PILLARS – Pathways to Inclusive Labour Markets: Discussion of impacts of automation technologies on the labour market

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Tatjana Guznajeva, Juanita Garcia Gutierrez, Anastasiia Konstantynova, Kleitia Zeqo, Reda Nausedaite, Olaf Kooijmans

Technopolis

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1 Introduction

Throughout centuries, technological developments have been advancing economic and social development, contributing to industrialisation, economic growth, innovation, and higher living standards in general. The fourth industrial revolution has made automation and digitisation ever more prominent across nearly all industries, while upcoming technological and industrial transformations, coupled with globalisation and changes in the global value chains, are expected to have a profound impact on the economy and society at large.

Given that emerging automation technologies reduce the level of human input for specific tasks/jobs they may produce different positive and negative effects on the labour markets. Specifically, these technologies may **create new jobs** supporting entrepreneurship and innovation, **displace/destroy jobs** by replacing human labour, or **transform/change existing jobs** and the nature of work following technology adoption. The latter also raises the question on what challenges employers are facing while integrating a technology into an organisation (either a private entity or a public institution). Historically, automation has created more jobs than it destroyed, by increasing productivity and reducing costs, and stimulating innovation and development of new industries and sectors. Nevertheless, the challenges posed by automation technologies for the labour market require attention of policymakers to prevent rising inequality, and to ensure steady economic growth and social inclusion.

In view of the above, **it is crucial that policymakers identify the impacts of technological transformation on the labour market and develop policies to mitigate negative effects**, thereby protecting vulnerable groups to avoid increasing inequalities. Simultaneously, policymakers should **stimulate positive effects** on the labour market, taking advantage of new technology-enabling opportunities and facilitate their redistribution in the society. The Pillars project aims to support policymakers with these important tasks.

The current article discusses the three types of effects associated with the impacts of automation technologies on the labour market, including:

1. Job displacement effect,
2. Job creation effect,
3. Job transformation effect.

- **Job displacement** refers to involuntary job loss and redundancies for employees, following eliminations of tasks or of types of jobs.
- **Job transformation** implies a change in the nature of work and of the workplace itself.
- **Innovation job creation** refers to the process of creation of new jobs due to adoption of automation technologies.
- **Inclusive job creation** refers to the process of creation of new jobs that stimulate inclusion, especially for people who were previously unemployed or inactive on the labour market.

Source: Pillars (2022)

2 Job displacement effect

Job destruction or job displacement effect occurs following the elimination of certain tasks from a job or when a specific job becomes obsolete altogether (i.e., when an automated technology fully replaces a human job). Job displacement is associated with worker layoffs and unemployment. In contrast, when the composition of tasks has been changed following a technology adoption, but it did not result in layoffs, this should be assessed within the context of job transformation effects.

Job displacement has been widely discussed in (academic) literature, as it causes major concerns among policymakers about the benefits of technological transformation and innovation. Although currently 14% of jobs are at high risk of automation, some forecasts indicate that **between 15% and 30% of the global workforce could be displaced by automation in the period of 2016-2030** (OECD 2021a; Manyika et al. 2021). Some experts argue that these estimates are exaggerated, although in view of higher levels of technology-related unemployment, income inequalities should be anticipated. These challenges call for policy intervention, **supporting members of the labour force that are already displaced or at a high risk of soon displacement by automation technologies, and preparing the next generation of labour force for the future of work**.

Due to the variety in **automation technologies**, **their impacts on the labour market are diverse as well** (Ciarli et al. 2022). For example, robotic technologies are designed more to substitute workers than to complement them, while data-intensive technologies are consistently more complementary to humans (Savona et al. 2022). However, there is evidence that technological penetration of robots is associated with higher employment in low-tech regions in the short run, while service/knowledge-intensive regions and cities experience decreased employment from adoption of robots (Ciarli et al. 2022). Therefore, **it is not easy to forecast the scale of the job displacement effect** following technology adoption at a macro level - in a community/region or a country. This difficulty, coupled with a lack of attention to the topic, resulted in a lack of understanding of the current and upcoming challenges (i.e., what type of jobs will be destroyed, in what industries/sectors, what occupations and population groups are most vulnerable) and a **lack of policies to address a job displacement effect.**

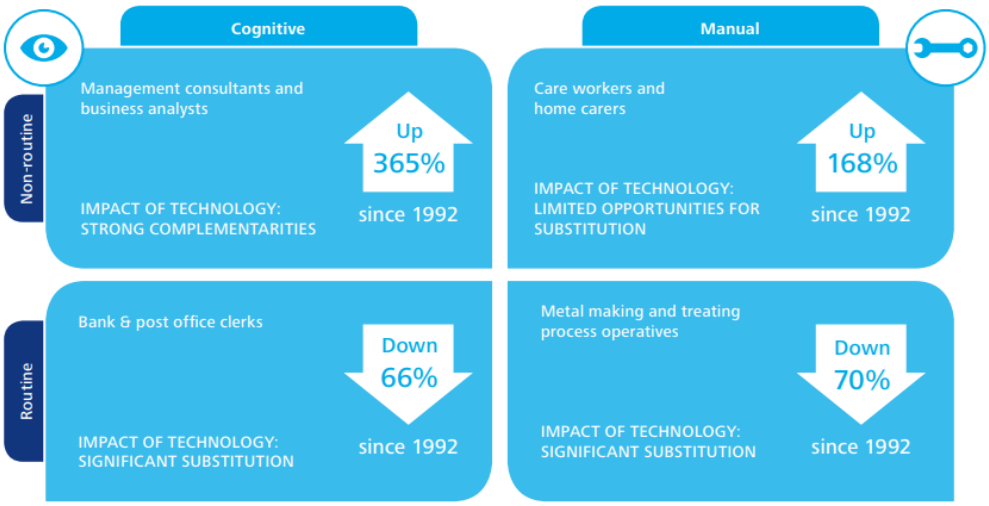
2.1 Tasks and occupations at risk of displacement

Stewart et al. (2015) highlights that technology substitutes **jobs that involve routine/repetitive cognitive and manual tasks**. The analysis of McKinsey (2018) shows that about half of the activities (not jobs) carried out by workers could be automated, particularly physical activities in highly predictable and structured environments, as well as data collection and data processing activities. This implies that **factory work, material moving**

machine operation, transportation, installation and repair, dishwashing, food preparation, office support represent declining occupations.

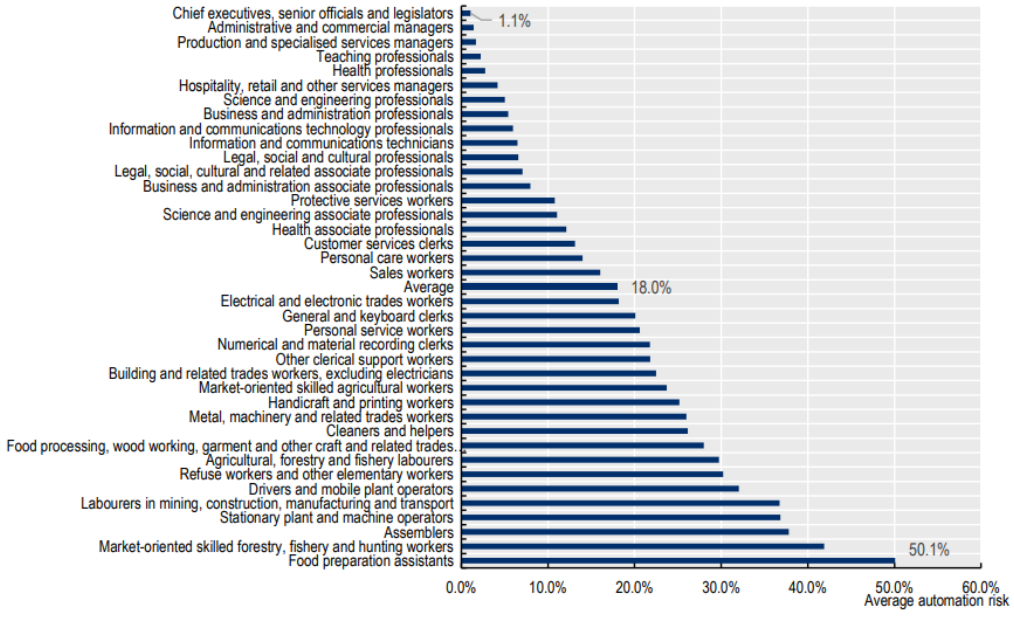
In contrast, least vulnerable activities and occupations include those that involve managing people and processes, providing expertise, and interfacing with stakeholders (Manyika et al. 2021). Figure 1 provides examples of the effect of technology on employment by nature of occupation since 1992, while Figure 2 illustrates a share of jobs at high risk of automation based on analysis conducted in 2018.

Figure 1 Examples of the effect of technology on employment by nature of occupation



Source: Stewart et al. 2015

Figure 2 Share of jobs at high risk of automation by occupation (averaged across OECD countries)



Source: OECD (2021a)

These figures reveal a sharp contrast in employment effect, highlighting that the so-called "winner occupations" (those that benefit from complementary functions of technologies) and occupations at risk of technology displacement. The findings of the OECD (2021) confirm that over the period 2012-2019 employment growth was much lower in occupations at high risk of automation (6%) than in occupations at low risk (18%) (OECD 2021a).

However, there is evidence that even high-skilled workers are not insulated from job displacement. For example, artificial intelligence technologies can replace tasks of lawyers or finance managers. The trend in job displacement is apparent: **traditional, low and middle-skilled occupations** (such as shoemaker, blacksmith and carpenter) **have been gradually declining, while new, high-skilled occupations, especially in knowledge-intensive, technology-related sectors**, such as software engineer, business consultant and product marketing manager **are emerging** (ILO 2015).

In view of the above, there is evidence that automation technologies, and to some extent international trade associated with task/job offshoring, lead to **changes in the occupational structures that have been polarising the labour market into high-skilled/high-paying jobs and low-skilled/low-paying jobs**. Given that some low-skilled/low-paying jobs are difficult to automate, such as caretakers, security guards and waiters, there is a small increase in demand for low-skilled (non-routine) workers and a decrease in demand for middle-skilled jobs (European Commission 2019a).

The findings of Peugny (2019) confirm the **erosion of middle-skilled employment in European countries**, highlighting that this may undermine the lower middle classes that predominantly consist of administrative workers, technicians and associated professional employees (Peugny 2019).

Given the importance of these labour market trends and developments, it is essential that the general public is aware of the skills demand and of declining/emerging occupations to make informed decisions about education, training and career choices.

2.2 Vulnerable communities and groups

Depending on the scale of the displacement effect, not only individuals (labour force) at the micro level will be impacted, but also entire industries (meso level) that recruited for declining occupations and communities/regions (macro level). The OECD (2018b) states that **regions with higher concentration of manufacturing are facing higher risks of job disruption and employee displacement**, as manufacturing involves more repetitive and manual tasks and, therefore, is at a higher chance for automation of tasks (OECD 2018b). Similarly, **agricultural, transportation, financial and service sectors** have been experiencing significant labour substitution by automation technologies, especially when production has been outsourced to countries that can produce it cheaper (ILO 2009). **Mass layoffs of workers can cause significant shocks for the labour market and for the local economy**.

There are several **vulnerable groups that are more susceptible to job displacement effects following adoption of automation technologies**, although it is important to point out that the composition of these groups might differ per community/region or country. Vulnerable groups may include migrants or social/ethnic minorities, workers with disabilities, workers in rural areas, youth and older workers. The uniting characteristic for considering these population groups as vulnerable is that **they are more likely to be engaged in manual work and either do not possess or possess a lower level of skills complementary to technologies**. **Thus, a level of education, skills of the labour force and ability to acquire them are the key determining factors behind job displacement**. This stresses importance of accessibility to good quality, market-relevant education and training, and of lifelong learning.

In the case of older workers, migrants or social/ethnic minorities and workers with disabilities, their educational background might not be market-relevant, as it was **obtained many years ago, in a country with different education standards or had a limited scope**. In addition, these population groups might experience learning difficulties for upskilling or reskilling (please see definitions of concepts in Box 2) due to **language or physical barriers**. The risk of job displacement for rural workers is also typically associated with low educational attainment or difficulties to acquire new skills, as rural workers might be affected by **poorer quality of education and dominance of low-skilled jobs in rural areas**. In addition, some researchers observe a link between lower educational attainment of rural workers with the socio-economic and educational background of their parents (OECD 2020). With respect to young workers – they typically **struggle to enter the labour market and therefore tend to engage in low-skilled/low-paid jobs**. Despite that, there is evidence that young people find work relatively quickly following displacement and choose career with greater skills gap, thereby building a new skill-set (Neffke et al. 2022).

Box 1 Concepts related to skills

Skill: Ability to apply knowledge and use know-how to complete tasks and solve problems.

Upskilling: Short-term targeted training typically provided following initial education or training, and aimed at supplementing, improving or updating knowledge, skills and/or competences acquired during previous training. Thus, upskilling is aimed at improving the expertise in a particular domain to avoid obsolescence of skills.

Reskilling: Training which moves beyond previous educational attainment to embrace the different dimensions comprising the overall skills and competences. Thus, reskilling has the goal of changing people from one domain of expertise to another.

Deskilling: deterioration or loss of skills level required to perform a job. Deskilling is associated with elimination or diminishing of the need for skills by an industry.

Skills shortages: A situation where the demand for workers equipped with a particular set of skills is greater than the supply of workers who come with these skills, are available and willing to work under existing market conditions.

Skills gaps: A situation where the existing workforce is under-skilled relative to skills requirements.

Skills mismatches: A situation of imbalance between the type of skills available - either on the labour market or within an organisation - and the skills required.

Source: Pillars (2022)

When comparing the employment outcomes following automation technology adoption by gender, it seems that both men and women may be at risk of job displacement, but for different reasons. Male workers appear noticeably **more vulnerable to potential future automation than women**, due to their significant **overrepresentation in occupations with higher automation risk of tasks** (Muro et al. 2019). In contrast, women comprise a significant share of the labour force in sectors that are less likely to suffer from displacement, such as health care, personal services, education-related jobs. However, occupations or some tasks that perform women in these occupations also might be substituted by technologies in the near future. Given that upskilling or reskilling of women is conditioned by **care-related responsibilities, cultural biases associated with employment and education of women**, especially in the STEM-related (science, technology, engineering and mathematics) fields, they may become a vulnerable group. In addition, women use automation technologies less frequently than men, which is likely to limit their employment prospects in jobs that depend on the use of such technologies (European Institute for Gender Equality 2021).

A recent study by the OECD (2021a) finds that even though low-educated workers tend to be more concentrated in high-risk occupations, **their employment rates kept pace with those in higher education groups since 2012**. This surprising fact is related to the declining numbers of low-educated workers in OECD countries, in line with the decreased demand for these types of workers. In addition, the study highlights that low-education workers are currently more concentrated in occupations at high risk of automation. This calls for **immediate support of public employment services (PES) in transition of these workers to other occupations through assistance in job search, career counselling, training for upskilling/reskilling in line with a demand in the labour market** (OECD 2016b).

Some vulnerable groups struggle to (re)integrate on the labour market due to automation technologies, especially following a long period of unemployed. It is related to the need of significant upskilling or reskilling for acquiring technology-complementing, labour market-relevant skills. In such cases, policymakers are introducing **support for self-employment, public works or short-term work schemes, hiring subsidies to employers or programmes that support a gradual transition to the labour and increase employability,** such as apprenticeships/internships/job placements (Ernst et al. 2022). In addition, to increase retention of employees, especially of vulnerable groups, **policymakers introduce private sector incentives** that may, for example, partially compensate wages of employees, reduce costs of workers' trainings (Eichhorst et al. 2022).

2.3 Implications of job displacement

When workers are displaced from their jobs, they often face **large and persistent earning losses**. The reasons for these are **deskilling or "professional downgrading" in a new occupation** (the deterioration or loss of skills level required to perform a job), **human capital mismatches**, **non-permanent contracts or loss of pre-displacement employment contracts** that had raised earnings beyond workers' marginal productivity, **high search costs of a job, fewer working hours in a new job, and stigmatization**. In addition, there is evidence that **displaced workers tend to return to jobs that require similar skills** to the ones they held prior to displacement, thereby exposing themselves to similar or higher risk of job displacement (Neffke et al. 2022). Such behaviour could be explained by **unwillingness or inability to invest in skills development, lack of awareness about prospects and risks of automation of specific occupations, or lack of knowledge of possible career options.**

In addition to reduced earnings, displaced workers also face **increased job and earnings instability**, with recurring spells of unemployment and more occupation and industry switches. A temporary loss of income following layoffs may result in a **lack of financial resources to meet basic needs**, preventing a person investing in skills development for a new job and creating conditions for accepting informal work. To support unemployed individuals the governments are offering **social protection transfers** (e.g., unemployment insurance, unemployment assistance) that represent income replacement (Ernst et al. 2022). These transfers are typically criticized for creating disincentives for work, therefore the so-called "passive" labour market policies should be paired with the "active" ones to stimulate reintegration on the labour market.

Furthermore, layoffs have been associated with higher mortality rates, reduced life expectancy, lower rates of home ownership, increased incidence of divorce, reduced educational achievement and cognitive development in children, and higher rates of entering disability insurance programs (Davis et al. 2011). Thus, **displacements have large social and economic consequences for individuals and communities in which they live**.

Box 2 Summary of key findings associated with the job displacement effect

- Typically, there is a lack of awareness of policymakers about the job displacement effect, following adoption of automation technologies
- Automation technologies lead to increasing substitution of labour, especially of routine/repetitive cognitive and manual tasks
- Due to a lack of relevant skills, automation technologies stimulate job polarisation and erosion of middle-skilled employment, resulting in wage inequalities
- Risks of mass layoffs in some regions, following adoption of automation technologies, may lead to significant shocks for the labour market and the local economy
- Some population groups experience education-related challenges, such as learning difficulties, accessibility to high quality education, responsibilities that impact education, cultural biases

- Typically, there is a lack of support in transition of low-skilled workers to other occupations and in upskilling/reskilling
- The public lacks awareness about risks of automation of specific occupations and of possible career options
- Displaced workers suffer from lower earnings, increased job instability and gradual deskilling in a new occupation

Source: Pillars (2022)

3 Job creation effect

Alongside job displacement effect, there is a **job creation** effect as a result of automation technologies adoption. As mentioned earlier, within Pillars we are interested to explore **innovative and inclusive job creation effect**. Overall, the relation between job creation and automation technology adoption is **very complex**. Therefore, making a straightforward link with positive or negative effect between job creation and automation technology adoption is incorrect and very conditioned (OECD 2018; Ciarli et al. 2022). Particularly, according to Eurofound, one should not be captured by earlier discussions about digitalization leading to either job creation or massive job losses, which are more nuanced, recognizing that changes to task profiles within jobs may be the more important employment impacts than simple decline in number of jobs or employment rate (Eurofound 2019). Likewise, OECD (n.d.) indicates that although there has been an overall perception that new technologies destroy jobs, especially among the low-skilled, there is also evidence showing job creation in different industries. Historically, this process has led to **net job creation**, as new industries replace old ones and workers adapt their skills to changing and expanding demand.

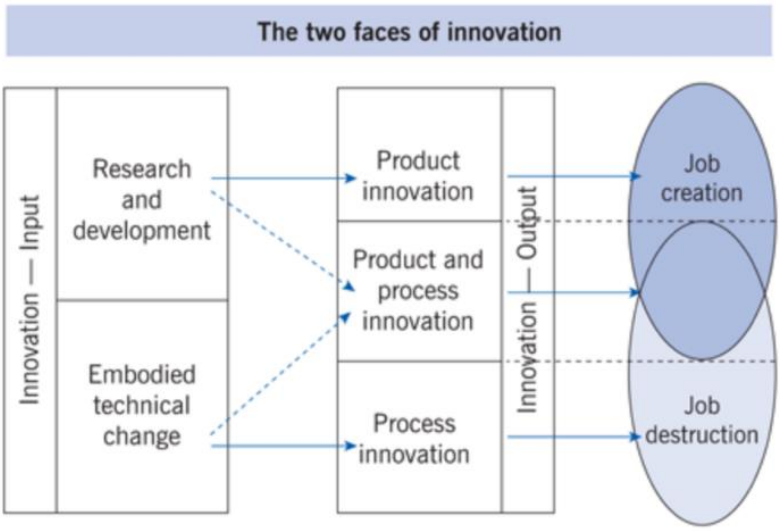
3.1 Innovative job creation

On the **macro level of analysis**, innovation and technology diffusion have always been associated with the job creation and economic growth, both in long and short term, and beyond traditional industries such as science and technology. Innovative highly paid jobs are generated at a higher rate along with the development of a knowledge economy, which comes as a result of investment in research, creation of innovation systems and technology diffusion (Australian Council of Learned Academics 2020). **Knowledge-based economies** enable society to be more flexible in terms of skill-set adjustments, which is critical in the context of global competition, where all countries are actively developing, transferring/adopting ideas and technologies that increase their productivity and quality of their services and products. Therefore, **stimulation of science, technology and innovation (STI) is essential for enabling innovative job creation**. Effective stimulation of STI needs a **long-term strategy and commitment of resources** by the government as well as by other stakeholders.

Technological innovation affects the economy through both **process and product innovation**, both of which can have employment impacts (see Figure 3). Among these two

types of innovation, as per Vivarelli (2015), **product-based innovation** is more likely to create jobs, while it is less the case for the process innovation. However, since process and product-based innovation are also inter-related and process innovation might also lead to job creation, the effect from a specific technology has to be studied.

Figure 3 Innovation and labour market effects



Source: Vivarelli (2015)

Given that the relation between automation technologies and job creation effect is very complex, it is important to discuss **key factors/conditions** (e.g., geographic, industrial, demography and labour market structure) **that determine this effect**. The first factor is **geographic conditions**. According to the OECD (2018b), job creation is mostly concentrated in **capital or metropolitan areas/regions**, characterised by concentration of economic resources, high degree of economic activity and integration into the GVCs (OECD Regional Statistics 2017). There is evidence that greater integration into the GVCs is supporting financial performance of firms that adopt automation technologies (Baur et al. 2022). Given that rural areas represent the fabric of a European society, there is a growing concern at the EU level that some citizens living in these areas are 'left behind'/excluded in terms of involvement in innovative, technological and economic processes (EPRS 2021). Thus, the **potential of innovative job creation in rural or disadvantaged areas is much lower**, and policymakers should provide targeted support to stimulate innovation and social inclusion in such areas. According to the OECD (n.d.), the focus in such areas should be on investment in infrastructure, support for entrepreneurship, education/training, and social protection. Governments willing to stimulate innovative job creation in rural or disadvantaged areas should carefully assess the regional context, including availability of resources and possible constraints, prior to designing support mechanisms.

The second critical factor that determines innovative job creation is **industrial structure** in an area/region. Based on the findings of Boschma et al. (2022) and of the OECD (2018), **if an**

innovative economic industry matches the industrial specialisation of an area/region, thereby supporting existing industrial structures, it is likely that an area/region will experience a higher innovative job creation effect and higher wages. To stimulate a better matching between the current and new innovative industries, policymakers should analyse the **needs of all industries and seek to address them**. For example, in many cases the education/training sector has been targeted, promoting STEM subjects at schools and developing a mix of cognitive and socio-emotional skills (European Commission 2019c). In addition, according to the EPRS (2021) and Cray et al. (2011), policymakers should adopt a more **mission-oriented industrial policy approach and place-based strategies** that imply targeted support to companies/industries (e.g., tax incentives, subsidies for R&D, special economic zones) that stimulate innovative job creation.

The third factor that determines the innovative job creation effect is the overall **technological readiness** of a region/area. The technological penetration of automation technologies, even of robots that are typically associated with job displacement, **in the low-tech regions or low-tech industries is likely to be associated with higher employment**, while adoption of a technology in a technologically advanced regions/areas or in high-tech industries is likely to limit the job creation effect, at least in the short run (Ciarli et al. 2022). The difference in employment impacts could be explained by the following argument: for a non-innovative area/industry technology adoption is likely to open a wide range of new business opportunities that do not immediately translate into higher technological productivity accompanied by labour replacement, especially as it takes time to adjust to a technological transition, while in advanced innovative areas/industries, characterised by availability of a large pool of highly-skilled labour, the employment effect can be minor.

On the meso-level of analysis, **innovative organisations tend to create more** – and to destroy less – **employment than non-innovative organisations** (Alonso-Borrego et al. 2002). Moncada (2013) also studies innovative companies/organisations and highlights that such organisations shape the dynamism of the economy's sectoral composition by stimulating more knowledge-intensive activities and contributing to the overarching economic growth. Moreover, **smaller, younger and women-owned innovative organisations** tend to have a more persistent job creation effect (Making labour markets inclusive n.d.). In part, this is attributed to a natural growth of small/young organisations, but it also highlights that such organisations tend to be more innovative/risk-prone, have a greater flexibility to respond to emerging market needs and as a result enjoy higher returns. In case of women-owned enterprises, a high job creation affect is attributed to a capitalisation of skills of educated women that otherwise would be blocked from advancement in a corporate world. However, it is known that many innovative small and medium-sized enterprises (SMEs) and start-ups **face barriers for launching and expanding their business**. These barriers are related to regulations, access to capital, information, human resources etc.

In view of the above, policymakers should offer support to **SMEs and start-ups**, as they are the drivers of innovation, employment and economic growth. Based on the OECD (2022b)

recommendations, there are three important channels of support. First, **putting in place cross-cutting and coherent approaches to SME and entrepreneurship policy design and implementation** (e.g. by coordinating and aligning SME and entrepreneurship policy across government entities and levels, setting up robust monitoring and evaluation mechanisms). Second, **facilitate the transition and resilience of SMEs and entrepreneurs** (e.g. by supporting the adoption of automation technologies, providing relevant services and data, enhancing participation in international trade and global value chains through open markets). Third, **enhance SMEs and entrepreneurs' access to resources** (e.g., by strengthening entrepreneurial ecosystems at national and local level, including by developing networks and linkages along supply chains, between SMEs and with large firms, within and across sectors; and by enhancing SME access to and participation in public procurement).

At the micro level, innovative jobs should be created in **occupations at low risk of automation** to avoid potential displacements (OECD 2018b). Building on the argument made earlier, it would be of particular value if such jobs are created in sectors/industries that **match the needs of innovative, growing economic sectors/industries**. There are instances where policymakers can effectively stimulate self-employment/entrepreneurship of the unemployed in occupations at low risk of automation. This would stimulate innovative and inclusive job creation effect.

3.2 Inclusive job creation

The relation between a structural economic change that fosters technological innovation and inclusion has largely been framed within the **pro-poor growth theories** that focus on the rate at which the income of the poor rises for a given increase in national income (absolute), or with respect to the growth of the rest of the population (relative). Such theories have drawn attention of policymakers, given **increasing income differences between populations groups** following adoption of automation technologies.

The reflections of Paunov (2013) on how innovation affects job creation, inclusion/inequality cover three dimensions: first, innovation has a **direct impact on income distribution** (e.g. innovation favours the highly skilled and risk takers), therefore they are more likely to benefit from technological change either through rising salaries/wages or by starting their own innovative business venture; second, innovations could offer **solutions for improving the welfare of vulnerable groups** (social and frugal innovators); third, innovations might **allow vulnerable/excluded groups to innovate themselves**, choosing the directions of welfare improvements (i.e. grass-roots and informal sector activities). As a result, **social innovation and social/inclusive entrepreneurship**, either managed by these vulnerable groups or not, has come to the fore of a discussion.

Given the above, Cray et al. (2011) and Guo et al. (2022) argue that policymakers need to ensure **access to education/training, stimulate the development of skills** that are in high demand and complementary to automation technologies, and **support inclusive, social**

entrepreneurship and social innovation by creating favourable conditions for doing business and innovation, particularly for the vulnerable groups. Given a broad set of objectives, supportive instruments can include fiscal and investment policies, including interest rate reductions, government hiring and purchases, infrastructure investments, training subsidies etc.

To realize the full potential of technological innovations in contributing to inclusion and specifically to inclusive job creation, governments need to **integrate STI and inclusion into a broader policy agenda**. This could be achieved by, for example, establishing better coordination mechanisms with structural (sector) reforms, giving specific attention to inclusion of vulnerable groups in innovation and entrepreneurship, education and training policies etc. On top of this, Acemoglu and Robinson (2012) argue that there is a need to review **effectiveness and inclusiveness of existing institutions and ecosystems** that stimulate innovation and entrepreneurship (e.g., trade unions, labour administrations, entrepreneurship and innovation centres). Particular attention should be paid to the collaboration between research and industry organisations that can stimulate innovation, job creation and inclusion.

Box 3 Summary of key findings associated with the job creation effect

- Stimulation of STI is critical for innovative and inclusive job creation
- Product-based innovation is more likely to create jobs than process innovation
- Potential of innovative job creation in rural or disadvantaged areas is much lower than in capital/metropolitan areas
- Adoption of automation technologies in low-tech regions or low-tech industries is likely to be associated with higher employment than in high-tech regions/industries
- Innovative job creation effect is higher when growing, innovative economic sectors/industries match the industrial specialisation of a region/area
- Innovative organisations produce a higher job creation effect
- Innovative SMEs, start-ups and women-owned enterprises are the drivers of economic growth and innovation, producing a higher innovative job creation effect
- Social innovation and social entrepreneurship should be stimulated to support inclusive and innovative job creation

Source: Pillars (2022)

4 Job transformation effect

The research on the topic of automation of jobs indicates that **job transformation is the most prevalent and widespread effect**. The past 5 years have seen the use of automation technologies increase in almost 9 out of 10 workplaces in the EU (European Institute for Gender Equality 2021). Hence, it is argued that individual tasks are likely to be affected across most occupations, while new tasks that are complementing/supporting technologies are

being increasingly introduced. In essence, **job transformation implies a change in the nature of work and of the workplace itself**. The discussions on job transformation raise questions related to quality of jobs, wages, health and safety at work, organisation of work and work processes, redefinition of tasks and activities at work, relations between employees and with their employers/managers, business processes and relations with suppliers and customers etc. Given that the answers to these questions require **qualitative, in-depth analysis** in organisations that adopted automation technologies, policymakers struggle to collect and aggregate findings on the topic of job transformation. Thus, the **opportunities for policy intervention are limited to regulations, monitoring of their compliance via labour-related institutions, engagement and support through worker and employer representative organisations.**

Job transformation is likely to continue growing in the same way that automation technologies will continue to become more far-reaching. A study by the OECD (2017) indicates that this effect depends on the **speed at which automation technologies are adopted and on wage costs**, as low wages create a disincentive to adopt labour-replacing technologies (OECD 2017). However, it is important to note that the extent to which different workers are affected by technologies will depend on **exposure to them and the type of work employees do**. This chapter discusses the effects and challenges that job transformations may lead to, focusing on three areas: **tasks and work organisation; working and employment conditions** (at times named as "job quality"); **and industrial relations**. Such categorisation has been derived from analytical frameworks developed by Eurofound (2012).

4.1 Task and work organisation

Work organisation is a broad concept that refers to how work is planned, organised and managed – via production processes, job design, task allocation, rules, procedures, communication, responsibilities, management and supervisory styles, work scheduling, work pace, career development, decision-making processes, interpersonal and interdepartmental relationships (Eurofound 2017b). **At the very core of any work and work organisation lie tasks**, namely work-related activities that are performed for a specific job. A change in the type or composition of tasks leads to transformation of work processes, redefinition of job responsibilities of employees, procedures on how remaining or new tasks should be performed, and how they are monitored/controlled. As it was mentioned earlier, following adoption of automation technologies, some tasks, particularly manual, routine and machine-use tasks, might be performed by new technologies, codified and programmed. Regardless of whether it leads to layoffs or not, **the amount and the type of work that should be performed by remaining employees will change**. Reallocation and redefinition of tasks, task content and job responsibilities might lead to above-mentioned **deskilling, upskilling or reskilling, and upward or downward career development**.

In the case of job polarisation and erosion of middle-skilled jobs, these jobs can be transformed into low-skilled jobs leading to **deskilling of the occupation and downward career trajectory**. However, if a middle-skilled employee can move to a higher-skilled position in the same industry it will result in **upskilling or even reskilling**. For employees, deskilling may result in irreparable loss of important skills and a lower salary. Eventually, the gradual reduction of tasks and skills may even lead to job displacement. Deskilling can also take place where complex skilled work undertaken by employees is broken down into simple tasks (Silkin 2021). In cases where automation of tasks leads to introduction of new and complex tasks, employees will learn new skills and thereby **improve their job and career prospects** (Scientific Foresight Unit 2021). Despite a potential improvement of job prospects, this discussion highlights that **vulnerable groups – those at risk of deskilling – are individuals who possess lower level of skills complementary to technologies and occupy low/middle-skilled jobs.**

The discussion about transformed tasks (i.e., number of tasks, task content, complexity, repetitiveness, pace of work) is closely linked with the demand for skills necessary to complete these tasks. The research findings on impact of automation technologies on skills demand reveal a complex picture. On the one hand, based on preliminary estimates, **the largest growth in labour demand will be for technological skills**, rising 55% by 2030 to represent 17% of hours worked, up from 11 % today (Bughin et al. 2021). These skills are essential for the design, operation and maintenance of new technologies that affect all industries and sectors, as work will imply greater interactivity between employees and technologies (ETF et al. 2016). On the other hand, there is evidence that greater penetration of technology **increases the demand for intellectual/cognitive, human/social skills**, such as creativity, interpretation, problem-solving, communication, innovation, ability to analyse complex information, management and collaboration (European Commission 2017; ILO 2019b; OECD 2018b). In addition, some research findings reveal that automation technology adoption will imply that workers must conduct a **more complex and diverse set of tasks** (OECD 2016a). Thus, employees should learn to **adapt continuously to changing work requirements,** especially given the fast pace of technology development and their functionalities (Spitz-Oener 2006; Bessen 2015). The capability to swiftly adapt to changing work requirements can be understood as **'meta-skills**' (Ciarli et al. 2021a; Olivares-Aguila et al. 2021). These skills have been widely discussed in recent literature, together with examples of how professionals are combining traditional skills with technical expertise or reinvent their occupations, job profiles to stay relevant for their industry and the labour market, in general (Jara 2022).

Automation technologies can **improve effectiveness, efficiency and productivity of workers** by helping them to perform daily tasks, reducing the amount of repetitive, manual tasks and thereby increasing their job satisfaction. For example, AI technology has been effective in supporting oncologists in identification of cancerous patterns, invisible to the human eye. Overall, workers' productivity depends not only on their own capabilities and on capabilities of technologies they are using, but also on effectiveness of work organisation.

Work organisation concerns three levels, depicted in Figure 4. At the first level, introduction of automation technologies to an organisation may lead to significant **restructuring of work/production process along the value chain, affecting partners/suppliers and internally employed workers**. In some cases, restructuring may result in work dislocation, downsizing or outsourcing.

Figure 4 Three levels of work organisation, based on Eurofound

Source: Based on Eurofound (2015). Third European Company Survey – Overview report: Workplace practices – Patterns, performance and well-being. Luxembourg: Publications Office of the European Union.

At the second level, work may be re-organised across different **departments and teams, impacting organisational and information management and associated processes, such as workflows, quality control, knowledge and data sharing**. On the one hand, changes in activities, collaboration pattens, forms of interaction, structure of teams might improve social and other skills, as new tasks are introduced. In addition, lower human involvement in some tasks can improve quality standards, as technologies are becoming more precise and effective. On the other hand, changes in internal organisation may complicate work processes, leading to inefficiencies and excessive stress for employees (Accenture 2014). According to research findings, the latter is also strongly associated with the ability of automation technologies to **improve monitoring of work processes and of tasks** (Gerten et al. 2019). Greater, real-time data collection, monitoring and its centralisation, enabled by new technologies, may influence workers' behaviours, limit their autonomy and open the door to surveillance practices, negatively impacting workers' trust in management.

The discussion on this topic is closely linked to ethics, privacy and data protection (i.e., safety of storage, use). Some case studies reveal that **many employees**, and even employers, are **not aware of their rights and labour-relation regulations** (Raj-Reichert et al. 2019). Hence, they might not realise when they are mistreated, when their rights are violated. At the same time, automation technologies can support workers in controlling work processes and tasks, improving collaboration across departments and teams, thereby increasing autonomy of individual workers.

At the third level of analysis, the impact of automation technologies on **daily decision-making and worker autonomy is explored**. It is frequently argued that automation technologies may support employees in better management of personal resources (time and skills), improve their decision-making based on available data flows, increase the level of autonomy from the management, and, as mentioned earlier, facilitate effective teamwork. However, some research suggests that new technologies stimulate a tendency towards **job specialisation, standardization and centralisation of decision-making, thereby undermining discretion and autonomy** (Anzolin 2021). In some organisations, adoption of automation technologies led to **changes in organisational culture** – either positive or negative for workers. In case of a positive change, automation technologies enabled an increased engagement of employees in decision-making which implies changes in power balance, new communication formats (i.e., digital, face-to-face, hybrid), discussions on employees' experiences, suggestions and needs related to automation technology adoption (Hamburg 2020). However, in other organisations employees, following adoption of technologies, experienced **greater distance from the management and lower levels of consultation/engagement**, especially in cases of remote work or significant restructuring of organisational, business processes.

The level of success during the transition period, following technology adoption and consequent restructuring, **depends on the management team and on the quality of communication/collaboration between employers and employees**. Some research indicates that the management teams are lacking knowledge and skills **how to develop and implement strategies for effective and efficient re-organisation of work**. In particular, they are not aware how to ensure **sufficient skills of employees** and to use **technological capabilities to their maximum benefit for the company and its employees**, limiting physical and psychosocial risks and respecting workers' data ownership and privacy (Khan et al. 2017; Mandl 2021). Due to dynamic changes in the market of technologies even the IT professionals or technology experts struggle to keep track of changes in the market and to understand the use and application of particular technologies (Capgemini et al. 2019). The absence of knowledge and experience in developing appropriate strategies **demotivates managers of the organisations to embark on technological transformation**.

4.2 Working and employment conditions

Working conditions refer to the **working environment and aspects of an employee's terms and conditions of employment**. These include aspects related to employment conditions, such as career and employment security, development of skills, well-being and health at the workplace and work-life balance (Eurofound 2012). Working conditions are a subject of labour law and are regulated by all of its various sources: legislation, collective agreements, work rules, employment contract, as well as custom and practice (Eurofound 2022a). Based on the analytical framework of Eurofound, the working and employment conditions encompass the following indices:

Table 1 Eurofound framework on working and employment conditions

Index	Indicator
Physical environment	• Posture-related (ergonomic) • Ambient (vibration, noise, temperature) • Biological and chemical
Social environment	• Adverse social behaviour • Social support • Management quality
Work intensity	• Qualitative demands • Pace determinants and interdependency • Emotional demands
Working time quality	• Duration • Atypical working time • Working time arrangements • Flexibility
Skills and discretion	• Cognitive dimension • Decision latitude • Organisational participation • Training
Prospects	• Employee status • Career prospects • Job security • Downsizing
Earnings	• Salary

Source: Eurofound (2017a), Sixth European Working Conditions Survey – Overview report (2017 update), Publications Office of the European Union, Luxembourg.

Some studies indicate that one of the benefits of adoption of automation technologies are **safer working/physical environments and better occupational health and safety conditions**, as technologies can handle hazardous materials, work in a dangerous environment or take over manual tasks that could cause injuries (Mash 2022). In addition, greater control/monitoring of working/production processes via technologies allows to **detect, alert risks and prevent hazards**. In this context, automation technologies that have worker health monitoring capabilities (i.e., measuring heart rate, blood pressure) should also be mentioned, as their use contributes to workers' health and safer working conditions. Besides that, in some cases **automation technologies are contributing to the inclusion of**

people with disabilities, as they replace tasks requiring physical strength and contribute to creation of new, less labour-intensive tasks that even could be performed remotely (ILO 2022).

Despite positive impacts of technologies on the workplace, there is evidence that **automation technologies may be posing new physical risks to workers**, due to high intensity of human-machine interaction. First, technical or technological errors may lead to incorrect decisions, uncontrollable processes, unsafe working conditions, leading to dire consequences for workers. Second, several studies indicate that work with technologies can threaten mental health, due to psychosocial demands (e.g. higher workload, complexity, conflicts between work and other life domains) and resulting psychobiological stress reactions, anxieties. In view of this, **occupational risk assessment and management are critical**.

The quality of social environment at the workplace is dependent on relationships between workers, and between workers and the management. As it was discussed earlier, integration of automation technologies in the workplace may have a strong impact on intensity, format and type of collaboration within teams and with the management, leading to either stronger consultation, sharing of decision-making power, or exclusion and greater distancing. Some research indicates that automation of tasks is associated with a decreased human interaction between employees, thereby increasing their exposure to strain, burnout, decline in health-related outcomes (C.W. Peeters et al. 2022). **The employer can stimulate healthy social environment even when employees are working at a distance** by encouraging the use of tools for remote communication, such as internal chats, web conferencing, information sharing, collection of feedback from colleagues or by stimulating interaction between workers (Gordon 2016).

Local culture and organisational culture seem to play a dominant role in relationship between employees and with the management. The research on this topic indicates that a **clear, open communication** in an organisation is **reducing stress and assists employees in putting up a better performance**. Involvement of employees in the management of the organisation makes them **energised, committed and stimulates innovation** (Samuel 2015). As it was mentioned earlier, the **quality of communication within the organisation** that undergoes technological transformation is essential for dealing with any arising challenges.

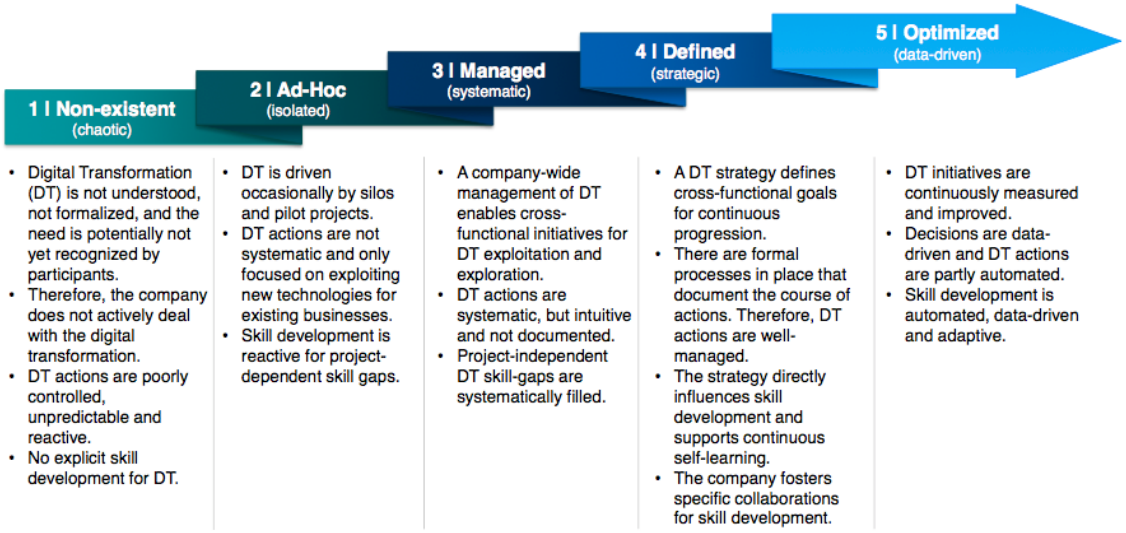
Several studies show that introduction of automation technologies enhances the **flexibility of working arrangements**, as employees can work remotely, and allows employees to **better regulate the pace/intensity of their work** (Parry 2019). A greater flexibility of working arrangements may increase the degree to which employees can adjust their tasks to non-work activities, positively impacting **work-life balance and job satisfaction**, allowing parents to combine family responsibilities with work and increasing the employment rates of workers with disabilities. At the same time, there is evidence from research indicating that an **increased monitoring and continuous connectivity to work**, enabled by technologies, leads to the opposite effects, namely, to **work intensification and a lack of work-life balance** (Szalavetz 2021).

In this context, it is worth mentioning the **platform and non-standard working arrangement**, which encompasses temporary employment, part-time and on-call work, temporary agency work and other multiparty employment relationships, as well as disguised employment and dependent self-employment (Eurofound 2021). In recent years, **the non-standard forms of employment have been increasingly proliferating**, driven by adoption of automation technologies that impact occupational structures, macroeconomic challenges, women's increased participation in the labour market that calls for flexible working arrangements. In the EU-27 and the UK, the share of part-time employment in total employment (age group 15-64) went up from 15.6% in 2002 to 19.4% in 2017, while the share of temporary employment grew from 12.4% to 14.3% during the same period (European Commission n.d.). Non-standard working arrangements presents advantages for workers in terms of flexibility of when and where to work, although it might result in **high stress levels, low wages, high work intensity, and it is characterised by a lack of social security coverage** (Messenger et al. 2019). For example, more than 50% of independent workers in Europe are not covered by unemployment benefits. In addition, non-standard work might be undeclared, thereby it may contribute to expansion of the informal economy (ILO 2017).

Organisational support in acquisition of skills is another important indicator related to working and employment conditions. Besides personal learning capabilities, the ability of workers to learn new skills depends on **quality/relevance of training and available resources** (i.e., time, financing) that is connected to **investment that an organisation is ready to make to support workers** and to **ability to design or identify a training that responds to employee needs**. The latter is strongly influenced by communication between the management and employees. The findings of the ILO (2017) indicate that enterprises, particularly small and medium-sized enterprises, underinvest resources in training as they fear poaching of trained employees, incomplete or asymmetric information on the quality of training and the return on training investment, and high transaction costs (ILO 2017).

To fill the skills gaps, organisations offer training to employees either **in-house** (involving colleagues or inviting experts) or **externally** (outsourcing the task to train employees to independent organisations). These trainings can be organized in different modes (i.e., digital, in-class, hybrid), taking the form of short courses, on-the-job mentoring, MOOCs (massive open online courses) etc. According to the European Research Center for Information System, a successful technological/digital transformation requires systematic skill development. Thus, the **readiness of organisations to embrace such transformation determines the approach towards skills development**.
Figure 5 illustrates the stages of technological/digital transformation and the corresponding approaches/strategies towards skills development.

Figure 5 Digital maturity model: Skill Development for Digital Transformation



Source: Capgemini Invent et.al (2019)

Lastly, earning and job/employment prospects have been touched upon while discussing job displacement, tasks and work organisation. To reiterate, job polarisation, following adoption of automation technologies, is likely to lead to **greater income/wage inequality in society due to larger wage differences between high-skilled and low-skilled employees** (Petropoulos 2021). In cases where specific population groups could be characterised as low-skilled/middle-skilled, automation technologies may lead to **marginalisation of such groups**. For instance, migrants are typically at the lower end of the skill spectrum, as they tend to have worse language skills, less access to local networks, labor market institutions and information about the need to adapt their skill-set (EconPol Forum 2022). Former medium-skilled workers who can secure new employment often find themselves **earning significantly less than before**. Outsourcing also puts direct pressure on the wages of workers, as foreign competition pushes down the price of goods and forces employers to cut cost (ILO 2015). In terms of job/employment prospects, it is largely dependent on the type of skills that they use daily. Overall, **technological change has generally been skill-biased**, meaning that it has made skilled labour more productive and, therefore, **increased the demand for it**. Thus, high-skilled workers have skill supply surpluses for available vacancies, while manual/low-skilled workers cannot fulfil current job requirements (Savona et al. 2022).

4.3 Industrial relations and social dialogue

Industrial relations refer to the **opportunities for workers to take part in decisions that affect their work**, either in their immediate job or tasks and in relation to wider organisational

issues (Duran et al. 2016). Industrial relations can be understood as the **social dialogue, either tripartite (between public authorities, employers and workers) or bipartite (between employers and workers)** (ILO n.d.). As it was highlighted earlier, social dialogue, good quality of communication between employers and employees is critical for shaping working and employment conditions, to support effective restructuring of work and its organisations, ensuring awareness and compliance with organisational policies and strategies. In essence, social dialogue enables **informative consultation, collaboration, balances interests of stakeholders involved, stimulates inclusion, and reduces the possibility of conflicts and inefficiencies**. Based on the analysis of the European Working Conditions Surveys for 2010 and 2015, some negative job quality effects after adoption of technologies have been **greatly enhanced where there is below-median collective bargaining** (Berg et al. 2022).

In 2002, the EU issued a Directive (2002/14/EC) that sets a general framework for informing and consulting employees, setting minimum principles, definitions and arrangements for information and consultation of employees at the enterprise level within each country. Given the range of industrial relations practices across the Member States, they enjoy **substantial flexibility in applying the Directive's key concepts** (employees' representatives, employer, employees etc.) and implementing the arrangements for information and consultation. **Management and labour play a key role in deciding those arrangements** (Employment, Social Affairs & Inclusion n.d.). To avoid undue burdens on small and medium-sized enterprises, the Directive applies **only to undertakings employing at least 50 employees**, or to establishments employing **at least 20 employees**, according to the choice made by the Member State.

Worker involvement can be **indirect**, referring to the involvement of worker representatives (e.g., local trade unions, works councils) in the decision-making processes, or **direct**, implying direct interaction between employers and workers. The power of worker representatives varies depending on **organisational policies, structure of the organisation, and culture**. Traditionally, **pay/minimum wage and working time** are in the centre of attention of organisations/groups that represent workers (Eurofound 2022b). In addition, worker representative are involved during organisational restructuring, as it may lead to mass layoffs, worker transfer to another location or changes in working/employment conditions and organisation of work. Several studies emphasise that automation technologies challenge industrial relations and social dialogue, especially in organisations that have traditional management mindset (Accenture 2014). There is numerous evidence that **a more collaborative approach, effective social dialogue between employees and the management team are more beneficial** for an organisation that undergoes technological transformation (Racounteur et al. 2015).

In view of the above-listed possible effects and challenges caused by the job transformation effect and the policy objective to **support employers and employees during job transformation**, the following **policy goals** should be established:

Box 4 Summary of key findings associated with the job transformation effect

- Policymakers lack knowledge on the impact of automation technologies on job transformation
- Reallocation and redefinition of tasks, task content and job responsibilities may lead to deskilling
- Job transformation demands high adaptability to changing work requirements and a more complex skills set (i.e., technical, social/human and 'meta' skills)
- The demand for low-skilled labour declines, leading to lower wages and poorer job/career prospects of low-skilled employees
- Transformation of work organisation might imply dislocation of workers, complicated work/organisational processes, leading to inefficiencies and excessive stress
- Increased monitoring of work processes may influence workers' behaviours, limit their autonomy and privacy, enhance surveillance practices
- Many workers are not aware of labour-related rights and regulations
- Changes in organisational culture and new working conditions may result in a lack of social interaction, greater distance of workers from the management and lower levels of consultation/engagement
- Employers tend to underinvest in the upskilling/reskilling of employees
- Management teams are lacking knowledge and skills on how to develop and implement strategies for smooth, effective and efficient re-organisation of work, working and employment conditions
- Automation technologies may pose new physical and mental risks to workers, due to high intensity of human-machine interaction, lack of work-life balance
- Social protection for non-standard employment is missing

Source: Pillars (2022)

5 References

Capgemini Invent, European DIGITAL SME Alliance, & Technopolis Group. (2019). *Skills for SMEs: Supporting specialised skills development: Big Data, Internet of Things and Cybersecurity for SMEs*. European Commission. Retrieved 2022, from https://skills4industry.eu/sites/default/files/2021-05/EA0420007ENN_en.pdf

Scientific Foresight Unit. (2021, January). *Digital Automation and the future of Work - European Parliament*. Retrieved December 19, 2022, from https://www.europarl.europa.eu/RegData/etudes/STUD/2021/656311/EPRS_STU(2021)656311(ANN1)_EN.pdf

6 ways to promote inclusivity in higher education. Kognito. (2022, May 18). Retrieved December 20, 2022, from https://kognito.com/blog/6-ways-to-promote-inclusivity-in-higher-education/

Accenture. (2014). *From looking digital to being digital: The impact of technology on the Future of Work*. Unistra. Retrieved December 20, 2022, from https://ccn.unistra.fr/websites/ccn/documentation/Travail-Transformationmetiers/accenture-impact-of-technology-april-2014.pdf

Agouridis, A. (2022, October 27). *5 Strategies to Upskill and Reskill Your Workforce*. Jobylon. Retrieved December 20, 2022, from https://www.jobylon.com/blog/5-strategies-to-upskill-and-reskill-your-workforce

Alonso-Borrego, C., & Collado, D. (2002). Innovation and job creation and destruction . *Recherches Économiques De Louvain*, *68*(1), 148. https://doi.org/10.3917/rel.681.0148

Anzolin, G. (2021). *Automation and its Employment Effects A Literature Review of Automotive and Garment Sectors*. JCR. Retrieved 2022, from https://joint-research-centre.ec.europa.eu/system/files/2021-11/jrc126870.pdf

Australian Council of Learned Academies. (2020, August). *Stimulating the science and research ecosystem creates jobs and investment*. Retrieved December 21, 2022, from https://acola.org/wp-content/uploads/2020/09/ACOLA_stimulating-science-and-research-ecosystem-creates-jobs-and-investment.pdf

Baur, A., Flach, L., & Gourevich, I. (2022). *The effect of robotization in OECD countries on Latin American exports*. CESifo. Retrieved December 21, 2022, from https://www.cesifo.org/en/publications/2022/article-journal/effect-robotization-oecd-countries-latin-american-exports

Bejaković, P., & Mrnjavac, Ž. (2018). The danger of long-term unemployment and measures for its reduction: The case of croatia*. *Economic Research-Ekonomska Istraživanja*, *31*(1), 1837–1850. https://doi.org/10.1080/1331677x.2018.1521295

Berg, J., Green, F., Nurski, L., & Spencer, D. (2022, September 22). *Risks to job quality from digital technologies: Are Industrial Relations in Europe ready for the Challenge?* Bruegel. Retrieved December 20, 2022, from https://www.bruegel.org/working-paper/risks-job-quality-digital-technologies-are-industrial-relations-europe-ready

Bessen, J. (2020). Learning by Doing: The Real Connection between Innovation, Wages, and Wealth. *ResearchGate*. https://doi.org/10.12987/9780300213645

Boschma. (2022). Industrial dynamics and regional wage disparities. *Pillars Working Paper*. Retrieved 2022, from https://www.h2020-pillars.eu/sites/default/files/2022-02/PILLARS_Deliverable_1_4_Industrial%20dynamics%20and%20regional%20wage%20disparities.pdf .

Broschinski, S., & Assmann, M.-L. (2020). The relevance of public employment services for the labour market integration of low-qualified young people – a cross-european perspective. *European Societies*, *23*(1), 46–70. https://doi.org/10.1080/14616696.2020.1764998

Bughin, J., Hazan, E., Lund, S., Dahlström, P., Wiesinger, A., & Subramaniam, A. (2021, January 23). *Skill shift: Automation and the future of the workforce*. McKinsey & Company. Retrieved December 21, 2022, from https://www.mckinsey.com/featured-insights/future-of-work/skill-shift-automation-and-the-future-of-the-workforce

C.W. Peeters, M., & Plomp, J. (2022). For better or for worse: The impact of workplace automation on work characteristics and employee well-being. *Digital Transformation - Towards New Frontiers and Business Opportunities*. https://doi.org/10.5772/intechopen.102980

Ciarli, T., Jaccoud, F., & Petit, F. (2022). *Heterogeneous adjustments of employment to automation technologies: Evidence from manufacturing industries in European regions*. CESifo. Retrieved December 21, 2022, from https://www.cesifo.org/en/publications/2022/article-journal/heterogeneous-adjustments-employment-automation-technologies

Ciarli, T., Kenney, M., Massini, S., & Piscitello, L. (2021). Digital Technologies, Innovation, and skills: Emerging trajectories and challenges. *Research Policy*, *50*(7), 104289. https://doi.org/10.1016/j.respol.2021.104289

Ciarli, T., Savona, M., & Thorpe, J. (2021, June 24). *Innovation for Inclusive Structural Change*. Sussex Research Online : Sussex Research Online. Retrieved December 21, 2022, from http://sro.sussex.ac.uk/id/eprint/94739/

Covid-19: Public Employment Services and labour market policy responses. International Labour Organization. (2020, August 17). Retrieved December 20, 2022, from https://www.ilo.org/emppolicy/areas/covid/WCMS_753404/lang--en/index.htm

Cray, A., Nguyen, T., Pranka, C., Schildt, C., Sheu, J., & Rincon Whitcomb, E. (2011, June). *Job creation: A review of policies and strategies*. Institute for Research on Labor and Employment. Retrieved December 21, 2022, from https://irle.berkeley.edu/job-creation-a-review-of-policies-and-strategies/

Davis, S. J., & von Wachter, T. (2011). Recessions and the costs of job loss. *SSRN Electronic Journal*. https://doi.org/10.2139/ssrn.1969505

Deganis, I., Tagashira, M., & Yang, W. (2021, September 20). *Digitally enabled new forms of work and Policy Implications for Labour Regulation Frameworks and Social Protection Systems*. United Nations: Department of Economic and Social Affairs. Retrieved December 20, 2022, from https://www.un.org/development/desa/dspd/2021/09/digitally-enabled-new-forms-of-work-and-policy-implications-for-labour-regulation-frameworks-and-social-protection-systems/

Deltek. (2022). *Five best practices to improve technology adoption*. The American Institute of Architects. Retrieved December 20, 2022, from https://www.aia.org/articles/6479703-five-best-practices-to-improve-technology-

DG Employment, Social Affairs and Inclusion. (2011). The European Commission Mutual Learning Programme for Public Employment Services. Brussels.

Directorate-General for Regional and Urban Policy EC. (2013, May 29). *Guide to social innovation.* Publications Office of the European Union. Retrieved December 20, 2022, from https://op.europa.eu/en/publication-detail/-/publication/12d044fe-617a-4131-93c2-5e0a951a095c

Doing Business 2020. (2020). *Chapter 6 ease of doing business score and ease of doing business ranking*. Retrieved December 20, 2022, from https://openknowledge.worldbank.org/bitstream/handle/10986/32436/9781464814402_Ch06.pdf

Drahokoupil , J., & Müller, T. (2021). *Job retention schemes in Europe*. etui. Retrieved December 20, 2022, from https://www.etui.org/publications/job-retention-schemes-europe

Duran, J., & Corral, A. (2016). *Employee involvement and participation at work: Recent research and*. Eurofound. Retrieved December 21, 2022, from https://www.eurofound.europa.eu/publications/report/2016/eu-member-states/employee-involvement-and-participation-at-work-recent-research-and-policy-developments-revisited

EconPol Forum 05/2022. (2022). *European Labor Markets: How can we effectively manage technological and structural change?* CESifo. Retrieved December 21, 2022, from https://www.cesifo.org/en/publications/2022/journal-complete-issue/econpol-forum-052022-european-labor-markets

Eichhorst, Marx, Rinne, & Brunner. (2022). *Job Retention Schemes during COVID-19: A Review of Policy Responses*. IZA. Retrieved 2022, from https://docs.iza.org/pp187.pdf

Employment, Social Affairs & Inclusion. (n.d.). *Employee Involvement - Framework on Information and Consultation*. Employment, Social Affairs & Inclusion. Retrieved December 21, 2022, from https://ec.europa.eu/social/main.jsp?catId=707&intPageId=210&langId=en

EPRS. (2021). *EU long-term vision for rural areas* . Europarl. Retrieved December 20, 2022, from https://www.europarl.europa.eu/RegData/etudes/BRIE/2021/690699/EPRS_BRI(2021)690699_EN.pdf

Ernst, E., Merola, R., & Reljic, J. (2022). *Labour market policies for inclusiveness: A literature review with a gap analysis*. ILO. Retrieved 2022, from https://www.ilo.org/wcmsp5/groups/public/---dgreports/---inst/documents/publication/wcms_855080.pdf

ETF, CEDEFOP, and ILO, Using Labour Market Information: Guide to Anticipating and Matching Skills and Jobs (2016). Publications Office of the European Union. Retrieved 2022, from https://www.ilo.org/wcmsp5/groups/public/---ed_emp/---ifp_skills/documents/publication/wcms_534314.pdf.

EUNEC. (2014, October 21). *Bridging the Transition Between Education and the Labour Market*. Retrieved 2022, from https://eunec.eu/sites/www.eunec.eu/files/event/attachments/report_1.pdf

Eurofound. (2012). *Trends in job quality in Europe*. Eurofound. Retrieved December 21, 2022, from https://www.eurofound.europa.eu/publications/report/2012/working-conditions/trends-in-job-quality-in-europe

Eurofound. (2015). *Third European Company Survey – Overview report: Workplace practices – Patterns, performance and well-being*. Eurofound. Retrieved December 21, 2022, from https://www.eurofound.europa.eu/publications/report/2015/third-european-company-survey-overview-report-workplace-practices-patterns-performance-and-well

Eurofound. (2017a). *Sixth european working conditions survey – overview report*. Eurofound. Retrieved December 21, 2022, from https://www.eurofound.europa.eu/publications/report/2016/working-conditions/sixth-european-working-conditions-survey-overview-report

Eurofound. (2017b). *Work Organisation*. Eurofound. Retrieved December 21, 2022, from https://www.eurofound.europa.eu/es/observatories/eurwork/about-eurwork/work-organisation

Eurofound. (2019, April 11). *Job creation*. Eurofound. Retrieved December 21, 2022, from https://www.eurofound.europa.eu/topic/job-creation

Eurofound. (2021, March 11). *Non-standard employment*. Eurofound. Retrieved December 21, 2022, from https://www.eurofound.europa.eu/topic/non-standard-employment

Eurofound. (2022a, December 15). *Working Conditions*. Eurofound. Retrieved December 21, 2022, from https://www.eurofound.europa.eu/topic/working-conditions

Eurofound. (2022b, December 20). *Industrial relations*. Eurofound. Retrieved December 21, 2022, from https://www.eurofound.europa.eu/topic/industrial-relations

European Agency for Safety and Health at Work. (2021). *Improving compliance with Occupational Safety and Health Regulations: An overarching review*. OSHA. Retrieved December 20, 2022, from https://osha.europa.eu/en/publications/improving-occupational-safety-and-health-changing-world-work-what-works-and-how

European Commission, Directorate-General for Employment, Social Affairs and Inclusion, Peters, M. (2020, August 20). *Assessment report on PES capacity : 2019*. Publications Office of the European Union. Retrieved December 20, 2022, from https://op.europa.eu/en/publication-detail/-/publication/947c3460-e353-11ea-ad25-01aa75ed71a1/language-en

European Commission, Executive Agency for Small and Medium-sized Enterprises. (2020). *Supporting specialised skills development : big data, Internet of things and cybersecurity for SMEs*. Publications Office of the European Union. Retrieved December 20, 2022, from https://op.europa.eu/en/publication-detail/-/publication/bb5c6c09-6285-11ea-b735-01aa75ed71a1/language-en

European Commission. (2017). *ICT for Work: Digital skills in the workplace, study prepared by Ecorys and the Danish Technological Institute*. European Commission. Retrieved 2022, from https://digital-strategy.ec.europa.eu/en/library/ict-work-digital-skills-workplace

European Commission. (2019a). *High-Level Expert Group on the Impact of the Digital Transformation on EU Labour Markets*. Shaping Europe's digital future. Retrieved December 21, 2022, from https://digital-strategy.ec.europa.eu/en/news/final-report-high-level-expert-group-impact-digital-transformation-eu-labour-markets#:~:text=EU%20Labour%20Markets-,Download%C2%A0,-Related%20topics

European Commission. (2019b). *Legal migration: Attracting skills and talent to the EU*. European Commission. Retrieved December 21, 2022, from https://ec.europa.eu/commission/presscorner/detail/en/IP_22_2654

European Commission. (2019c). *Skills for smart industrial specialisation and digital transformation*. Publications Office of the European Union. Retrieved 2022, from https://data.europa.eu/doi/10.2826/550778

European Commission. (2021). *Better Regulation Toolbox*. European Commission. Retrieved December 19, 2022, from https://commission.europa.eu/law/law-making-

process/planning-and-proposing-law/better-regulation/better-regulation-guidelines-and-toolbox/better-regulation-toolbox_en

European Commission. (2022a). *Access to social protection*. Access to social protection - Employment, Social Affairs & Inclusion - European Commission. Retrieved December 20, 2022, from https://ec.europa.eu/social/main.jsp?catId=1312&langId=en

European Commission. (2022b). *Accidents at work and occupational diseases*. Employment, Social Affairs & Inclusion - European Commission. Retrieved December 20, 2022, from https://ec.europa.eu/social/main.jsp?langId=en&catId=864

European Commission. (2022c). *Inclusive entrepreneurship and microfinance*. Employment, Social Affairs & Inclusion. Retrieved 2022, from https://ec.europa.eu/social/main.jsp?catId=1560&langId=en

European Commission. (2022d). *Long-term unemployment*. Long-term unemployment - Employment, Social Affairs & Inclusion. Retrieved December 20, 2022, from https://ec.europa.eu/social/main.jsp?catId=1205&langId=en

European Commission. (n.d.). *Non-standard forms of employment on the rise*. Retrieved December 21, 2022, from https://knowledge4policy.ec.europa.eu/foresight/topic/changing-nature-work/non-standard-forms-of-employment-on-rise_en

European Council. (2022, December 8). *EU rules on platform work*. Consilium Europa. Retrieved December 20, 2022, from https://www.consilium.europa.eu/en/policies/platform-work-eu/

European Institute for Gender Equality. (2021, January 8). *Gender Equality Index 2020: Digitalisation and the future of work*. European Institute for Gender Equality. Retrieved December 21, 2022, from https://eige.europa.eu/publications/gender-equality-index-2020-report/job-automation-use-new-technologies-and-transformation-labour-market

European Parliament. (2017). *The Social Protection of workers in the platform economy*. Think Tank | European Parliament. Retrieved December 20, 2022, from https://www.europarl.europa.eu/thinktank/en/document/IPOL_STU(2017)614184

European Parliament. (2022). *Policy for research and technological development*. Fact Sheets on the European Union. Retrieved December 20, 2022, from https://www.europarl.europa.eu/factsheets/en/sheet/66/policy-for-research-and-technological-development

European Semester: Thematic factsheet – Active labour market policies. (2017). Retrieved 2022, from https://commission.europa.eu/content/thematic-factsheets/labour-markets-and-skills_en.

Euwema, M., García, A. B., Munduate, L., Elgoibar, P., & Pender, E. (2014). Employee representatives in European organizations. *Industrial Relations & Conflict Management*, 1–17. https://doi.org/10.1007/978-3-319-08605-7_1

Fernando, J. (2022, May 27). *Corporate Social Responsibility (CSR)* . Investopedia. Retrieved December 20, 2022, from https://www.investopedia.com/terms/c/corp-social-responsibility.asp

Froy, F., Giguère , S., & Meghnagi, M. (2012). *Skills for competitiveness: A synthesis Report*. OECD. Retrieved December 20, 2022, from https://www.oecd.org/cfe/leed/Skills%20for%20competitiveness%20Synthesis%20FINAL.pdf

G20 Research Group. (2018). *Informality and non-standard forms of employment*. G20. Retrieved December 20, 2022, from http://www.g20.utoronto.ca/2018/g20_paper_on_nse_and_formalization_ilo.pdf

Gerber, S. (n.d.). *12 ways to foster a more entrepreneurial culture*. business.com. Retrieved December 21, 2022, from https://www.business.com/articles/12-ways-foster-entrepreneurial-culture/

Gerten, E., Beckmann, M., & Bellmann, L. (2019). Controlling working crowds: The impact of digitalization on worker autonomy and monitoring across hierarchical levels. *Jahrbücher Für Nationalökonomie Und Statistik*, *239*(3), 441–481. https://doi.org/10.1515/jbnst-2017-0154

Gordon, J. (2016, April 26). *ADP Brandvoice: Remote Workplaces: Unraveling the risks and reward of flexible work environments*. Forbes. Retrieved December 21, 2022, from https://www.forbes.com/sites/adp/2016/04/26/remote-workplaces-unraveling-the-risks-and-reward-of-flexible-work-environments/

Guo, Y., Langer, C., Mercorio, F., & Trentini, F. (2022). *Skills Mismatch, automation, and training: Evidence from 17 European countries using survey data and online job ads*. CESifo. Retrieved December 21, 2022, from https://www.cesifo.org/en/publications/2022/article-journal/skills-mismatch-automation-and-training

Hamburg, I. (2020). Implementation of a digital workplace strategy to drive behavior change and improve competencies. *Strategy and Behaviors in the Digital Economy*. https://doi.org/10.5772/intechopen.85135

Harmonic Drive SE. (n.d.). *Automation technology*. Harmonic Drive SE. Retrieved December 21, 2022, from https://harmonicdrive.de/en/glossary/automation-technology

How to promote entrepreneurial culture in the community. Insightssuccess Media and Technology Pvt. Ltd. (2022, January 31). Retrieved December 21, 2022, from

https://insightssuccess.com/how-to-promote-entrepreneurial-culture-in-the-community/

How upskilling employees strengthens your business. PwC ProEdge RSS. (2022). Retrieved December 20, 2022, from https://proedge.pwc.com/upskilling-employees-makes-for-a-stronger-team

Ikari, H., Kono, T., & Zhou, Y. (2022). Industrial specialization patterns across cities, agglomeration of skilled labour and technological growth. *Spatial Economic Analysis*, *17*(3), 311–331. https://doi.org/10.1080/17421772.2021.2014944

ILO. (2009). *A guide to worker displacement: Some tools for reducing the impact on workers, communities and enterprises*. ILO. Retrieved 2022, from https://www.ilo.org/wcmsp5/groups/public/@ed_emp/@ifp_skills/documents/publication/wcms_103594.pdf

ILO. (2010, February 25). *Promoting social dialogue*. International Labour Organization. Retrieved December 20, 2022, from https://www.ilo.org/jobspact/policy/WCMS_DOC_GJP_ARE_DLG_EN/lang--en/index.htm

ILO. (2013, December 2). *National Tripartite Social Dialogue: An ILO guide for improved governance*. International Labour Organization. Retrieved December 20, 2022, from https://www.ilo.org/ifpdial/information-resources/publications/WCMS_231193/lang--en/index.htm

ILO. (2015). *Is the hollowing out of middle-skill jobs an unavoidable consequence of technological advancement?* ILO. Retrieved December 21, 2022, from https://www.ilo.org/newyork/voices-at-work/WCMS_363034/lang--en/index.htm

ILO. (2017). *The rising tide of non-standard employment*. InfoStories. Retrieved December 21, 2022, from https://www.ilo.org/infostories/Stories/Employment/Non-Standard-Employment#what-does-it-mean-for-workers

ILO. (2019a). *Changing Business and Opportunities for Employer and Business Organizations*. ILO. Retrieved 2022.

ILO. (2019b, March 27). *Changing Business and opportunities for employer and Business Organizations*. ILO. Retrieved December 21, 2022, from https://www.ilo.org/actemp/areas-of-work/WCMS_679582/lang--en/index.htm

ILO. (2022). *Inclusion of persons with disabilities in the digital and green economy*. ILO. Retrieved 2022, from https://www.ilo.org/wcmsp5/groups/public/---dgreports/---ddg_p/documents/publication/wcms_840306.pdf

ILO. (n.d.). *Social Dialogue*. International Labour Organization. Retrieved December 20, 2022, from https://www.ilo.org/ifpdial/areas-of-work/social-dialogue/lang--en/index.htm)%20%20a

Infrastructure investing: Why now? Brookfield. (2021, July 14). Retrieved December 21, 2022, from https://www.brookfield.com/insights/infrastructure-investing-why-now

Inspire: Digital Inclusion. Inspire. (2022). Retrieved December 20, 2022, from https://www.digitalinspire.co.uk/

Is landing a job really about who you know? The Job Sauce. (2022, October 12). Retrieved December 20, 2022, from https://thejobsauce.com/is-landing-a-job-really-about-who-you-know/#:~:text=A%20study%20completed%20by%20Lever,0.4%25%20if%20applied%20online

Jara Tamayo, H. X., & Tumino, A. (2020). Atypical work and unemployment protection in Europe*. *JCMS: Journal of Common Market Studies*, *59*(3), 535–555. https://doi.org/10.1111/jcms.13099

Jara, A. (2022, November 8). *Level up: Why digital transformation calls for new skills*. GetSmarter Blog. Retrieved December 21, 2022, from https://www.getsmarter.com/blog/career-advice/level-up-why-digital-transformation-calls-for-new-skills/

Khan, N., Lunawat, G., & Rahul, A. (2017). *Toward an integrated technology operating model*. McKinsey & Company. Retrieved December 21, 2022, from https://www.mckinsey.com/capabilities/mckinsey-digital/our-insights/toward-an-integrated-technology-operating-model

Law enforcement: A forgotten determinant of labour law impact. European Commission . (2016). Retrieved December 20, 2022, from https://ec.europa.eu/social/main.jsp?langId=en&catId=1196&newsId=2481&furtherNews=yes

Maiello, F. (2022). Role of Political Environment in Business. *Review Pub Administration Manag.* https://doi.org/10.35248/2315-7844.22.10.334

Making labour markets inclusive. OECD. (n.d.). Retrieved December 21, 2022, from https://www.oecd.org/employment/making-labour-markets-inclusive.htm

Mandl, I. (2021). *Work organisation and job quality in the Digital age*. Eurofound. Retrieved December 21, 2022, from https://www.eurofound.europa.eu/data/digitalisation/research-digests/work-organisation-and-job-quality-in-the-digital-age

Manyika, J., & Sneader, K. (2021, September 9). *Ai, automation, and the future of work: Ten things to solve for*. McKinsey & Company. Retrieved December 21, 2022, from https://www.mckinsey.com/featured-insights/future-of-work/ai-automation-and-the-future-of-work-ten-things-to-solve-for

Martínez B. Kukutschka, R. (2014, October 31). *Building political will topic guide - transparency*. Retrieved December 19, 2022, from https://www.transparency.org/files/content/corruptionqas/Topic_Guide-_Political_Will.pdf

Mash, S. (2022). *Safety benefits and risks created by industry 4.0*. Electronics360. Retrieved December 21, 2022, from https://electronics360.globalspec.com/article/18267/safety-benefits-and-risks-created-by-industry-4-0

Messenger, J., Vargas Llave , O., Gschwind, L., Boehmer, S., Vermeylen, G., & Wilkens, M. (2019). *Working Anytime, anywhere: The effects on the world of work*. Eurofound. Retrieved December 21, 2022, from https://www.eurofound.europa.eu/publications/report/2017/working-anytime-anywhere-the-effects-on-the-world-of-work

Miedzinski, M., Kanehira, N., Cervantes, M., & Mealy, S. (2020). International STI collaboration and investment for Sustainable Development Goals. Science, Technology and Innovation (STI) for SDGs Roadmaps. *ResearchGate*. Retrieved 2020, from https://www.researchgate.net/publication/345978505_International_STI_collaboration_and_investment_for_Sustainable_Development_Goals_Science_Technology_and_Innovation_STI_for_SDGs_Roadmaps.

Ministerie van Economische Zaken en Klimaat. (2020, March 20). *Mobiliteitscentrum helpt kolenwerkers naar Ander Werk*. Klimaatakkoord. Retrieved December 20, 2022, from https://www.klimaatakkoord.nl/actueel/nieuws/2020/03/20/mobiliteitscentrum-helpt-kolenwerkers-naar-ander-werk

Moncada-Paternò-Castello. (2013). Innovation and Job Creation. A Sustainable Relation? *ResearchGate*. https://doi.org/10.2791/76791

Muro, M., Maxim, R., & Whiton, J. (2019). *Automation and Artificial Intelligence: How machines are affecting people and places*. Brookings. Retrieved 2022, from https://www.brookings.edu/wp-content/uploads/2019/01/2019.01_BrookingsMetro_Automation-AI_Report_Muro-Maxim-Whiton-FINAL-version.pdf#page=44

Muskin, J. A. (2017). *Continuous Assessment for Improved Teaching and Learning: A Critical Review to Inform Policy and Practice*. Unesdoc.unesco.org. Retrieved December 20, 2022, from https://unesdoc.unesco.org/ark:/48223/pf0000255511

Nedelkoska, L., & Quintini, G. (2018). Automation, skills use and training. *OECD Social, Employment and Migration Working Papers*. https://doi.org/10.1787/2e2f4eea-en

Neffke, F., Nedelkoska, L., & Wiederhold, S. (2022). Skill mismatch and the costs of job displacement. *SSRN Electronic Journal*. https://doi.org/10.2139/ssrn.4087958

OECD regional statistics. (2017). *OECDLibrary*. https://doi.org/10.1787/region-data-en

OECD. (2014). *Lifelong learning for all: Policy lessons*. OECD. Retrieved 2022, from https://www.oecd.org/officialdocuments/publicdisplaydocumentpdf/?cote=DEELSA/ED/CERI/CD(2000)12/PART1&docLanguage=En

OECD. (2016a). *Skills for a Digital World*. OECD. Retrieved December 21, 2022, from https://www.oecd.org/els/emp/Skills-for-a-Digital-World.pdf

OECD. (2016b). The World of Public Employment Services. *Local Economic and Employment Development (LEED)*. https://doi.org/10.1787/9789264251854-en

OECD. (2017). *Future of work and skills*. OECD. Retrieved December 21, 2022, from https://www.oecd.org/els/emp/wcms_556984.pdf

OECD. (2018a). *Effective teacher policies: Insights from PISA*. Retrieved December 20, 2022, from https://read.oecd-ilibrary.org/education/effective-teacher-policies_9789264301603-en#page33

OECD. (2018b). *Opportunities for all: A framework for policy action on inclusive growth*. OECD. Retrieved December 21, 2022, from https://www.oecd.org/economy/opportunities-for-all-9789264301665-en.htm

OECD. (2019, December 11). *OECD Skills Strategy Poland: Assessment and recommendations*. OECD. Retrieved December 20, 2022, from https://www.oecd.org/education/oecd-skills-strategy-poland-b377fbcc-en.htm

OECD. (2020). Raising the basic skills of workers in England, United Kingdom. *OECD Skills Studies*. https://doi.org/10.1787/4ff42de8-en

OECD. (2021a). *What happened to jobs at high risk of automation?* (pp. 1–9). Retrieved 2022, from https://www.oecd.org/future-of-work/reports-and-data/what-happened-to-jobs-at-high-risk-of-automation-2021.pdf.

OECD. (2021b, December 6). *The missing entrepreneurs 2021: Policies for inclusive entrepreneurship and self-employment*. Publications Office of the European Union. Retrieved December 20, 2022, from https://op.europa.eu/en/publication-detail/-/publication/70eb8ecc-57dc-11ec-91ac-01aa75ed71a1/language-en

OECD. (2021c, September 10). *Building local ecosystems for Social Innovation*. OECD iLibrary. Retrieved December 20, 2022, from https://www.oecd-ilibrary.org/industry-and-services/building-local-ecosystems-for-social-innovation_bef867cd-en

OECD. (2022a). *HEInnovate*. HEInnovate Self-assessment . Retrieved December 20, 2022, from https://heinnovate.eu/en

OECD. (2022b). *OECD recommendation on SME and entrepreneurship policy*. OECD. Retrieved December 21, 2022, from

https://www.oecd.org/cfe/smes/oecdrecommendationonsmeandentrepreneurshippolicy/

OECD. (2022c). *Stimulating social entrepreneurship and Social Innovation*. OECD. Retrieved December 20, 2022, from https://www.oecd.org/cfe/leed/social-entrepreneurship-pow2015-16.htm

OECD. (n.d.). *Small businesses, job creation and growth: Facts, obstacles and best practices*. Retrieved December 21, 2022, from https://www.oecd.org/cfe/smes/2090740.pdf

Olivares-Aguila, J., ElMaraghy, W., & ElMaraghy, H. (2021). Human capital transformation for successful Smart Manufacturing. *Towards Sustainable Customization: Bridging Smart Products and Manufacturing Systems*, 871–878. https://doi.org/10.1007/978-3-030-90700-6_99

OYED. (2022). *Organization for Youth Education & Development*. Organizations for Youth Education & Development. Retrieved December 20, 2022, from https://www.oyed.org/index.php?en_about

Parry, E., & Battista, V. (2019). The impact of Emerging Technologies on work: A review of the evidence and implications for the human resource function. *Emerald Open Research*, *1*, 5. https://doi.org/10.12688/emeraldopenres.12907.1

Petropoulos, G. (2021, April 1). *Automation, covid-19, and Labor Markets*. Asian Development Bank. Retrieved December 21, 2022, from https://www.adb.org/publications/automation-covid-19-and-labor-markets

Peugny, C. (2019). The decline in middle-skilled employment in 12 European countries: New evidence for job polarisation. *Research & Politics*, *6*(1), 205316801882313. https://doi.org/10.1177/2053168018823131

PILLARS. (2022). *Pillars*. PILLARS. Retrieved December 21, 2022, from https://www.h2020-pillars.eu/project/about_pillars

Quain, S. (2018, November 26). *Problems facing industrial relations*. Small Business - Chron.com. Retrieved December 20, 2022, from https://smallbusiness.chron.com/problems-facing-industrial-relations-4840.html

Raconteur & Google for Work. (2015, August 25). *Working Better together – A study of innovation and collaboration at work*. Google Cloud. Retrieved December 20, 2022, from https://cloud.googleblog.com/2015/08/working-better-together-a-study-of-innovation-and-collaboration-at-work.html

Raj-Reichert, G., & Plank, L. (2019). *Labour Law Compliance and the Role of Labour*. ILO. Retrieved 2022, from https://www.ilo.org/wcmsp5/groups/public/---ed_emp/---emp_ent/---multi/documents/publication/wcms_756179.pdf

Recognition of skills and qualifications acquired through non-formal and informal learning – the practical input of Organised Civil Society. European Economic and Social Committee. (2015). Retrieved December 20, 2022, from https://www.eesc.europa.eu/en/our-work/opinions-information-reports/opinions/recognition-skills-and-qualifications-acquired-through-non-formal-and-informal-learning-practical-input-organised-civil

Samuel, O. B. (2015). The Effects of Organisational Culture and Stress on Organisational Employee Commitment. *Scientific & Academic Publishing*. https://doi.org/10.5923/j.mm.20150503.03

Sarkar, A. (2022). *Technology adoption - benefits, Challenges & How to create it - technology*. Scribe. Retrieved December 20, 2022, from https://scribehow.com/library/technology-adoption

Savona, M., Ciarli, T., Steinmueller, E., & Vannuccini, S. (2022). *The design of Digital Automation Technologies: Implications for the future of work*. CESifo. Retrieved December 21, 2022, from https://www.cesifo.org/en/publications/2022/article-journal/design-digital-automation-technologies-implications-future-work

Seed. (2022, December 9). *Social Innovation Ecosystem Development*. Seed. Retrieved December 20, 2022, from https://www.seedeuproject.eu/

Silkin, L. (2021, February 28). *Deskilling: what are the historical, societal and legal implications?* futureofworkhub. Retrieved December 21, 2022, from https://www.futureofworkhub.info/explainers/2021/4/28/deskilling-what-are-the-historical-societal-and-legal-implications

Skills forecast. CEDEFOP. (2021, December 1). Retrieved December 20, 2022, from https://www.cedefop.europa.eu/en/tools/skills-forecast

Skills-ovate. CEDEFOP. (2021, November 10). Retrieved December 20, 2022, from https://www.cedefop.europa.eu/en/tools/skills-online-vacancies

Spitz-Oener, A. (2006). Technical change, job tasks, and rising educational demands: Looking outside the wage structure. *Journal of Labor Economics*, *24*(2), 235–270. https://doi.org/10.1086/499972

The state of AI adoption in 2021. Impact Networking. (2021, April 8). Retrieved December 20, 2022, from https://www.impactmybiz.com/blog/state-of-ai-adoption-2021/?utm_source=website&utm_medium=blog-internal-link&utm_campaign=biggest-barriers-to-technology-adoption-in-business

Stewart, I., De, D., & Cole, A. (2015, December 31). *Technology and people: The great job-creating machine*. Deloitte Turkey. Retrieved December 21, 2022, from https://www2.deloitte.com/tr/en/pages/technology/articles/technology-and-people.html

Szalavetz, A. (2021). *Digital technologies and the nature and routine intensity of work*. etui. Retrieved 2022, from https://www.etui.org/sites/default/files/2021-02/Digital%20technologies%20and%20the%20nature%20and%20routine%20intensity%20of%20work_2021_web.pdf

Technopolis Group. (n.d.). *Digital Skills Gap? Let's focus on digital mentality gap!* Technopolis Group. Retrieved December 21, 2022, from https://www.technopolis-group.com/fr/digital-skills-gap-lets-focus-on-digital-mentality-gap/

Training fund. CEDEFOP. (2022). Retrieved December 20, 2022, from https://www.cedefop.europa.eu/en/tools/financing-adult-learning-db/instrument-types/training-fund

Trémolet, S., & Binder, D. (2009). *Instability – how can regulators ensure stable (and predictable) regulatory regime under changing market and technological conditions?* Regulation body of knowledge. Retrieved December 20, 2022, from https://regulationbodyofknowledge.org/faq/foundations-of-regulation/instability-how-can-regulators-ensure-stable-and-predictable-regulatory-regime-under-changing-market-and-technological-conditions/

UNESCO Institute for Lifelong Learning. (2020). *Embracing a culture of lifelong learning: Contribution to the Futures of Education Initiative*. Unesdoc.unesco.org. Retrieved December 20, 2022, from https://unesdoc.unesco.org/ark:/48223/pf0000374112

United Nations. (2013). *Science, Technology and Innovation (STI) and Culture for Sustainable Development and the mdgs | economic and social council*. United Nations. Retrieved December 21, 2022, from https://www.un.org/ecosoc/en/content/science-technology-and-innovation-sti-and-culture-sustainable-development-and-mdgs

Vivarelli, M. (2015, May 1). *Innovation and employment*. IZA World of Labor. Retrieved December 21, 2022, from https://wol.iza.org/articles/innovation-and-employment/long

WEgate. (2019). *Studies highlight the issues facing female entrepreneurs*. WEgate. Retrieved December 20, 2022, from https://wegate.eu/news-events/news/studies-highlight-issues-facing-female-entrepreneurs

Wong, K. (2022, November 22). *10 employee incentive programs to engage your team*. Achievers. Retrieved December 21, 2022, from https://www.achievers.com/blog/employee-incentive-programs/