



Implications of Technology Development on the Labor Market

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Abstract: *The level of resources invested in STEM, innovation and R&D has never been higher, resulting in new technologies that are promising higher return rates and a new competitive edge. Technology development is influencing the way the work is performed, thus changing the structure of the organization, content of work and demand for workers' skills. Thus, technology development changes industries, organizations and occupations. When occupations are displaced, many workers are forced to reconsider their possibilities at the labor market and to broaden their job perspectives by upgrading their skills portfolio. At the same time, due to the increase in production productivity, new products and services are offered, and new markets emerge. Thus, new jobs are instated and new skills for performing them are required. Technology development led by automation (including AI, ML, etc) and digitalization have found creative and efficient ways to change traditional business models, not necessarily through resource internalization and standard employment agreements. This paper is elaborating on the concept of job and employment, and the effect technology advancements have on labor markets. Findings are related to newly emerging forms of employment and their implications for organizations and workers.*

1. INTRODUCTION

The concept of what was until recently dominantly considered a standard job, where an employee did work according to an on-going employer-employee agreement, usually at a specific fixed time, at the employer's premises and for a relatively constant monthly pay, was rare until the Industrial Revolution. Until the 19th century, the predominant standard job was in agriculture. In the agriculture society, the breakthroughs in technology (plow, use of animals and fertilizers, etc.) led to improvements in agricultural production efficiency. Efficiency increase resulted in producing beyond individual/family needs. Thus, people were able to make surpluses, i.e. gains additional to covering existential needs, which could be used as additional consumption, investments or savings. Those surpluses had a distinctive impact on civilization; they provided the economic foundation for capitalism; they led to the development of business organizations as the main providers of work (including their operational consequences such as division of labor and occupational specialization); they encouraged the foundation of urban areas; they had spillover effects on supportive production activities, and consequently, they were responsible for the social and economic development of the modern states.

In the agriculture society, capital gains not only stimulated investments in technology development in the agriculture domain, but in the domain of support activities, such as transportation or artisan crafts (potters, smiths, spinners and weavers, brewers, and other specialized artisans) (Volti, 2011). People started to specialize (train, educate, master) in a (set of) specific skill(s), distinctive to skills of others and crucial to perform a narrow set of tasks leading to the production of unique product tradable for other existentially important goods. Artisan work was predominantly a small-scale activity, usually performed from home, involving family members and a few apprentices, until the

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technology advancements and business creativity of entrepreneurs allowed for the development of firms and new business models with additional capital gains. That led to new investments, additional efficiency increases and innovations. For example, until the 20th century, textile workers often worked from home, buying raw cotton from a merchant, weaving it into the fabric and selling it on from their doorsteps; in the 1970s, cotton mills began to appear in Lancashire, England, using spinners powered by water wheels, enabling establishments of the first textile manufactures. In those manufactures, workers were hired and paid but not employed based on continuity. This specific arrangement would not provide for any kind of security: they would often work in twelve-hour shifts, six days a week; still, they would be paid per unit of work (hourly), with no entitled work-related rights, nor social or health security (on top of that, penalties for damage to machinery would be deducted from their salary). Individuality gave them no power to fight for better working conditions nor to prevent exploitation by their employers. However, the realization that all workers have similar requirements, especially regarding working conditions, led to the recognition of the power of collective bargaining and the formation of workers' unions in the 20th century. As unions grew larger, their sphere of influence increased and began to involve political lobbying, public advocacy and networking, resulting in a labor law and employment contracts enforced to protect labor rights.

During the late 20th century, a cheaper labor force in (East) Asia caused the decline in traditional production in Europe and USA. Advanced economies were forced to employ alternative strategies to compete with lower production costs in emerging economies, and one of the rational solutions was to lessen the proportion of labor costs in total production costs. Along with moving their production to the East, they invested their money and efforts in technological systems to compensate for higher costs of human resources. Increased focus on automation and digitalization processes has led to the increase in production followed by efficiency gains, as well as labour market structural changes. In the EU, in recent decades, the decline in employment in primary industries and basic manufacturing (basic metals, wood, shipbuilding, textiles and clothing, etc.) is accompanied by a rise in employment in higher value-added manufacturing activities (computers, electronics, naval equipment, etc.) and services (tourism, retail, research, etc.). As economies increasingly turn to tech-based solutions (automation, artificial intelligence, and digitalization), low skilled workers have to reconsider their position on the labor market, especially since cheap labor is no longer a guarantee of firms' sustainability and economic growth. Another phenomenon related to increased industrial investments (particularly in R&D, machinery and equipment) results in rising costs of high skilled labour (IT, health care), while at the same time technology becomes cheaper due to scalability and imitability. Therefore, at a quantitative level, jobs in production are replaced with machines, but new jobs in supporting and service industries arise, thus increasing the aggregate demand on labour market. In reality, gaps in skills result in labour market inefficiencies and are responsible for structural unemployment phenomena.

In this paper, we start with presenting technology development as the main force behind developments in the labor market and continue with implications of technology advancements on the labour market. In the last part of the paper, we discuss the effects of the new forms of employment for working conditions and labour market.

2. TECHNOLOGY AS A CHANGING FORCE

The most prominent technology developments that are changing work around the world nowadays are digitalization (Eurofound, 2020), automation (Ford, 2016; Manyika et al., 2017; Acemoglu and Restrepo, 2020) and platforms (Eurofound, 2021) (Figure 1). These technology developments pri-

marily aim to increase productivity, but while digitization refers to supporting processes and tasks digitally, automation refers to performing processes and tasks autonomously and automatically, thus serving as a replacement for human work with technical solutions (Satchell, 1998). Platforms serve as coordination mechanisms and consequently they replace former (physical) markets. They use digital networks and algorithms to coordinate economic transactions (Eurofound, 2021). Artificial intelligence (AI), depending on how we define the term, is at the intercept of automation, platforms and digitalization. It represents technologies, systems or even processes that mimic how human beings function. AI aims to replace complex and sophisticated human work in the area of decision making, planning, understanding and creating new information. A very important subset of AI for understanding the future of work is machine learning (ML). It enables systems and processes to learn from data, identify patterns and recommend decisions without human involvement. It uses algorithms to find patterns in large quantities of data (Big Data).

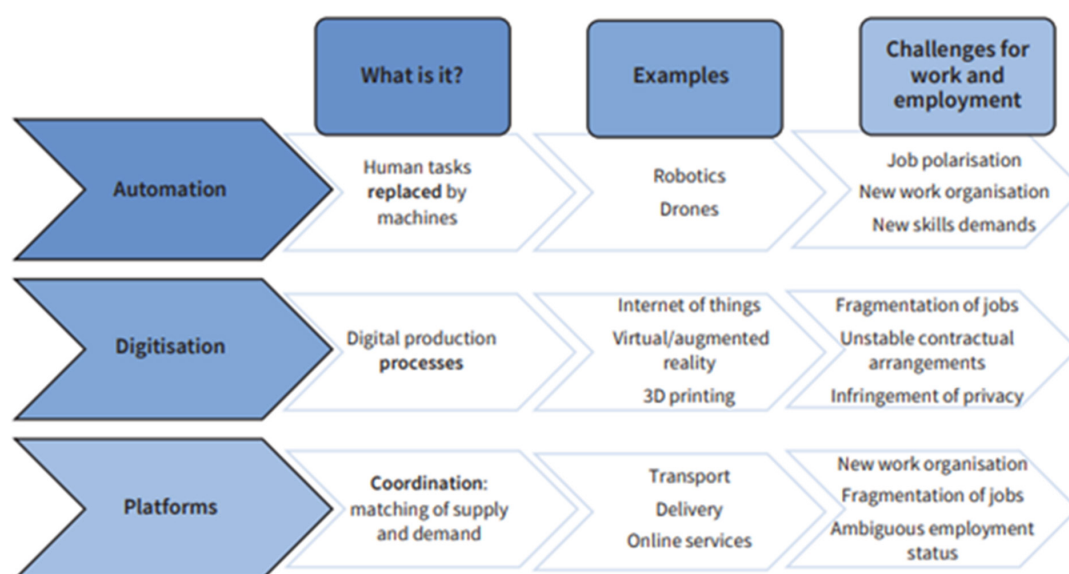


Figure 1. Overview of the expected challenges for work and employment by vector of change

Source: Eurofound, 2021.

The combination of technology development and restrictions in the pandemic Covid 19 put additional pressure on the digitalization of the economies and required from citizens all over the world sudden and fast improvements in digital literacy. Adoption and upgrading of digital skills became crucial for successful participation in the global digital transformation (Eurofound, 2021).

Automation includes a wide range of technology solutions from enterprise resource planning software (ERP) through scanners used in automatic billing of parking lots, robots in manufacturing or logistics operations, augmented reality in the entertainment, to artificial intelligence in the healthcare industry or financial consulting services. Thus, automation substitutes for human labor. However, automation as well as other technological advancements, does not diminish the need for the human factor in the organization. Rather, it changes the content of the job by substituting for both physical and cognitive tasks that are part of an existing occupation, and therefore creates new occupations, transforms existing ones, or makes whole occupations obsolete.

Until recently, studies predicted that the innovation in automation would mostly substitute routine tasks, and thus would especially affect lower-wage, lower-educated workers in occupations characterized by routine work (Muro et al., 2019). With the development of AI (including ML

and deep learning) not only repetitive menial jobs are about to become obsolete. Higher educated white collars with high-wage jobs working in more cognitive-intense occupations (such as managers, leaders, healthcare professionals) are also becoming replaceable to a certain extent.

A vibrant dilemma about the effects of technological trends on labor demand, productivity, wages, and employment has brought out two dominant streams of thought: researchers who are looking into the negative effects of automation on employment, and the phenomenon of unemployment as a direct consequence of human labor being replaced by machines (Brynjolfsson and McAfee, 2014; Frey and Osborne, 2017; Author and Salomons, 2018); and the ones who advocate automation as a growth factor that will consequently introduce more jobs (Harari, 2018; Acemoglu and Restrepo, 2019). All of them agree on the importance of individual and collective skills upgrading speed for the balance of demand and supply in the labor market.

3. IMPLICATIONS OF TECHNOLOGY ADVANCEMENTS ON WORK AS AN ECONOMIC RESOURCE

Technology developments are affecting all parties on the labor market: employers (i.e. organizations), employees (i.e. work content and skills) and regulators (through labor law and employment policies). In other words, new technologies are intervening in the organization structure, affecting value formation and appropriation, work content, work organization and work patterns, distribution of time, requirements related to workplace or working hours; they are influencing workers' employability and desirability on the labor market.

3.1. Structure of the organization

Technology advances are changing whole industries (Babić et al., 2019), forcing products/services out of the market, and therefore rendering tasks and skills leading to their production obsolete. Due to lower labor costs in developing countries, many western hemisphere large manufacturing organizations had to downsize their European and USA business and rely on either relocating their production to emerging economies or on outsourcing. The restructuring was based on changes in strategic focus and new perceptions of sources of competitive advantage. Competitive advantage was no longer related to internalization of resources. In other words, the boundaries of organizations started to blur, and vertical hierarchies and bureaucracies were replaced with flat organizations, collaborations, agile teams and networking, dependent on cost efficiencies. In many cases, the competitive advantage consists of production according to cost strategies and economies of scope, and when applicable, differentiation based on distinctive higher added-value product/services features.

Since the pace of changes is accelerated in a globalized world, in order to stay competitive and sustainable, firms are focused on becoming flexible and adaptable. For that reason, employers advocate for flexible hiring and firing policies. The logic of flexibility is to acquire workers quickly when in need and release them from a payroll even faster in downturn cycles. In the meantime, while waiting for regulator/institutions to accommodate business needs, employers seek loopholes in labor law regarding employment policies, as well as for employment options that allow them to circumvent regulations agreed/lobbied by unions. These experiments, which are aiming to achieve more flexibility in managing the business, do not necessarily represent illegal business behavior. Rather, they are resulting in establishing new forms of employment and finding new sources of competitiveness, either derived from labor market surpluses (contin-

gent work) or boosted by ensuring access to scarce resources (specific expertise). On the other hand, flexibility is not necessarily required only by employers; employees nowadays appreciate more time for their private lives, desire more autonomy in choosing a workplace, work projects and/or worktime, and thus also from their side they push forward more non-standard forms of employment. As the human resource factor has become truly global, organizations are forced to transform once again to accommodate those changes and to find alternative ways of organizing work, such as in a full remote organization or hybrid organization models.

3.2. Content of work

Changes in the content of production affect the (re)allocation of production factors (i.e. capital and labor). New technologies introduce alterations in human activities by modifying tasks that need to be done in order to support the production of products and services. According to the task-based approach (Acemoglu and Restrepo, 2018), new technologies increase the productivity of factors of production. At first, new technologies increase the efficiency of the capital since (part of) human work is automated or otherwise replaced. This substitution of human work with machines changes the content of the work, and thus alters the job requirements as well as the skills needed for an occupation.

Replacement of human work with new technologies is known as a *displacement effect*, which means that capital is taking over tasks (and entire jobs) previously performed by labor. Automated tasks achieve a higher level of efficiency (faster, unified, with fewer mistakes), which results in increased productivity, and in turn adds more capital to the production system (Acemoglu and Restrepo, 2017). More capital leads to new investments, spillovers to related, supporting or non-related industries, creation of new markets for products and services, and consequently to the creation of new jobs – a phenomenon called *reinstatement effect*.

3.3. Workers skills

Technology advancements greatly affect labour force. Contrary to the mainstream forecasts in the 20th century, more recent studies elaborate that not only routine tasks are in jeopardy of being substituted with technology; while jobs of blue-collars are replaceable with industrial robots (Graetz and Michaels, 2018; Acemoglu and Restrepo, 2018), jobs of white-collar workers are in danger of artificial intelligence development (apps, chat-bots, counseling) and machine learning. Contrary to robotics, which replaces routine work defined as (set of) repetitive and predefined tasks, AI endangers cognitive and socio-emotional work by introducing solutions for replacing interpersonal tasks such as human resource management, decision-making, problem-solving, etc. Studies show that highly skilled workers are more resistant to changes in technology and content of work (Dahlin, 2019), while low-skilled workers are less adaptable to changes and therefore tend to stay on the labor market longer (Acemoglu and Restrepo, 2018).

Job-relevant skills are task-related (such as computer use) and are built on a combination of cognitive and socio-emotional skills. Cognitive skills are defined as “the ability to understand complex ideas, adapt effectively to the environment, learn from experience, engage in various forms of reasoning, and overcome obstacles to thinking” (World Bank, 2014). Literacy, arithmetic and the ability to solve abstract problems are all cognitive skills. Socio-emotional skills, sometimes referred to in the literature as non-cognitive skills or soft skills, refer to traits that cover multiple domains (such as social, emotional, personality, behavior, and attitudes). Given

the dynamics of technology development and the speed of jobs change, contemporary labor policies emphasize the development of transferable skills, generic and non-cognitive skills. In that way, workers regardless of formal education and profession could become more flexible to change jobs and acquire new knowledge and skills. Non-cognitive skills, including communication, planning and team working, are becoming increasingly important, equally as problem solving (Gonzalez Vazquez, I. et al., 2019). There is a growing demand for workers with creative and social intelligence, such as entrepreneurs, leaders or managers.

Changing requirements and better skills-job alignment require adjustments of the training and education system, which often require social effort and significant investment (Kastelan Mrak and Sokolic, 2017). Countries that adopted their education and training systems are making visible progress towards a more balanced labor market, economic growth and prosperity (Cvecic et al., 2018).

4. FUTURE RESEARCH DIRECTIONS

Technology development, together with the rigidity of national labor markets, led to emerging of new forms of employment. They differ in many ways from standard work arrangements between employer and employee. Some change the relationship between employer and employee, some change the organization of work and patterns of work, and some both (Eurofound, 2015). The drivers for their presence in the labor market are different, from the necessity to opportunity reasons on both employer and employee sides. However, the one thing they all have in common are aspirations towards flexibility. Even though some of the forms are present for a longer time and research is available for policy makers, some of them are still relatively new in practice, and there is no consistent research on their effects on labour market or working conditions. For illustration, Figure 2 compares the implications which some of the new forms of employment have on employees with the implications they have on labour market.

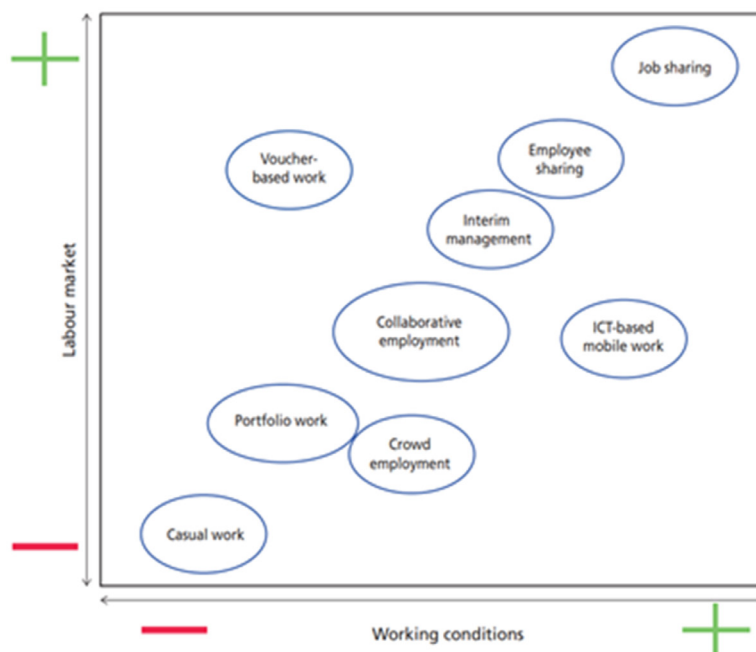


Figure 2. Assessment of implications of new forms of employment for working conditions and the labor market

Source: Eurofound, 2015

However, there are some indications that not all of them are equally beneficial for employees and labour market. For example, contingent employment practices (gig workers) do not ensure standard workers' rights (social protection, health security, integration in organization, career development opportunities). They also affect segregation on the labor market (low skilled workers whose skills are in low demand experience difficulties in changing their career paths), and broaden the gap between the low and high end of the labor market (Eurofound, 2020). Further research should be oriented towards a better understanding of the effects that specific forms have on labour market, economic growth and well-being.

5. CONCLUSION

The transforming nature of new technologies changes organizations and their business models, occupations, as well as workers' position in the labor market and their work-related possibilities and preferences. In the era of the rapid advancements in technology, conditions on the labor market are greatly affected by the following processes: a) replacing existing tasks with machines that makes contingent of workers redundant, b) introducing new tasks for whose performance new skills are needed and usually scarce, at least in the beginning phase.

It might be the case that capital fully replaces labor in some occupations (for example, sales force in automated self-check out stores), while it replaces labor only partially in some other occupations, or create spillover effects for which new occupations have to be designed (broadening of products and services portfolio). Since in any case occupations either disappear or change to include new tasks, workers are forced to upgrade their skills.

Acquiring new skills can bring higher employability, versatile career possibilities and higher income for the employee, as well as higher creativity and innovation potential for organizations. Additional training and education require additional resources, time being a prominent one. For that reason, even though technology eventually increases labour demand, the requirement for new competencies can cause problems of impeded employability and ultimately structural unemployment. Therefore, technology development can have a large impact on productivity and labor demand.

As the content of work is changing professions and occupations, acquiring new skills has become essential to staying employable and/or developing a career. In addition, due to market uncertainty and cost efficiency pressure, employers are negotiating with regulators on more flexible employment policies. Employees' agenda is twofold: while some of them are struggling to stay in employment, others are eager to achieve a more favorable work-life balance. On top of all that, pandemics is hitting hard on demanding higher levels of digital literacy, as well as skills in online communication, managing virtual teams, self-organizing skills, etc. The velocity of technological changes, industry/market context and rigidity of labor market policies stimulate employers and employees to search for alternatives to standard employment schemes, resulting in new forms of employment. Due to their different nature and socio-economic rational of their appearance, some of them are beneficial for employees, organizations and labour market, while some of them contribute to additional labor market segmentation and further polarization of wealth and well-being.

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