# The Silver Innovation
# Older workers characteristics and digitalisation of the economy[1]

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**Abstract**

The current trends in the ageing of the work-force, which are only in part counterbalanced by immigration flows, risk to expose European enterprises to a widespread situation of skills shortage, together with the loss of a huge wealth of knowledge and experience, as a consequence of baby boomers retirement. In this context, the automation/digitalisation of production represents one of the main tools in the hands of advanced economies and organizations to react to the shrinking of the labour force, while boosting productivity and containing costs.

The paper attempts to provide an initial framing of the problematic relationship which intervenes between digital innovation and employability of older workers. The discussion will offer a possible interpretation of on-going transformations and a provisional explanation of the current situation in Italy.

The contribution will summarize the most important demographic transformations which affected the labour market during these years, in the light of the (potentially) disruptive spread of digital technologies. The topic of the digital evolution of jobs' task content and its influence on training needs will be addressed. Reflections concerning the relationship between the adoption of technological innovation and the quality of human capital will be presented and some hypothesis concerning the recent evolution of employers' attitudes towards older workers, about facing technological innovation, will be suggested.

[1] The paper illustrates the point of view of the author. The opinions expressed and arguments employed do not necessarily reflect the official views of INAPP.

## 1. Introduction

The current trends in the ageing of the work-force, which are only in part counterbalanced by immigration flows, risk to expose European enterprises to a widespread situation of skills shortage, together with the loss of a huge wealth of knowledge and experience, as a consequence of baby boomers retirement. In this context, the automation/digitalisation of production represents one of the main tools in the hands of advanced economies and organizations to react to the shrinking of the labour force, while boosting productivity and containing costs.

However automation/digitalisation processes could favor extensive job losses, probably affecting professions and economic sectors with lower salaries, causing the exit from the labour market of a large number of workers in short periods of time, thus contributing to increase the risk of long term unemployment, especially among older workers.

In addition to a less dynamic labour supply - in terms of adaptability and geographical mobility - as a matter of fact longer working careers imply a growing risk of skill obsolescence, both in the private and the public sector. This topic will be even more relevant as Italy will start facing the transformations in production, which are going to occur within the so-called "Fourth Industrial Revolution".

This paper aims at providing an initial framing of the problematic relationship which intervenes between digital innovation and employability of older workers. The discussion will offer a possible interpretation of on-going transformations and a provisional explanation about the current situation in Italy, also by means of a survey realized by INAPP in 2014, on a representative sample of small and medium sized private enterprises (10-249 employees) and by means of information coming from the national project on occupations and their skill needs jointly realized by INAPP and ISTAT on behalf of the Ministry of Labour and Social Policies.

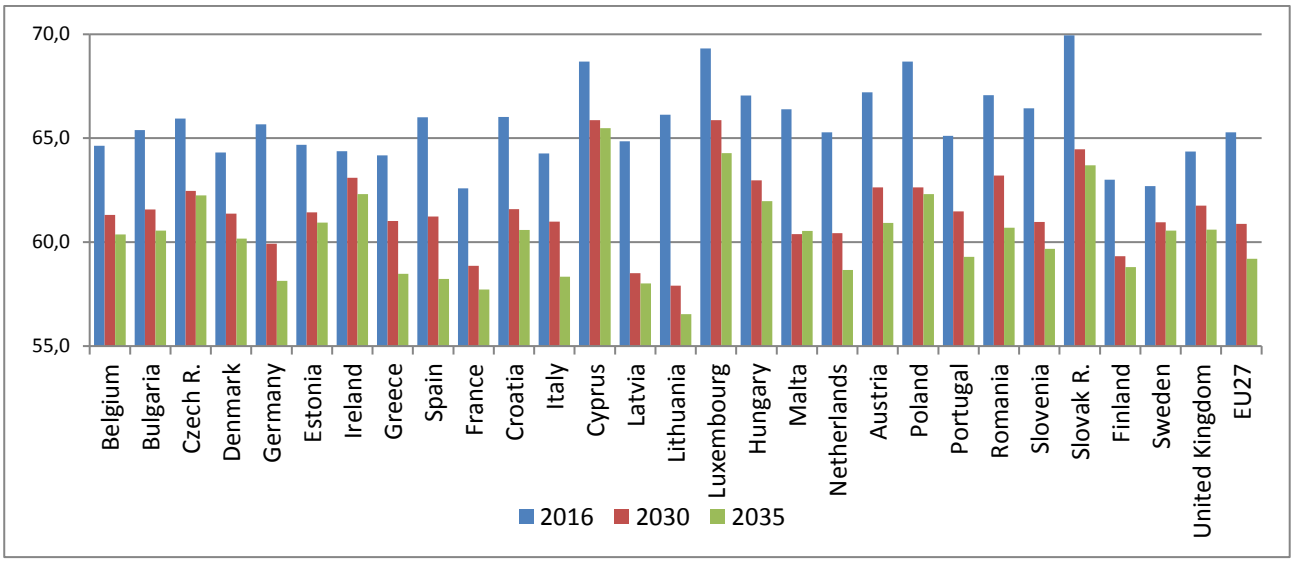
This contribution is one of the outputs of a three-year research project of INAPP, funded by the European Social Fund (ESF, PON SPAO 2014-2020), aimed at describing and analyzing the strategies of private enterprises for digital innovation, comparing them with the characteristics of the work force in general and of older workers in particular.

The second paragraph will summarize the most important demographic transformations that affected the labour market during these years, in the light of the (potentially) disruptive spread of digital technologies. The third paragraph will introduce the topic of the digital evolution of jobs' task-content and its influence on training needs. The fourth paragraph will present some reflections concerning the relationship between the adoption of technological innovation and the quality of human capital. The fifth will suggest some hypothesis about the recent evolution of employers' skills needs in face of technological innovation. The sixth paragraph will discuss the main results, while the seventh will provide some provisional conclusions, suggesting topics for further research as well.

## 2. Population ageing, labour market and digitalisation of the economy

In Italy, as in the other advanced economies, the gradual shrinking of the working age population (15-64) is going on, in parallel with the growth in the share of 50+ in the same age class. According to the 2018 Ageing Report by the European Commission (European Commission, 2018) the 15-64 population was 64.3% of the total population in 2016 and it is expected to decrease by 3.3 points (61%) in 2030 and by almost 3 more points by 2035 (figure 1). During the same period, the share of the elderly population (65 and over) is projected to grow by 8 points, from 22.1% to 30.1% of total population.

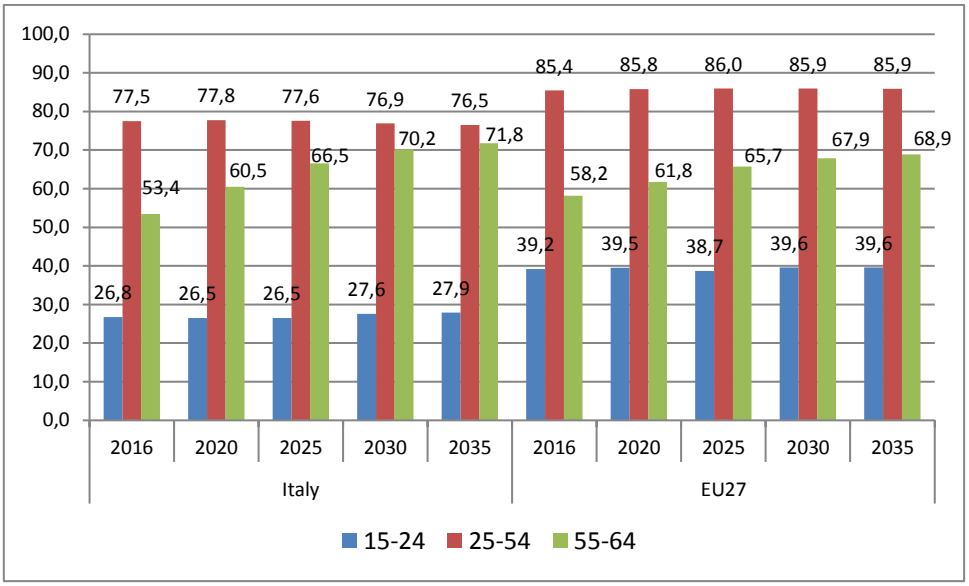
Figure 1 - Working age population (15-64) as % of total population. EU 27 and UK (%)




Source: elaboration on European Commission, 2018.

The demographic evolution will continue to be accompanied by different participation rates of various groups in the labour market (figure 2). While the participation of younger cohorts (15-24) will continue to remain low, in comparison to the EU27 average (around 12 points lower during the period of projections), that of central cohorts (25-54) will slightly decrease, widening its gap from EU 27 from -7.9 points to -9.4. In this scenario, only older cohorts (55-64) will constantly increase their participation, scoring 60,5% in 2020 and exceeding 71% in 2035, and gradually performing better than EU27 average.

Figure 2 – Participation rate by age classes. Italy vs EU27 (%)




Source: elaboration on European Commission, 2018.

The same projections forecast that the share of the 55-64 age class on the Italian employed population aged 15-64 will grow from 17.6% in 2016 up to a maximum of 28.5% in 2030, before starting to slightly decline. Following this evolution, the old age dependency ratio will steadily increase from 34.5 in 2016 to 51.5 in 2035 and up to a maximum of 62 in 2055, before starting to decline during the following five years.

These important demographic changes, both at population and organizations level, together with the forthcoming entering in the labour market of narrower cohorts, risk to expose Italian and European enterprises as well to a widespread situation of skills shortage, along with the loss of a huge wealth of knowledge and experience, as a consequence of many older workers' retirement. Even if these latter do not perceive a marked mismatch between their skills and the demand of employers, some information confirm their lower qualification levels, in comparison to younger workers and predict an actual risk of skill obsolescence, in view of the coming technological revolution (EU-OSHA, Cedefop, Eurofound and EIGE, 2017). The current automation/digitalisation processes therefore represents one of the main tools in the hands of advanced economies and organizations to react to the shrinking of the labour force and the retirement of baby boomers (Harris, Kimson, Schwedel, 2018).

A number of forecasting studies tried to estimate the possible outcomes of the on-going innovation processes, in the context of the demographic transition which will gradually affect all of the societies of the world (Pew Research Centre, 2014; United Nations, 2017).

Several authors suggest that the combination of demographic transformations and the impact of digitalization on the economy could cause growing income and social inequalities (Harris, Kimson, Schwedel, 2018). The speed and the pervasiveness of digitalisation could actually favor huge job

losses in specific professions and economic sectors, probably affecting lower salaries within a context characterized by shrinking wages, even due to a growing share of capital to the disadvantage of these latter. In this situation, we could witness the firing of many workers in a short period of time, with the resulting increase of the risk of long term unemployment. In parallel there could be a rising demand for jobs requiring "high" social and analytical skills, which are already better paid. These jobs could suffer from a lower supply for a long period, so contributing also to keep up the demand for baby boomers workers with these characteristics (Ibid.).

While according to some authors only 5% of all the jobs could be fully automated, at least 60% of them could have 30% of their activities which could be performed by machines, bearing in mind that these transformations are more likely to affect physical activities and/or activities performed within highly predictable and standardized environments, and information/data gathering and processing (McKinsey&Company, 2017). It's about jobs which are mostly within manufacturing or accommodation and food services, or tasks requiring medium level skills. According to the Boston Consulting Group (Sirkin, Zinser, Rose, 2015) the four industrial sectors more susceptible to automation are computers and electronic products, electrical equipment, appliances and components, transportation equipment, machinery. By 2025 authors estimate the concentration of 75% of robot installations in these sectors, traditionally characterized by higher wages, along with 40-45% of tasks automation. Plastics and rubber products, petroleum and coal products, primary metals will instead see the automation of 10-20% of their tasks. In this case, despite jobs would allow to automate in theory 85% of tasks, wages will probably remain low, so causing a slower pace of innovations adoption. Finally, chemicals, wood products, paper, fabricated metals, food processing, textile products will probably automate no more than 1-5% of their tasks in 10 years, due to technical obstacles and also to lower salaries, both of which will discourage digitalisation (Ibid.).

The sophisticated analysis by Frey and Osborne (Frey, Osborne, 2017), on the one hand points to a potentially negative correlation between the wage level of jobs and their exposure to the risk of being automated; on the other to a similar negative correlation between educational attainment of workers and their likelihood to be substituted by computer capital.

If confirmed, such hypothesis would mark a break in comparison to the trend which occurred during the informatics revolution of the 20th century, during which several middle level professions disappeared following the massive computerization of skills and jobs. As Frey and Osborne point out, their model cannot allow any estimation of the future aggregate changes of labour supply. Its interest is instead connected to the possibility of forecasting the substitution effect of technologies, which will be greatly influenced by the success of machines in overcoming the characteristics of jobs which are typical of human beings, namely perception and manipulation tasks, creative intelligence tasks and social intelligence tasks (Ibid.).

As concerns the estimations on American economy, Frey and Osborne further contend that: a) in the long run the growing of wages will make computerisation more and more suitable; b) policies and regulations could slow down the process; c) it is difficult to estimate how much time machines

will take to overcome human beings' typical skills; d) the computerization of tasks will originate consequences on jobs, due to productivity gains and the subsequent shift of human work on other tasks (Ibid.).

As concerns Europe, a recent analysis by the Institute of Labor Economics (Pouliakas, 2018) reach almost the same conclusions, based on the elaboration of very detailed information from the European skills and jobs survey (ESJS). The analysis, which follows the approach of Frey and Osborne, contends that a 51% of European employees does a job that could be automated. In particular, 14% of European employees has a job with a very high risk of automation, while 40% have equally a rather meaningful chance of automation. Men appear more likely to do jobs and/or to work in sectors with a higher automation risk, while it is confirmed that workers with a higher educational attainment level have also a lower probability of being in an automatable job (Ibid.).

According to the same study, the probability of automation also seems higher for persons in temporary contracts. Moreover, European workers in jobs which are more likely to be automated appear to be more frequently without career prospects and/or role and tasks changes. They also are less likely to have participated in any type of training and show higher skill gaps in their digital skills and in some important generic skills, such as communication, team working, customer-service, problem solving and planning. (Ibid.).

### 3. Digital transformation of tasks and training needs

All the analysis agree about the fact that the relationship among innovation, skills, position of enterprises along the national/international value chains, training and policies of regulation represent the main systemic components with which the State and the other actors of the economy can mitigate the potential displacement of large portions of the work-force, also boosting employment in sectors less susceptible to computerisation.

As reported by the Boston Consulting Group, in 2015 Italy was part of the group out of the top 25 manufacturing export economies that were installing robots at the slowest pace, despite the highest labour costs, in relation to productivity and the advanced ageing of the work-force, which would cause serious skill shortages in the mid-term. Remaining the 2015 trend unchanged, in 2025 Italy would have covered by robots 25% of the tasks, taking several decades to reach market saturation (Sirkin, Zinser, Rose, 2015).

In the short run the main question to address is therefore how automation and machine learning will in practice "absorb" human skills used to perform specific tasks, within different production settings, and what they will give them back, in terms of skills improvement or the other way round as simplification and impoverishment of their experience (Magone, Mazali, 2016).

As recently highlighted by OECD, digitalization can affect workers' tasks in two different ways (Bechichi, Jamet, Kenedi, Minea, 2017):

- there could be a complementarity effect, when by means of technology (including ICTs) workers can perform their tasks in a different way (e.g. collecting information or communicating with colleagues and customers);
- there could occur a substitution effect, as suggested by Frey and Osborne, when workers are replaced by machines; given that this is more likely to occur in the case of routine tasks which are easy to automate, we can have also a decrease in the routine intensity of a job.

According to this model, digitalisation would promote the expansion of non-routine tasks, performed with an extensive use of ICTs; on the other hand, a decrease of routine tasks would occur, performed both with a high or low use of ICTs and also of non-routine tasks, performed with a low use of ICTs (Ibid.).

The susceptibility of jobs to digitalisation is then described in terms of the intensity of the present use of ICTs and of the routine intensity of the same jobs. High-skilled jobs (such as managers or professionals) would supposedly evolve towards a greater use of ICTs, whereas reducing their routine tasks. On the other hand, jobs with a low use of ICTs and a high routine intensity would suffer a massive digitalisation process, as robots and artificial intelligence technologies will be able to take over routine tasks (Ibid.).

The elaboration on PIAAC data by Bechichi and colleagues more over hints that, when a job become more digitalized, workers are asked to perform more cognitive skills, jointly with communication, marketing and management ones, together with the so called STEM skills (Science, Technology, Engineering, Mathematics). These workers show also a higher readiness to learn (another key factor in the context of a digital economy) if compared to those who work in less digitalized environments.

A central element of this discussion concerns the comparison among countries about the preparedness of their workforce to enter the digital era. Following the arguments by OECD, less specialized workers, with an adequate level of cognitive basic skills, appear more ready to the coming changes at organizations and labour market level. Countries like Italy, which has a particularly specialized work force, could be less prepared for digitalisation, given that their workers would master to a lesser extent cognitive, communication, management, marketing and STEM skills, more useful to flexibly adapt to changes, possibly reinforced by transversal skills, such as critical and creative thinking, problem solving, decision-making ability and collaborative behavior (Ibid.).

In Italy, field observations by the management and some surveys within manufacturing and logistics seem to confirm OECD statements (Magone, Mazali, 2016). With digitalisation, firstly the tendency to enhance multitasking looks like to be consolidated, jointly with the learning speed, thanks to the support of digital media. This occurs within more and more integrated organizational environments, where the vision of the entire production process is provided to the single worker

and media devices contribute to lessen fragmentation. In this context, an overturning between general and specialized knowledge can also occur, eventually causing a deskilling trend of tasks, to the advantage of a faster entering of the work force into production (Ibid.).

A narrower set of specialized skills seems more useful for an organizational setting in which reading and using digital information become of primary importance, even if the authors consider a mistake to see the new blue collars as nearly-knowledge workers. If it does exist, the philosophy 4.0 is based on the transfer of human skills to intelligent machines, namely converting knowledge and skills in replicable information, stored within data bases. Additional attention should be devoted to the possibility of an easier use of temp work force to manage peaks in products demand, thanks to the speed in transferring information and to the steady effort of translating knowledge in information to be stored and circulated through the organization (ibid.).

The disruptive transformation of jobs caused by digitalisation, jointly with the transfer of knowledge and tasks to machines, lead OECD to strongly emphasize the importance of the certification of skills still owned by human beings (Bechichi, Jamet, Kenedi, Minea, 2017). This because, as digitalization will take place, the value added represented by the tasks still performed by workers will grow, giving their enterprises a competitive advantage (Ibid.).

This is increasingly urgent in the service sector. As the OECD authors admit, their information and models can hardly explain what is going on within the borders of the new forms of labour represented by the platforms or other characteristics of the GIG economy. As scholars already highlighted (De Minicis, Mandrone, Marocco, 2017; De Stefano, 2017; Guarascio, Sacchi, 2017), the new forms of work developing in this area can be divided in crowdwork, in which both the contact between buyers and sellers and the performing of tasks is done entirely on-line, and temporary physical jobs, usually provided at local level (e.g. UBER). Crowdwork can be represented both by complex and elaborate automated activities and the so called “artificial artificial intelligence” (Pessl, 2018), in which tasks are still performed by human beings who are unattainable and sometimes intentionally hidden to customers.

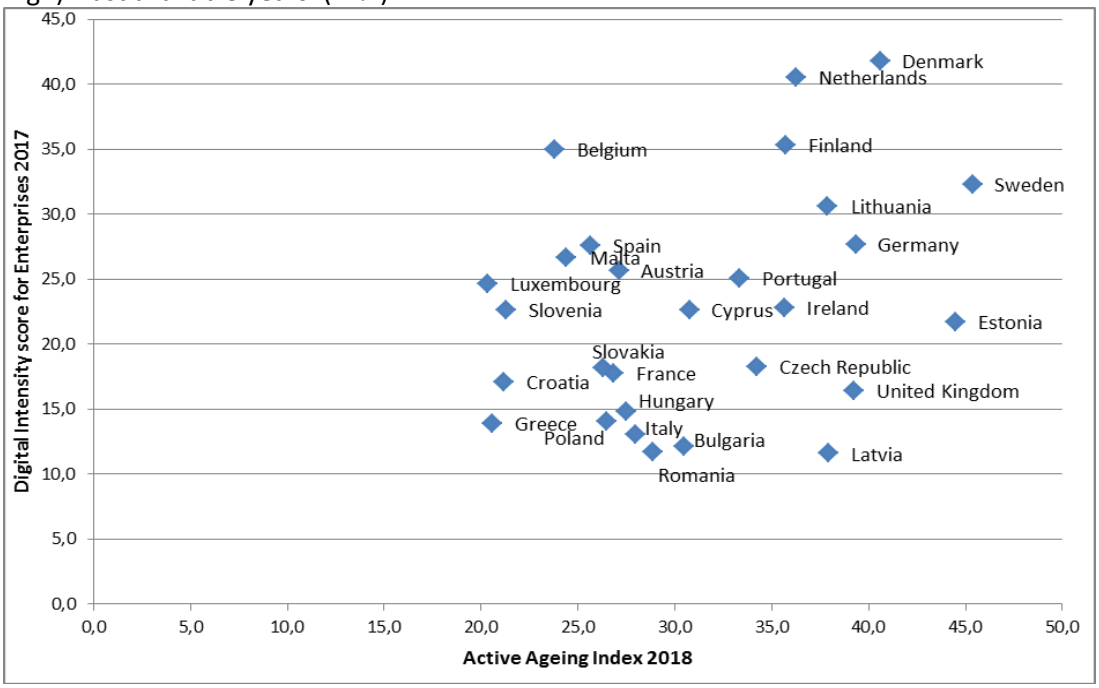
In this circumstances digital instruments, and the Internet in particular, are mainly used to match labour demand and supply at an extremely high and unprecedented speed. The matching function is almost always accompanied by procedures aimed at monitoring and rating job performances, also by means of tools (apps etc.) specifically designed to organize and control workers.

The first risk that this imply is a true re-commodification of work, circumventing legal rights traditionally connected to the regulation of the labour market in the context of the modern welfare state, both for employees and self-employed. In some cases, the matchmaker activity succeed in concealing the same nature of performances as jobs, thus denying the right of workers of having the protection of laws regulating the open labour market. Last but not least, platforms put on the worker the burden of the risk of a drop of labour demand or the consequences of a temporary inability to perform the job (e.g. due to illness).

## 4. The coming of the digital revolution and the quality of human capital

Due to the ageing of the work force, which originated from demography and from the effects of pensions reforms (which climaxed with the Fornero reform in 2011), the digitalisation of economy will impact, more in Italy than in other countries, on the employability of older workers. The comparison with the other Member States of EU, on the basis of ageing indicators and the Digital Intensity score for Enterprises of Eurostat[2], gives us the image of a labour market which will face a growing complexity and potential conflicts among different groups in the years to come (Checcucci, 2018) (Fig. 3).

Figure 3 - AAI Indicator Employment vs Digital Intensity score for Enterprises (High and Very High). Last available years. (v. %)




Source: Author's elaboration on data by Eurostat and Active Ageing Index project

Looking at the Active Ageing Index Employment[3] and the Digital Intensity score for Enterprises in last available years (2018 and 2017 respectively), we can see that Italy ranks lower in comparison

[2] The Digital Intensity score is based on counting how many out of 12 technologies are used by each enterprise. Then they are divided into four clusters of digital intensity: Very Low (scores 0-3), Low (score 4-6), High (score 7-9), Very High (score 10-12). https://digital-agenda-data.eu/datasets/digital_agenda_scoreboard_key_indicators/visualizations.

[3] The Active Ageing Index (AAI) is a complex indicator developed by UNECE within the framework of the 2012 European Year for Active Ageing and Solidarity between Generations (EY2012), with the contribution of European Union. The AAI is designed to measure the untapped potential of older people for active and healthy ageing at national and subnational levels and is constructed from 22 individual indicators that are grouped into four domains: Employment, Participation in Society, Independent, Healthy and Secure Living, Capacity and Enabling Environment for Active Ageing. Individual indicators are calculated on the basis of the results of the following surveys: EU Labor Force Survey (EU-LFS), European Quality of Life Survey (EQLS), EU Survey of Income and Living Conditions (EU-SILC), European Health and Life Expectancy Information System (EHLEIS),Eurostat ICT Survey, European Social Survey (ESS). https://statswiki.unece.org/display/AAI/Active+Ageing+Index+Home.

to its main European partners in both domains, significantly far from Germany and even more from Northern European Countries. The figure clearly shows that a high level of participation in the labour market by the older population does not necessarily conflict with the capacity of enterprises to adopt digital innovation. If we actually look at some of the Active Ageing Indicators (Table 1) we can notice that some Member States, out of the top 25 manufacturing export economies, with a high Digital Intensity Score rank higher than Italy also in some important features.

Table 1 – AAI Indicators Employment, Use of ICT and LLL vs Digital Intensity Score for Enterprises. Last available years. (v. %)

| | AAI Employment 2018 | AAI Employment 2018 - Gender Gap | AAI Capacity and enabling environment for active ageing - Use of ICT (ICT Survey 2016) | | Independent, healthy and secure living - Lifelong learning (LFS 2016) | | Digital Intensity score for Enterprises 2017 High (7-9) + Very High (10-12) |
|---|---|---|---|---|---|---|---|
| | | | Men | Women | Men | Women | |
| **Belgium** | 23,8 | -6,7 | 74,0 | 61,0 | 2,6 | 3,2 | 35,0 |
| **Bulgaria** | 30,5 | -5,7 | 26,0 | 25,0 | | | 12,1 |
| **Czech Republic** | 34,2 | -11,3 | 54,0 | 50,0 | 3,0 | 3,4 | 18,2 |
| **Denmark** | 40,6 | -9,8 | 86,0 | 88,0 | 12,5 | 25,9 | 41,8 |
| **Germany** | 39,4 | -8,2 | 73,0 | 64,0 | 2,3 | 2,5 | 27,7 |
| **Estonia** | 44,5 | 2,8 | 60,0 | 62,0 | 3,9 | 10,0 | 21,7 |
| **Ireland** | 35,7 | -14,5 | 50,0 | 51,0 | 1,9 | 2,6 | 22,8 |
| **Greece** | 20,6 | -10,7 | 33,0 | 23,0 | 0,6 | 0,7 | 13,9 |
| **Spain** | 25,7 | -7,0 | 51,0 | 43,0 | 2,5 | 3,5 | 27,6 |
| **France** | 26,9 | -2,5 | 63,0 | 63,0 | 7,0 | 12,2 | 17,8 |
| **Croatia** | 21,2 | -8,5 | 41,0 | 30,0 | | 0,2 | 17,1 |
| **Italy** | 28,0 | -14,0 | 46,0 | 34,0 | 3,5 | 4,0 | 13,1 |
| **Cyprus** | 30,8 | -12,6 | 42,0 | 30,0 | 2,1 | 4,1 | 22,7 |
| **Latvia** | 37,9 | -1,2 | 50,0 | 48,0 | 1,9 | 3,3 | 11,6 |
| **Lithuania** | 37,9 | -3,3 | 36,0 | 40,0 | | 2,8 | 30,7 |
| **Luxembourg** | 20,4 | -7,4 | 95,0 | 86,0 | 7,0 | 5,1 | 24,7 |
| **Hungary** | 27,5 | -10,0 | 50,0 | 51,0 | 1,8 | 2,0 | 14,8 |
| **Malta** | 24,4 | -21,1 | 50,0 | 41,0 | 2,7 | 3,4 | 26,7 |
| **Netherlands** | 36,3 | -14,0 | 87,0 | 82,0 | 8,4 | 9,1 | 40,5 |
| **Austria** | 27,2 | -9,8 | 68,0 | 50,0 | 4,9 | 7,6 | 25,7 |
| **Poland** | 26,5 | -12,2 | 39,0 | 36,0 | 0,6 | 1,0 | 14,1 |
| **Portugal** | 33,4 | -11,7 | 40,0 | 32,0 | 3,4 | 3,9 | 25,1 |
| **Romania** | 28,9 | -11,1 | 27,0 | 21,0 | | | 11,7 |
| **Slovenia** | 21,3 | -5,2 | 43,0 | 39,0 | 2,7 | 5,5 | 22,6 |
| **Slovakia** | 26,3 | -6,4 | 51,0 | 47,0 | 0,7 | 0,8 | 18,1 |
| **Finland** | 35,7 | -1,1 | 76,0 | 77,0 | 9,8 | 17,0 | 35,3 |
| **Sweden** | 45,4 | -5,3 | 87,0 | 86,0 | 11,9 | 23,6 | 32,3 |
| **United Kingdom** | 39,3 | -10,1 | 82,0 | 79,0 | 6,3 | 8,7 | 16,4 |

Source: Author's elaboration on data by Eurostat and Active Ageing Index project

In particular these economies show:

- a lower gender gap among older workers;
- a use of ICTs among 55+ clearly higher than ours;
- in the case of UK and Northern European Countries, a higher rate of participation to life-long learning initiatives of the older population.

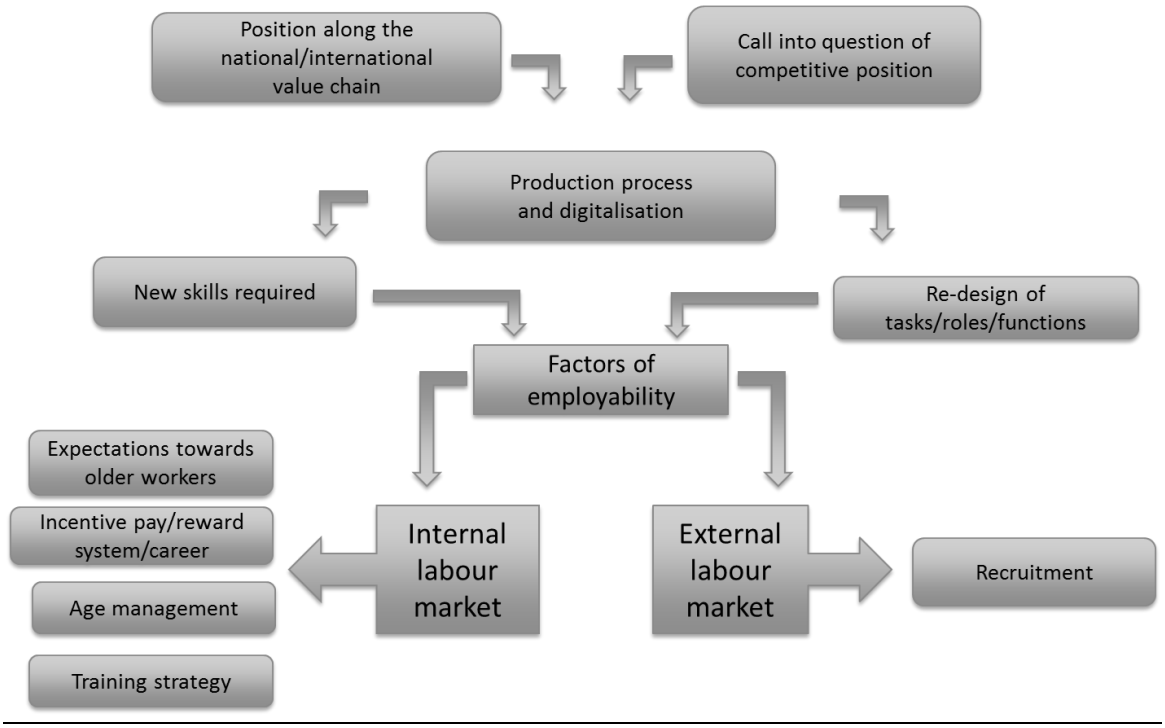
This seems consistent with the contribution by Acemoglu and Restrepo (Acemoglu, Restrepo, 2018), who contend that current trends in population ageing, looking at the period 1990-2025, can explain the automation level of various countries, even if there are other factors to be taken into consideration. Observing that nations and enterprises with higher ageing rates show a higher pace in the installation of robots and the import of automation technologies, they suggest that this digitalisation effort is directed to substitute the lack of middle-aged workers, often performing tasks requiring strength and physical dexterity, which is comparatively less likely among older workers.

The previous arguments suggest that it would be impossible to think that the Fourth Industrial Revolution could root without involving 50+ workers, which by now represent an important portion of the work force of the advanced economies. It is rather clear how the quality of human capital, and the adoption of strategic age management measures at organizational level represent two key elements to enhance the employability of this group, in this time of rapid and disruptive technological transformations.

## 5. The evolution of employers' expectations towards the employability of older workers

The diffusion of digital technologies will not restrict its influence only to the automation of production. It will instead urge organizations to find a better position along the national/international value chains, calling into question their competitive position (diagram 1). As scholars suggest (Magone, Mazali, 2016; Fantoni et alii, 2017; Hecklau et alii, 2016) the changes which will be induced in production will call for new skills and the adaptation of the old ones, as tasks, roles and functions will be rebuilt in accordance with the new paradigm. These changes will be reflected on the set of factors of employability (McQuaid, Lindsay, 2005) of all the workers in general, and of the older ones in particular, affecting both the internal and the external labour market.

Diagram 1 – Digitalisation, employability and age management




In Italy this evolution will affect a labour market which progressively went out the young in – old out model (Contini, Rapiti, 1999; Checcucci, 2013), in favor of the lengthening of the working lives of older cohorts. This latter was an age management strategy aimed at safeguarding the sustainability of the public pension pillar; but lacking a more comprehensive approach for the enhancement and development of employability of silver workers, this strategy probably favored a sort of "blocking effect" in the intergenerational turn over (Thijssen, Rocco, 2010; Checcucci, 2013; Boeri, Garibaldi, Moen, 2016).

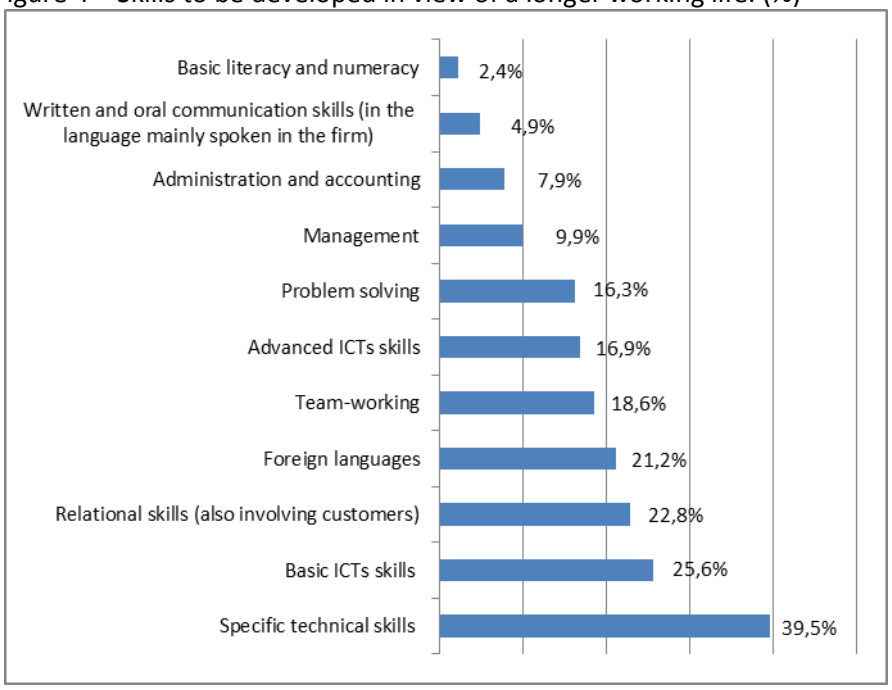
In this frame of reference, the 4.0 revolution could affect employability factors. This calls into question whether innovation strategies planned by organizations would seriously take into account the situation and the untapped potential of older workers, both on the internal and the external labour market.

As already highlighted by previous research (Aversa et alii, 2017), some interesting considerations, in the context previously depicted by OECD, can be formulated after looking at the skills that SMEs' employers declare to be necessary in view of a longer working life (Fig. 4). The priority given to specific technical skills (39.5%), in connection with the tasks already performed, could confirm a propensity to maintain a high specialization level of the work force, consistently with a perception of older workers as a guarantee of stability and know how. Secondly, the importance given to basic ICTs skills (25.6%) and to a lesser extent to the advanced ones (almost 17%) suggest probably a positive attitude in investing resources in business digitalisation, aiming at not excluding older workers from innovation processes.

The set of communicative skills, here represented by relational skills and foreign languages, appeared also relevant, with a share which was similar to basic ICTs skills. Communicative skills were moreover reinforced by a certain level of importance given to transversal ones, such as problem solving and team working, which receive great importance, as we already know, in the context of the 4.0 paradigm. The same was not true for management, administration and accounting, which received less attention by SMEs.

Strangely enough, basic numeracy and literacy, together with written and oral communication skills, received very little attention, confirming that a part of employers underestimated the weaknesses already reported by the PIAAC survey in the same period of time, among the Italian population in general and the older cohorts in particular (Checcucci, Mandrone, Roma, 2014).

Figure 4 – Skills to be developed in view of a longer working life. (%)




Source: INAPP, 2014.

Table 2 groups these information by skill set and disaggregates data in relation to the main structural variables.

On the side of specific technical skills, it seems to emerge a preference for specialization in middle dimension enterprises, in the industrial sector and in the constructions. As concerns ICTs, bigger enterprises, industry and services show the most relevant interest. A similar situation affects relational skills, where understandably services show a higher percentage.

The situation of transversal skills appears to be different, especially as concerns team working, because the research registered a certain concentration on SMEs with more than 50 employees, in the industrial sector and the constructions. Lastly, management, administration and written and oral communication skills see a certain prevalence in high value added services.

Table 2 - Skills to be developed in view of a longer working life. By dimension, economic sector and geographical areas. (%)

| | 10-19 | 20-49 | 50-249 | Industry | Constructions | Services (low added v.) | Services (high added v.) | North-West | North-East | Centre | South |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Specific technical skills | 38,3% | 43,5% | 37,5% | 40,5% | 46,3% | 37,6% | 35,5% | 40,7% | 41,7% | 35,6% | 38,9% |
| Basic ICTs skills | 22,9% | 29,4% | 32,4% | 26,9% | 21,8% | 23,3% | 32,4% | 27,1% | 25,2% | 24,7% | 24,5% |
| Advanced ICTs skills | 17,0% | 14,2% | 22,5% | 15,2% | 12,7% | 15,2% | 30,9% | 19,3% | 18,5% | 16,8% | 11,5% |
| Relational skills (also involving customers) | 21,9% | 25,0% | 23,5% | 17,7% | 16,8% | 29,6% | 23,7% | 22,6% | 19,1% | 23,1% | 27,3% |
| Foreign languages | 20,3% | 21,6% | 25,9% | 18,5% | 11,9% | 26,5% | 22,6% | 21,5% | 21,5% | 21,4% | 20,2% |
| Team-working | 18,1% | 18,9% | 21,2% | 19,6% | 23,2% | 16,7% | 17,0% | 18,7% | 18,5% | 18,9% | 18,5% |
| Problem solving | 16,0% | 16,3% | 17,8% | 17,5% | 15,2% | 14,6% | 18,8% | 17,9% | 15,7% | 14,5% | 16,2% |
| Management | 9,5% | 10,5% | 11,2% | 9,6% | 7,3% | 8,7% | 16,9% | 10,9% | 10,3% | 9,1% | 8,7% |
| Administration and accounting | 7,3% | 9,0% | 8,8% | 6,8% | 6,7% | 8,3% | 11,0% | 8,5% | 9,8% | 4,5% | 7,8% |
| Written and oral communication skills (in the language mainly spoken in the firm) | 4,1% | 6,8% | 5,4% | 4,7% | 3,6% | 4,8% | 7,2% | 5,9% | 5,4% | 3,9% | 3,8% |
| Basic literacy and numeracy | 2,4% | 2,7% | 1,3% | 2,8% | 3,4% | 1,6% | 2,5% | 2,8% | 1,7% | 0,7% | 3,9% |

Source: INAPP, 2014.

The lower level of ICT skills required in industry, construction and low added value services appears consistent with the findings of the European skills and jobs survey, which in 2014 positioned Italy in penultimate position in the incidence of basic/moderate ICT skills gap and in the last position considering the gap in advanced ICT skills needed by the job (Cedefop, 2018).

Coming to more recent days, in 2017 the knowledges required by Italian enterprises (table 3), in relation to training needs of their whole employees, could confirm in our opinion: a) a certain concentration on specialization (such as in relation to management in the case of technicians and Clerical support workers, or production and industrial process in the case of Plant and machinery operators and assemblers); b) a growing importance given to informatics, even with a lasting concentration on technical profiles and clerical workers; c) a very limited priority given to mathematics as well as to other sciences; d) a clear priority given to Italian and even more to foreign languages, even if with a certain concentration on technical, clerical and services profiles.

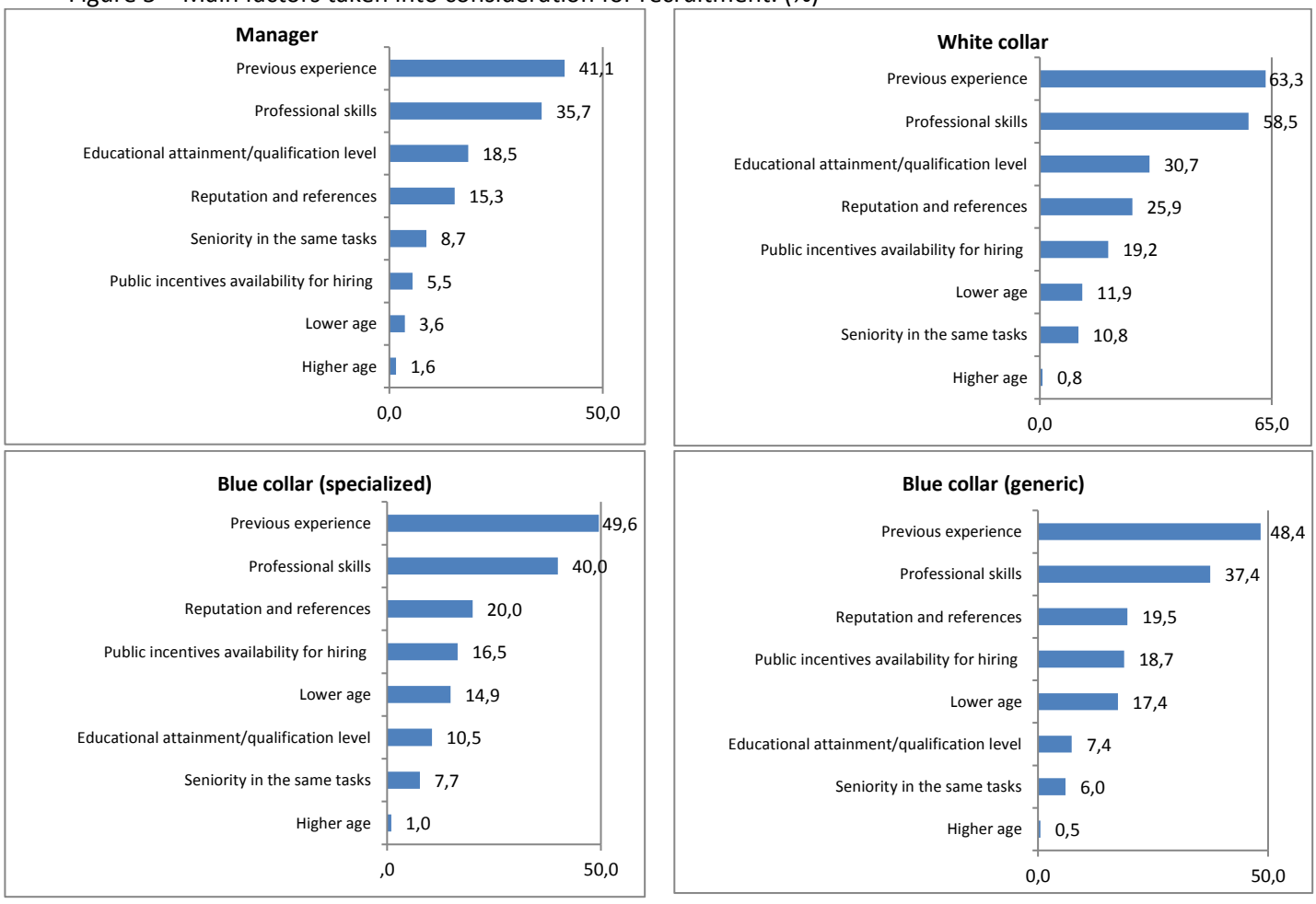
Table 3 – Knowledges required by type of profession. 2017 (%)

| | Technicians and Associate Professionals | Clerical Support Workers | Services and Sales Workers | Craft and related Trades Workers/Skilled Agricultural, Forestry and Fishery Workers | Plant and machinery operators and assemblers | Elementary occupations |
|---|---|---|---|---|---|---|
| **Management and administration** | 32 | 44 | 6 | 2 | 1 | 1 |
| **Office work** | 37 | 77 | 6 | 2 | 1 | 1 |
| **Economy and accounting** | 29 | 45 | 4 | 2 | 1 | 1 |
| **Marketing and sales** | 30 | 22 | 37 | 6 | 3 | 3 |
| **Services to customers and people** | 49 | 51 | 64 | 21 | 15 | 22 |
| **Personnel management** | 15 | 15 | 3 | 2 | 1 | 0 |
| **Production and industrial process** | 23 | 4 | 16 | 43 | 50 | 17 |
| **Computer science and electronics** | 51 | 61 | 10 | 24 | 23 | 13 |
| **Engineering and technology** | 18 | 2 | 1 | 11 | 9 | 0 |
| **Technical design** | 23 | 2 | 0 | 16 | 10 | 1 |
| **Building and construction** | 8 | 1 | 0 | 20 | 10 | 16 |
| **Mechanics** | 9 | 1 | 1 | 39 | 45 | 11 |
| **Telecommunications** | 11 | 7 | 2 | 7 | 3 | 3 |
| **Transportation** | 7 | 7 | 1 | 6 | 54 | 30 |
| **Mathematics** | 14 | 11 | 5 | 7 | 7 | 4 |
| **Physics** | 6 | 1 | 0 | 3 | 2 | 0 |
| **Chemistry** | 9 | 1 | 11 | 5 | 4 | 3 |
| **Biology** | 6 | 0 | 2 | 1 | 0 | 2 |
| **Psychology** | 10 | 9 | 13 | 1 | 2 | 1 |
| **Sociology and Anthropology** | 4 | 2 | 2 | 0 | 0 | 0 |
| **Geography** | 1 | 1 | 0 | 0 | 1 | 1 |
| **Italian language** | 49 | 54 | 69 | 41 | 47 | 54 |
| **Foreign language** | 89 | 91 | 74 | 24 | 37 | 38 |
| **Media and comunication** | 25 | 18 | 7 | 2 | 1 | 4 |

Source: INAPP, web site professionioccupazione.isfol.it, 2018.

As concerns the external labour market, the employers involved in the 2014 INAPP research on SMEs (Checcucci, Fefè, Scarpetti, 2017) listed the main factors taken into consideration for recruitment of employees (Fig. 5). Firstly, previous experiences and professional skills represented two major factors to be considered when looking at the employability of job seekers (in particular in the case of white collars). Secondly, in addition to reputation and references which were very frequently chosen in relation to all the profiles, educational attainment and qualification level were considered prior for managers and white collars, while public incentives showed a higher share in the case of blue collars. The seniority in the same tasks didn't seem so important, while lower age was considered more often than the higher one.

Figure 5 – Main factors taken into consideration for recruitment. (%)




Source: INAPP, 2014.

In 2017, consistently with the priorities declared by enterprises in relation to training needs of their work force, expected hirings in which enterprises require digital skills (Unioncamere, 2017) appear higher for managers, professional, technicians and clerical workers, in comparison to the other job profiles (table 4).

Table 4 - Expected hiring in 2017 in which enterprises require digital skills and average job demand 2018-2022, by major professional groups (%)

| | Expected hiring in 2017 in which enterprises require: | | | |
|---|---|---|---|---|
| | Skills in mathematical and computer languages and methods | Digital skills and knowledge about visual and multimedia communication tools | Management of innovative solutions by means of 4.0 technologies | Job demand - average share 2018-2022 (%)* |
| **Managers** | 97,4 | 96,7 | 70,8 | 0,9 |
| **Professionals** | 86,2 | 91,9 | 63 | 16,8 |
| **Technicians and Associate Professionals** | 80,8 | 90,1 | 56,6 | 18,2 |
| **Clerical Support Workers** | 78,1 | 87,2 | 45,2 | 8,9 |
| **Services and Sales Workers** | 45,4 | 55,2 | 28,9 | 26,0 |
| **Craft and related Trades Workers/Skilled Agricultural, Forestry and Fishery Workers** | 48,5 | 50,3 | 37,9 | 10,3 |
| **Plant and machinery operators and assemblers** | 40,1 | 47,3 | 26,3 | 6,6 |
| **Elementary occupations** | 22,6 | 26,2 | 15 | 11,9 |

Source: elaboration on Unioncamere-ANPAL, Sistema Informativo Excelsior

* Sum does not make 100 because Armed forces are not included.

Looking at the average job demand 2018-2022 (Unioncamere, 2018), we can see that more than 54% of this latter refers to major professional groups for which digital skills are required to a lesser extent. Comparing Technicians and Associate Professionals with the other groups, we see a growing distance in the share of enterprises requiring digital skills. Interestingly this gap is lower in the case of Management of innovative solutions by means of 4.0 technologies, which is the set of skills less requested even among top professional groups.

Even if these information are not disaggregated by age, we should bear in mind that in 2017 only 2.8% of expected hirings were in the 45-54 age class and 0.3% involved 55+ (Unioncamere, 2017). 45-54 workers were more wanted in manufacturing and building (3.7% and 5.4% respectively) than in public utilities or services (2.4% and 2.2% respectively). Understanding whether this job demand is to be related to digital skills would obviously be of utmost importance.

## 6. discussion

In our opinion, the answers given by the employers involved in the INAPP survey in 2014 - in a moment in which the Fourth Industrial Revolution had not yet show all its potential, at least in Italy – seem consistent with the considerations by OECD about the relationship between the specialization of the work force and the readiness to digitalisation of the economy. In particular,

employers appear to have given priority to consolidate the specific technical skills of older workers, in line with their vision of being these latter a guarantee of know-how and a reliable staff in every situation. Besides this, the survey also captured the awareness of the opportunity to introduce or strengthen ICT skills, jointly with communication, management and marketing, as well as transversal ones (problem-solving, team working etc.), which are considered very useful in the adaptation to the new working environment. Lastly, poor attention was given to basic skills, whose deficit in Italy the PIAAC survey had reported in the same period.

Three years later the knowledges required by Italian enterprises in training programs can still confirm in our opinion a certain concentration on specialization, a growing importance given to digital skills, a limited weight of mathematics as well as to other sciences and a good relevance given to Italian and even more to foreign languages.

On the side of the external labour market, in 2014 job seekers were evaluated mostly looking at their experiences and specific professional skills, while their higher age was kept in low consideration (actually giving priority to lower age). In 2017, information from Excelsior seem to show a great attention to digital skills, but with a higher concentration on managers, professional, technicians and clerical workers. Moreover the skills related to the management of innovative solutions by means of 4.0 technologies score a lower share in every professional group, probably confirming that the implementation of such systems is going to be realized gradually, following a path which entails the mapping of all processes, the horizontal and vertical integration of the organization and its information sets, in order to reach a level of self-controlling manufacturing and logistic (Benešová, Tupa, 2017). In this context, the positive opinion that employers show about older workers could be strengthened by the importance of their knowledge and experience in the mapping of processes and the integration of existing information (Ibid.).

The propensity to maintain the work force specialization is certainly due to historical reasons, which are rooted in the evolution of the Italian labour market, also in connection with the whole structure of the network which interconnect the various economic sectors (ISTAT, 2018, pp. 55-97). Specialization issues recall some research topics which, since the nineties, dealt with the relationship between age and work experience, with its potential effects on individual attitude to flexibility and adaptability. For instance, the Experience Concentration Theory (Thijssen, Rocco, 2006, 2010) states that as workers age their experiences naturally increase in quantity, while at the same time a decrease in experience diversity will occur, leading thus to the experience concentration. Both broadness (variation) and restriction (concentration) of experience can become quite extreme, leading to what can be defined alternatively as experience fragmentation or experience deprivation, both of which have not a positive influence on employability. On the labour market side, authors speak about functional concentration, when the structure of experience at older age is restricted to minor task adaptation, and drastic changes in the tasking package and/or mobility are normally avoided (Ibid.).

Even if the association between ageing and cognitive decline is not considered correct any more, especially in the working domain (Kanfer, Ackerman, 2004), over the years we can observe a

decline in the so called “fluid intelligence” (linked to abstract, inductive and quantitative reasoning and to problem solving), which is often counterbalanced by an increase in “crystallized intellectual abilities” (related to educational attainment and represented for example by lexical richness, comprehension, individual level of information and culture, together with his/her capacity to use personal skills, knowledge and experiences). On the personality side, these changes would be mirrored by a decrease in the readiness to new experiences and by the prevalence of scrupulosity, the attitude to be generative (taking care of relatives, other people, the society and future generations in a broad sense), control of emotions and self-awareness, the preference for situations and context which strengthen the self and the individual identity (Ibid.).

Furthermore, the Experience Concentration Theory points out that learning strategies could reduce to what can be defined as “incidental learning”, as people age. This attitude is characterized by a less frequent use of formal education and in a general refuse of learning initiatives (Thijssen, Rocco, 2006, 2010).

The seeming antinomies which appears in the employers’ opinions about older workers, also recall the erratic way in which age is currently shaping modern organizations, worker’ identity and the roles and statuses performed by them (Thomas, Hardy, Cutcher, Ainsworth, 2014). This uncertainty is a consequence of the desynchronization of the ages of life (Guillemard, 2005) which is occurring with the declining of Fordism, whose paradigm had greatly contributed to the institutionalization of the life-course (Kholi, 2007). Under this point of view, the digitalization of the economy would probably amplify a process which is already under way, perhasps contributing to hide even more the issue of age diversity in the Italian labour market.

## 7. Conclusions

As depicted by the Ageing Report by the European Commission, Italy will deal with the years of the Fourth Industrial Revolution with an aged work force, enduring difficulties in the intergenerational turn over and frequent labour shortages in specific economic sectors.

The European comparison based on the Active Ageing Index shows that a higher participation of the older population in the labour market is not in contradiction with the capacity of enterprises to adopt digital innovations. In this situation it seems unavoidable that the research on the 4.0 paradigm will intersect age management issues, putting under observation the interrelations among skills and employability factors of older workers (Walker, 2005; Aversa, D’Agostino, Parente, 2015).

As innovative solutions based on 4.0 technologies will gradually take place, we will probably witness the disappearance of some jobs and the creation of some others, in every economic sector. Along this path, older employees could play a pivotal role, due to their knowledge of the existing production processes, their reliability and experience, and the fact that employers frequently look at them as a resource for the stability of enterprises, their know how and core business (Benešová, Tupa, 2017).

Under this point of view, further research should explore some specific topics (Checcucci, 2018). First of all, strategic options adopted by enterprises about digital transformations should be analyzed in the light of the demographic structure of organizations, in order to appraise the importance given to this dimension in innovation planning. Secondly, it would be necessary to recap the transformations that occurred in specific working environments, highlighting the impact of innovation on the skills, tasks and roles actually performed by older workers. Thirdly, training strategies and programs which are accompanying digitalisation should be described, looking at the involvement of older workers and if/how their cognitive characteristics are taken into account. Lastly, the changes of employers' attitudes towards the external labour market should be surveyed, focusing on recruitment strategies and the skills required of job seekers.

Together with this research program on organizations, it seems necessary to understand how national and regional policies (Enterprise 4.0, Smart Specialization Strategy etc.) are contributing to the establishment of an institutional environment which is friendly for innovation, but that also takes into account the opportunity to prolong working life and to gradually close the gender gap in the labour market.

**Bibliografia**


Acemoglu Daron, Restrepo Pascual (2018), *Demographics and Automation*, NBER Working Paper No. 24421, March.

Aversa Maria Luisa, D'Agostino Luisa, Parente Maria (2015), *L'age management nelle grandi imprese italiane. I risultati di un'indagine qualitativa*, ISFOL, I libri del Fondo sociale europeo, 210.

Aversa Maria Luisa, Checcucci Pietro, D'Agostino Luisa, Fefè Roberta, Scarpetti Giuliana (2017), *Il ruolo delle politiche per la qualità del lavoro nel contrasto ai fattori di espulsione dei lavoratori maturi*, Conferenza internazionale: analisi e prospettive delle politiche del lavoro, 14-15 dicembre, Università Roma Tre, Dipartimento di Economia.

Bechichi Nagui, Jamet Stéphanie, Kenedi Gustave, Minea Andreea (2017), *Digitalisation: an opportunity for workers to develop their skills?*, OECD.

Benešová Andrea, Tupa Jirí (2017), *Requirements for Education and Qualification of People in Industry 4.0*, 27th International Conference on Flexible Automation and Intelligent Manufacturing, FAIM2017, 27-30 June 2017, Modena, Italy.

Boeri Tito, Garibaldi Pietro, Moen Espen (2016), *A clash of generations? Increase in Retirement Age and Labor Demand for Youth*, WorkINPS Papers, n. 1, luglio.

Cedefop (2018), *Insights into skill shortages and skill mismatch: learning from Cedefop's European skills and jobs survey*, Luxembourg: Publications Office. Cedefop reference series; No 106.

Checcucci Pietro (2013), *Actively ageing: Italian policy perspectives in light of the new programming period of ESF*, Intervention to the 2013 Demography Forum, Brussels, May 6th and 7th.

Checcucci Pietro (2018), *Lavorare a 50-60 anni, quale futuro nell'economia digitale*, agendadigitale.eu · October 23.

Checcucci Pietro, Mandrone Emiliano, Roma Fabio (2014), *Il prolungamento della vita attiva*, Paper for the Espanet Conference "Sfide alla cittadinanza e trasformazione dei corsi di vita: precarietà, invecchiamento e migrazioni", Università degli Studi di Torino, Torino, 18 - 20 Settembre.

Checcucci Pietro, Fefè Roberta, Scarpetti Giuliana, (a cura di), (2017), *Età e invecchiamento della forza lavoro nelle piccole e medie imprese italiane*, FSE, INAPP, INAPP, Roma.

Contini Bruno, Rapiti Fabio M. (1999), *"Young in, old out" revisited: New patterns of employment replacement in the Italian economy*, International Review of Applied Economics 13(3), pp. 395-415.

De Minicis Massimo, Mandrone Emiliano, Marocco Manuel (2017), *Tempi Moderni: dalla Parasubordinazione alle Piattaforme di Lavoro*, paper presentato alla Conferenza internazionale: Analisi e prospettive delle politiche del lavoro, 14-15 dicembre 2017, Università Roma Tre, Dipartimento di Economia, Scuola di Economia e Studi Aziendali.

De Stefano Valerio (2017), *Lavoro "su piattaforma" e lavoro non-standard in prospettiva internazionale e comparata*, International Labour Office.

EU-OSHA, Cedefop, Eurofound and EIGE (2017), *Joint report on Towards age-friendly work in Europe: a life-course perspective on work and ageing from EU Agencies*, Publications Office of the European Union, Luxembourg.

European Commission (2018), *The 2018 Ageing Report. Economic and Budgetary Projections for the EU Member States (2016-2070)*, Institutional Paper 079, Luxembourg, Publications Office of the European Union.

Fantoni Gualtiero, Cervelli Gloria, Pira Simona, Trivelli Leonello, Mocenni Chiara, Zingone Roberto, Pucci Tommaso (2017), *Ecosistemi 4.0: imprese, società, capitale umano*, Quaderni Fondazione Giacomo Brodolini, Roma, Dicembre.

Frey Karl Benedict, Osborne Michael A., (2017), *The future of employment: How susceptible are jobs to computerisation?*, Technological Forecasting & Social Change, 114 (2017), 254-280.

Guarascio Dario, Sacchi Stefano (2017), *Digitalizzazione, automazione e futuro del lavoro*, INAPP.

Guillemard Anne-Marie (2005), *The advent of a flexible life-course and the reconfiguration of welfare*, in J.G. Andersen, A.M. Guillemard, P. Jensen, B. Pfau-Effinger (a cura di), *The Changing Face of Welfare*, Policy Press, Bristol, pp. 55-75.

Harris Karen, Kimson Austin, Schwedel Andrew (2018), *Labor 2030: the Collision of Demographics, Automation and Inequalit*y, Bain & Company, Inc.

Hecklau Fabian, Galeitzke Mila, Flachs Sebastian, Kohl Holger (2016), *Holistic approach for human resource management in Industry 4.0*, Procedia CIRP 54 ( 2016 ) 1 – 6.

ISTAT (2018), *Rapporto annuale 2018. La situazione del Paese*, ISTAT, Roma.

Kanfer Ruth, Ackerman Phillip L. (2004), *Aging, adult development, and work motivation*, Academy of Management Review, vol. 29, No. 3 (2004), pp. 440-458.

Kholi Martin (2007), *The institutionalization of the life course: looking back to look ahead*, «Research in Human Development», 4 , n. 3-4, pp. 253-271.

Magone Annalisa, Mazali Tatiana, a cura di (2016), *Industria 4.0: uomini e macchine nella fabbrica digitale*, Guerini e associati, Firenze.

McKinsey&Company (2017), *A future that works: automation, employment, and productivity*, January.

McQuaid Ronald W., Lindsay Colin (2005), *The Concept of Employability*, Urban Studies, Vol. 42, No. 2, 197–219, February.

Pew Research Centre (2014), *Attitudes About Ageing: a Global Perspective*, January.

Pessl Jeremias (2018), *Humans as a service*, Oxford University Press.

Pouliakas Konstantinos (2018), *Determinants of Automation Risk in the EU Labour Market: A Skills-Needs Approach*, IZA DP No. 11829, September.

Sirkin Harold L., Zinser Michael, Rose Justin Ryan (2015), *The Robotics Revolution*, The Boston Consulting Group, September.

Thijssen Johannes, Rocco Tonette, Editors (2006), *Older Workers, New Directions. Employment and Development in an Ageing Labor Market*, Center for Labor Research and Studies, Florida International University.

Thijssen Johannes, Rocco Tonette (2010), *Development of older workers: revisiting policies*, in: European Centre for the Development of Vocational Training (Ed), *Working and ageing - Emerging theories and empirical perspectives*, Publications Office of the European Union, Luxembourg, pp. 13-27.

Thomas Robyn, Hardy Cynthia, Cutcher Leanne, Ainsworth Susan (2014). *What's age got to do with it? On the critical analysis of age and organisations*, Organization Studies 35 (11) , pp. 1569-1584.

Unioncamere (2017), *Competenze digitali. Sistema informativo Excelsior. Analisi della domanda di competenze digitali nelle imprese italiane per il 2017*, Sistema Informativo Excelsior, Roma, novembre.

Unioncamere (2018), *Sistema informativo Excelsior. Previsione dei fabbisogni occupazionali e professionali in Italia a medio termine (2018-2022)*, Sistema Informativo Excelsior, Roma, maggio.

United Nations, Department of Economic and Social Affairs, Population Division (2017). *World Population Prospects: The 2017 Revision, Volume I: Comprehensive Tables*, (ST/ESA/SER.A/399).

Walker Alan, (2005), *The emergence of age management in Europe*, International Journal of Organisational Behaviour, Volume 10 (1), 685-697.