation in crowd-working is biased towards soft and entrepreneurial skills. Crowd-workers tend to adopt self-regulated learning strategies, mostly using fast-paced and short online learning modules, with little support provided by platforms or platform clients. Skills matching is also different: compared to standard labour markets, where publicly regulated qualification systems play an important role, in the online labour market, platforms' proprietary data and matching algorithms dominate.

TABLE 1. **SKILLS DEVELOPED THROUGH PLATFORM WORK: EVIDENCE FROM INTERVIEWS WITH CROWD-WORKERS**

Technical skills computer programming, marketing, search engine optimisation, geographic information systems	**Setting up as freelancer** obtaining business permits, taxes, visas
Language skills English, German, Spanish	**Organisational skills** Project and/or time management, being organised
Obtaining platform work applying/marketing/pricing own work using the platform, pitching, who to trust, self-presentation	**Communication skills** communication, handling cultural differences, handling customers, community-building offline, teamwork
Learning to learn	**Personal dispositions/attributes** confidence, independence, resilience, punctuality, risk tolerance, discipline, working alone, creativity, empathy, flexibility

Source: Cedefop's CrowdLearn project (interim report).

BOX 2. **CEDEFOP'S WORK ON THE FUTURE OF JOBS AND SKILLS**

To understand better the risks and opportunities of current technological advances, Cedefop has recently set up its new Digitalisation and future of work activity. A key output so far is the recent launch of the Second European skills and jobs survey, which will collect new data and provide unique insights into the impact of digitalisation and automation on EU workers' jobs and skills. Cedefop is also exploring how AI technologies may enable better and faster skills anticipation to inform VET policies: examples are EU anticipatory policies for matching skills and Cedefop's real-time skill needs analysis based on online job adverts.

DOES VET OFFER ANSWERS?

To allow for successful integration of new digital processes, people, businesses and labour markets will have to adapt and fundamentally change the way they work. To cooperate with machines, workers across the board – from doctors to construction workers – will need to acquire new skills. Education and training will have to respond to people's upskilling and reskilling needs; it falls to policy-makers to frame this vast ongoing transformation to ensure nobody is left behind.

New learning patterns and environments in digital labour markets also caution that the standard European skills matching and upskilling policy toolkit – including formal skills validation processes – will have to be responsive to emerging skill needs, for instance by integrating and safeguarding quality assurance of new digital and sector-specific credentials.

It is of critical importance that countries invest in 'robot-proof' lifelong learning for all. At the same time, individuals need to manage their learning: how and when to renew their skillsets with up-to-date skills. To do so, they need strong foundations from initial education or training and companies promoting continuing experiential learning.

Sound digital and technological literacy is key to social and economic participation. More than 80% of adult workers in the EU today need a certain level of digital competence to perform their jobs ([2]). However, 43% of them lack basic digital skills ([3]) and around one third are at risk from digital skills gaps ([4]). To help close these gaps, VET programmes across Europe offer both occupational digital skills (such as software programmer) and digital skills as a key competence forming part of a wider programme ([5]).

Robot-compatible education is not primarily about digital skills but about blending an array of key competences (entrepreneurship, digital, STEM, languages, learning to learn) into curricula and learning methods, within comprehensive VET programmes and policy actions. As Cedefop's analysis of online job vacancies revealed, the skill most sought after by European employers is adaptability to change, mentioned in three out of four vacancy notices in a sample of over 30 million vacancies ([6]). Being able to embrace change is paramount to thriving in a world where humans and robots will interact ever more closely.

cedefop | European Centre for the Development of Vocational Training

Briefing note – 9140 EN
Cat. No: TI-BB-19-005-EN-N
ISBN 978-92-896-2798-6, doi:10.2801/862703

Briefing notes are published in English, French, German, Greek, Italian, Polish, Portuguese and Spanish, and the EU Presidency country's language. To receive them regularly register at:
www.cedefop.europa.eu/en/user/register

Other briefing notes and Cedefop publications are at:
www.cedefop.europa.eu/EN/publications.aspx

Europe 123, 570 01 Thessaloniki (Pylea), GREECE
Postal: Cedefop, Service Post, 570 01 Thermi, GREECE
Tel. +30 2310490111, Fax +30 2310490020
Email: info@cedefop.europa.eu

visit our portal **www.cedefop.europa.eu**

([2]) Cedefop (2018). *Insights into skill shortages and skill mismatch: learning from Cedefop's European skills and jobs survey*, Cedefop reference series; No 106.
([3]) European Commission (2018). Human captial: digital inclusion and skills. In Digital economy and society index report.
([4]) Cedefop (2016). *The great divide: Digitalisation and digital skill gaps in the EU workforce*, #ESJsurvey Insights No 9, Thessaloniki, Greece.
([5]) Preliminary results of a Cedefop study reveal that almost half (47%) of initial VET programmes integrate digital skills in subjects rather than offering them as stand-alone subjects.
([6]) See Cedefop briefing note *The skills employers want!*