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Active Labour Market Policies for Digital Economy: Skills Development and Workforce Preparation

Adele Bianco[1]

SUMMARY: 1. The digitization process. Theoretical framework and technological driver – 2. Digital economy and employment – 3. Making the digital work. A policy agenda – 4. Concluding remarks – 5. References

Work is undergoing technological upgrading and innovation driven by digitization, the so called Fourth Industrial Revolution (Schwab 2016). The technological advancement makes possible to achieve higher levels of work and total factors productivity and to implement the Sustainable Development Goals (ILO 2016; Dodds et al. 2017). The issue is particularly sensitive, because of the coming impact of technological innovation on employment and the consequential intensified risks of social unrest (Frey, Osborne 2013).

This is the reason why it is extremely relevant to equip people to stay ahead of technological change. To prepare the workforce for tomorrow, the attention has to be posed particularly on educational, training and re-skilling programs (Goldin, Katz, 2010).

One problem is that — in Europe, but also elsewhere — this technological and organizational revolution is likely to be realized with an army of grey-haired workers (Kuhn, Ochsen 2009), but it must be taken into account that in a very near future workers of other age groups, adult and even young workers, will be the involved in some reskilling programs and in changing schooling processes. It is therefore appropriate to promote policies aimed at reskilling these workers and at making the young people fit for the coming digital economy. From this point of view, the permanent training will acquire an unprecedented role in the history of work.

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The paper is structured as follows. The *first* paragraph gives a short definition of the digitization process that has been taking place for some years and highlights the theoretical framework and technological areas involved in the digitization process. The *second section* is focused on the impact of the digital economy on the employment. The *third* paragraph is devoted to the skills requested by the digital economy and to measures that should be undertaken to enable the workers to stay on the labour market and to make more inclusive the workplaces. Evidences make clear that managers play a relevant role in supporting this kind of implementation process, particularly referred to the older workers, and in training and in introducing new forms of work organization (Sterns et al.1994; Maurer, Weiss, Barbeite 2003).

1. The digitization process. Theoretical framework and technological driver

This paragraph is devoted to the digitization process and its technological areas. The first part gives a short definition of the digitization process that has been taking place for some years and the second part is focused on the theoretical framework and the technological areas involved in the digitization process.

1.1 Definition of the digitization process

It is not simple to give a definition of the digitization process, firstly because there are several definitions, secondly because the fields involved are many human activities, not only the industrial ones[2]. As stated by Hirsch-Kreinsen (2016: 1-2) «the diffusion and implementation of digital technologies for work […] in industries […] is variously called the "second machine age" (Brynjolfsson and McAfee 2014), the "third industrial revolution" (Rifkin 2011) or, in the German-speaking world, the "fourth industrial revolution" — respectively, "Industry 4.0" (research Union and acatech 2013)». According to the European Parliament, "Industry 4.0" «describes the organization of production processes based on technology and devices autonomously communicating with each other along the value chain: a model of the 'smart' factory of the future where computer-driven systems monitor physical processes, create a virtual copy of the physical world and make decentralized decisions based on self-organization mechanisms» (European Parliament 2016, 20). OECD adds that the new work organization is based on «the connection of most devices and objects over time to a network of networks. It encompasses developments in machine-to-machine communication, the cloud, big data and sensors, actuators and people. The convergence will lead to machine learning, remote control and eventually autonomous machines and systems» (2015, 239).

[2] A review of the meanings and the implications of the Industry 4.0 concept, see Pereira, Romero, 2017.

Some researchers point out that we are witnessing a new industrial paradigm because of the digitization process. According to Oesterreich and Teuteberg' statement (2016), the main features of the Industry 4.0 is based on digitization and automation in manufacturing, so that the outcoming value chain is a digital one. Kagermann et al. (2015) stress the three dimensions of integration: the first is a horizontal one and concerns the value networks; the second involves the manufacturing systems seen as a vertical integrated network and the third dimension concerns the digital integration along the entire (end-to-end) value chain.

In sum, the digitization process in the industrial sector means a set of technological and organizational interconnected to each other. This involves not only the industrial production but also design, management, logistics, distribution, after-sales services (European Parliament 2016, 20-21; Broy 2010; Reinhart et al., 2013, 84-89).

The digitization process makes possible to increase productivity, to set the organization and distribution in a more efficient way. In fact, thanks to the continuous connection within the value chain, it is possible to create goods on client's demand. Therefore, the distinction between production and post-production services is not so easy to mark (Wahlster et al. 2014). Moreover, the digitization process could involve not only the industrial but also the everyday life activities (Hess, 2015; Vogel-Heuser et al. 2015; World Economic Forum 2016, 5-8).

1.2. Technological change areas

Digitization is related to four technological change areas. The *first* concerns the big data analytics. Data analytics is one of the most important driver of the high-tech economy. It consist in the processing data sets in order to examine who we are and what we are likely to do as consumer and as citizen/voters. Data analytics technologies and techniques make possible new business models based on more-informed business decisions. In this sense, it could be said that Big Data are the oil of the 21st century and that Data analytics technologies and techniques their refinery. Thanks to the increasing computing power, it is possible to process data more efficiently and profitably (McKinsey 2011).

The *second* area concerns the artificial intelligence or machine learning. Such applications made impressive progress in recent years and make possible to take relevant decisions also referred to sensitive issue like healthcare. It is the case of the applications Watson 4 IBM already in use in some US cancer care hospitals. This software can process the information on the patient's health conditions, compare it with the scientific literature and the care protocols, and finally suggest a therapy to be evaluated by the oncologists. Another application of the Artificial Intelligence (AI) is the no driver car. Thanks to the AI, it is possible that cars "learn" to avoid an obstacle and "choose" the right direction (Bonnefon et al. 2016).

The *third* area concerns the Human Computer Interaction. Such applications can help people in strenuous or heavy tasks. They can also increase human capacities thanks to touch interfaces and human sensory perception thanks the Augmented Reality, of which Google Glasses are an example (Kipper, Rampolla 2012). The *fourth* area concerns the relationship between physical and digital worlds. The progressive interoperability between physical and virtual reality sets cyber-physical systems (Gill 2006; Acatech 2011). In this regard, significant examples are the

additive manufacturing (3-D printing) (Gibson et al. 2010) and the advanced robotics in the Leipzig BMW plant[3].

2. Digital economy and employment

This section is devoted to the impact of the digital economy on employment. Even if the technological upgrading is a historical *Leitmotiv* in reducing old jobs and in creating new one (Mokyr et al. 2015), this time the question could be sensitively different. The technological upgrading will be this time not simply a labour saving production model, because many repetitive tasks are at risk to be substituted by machines, but also the middle-skilled occupations could be replaced and even professional sectors could be involved in some forms of automation.

In the second part of this paragraph we are going to examine the skills requested by the digital economy.

2.2 The occupational perspectives

There are diverging estimates on the occupational perspectives influenced by the digitization process. Spath et al. (2013) — referring to the German case — observe that digitization is a chance to increase occupation. According to the Boston Consulting Group's analysis the impact of Industry 4.0 «on German manufacturing […] will lead to a 6 percent increase in employment during the next ten years» (BCG 2015, 8). Other authors think that the digital technologies will cause unemployment because of the substitution of human workforce. According to Frey and Osborne's estimates (2012, 38), America will be lose about half of the today jobs because of automation. Also Brynjolfsson and McAfee (2014, 177 ff.) outlined somewhat worrisome forecasts concerning the occupational compensation between old and new jobs.

Other arguments consider the loss of old and the gain of new, digital jobs, which are at the moment not still known. The World Economic Forum (2016) — referring to the different kind of jobs and occupations — foresees a «strong employment growth across the Architecture and Engineering and Computer and Mathematical job families, a moderate decline in Manufacturing and Production roles and a significant decline in Office and Administrative roles» (ivi, 11).

Consequently the World Economic Forum accounts «current trends could lead to a net employment impact of more than 5.1 million jobs lost to disruptive labour market changes over the period 2015–2020, with a total loss of 7.1 million jobs […] and a total gain of 2 million jobs» (2016, 13).

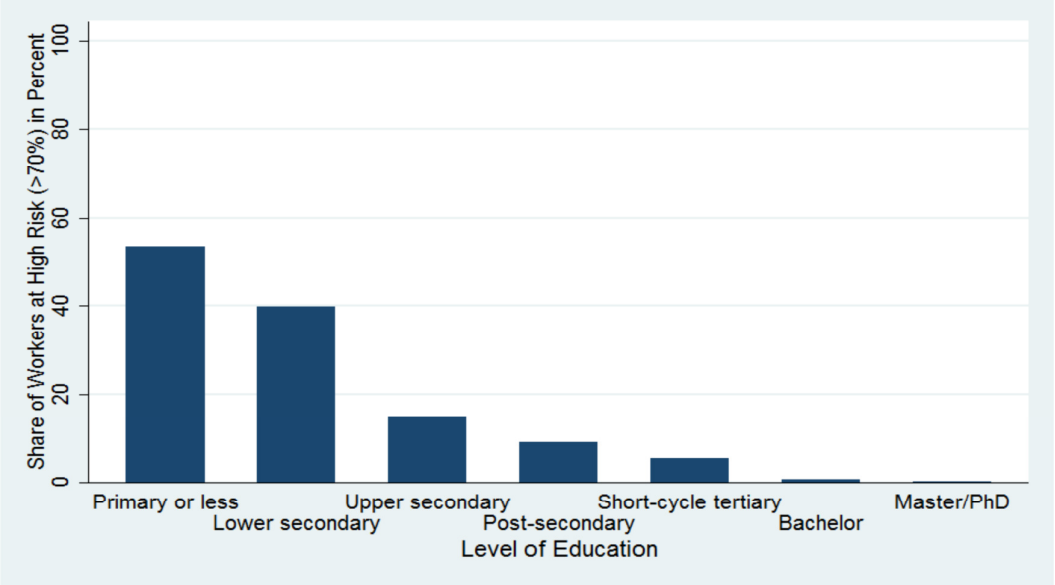
Some researchers disagree with Frey and Osborne's approach, because it leads to an overestimation of the job loss. Arntz et al. (2016), f. i. point out that the evaluation of the technological impact on employment should take into consideration the quality of the employment. They stress the relevance of the task involved and the qualification level of the workforce. In their research, they show that the automation and digitalization could have a deeper impact on low skilled workers, because their task are easy to be automatized. At the

[3] https://www.press.bmwgroup.com/deutschland/article/detail/T0209722DE/neuartige-mensch-roboter-zusammenarbeit-in- der-bmw-group-produktion? language = de

same time high skilled workers, with a high education level are not at risk to be unemployed, because their jobs are hardly to be replaced by machines. As shown in Figure n. 1, there is a close correlation between education level and automatization of jobs.

That means that countries with massive low skilled workforce and hardly to be re- and upskilled could experience in a very near future a dramatic rise of unemployment.

Figure 1. Share of Workers with High Automatibility by Education



Source: Arntz et al. 2016, p. 20

Concerning the digital skills, the scientific debate point out two different trends (Ittermann *et al.,* 2015; Hirsch-Kreinsen 2014). The first outlines a *skill upgrading* (Hirsch-Kreinsen et al., 2015, 15ff.), the second a *polarization* between high-skilled, high-paying occupations (managers, professionals, technicians) and low-skilled, low-paying occupations (elementary, service, and sales workers) (Michaels et al. 2010), because many repetitive tasks will be made by machines.

The skill upgrading means an increasing knowledge based content. More complex and interactive machines need higher skilled workers (Baldissera 1992; 1996). The digital worker will be asked to be a high skilled system operator. Managing ICT systems means not only to develop technical abilities and to be a competent user of working tools, but also to understand

and to manage complex situations, to deal information processes, to find and to solve problems thanks to a critical mind (high-order cognitive abilities). Another important character for the digital worker will be the socio-emotional (soft or non-cognitive) skills (World Bank 2016, 122ff.)

The coming workplace will be less hierarchical and more collaborative, and the working organization will be structured in flexible teams. Consequently the workers will be requested to be in attitudes, behaviors, and values autonomously proactive, propositive and easily adaptable to changing situations.

According to the above drafted framework, it is quite easy to foresee that the repetitive, low-skilled jobs in industries and offices will be in a very near future affected by these innovations (World Bank 2016). But also the professional sectors could be involved. The middle-skilled occupations — clerks, plant and machine operators but also those working in logistics and processing, digitization (data entry, publishing/printing) — are at risk to be substituted by some forms of automation.

In sum, the digitization processes have an impact on the occupational perspectives as well as in reshaping the skills asked by the coming digital labour market. These changes have a positive effect on increasing productivity but are a problem for people who must adapt their career and life to the transition to new jobs. This is the reason why it is necessary that the involved workforce, particularly the greying one, will be positively turned to reskilling programs (OECD 2015a).

3. Making the digital work. A policy agenda

This paragraph is focused on measures to make more inclusive the workplaces and to enable the workers to stay on the labour market.

Before going on, it is to define more precisely what are the digital skills. The abovementioned digital skills to be developed are : i) technical, ii) high-order cognitive, and iii) socio-emotional. These set of three skills are necessary for the digital worker at the same time, so that he/she can easily change jobs and occupations across the labor market.

The technical digital skills can be distinguished between basic and advanced (EU 2017). The digital *basic* skills concern people who use the internet not in a professional way and are able to use mailbox, editing tools, installing new devices. Therefore they use internet to read online news sites, newspapers or news magazines or to play or download games, images, films or music or to use video on demand services. They can also communicate via internet — taking part at video calls (e.g. Skpe) and social networks. They are also able to make electronic transactions such as internet banking, shopping, ordering goods and services online. All of these (more or less) basic skills are therefore socially relevant. They point out the digital abilities within a society that makes possible broader development benefits from using these technologies (World Bank, 2016).

The *advanced* skills are referred to ICT specialist, considering among them ICT service managers and technicians, and the STEM (Science, Technology, Engeneering, Mathematichs)

Graduates (people aged 20 - 29). The technical abilities enable workers in using working tools. Focusing the attention on this skill development people have to be trained in computational thinking. Thanks to the Massive Open Online Courses (MOOCs), virtual laboratories and simulation games, the workers can improve their skill along their life. The technical abilities have to be developed and constantly improved by additional training, because of the skill obsolesce in contemporary society.

Considering young generations, STEM education should be strengthened, that means promoting these subjects in the school and particularly among girls (see OECD 2015b).

The second kind are the high-order cognitive abilities. This kind of abilities enable the digital worker to understand and to manage complex situations, to deal information processes, to find and to solve problems. This is the reason why this requires a critical minded worker.

In the digitization process the tasks previously carried out by qualified technicians are carried out by an operator specialized in complex systems (Windelband, Dworschak 2015). He/she operates in real time, manages data flows, and makes decisions together with managers. It is also well known that unforeseen variations, including technological accidents, are not just a technical question, but a difficult relationship between human beings and technique that operator has to solve (Baldissera 1998). Therefore, digitization requires workers to manage sophisticated technologies, not only from the technical-productive point of view, but also in supporting production processes and in planning it (Bauer, Schlund 2015; Schnalzer, Ganz 2015). Moreover, the worker will be required to deal with any emergencies, like the "ironies of automation" (Bainbridge 1983). In such cases he/she should come to a decision, also playing the role of the "manager of uncertainty" (Dombrowski et al., 2014, p. 149; Grote 2015).

The last but not least skill required at the digital worker is the socio-emotional (or soft or non-cognitive) one (World Bank 2016, 122ff.). It will be more and more relevant because new technologies tend to level up internal hierarchies and it will change the traditional statement at the coming workplace making it more horizontal. So, the digital worker should interact with other colleagues directly and properly and this point is crucial, because of the possible conflicts between technicians and managers. This social figuration puts managers at the same level as the workers. According to the organization theory, interdependencies and balance of power are influenced by the actors' interests and attitudes (Barnard 1938). That is the reason why it is crucial that the managers are appropriately skilled when technology develops and the digitization process (Zuboff 1988; Burries 1998) takes place.

Concluding remarks

Contemporary societies, especially in the advanced countries, are witnessing the technological upgrading and innovation process driven by digitization. The focal point of the active labour market policies is to equip people to stay ahead of technological change (van Deursen et al. 2014). This is the reason why lifelong learning and promoting labour policies aimed at reskilling the workers and at making them fit for the coming digital economy are pivotal issues.

But the transition to a digital work organization is not an easy transition process. Innovations and new technologies are double-sided. They can facilitate but at the same time create new barriers when they are not enough user friendly. In fact, even if technologies have been implemented to help workers, they can be not a support but source of new problems and a challenge.

This is particularly stressful for ageing people. The older workers should adapt themselves to technological changes and also develop new kinds of skills. Anyway also the young workers have to be appropriately trained and in so doing reducing the risk to be affected by skills mismatch (ILO 2014; 2010).

Evidences show that high skilled workers are successful in the challenge with new technologies and that they can use them very profitably (Paloniemi 2006; WHO 2002). Workers with a good professional experience and good qualification and that frequently use computer at the workplace continue to be active, are ready to spend time and energy in upskilling training and, when they are older workers, they tend to delay retirement (Selwyn 2004; Potocnik 2017). As known, the lifelong learning is a policy measure to increase the labour force participation rates among the oldest cohort in some advanced countries and to achieve by 2030 according to the Sustainable Development Goals[4] full and productive employment and decent work for everybody (ILO 2016; https://sustainabledevelopment.un.org/sdgs).

Lifelong learning is the way to develop the human capital and to make it competitive, to promote individual talent and competences for digital jobs, thanks to appropriate skilling measures (Tikkanen 1998). It is also a key issue for the contemporary knowledge-based society, because these measures are inclusive, learning supportive and create partnership, and it is a challenge for everybody. Every actor of the digitization process — employers and employees, but also managers, Trade Unions, educational institutions — are involved in developing and shaping the digital society of the 21st century.

Considering young generations, STEM (Science, Technology, Engineering, Mathematics) education should be strengthened, that means promoting these subjects in the school and particularly among girls (OECD 2015b). In so doing they get a basic education technologically oriented and reduce the risk to be affected in their career by skills mismatch.

[4] If the digital innovations contribute to improve the quality of people's lives, achieve equitable growth, and help protect the environment is a debatable topic. There are both of opportunities and challenges in the relationship between digitalization and sustainability (Osburg T., Lohrmann 2017; Zacher 2017).

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