



Digital skills

Rethinking education and training
in the digital age: Digital skills
and new models for learning

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Preface

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This paper was prompted by reflection – meditation which PwC encourages on a global network level – on the impact that new technologies will have on our society.

Not a day goes by in which PwC does not investigate, and urge adoption of, leading-edge technological solutions. In this regard, PwC provides its assistance to clients who intend to implement such solutions.

However, the prospects opened up by automation and artificial intelligence appear so vast that we must seek out broader horizons of thought, transcending the idea of adopting specific tools and instead focusing on the overall direction that we wish to confer upon the changes awaiting us.

One figure alone tells us the extent to which the digital revolution shall transform our lives, even with regard to aspects that seem decidedly trivial to us today: a PwC study entitled *Will Robots Really Steal Our Jobs?* estimates that, by 2035, robots and artificial intelligence could replace 39% of the jobs currently existing in Italy⁽¹⁾. However, since new jobs, unimaginable at the present time, shall emerge in sectors that we are unfamiliar with, the balance will ultimately turn out to be positive.

So as not to fall victim to the new technologies but rather benefit from the opportunities they present, various social actors such as governments, businesses, universities and intermediate bodies must therefore – all within their respective ambits – develop action plans capable of managing these dynamics.

This revolution shall bring about transformations in all sectors and professions, at all levels. However, not all workers will be affected in the same way: only 16% of graduates risk seeing their jobs disappear, while 45% of those workers whose higher education is incomplete are under threat. The social risks posed by this transition are therefore clear, particularly for Italy, which ranks lowest among the advanced countries in regard to all the main indices relating to levels of education and training.

The figures tell us at PwC Italy that we have to focus on the theme of skills and training, in the firm belief that our track record within these ambits may contribute to jointly thought out solutions, enabling the system to “ride the revolution” which has already begun.

In the century of the “knowledge economy”, investment in training takes on a strategic value, both systemically and from the point of view of individual companies. However, today’s Italy is still far from adopting a model that focuses not only on skills but also on constantly upgrading these skills.

According to the latest ISTAT surveys, only 8.1% of working age Italians were engaged in “lifelong learning” activities in 2015. Approx. 40% of companies employing more than 10 employees still do not provide any opportunities for training. Such mean values actually tell us rather little. While the large companies have come to appreciate the need to invest in training, small businesses struggle to understand that a paradigm shift is required. Moreover, the professional training proposed targets primarily those who are already well-educated. For others, with a low skills-base, it is harder to gain access to upskilling or reskilling services, although these are the people who – in all likelihood – need such attention most!

Italy has a vital need to train its talents. After all, high added-value sectors sustain the country’s economy, and they are staffed by highly skilled operatives. Indeed, between 2010 and 2017, only the export performance driven by high-tech products contributed positively to GDP growth: the data processed by Federmacchine⁽²⁾ indicate that in 2018 alone, the trade balance in the machinery and mechanical equipment sector was worth over €50 billion, i.e. more than the commercial balances of clothing, furnishings and agroindustrial products combined.

1) Hawsworth, J., Berriman, R., and Goel, S., “Will Robots Really Steal Our Jobs?: an international analysis of the potential long term impact of automation”, London: PricewaterhouseCoopers, 2018

2) Federmacchine, “Il settore dei beni strumentali nel 2018, Rapporto di settore Federmacchine”, Cinisello Balsamo, July 2019, pp. 7-8

Revival and growth are therefore the results of policies aimed at creating an ecosystem open to innovation, with a focus on research, capable of generating excellence and of attracting investments and talents. It is essential to foster more frequent dialogue among training and technological innovation players. Teaming up with the Intergruppo Parlamentare per la Sussidiarietà (Parliamentary Intergroup for Subsidiarity), PwC's Research Department seeks to further this cause.

Therefore, this paper aims to stimulate debate on these issues, establishing dialogue among various players and seeking stimuli from worlds even very distant from ours.

The following pages firstly provide a description of the current scenario. Proposals are then made as regards implementing certain drivers capable of influencing acquisition of *Digital skills*, both with a view to training "digital experts" (who may perhaps join the company) and fostering what can be described as "digital citizenship", i.e. providing everyone with the ability to participate in the social life of a world shaped to an ever increasing extent by new technologies.

The document shows that technology and the digital must not be studied as subjects in their own right. They must instead be presented holistically as part of a growth curve. The young and the old alike must be provided with an opportunity to understand how to make responsible use of these resources, while maintaining a balance – which is often found to be missing – between the element of technological competence and the "human" factor. The key then seems to lie in putting people first and stimulating their curiosity; giving them the opportunity to gradually understand that – if they have the courage to discover a new world – the digital can truly open doors for them.



Introduction

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In line with our values and our purpose - fostering trust in society and successfully tackling major problems - in this paper, we deal with the theme of *Digital skills* and consider the role of public administration in preparing the public at large for the current industrial revolution, identifying a possible roadmap that Italy (as part of the broader European process) can undertake to face the challenges of our digital future. The paper is therefore part and parcel of a broad-reaching exercise or thought process that PwC has embarked on regarding upskilling and reskilling its own people, while addressing the broader challenges that institutions (of which we are suppliers and partners) must face up to in order to guarantee – now more than ever – the public's right to engage in lifelong learning and thus be able to ride the wave of digital transformation and not fall victim to that very same wave.

For about two decades, in Italy as elsewhere, the challenge has been to reform education and training in the name of an open, creative system of lifelong learning suited to the challenges posed by the new millennium. The fourth industrial revolution and the generation of digital natives request us that we speed up this process, and that we do so not (or not only) by creating more digital experts for the labour market but, rather, by also taking a second look at how we learn and think, in the presence of a new generation that has evolved in response to “Web” stimuli.

Unexplored universes are opening up before our eyes, replete with the dangers of cognitive distortion (and even misuse/altered uses of technologies) and yet also with stunning potentials from the creativeness viewpoint.

New opportunities also from the “gender” viewpoint.

In fact, for women, sectors that are still predominantly “male” (e.g., mechanics and agriculture) may become permeable if women can become protagonists in the processes of innovation and digitalization of these sectors, also through greater or more forthright involvement in digital and technological skills training.

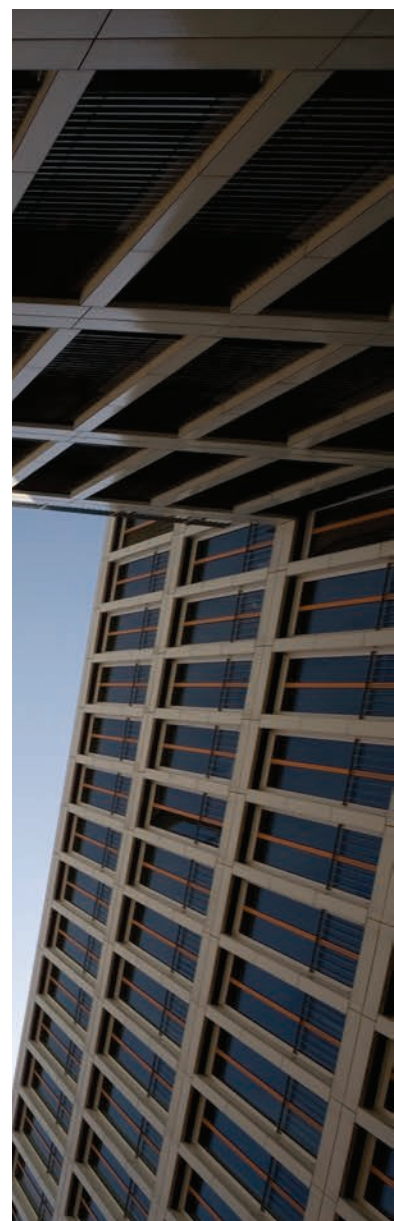
In this sense, a new cycle has emerged for accessible and inclusive education pivoting toward new technologies. Furthermore, many disabilities shall no longer hinder learning and professional advancement.

Working creatively in the education and training system can sow the seeds of a generation of people capable of using “digital” tools in a manner that reflects the correct balance between the respect due to others and the respect due also to oneself. Consider, for example, the delicate issue of the balance between ceding data – in an informed and aware manner – and receiving services (this issue lying at the core of privacy concerns). What trends might emerge from the vanguard of the fourth revolution (USA, Australia, Canada, Northern Europe, Japan, etc.)? How do we act on our system of education, training and active labour market policies (ALMPs)? What new best practices must we consider?

For some time now, we have been analysing and probing the theme both globally and domestically. We do so from an ideal viewpoint, i.e., one from which we may assess the “labour market” and the enterprises of which we are suppliers and partners in processes of innovation, while also engaging in dealings with public sector clients in the fields of Education, Training and Employment policy-making (ministries, research institutes, national agencies and regional government authorities).

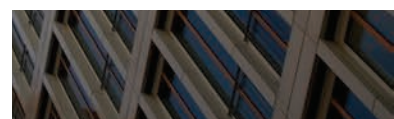
It is precisely for this reason that we have decided, through our Research Department, to activate a permanent Observatory on integration between policies regarding Education, Training, Employment and the production system, with an emphasis on skills seen as a “currency”, as a “language” and as “common goods”.

With this paper on *Digital skills*, therefore, the PwC Observatory's ambitious project, “Skills for Italy”, has been launched with the aim of stimulating debate and social dialogue with policymakers and the production system.



Chapter 1

Scenario



1. Scenario



Whenever a person or “thing” connects to the digital world, it contributes to the expansion of new global common goods. This presents unprecedented opportunities and advantages, but also poses a number of problems and dilemmas. Existing institutions and models may not be able to respond effectively to the pace of change, embodied by our new digital assets. A more collaborative approach to such problems could ensure a sustainable and inclusive digital future ⁽³⁾

1.1. The elements of change

Artificial intelligence, cloud, robotics, 3-D printing, augmented reality, virtual reality, blockchain: these and other emerging technologies are transforming our lifestyles and approaches to life, thought and work.

Change is disruptive, rapid and at times elusive. Digitalization and the new technologies impose a profound transformation on all organisational levels (corporate, social and family), reflected not only in a freshly ‘revamped’ set of skills to be acquired but also in an ‘overhauling’ of our traditional approaches to study and the labour market.

Let’s try to examine the main aspects of this innovative wave with a look at the impact on *Skills*.



Disciplinary integration

Change gives rise to **de-structured integration** of a variety of disciplines. The production sectors that, until 20 years ago, grew and developed in an autonomous manner are now reciprocally functional and interdependent. Just think of the industrial or commercial sectors: we see how we can no longer demarcate clear boundaries between varying segments/sectors or disciplines and technologies. The use of a given technology as part of the production process (industrial field) may in fact be driven by the marketing needs characterising diffusion of the product within the marketplace (commercial field).

Pastry shops use 3-D printing technology to make cookie cutters and moulds, and can therefore immediately meet the varying needs of their customers.



Speed

New technologies, such as those mentioned here, emerge unceasingly, with impacts on society (such as simplification and replacement of processes).

We live in a context in which **the speed and the sheer scale** of the changes taking place mean that organisations must adopt a certain spirit or mindset, and must accordingly develop a capacity to readily, effectively and “painlessly” adapt, under penalty – otherwise – of failing to “ride the wave” of digital transformation. This development does not emerge only in business – i.e. in organisations that must survive within the marketplace –; it also impacts the institutional, educational, training and social spheres.

In the field of distribution of multimedia content, we have, in a handful of years, gone on from possession of physical media (videos/cassettes, floppy discs, CDs) to the possession of files (I-tunes) and cloud streaming (Spotify). New consumer trends and revolutionary models for business have transformed the music distribution industry, enabling companies to compete globally, more efficiently and with greater commercial outreach.

Digital transformation points to an opportunity to monitor and, where necessary, to rethink – from an adaptive viewpoint – the processes of (and steps toward) developing skills, to ensure governance and economic exploitation of the technological innovations of the fourth industrial revolution. In other words, the pathways of “adaptation to change” and of forecasting future scenarios, can contribute to optimising the very effects of technological development. They can do so by rationalizing elements of greater complexity which, as we have seen, pertain to:

1. the role of the human being, who is both a “creator” and a user of technology;
2. the implications of technology on organisational, cognitive and behavioural processes;
3. the speed and multi-dimensional nature of technological innovations.

⁽³⁾ World Economic Forum, The Future of Jobs. Report 2018, Center for New Economy and Society Insight Report, Geneva, 2018

It is therefore vital that all parties called upon to “manage” change closely analyse such elements in order to optimise outcomes and to ensure that transformation has a positive impact. The metaphor of the wave – a wave of digital transformation⁴⁾ that may cast us down into the deeps, or sweep us instead onto a welcoming beach – still serves as a guide in orienting our thoughts.

1.2. The impacts of change

We are therefore witnessing a revolution that, conceptually, has implications for the paradigms that connect individuals to various contexts (the professional sphere, education and training systems, exercise of citizenship, private life) in which they act, and to which they relate. It is clear that new technologies may have enormously positive impacts on how we tackle the main “global” challenges: urbanization, development and demographic imbalances between areas of the world, climate change, poverty, gender differences etc. For example, “accessing” and “interpreting” ever-increasing amounts of data can bring concrete benefits to society in many areas, ranging from health care to renewable energy, or from road safety to cyber security.

The technological innovations that characterise the fourth industrial revolution can therefore **generate a multiplier effect of development and cohesion** capable of sidestepping concretely “negative consequences”, both in economic and social terms (and primarily the risk of an exponential increase in incidence of inequality). The population seems to be aware of positive impacts of this kind: according to the *Special Eurobarometer – 460 Survey: attitudes towards the impact of digitisation and automation on daily life*⁵⁾, approx. 74% of interviewees declare that it is possible that the latest digital technologies will have a positive impact on the economy. A similar confidence in innovations is noted with respect to the positive impact that such technologies may have on society (approx. 63% of respondents) and on quality of life (approx. 66% of respondents).

The enthusiasm associated with the positive aspects of change is accompanied, however, by certain concerns relating mainly to the effects of technological innovations on the labour market. Indeed, when referring to the undesired impacts on employment of automation of some processes (in the field of production and elsewhere), that were generally carried out by people, experts speak of “technological unemployment”⁶⁾. In any case, the technological unemployment debate has pointed to the presence of two approaches.

Technological innovation and employment: which scenarios?

Concerns about the economic impact of new technologies were a key issue in the 2018 Global Risks Perception Survey (GRPS) conducted by the World Economic Forum⁷⁾. In regard to risks, the interconnection most frequently cited concerned unemployment and the negative impacts of technological progress.

Concerning this, we can broadly speak of two opposing views of the effects of the new technologies on the labour market.

On the one hand, a vision of **technology bringing with it a new era of prosperity, and the creation of new professions**, which will be able to “absorb” workers once employed in tasks that technology is rendering obsolete. In this regard, a recent international analysis by PwC – “*Will Robots Really Steal Our Jobs?*”⁸⁾ – shows that despite the disruptive impact of automation on the jobs of the future, it is plausible that, while eliminating some of the more routine, repetitive tasks, the new technologies may also **lead to the creation of new types of work**. Many professions and industrial activities will be transformed, and new activities/professions will emerge.

The other opposing vision is **less encouraging, pointing to the risk that technological innovations shall create large-scale unemployment**, with remedies out of reach, and therefore perhaps also to significant social and political impacts.

4) Bower J.L., and Christensen, C.M., “Disruptive Technologies: Catching the Wave”, *Harvard Business Review* 73, no. 1, 1995, pp. 43-53

5) European Commission, *Attitudes towards the impact of digitisation and automation on daily life*, Special Eurobarometer 460, May 2017

6) For further information, see Keynes, J.M., “The Economic Possibilities of Our Grandchildren” (1930), McGaughey, E., *Will Robots Automate Your Job Away? Full Employment, Basic Income, and Economic Democracy*, SSRN, part. 2(2), 2018; Frey, C.B. and Osborne, M.A., *The Future of employment: how susceptible are jobs to computerization?* University of Oxford, Oxford OX1 1PT, United Kingdom Department of Engineering Science, 2013; Brynkolfsson, E., and McAfee, A., *The second machine age: work, progress and prosperity in a time of brilliant technologies*. In WW Norton & Company, New York, 2014

7) World Economic Forum, *The Global Risks Report 2018*. 13th Edition, World Economic Forum Global Challenge Insight Report, Geneva, 2018, pp. 8-17

8) Hawksworth, J., Berriman, R., and Goel, S., op. cit.



This vision – which identifies, among the main potential risks of technological innovation, an increase in social inequalities adversely affecting cohesion – was also recorded in The Global Risks Report of the World Economic Forum 2018⁹⁾, which pointed to marked interconnections between rising income inequality, unemployment (or underemployment) and profound social instability.

Starting out from an **analysis of strengths and weaknesses** relating to the context and the effects of technological innovations, we should exploit the opportunities made available by new technologies adequately and prevent potential threats. As the “World Development Report 2019: The Changing Nature of Work” points out *“It is true that in some advanced economies and middle-income countries manufacturing jobs are being lost to automation. Workers undertaking routine tasks that are ‘codifiable’ are the most vulnerable to replacement. And yet technology provides opportunities to create new jobs, increase productivity, and deliver effective public services. Through innovation, technology generates new sectors and new tasks”*¹⁰⁾.

Therefore, by focusing on certain domains on which the effects of change will have the greatest impacts, such as the labour market and social inclusion (citizenship rights, gender equality, the disadvantaged etc.), it is possible to outline the main strengths and weaknesses as well as the pertaining opportunities and the threats to be monitored.

9) Ibid

10) World Bank. World Development Report 2019: The Changing Nature of Work. Washington, DC: World Bank, 2019 doi:10.1596/978-1-4648-1328-3, p. 2

Strengths	Weaknesses
<ul style="list-style-type: none"> • Application of new technologies in sectors with high social impact • Multiplier effect of technologies on the propensity to innovate • PA online services for citizenry and businesses • Specialisation in sectors of production with high transversal added value for other productive sectors of production (economies of scale) • Birth of new professions • Fewer alienating, dangerous and low added-value jobs 	<ul style="list-style-type: none"> • Lack of adequate “basic” and professional <i>Digital skills</i> in large portions of the population • Human labour replacement effect • Digital infrastructures do not always adequately ensure access to technological potentials
Opportunities	Threats
<ul style="list-style-type: none"> • New jobs in highly qualified professions • Greater business opportunities in highly specialised sectors (e.g. data-driven economy, big-data analysis etc.) • Greater access to online PA services • Greater access to education and training • Greater access to information sources 	<ul style="list-style-type: none"> • Increased unemployment in some production sectors marked by high numbers of unskilled or low-skilled workers • Potentially new forms of job flexibility • Social exclusion of persons with less access to technology • Further spread of cyberbullying • Dissemination of fake news/fake profiles and inability to identify these falsehoods as such • Exposure to cyber attacks (data security)

It may be concluded that the elements of complexity generated by new technologies broaden the scope for various approaches to our current and future “reality”. This precludes any clearcut demarcation between opportunities and threats. In any case – with respect to the *Digital skills* needed for **talent development and upskilling or reskilling** of citizens and workers –, these opportunities and threats are directly related to the challenges emerging when we consider mismatches and shortfalls in our education and training systems.

The imperative should therefore be to adopt a **“systematic” approach** to analysis and intervention, enabling actions regarding the capacity and resilience of educational and training systems when faced by the challenges posed by current changes.

In this regard, the aforementioned World Bank “World Development Report 2019: Changes in the world of work”¹¹⁾ stresses the need to prioritise investment in **skills most in demand within the labour market**.

These skills include, in particular, advanced cognitive skills (such as problem solving), socio-behavioural skills (e.g. teamwork), and a combination of skills such as logical reasoning and self-efficacy, ensuring workforce versatility.

These changes require our attention. We must analyse and isolate the variables and key factors of change, in order to ensure economic and social advancement for the citizenry as a whole.

1.3. Digital jobs, the professions of the future: new names for old professions or new *Digital skills* requiring integration?

We have seen that digital transformation and technological development are accompanied by challenges to be managed and opportunities to be seized, while – in a balanced and strategic manner – we develop and nurture new skills. Most of today’s – but above all tomorrow’s – jobs will be characterised by a two-way focus on skills: on the one hand, a growing demand for solid knowledge and technical-scientific expertise; on the other, application of soft skills and aptitudes (flexibility, sharing, an ability to cope with change). Indeed, the demand for these skills has grown as a result of digital transformation. Jobs will be less and less tied into specific tasks. They will require interconnected skills. Hence the emerging need to support development of skills suitable for the professions of the future (or, rather, for the workforce of the future), which skills inevitably intertwine with this unstoppable process of technological and digital evolution.

11) Ibid., p. 12

As the OECD notes in the position paper “*The Future of Education and Skills – Education 2030*”⁽¹²⁾, the sphere of education and training is faced with the growing demand/need to prepare students to deal with rapid economic development, environmental and social changes, and the prospect of jobs yet to be contemplated or created, not to mention technologies that have yet to be born – also in order to cope with social issues likewise upcoming or unplanned for. Education can provide students with the ability to deploy skills and with a will to remodel their own lives and contribute to the lives of others.

Although the findings are not validated by structured statistical data, the data of the WEF report points to the prospect that, once they have received a diploma or degree, 65% of the children in school today **will take on jobs which have yet to come into being**⁽¹³⁾.

In this context, the scenarios are marked by rapid technological and digital transformation that confirms our analysis of the professions of the future (e.g. use of big data and predictive analysis). However, this transformation complicates our forecasts, since the information collected immediately becomes obsolete.

In a climate of concern over, and of curiosity regarding what is (and shall continue to be) a digitally permeated job market, it is worthwhile to dwell on the **nature of the new professions**. While some tasks shall be completely mechanized, automation shall bring with it new activities in equal number. Beyond the pervasiveness of digital culture, the impact shall in any case vary from sector to sector and country to country, also in the light of the so-called mega-trend of globalization.

On the structure of the effects of change, the OECD speaks of the labour market in terms of polarization and de-industrialization. **Polarization** is understood as the circumstance whereby the average level of skills cedes ground to highly paid jobs for, likewise, highly skilled workers or, conversely, to minimum wage jobs with low skills requirements⁽¹⁴⁾.

The concept of **de-industrialization** points, instead, to a transition from typical manufacturing jobs to service sector jobs, a sector in which the dissemination of technologies (especially ICT) has led to a transformation of methods of access and utilization⁽¹⁵⁾. With reference to the two concepts outlined above, we learn that the 2019 OECD Employment Outlook points to a general trend toward polarization of the labour market: low-skilled and highly-skilled jobs rose in number, while we witness a downturn in average-skill jobs. This trend has been driven also by skill-based technological change (i.e. changes that favour the skilled over the unskilled workforce, thus mainly benefitting workers with higher skills). However, Italy and Ireland display a low rate of polarization: the downturn in medium-high skilled jobs is matched by an upturn only in low-skilled jobs⁽¹⁶⁾.

Confirming our impression of the pervasiveness of these phenomena, the demand for *Digital skills* for today’s and tomorrow’s professions regards not only specialised “core” sectors but also more traditional fields of activity. In Italy, reflection on the theme of digital culture and its role within the national training and work landscape is conducted annually at the Osservatorio sulle Competenze Digitali (*Digital skills Observatory*), with which the major ICT associations (Aica, Assinform, Assintel and Assinter Italia) collaborate on the project together with the Agenzia per l’Italia Digitale (Agency for Digital Italy) and the Ministry of Education, University and Research. According to latest *Digital skills Observatory* report (2018), **the digital skill rate (DSR) has become an essential component of non-IT professions**, in regard both to the characteristic activities of business concerns and to Support and Management activities. This development is more evident in Industry, where the DSR ranges from 20% on average for Support and Management professions to 17% on average for “core” operatives, with peaks in production, design, R&D, marketing and HR management⁽¹⁷⁾.

In Europe, while 9 out of 10 jobs shall require *Digital skills*, 169 million Europeans aged between 16 and 74 (44%) do not have basic *Digital skills*⁽¹⁸⁾.



In the age of the machine, people matter more than ever

Soft Skills in 2020

World Economic Forum

- Complex problem solving
- Critical Thinking
- Creativity
- People Management
- Coordinating with others
- Emotional intelligence
- Judgement and decision making
- Service orientation
- Negotiation
- Cognitive flexibility

12) Howells, K. *The future of education and skills: education 2030: the future we want*. Working Paper. Paris: OECD, 2018

13) World Economic Forum, *The future of jobs: employment, skills and workforce strategy for the Fourth Industrial Revolution*, *World Economic Forum Global Challenge Insight Report*, Geneva, 2016, p. 3

14) Quaranta, R., Gualtieri, V., Guarascio, D., *Cambiamento tecnologico, mansioni e occupazione*, Inapp Policy Brief no. 4, 2017

15) OECD, *OECD Employment Outlook 2017*, OECD Publishing, Paris, 2017, http://dx.doi.org/10.1787/empl_outlook-2017-en

16) OECD, *OECD Employment Outlook 2019: The Future of Work*, OECD Publishing, Paris, 2019, <https://doi.org/10.1787/9ee00155-en>

17) AICA, *Osservatorio Competenze Digitali 2018*, Aica, Milan, 2018

18) DG Connect, “The *Digital skills* Gap in Europe”, *Digital Single Market*, <https://ec.europa.eu/digital-single-market/en/news/digital-skills-gap-europe> (September 2019)

In Italy, only 16.2% of enterprises with a staff of at least 10 employ ICT professionals (as opposed to 72.3% of large enterprises). However, both groups have encountered difficulty in recruiting experts⁽²¹⁾.

1.4. What do we need if we are to ride the wave?

Before us there is a broad range of potential technological advantages. But what exactly do we have to modify to grasp these advantages, and govern them, if we are to ride the wave?

Our guidance counsellors – parents, teachers, jobcentre navigators and so forth – do not always possess the tools needed to understand and participate in digital change.

Overhauling training courses at all levels with digital in mind – whether secondary school or university, or at a professional retraining or management training level – is therefore a step that we can't afford to put off any longer.

As explained above, so-called “skills mismatches” are common throughout Italy, i.e. a mismatch between skills possessed by workers and the skills required by the market to take on specific tasks. Mismatching also assumes the form of “overqualified” workers: 11.7% of workers have an excess baggage of skills; 18% are overqualified for the tasks required of them⁽²²⁾.

Who is responsible for developing these skills? If we are to meet the needs of tomorrow, where shall we look to find “who” is to be called upon to invest in this development, and “what” must be aided/facilitated?

Just as the impacts of the digital are manifold and varied in nature, the parties engaging in furthering the digital, on all fronts, shall report to a variety of groups. Firstly, let's look at the **role of the institutions**: one must consider the importance of the education and training system and the employment system – i.e. institutional pillars that must meet the challenges of innovation and change. Where technology reigns supreme, changing our conceptions of “knowledge” (unmediated searches for information on the Web), and of trading dynamics (e-commerce, online delivery services etc.), as well as interpersonal relationships (social media), the human relationship between the providers of training/education and learners remains essential.

Whether acting as policy-making bodies or as institutions that provide educational/training services, the **system of education**, training and employment must move towards developing learning “programmes” and, above all, “educational projects” that include new tools and methodologies. These tools and methodologies must be capable not only of transferring the technical knowledge conducive to acquisition of *Digital skills* but also of developing the soft skills subtending the digital world (i.e. cultivating public awareness of the active role that the citizenry can play in the knowledge society, alongside a workforce able to deploy *Digital skills* in their respective sectors). Schools, universities and training bodies can be seen therefore to be active within a markedly dynamic ambit (in which teachers/trainers, designers and evaluators are in the front line as changemakers).

What do businesses need?

Professionals shall be required to possess a number of key skills that will enable them to face the challenges of the fourth industrial revolution, in addition to the specialised skills of their own professional domain. But what are these key skills? And how significant is the “digital” component that will be required? The data cited by the *Digital skills* Observatory (2018)⁽¹⁹⁾ indicate that ***Digital skills* (e-skills)** are among the **most sought after by businesses** – almost 63% of the estimated total in more than 4 million job openings. Actually, these skills are the so-called *Digital skills* that do not necessarily entail computer/digital specialisation. In 57.7% of cases, the e-skills required by companies regard “use of internet technologies and the ability to manage visual and multimedia communication”. The problem is that businesses struggle to find applicants with *Digital skills*, depending not only on the fact that these profiles are

hard to come by, but also, as companies report, on the **inadequate training of the applicants**.

If, on the one hand, among the various reasons, we can ascribe this skills gap to a **lack of awareness among young people about the potentials offered by digital transformation**, it is also true that companies **still invest too little in training (or, rather, in upskilling and reskilling)**. A survey carried out by University2Business (Digital360 group) shows that only 38% of companies and businesses invest in developing their employees' *Digital skills*, and only 28% invest in developing entrepreneurial skills⁽²⁰⁾. Therefore, cultural change is still at the embryonal stage, basically incapable of exploiting labour-market opportunities according to a vision of developing “the skills of today” (not only technical-scientific but also managerial and change- and innovation-driven skills).

Likewise, the institutional actors responsible for labour market policies must collaborate to an even greater extent, and constantly interact with **employers' and trade union representatives** (both on a social and territorial level) in order to further a greater “matching” of tools – a supply side constituted by “content” updated to tally with the required *Digital skills* .

Indeed, within a *Digital skills* ecosystem, the role of companies is vital. In addition to working toward a convergence between the training supply-side and the work sphere, companies too must “gird themselves” (i.e. adopt technologies, infrastructures and, specifically, skills) for the upcoming Industry 4.0 changes. First and foremost, human capital must be adapted to current cultural changes. We return to the concept of developing *Digital skills*, this time in the light of business concerns in the field. We must raise the level of competence - **Upskilling** - starting out from verification of adaptation of people's skills vis-à-vis the skills required by the marketplace, and then we must engage in **Reskilling**, i.e. upgrading profiles in terms of attainable skills required by companies.

But which *Digital skills* must we pinpoint, cultivate and consolidate? If we wish to ride this wave, we must familiarise ourselves with its ways – classify, decodify.

Talent trends 2019

Upskilling for a digital world



79% of CEOs express concern over the availability of key skills

«It's understandable that organisations are concentrating on **reskilling**. Given the right context, people can be highly adaptable, and the ability of organisations to harness that adaptability will be critical as the labour market evolves. The good news is that employees are more than willing to **reskill**. According to a PwC global survey of more than 12,000 workers, employees are happy to spend two days per month on training to upgrade their digital skills, if such training is offered by their employer»



PwC 22nd CEO Survey – Annual Global CEO Survey trends series

19) AICA, op. cit., p. 9

20) Bocchi F., et al. *Il futuro è oggi: sei pronto? 3^a Edizione della ricerca*, University-Business (Digital360 group), 2017

21) Istat, “Cittadini, Imprese e ICT”, Statistiche Report, https://www.istat.it/it/files/2017/12/ICT_Anno2017.pdf, (September 2019)

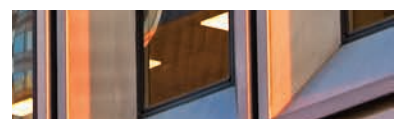
22) OECD, *Strategia per le Competenze dell'Ocse, Sintesi del rapporto Italia*, OECD Publishing, Paris, 5 October 2017, <https://www.oecd.org/skills/nationalskillsstrategies/Strategia-per-le-Competenze-dell-OCSE-Italia-2017-Sintesi-del-Rapporto.pdf>





Chapter 2

Digital skills



2. Digital skills



The structure of skills and the capacity of these skills to dynamically adapt to technological change are two critically important elements explaining the ability of economies to offset the negative effects on employment ⁽²³⁾

2.1. European classification of Digital skills

With respect to Europe, digital “citizenship” skills are to be found within the pertaining **Digital Competence Framework for Citizens (DigComp 2.1)** which also classifies levels of mastery and functionality in respect of learning tasks. The picture indicates a cause-effect mechanism between levels of mastery of *Digital skills* (foundation, intermediate, advanced, highly advanced) and learning outcomes. This mechanism is summarized by the interrelation between dimensions (descriptors and examples of use) and *Digital skills*.

From **DigComp 2.1**, other sectoral reference frameworks have emerged such as:

1. **DigCompEdu**, for educators;
2. **DigCompOrg**, for educational bodies;
3. **DigCompConsumers**, for consumers.

Also, at a European level, *ad hoc* classifications were developed for skills relating to the sector of Information and Communication Technology (ICT). The most relevant work, to which Italian experts from the labour market have contributed, is the e-CF (which has now reached its version no. 3.0), a common European Framework for ICT Professionals in all industrial sectors. This framework gathers together five areas of competence pertaining to corporate organisational processes (plan, build, run, enable and manage). It matches each process with various specific skills, which skills are in turn broken down into various levels (compatible with EQF levels 3-8).

ESCO is, in turn, the European multilingual classification of Skills, Competences, Qualifications and Occupations. It represents a truly Europe-wide taxonomy (translated into 27 languages also with the backing and support of PwC). In its “skills group”, ESCO includes 5 subgroups dedicated to *Digital skills* (ICT security, digital data processing, communication and collaboration through digital means, use of hardware and ICT tools for problem-solving, creation of digital content) which in turn list a total of 21 skills defined as “transversal” but still digital.

With purposes related to definitively establishing educational systems, the European Union has, since the very commencement of classificatory processings, introduced *Digital skills* among the 8 key elements for lifelong learning on the part of European citizens, as indicated by the key role played by the digital as lifelong learning proceeds. This element of **the European framework of key competences for lifelong learning**, reviewed in May 2018, includes: computer and digital literacy, communication and collaboration, media literacy, creation of digital content, security, intellectual property issues, problem-solving, and critical thinking. Therefore, digital competence presupposes, above all, an interest in digital technologies and their use, familiarity with use procedures, plus a critical and aware spirit, furthering learning, work and participation in society.

23) Inapp, Guarascio D., Sacchi S., *Digitalizzazione, automazione e futuro del lavoro*, INAPP, Rome, 2017

Timeline of approvals of European Frameworks and of classifications (also) regarding *Digital skills* [drawn up by PwC]

Legenda

Competenze chiave per l'apprendimento permanente, Raccomandazione del Parlamento europeo e del Consiglio

E-CF: European e-competence framework, CEN Technical Committee "ICT Professionalism and digital competences

ESCO: Classificazione Europea di abilità/competenze, qualifiche e occupazioni, Commissione Europea – DG EMPL

DIGCOMP: Digital Competence Framework for Citizens, Commissione Europea – DG EMPL e JRC

From the viewpoint of industrial development and of competitiveness of production systems, in 2016 – again with the contribution of PwC – specialist skills were developed in the classification of **KETs - Key Enabling Technologies**, or technologies that enable process, goods and services innovation in the economy, include (1) micro- and nanoelectronics, (2) nanotechnologies, (3) industrial biotechnology, (4) advanced materials, (5) photonics, and (6) advanced manufacturing technologies.

As regards the Italian national panorama, in addition to implementation of the above frameworks, we have focused in recent years on the construction of the

Quadro Nazionale delle Qualificazioni (NQF - National Qualifications Framework). With respect to regional qualifications, the pertaining technical element consists in the **Atlante del Lavoro e delle Qualificazioni** (Atlas of Jobs and Qualifications), which details the content matter of employment in terms of activities and products-services potentially deliverable on carrying out the activities in question. Among the 24 economic-professional sectors into which the Atlas is divided (PwC experts also backed up the process of delineating these sectors) we find ICT, which includes a description of the work processes envisaged for the sector, "slotting in" the pertaining professional roles, linked to the qualifications issued regionally.

To manage our confusing “babel” we must:

- Define
- Standardize
- Classify

...however there are many classifications



PwC processing of
European Commission data

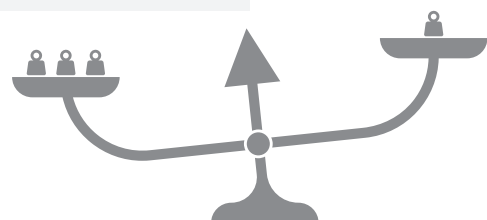
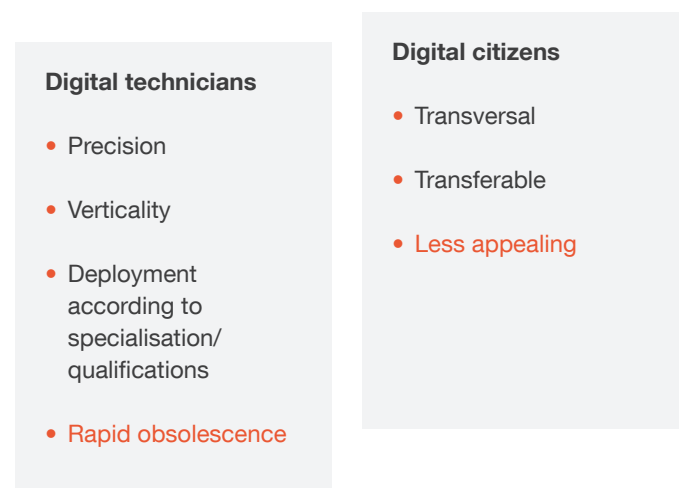
2.2. Different classifications for different purposes and “objects”

The (non-exhaustive) list of classifications mentioned in the previous section tells us we must consider how this frameworks arrangement came about. Over time, in order to classify our *Digital skills*, we had to “define” the concept of *Digital skills*, “standardizing” the concept in order to arrive to a shared understanding on the plane of “classification”:

The transition from a “babel” to order, coming about through classification, allows us to clarify to what extent level of detail in *Digital skills* is meaningful. In other words, this transition allows us to reflect on some elements of equilibrium: do we need to develop specialised skills (i.e. the skills of a digital expert), or do we need to cultivate a more broadly-based idea of digital citizenship?

Considering *Digital skills* in this dual (but not necessarily dichotomous) light enables us to detect the broad reach of these very skills. On the one hand, we have highly specialised professionals who use as the “raw material” of their job the results of incessant technological development. Their *Digital skills* are linked to technical and scientific skills and knowledge. However, there are others whose *Digital skills* point to new approaches to the labour market and society, who deploy what is known as soft skills.

Level of detail for *Digital skills*





Chapter 3

The challenges facing the education and training system

3. The challenges facing the education and training system



(...) If education is to be the backbone of growth and inclusion in the EU, a key task is preparing citizens to make the most of the opportunities and meet the challenges of a fast-moving, globalised and interconnected world ⁽²⁴⁾

To foster innovation, economic growth and progress it is necessary, inter alia, to:

- improve **literacy and inclusion** in the digital world;
- go beyond the “foundation level” of Digital skills and develop a **critical and aware use** of new technologies.

How can these goals be achieved? What are the tools and channels for disseminating *Digital skills*? And who are actors who can contribute to such a diffusion of knowledge?

Digital citizenship can be defined as “new” citizenship which foresees a renewal of methods and tools for exercising the rights and duties foreseen in regulations.

Teachers/trainers are therefore the main protagonists who must engender digital abilities in students. Two key considerations therefore arise:

- it is essential that teachers/trainers be **aware of their role as catalysts** of Digital skills;
- they must in turn supervise these skills and “nurture” them so that these skills be duly **updated**, as per by the latest Eurydice report “Digital Education at School in Europe”, August 2019⁽²⁵⁾.

Broadly speaking, educational and training systems are therefore called upon to adapt to the contemporary world, to understand changes and acquire change-resilience, in line with the challenges posed by technological progress.

In which areas do these challenges emerge?

One could answer, in all areas. As described in the first Chapter, there are no sectors in which technological innovations have not had an effect. This confirms the view that the training and education systems should first of all **invest in the digital component proposed by designers and implementers of educational-training projects**, enabling individuals to carry out the jobs of the future and engage in the forms of traditional jobs that, in any case, have (to varying degrees, but all without exception!) been impacted by new technologies.

Many other aspects of life and society are subject to changes and improvements determined by technological progress. Since it is impossible here to deal with all issues, two should be investigated that are of particular interest: **digital citizenship** and **gender equality**.

The concept of **digital citizenship** indicates the exercise by citizens of rights and duties through the use of digital tools and services, e.g.:

- digital identity
- digital signature
- digital domicile

²⁴⁾ European Commission, *Communication from the Commission to the European Parliament, the Council, the European Economic and Social committee and the Committee of the Regions on the Digital Education Action Plan*, COM (2018) 22 final, Brussels, 17 January 2018

²⁵⁾ European Commission/EACEA/Eurydice, 2019, *Digital Education at School in Europe. Eurydice Report*, Luxembourg: Publication Office of the European Union, pp. 45-61

“Digital skills” Survey

In order to monitor the perceptions of teachers vis-à-vis their role as catalysts of *Digital skills*, PwC carried out a preliminary survey of a number of primary school and lower and upper secondary school teachers in the Veneto Region. The survey took in a sample of about 150 teachers, of whom 63.81% from lower and upper secondary schools and the remaining 36.18% from primary schools. More than 75% of the interviewees were aged between 40 and 59, the remaining 25% mainly 25-39-year-olds (19.08%) and, to a lesser extent, some over-60-year-olds (4.61%). In regard to age brackets, the composition of the sample was thus found to be in line with the latest OECD⁽²⁶⁾ data, according to which Italy ranks among OECD countries as the country with the highest proportion of teachers aged over 50. Although the teaching staff were not selected for the representativeness of the sample, the results are of particular interest and worthy of mention. Respondents showed that they consider new technologies indispensable resources for learning and acquiring skills – not only in the STEM field (86.84%) –, but also for teaching “humanities” subjects (64.47 %) and for development of so-called soft skills (63.15%). Furthermore, according to more than 5 out of 10 respondents, the use of new technologies for learning might positively impact integration among students and might lower the early school-leaving rates, and function as a bridge between generations (72.37%). In addition to the need to invest more in innovative, multidisciplinary educational programmes dealing with use of digital tools, the survey highlights the opinions of the teachers interviewed who claim one cannot talk about the effective use of new digital technologies without simultaneously working toward developing the *Digital skills* of teachers. Over 90% of the respondents agreed that this latter aspect must be viewed as an absolute priority for decision-makers.

In this regard, one of the survey queries aimed at examining more closely the methods adopted by primary and secondary school teachers to enhance their *Digital skills*. Interestingly, almost two thirds of the respondents, 63.15%, are training mainly independently, by reading books or personally interacting with friends, relatives and colleagues. Learning practices through e-learning courses and institutional courses made available by the Ministry of Education, University and Research and by the Ufficio Scolastico Regionale (regional educational department) are much less widespread or significant (24.34% and 28.95% of interviewees, respectively).

150

Primary and secondary school teachers

65%

Believe that the use of new technologies is important for acquisition of “soft skills”

29%

Augment their *Digital skills* through institutionally provided courses (Ministry of Education, University and Research and the Ufficio Scolastico Regionale)

This preliminary survey thus points to a strength and at least two aspects worthy of attention: a widespread awareness on the part of teachers of the impact of new technologies on their profession (on the one hand, accompanied by the risk of an unexpressed demand for *Digital skills* learning; and, on the other, accompanied by the presence of an educational supply side consisting in courses and institutional programmes that teachers perceive as still partial and not able to fully meet their needs).



26) OECD (2019), Education at a Glance 2019: OECD Indicators, OECD Publishing, Paris, <https://doi.org/10.1787/f8d7880d-en>

27) OECD, “Going Digital: The Future of Work for Women”, Policy Brief on The Future of Work, OECD Publishing, Paris, 2017, <http://www.oecd.org/employment/Going-Digitalthe-Future-of-Work-for-Women.pdf>

28) Netconsulting cube on behalf of CA Technologies and Fondazione Sodalitas (2016), *Digital gender gap: valorizzare il talento femminile nel settore tecnologico*, http://www.educational.rai.it/materiali/pdf_articoli/33063.PDF

29) European Commission, *Women in the Digital Age*, Luxembourg, Publications Office of the European Union, 2018

Some key instances of digital citizenship



The public system for the management of digital identity (**Sistema Pubblico per la Gestione dell'Identità Digitale (SPID)**), enables citizens to access PA online services using a single digital identity, thanks to the possession of a username and password.



With a **digital signature** one can exchange documents with full legal validity online, because the signature is a guarantee of authenticity, integrity and non-repudiation. To affix the signature, the holder must possess and use two symmetric digital keys.



The **digital domicile** is the electronic address selected by the individual for receipt of PA documents by electronic means.



What are the benefits of digital citizenship?

In this case, digital technologies are used to **simplify** relations among citizens, businesses and public administration. In addition, online accessibility of such services generates many **opportunities for inclusion** because it breaks down the space-time barriers that are otherwise present.

For citizenship to be achievable, however, digital citizens must be able to access services and therefore must possess adequate *Digital skills*, e.g. the ability to surf the Internet, use encrypted keys and open protected documents (skills that they may have learned as part of educational/training courses).

With respect to the issue of **gender equality**, it should be noted that, in OECD countries, most graduates are female. Attention is therefore dedicated to those higher skills required by the labour market that should tip the balance in their favour. However, it is noted that **only 1.4% of female workers possess specialist ICT skills** (vs 5.5% of men). Despite this, it is clear that new opportunities for the universe of women can arise out of mastery of digital and soft skills. We need only think of those typically “male” professions that, thanks to automation and the use of digital tools, may be opened up to female workers (in the manufacturing and agriculture sectors)⁽²⁷⁾.

The impact of digital transformation on the position of women within the labour market: automation meets flexibility

A **NetConsulting Cube** research project for CA Technologies – conducted with the involvement of a sample of HR and CIOs from 60 Italian companies and of 225 students from upper secondary schools and training schools – points to a low percentage of women graduating in STEM (Science, Technology, Engineering and Math) disciplines. 46% believe they do not have the qualities required to make a career in the technical-scientific field⁽²⁸⁾.

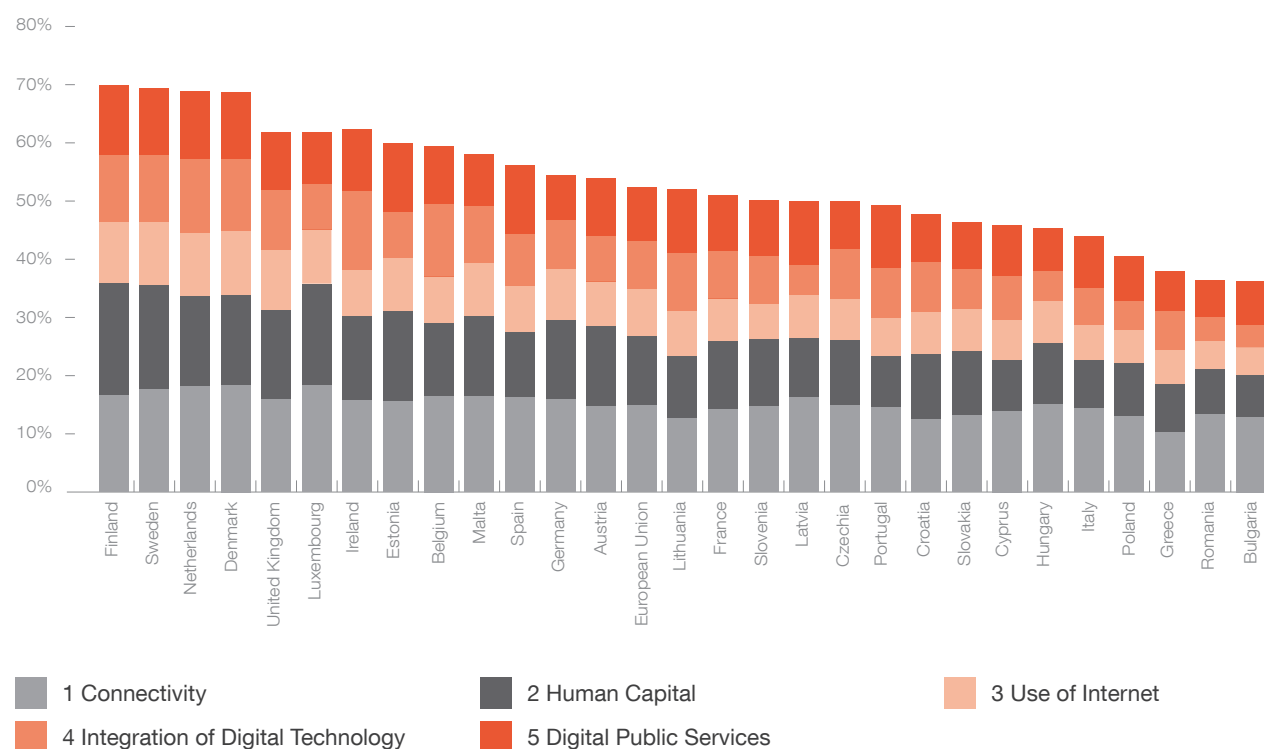
The recent European study, “**Women in the Digital Age**”⁽²⁹⁾, conducted by DG Connect, shows that even specific and ICT-oriented education is not enough to ensure that women attain a higher percentage of success in work sphere. The proportion of women working in the digital sector who tend to leave their jobs is higher than among men. This is particularly notable among women in the 30-44 age bracket, i.e. in the period of fullest professional development, but also a period of their lives in which most European women have their first child and/or in which they dedicate themselves to child-rearing. Indeed, while 1.2% of male digital workers with a university education left their profession for family reasons in 2015, the figure quadruples for female digital workers (8.7% in 2015, i.e. approx. 1.5% more than in 2011).

Although the digital revolution is underway, companies confirm that there is a lack of applicants for technical-scientific posts. However, they also admit that **forms of cultural resistance** exist and that **the working conditions are not always such that would ensure a growth in numbers of female employees in certain roles**, where such women could otherwise contribute to product/service innovation. The element of “flexibility” might indeed be of considerable benefit to “digital women”. Organisationally speaking and for families (i.e. smart working), OECD countries that display higher percentages of women working from home also present higher working-mother rates. Moreover, from the point of view of remuneration, the gender pay gap is narrower in sectors within which organisation of work is more flexible.

As highlighted in the recent literature, “only if it can also impact organisation of the social – and not merely the production – sphere will the Fourth Industrial Revolution keep its promise of emancipation”⁽³⁰⁾.

The summary analysis of the requirements dictated by technological innovations points to the desirability of adopting **models of integrated innovation** – in some respects, entirely novel models – which, by fostering the development of *Digital skills*, must be capable of embracing the heterogeneity of the factors of digital change while enhancing the core role played by human resources. Given Italy’s level of digitization, highlighted in the DESI index graph, it would be appropriate to reflect upon the role that public policies (in the most strategic and exalted sense of this term) can play in raising this level.

Digital Economy and Society Index (DESI) 2019 ranking



PwC processing of the graph from *Digital Economy and Society Index (DESI) - 2019 country report Italy*

Italy ranks 25th (out of 28 Member States, plus the EU mean) in terms of national digitalization rate (DESI index). The Digital Economy and Society Index (DESI) “monitors” performance of Member States in regard to digital connectivity, *Digital skills*, online activities and digitalization of businesses and public services

³⁰⁾ Tonarelli A., “La Quarta Rivoluzione industriale sarà un’opportunità per le donne?” Cipriani A., Gramolati A., Mari G. (ed.), *Il lavoro 4.0 La Quarta Rivoluzione industriale e le trasformazioni delle attività lavorative*, Florence: Firenze University Press, 2018, pp. 463-475

3.1. Drivers of effective digital policies

In a recent study⁽³¹⁾, UNESCO summarized some key elements for ensuring widespread dissemination of the *Digital skills* required to face up to the challenges of the future. Starting out from this literature, we may note that the **level of Digital skills may be influenced mainly** by the factors presented in the figure below.

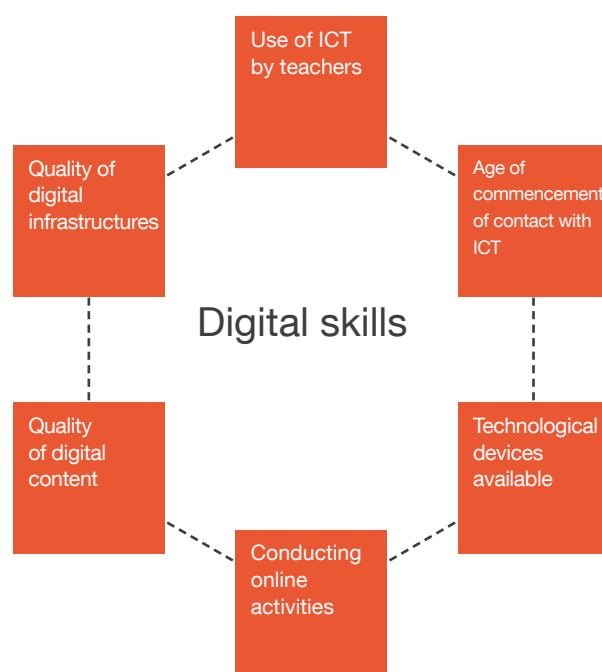
This set of factors relates to two macro-dimensions of intervention on the part of the policy maker:

- **transversal policies** - which foster creation of an environment conducive to development of *Digital skills* (quality of infrastructures, propensity to engage in online activities, quality of content available online);
- **sectoral policies** focusing on education and on the link between these policies and the labour market (age of commencement of use of ICT for learning purposes, extent to which ICT is used by teachers, availability of digital devices used for learning purposes).

By focusing on **sectoral policies**, we can identify as the main drivers, three areas of intervention: ICT integration, overcoming the generation gap between learners and teachers/trainers, curricula and adequate educational projects.

Accordingly, from PwC's viewpoint, a scenario is outlined according to which educational and training systems can truly innovate. This scenario may be derived from two elements:

- **Concentration of resources** on clearly defined, measurable objectives;
- **Consultation with actors** as stakeholders (schools, companies, trade associations etc.).



31) Fau, S., Moreau, Y., *Managing tomorrow's Digital skills: what conclusions can we draw from international comparative indicators?* Working Papers on Education no. 6, Paris, 2018: Unesco

Possible areas of intervention

ICT integration

Intervening both on infrastructures and processes, including significant changes in techniques, equipment and software; integration of these into learning processes.



Finding the right mix between traditional learning and use of technology



Selecting software solutions that are truly appropriate for the educational and training objectives

Overcoming the gap between learners and teachers

Ensuring that technology shall be sustainably and effectively introduced into learning environments



Enhancing the *Digital skills* of teachers



Disseminating “digital” teaching methods

Appropriate curricula for the job market

Developing “unprecedented” skills with reference to the rapid digital changes that characterise the fourth industrial revolution, disseminating *Digital skills* with high inclusive potential and in line with the supply-and-demand employment scenario.

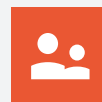


Considering the teaching of *Digital skills* as something more than imparting technical skills included in a training course



Learning /training programmes with a focus on advanced *Digital skills*

Elements of the innovative approach, for educational and training systems



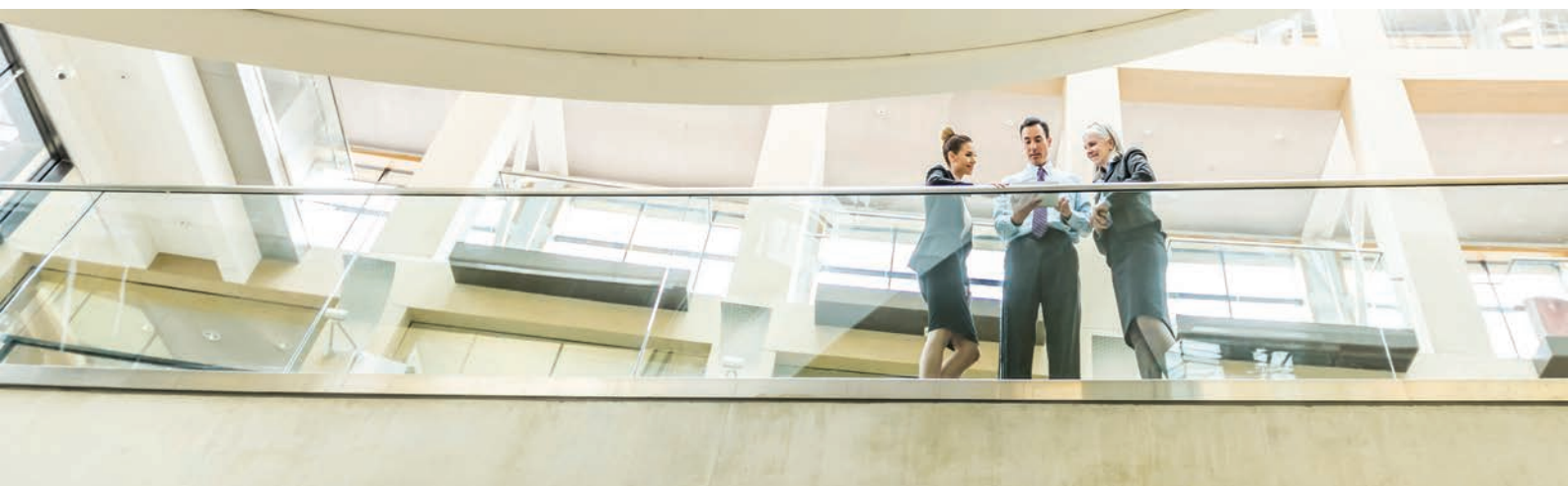
Involvement of all stakeholders

The various sectors of public administration and of research; the broad range of non-governmental actors, businesses, professionals and trade associations.



Measurement systems for policy outcomes firmly anchored to the objectives set

Adopting observation metrics to assess the relationship between innovation and dissemination of *Digital skills* and of policy results.



Integration of ICT into learning processes

Technology offers opportunities for new, gamified, customised approaches to learning, which may change the traditional role of teachers, facilitating hybrid learning experiences.

Integration of ICT into educational and training systems is one of the key drivers of the change foreseen for enhancement of *Digital skills*, deploying **enabling** effects that are particularly relevant in terms of:

Social inclusion

Introducing the use of ICT right from primary schooling ensures for everyone the same level of access to learning *Digital skills*.

Work inclusion

The *Digital skills* required by the labour market can be learned more satisfactorily within contexts that exploit the same ICT that shall be encountered in the workplace.

Multiplier effect

ICT and the internet can enhance learning experiences and can act as catalysts for an evolutionary transition toward broader horizons of learning.

However, up to the present, the use of technologies for educational purposes has not kept pace with “changes” and technological innovations.

Furthermore, in regard to the ability to exploit technological devices for learning, the analyses carried out by OECD⁽³²⁾ – on performance as recorded during PISA surveys – indicate that **when students use the internet to carry out school tasks, they are unable to optimally plan and perform searches.**

OECD analyses have also shown that the ability is lacking to evaluate the usefulness of information or the reliability of sources, thus concluding that **introduction of digital technologies and devices into schools has not always improved learning performance.**

With regard to students, it is possible to hypothesize a **positive relationship between learning outcomes and spread of *Digital skills*** which skills represent, in fact, a precondition for technology as an aid for learners to acquire increasingly “advanced” skills.

Enabling learners to use their *Digital skills* for learning is therefore required.

Students will be able to truly develop their *Digital skills* and to effectively use technologies only if **the *Digital skills* of the teachers/trainers themselves have been developed and only if development of *Digital skills* is seamlessly integrated into educational/training projects.** In fact, teachers must fulfil the role not just of trainers but also of facilitators, as previously indicated, in regard to the use of technology for learning.

Data on the national situation

In Italy, according to OECD data as of 2015, there is one computer for every two students (compared to an OECD mean value of 0.8 computers per student).

According to MIUR* data, 13% of Italian schools have an optical-fibre link.

* https://www.agi.it/data-journalism/scuola_digitale_fedeli_piano_miur_foia-2313064/news/2017-11-02/

For example, some experiments indicate that **educational robotics**, especially in primary schools, provides an **effective means of learning about – and enabling use of – technology** for educational purposes, also considering effects in terms of **proximity and collaboration between teachers and students.**

³²⁾ OECD, *Innovating Education and Educating for Innovation: The Power of Digital Technologies and Skills*, OECD Publishing, Paris, 2016, <http://dx.doi.org/10.1787/9789264265097-en>

Educational Robotics and coding⁽³³⁾

In Italy, Educational Robotics and Coding are research themes currently being examined by Indire (since 2014); their field of application is the Coding and Robotics research project, which has supported and backed up experimentation since 2016, furthering teamwork with schools and teachers throughout Italy.

Educational Robotics and coding embody certain prerogatives that are typical of workshop activities: motivational (when students build or model their very own artifacts and are therefore likely to self-identify with these products, and furthermore are motivated to face up to failures, and to seek solutions for improvement, or alternative solutions; and, by contextualizing knowledge, a capacity for inference is engendered in students). Thanks to adequate didactic planning, Robotics and Coding contribute to the learning process by encouraging a transversal approach to disciplines, enabling students to re-process the knowledge they have acquired and apply it to a variety of contexts.

The orientation of Indire's research into robotics and coding comes out of its enquiry into how robotics and coding can be used within both the curriculum and disciplines, testing, together with teachers, didactic plans relating both to the curriculum and verticality. The experimentation conducted so far has regarded various projects involving groups (limited in size) and classroom activities, with particular attention paid to possible effects regarding processes of verticalization of the curriculum and multidisciplinary and inter-department design work, both for teachers and students.

Overcoming the generation gap between learners and teachers

Directly linked to the theme of enhancing digital learning through ICT is the question of the “profound” gap between target students and operators with a teacher/trainer role.

Globally, the “**digital native-digital immigrant**” dichotomy is superimposed upon the binary construct of the “**learner-teacher**”. Today's learners are largely “digital natives”, while teachers/trainers are more frequently “digital immigrants”, so to speak, representing a generation which must adapt to change and must do so “digitally”.

The characteristics of what could be called “two universes” – learners-teachers/digital natives-immigrants – provide a cogent **key to interpretation, with which we can then face the challenges posed to the education/training system** when seeking to enhance *Digital skills*.

In view of the fact that today's students were born directly into an already digital world, it is appropriate – in order to counter “misuse” of devices and connectivity – to orient digital natives toward learning methods aimed at developing *Digital skills*.

In this regard, the **skills of educators/trainers are of fundamental importance**. It is therefore necessary that educators/trainers develop a standard baseline for *Digital skills* that meets new training needs and that is in line with the tools available, while maintaining the balance between (traditional/“technological”) teaching methods.

Teacher training should take place on two levels:

(1) ICT training so that *Digital skills* can be effectively transmitted to students and (2) training aimed at integrating ICT into teaching methods, so that digital technology is seen not solely as a goal per se but also as a vector for the development of all skills.

33) For an account of experiences and pertaining objectives, see <http://codingrobotica.indire.it/>

Curricula that meet the needs of the labour market

Regarding the need for curricula that meet labour market demand, educational and training systems should orient the supply side not so much toward this or that discipline (e.g., STEM) – or solely dedicating themselves to given disciplines –; rather, they should work toward **interdisciplinary integration**, thus going beyond the usual boundaries implied when training is seen as acquisition of technical skills (such skills being understood as basic skills, as in computer science or technology courses).

Developing integrated skills such as programming and the development of “logical thinking” (enabling us to keep pace with evolving technologies) is an absolute priority. Developing these skills should be fully integrated into most educational and training curricula, as part of the educational ‘mainstream’ for the new citizenry.

Lastly, setting curricula that are **firmly anchored to the needs of the labour market and to digital citizenship** is a decisive factor in attaining what we expect from enhancement of *Digital skills*.

A data-driven understanding of the labour market in terms of skills (either available or that are to be made available) is in fact essential for formulating education and training programmes aimed at ensuring the employability of individuals (and, in doing so, ensuring the competitiveness of enterprises). Collaboration among government, educational and training institutions, and the business world assumes strategic significance, and joint action must be encouraged.

The direction taken by Italy in developing a national framework of educational and professional training qualifications⁽³⁴⁾ with skills firmly anchored to an innovative system of classification of work processes (the “Atlante del Lavoro e delle Qualificazioni”, or Atlas of Jobs and Qualifications)⁽³⁵⁾, constitutes an innovative way of fostering social dialogue and providing response to the needs of the production system. We can achieve this goal by making sure skills (understood as the learning objectives of education and training courses) are linked to real production and labour practices (<https://atlatelavoro.inapp.org/>).

3.2. Some good practices

The “directions” of innovation mentioned above are observable in certain top performing countries in the field of *Digital skills*.

Generally speaking, the public education policies of top performing countries see the strengths of their good practices converge on the monitoring of levels of *Digital skills*, as well as on integration of digital technology into the ecosystem of global education (stepping out of the ICT lessons ‘box’), on bolstering educational reforms via teacher/trainer training activities, and, lastly, on countering digital exclusion (frequently leading to social exclusion).

Below, starting out from recent UNESCO research findings⁽³⁶⁾, we shall examine various examples of the strategies adopted by countries displaying excellence of results within the ambits of digitalization and *Digital skills*.

34) D.Lgs. (legislative decree) no. 13 of 16 January 2013, regarding “Definizione delle norme generali e dei livelli essenziali delle prestazioni per l’individuazione e validazione degli apprendimenti non formali e informali e degli standard minimi di servizio del sistema nazionale di certificazione delle competenze, a norma dell’articolo 4, commi 58 e 68, della legge 28 giugno 2012, n. 92” (specification of the general standards and essential levels relative to performance in order to pinpoint and rate outcomes of non-formal and informal learning processes, as well as minimum standards of service of the national system of certification of skills pursuant to art. 4, par. 58 and par. 68 of Law no. 92 of 28 June 2012)

35) D.M. (ministerial decree) of 8 January 2018 regarding “Istituzione del Quadro nazionale delle qualificazioni rilasciate nell’ambito del Sistema nazionale di certificazione delle competenze di cui al D.Lgs. 16 gennaio 2013, n. 13” (establishing a national framework for qualifications issued within the ambit of the national system of certification of skills in accordance with D.Lgs. (legislative decree) no. 13 of 16 January 2013)

36) Fau, S, Moreau, Y, op. cit.

1

Singapore

Since 1997, on a five-year basis, Singapore has adopted specific education masterplans. These masterplans include the actions to be carried out in various intervention domains linked to enhancing *Digital skills*. The main areas of intervention and objectives pursued in the masterplans are:

- providing schools with the necessary infrastructure;
- training teachers in the use of ICT;
- integrating ICT into teaching methods;
- bringing the teaching of *Digital skills* into all levels of education.

The aim pursued so far has been to balance curricula between, on the one hand, acquiring factual knowledge and, on the other, learning to use digital tools in order to seek, re-use and interpret information, solve problems and communicate ideas effectively.

The underlying rationale is one of adapting the tools and contents of learning in the light of technological change, thus enabling students to acquire the skills necessary for practising new professions in the digital world.

Indeed, Singapore encourages schools to experiment with new teaching methods via emerging technologies (such as 3D virtual learning environments) to foster greater diversity and to raise levels with regard to uses of digital technology.

2

Norway

Norway dedicates much attention to assessing and monitoring the *Digital skills* of students.

The national monitoring and evaluation system assesses the *Digital skills* of students at various levels (primary and secondary education) by collecting information and data relative to a variety of dimensions observed, such as ICT use and aptitude, development of pedagogical strategies that integrate new technologies, and the results of these strategies.

The Norwegian system also provides for a national *Digital skills* assessment test for all students at the eighth year of mandatory schooling. By means of this type of monitoring of *Digital skills*, students' strengths and weaknesses are correctly identified, with a view also to improving public policies based on real needs.

3

Czech Republic

For the Czech Republic, development of algorithms and of logical thinking was adopted as one of the main objectives of the country's 2020 digital education strategy, adopted in 2014.

The strategy concurrently calls for reduced use of ICT at school.

The results achieved by the Czech Republic (in particular as regards levels of *Digital skills* among primary school students) confirm the view that acquisition of skills takes place over and above the use of computers and the gaining of abilities on the operational front. Integration of structural and strategic skills into educational strategies is therefore a key point to be kept in mind.

37) European Commission, *Recommendation for "Council Recommendation on the 2019 National Reform Programme of Italy and delivering a Council opinion on the 2019 Stability Programme of Italy"*, COM(2019), 512 final, Brussels, 5 June 2019: "There has been limited progress in Digital skills and infrastructure. Investment in human capital is a pre-requisite for boosting public and private investment and current measures to boost Digital skills and adult learning lack a comprehensive approach"

38) European Commission, *Proposal for a "Regulation of the European Parliament and of the Council establishing the Digital Europe programme for the period 2021-2027"*, COM(2018), 434 final, Brussels, 6 June 2018

3.3. A “multidimensional” national roadmap for Digital skills

In the above paragraphs we delineated areas of intervention and drivers for change, which are of use to us in delineating an Italian pathway toward developing *Digital skills*. We wish to outline and clarify this below by means of a possible roadmap which, due to the complexity and scope of the objective, cannot but contemplate multiple dimensions and entail multi-level governance.

Given the ‘landscape’ that has emerged, the areas of intervention can be combined, iconographically, on two perpendicular axes, which respond to the weaknesses noted in Italy in general:

1. **the Axis of development of digital citizenship skills and soft skills, both transversal and enabling** (creativity, problem solving, critical thinking etc.) linked to the new technologies; as per the DIGCOMP framework – not looking to use of specific tools, but catering to the needs of every citizen of the information and communication society: the need to be informed; to interact; to express oneself; to access protection; and to manage the criticalities associated with technological tools and digital environments.
2. **the Axis of the strengthening of vertical technical skills** corresponding to a more highly specialised area that contemplates technical abilities, or the so-called hard skills, which allow individuals to identify, evaluate, use, share and create content using information technology and the Internet. These skills are more specific and advanced (e.g. coding or developing software systems for artificial intelligence).

To act on the **first Axis** it is necessary to intervene with actions aimed at the population as a whole and not merely students, with a view to upskilling and reskilling, and adopting a mainstream approach for schools and training with learning spaces that are digital, in order to enable: collaboration; sharing; increasingly absorbing/enthralling learning experiences; and dissemination of innovative methodologies and approaches to learning. We must therefore work not only on skills enabling use of digital tools but also on the basic *Digital skills* that are now also necessary for practising “non-digital” professions.

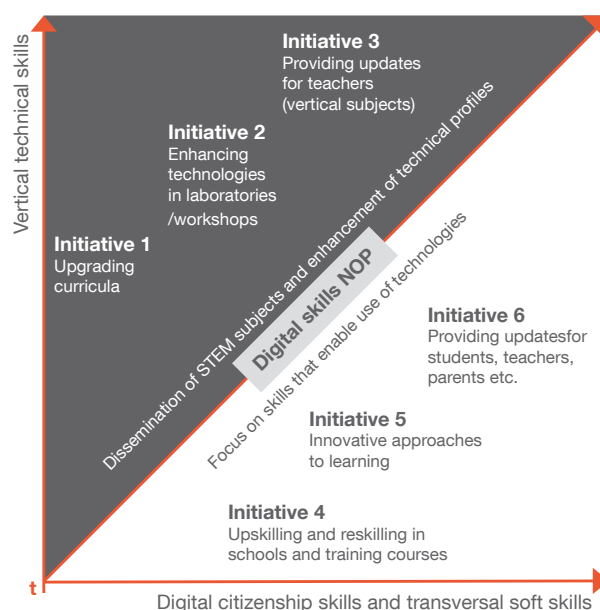
To engage with **second Axis** intervention, we require dissemination of STEM (science, technology, engineering and mathematics) knowledge; linking curricula to the needs of the labour market; seeking the involvement of companies and external experts in education and training; providing updates for teachers of “specialist” and technical subjects; providing laboratories/workshops with leading-edge

technologies etc. (thereby creating the intermediate or highly specialised technical profiles required to maintain competitiveness).

The vector for interventions along these two Axes – while clearly distinguishing between the two objectives – must take the form of a **single national strategy** of synergic actions, taking place hand in hand and in accordance with an overall vision that privileges the interconnectedness of the two Axes.

Responding to the Recommendations to Italy of the European Semester⁽³⁷⁾, which highlighted the lack of systemic governance of the *Digital skills* strategy, the national strategy might take the form of a **National Operational Programme (NOP) dedicated to Digital skills** in line with the **Digital Europe Programme**⁽³⁸⁾, which foresees a specific area for development of *Digital skills* in Europe via investment of about **700 million euros**. The European Commission itself – which faces the challenge of digital innovation from numerous and diverse directions (research, technological development, competitiveness, training and requalification etc.) – has recently decided to adopt a single Digital Education Action Plan with 3 priorities:

1. Making better use of digital technologies for teaching and learning.
2. Developing *Digital skills* and abilities of significance for digital transformation
3. Bolstering education through improved data analyses and predictive analyses.





Chapter 4

PwC's contribution to
developing Digital skills

4. PwC's contribution to developing Digital skills



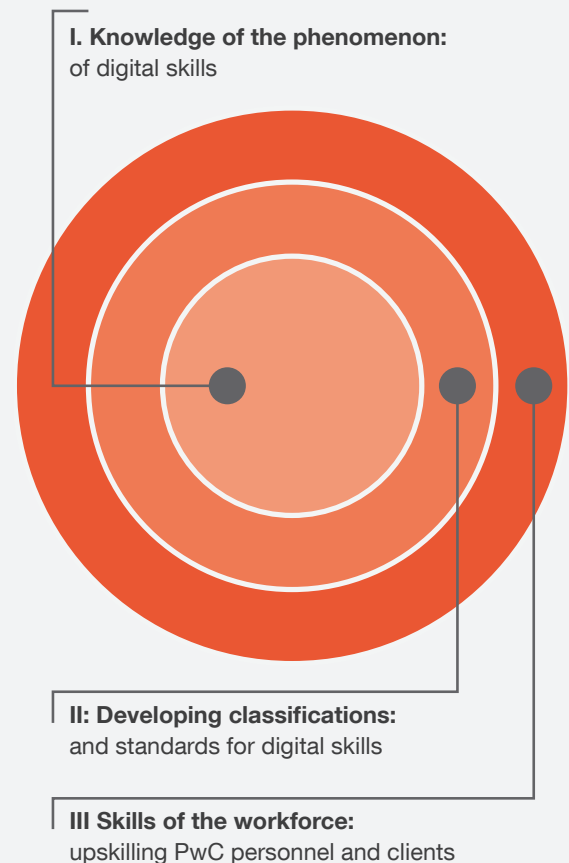
As a national and global player, PwC is fully committed to backing up the efforts of enterprises and public administration bodies to upskill and reskill their HR, to enable them to ride the wave of the fourth industrial revolution

As a national and global player, PwC is fully committed to backing up the efforts of enterprises and public administration bodies to upskill and reskill their HR, to enable them to ride the wave of the fourth industrial revolution. Furthermore, PwC fosters initiatives backing up policy makers when drawing up strategies and policies for the creation of education, training and work systems capable of catering to the needs of citizens, workers and enterprises.

Our front lines of action might be understood as comprehending three key areas of intervention: 1) developing **knowledge** of the phenomenon of the impact of digitalization understood as a global mega-trend, through analyses, studies, conference papers and publications created by PwC departments to facilitate a global vision, catering for the viewpoints noted in all continents; 2) developing **in-house skills** for training of staff so that they can seize the opportunities that digitalization offers our clients, leading the way as upskillers of their own workforces; 3) developing projects dedicated to analysis of work and skills at a national and European level in order to produce **classifications** and maps serving 'navigators' on the 'sea' of *Digital skills*, and in order to develop curricula and tools that link the training and education supply side to the needs of the work sphere.

Below is a brief, non-exhaustive review of PwC initiatives at a national and international level, linked to *Digital skills*. This summary has been articulated in accordance with the strategic rationale shown in the diagram.

PwC's contribution to *Digital skills*: three areas of intervention





I. Knowledge of the phenomenon

PwC is committed to developing **knowledge of the phenomenon**, analysing the risks and opportunities of digitalization at a national and global level, and the compensatory capacities of the system: risk of losses (jobs or entire sectors of activity) and fresh openings for profit-making (new jobs, new professions, new skills).

The Lost Workforce: Upskilling for the Future



www.pwc.com/it/lost-workforce



A paper that deals with innovative, ambitious and practical solutions targeting various government policies aimed at increasing a portfolio of skills that is not as fully exploited by the talent pool as desired.

Given the rise in the job vacancies, companies are desperately seeking applicants. Meanwhile, hundreds of millions of unemployed, overqualified or unskilled workers do not – or no longer – possess the skills required for specific roles.

This lost workforce can only be seen as an incredible waste, in terms of growth and of economic opportunities.

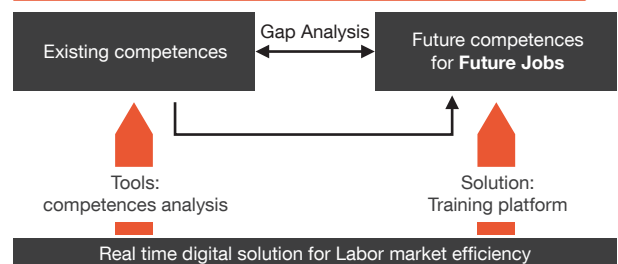
Upskilling Toolbox

Key component of the toolbox

Communication activities

Financing

New regulatory framework



PwC processing of *The Lost Workforce - Upskilling for the Future*

Will robots steal our jobs



www.pwc.com/it/impact-of-automation



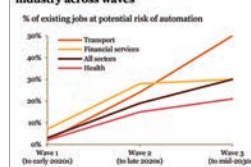
International analysis of the potential long-term impact of automation, conducted by PwC using an OECD database regarding 29 countries.

“In the long run, less well-educated workers may be particularly exposed to automation. This underscores the importance of greater investment in lifelong learning and professional retraining”

Key findings: impact of automation

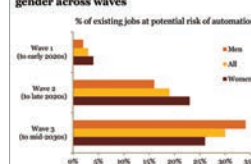
Financial services jobs could be relatively vulnerable to automation in the shorter term, while transport jobs are more vulnerable to automation in the longer term

Figure 1 – Potential job automation rates by industry across waves



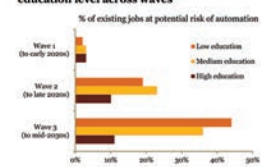
Female workers could be more affected by automation over the next decade, but male jobs could be more at risk in the longer term

Figure 3 – Potential job automation rates by gender across waves



In the long run, less well educated workers could be particularly exposed to automation, emphasising the importance of increased investment in lifelong learning and retraining

Figure 2 – Potential job automation rates by education level across waves



Waves	Description and impact
Wave 1: Algorithmic wave (to early 2020s)	Automation of simple computational tasks and analysis of structured data, affecting data-driven sectors such as financial services.
Wave 2: Augmentation wave (to late 2020s)	Dynamic interaction with technology for clerical support and decision making. Also includes robotic tasks in semi-controlled environments such as moving objects in warehouses.
Wave 3: Autonomous wave (to mid-2030s)	Automation of physical labour and manual dexterity, and problem solving in dynamic real-world situations that require responsive actions, such as in transport and construction.

Workforce of the future

The competing forces shaping 2030



www.pwc.com/it/workforce-of-the-future



The “Workforce of the Future” report is based on research initiated in 2007 by a team from PwC and the James Martin Institute for *Science and Civilization*, and on an international survey involving 10,000 people in China, India, Germany, the United Kingdom and the United States. Thanks to this work, we learned what people think of evolution of the working environment and of how this will affect their employment prospects and their future working lives.

No exploration of the future of work can ever be definitive or final. Indeed, **one of the distinctive features of our era is its ability to surprise and confound us**. In order to help us reflect on, and prepare for, the future, this report shall elaborate upon “Four future scenarios – or worlds – of work” for the year 2030.



Other initiatives regarding Digital skills

Among the *Digital skills* initiatives in which PwC is active, there are also some projects and services that back up the European Commission. These actions include drawing up studies, reports and guidelines, and focusing on the search for innovative solutions enabling us to meet the upskilling and reskilling needs of workers (e.g. Curriculum Guideline for KETs and AMT, which aims to enhance the quality and relevance of curricula and to augment cooperation between the worlds of industry and of training by match-making between training programmes and the current needs of enterprises. PwC is also engaged at a European level in providing support to networks of Digital Innovation Hubs (bodies contributing to the digitalization of local ecosystems, frequently entailing – among their various tasks – that of developing the *Digital skills* of businesses and of local public administration bodies).

- **“Promoting Online Training Opportunities for the Workforce in Europe”**, EASME/DG GROW European Commission, October 2017 – September 2019
- **“Curriculum Guidelines for Key Enabling Technologies (KETs) and Advanced Manufacturing Technologies (AMT)”**, EASME/DG GROW European Commission, January 2018 – December 2019
- **“Skills for Smart Industrial Specialisation and Digital Transformation”**, EASME/DG GROW European Commission, October 2017 – November 2019, EUR 495,000
- **“High-Tech Skills for Europe: National Policies and Funding Programmes for Skills Development”**, EASME/DG GROW European Commission, August 2017 – September 2019
- **“Digital Innovation Hubs Network”**, DG CNECT Commissione Europea, Ottobre 2018 – Marzo 2020, EUR 1,1 Mio



II. Classifications

PwC is committed to fostering initiatives in support of Public Administration bodies – at a European, national and local level – in efforts to develop **classifications** and data banks for assessment of *Digital skills* and to favour matching between the supply and demand sides of the labour market.

Creating case data sheets for the production of the Atlante del Lavoro (Atlas of Jobs), and for consolidation and development of the data banks and related web pages

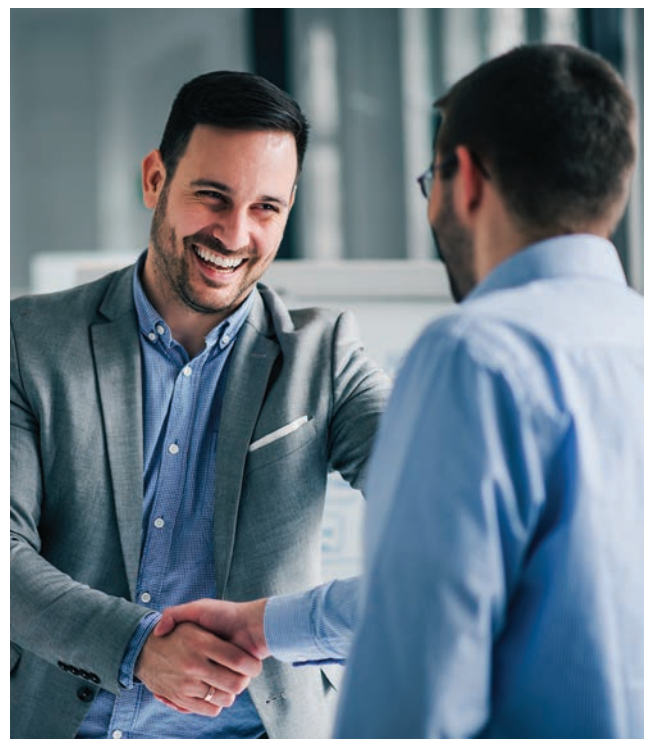
The project commissioned by INAPP (the Italian National Institute for Public Policy Analysis) sees the PwC team engaged in construction of the elements of the Atlante del Lavoro (Atlas of Jobs) pertaining to case data sheets, of use in assessing **skills** and which will therefore serve to complete the range of national classification descriptors. This Atlas is the fruit of the joint work of INAPP, MLPS (Ministry of Labour and Social Policies), the Regioni (regional government authorities) and technical experts from 24 sectors of economic-professional activities. It is, to date, the most effective bridge between the labour market and the education and training systems: in order to improve the mechanisms that ensure matching, work processes and specific/dedicated activities are gathered together and collated.

Focus on IT services

Within the ambit of the project, we are engaged in a reassessment of the professional and economic sector denominated “Servizi Informatici” (IT services) of the Atlas of Jobs and Qualifications, while developing data analysis on web job vacancies, in order to identify the most relevant descriptors for the ICT ambit.

Developing, managing and disseminating Europe's ESCO classification

PwC has backed up the European Commission in developing the contents of the European classification, ESCO (European Skills/ Competences, Qualifications and Occupations). The work saw the involvement of translators and methodological and labour market experts from 28 Member Countries, who contributed to the creation of this classification in 27 languages. Between 2013 and 2017 – in collaboration with the Giacomo Brodolini Foundation, 3s and Tipik – PwC coordinated the project activities and backed the Commission up in its efforts to develop ESCO.





III. Workforce skills

PwC constantly invests in human capital and in-house skills, to enable these skills to keep pace with the disruptive impact of current technological changes.

The “Digital Upskilling” Programme

PwC Italy is about to launch the Digital Upskilling programme for its in-house staff, a training programme that is also designed to facilitate our understanding of the digital world, with outreach also beyond the company itself to our clients.

The Digital Upskilling pathway is to cover three main initiatives:

“Our work cannot ignore the need to disseminate and to integrate new technologies into its processes, while investing in our people, who are increasingly exposed to digital change. [...] This will be an opportunity to govern change and to ensure our preparedness for the upcoming impact of the digital on our profession”.



Digital Academy

Specialised training on Data Analytics, Robotics and Artificial Intelligence technologies. E-learning and lecture format sessions are scheduled, Project Work.



Digital Accelerators

Digital specialists tasked to promote dissemination of new technologies and methodologies, helping teams to automate processes, create value and improve the quality of approaches to work.



Digital Lab

A PwC community for online technology sharing where people can find, build and contribute to ideas in order to foster efficiency at all levels.

PwC's Experience Centre at the Rome office

The concept was developed by the PwC Network, in collaboration with Google. It fosters a convergence of professionalism with new technologies, ranging from Artificial Intelligence to Robotics, from the Internet of Things to Virtual Reality.

The Experience Centr, hosted by the Rome office, was created with the aim of allowing clients (ranging from corporate to public administration) to experiment with new tools and solutions and – more broadly speaking – to prepare for the processes of rapid technological change that are revolutionizing our daily life, society and culture. Workshops and events organised at the Experience Center include initiatives that relate to the theme of development of *Digital skills*, i.e. initiatives designed with digital education in mind: teaching for children and adults:

The Experience Center is PwC's digital catalyst

The Experience team works side by side with clients to understand their key problems, and to then co-create solutions that can be realized in digital or physical prototype forms, and rapidly brought into the marketplace.

Juan A. Pujadas

Global Vice Chairman of Advisory Services

PwC's Experience Centre is in fact the national hub for the IXDA (Interaction Design Association). It hosts meetings held on a regular basis with various speakers. More than 50 people, professionals and design students attended the last meet-up.

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New world. New skills.

PwC's global initiative "**New world. New skills**" aims to help millions of people internationally as they enhance their awareness and skills, and knowledge of the challenges posed by the digital world. The economy and the production system play a key role, to make sure that no one is inadvertently left behind. Indeed, in addressing this criticality of growing proportions, we urgently need the collaboration of all parties involved (organisations, governments, trainers and citizens). As a player, PwC intends to encourage debate and to cooperate with many stakeholders in order to pinpoint functional solutions common and appropriate for each country. This paper "*Digital skills - Come ripensare l'istruzione e la formazione nell'era digitale: competenze digitali e nuovi modelli per l'apprendimento*" (Digital skills - How to rethink education and training in the digital age: *Digital skills* and new models for learning) is just such an initiative. It aims to stimulate debate in Italy among policy makers, social partners and stakeholders.

We support public and private sector organisations in their efforts to promptly acquire the skills they will need in the future, working together for global solutions. Over the next four years, we shall dedicate \$3 billion to upskilling processes – not only for our own staff, but also regarding new technologies to support our clients, communities and other local stakeholders.

Furthermore, we are directing most of our community initiatives towards upskilling.

For further information: www.pwc.com/upskilling

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