REthinking
EDUcation COmpetencies.
Expertise, best practices
and teaching in Digital Era

IO1.A1.3 - Needs analysis

Competence profiles update perspective and impacts for the future digital society

ITALY National Desk research

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Foreword

The present report is part of IO1 of the RE-EDUCO Project (REthinking EDUcation COmpetencies. Expertise, best practices and teaching in Digital Era) KA201 - Strategic Partnerships for school.

The IO1.A1.3 focuses on *Needs analysis. Competence profiles update perspective and impacts for the future digital society*; it has been realized on the basis of IO1.A1.1 and related Annexes (IO1.A1.2) prepared by the Italian team in the first phase, describing the entire research design in relation to methodology, sources for desk research and outputs to realize all national Need Analysis.

The Annexes (IO1.A1.2) have been used by all partner countries for the elaboration of the national desk research.

This report presents the Italian National Desk research conducted by Italian partner on the basis of a shared Template above mentioned.

Following the Annexes of the IO1.A1.1 "T*emplate for National on desk research "Needs analysis Competence profiles update perspective*" this report summarizes:

- the types and selection of sources adopted for national desk analysis; the last three years have been examined;
- a reconstruction of the national scenario in relation to the digital challenges and national market labour trends on the basis of selected sources;
- glossary and F.A.Q. for common and/or specific terms.

Introduction

Digitization is a pervasive change in the economy and society that is leading to a rapid multiplication in all those information-intensive systems: Smart Home, Smart City, Smart Car, Smart Manufacturing. For this reason, we speak of "digital disruption as the change that occurs when new digital technologies and business models developed with them influence the added value, the value proposition of existing products or services".

All this must be seen as a natural evolution of mankind and as such it is unstoppable.

This change, only if governed, could offer countless opportunities. But in this case, the temporal component plays a fundamental role, causing an acceleration of changes that is not easy to manage and control.

This is precisely the main difficulty that human capital encounters in adapting according to the times that digitization rigorously imposes, because its adaptation implies structural and cultural changes that, on the contrary, take a long time. The ideal to strive for is to be able to respond adequately by preparing in time, to be able to prevent possible evolutionary scenarios, by means of training policies that respond to predictable market demands. This would eliminate the current gap, converting it so that the offer is ahead of the demand. Today, it appears as a utopian vision but through digital technology, in particular with artificial intelligence and quantum computers, this will be an achievable goal in the near future.

The report analyses the national strategies adopted to foster digital transformation with particular attention to the impact on the world of work and education, the loans that support these strategies and, finally, the emerging professional profiles in the framework of the new skills required by the labour market. The last paragraph is dedicated to criticalities and possible future developments of the Italian system.

The sources taken into consideration for carrying out the described analysis are:

- Institutional sources:
    - ISTAT citizens and ICT Report 2019
    - MIUR contributes data on ICT graduates and graduates
- Local/national sector sources:
    - Digital Skills Observatory, conducted by the major ICT Associations in Italy: Aica, Anitec-Assinform, Assintel and Assinter Italia, with the contribution of the Tertiary Management Training Center
    - XXII Survey (2020) - Employment conditions of graduates (ALMALAUREA)
    - Excelsior-Unioncamere Information System
    - Unioncamere and Anpal

- Digital Economy and Society Index (DESI)
- The country's strategy for innovation and digital transformation: MID, Italy 2025
- Public Notice of New Skills Fund (FNC)
- We are social e Hootsuite report (2018, 2019, 2020)
- 2018 I-Com Report, *The Intelligence of Protection. Consumers between protection and empowerment at the time of AI* (Analysis of digitalization on a European scale in the manufacturing sector between companies and consumers)
- 2019 I-Com Report on *Next-Generation Networks & Services* (which describes the progress of the digitization process of our country in the international context, showing the degree of "digital maturity" achieved)

The Report is articulated in two sections.

The first section illustrates the reconstruction of the national scenario in relation to the digital challenges in the market labour and education system.

The second section presents the results of the Italian national desk research in terms of emerging profiles and competencies; mismatch in job offer/demand.

A brief SWOT analysis focused on strengths, weaknesses, risks/threats and opportunities about the digital revolution in local market labour close the analysis.

The last section includes a brief glossary to explain specific terms.

FIRST PART - THE RECONSTRUCTION OF NATIONAL SCENARIO

1. National framework for the adoption of ICTs in the national labour market

In Italy, there is no national strategy for the detection of ICT skills; more than anything else there are inhomogeneous local experiences, conducted by individual administrations, which are not structured as real statistical sample surveys, based on a representative statistical sample, a research object, the corresponding units of analysis, and a CAPI[1], CATI[2] o CAWI[3] survey technique.

However, Italy carries out, every five years, a survey on professions (based on the O*Net[4] model) through which it detects and measures the tasks associated with each of the 800 Professional Units (UP)[5] contained in the classification of professions (CP2011[6], the national equivalent of ISCO08[7]).

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[1] Computer Assisted Personal Interviewing

[2] Computer Assisted Telephone Interviewing

[3] Computer Assisted Web Interviewing

[4] The Occupational Information Network (O*NET) is a free online database that contains hundreds of occupational definitions to help students, job seekers, businesses and workforce development professionals to understand today's world of work trends in the United States. It was developed under the sponsorship of the US Department of Labor/Employment and Training Administration.

[5] The Professional Units (UP) represent the maximum level of detail of the classification (fifth level, fifth digit). Within the site it is precisely on the pages of the individual PUs that it is possible to consult all the information on the professions deriving from national surveys designed and carried out by Isfol. The Professional Unit, in particular, is intended as a set of homogeneous professions with respect to knowledge, skills, abilities and work activities carried out. The description of each PU provides the average representation of the structure of professions in Italy (source: Isfol-Istat survey on professions). Furthermore, this representation also constitutes the tool with which to read the difference between what is there and what is lacking in terms of professional skills in the country's production system (source: Isfol Audit survey on professional needs).

[6] The CP 2011 is the official classification of professions, adopted in Italy (to consult it in its entirety, consult the website www.cp2011.istat.it). Within this site, the CP 2011 represents the access key for consulting all information relating to the professions, in particular within the Professions section. The CP 2011, in fact, inherited the logical and conceptual structure of the Nomenclature of Professional Units (NUP), the intermediate level of classification that was developed in 2006 jointly by Istat and Isfol with the aim of introducing a fifth level (fifth digit, Professional Unit) in the tree structure of the previous classification (CP 2001). The NUP, thanks to a more detailed articulation, was designed to constitute the reference base used to detect the professions present in the labor market in a more precise way and describe their contents.

[7] ISCO-08 is the International Standard Classification of Occupation. ISCO-08 was adopted through a resolution of a Tripartite Meeting of Experts on Labour Statistics held in December 2007. ISCO is an International Labour Organization (ILO) classification structure for organizing information on labour and jobs:

https://www.ilo.org/public/english/bureau/stat/isco/isco08/

On the basis of CP2011, a set of initiatives were undertaken to define the professional needs of the professions associated with the ICT sector to which a set of specialist skills, defined through the e-CF model, were associated.

The main structured sources to refer to in order to provide an overview and possibly a survey methodology are, at the national level:

- The AGID guidelines for the harmonization of ICT professions;
- The sample survey on professions;
- The Atlas of Labor and the national skills certification system (Legislative Decree 13/2013);
- The Excelsior survey for the detection of professional needs;
- The experimental survey on professions in Public Administration was conducted by the MEF.

The cited sources, with the exception of the AGID Guidelines, do not explicitly concern the ICT sector but include the universe of professions and skills.

A methodological approach that allows a real "measurement" of specialist skills should necessarily integrate, through structured methods and tools, three dimensions:

- skills,
- tasks,
- and the professions.

In this way, it would be possible to estimate different types of needs, cognitive gaps and recruitment plans. To conduct research of this type, it is possible to refer to the AGID Guidelines, within which the second generation ICT UNI profiles are linked to CP2011.

The CP2011 is built on the basis of a rigorous methodology and is used in numerous sample surveys (Labor Forces, PhDs, Diplomates, Graduates) and census surveys (Population Census, Experimental survey on PA professions).

A targeted survey of specialist skills must necessarily include a defined, structured and long-lasting set of ICT professions. In this regard, ISTAT and AGID have identified some Professional Units (referring to the ISCO-08 standard) which, while maintaining a certain level of genericity, mainly describe the ICT sector.

1. Directors and general managers of companies in the IT and telecommunication services.
2. Directors and executives of the IT services department.
3. Software analysts and designers.

4. System analysts.
5. Web application analysts and designers.
6. Computer networks and communications specialists.
7. Database analysts and designers.
8. Systems administrators.
9. Cybersecurity specialists.
10. Technical programmers.
11. Application engineers.
12. Web technicians.
13. Database managers technicians.
14. Technicians managing networks and telematic systems.
15. Electronic technicians.
16. IT equipment installers, maintainers and repairers.

Each professional unit is fully described by the sample survey on professions.

These two models can be combined with the e-CF classification model (which became a European standard in 2016), which classifies 40 skills in five areas of ICT activity. The key concept of this model is competence, defined as:

"The demonstrated ability to use and apply knowledge and skills in an independent and self-directed way" (Cfr. ESCOpedia).

Within the e-CF, skills are described from the point of view of observable behaviour in the workplace and the measurable elements of a specific skill.

Competence is a lasting concept that is independent of technology, employment, marketing terminology and promotional concepts within the ICT environment; although these variables change rapidly, the e-CF model remains durable and requires an update every three years (Fig. 1). A competency can be a component of a professional role, but cannot be used to replace job titles of the same name; for example, competence, D.7. "Sales Management" does not represent the full content of a "Sales Manager" job role.

Competencies can be aggregated to represent the essential content of a role or job profile just as a single competence can be assigned to a number of different job profiles.

The competencies envisaged by the framework must not be confused with processes or technologies and do not contemplate an in-depth level of detail that describes the nuances of every possible competence of an ICT professional.

Some competencies introduced in the e-CF model (for example "Problem management" or "Risk management") are common to other professions but represent an important plus for the ICT professions, which however excludes generic competencies such as "General Management".

The plus provided by the e-CF model concerns the possibility of explicitly "measuring" the level of competence (from 1 to 5) in terms of three variables: height (autonomy), depth (complexity) and breadth (behaviour), to represent the reality of the workplace as closely as possible. In particular, digital competencies refer to the professional units relating to CP2011 and include six different thematic areas (Business management, Technical management, Design, Development, Service & Operation, Support), which can be used, within a questionnaire, for the measurement of specialist competencies.

Figure 1: e-CF model

Dimension 1 5 e-CF areas	**Dimension 2** 41 e-Competences identified	**Dimension 3** 5 e-Competence proficiency levels				
		e-1	e-2	e-3	e-4	e-5
A. PLAN	A.1. Information Systems and Business Strategy Alignment				■	■
	A.2. Service Level Management			■	■	
	A.3. Business Plan Development			■	■	■
	A.4. Product/Service Planning		■	■	■	
	A.5. Architecture Design			■	■	■
	A.6. Application Design	■	■	■		
	A.7. Technology Trend Monitoring			■	■	■
	A.8. Sustainability Management			■	■	
	A.9. Innovating				■	■
	A.10. User Experience		■	■	■	
B. BUILD	B.1. Application Development	■	■	■		
	B.2. Component Integration		■	■	■	
	B.3. Testing	■	■	■	■	
	B.4. Solution Deployment	■	■	■		
	B.5. Documentation Production	■	■	■		
	B.6. ICT Systems Engineering			■	■	
C. RUN	C.1. User Support	■	■	■		
	C.2. Change Support		■	■		
	C.3. Service Delivery	■	■	■		
	C.4. Problem Management		■	■	■	
	C.5. Systems Management	■	■	■		
D. ENABLE	D.1. Information Security Strategy Development				■	■
	D.2. ICT Quality Strategy Development				■	■
	D.3. Education and Training Provision		■	■		
	D.4. Purchasing		■	■	■	
	D.5. Sales Development		■	■	■	
	D.6. Digital Marketing		■	■	■	
	D.7. Data Science and Analytics		■	■	■	■
	D.8. Contract Management		■	■	■	
	D.9. Personnel Development		■	■	■	
	D.10. Information and Knowledge Management			■	■	■
	D.11. Needs Identification			■	■	■
E. MANAGE	E.1. Forecast Development			■	■	
	E.2. Project and Portfolio Management		■	■	■	■
	E.3. Risk Management		■	■	■	
	E.4. Relationship Management			■	■	
	E.5. Process Improvement			■	■	
	E.6. ICT Quality Management		■	■	■	
	E.7. Business Change Management			■	■	■
	E.8. Information Security Management		■	■	■	
	E.9. Information Systems Governance				■	■

Source: e-CF

The combination of Professional Units and e-CF skills allows the adoption of differentiated national strategies ranging from the structured survey of data, relating to the labour market and training needs.

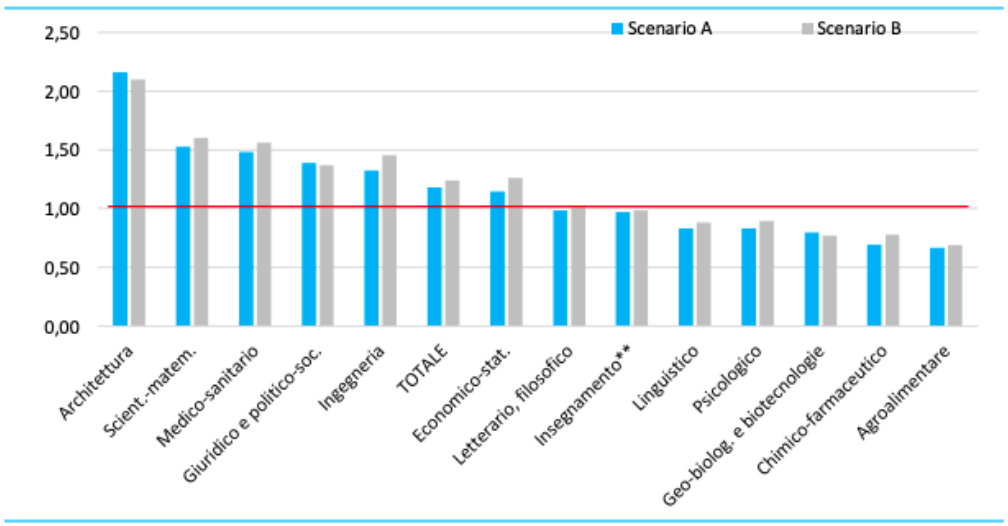
For the five-year period 2021-2025, the employment needs of the private and public sectors are expected to be between 3.5 and 3.9 million workers, of which 933 thousand-1.3 million units determined by the economic growth component (expansion demand), as far as turnover is concerned, it will concern the remaining 70% of the need for employees (Source: Unioncamere – ANPAL, Sistema Informativo Excelsior 2021)

The analysis also provides a specific focus on the future of work in the following sectors, from those that were most affected by the macroeconomic contraction to those that instead of experiencing an increase: trade and tourism, finance and consulting, health, training and culture, construction and infrastructure, mobility and logistics, mechatronics and robotics, information technology and telecommunications, food, wood and furniture and fashion.

For graduates, the demand-supply comparison (net of graduates looking for work already present on the market), highlights a situation of a slight supply shortage as a whole, but with considerable differentiation by address. A shortage of supply is estimated in the medical-health, scientific-mathematical-physical, engineering and architecture sectors (Fig. 2).

The shortage of medical-health profiles (estimated at about 11-13 thousand graduates per year) will depend on the ageing of the population and the adaptation of post-pandemic health systems.

Figure 2: Report Demand / Offer Of Graduate Entry Into The Labor Market Study To Address In 2021-2025



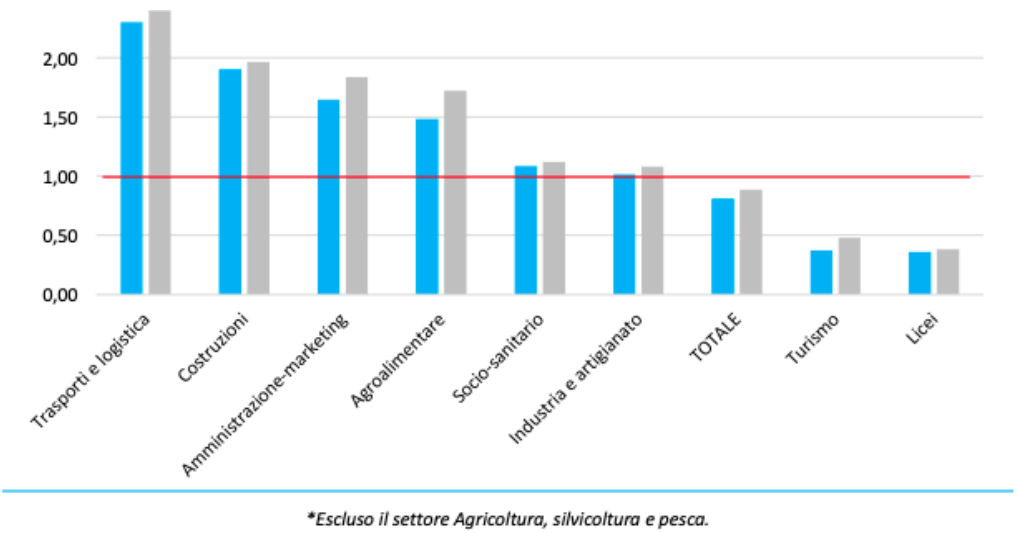
**Escluso il settore Agricoltura, silvicoltura e pesca. **Comprende scienze motorie.*

Source: Unioncamere – ANPAL, Sistema Informativo Excelsior 2021

For school graduates, there is a need higher than the supply, in particular for administrative marketing, construction, transport logistics and agri-food. Instead, a substantial balance is outlined for the socio-health policy and for the craft industry. For the tourist address and the high schools as a whole, there is a significant excess of the supply of profiles (Fig. 3).

As regards Regional Vocational Education and Training (IeFP), the most relevant needs in the five-year forecast period are found for the mechanics, catering (with an estimated interval for the two scenarios between 23 thousand and 32 thousand units per year), welfare, sales and administrative-secretarial services.

Figure 3: Report Requirements / Offer of Graduate School Students Entry Into The Labor Market By Study Address In 2021-2025



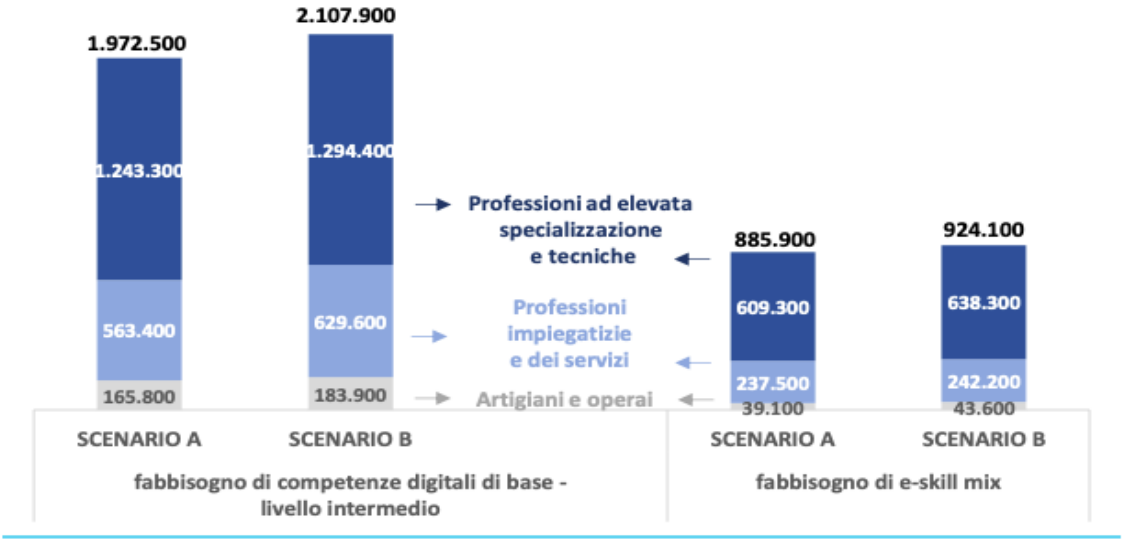
Source: Unioncamere – ANPAL, Sistema Informativo Excelsior 2021

The drive towards the green transition will require green skills from professions transversal to multiple sectors, such as the environmental lawyer, the specialist in green accounting, the expert in green investment funds, the commercial expert for the promotion of new sustainable materials or the manager of green purchases, as well as all those more traditional professions that will have to approach the ecological transition.

Also important is the role of digital, STEM and innovation 4.0 skills that will be sought with an e-skill mix (the possession with a high degree of importance of at least two e-skills) in an estimate between 886 thousand and 924 thousand units (Fig. 5).

The demand for digital skills will affect both existing professional figures and new emerging professions, such as data scientists, big data analysts, cloud computing experts, cyber security experts, business intelligence analysts and artificial intelligence system engineers, as well as more traditional figures who will need digital skills to face the changing world of work.

Figure 4: Employment Needs for Professionals with Digital Skills In The Period 2021-2025 - Scenarios A and B*



Source: Unioncamere – ANPAL, Sistema Informativo Excelsior 2021

* *Scenario A* envisages - due to the resurgence of the pandemic from Covid-19 and the continuation of a series of restrictive measures - a more gradual recovery starting from the third quarter of 2021, and for the following years, a return to a path of recovery is assumed, rather a strong trend growth.

The most favourable *Scenario B* considers the rates of the NADEF policy framework which provided for more sustained growth of the Italian economy starting from 2021.

2. Digital transformation. Description of the national scenario

2.1 National framework for adoption of ICT in local market labour

In the last 20 years, we have witnessed a constant evolution of information technology tools, both in the workplace and in education and, finally, in society.

The advent of the *Information Society* has identified the beginning of the third industrial revolution (or "post-industrial") where we have moved from the growth of traditional goods to intangible ones, and the new centrality of knowledge, information, access to networks as a tool for creating social and economic value.

ICT has highlighted and reduced the perception of space and time contributing to the phenomenon of globalization as a "narrowing" of the boundaries of the world, in which it is possible to move goods, information and ideas much faster. This revolution has determined the change of phenomena such as:

- *Teleworking*, which makes it possible to carry out professional activities at a distance, determines new ways and times of working, making them more flexible with those of the rest of one's life.
- *Telemedicine*, which already allows clinical examinations and diagnoses to be carried out remotely, making the quality of the service independent of the physical location in which it is provided, and which in the future will allow for systems that would be unthinkable today of widespread monitoring of the state of health; an immediate response in this dark time where digitalization has been the most effective means of guaranteeing assistance and extreme speed of data transmission.
- E-*government*, which allows everyone, citizens and businesses, to dialogue with the Public Administration in a rapid manner. The use of information and communication technologies (ICT) in administrative processes will make the action of the public administration increasingly efficient, improving, on the one hand, the quality of public services provided to citizens and decreasing on the other, the costs for the community.
- E-*learning,* which provides new opportunities for training and knowledge that are flexible in time and place, reducing costs. E-learning guarantees all users easy access to knowledge resources. In fact, there is a growing need to provide users with special systems to create an information society, which requires a continuous process of information provision, so we talk about life-long learning, learning that takes place throughout life, thus opening up new possibilities for those who work to continue to study and learn.

- The *unlimited availability of services and information*, which makes it possible to simplify work and life through more efficient and rapid management of daily tasks and greater access to new opportunities, new ideas, new solutions, the very circulation of which makes it possible to create value.
- The availability of *new communication tools*, which allow people to interact in real-time on a global scale at very low costs, so as to become increasingly informed and active citizens, more demanding and aware consumers and users, more productive and qualitative workers. The goal is to give life to an "Intelligent Country-System", able to contribute to the creation of a reticular development model that improves the quality of life of citizens, and the use of resources of our territory and historical heritage, integrating different production chains.

2.2 Italian funding programs for digital technologies

Italy has set up various incentives to finance R&D and Innovation, in an attempt to respond to the ongoing pandemic crisis. The much-debated relaunch program, based on the multi-year recovery plan promoted by the European Union, assigns a fundamental role to digital and accentuates the need to promote the R&D sector and increase investments in ICT research, to keep up with European technological leaders.

During the first pandemic emergency, for example, the government approved the D.l. n. 34/2020 of May 19, 2020 (the so-called "Legislative Decree Relaunch" in response to the Covid-19 emergency) which provides incentives both in terms of capital investments and for strengthening the ecosystem of innovative startups. The Legislative Decree Relaunch was then converted into the law of 17 July 2020, n. 77 of conversion with amendments.

Then, to this is added the implementing decree of the 2020 Budget Law for the reform of the *Research & Development tax credit,* as part of the revision of the *Transition Plan 4.0 for 2021-2022*. Funds are available both for Italian companies and to increase resources for universities and to promote the national research system and encourage Italian participation in initiatives relating to the EU framework programs.

Among the various funds made available for the digital transformation we should also mention:

- A *Fund for technological innovation and digitization*: Its initial endowment is 50 million euros, entrusted to the Ministry for Technological Innovation and Digitization. They will serve to digitize public administration services for citizens and businesses, first of all, to increase the type of practices that can be carried out electronically. The new Fund aims to increase the number of services obtainable through the Digital Identity Service (Spid).

This operation requires complex interventions, not only technological but also training, administrative and procedural. The funds may be used, as well as for software purchases, to support the implementation of necessary changes aimed at making relations between citizens and the public machine more agile. Increasing the demand for innovative technologies by the Public Administration is an engine of growth. It can encourage companies, start-ups and software producers (software houses) in the country to create increasingly advanced systems designed for the Public Administration, recognizing it as a client whose needs must be met and not as a passive customer who absorbs products tailored to other needs.

- Directorial Decree n.1628 of 16-10-2020 - PRIN 2020 call. The Ministry of University and Research launched a new program of Projects of Relevant National Interest (PRIN), for the financing of public research projects, with the aim of promoting the strengthening of national scientific bases, also in view of more effective participation in European initiatives relating to the European Union Framework Programs. For the years 2021 and 2022, the ordinary resources allocated to the PRIN will make use of the amounts of 250 million and 300 million euros respectively.
- The increase in the *Fund for investments in scientific and technological research* (FIRST) for the year 2021 by 250 million and for the year 2022 by 300 million euros, in the form of non-repayable grants, subsidized loans, guarantees, innovation vouchers and tax credit.
- The increase in the *Fund for the ordinary funding of Universities (FFO)* for the year 2021 by 100 million euros and from 2022 by 200 million euros, intended to cover institutional expenses, including personnel and operating costs.
- The anticipation of the planning decree of five MISE calls with subsidized loans to patent and enhance industrial property (43 million euros for 2020).
- A Fund for technology transfer (the law of 17 July 2020, n. 77, art 42): 500 million euros for the year 2020, entrusted to ENEA, the National Agency for New Technologies, Energy and Sustainable Development. In particular, the Enea Tech Foundation, a private law body, was established, which should implement the initiatives relating to the Fund for Technology Transfer. Italian companies and, in particular, innovative start-ups can benefit. The activities carried out by the Foundation will be the following:

  a) conducting major research, development and demonstration programs, mainly with engineering and technological content;

  b) study, research and development in the field of advanced technologies for special and innovative materials;

c) promotion of collaboration programs with national and international bodies and institutions operating in the scientific-technological field.

- A Relaunch Fund: 200 million euros, established by resolution of the Board of Directors of Cdp Venture Capital Sgr - National Innovation Fund, which will have a ten-year duration that can be extended for a further 3, to support investments in the capital of innovative startups and SMEs investment with regulated (structured as funds or other investment vehicles) or qualified investors (accelerators or incubators, business angels and family offices).

To improve its position, Italy will have to invest more and better in Research & Development and ICT innovation. According to the 1st ICT Research and Innovation Report in Italy, presented by Anitec-Assinform, the Association for Information and Communication Technology (ICT) of Confindustria in collaboration with APRE – the Agency for the Promotion of European Research, ICT companies have invested about 2.6 billion euros in research and innovation (R&I) in 2018, up 6.4% compared to 2017, Italy invested only 0.15% of GDP, where Germany put 0.21% on the Tab. and the European average stood at 0.22%. It means that to bring Italy back to "German Levels" it will be necessary to invest at least 160 million euros more per year (Cfr. 1st Anitec-Assinform Report on ICT Research and Innovation in Italy - 2020).

Italian investment in digital transformation is growing but still much lower than the European average.

European funds for digital showed a total budget 2014-2020: 75.8 billion euros (44.4 EU, 31.4 IT), of which:

- Research & Innovation 7 billion
- ICT 3 billion
- Efficient administration 1.3 billion

Table 1. Areas and programs funded for each FUND

Fund	Programm	Context	Total Budget 2014-2020	Resources already allocated as a percentage of the total	Reference authority
FESR FSE	PON RESEARCH AND INNOVATION (Italy, regions of Abruzzo, Molise, Campania, Puglia, Basilicata, Calabria, Sicily, Sardinia)	Various (including Digital Agenda, Smart Communities, Intelligent Mobility Systems)	1.3 billion of which 772.5 million ERDF 203.7 million ESF	49%	MIUR: Directorate General for the coordination, promotion and enhancement of research www.miur.it
FESR	PON Governance and Institutional Capacity	ICT Optimization of online services and digital inclusion	96 millions	37%	Agency for Territorial Cohesion - Staff Office 5 www.agenziadicoesione.gov
FESR	PON Metropolitan Cities	Metropolitan digital agenda	98 millions	42%	Office of the Management Authority of the PON Metropolitan Cities Directorate General for the Community Unitary Regional Policy. www.dps.gov.it
FESR	PON Enterprises and Competitiveness	Research and Innovation TIC	1,1 billion 232 millions	20%	Ministry of Economic Development Directorate General for business incentives www.sviluppoeconomico.gov.it
FESR	POR Abruzzo	Research Technological development and innovation Diffusion of digital services	45 millions 26 millions	36%	Department of the Presidency and Relations with Europe - Adg POR FESR and POR FSE OdP par FSC
FESR	POR Basilicata	Strengthening Research Technological development and innovation Better use and quality of ICT technologies	98 millions 95 millions	43%	PO FESR Basilicata Communication and Information Management Authority Office, Planning and Finance Department www.porfesr.basilicata.it

Fund	Programm	Context	Total Budget 2014-2020	Resources already allocated as a percentage of the total	Reference authority
FESR	POR Bolzano	Excellence in research and development PA Digitization and digital divide reduction	32,7 millions 32,7 millions	57%	Autonomous Province of Bolzano European Division, Office for European Integration www.provincia.bz.it
FESR FSE	POR Calabria	Promotion of research and innovation Digital agenda development	210 millions 168 millions	42%	Calabria Region www.regione.calabria.it
FESR	POR Campania	Enhancement and promotion of research, technological development and innovation Improvement and expansion of access to ICT	514 millions 349 millions	54%	Campania Region www.regione.campania.it/it/utilita/programmazione-unitaria-regionale
FESR	POR Emilia Romagna	Strengthening research, technological development and innovation ICT	70,2 millions 40 millions	111%	Emilia Romagna Region https://fesr.regione.emilia-romagna.it/
FESR	POR Friuli Venezia Giulia	Research and innovation ICT	77,1 millions 1,7 millions	61%	Friuli Venezia Giulia https://www.regione.fvg.it/rafvg/cms/RAFVG/fondi-europei-fvg-internazionale/por-fesr/FOGLIA128/
FESR	POR Lazio	Research and innovation Lazio Digitale	180 millions 144 millions	65%	http://porfesr.lazio.it

Fund	Programm	Context	Total Budget 2014-2020	Resources already allocated as a percentage of the total	Reference authority
FESR	POR Liguria	Strengthening research, technological development and innovation Improvement of ICT access and related services	80 millions 36 millions	23%	https://www.regione.liguria.it/argomenti/affari-e-fondi-europei.html
FESR	POR Lombardia	Improvement and promotion of research, technological development and innovation Broadband extension and introduction of high-speed networks	349,2 millions 20 millions	65%	www.ue.regione.lombardia.it
FESR	POR Marche	Strengthening research, technological development and innovation Network extension and broadband services	134,1 millions 24,3 millions	17%	www.europa.marche.it
FESR FSE	POR Molise	Improvement and promotion of research, technological development and innovation Improvement and expansion of ICT access	23,3 millions 11,6 millions	28%	www.regione.molise.it

Fund	Programm	Context	Total Budget 2014-2020	Resources already allocated as a percentage of the total	Reference authority
FESR	POR Piemonte	Improvement and promotion of research, technological development and innovation Improvement and expansion of ICT access	355,2 millions 88,2 millions	22%	www.regione.piemonte.it/europa2020/
FESR	POR Puglia	Research and innovation projects mainly for SMEs Use and quality of ICT broadband digital inclusion digital culture	672 millions 272 millions	44%	fesr.regione.puglia.it/portal/pls/portal
FESR	POR Sardegna	Digital agenda Scientific research technological development innovation	130,3 millions 128,7 millions	26%	www.sardegnaprogrammazione.it
FESR	POR Sicilia	Strengthening research, technological development and innovation Access to ICT - Digital Agenda	457,2 millions 342,6 millions	45%	www.regione.sicilia.it

Fund	Programm	Context	Total Budget 2014-2020	Resources already allocated as a percentage of the total	Reference authority
FESR	POR Toscana	Improvement and promotion of research, technological development and innovation Improvement and expansion of ICT access	275,1 millions 79,5 millions	33%	www.regione.toscana.it/porcreo-fesr-2014-2020
FESR	POR PA Trento	Improvement and promotion of research, technological development and innovation	54,8 millions	24%	www.europa.provincia.tn.it/servizioeuropa/
FESR	POR Umbria	Improvement and promotion of research, technological development and innovation Broadband extension and diffusion of high-speed ICT e-government networks	102,8 millions 30,8 millions	9%	www,regione.umbria.it/programmazione-fesr
FESR	POR Valle D'Aosta	Development of ICT services and infrastructures Improvement of the regional research, development and innovation system	14,5 millions 13,5 millions	74%	www.regione.vda.it

Fund	Programm	Context	Total Budget 2014-2020	Resources already allocated as a percentage of the total	Reference authority
FESR	POR Veneto	Research, technological development and innovation Digital agenda	114 millions 85 millions	23%	www.regione.veneto.it/web/guest/sezione-programmazione-e-autorita-digestione-fesr

In its proposal for *European programming and funding for the period 2021-2027*, the Commission has unveiled the *pan-European Digital Europe program*, aimed at increasing and maximizing the benefits of digital transformation for all European citizens, public administrations and businesses. A new EU instrument, to which around € 9.2 billion will be allocated, and which will be part of the *Single Market, Innovation and Digital Agenda*, for funding research and innovation activities in the field of digital technologies, such as the Horizon Europe program. The two programs will be able to operate in an interdependent manner: Horizon Europe through essential investments in research and Innovation and Digital Europe through the strengthening and deployment of digital infrastructures and capabilities necessary to support future research in the sector.

The Digital Europe program, aimed at fostering the adoption and use of the latest digital technologies by Small and Medium Enterprises and Public Administration, from 2012-2027, will be structured in five pillars:

Figure 5: Digital Europe program 2012-2027

Source: https://www.agendadigitale.eu/tag/digital-europe/

Each area has been broken down into operational objectives to be pursued through a dedicated budget.

HIGH PERFORMANCE COMPUTING

2.7 billion euros to finance projects to develop and strengthen supercomputing and data processing capabilities in Europe. In the area of supercomputers, the European Commission aims to develop a world-class data and supercomputer infrastructure with exascale capacity by 2022/2023 and post-exascale computing facilities by 2026/2027, equipping the EU with its own autonomous and competitive technology park that will enable it to achieve excellence in supercomputing applications while expanding their availability and use.

Figure 6: High Performance Computing

Source: https://www.agendadigitale.eu/tag/digital-europe/

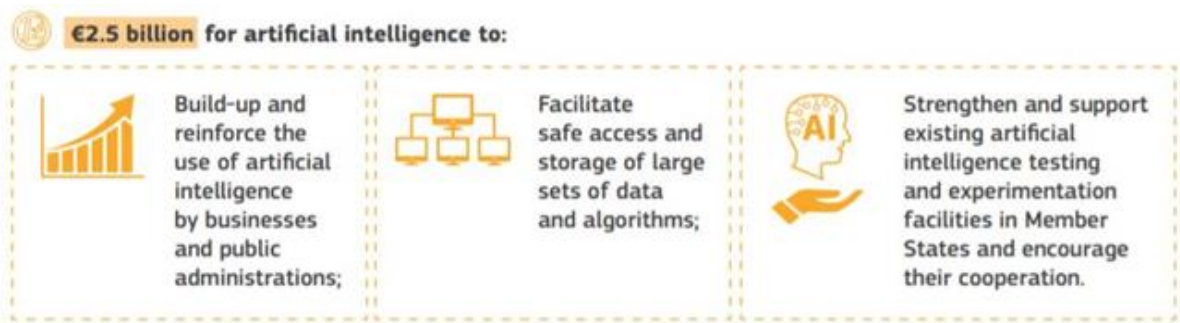
Operational objectives include:

- implement, coordinate at the Union level, and operate in the Union an integrated, world-class exascale data and supercomputing infrastructure accessible on a non-commercial basis to public and private users and for publicly-funded research purposes;
- deploy off-the-shelf/operational technology derived from research and innovation activities to create a Union-wide integrated ecosystem for high-performance computing encompassing all segments of the scientific and industrial value chain, including hardware, software, applications, services, interconnections, and e-skills;
- implement and operate a post-exascale infrastructure, including integration with quantum computing technologies, and develop new research infrastructures in computing.

ARTIFICIAL INTELLIGENCE

2.5 billion to help deploy artificial intelligence in the European economy and society. The Commission aims to stimulate investment to maximize the potential of artificial intelligence, taking into account the socio-economic changes it will bring and ensuring an appropriate ethical and legal framework. It also aims to improve access to existing testing and experimentation facilities in the various Member States and to create common "European libraries" of algorithms accessible to all, to help the public and private sectors identify and acquire the solutions best suited to their needs.

Figure 7: Artificial Intelligence



Source: https://www.agendadigitale.eu/tag/digital-europe/

Operational objectives:

- Develop and enhance the core capabilities of artificial intelligence in the Union, including data resources and algorithm stores, in compliance with data protection legislation;
- make these capabilities accessible to all businesses and public administrations;
- strengthening and networking existing testing and experimentation facilities for artificial intelligence in the Member States.

CYBER SECURITY AND TRUST

2 billion will be invested in safeguarding the digital economy, society and democracies by promoting cyber-defence and cyber-security of EU industry. The Commission wants to fund state-of-the-art equipment and infrastructure in the area of cyber security, supporting the development of the necessary skills and knowledge.

Figure 8: Cyber security and trust

Source: https://www.agendadigitale.eu/tag/digital-europe/

Operational Objectives:

- Support, together with the Member States, the acquisition of advanced cyber security equipment, data infrastructure and tools, in full compliance with data protection legislation.
- Support the optimal use of European knowledge, capabilities and expertise related to cyber security.
- Ensure broad implementation of the latest cyber security solutions across all economic sectors.
- Strengthen capacities in the Member States and the private sector to help them comply with the EU Directive on measures for a common high level of security of network and information systems in the Union.

ADVANCED DIGITAL SKILLS

700 million to ensure that European workers have the opportunity to easily acquire e-skills through short and long-term training courses and on-the-job placements, regardless of their Member State of residence.

Figure 9: Advanced digital skills

Source: https://www.agendadigitale.eu/tag/digital-europe/

Operational Objectives:

- Support the design and implementation of long-term training courses and activities for students, IT professionals, and the workforce.
- Support the design and implementation of short-term training courses and activities for entrepreneurs, small business managers, and the workforce.
- Support internship and on-the-job training activities for students, young entrepreneurs, and graduates.

IMPLEMENTATION, OPTIMAL USE OF DIGITAL CAPACITY AND INTEROPERABILITY

1.3 billion to ensure the digital transformation of public administration and public services and their EU-wide interoperability, facilitating business access to technology and know-how.

Figure 10: Implementation, optimal use of digital capacity and interoperability

Source: https://www.agendadigitale.eu/tag/digital-europe/

Operational Objectives:

- Ensure that the public sector and sectors of public interest, such as health and care, education, justice, transport, energy, environment, and the cultural and creative sectors, can access and deploy state-of-the-art digital technologies, in particular high-performance computing, artificial intelligence, and cybersecurity.
- Deploy, operate and maintain interoperable digital service infrastructures at the trans-European level (and related services), in complementarity with national and regional actions.
- Facilitate the development, upgrade and use of solutions and frameworks by public administrations, businesses and European citizens, including the re-use of solutions and frameworks for interoperability.
- Enable public administrations to access piloting and testing of digital technologies, including their use across borders.

- To support the take-up by the Union industry and in particular by SMEs of advanced digital and related technologies, including in particular high-performance computing, artificial intelligence, cyber security and future emerging technologies.
- To support the design, testing, deployment and implementation of interoperable digital solutions for public services at the Union level delivered through a platform of data-driven reusable solutions, to foster innovation and to establish common frameworks to realise the full potential of public administration services for European citizens and businesses.
- Ensure continued capacity at Union level to observe, analyse and adapt to rapidly evolving digital trends and to share and integrate best practices.
- Support collaboration on the establishment of a European ecosystem for trusted infrastructures using distributed ledger services and applications, including support for interoperability and standardisation and promotion of the deployment of EU cross-border applications,
- Implementing and enhancing the network of digital innovation hubs.

In addition to the Digital Europe program, the European Commission assigns a key role in the implementation of the program to *Digital Innovation Hubs*. In particular, the Hubs should stimulate a broad adoption of advanced digital technologies by industry, public organizations and academia. In the Commission's vision, *Digital Innovation Hubs* will serve as access points to the latest digital capabilities, including high-performance computing, artificial intelligence, cybersecurity, and other existing innovative technologies as key enabling technologies. The hubs will serve as one-stop shops for access to proven and validated technologies and promote open innovation. They will also provide support in the area of advanced digital skills. The *Digital Innovation Poles network* should also facilitate the participation of the outermost regions in the Digital Single Market.

The first group of *Digital Innovation Poles* will be selected on the basis of proposals from the Member States and, subsequently, the network will be expanded through an open and competitive procedure to ensure maximum geographical coverage across Europe.

Digital Innovation Poles will receive funding in the form of grants to:

- provide digital transformation services (including testing and experimentation facilities) geared toward SMEs and mid-cap companies, including in areas where adoption of digital and related technologies is slow;
- transfer skills and know-how across regions, particularly by networking SMEs and mid-cap companies established in one region with digital innovation hubs established in other regions that are best able to provide the required services;

- providing thematic services including those related to artificial intelligence, high-performance computing, and cybersecurity and trust-to governments, public sector organizations, SMEs, and mid-cap companies. Individual digital innovation hubs may specialize in specific thematic services and are not required to provide all of the thematic services mentioned in this paragraph.

2.3 Digital technologies in education

Education and training are the best investments in Europe's future. They play a key role in stimulating growth, innovation and job creation. European education and training systems must provide people with the future-oriented knowledge, skills and competencies they need to evolve and progress. They also play an important role in creating a European identity based on common values and cultures. Education should help ensure that young people can express themselves and engage, participate and shape the future of a Europe characterized by democracy, solidarity and inclusion. Digital technology enriches learning in a variety of ways, provides learning opportunities that should be accessible to all, and opens up access to a huge amount of information and resources.

In the March 2017 *Rome Declaration*, EU member states emphasized their commitment to providing young people with "the best education and training." The October 2017 European Council called for education and training systems to be "adapted to the digital age",

In Gothenburg in November 2017, the Parliament, Council and Commission proclaimed the European Pillar of Social Rights, which enshrines the right to quality and inclusive education, training and lifelong learning. In its communication entitled *Strengthening European Identity through Education and Culture*, the Commission lays out the idea of a European Education Area by announcing a targeted action plan for digital education.

The *European Action Plan* defines how education and training systems can make better use of digital innovation and technology as well as support the development of the relevant digital skills needed to live and work in an era of rapid digital change. The Action Plan places a particular emphasis on initial education and training systems and covers school education, vocational education and training (VET) and higher education. That is why it is crucial to invest in one's digital skills throughout life. (Communication from the Commission to the European Parliament, the Council, the European economic and social committee and the Committee of the regions on the eLearning Action Plan).

More than 80 % of young people in Europe use the Internet for social activities[8].

Internet access on mobile devices has increased considerably in recent years, but the use of technology for educational purposes has not kept pace. Not all primary and secondary schools in the EU have broadband connections and not all educators have the skills and familiarity to use digital tools to support teaching. A recent study found that an estimated 18% of primary and secondary schools in the EU were not connected to broadband in 2015[9]

Innovation within education systems, understood as the adoption by education organizations of new services, new technologies, and new skills, can help improve learning outcomes, increase equity, and enhance efficiency 10 (OECD (2016).

It is most effective and sustainable when managed by appropriately trained faculty and embedded in clear educational objectives. More needs to be done about how best to use digital tools to achieve education goals.

Digital advances also bring new challenges for European pupils, students and teachers.

The *Action Plan* focuses on the need to foster, support and enhance the appropriate use of digital and innovative teaching practices and their implementation. It will draw on a wide range of stakeholders from the education and training sector, including businesses, researchers, and NGOs, as well as non-formal education, as appropriate. It envisions three priorities:

1. Improve the use of digital technology for teaching and learning to ensure equity and quality of access and infrastructure. Improving access to technology and connectivity for all pupils must be a starting point for reducing inequality and exclusion.
2. Develop digital skills and capabilities relevant to digital transformation. To operate and progress in the digital society and to overcome digital risks, citizens need skills that help them meet the challenges and seize the opportunities of digital transformation. Digital skills, alongside literacy and numeracy, are basic skills needed in all areas of life; yet, too many citizens have limited or outdated digital skills. There is a need for broad dissemination, as all citizens need to understand, at different levels, the various aspects of digital competence, and for in-depth work, as ICT professionals need more specialized e-skills. Digital competencies are part of the revised *European Reference Framework of Key Competencies for Lifelong Learning* that all citizens should possess.
3. Improve education through better data analysis and forecasting.

   Data is critically important to education and training. From the use of technology comes actionable data. The challenge lies in how to use these data to develop better

[8] http://ec.europa.eu/eurostat/statistics-explained/index.php/Being_young_in_Europe_today_-_digital_world

[9] European Commission (2017), Satellite broadband for schools: Feasibility study: http://ec.europa.eu/newsroom/document.cfm?doc_id=46134

understanding and prediction, which can in turn improve education systems or address current issues in education.

Data also helps identify and address the need for evidence-based policy measures; but comparative data, in particular, are rarely used. Big Data and learning analytics offer new opportunities to capture, analyze, and use data to improve education.

Multiple initiatives are underway in various EU member states to move from a one-size-fits-all teaching approach, in subjects such as mathematics, to more personalized learning, with the ability to tailor content to the needs of individual learners (In Luxembourg, for example, the Ministry of Education, Children and Youth, in support of its "Digital Lëtzebuerg" strategy, has launched the national digital transformation project "MathemaTIC," aimed at enabling students to interact with stimulating, research-supported mathematical resources tailored to students' specific needs and aligned with learning outcomes across the curriculum. Learning analytics can improve personalized learning e.g. by identifying at-risk students, and can assess the impact of various teaching strategies. (COM(2013) 654 final: Opening up education. Innovative teaching and learning techniques for all through new technologies and open educational resources).

The *Digital Education Action Plan 2021-2027* builds on the 2018-2020 plan, further emphasizing the need to harness the potential of digital technologies for learning and teaching and to develop the digital skills of all. Education and training are fundamental to personal fulfillment, social cohesion, economic growth, and innovation. They also constitute a crucial element in building a more fair and sustainable Europe. Improving the quality and inclusiveness of education and training systems and the provision of e-skills for all during the digital transition and the transition to a green economy is of strategic importance for the EU.

The rapid digitalization that has occurred over the last decade has transformed many aspects of daily and working life. The use of digital technologies is also key to achieving the goals of the European Green Deal and climate neutrality by 2050. Digital technologies are important tools for the transition to a green economy, as well as for the transition to a circular economy and the decarbonization of energy, transport, construction, agriculture and all other sectors and industries. In parallel, it is important to reduce the climate and environmental footprint of digital products and facilitate the shift to sustainable behaviors in both the development and use of digital products.

In the near future and with the acceleration caused by the pandemic crisis, economic activities will be increasingly knowledge intensive, and it is necessary to ask whether current education, especially tertiary education, is capable of training young people who have adequate skills, not only digital, to be employable even in a market where artificial intelligence (AI) and innovation connected to Industry 4.0 are spreading.

All forecasts point to these changes as emerging new needs of protection, both in the digital environment to work: the impact of technology is on the job generating phenomena that require new rules. Again, education plays a fundamental role, because it must provide students with the tools they need to be more aware of the role of digital, acquiring the skills and appropriate skills to be leaders of the future of work.

These sudden changes also impact on the training and professional orientation paths that the education system offers to its students. In a rapidly changing context, the need for an orientation capable of looking up, broadening horizons, and understanding as much as possible the complexity of the factors at play is increasingly evident. Students must be able to raise awareness of the professional prospects that await them, of the sectors where employability is greatest, of the skills required by the professional field, of the activities that characterize the different professional profiles.

The dramatic impact of the epidemic made even more evident how important the use of digital technology is for social and economic life, as well as for education.

Currently only 42% of Italians aged between 16 and 74 years have basic digital skills (58% in the EU), with a significant impact on the use of digital services. Among the European countries, Italy ranks last for the use of the Internet with 17% of people between the ages of 16 and 74 who have never surfed the net (9% in the EU). The data also indicate that only 1% of Italian graduates have an ICT qualification (the worst position in the EU) and that the percentage of ICT specialists - although it has increased over time and reached 3.6% of total employment - is still way behind the EU average (4.2%) (Source: Eurostat 2019).

With respect to the number of ICT graduates, the gap between supply and demand is growing, with a shortage of 5,100 graduates e.g. 35% of the total (data from the Digital Skills Observatory 2019).

Digital technology, when deployed in capable, equiTab., and effective ways by educators, can fully support the agenda for inclusive, high-quality education and training for all learners. It can facilitate more personalized, flexible, and learner-centered learning at all stages and phases of education and training. Technology can be a powerful and engaging tool for collaborative and creative learning. It can help learners and educators access, create, and share digital content. It can also allow learning to take place outside the walls of a lecture hall, classroom or workplace, offering greater freedom from the constraints of time and physical location. Learning can take place entirely online or in a blended mode, following times, places and rhythms tailored to the needs of the individual learner. Recent data show a mixed picture across Member States regarding digital education. Data from the 2018 OECD PISA survey shows that many low-income households did not have access to computers. Eurostat data from 2019 show that broadband internet access varies widely across the EU, from 74 % of households for the lowest income quartile to 97 % in the highest income quartile. Regarding teacher preparedness, the 2018 OECD

International Survey on Teaching and Learning showed that only 39 % of educators in the EU felt prepared or very prepared to use digital technologies in their daily work, with significant differences between Member States.

With the COVID-19 crisis, a situation arose for the first time where there was no choice but to make use of digital technologies to deliver education and training. At the same time, this pandemic also highlighted the gaps that needed to be filled in order to successfully integrate digital technologies into education and training systems.

Efforts to counter the COVID-19 pandemic led to the closure of school buildings, campuses, and other education and training sites and resulted in a forced shift to emergency digital education modes. These emergency modes have resulted in widespread deployment of online and distance learning (Communication From The Commission To The European Parliament, The Council, The European Economic And Social Committee And The Committee Of The Regions, *Digital Education Action Plan 2021-2027 Rethinking Education and Training for the Digital Age* COM/2020/624 final).

The massive and unprecedented use of technology for learning has given rise to many opportunities for teachers to organize their teaching differently and to interact with students in a more personalized way, focusing on their specific needs. In some member states, the vast majority of educators and learners had little, if any, experience with online teaching and learning and the different pedagogical approaches needed for this mode of teaching. Not all tools or contents were accessible and learners with disabilities faced particular difficulties. The crisis requires us to rethink how education and training, across all disciplines, are designed and delivered to meet the needs of a rapidly changing and increasingly digital world. Currently, inclusive and quality education should be based on the needs of our current and future society.

The COVID-19 crisis highlighted key enabling factors for effective digital education and training: adequate connectivity and digital equipment for learners and educators; teachers and trainers competent and confident in using digital technology to support their teaching and adapted pedagogy; leadership; collaboration and sharing of best practices and innovative teaching methods. It also confirmed the need for diverse pedagogical approaches in online teaching. Teachers and learners also need to develop the skills and know-how for this different mode of learning.

In the first Digital Education Action Plan, adopted in 2018, the EU addressed digitization in education with a number of measures (The first Digital Education Action Plan was adopted in January 2018 as part of the goal of creating a European Education Area. It included eleven actions. For more information on this, see the Commission Staff Working Paper).

The new action plan presents a vision for improving digital literacy, skills, and capacity at all levels of education and training and for all levels of digital skills (from basic to advanced). The action plan will support the Skills Agenda's goal of ensuring that 70 per cent of people ages 16-74 have at least

basic digital skills by 2025. The new action plan also supports the goals of the Commission's recently adopted proposal for a Council Recommendation on Vocational Education and Training (VET) for Sustainable Competitiveness, Social Equity and Resilience, which places a strong emphasis on digital transformation in VET.

The Action Plan can benefit from the Erasmus program, the European Social Fund, the European Regional Development Fund and Smart Specialization policies, the Connecting Europe Facility, the Digital Europe program, and Horizon Europe.

Building on the work of the European Parliament (For example, the work of the European Parliament's CULT Committee, which has produced relevant reports on digital education, artificial intelligence, and other related issues), the Council (For example, the Council Conclusions on COVID in Education during the Croatian Presidency of the Council of the European Union.), and the Commission, the Action Plan includes measures for inclusive and high-quality digital education and training, which will require a combination of actions and policies to be effective. This action plan covers the next programming period (2021-2027) and defines priorities and corresponding actions where the EU can add value.

According to the Digital Skills and Jobs Coalition of the European Commission and through the Strategy Italia 2025 and in particular with its main pillar *Repubblica Digitale*, and the *National Strategy for Digital Competencies*, Italy has established three areas of intervention and related objectives:

- **Digital Education:** the empowerment of digital skills is a core objective to improve full citizenship, growth, competitiveness, creation of public value, and the well-being of the country. In this process, private and public sectors are involved, together with the education system that has the goal to fight digital illiteracy and to reduce digital inequalities.
- **Digital Citizenship:** digital technology can foster the development of a new form of citizenship based on quality information, participation in deliberations, civic engagement, and a more effective relationship between citizens and public administration; digital technology centred around citizens' rights may become the common language in the dialogue between citizens, public administrations and businesses, and contribute to reducing inequalities.
- **Ethical, human and non-discriminatory digital:** digital can become an opportunity for equality and the growth of communities and individuals; public and private should contribute to the removal of all social, economic, geographical, technological, and cultural obstacles that can foster inequality between citizens not only in the use of public and private digital services but also in the access to the opportunities offered by the digital era.

SECOND PART - DESCRIPTION OF THE NATIONAL DESK RESEARCH

1. Description of the national desk research

1.1 Introduction

The research is preceded by a premise on the state of diffusion of digital technology in the world, Europe and Italy, which will make it possible to highlight the delay in our country and, in particular, the causes that generate it.

The research carried out on the Italian national market about the criticality of the delay between supply and demand in terms of skills focusing the study on the supply of high school, according to the methodological approach defined and shared within the project Re-Educo, data provided by institutional sources where available and other sources with the main objective to clarify:

- strengths, weaknesses, risks, threats, and opportunities of the digital revolution in the local labour market and in high schools;
- needs and prospects for improvement;
- the most important problems detected at the local level and possible solutions.

The national on-desk analysis will be supported by Tab.s and charts that always clearly explain the sources used and the date of consultation. Graphs and Tab.s will be used to make the presentation of data more effective and accompanied by a brief explanatory caption respecting editorial standards and the project model in use.

Then the second part, developed in two chapters, summarizes the on-desk analysis focusing on the main results that emerged from the on-desk research, with the aim of providing data to better align the training offer with the demand for digital skills, illustrating:

- national labour market trends with specific reference to the digital revolution (industry 4.0);
- professional development and emerging profiles;
- digital skills sought;
- misalignment between labour supply and demand;
- issues for educational institutions.

The research is conducted referring to the analysis of the digitalization of the skills required in our country both in the processes of management of information systems (ICT Professions) and in the functional areas of organizations (non-ICT Professions).

The research will refer to the analysis contained in the report "Osservatorio delle Competenze Digitali 2019" (Digital Skills Observatory 2019) by Aica, Anitec-Assinform, Assintel, Assinter Italia and hereafter referred to simply as "Report". The analysis indicates which are the ICT professions most sought after in the WEB ads, the need for digital knowledge also for non-ICT professions and which are the evolution scenarios, useful to orient policy initiatives towards the needs of the 4.0 labour market and answer the main questions on training.

For the analysis of occupations and skills, the report used the CEN and e-CF 3.0 taxonomy, respectively. In anticipation of the e-CF 4.0 standard, in order to improve the mapping between e-CF and ESCO the analysis used more skills and identification of entirely new skills. The elementary level skills are provided in conjunction with the ESCO standard for established occupations. Conversely, new skills (i.e., skills not yet included in the ESCO standard) are provided with market mentions. The analysis of occupations and skills for ICT occupations thus identified:

- thirty established occupations: Account Manager, Business Analyst, Business Information Manager, CIO, Data Scientist, Data Specialist, Database Administrator, Developer, DevOps Expert, Digital Consultant, Digital Educator, Digital Media Specialist, Digital Transformation, Enterprise Architect, ICT Operations Manager, Information Security Manager, Information Security Specialist, Network Specialist, Product Owner, Project Manager, Quality Assurance Manager, Scrum Master, Service Manager, Service Support, Solution Designer, Systems Administrator, Systems Analyst, Systems Architect, Technical Specialist, Test Specialist;
- seven potential new professions: Artificial Intelligence Specialist, Big Data Specialist, Blockchain Specialist, Cloud Computing Specialist, IoT Specialist, Mobile Specialist, Robotics Specialist.

1.2 Diffusion of digitization

Digitization is a pervasive change in both the economy and society, also referred to as "digital disruption," which occurs as new digital technologies and the resulting business models are developed to affect the value proposition of existing products or services.

The ideal to aim for would be to be able to respond adequately by preparing in time, (as foreseen in the third priority of the Digital Education Action Plan 2021-2027 "Rethinking education and training for the digital age" (COM/2020/624 final - Communication From The Commission To The European Parliament, The Council, The European Economic And Social Committee And The Committee Of The Regions), i.e. to be able to anticipate possible evolutionary scenarios by means

of targeted simulations and consequently to implement training policies that respond to foreseeable market demands. This would make it possible to eliminate the current gap, or rather reverse it so that supply is ahead of demand. Today, this seems like a utopian vision, but the continuous evolution of digital technology, in particular with artificial intelligence and quantum computers, will make this an achievable goal in the near future.

In addition, to this physiological delay in keeping up with the digital transformation, our country has a further delay compared to other countries, so it is essential to understand the causes in order to study how and where to intervene. Let's focus the study on the national phenomenon of digital transformation, taking as reference the position of our country compared to the rest of the world and in the European context. The level of diffusion of digitization, from surveys, conducted both on a global and European scale, provide the dimensions of the phenomenon and food for thought. On a global scale, the Global Digital 2020, a study conducted by "We are social and Hootsuite" on 240 countries around the world including Italy, provides an insight into the landscape referred to the entire globe that in January 2020 counted 7,750,000,000 inhabitants. The number of users: internet users exceeded 4 billion (59%), social networks exceeded 3 billion (49%), owners and users of mobile devices exceeded 5 billion (67%).

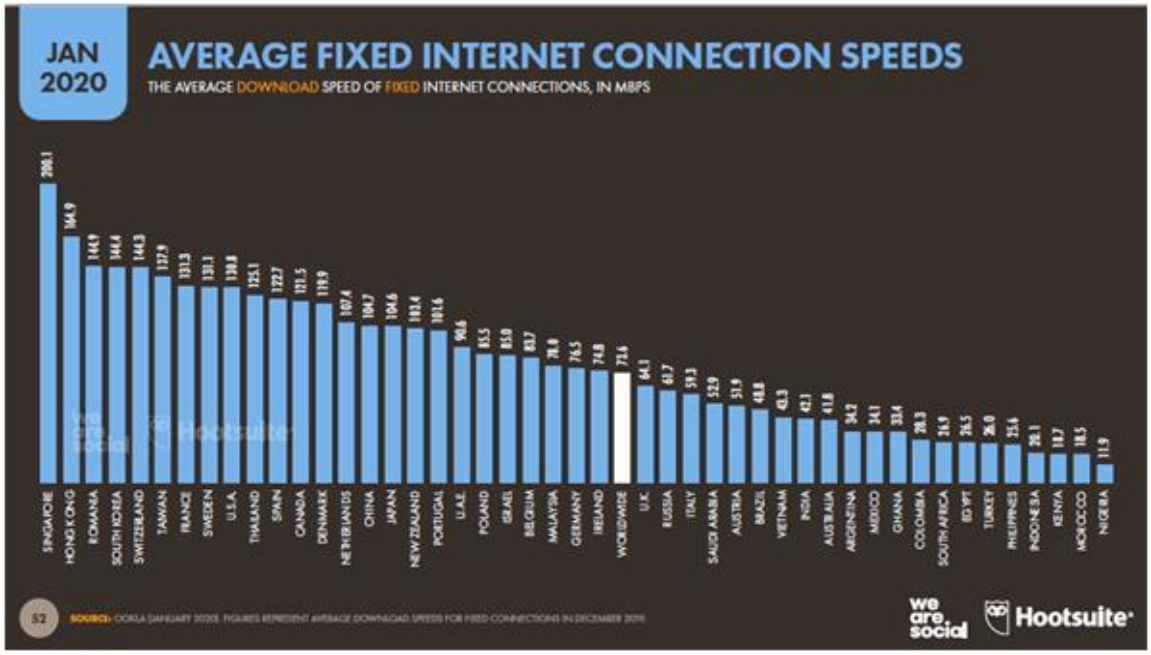
Figure 11: Digital diffusion

Source: Hootsuite – We are social (Report 2020)

Another interesting result is connection speed, which highlights how unevenly the world goes. Fixed-line on a global scale:

- Singapore results in the highest with a speed of 200.12 Mbit/s and an annual increase of +4.8%;
- Romania ranks third and is the highest of the European countries with speeds of 144.92 Mbit/s and an annual increase of 16%;
- Italy ranks 26th with a speed of 59.3 Mbit/s (32.8 Mbit/s in 2018 >86%).

Figure 12: Fixed-line connection speeds



Source: Hootsuite – We are social (Report 2020)

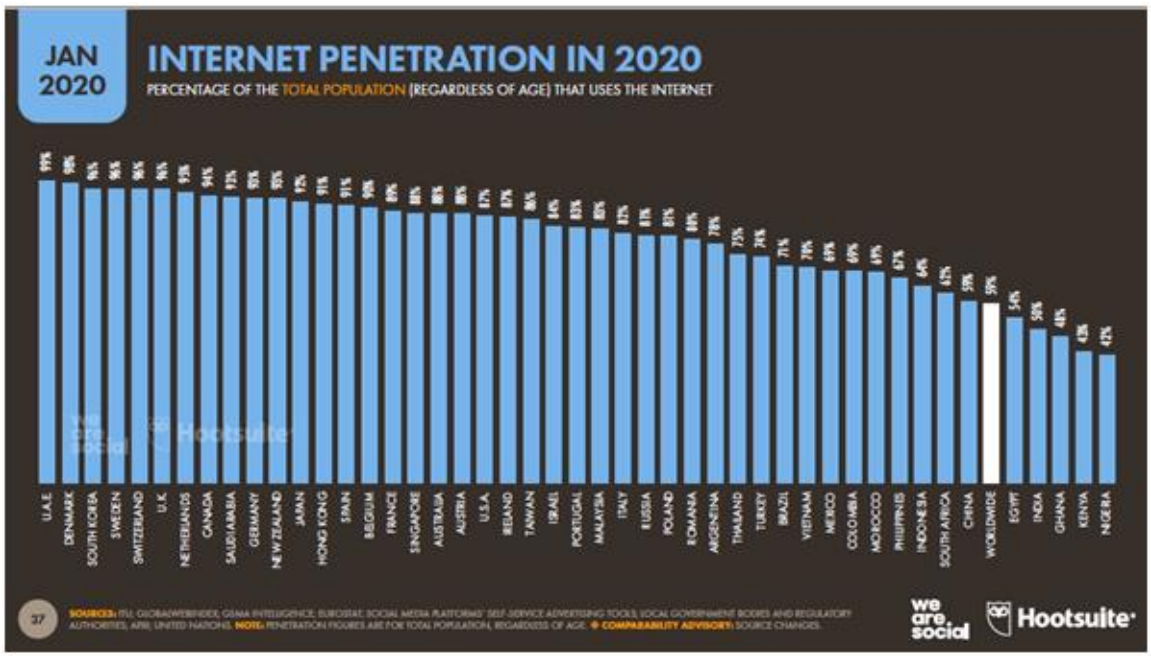
Worldwide mobile line:

- South Korea ranks highest with a speed of 103.18 Mbit/s and an annual increase of +102%;
- Netherlands 7th place and among European countries the highest with a speed of 67.08 Mbit/s and an annual increase of +22%;
- Italy ranks 20th with a speed of 36.8 Mbit/s (21.3 Mbit/s in 2018 >72%).

Poorly performing infrastructure and poor digital culture are the reasons why Italy is among the last places. Technology is constantly evolving, but sometimes equipping oneself with advanced

devices, if they do not correspond to performing infrastructures, the expected results are not achieved. This is the case, for example, of our country in terms of very low communication speed, and this is certainly a deterrent to the use of digital technology by society as a whole, but we can say that technology, while it is true that it represents a necessary condition, is not a sufficient condition for a conscious diffusion of digital technology. For example, we have seen that Romania, despite having a very high speed, sees it in third place in the world ranking for fixed-line, on the other hand, for the use of the Internet it falls to 28th place. While there are EU countries such as the Netherlands, Sweden, Denmark, Germany, France and others that in addition to having a high-performance infrastructure record an internet usage above the European average. This result can be attributed to the co-presence of both the technological component, or better, of high-performance infrastructures, and, above all, to the presence of a widespread digital culture that allows a conscious use of digital technology.

Figure 13: Ranking on Internet usage



Source: Hootsuite – We are social (Report 2020)

The Tab. below summarizes numerically the above limiting the analysis to the European context.

Table 2. European ranking with priority on the use of Internet

Country	Use of the Internet	Fixed Network	Mobile Network
DENMARK	2°	13°	12°
SWEDEN	4°	8°	14°
SWISS	5°	5°	7°
NETHERLANDS	6°	14°	6°
GERMANY	9°	10°	22°
BELGIUM	14°	22°	11°
SPAIN	14°	11°	24°
FRANCE	15°	7°	15°
AUSTRIA	18°	31°	13°
ITALY	25°	29°	20°
ROMANIA	28°	3°	19°

Source: Ing. Gianfranco Ossino on Hootsuite data – We are social (Report 2020)

It is possible to reduce or rather eliminate the gap of our country, improving the performance of infrastructure to aim for values of speed at least double those on written (and this is operating as we have seen the significant increases in % that we record but we have a lot to recover) and promoting the spread of a digital culture that leads to a conscious use. This delay in our country is obviously widespread, so it also concerns the work in terms of lack of digital skills required and that the school can not fulfill generating an inevitable gap between supply and demand with a consequent loss of competitiveness compared to other foreign countries. We will see first which are the enabling technologies and after which are the digital skills required.

2. Emerging national trends

2.1 National labor market trends with specific reference to the digital revolution (industry 4.0)

The fourth industrial revolution or Industry 4.0 stems from recent innovations in industrial automation that integrate new production technologies to improve working conditions, create new business models and increase the productivity and production quality of plants. Industrial revolution that stands alongside the previous ones and, like them, poses new technical and social challenges. The former are being overcome at an exponential rate, while the latter, as mentioned above, present the most critical issues. It is likely that this will revolutionize the welfare state and labor law as we know it. But now let's focus our interest on the potential opportunities that this change will offer in the world of work, opportunities that will increasingly favor more skilled work activities at the expense of routine activities by allowing for:

- improved productivity and speed of execution;
- greater personalization of productions;
- opening up to new business models, to new types of production and sales structures, to new types of relationships based on the territory and to new international competitions.

Specifically, we will address the third point in terms of potential employment generated by Industry 4.0 enabling technologies.

Figure 14: Industry 4.0, the enabling technologies

Source: Mistery of Economic Development (2018)

Technological progress is the cause on the production system of two contradictory effects and there are no rules that guarantee the prevalence of the positive effect on the negative one (Keynes).

The negative effect involves the *replacement of the role of workers* with new technologies that improved production processes.

The positive effect allows the *company to capitalize* because the introduction of new technology allows the company to expand into new markets or new areas.

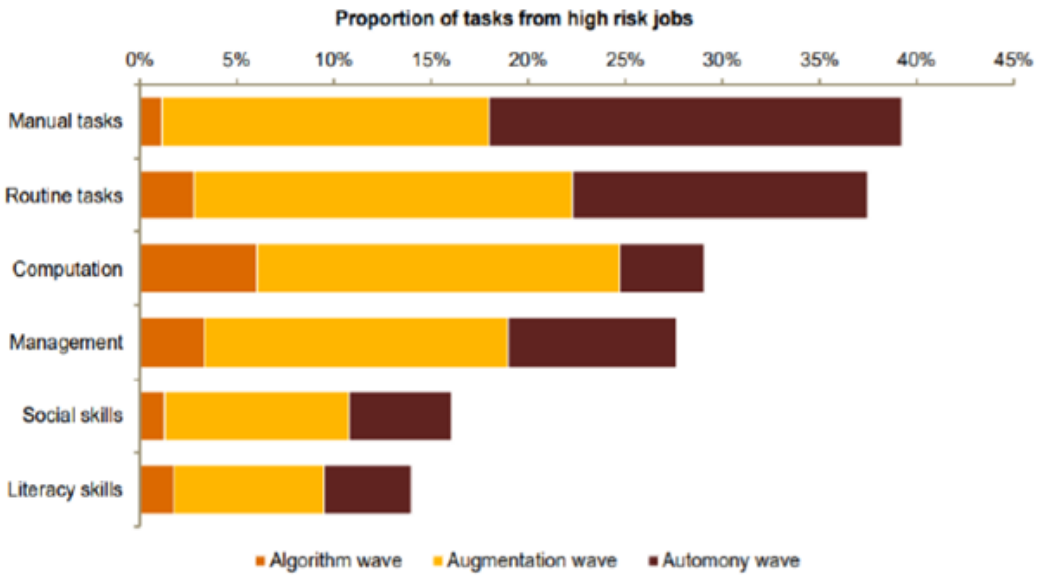
The weight of these two effects is a variable of the specific country and is closely dependent above all on the ability of the respective educational system in being able to train people who are adaptable to the pace of technological progress (Goldin and Katz -2009).

The ability of 4.0 innovations lies in disrupting non-routine activities with the observation that the capabilities of Artificial Intelligence (AI) are far superior to those of the human mind (Brynjolfsson and McAfee - 2011).

It is widely believed that change can be considered in three partially overlapping phases or waves (Hawksworth et al. - 2018):

1. Algorithm wave relates to computational tasks, i.e. those based on the use of basic software, mathematical calculations, telematics searches and the like.
2. Augmentation wave concerns more dynamic tasks, for example, routine form-filling activities.
3. Autonomy wave will be the one of autonomy and will be characterized by AI and robotics, without just going to replace routine tasks, but also going to perform more complex tasks from the point of view of manual dexterity (manual dexterity or the ability to use the hands in a skilful and coordinated way to grasp and manipulate objects and demonstrate small and precise movements) and also from the point of view of problem-solving skills required.

Figure 15: Percentage incidence of change in work activities



Source: Hawksworth et al. (2018)

The first phase is already underway, the second has just begun and is, in percentage terms, the wave that will have the greatest impact on labour change, to be followed by the third, which is expected by 2030. The percentage incidence forecasts for our country are shown in the Figure below 16.

Figure 16: Forecasts of incidence in Italy

Nazione	Algorithm wave (%)	Augmentation wave (%)	Autonomy wave (%)
Slovacchia	4	25	44
Slovenia	3	24	42
Lituania	4	26	42
Repubblica ceca	3	25	42
Italia	4	23	40
Usa	5	26	39
Francia	4	22	38
Germania	3	23	37
Austria	3	22	37
Spagna	3	21	34
Polonia	2	18	34
Turchia	1	14	33
Irlanda	2	19	33
Olanda	4	21	31
Regno unito	2	20	31
Cipro	2	19	30
Belgio	4	18	30
Danimarca	3	19	30
Israele	3	19	30
Cile	1	13	29
Singapore	4	18	27
Norvegia	3	18	26
Svezia	3	17	25
Nuova Zelanda	2	16	24
Giappone	4	16	24
Russia	2	12	23
Grecia	2	13	23
Finlandia	2	16	22
Corea del sud	2	12	22

Source: Hawksworth et al. (2018)

2.2 Professional development and emerging profiles

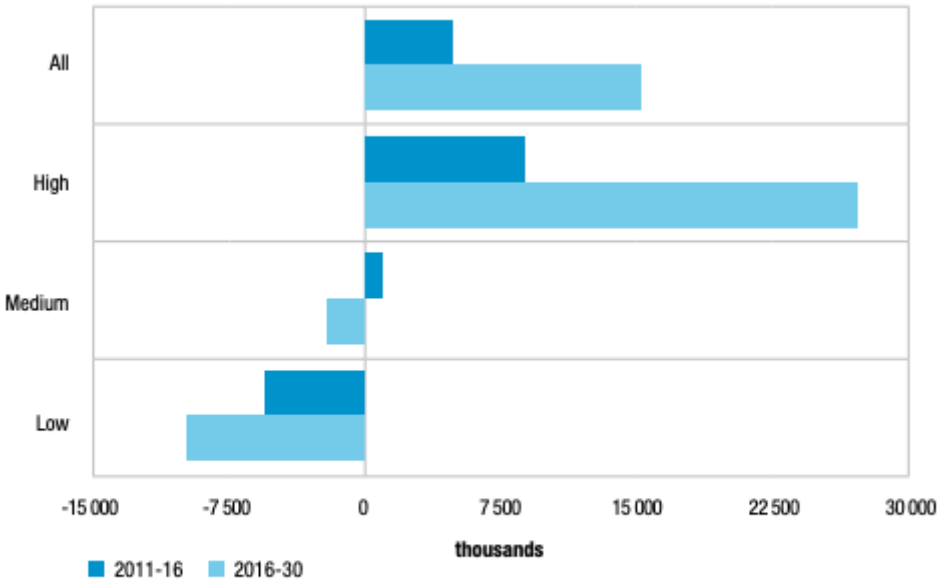
The transversality of digitization concerns the whole organization, users, administrative staff, ICT technicians, management or absence of digital skills could be the cause of several critical issues: difficulty in using or delivering a service, technical problems, difficulty in selecting suitable digital solutions, etc.

Therefore, e-skills are fundamental in a society that is aiming at the digitization of processes. At the national level, the Agency for Digital Italy (AgID) has defined a map of digital competencies, classifying them in:

- basic digital skills (users, including administrative staff), the ability to use information technologies with familiarity and critical thinking for work, leisure and communication. They represent the entry-level of digital skills necessary to be part of the information and knowledge society and exercise the rights of digital citizenship;
- specialized skills are related to ICT professionals and future professionals and are required in both the private and public sectors. The development of adequate ICT specialist skills is a crucial condition for digital growth, in the online public services sector, the evolution of manufacturing products, as well as for the efficiency and evolution of services. In this regard, the European e-CF reference tool, European e-Competence Framework 3.0, defines the competence of ICT professionals as "a demonstrated ability to apply knowledge, skills and attitudes to achieve observable results";
- e-leadership or e-business skills are the ability to make the best use of digital technologies within any type of organization and to introduce digital innovation in the specific market sector in which one operates. Digital skills are closely integrated with the leader's typical soft skills and industry-specific skills.

The World Economic Forum predicts that the digital transformation will increasingly record a reduction in less-skilled jobs and an increase in more skilled jobs, a phenomenon that we have already highlighted also in our country in the previous paragraph by reporting the percentage incidence of the change in work activities. The diagram of the European agency Cedefop (supports the development of programs and policies for Vocational Education and Training (VET) and contributes to their implementation) highlights this trend, in line with what the Industry 4.0 change is doing in the field of work.

Figure 17: Past and projected demand for qualifications: constrained (EU-28+3)



NB: Changes in numbers in employment, constrained to match E3ME total and to reconcile demand with available supply.

Source: Cedefop (2018 skills forecast)

Figure 18: Projected demand for qualifications: constrained (EU-28+3)

Levels (000s)	Base year 2016	Projected year 2030	Net change	Replacement demand 2016-30	Total requirement
Low qualification	45 747	36 079	-9 668	25 053	15 385
Medium qualification	114 429	112 360	-2 069	65 525	63 456
High qualification	76 871	103 299	26 428	52 289	78 717
All qualifications	237 047	251 738	14 691	142 867	157 558

Shares (per cent)			change (%)	as a proportion of base year (%)	
Low qualification	19.3	14.3	-21.1	54.8	33.6
Medium qualification	48.3	44.6	-1.8	57.3	55.5
High qualification	32.4	41.0	34.4	68.0	102.4
All qualifications	100.0	100.0	6.2	60.3	66.5

NB:Changes in numbers in employment, constrained to match E3ME total and to reconcile demand with available supply.

Source: Cedefop (2018 skills forecast)

2.3 Digital skills sought

Many jobs will give way to new categories of occupations, changing and influencing, as a result, the way we work.

In a new context, more and more technological and complex, in which it is necessary to react actively in making decisions, living with new production and business paradigms and interacting with increasingly diverse types of customers, it is necessary, therefore, to implement the so-called "soft skills", or transversal skills, it is precisely these that make a difference in the labour market.

Soft skills are perhaps the most important skills for a successful career start. They are the counterpart to the more well-known hard skills, which are those skills that can be quantified and measured objectively, such as knowledge of software or a programming language.

Soft skills include abilities related to personality traits, attitudes, communication styles and all those empathic and expressive skills, which we hardly learned during our training.

It is precisely on this subject that the World Economic Forum writes in its "Future of Jobs" report, listing the following 10 key skills for 2020 and the future of work.

1. **Problem-solving** in complex situations: competence inherent in understanding, managing and solving problems. In an increasingly intricate economic environment, it is essential to be flexible, adaptable and have the ability to interpret and manage new contexts in order to identify critical issues, develop optimal strategies and identify, in a short time, a solution to complex problems.
2. **Critical Thinking**: ability to develop thinking characterized by accuracy, precision and competence in the analysis and evaluation of different situations. Critical thinking is characterized by the ability to use logic and reasoning, analyzing possible solutions, the pros and cons of these. It is constituted, in fact, by the detection and observation of experience and a subsequent, effective and accurate reworking of it.
3. **Creativity**: In recent years, companies are increasingly investing in the development of creative thinking as a key competence to be acquired and strengthened in order to respond to the processes of change, which are more rapid and different than in the past. These more complex and ever-changing scenarios are driving leaders to look for people capable of combining the information available to develop new ideas and innovative solutions aimed at ensuring greater competitiveness.
4. **People management**. Human capital will always be a company's most important resource, despite technological development. For this reason, it is essential, particularly for managers and leaders, to have the ability to motivate and enhance the value of the people in their teams, to entrust them with tasks and duties in line with their potential and to give them constructive feedback for improvement. To do this you need to be an emotionally intelligent leader, as well as possess the ability to make effective decisions.

Thus, people management does not boil down to merely organizing tasks, work, and the team.

5. **Coordinate with others**. Teamwork is one of the most important factors within a company. As evidence of this, more and more training is being provided on this subject. In particular, the focus is on the ability to work together, on team building and, above all, on creating a synergy that leads to the achievement of a common goal through the contribution and coordination of all team members. To this end, it is necessary to organize the work to be done by defining priorities and changing them when and if necessary, dealing with obstacles.
6. **Emotional intelligence**. Emotional intelligence is defined by Mayer and Salovey as the ability to perceive and express emotions, to know how to use, understand and manage them, in oneself and in others. More specifically, it refers to the ability to recognize the information transmitted by emotions, identifying the causes and possible consequences, knowing how to classify and accurately describe emotions and moods, even complex ones, knowing how to reflect and integrate them into cognitive processes, in an adaptive way, to improve thinking, problem solving, decision making and planning. It seems clear, therefore, that this is an essential skill for teams and managers, who have to manage and coordinate a group of collaborators.
7. **The ability to make judgments and decisions**. This is a key skill, particularly for managers. In fact, making strategic decisions at the right time, especially in times of difficulty when it is even more complex, allows you to react and deal with change and overcome critical situations in the best possible way.
8. **Service orientation**. In an increasingly competitive market, in which the types of customers are more and more varied, it is essential to have the ability to identify and recognize the needs of others, in order to meet them in the best possible way, adopting an attentive and collaborative attitude.
9. **Negotiation**. In the penultimate place on the list of 10 key skills for 2020 and the future of work, we find negotiation. This skill is strategic within the work context as it ensures not only relational well-being, but also economic well-being, both at company and individual level. It is therefore important to hone this skill and not improvise by relying on common sense and instinct in the various interactions with others.
10. **Cognitive flexibility**. This last skill is necessary in order to better manage change and respond to new and unforeseen situations. Specifically, it means flexibility of response, or the ability to modulate one's responses and behaviors by dealing intelligently and quickly with changing tasks, duties or rules.

Resuming the analysis of the report "Digital Skills Observatory 2019", it provides interesting quantitative and qualitative information on the trend of demand (job offers) in the ICT sector 2018. Before examining the results of the analysis, a few clarifications to facilitate the reading of the results.

Summary context analysis contained in the report and concerning the need for ICT professions:

- Reference document: "Digital Skills Observatory 2019" by Aica, Anitec-Assinform, Assintel, Assinter Italia Digital Skills Observatory 2019
- Object of analysis: ICT job requirements and potential new ICT jobs
- Market: ICT and non-ICT economic sector
- Data source: Web ads
- Reference period Data: 2018
- Methodology/Tools: WollyBI
- Standards: CEN, ISCO, ESCO

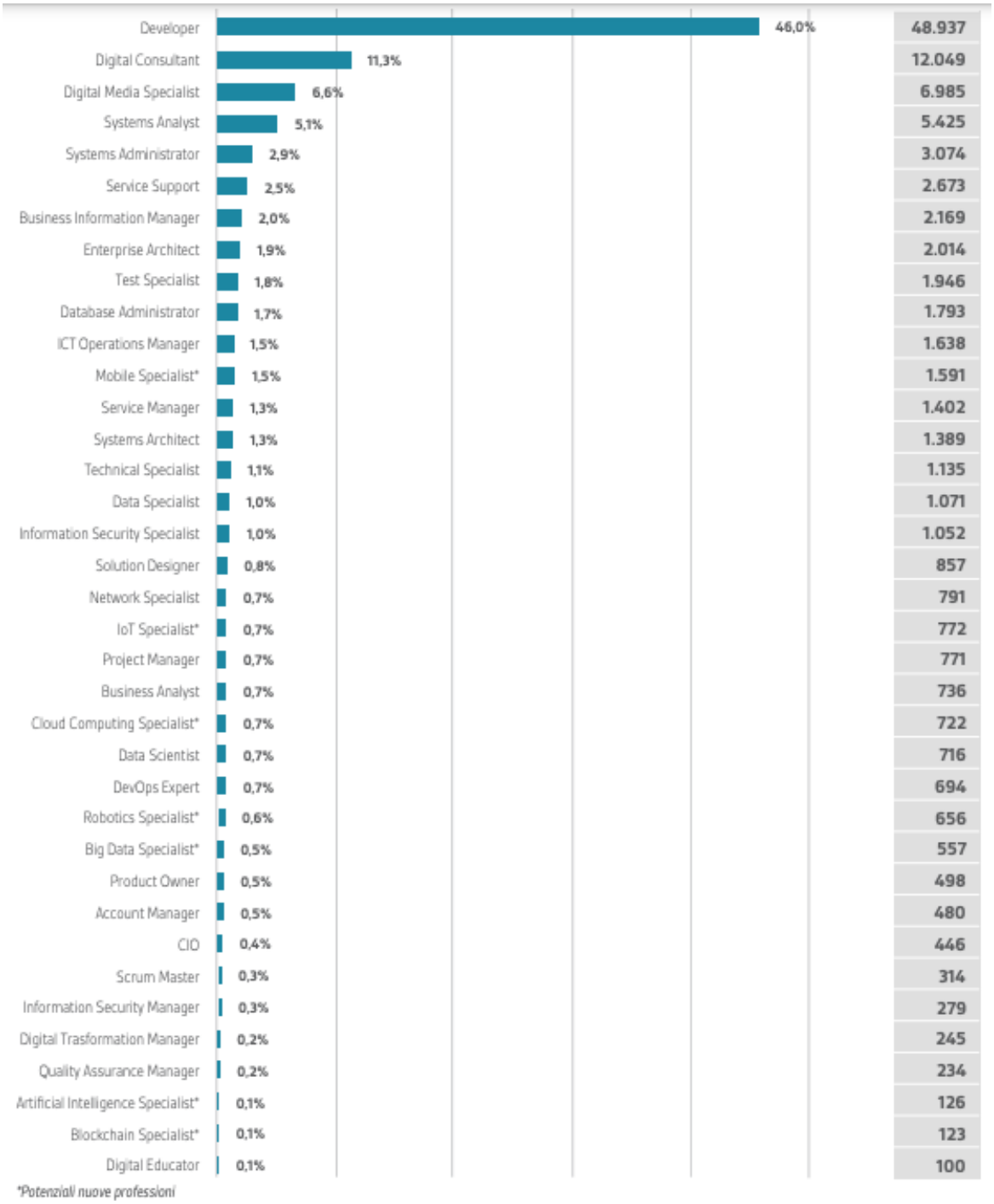
The analysis also considers digital skill rates because they play an enabling role in the profession, allowing us to highlight the pervasiveness of digital skills, albeit with different sensitivities, depending on the profession.

In the graphs, the ordinal size "CEN Professions" indicates the average value of all the thirty consolidated and enumerated professions at the beginning of this second part.

The analysis contained in the report is based on ads posted on the web in 2018 that represent the demand or need for ICT occupations for the market in both ICT and non-ICT fields. The graphs produced, in addition to the thirty established professions, also report the emerging professions generated by new technologies. Several views are developed:

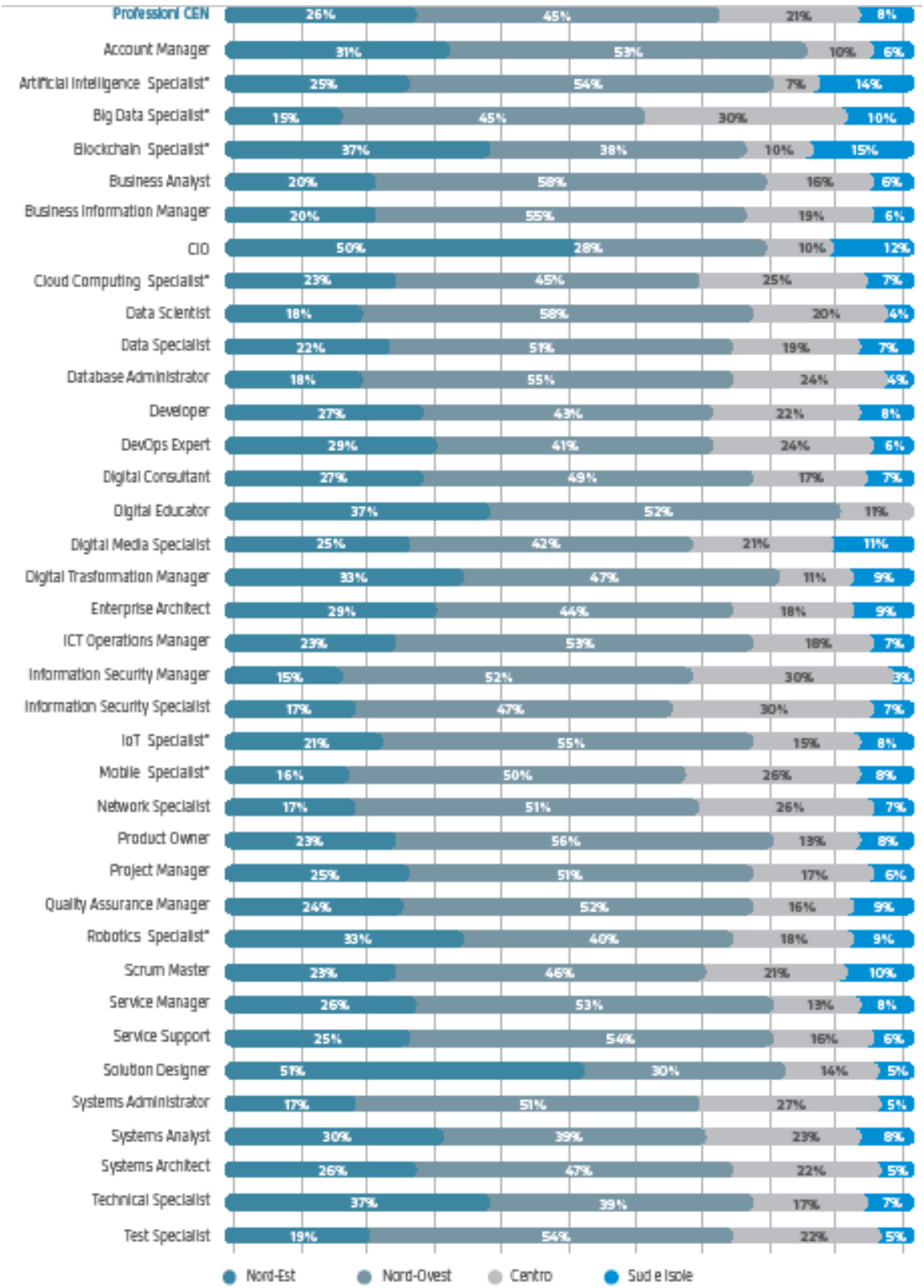
- breakdown by profession in percentage and absolute value fig. 19;
- distribution in percentage value of CEN profiles by geographical area fig. 20;
- distribution of the ads according to the sector required, from which it is clear that the demand comes from the ICT sector fig. 21;
- distribution of ads in percentage value of skill rates for each ICT profession fig. 22, providing a percentage indication of the pervasiveness of digital skills within each profession;
- distribution of ads in percentage value of CEN Profiles by e-CF skill macro area fig 23. Where the macro areas of expertise (e-CF) are: Plan (design and planning), Build (development, integration and testing), Run (operation), Enable (support and enablement), Manage (economic and technical management). Taken together, the skills in the "planning" area PLAN/BUILD/ENABLE make up almost two thirds of the skills present in the CEN Professions, leaving only one third for the "operation" area RUN/MANAGE, which confirms that the digital transformation sites are in full swing.

Figure 19: Number and breakdown of job openings by occupation. Values in units and percentage of total, 2018



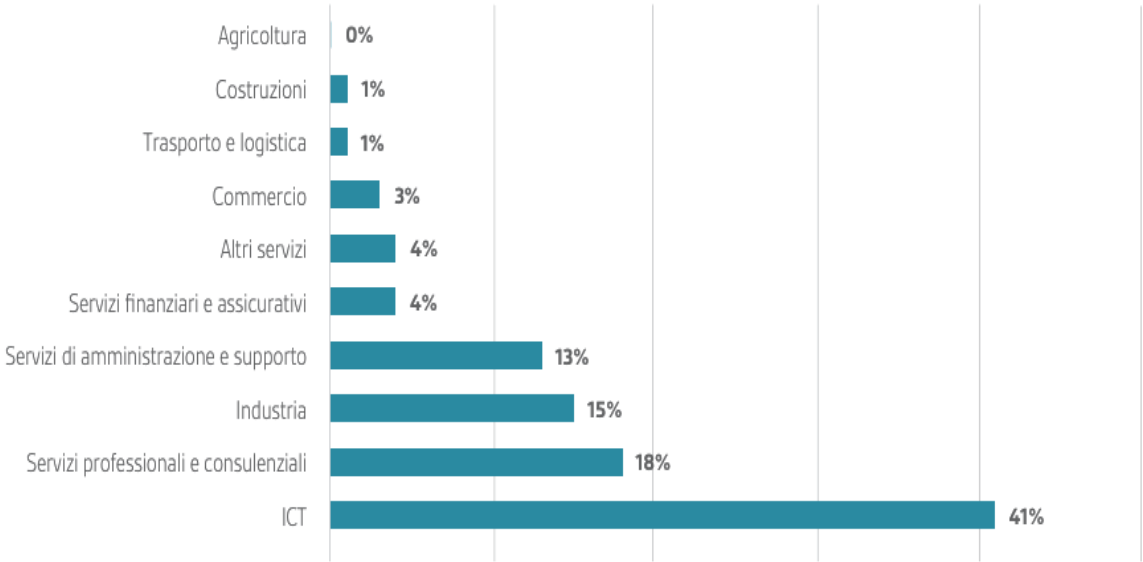
Source: WollyBI – (*Potential New Jobs)

Figure 20: Share of ads addressed to CEN profiles by geographical area (macro region, 2018)



Source: WollyBI – (*Potential New Jobs)

Figure 21: Distribution of ads by required industry

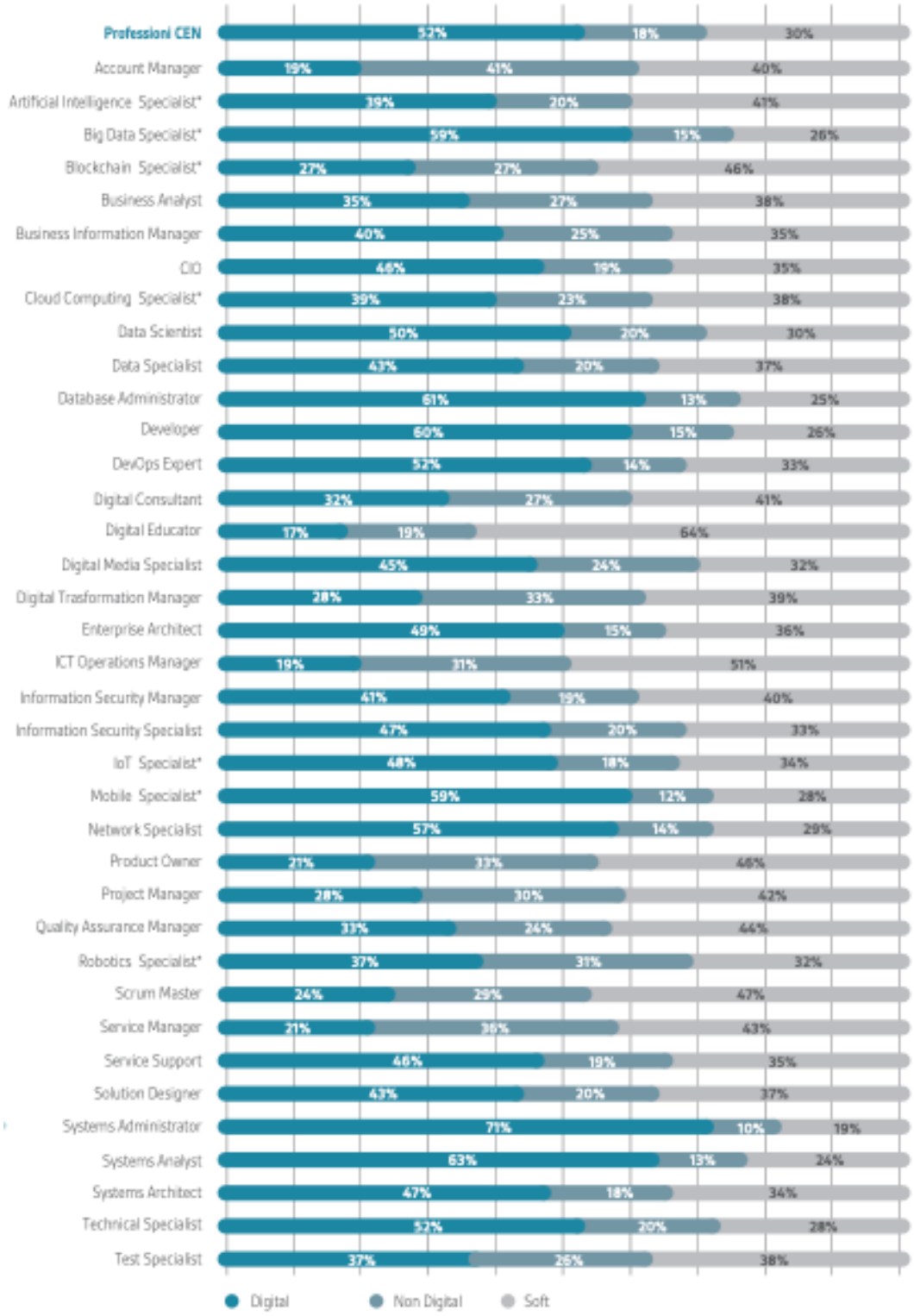


Source: WollyBI – (*Potential New Jobs)**

**Legenda:

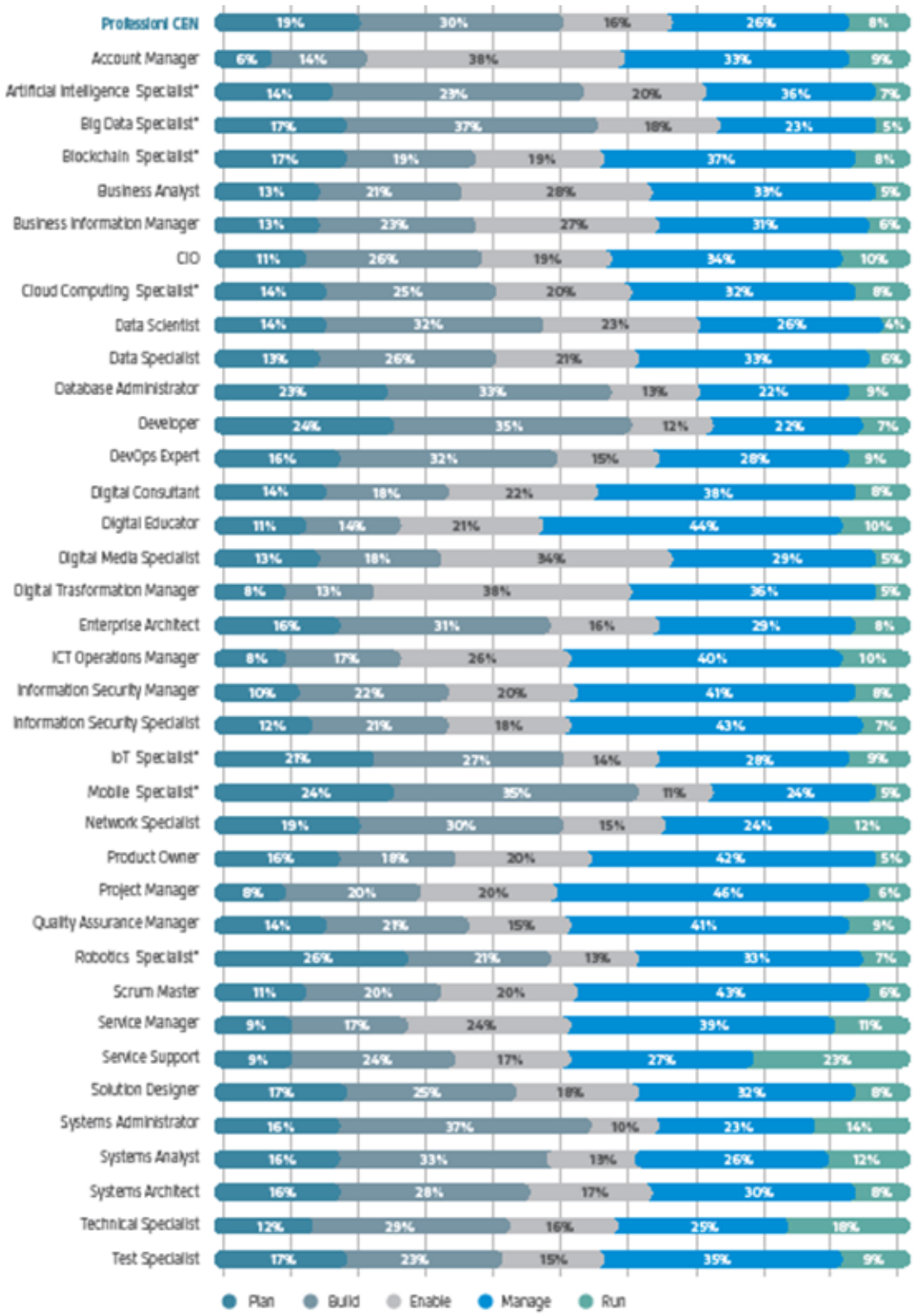
Agricoltura:	Agriculture
Costruzioni:	Buildings
Trasporto e logistica:	Transport and logistics
Commercio:	Trade
Altri servizi:	Other services
Servizi finanziari e assicurativi:	Financial and insurance services
Servizi di amministrazione e supporto:	Administration and support services
Industria:	Industry
Servizi professionali e consulenziali:	Professional and consulting services
ICT:	ICT

Figure 22: Distribution skill rate in ICT professions



Source: WollyBI – (*Potential New Jobs)

Figure 23: Share of ads addressed to CEN Profiles by macro area of competence e-CF



Source: WollyBI – (*Potential New Jobs)

The need or the demand for work regarding ICT professions analyzed, as written at the beginning of this paragraph, concerns the entire economic market of our country, therefore, both the ICT and non-ICT sectors. Other interesting points offered by the report concern the objective evidence of the pervasiveness of digitization, in this regard it is also interesting to provide the results on the incidence of digital knowledge on non-ICT professions.

This pervasiveness requires the coexistence of digital culture and digital competence, characteristics that all workers must aspire to in order to develop the awareness of the use of digital technology that allows them both to seize the opportunities but also to mitigate the risks. Specifically, here is some information from the report for both the private and public markets.

In the private sector, the change brought about by new technologies, globalization and the reorganization of production processes generate in companies the need for new professional Fig.s with technological skills and soft skills depending on the job position required.

The analysis contained in the report is based on ads published in 2018 on the web that represent the demand or the need for non-ICT professions for the private market.

Summary context analysis non-ICT professions on private market contained in the report:

- Reference document: "Osservatorio delle Competenze Digitali 2019" by Aica, Anitec-Assinform, Assintel, Assinter Italia Osservatorio delle Competenze Digitali 2019
- Object of analysis: non-ICT job requirements with indication of the pervasiveness of digital skills
- Market: non-ICT economic sector
- Data source: Web-based ads
- Data reference period: 2018
- Methodology/Tools: WollyBI
- Standards: CEN, ISCO, ESCO.

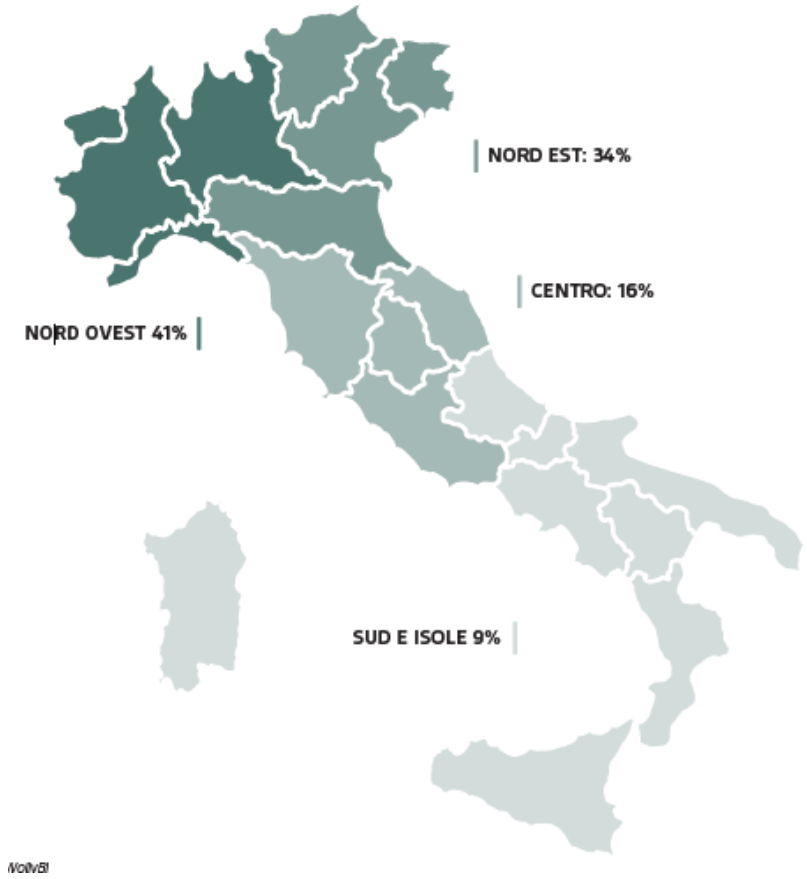
The analysis showed a Non-Digital Skill Rate of 40%, a Soft Skill Rate of 43%, and a Digital Skill Rate of 14%.

Table 3. Demand for non-ICT professions in the private sector – geographical distribution and by incidence of DSR

Macro Region	Non-Digital Skill Rate	Soft Skill Rate	Digital Skill Rate o DSR	Total
NORTH WEST	17%	18%	6%	41%
NORTH EAST	14%	15%	5%	34%
CENTER	7%	7%	2%	16%
SOUTH AND ISLANDS	4%	4%	1%	9%
ITALY	41%	44%	15%	100%

Source: Elaboration Ing. Gianfranco Ossino on data report

Figure 24: Demand for non-ICT professions in the private sector – geographical distribution



Source: WollyBI

As far as the public sector is concerned, the need for digital competencies for non-ICT professions is part of an initiative of the Department of Public Administration, which, according to a systemic vision of the entire Public Administration apparatus, proposes as a common guideline a single set of reference knowledge for the public employee at a national level, the Syllabus of Digital Competencies, shared by all administrations.

The Syllabus "Digital Competencies for PA" is the document that describes the minimum set of knowledge and skills that every civil servant, not an IT specialist, should possess in order to actively participate in the digital transformation of the public administration.

Organized into five thematic areas and three levels of mastery, the Syllabus is the reference tool both for the self-testing of digital skills and for the definition of courses aimed at addressing the training needs identified.

Table 4. Syllabus of digital competencies in public administration

	SYLLABUS OF DIGITAL COMPETENCES IN PUBLIC ADMINISTRATION
1	**DATA, INFORMATION AND IT DOCUMENTS**
1.1	Manage data, information and digital content
1.2	Produce, evaluate and manage IT documents
1.3	Knowing open data
2	**COMMUNICATION AND SHARING**
2.1	Communicate and share within the administration
2.2	Communicate and share with citizens, businesses and other public administrations
3	**SAFETY**
3.1	Protect devices
3.2	Protect personal data and privacy

4	**ON-LINE SERVICES**
4.1	Learn about digital identity
4.2	Provide online services
5	**DIGITAL TRANSFORMATION**
5.1	Know the goals of digital transformation
5.2	Learn about emerging technologies for digital transformation

Source: Osservatorio delle Competenze Digitali 2019" di Aica, Anitec-Assinform, Assintel, Assinter Italia Osservatorio delle Competenze Digitali 2019

3. Challenges for the labour market and higher education

In the European context, a series of tools have been set up to address the need for training in digital skills, which we can frame in two moments and whose response, taking into account the delay in particular as a country we have accumulated, can no longer be delayed:

- In the immediate concerns **work** in terms of:
    - management retraining on both digital change and new management models based on teamwork, employee empowerment, meritocracy, motivation, etc.;
    - reskilling and continuous training of obsolete staff;
    - continuous training of newly hired staff.

- In the near future it concerns the **school** so that it trains learners to learn to:
    - prepare digital citizens with awareness in the use of technology and combat functional illiteracy;
    - train the new generations in a functional way for the labor market, a role in particular that is the responsibility of high school.

3.1 Mismatch between labour supply and demand

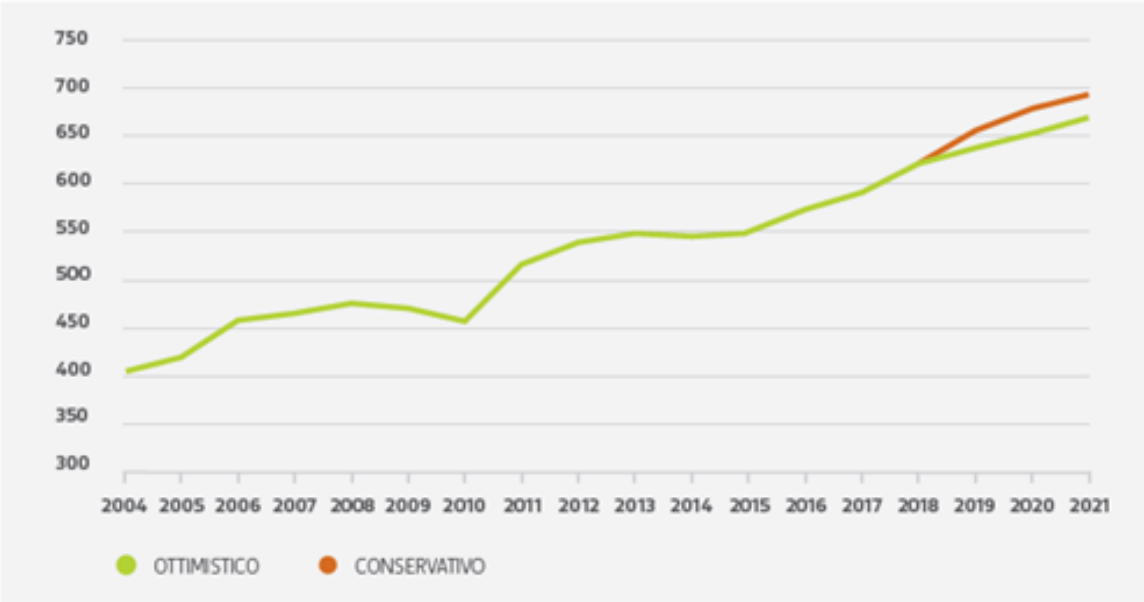
The report analysis is conducted on all economic sectors in our country for the ICT market and not to highlight misalignments between labor supply and demand regarding ICT professions.

The results are shown in the graphs below.

Let's start by examining the demand for ICT professionals shown in the 2004 2021 forecast, which shows two estimates:

- a conservative one obtained by applying a linear trend that would lead in the three-year period 2019-2021 to an increase from 653,000 to 683,000 employed people;
- an optimistic one obtained by taking into account the positive impact of digitization on the production system that would lead to an increase in employment from 672,000 to 710,000 over the three-year period 2019-2021.

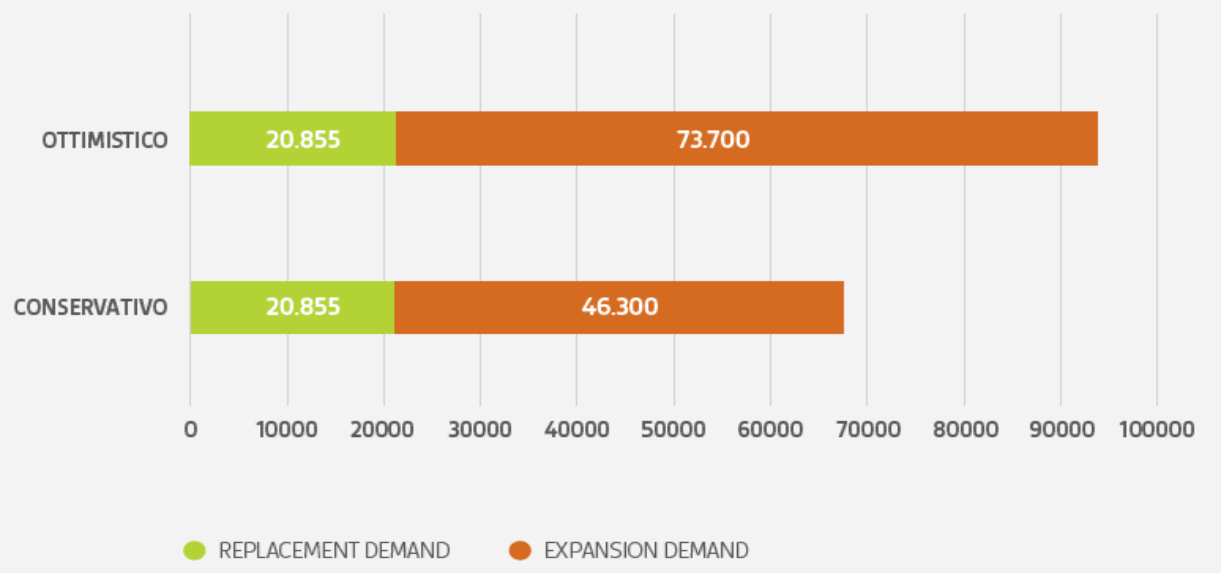
Figure 25: ICT professionals demand trend, forecast 2004-2021



Source: Eurostat, CRISP

In the above demand forecast, taking into account the replacement (replacement due to retirement or mortality) and expansion (an increase that in the case of ICT is greater than replacement) components, we have the need for ICT professions indicated in Figure 26, which in the three-year period 2019-2021 fluctuates between about 67,000 units in the conservative hypothesis and about 94,000 units in the optimistic hypothesis.

Figure 26: Estimated need for ICT occupations, cumulative values period 2019-2021



Source: Eurostat, CRISP**

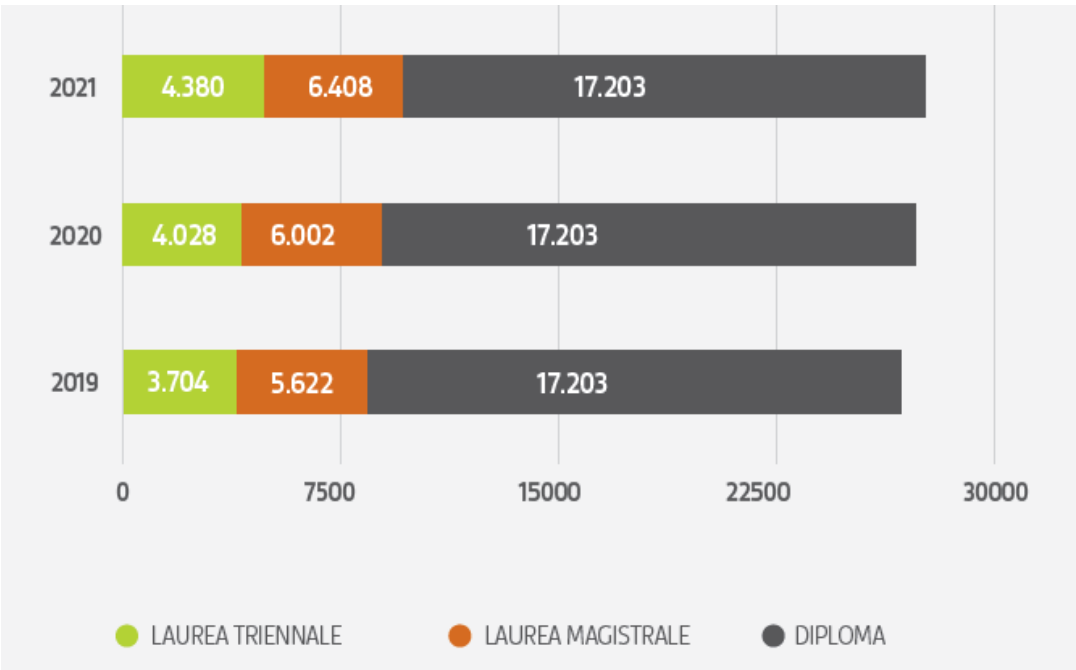
** On the X axis:
Ottimistico: Optimistic
Conservativo: Conservative

Let's now look at the ICT skills supply consisting of: incoming 2019-2021 graduates and undergraduates. The analysis refers to:

- to graduates of Technical Institutes in the economic ("administration finance and marketing - business information systems address") and technological ("information technology and telecommunications address") pathways; considering only graduates who do not continue to university studies, and assuming that all these graduates are actively seeking ICT jobs;
- to graduates of degree programs in Computer Science (both Engineering and Science), Electronics, Telecommunications, and Bioengineering.

Estimates show a labor market entry flow of about 81,700 for the three-year period 2019-2021, of which about two-thirds are high school graduates and just over one-third are college graduates.

Figure 27: ICT skills offerings: incoming undergraduate and graduate students 2019-2021



Source: Elaborazioni Anitec - Assinform e CINI su dati MIUR**

** On the X axis:
Ottimistico: Optimistic
Conservativo: Conservative

From the comparison of the demand-supply forecasts in synthesis, we obtain the following

Conservative demand 67,100 units and optimistic about 94,500 units, while supply about 81,700, so from this comparison the gap would be positive in the conservative case and negative in the optimistic case.

But from a supply-demand comparison that takes into account both graduates and high school graduates, the criticality of the gap emerges because supply-demand does not balance, as indicated in the following table.

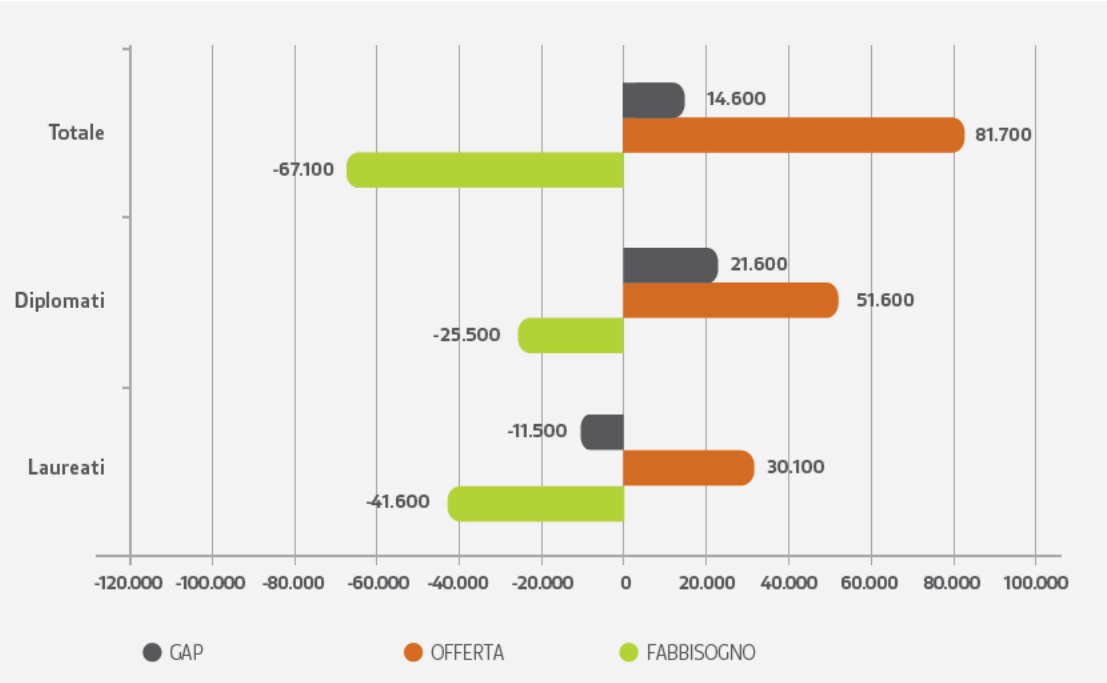
Table 5. Comparison of supply and demand for ICT professions

	Graduates	High School Graduates
Offer provides	35%	65%
Question requires	62%	38%

Source: Ing. Gianfranco Ossino from report

From these percentages applied to high school graduates and college graduates respectively in both the demand and supply cases, the charts below highlight the criticality of the gap.

Figure 28: Conservative case: Gap demand-supply of ICT professions 2019-2021

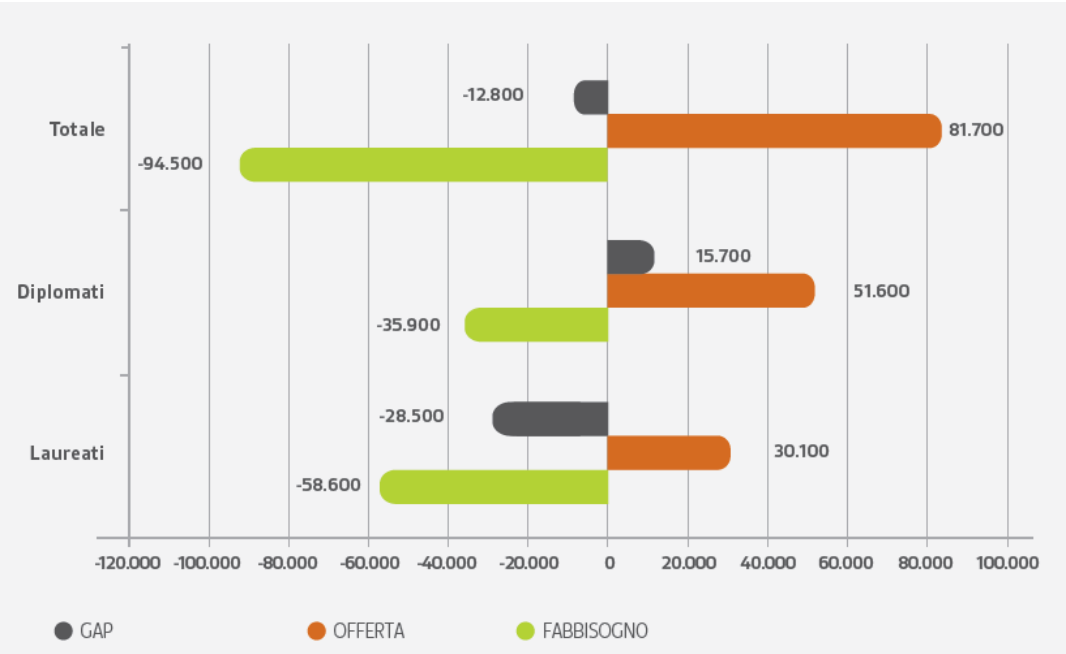


Source: CRISP*

* On the Y axis: Diplomati = Tertiary Education; Laureati = Bachelor's degree + Master's degree

* On the X axis: Offerta = Supply; Fabbisogno= Demands

Figure 29: Optimistic case: Gap demand-supply of ICT professions 2019-2021



Source: CRISP*

* On the Y axis: Diplomati = Tertiary Education; Laureati = Bachelor's degree + Master's degree

* On the X axis: Offerta = Supply; Fabbisogno= Demands

3.2 Digital Transformation - SWOT analysis for labour market and high school

The national analysis, supported by the sources consulted, highlights the critical points that explain the delay in Italy in the spread of digital technology. Digital transformation is a change that is a source of opportunities but also of risks, and so it must be governed by a planning approach that allows it to be used consciously and in a way that is functional to its mission. In this regard, the SWOT analysis is a strategic planning tool used to assess the strengths, weaknesses, opportunities and threats of a project in general for the achievement of an objective. The analysis can look at the internal environment (analyzing strengths and weaknesses) or the external environment of an organization (analyzing threats and opportunities). In our case, we have two projects, the world of work and high school, with a common goal of digital transformation.

In the following paragraphs, we report the SWOT analysis for the world of work and for high school. These analyses do not claim to be exhaustive, but they do aim to highlight elements in tune with the purpose of this research.

3.2.1. LaboUr market needs and prospects for improvement

Flexibility is an internal element of the company and in general is a strength, and specifically for digital transformation requires the right digital skills for both ICT and non-ICT personnel. Among the external elements that facilitate digital change and support companies in not losing competitiveness there is the availability of both technological infrastructure, in particular connectivity, and regulatory/economic/fiscal tools that the State makes available according to strategic plans for the country.

Table 6. Digitalization - SWOT Analysis labor market

SWOT Analysis	Qualities useful for digital change	Qualities detrimental to digital change
Internal elements	**Strengths** flexibility	**Weakness** insufficient digital skills and digital literacy
External elements	**Opportunities** technical infrastructure and regulatory tools	**Threats** loss of competitiveness

Source: Elaboration Ing. Gianfranco Ossino on data report

Some of the factors among the weaknesses that may not be conducive to flexibility (in the Tab. encapsulated in "insufficient digital skills and digital culture") are:

- criticalities in interactions between ICT and non-ICT managers;
- insufficient number of professional Fig.s to support digital transformation and, at the same time, interactions that are not always optimal between ICT functions and business functions;
- for non-ICT professions, an inadequate mix of digital and soft skills that concerns not only young people but also the employed according to a continuous and new training that avoids their obsolescence.

Intervene on these factors so that they become strengths from weaknesses:

- internal to spread digital culture at all levels and a new training model that allows continuous updating of human capital preserving it from obsolescence.
- external interventions regarding educational institutions, so that they can adapt their models to the changes taking place in order to train ICT and non-ICT professionals responding to market demand.

3.2.2. High school needs and prospects for improvement

Human capital is today more than ever a strength, starting from school. A resource that with the 5.0 change will become more and more central, so much so that we talk about digital humanism. The weakness lies in the school model that requires an evolution in order to arouse motivation in the teaching staff and interest in the students. Among the external elements, the growing demand, driven by the exponential growth of digital technology, represents a huge opportunity for schools to develop innovative models of training that increase motivation among teachers and discourage dropout from learners.

Table 7. Digitalization - SWOT Analysis high school

SWOT Analysis	Qualities useful for digital change	Qualities detrimental to digital change
Internal elements	**Strengths** human capital (faculty, alumni).	**Weaknesses** obsolete model
External elements	**Opportunities** application	**Threats** abandonment

Source: Elaboration Ing. Gianfranco Ossino on data report

The revisiting of the model towards a new evolved version to offer the market a range of:

- ICT professionals with skills that meet demand in both quantitative and qualitative terms
- non-ICT professionals with soft digital skills.

3.3 Issues for educational institutions

The critical points highlighted above frustrate the potential of digital technology and inevitably affect the gap between demand and supply of digital skills, leaving no short term perspective for a balanced and responsive supply of digital skills required by the market. The problem is obvious to all and not only in the national context, on where and how to intervene must be intensified and increase what has been done so far with new models of interaction supply-demand in the labor market ICT and non-ICT to respond in time with adequate training plans that can provide the skills and digital culture required.

In the educational world there is an encouraging increase in supply that unfortunately is not in step with the growing demand. This requires a training policy that responds effectively to market needs with inevitable positive effects on the economy.

3.3.1. The most important problems detected at local level and possible solutions

The "skill gap" is a phenomenon that, as emerges from the research, manifests itself through well-defined criticalities:

- few graduates in scientific subjects and not enough to meet the demand for employment of companies committed to riding the digital transformation;
- supply not balanced in terms of graduates and high school graduates required by the market;
- few enrolled in faculties related to computer science;
- training not adapted to the speed of updating of skills that the market requires;
- poor communication between companies, families and territory;
- Job offers are not always attractive.

The theme of digital skills is the focus of the debates on the development trajectories of the world of work. The centrality and transversality of these skills is repeated by many. This is the synthesis of Unioncamere and Anpal within the report "Hiring forecasts 2019-2023" (Excelsior Information System)" in which the weight that the Digital Transformation will have on the professional needs of companies, regardless of the specific sector considered in the coming years, has been highlighted.

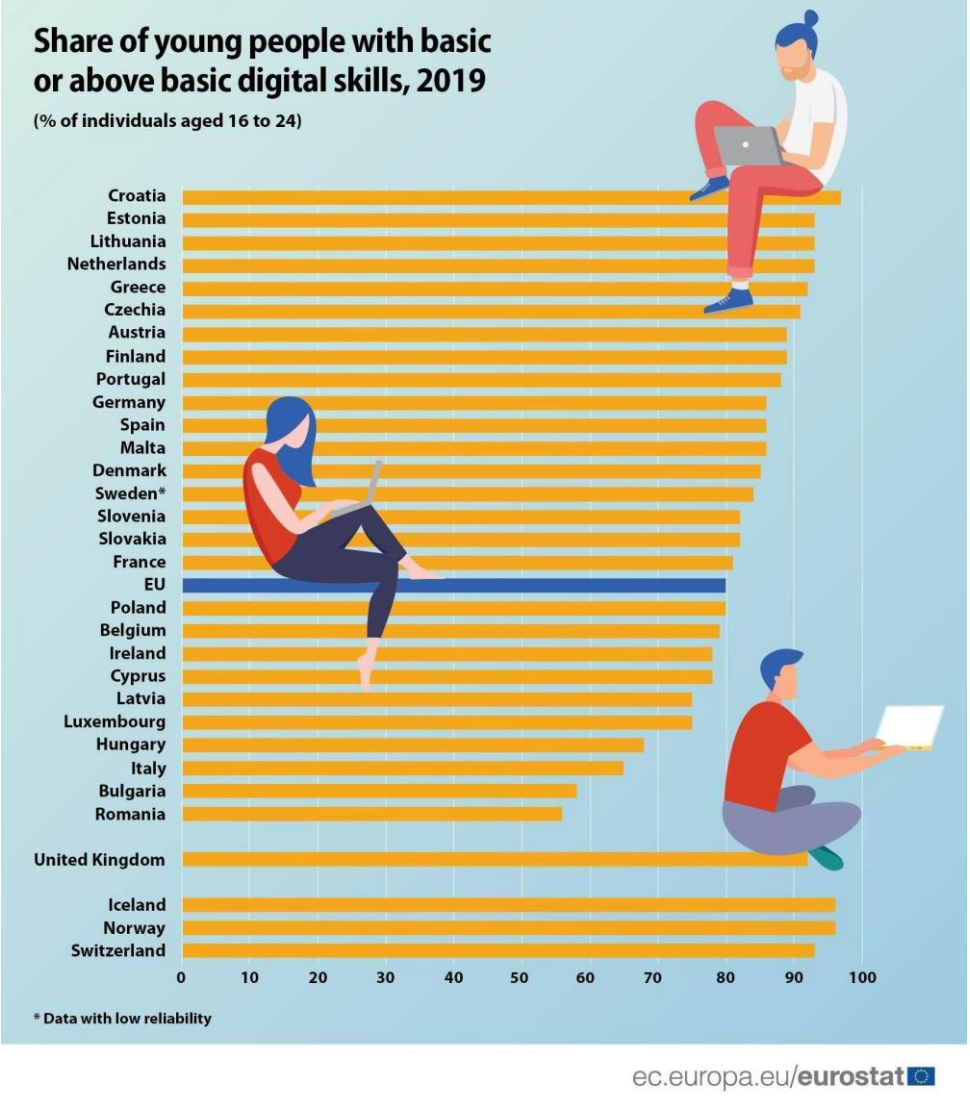
In terms of digitization, Italy is confirmed among the tail-end of Europe: according to the *Desi 2020 index* developed by the European Commission, Italy is in 25th place in Europe, placing itself in a better position only than Romania, Greece and Bulgaria.

According to the data of the *Desi 2020 index* on digital skills and human capital Italy is even last.

Among EU member states, Croatia had the highest share of individuals aged 16-24 with overall basic or higher digital skills (97%), followed by Estonia, Lithuania and the Netherlands (93% all three) and Greece (92%).

In contrast, the lowest shares were observed in Romania (56%), Bulgaria (58%), Italy (65%), Hungary (68%), Latvia and Luxembourg (both 75%).

Figure 30: EU Youth Digital Competencies 2019



Source: ec.europa/eurostat

The report's analysis of the market's demand for e-skills indicates a number of interventions, including those in the area of institutional training:

1. Strengthen training and updating of skills of teaching staff
2. Raise awareness that higher-skilled jobs will increase and lower-skilled jobs will be replaced by smart machines
3. Continuously realign courses of study with innovation and interdisciplinarity, also by directing students who drop out of ICT degree programs to ITS
4. Strengthen teaching on new technologies, methodologies and "soft" skills
5. Ensure an ecosystem more favorable to the spread of an entrepreneurial culture among ICT professionals
6. Multiply opportunities for apprenticeship experiences
7. Increase digital entrepreneurship opportunities for recent ICT graduates
8. Create transversal or "supply chain" ICT degree paths (e.g. Cloud, Cognitive Computing)

Glossary

CEN: European Committee for Standardization, which contributes with its technical standards to the achievement of the objectives of the European Union, in its European ICT Skills Meta-Framework published in February 2006.

Competencies: Professional competencies are specific skills acquired in a given field of work. They typically require training courses or "ad hoc" schools closely related to the trade in question. The e-CF polystically defines ICT competency as "a demonstrated ability to apply knowledge, skills, and attitudes to achieve observable results".

DSR: The Digital Skill Rate (DSR) provides a percentage indication of the pervasiveness of digital skills within an ISCO occupation in terms of the frequency and relevance of the skills present within it. Similarly, the Non-Digital Skill Rate and Soft Skill Rate are introduced, defined as a percentage value of the demand for non-digital and soft skills, respectively.

The purpose of the DSR is not the general profiling of occupations in terms of skills, but to give an indication of the pervasiveness of digital skills in individual occupations as it emerges from the needs of the market. In fact, the very nature of job ads leads those who write the ad to make explicit the skills considered most important in the business context of reference, leaving out those that are considered to be less important, if not obvious.

e-CF: e-Competence Framework European model for the definition of ICT skills.

EQF: European Qualifications Framework.

ESCO3: (The European Skills, Competences, Qualifications and Occupations Framework) is the European classification standard, which incorporates the ISCO standard for occupations and extends it with examples of occupations, skills, competencies and qualifications associated with each ESCO occupation.

ISCO: The International Standard Classification of Occupations) is the standard developed by the International Labour Organization as a hierarchical classification system for occupations2. It is subdivided into 9 macro groups (from Executives to Elementary Occupations), which in turn are divided into a 4-level (or digit) hierarchical structure.

IWA: Italy is the Italian section of IWA (International Web Association). IWA is a non-profit professional association recognized as a world leader in providing training principles and certifications for Internet professionals; it is present in over 100 countries, representing over 200,000 members.

Profession: Intellectual or manual activity exercised continuously and for the purpose of gain.

Qualifications: The qualification represents the professional status of the worker; in other words, the term professional qualification refers to the set of knowledge, skills, and competencies of a

specific professional Fig..... According to the EQF, it is the formal outcome of an assessment and validation process, acquired when a competent authority determines that an individual has achieved certain learning outcomes against predefined standards. Qualifications therefore perform the fundamental function of formally and officially indicating the "learning outcomes" achieved by a person, with the aim -for example- of giving these people access to specific professions or positions for which certain competencies are required.

Bibliography

AgID guidelines for the harmonization of ICT professions. Available at: www.agid.gov.it

AICA, Digital Skills Observatory. Available at: https://www.assinteritalia.it/code/15888/Digital-skills-observatory

Almalaurea, XXII Survey (2020) - Employment conditions of graduates. Available at: https://www.almalaurea.it/universita/indagini/rapporti-almalaurea-2020

Department of Public Administration (2019), *Syllabus "Digital competences for PA". Version 1.1.* Available at: https://www.competenzedigitali.gov.it/fileadmin/user_upload/syllabus-competenze-digitali-pa-dfp-uid-maggio-2019.pdf

Digital Economy and Society Index (DESI), 2020, Available at: https://digital-strategy.ec.europa.eu/en/policies/desi

European e-Competence Framework 3.0. Available at: http://www.ecompetences.eu/wp-content/uploads/2014/02/European-e-Competence-Framework-3.0_IT.pdf

Excelsior Information System, *Forecasts of employment and professional needs in Italy in the medium term (2019-2023),* Available at: https://excelsior.unioncamere.net/index.php?option=com_content&view=article&id=364:previsioni-dei-fabbisogni-occupazionali-e-professionali-in-italia-a-medio-termine-2019-2023&catid=108&Itemid=1698

Hawksworth, J., Berriman R. and Goal S. (2018). *Will robots really steal our jobs? An international analysis of the potential long term impact of automation*. PWC.

Hot Suite 2018, 2019, 2020 report. Available at: https://www.hootsuite.com/resources/digital-2020

MID (2019) The country's strategy for innovation and digital transformation: Italy 2025. Available at: https://assets.innovazione.gov.it/1610546390-midbook2025.pdf

OECD (2016), *Innovating Education and Education for Innovation. The Power of Digital Technologies and Skills. (Innovating Education and Education for Innovation: The Power of Digital Technologies and Skills*), OECD: https://www.oecd.org/fr/innovation/innovating-education-and-educating-for-innovation-9789264265097-en.htm

PEOPLEwellBe, *The 10 "soft skills' ' essential in 2020, according to the World Economic Forum*. Available at: https://www.risorseumane-hr.it/bacheca-hr/10-soft-skills-indispensabili-2020/

User guide for the application of the European e-Competence Framework 3.0. CWA 16234:2014 Part 2. Available at: http://ecompetences.eu/wp-content/uploads/2014/02/User-guide-for-the-application-of-the-e-CF-3.0_CEN_CWA_16234-2_2014.pdf

World Economic Forum (2020), The Future of Jobs Report 2020, available at: https://www.weforum.org/reports/the-future-of-jobs-report-2020

Sitography

Osservatorio delle competenze digitali: https://competenzedigitali.org/

CEN Comitato Europeo di Normazione o standardizzazione: https://www.cen.eu/work/areas/ict/eeducation/pages/ws-ict-skills.aspx

AgID: https://www.agid.gov.it/it/argomenti/competenze-digitali