



THE EUROPEAN
CLOUD COMPUTING HUB

CLOUD COMPUTING SKILLS

Trainings & Opportunities in Europe

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CLOUD COMPUTING SKILLS STATUS QUO

Europe needs digitally empowered and capable citizens, a digitally skilled workforce and way more digital experts than today. Basic digital skills for all citizens and the opportunity to acquire specialized skills in information and communications technology (ICT) for the workforce are a prerequisite to participate actively in the Digital Decade.

According to DESI 2022¹, in 2021, about 9 million people worked as ICT specialists in the EU. The highest numbers were reported in Germany (2 million ICT specialists), which provided work to more than one fifth (22.5%) of the EU ICT workforce. Germany was followed by France with 1.2 million ICT specialists (13.9% of the EU total) and Italy with 0.8 million (accounting for 9.5% of EU total). Their combined share accounted for more than 40% of the EU's ICT workforce. Within the Digital Compass², there is a proposed level of ambition that by 2030, 80% of all adults have basic digital skills, and at least 20 million are employed ICT specialists in the EU, with convergence between men and women.

It is important to note that in the modern economy, digital skills are the shared language (including everything from social media to cybersecurity), so all workers need to be proficient in this language, but they do not necessarily need to have software coding skills.

According to the IDC CEO Survey Interim Data³, the top 2 most critical Technology initiatives for the European CEOs are: Accelerating the shift to the cloud (46% answered this) followed by Improving technology staff competencies via in-house training, upskilling and talent recruitment initiatives (answered by 41% of the survey takers).

Furthermore, 20% of the answers remarked that "Skills Shortage" was the main reason why their organization's public cloud deployments were unsuccessful. Europe is facing an unprecedented shortage of IT professionals. Companies and organisations struggle to find experts (once they have decided to move forward to the digital transformation, they do not find the right people), which is blocking digital transformation of European economy and hampering its competitiveness.

This problem is even more acute in European SMEs. SMEs have problems in upskilling their employees, as they have neither a training budget nor a person to guide them in their professional career. The scale of this problem is huge, as two thirds of the employment in Europe is offered by SMEs, which means that two thirds of the people work for companies that have problems with digital resources needed for re-skilling/upskilling.

The problem of Cloud skills shortage in Europe

As the Global Knowledge's IT Skills and Salaries 2020⁴ report shows, cloud computing is the second most challenging area of recruitment. In Europe, 31% of IT decision-makers struggle to find the right people to keep pace with evolving technology needs. This is a concern because organisations have invested heavily in cloud software and services and are in need of architects, administrators, and other cloud experts to ensure those investments pay off.

1 Digital Economy and Society Index 2022 (<https://digital-strategy.ec.europa.eu/en/library/digital-economy-and-society-index-desi-2022>)

2 <https://digital-strategy.ec.europa.eu/en/policies/europes-digital-decade>

3 Presentation by Carla Arend "Head of Cloud Research IDC Europe". Cloud Expo Europe May 2022

4 [it-skills-salary-report-2020-global-knowledge-en-ww.pdf](https://images.globalknowledge.com/wwwimages/web/salary-report/current/it-skills-salary-report-2020-global-knowledge-en-ww.pdf) (<https://images.globalknowledge.com/wwwimages/web/salary-report/current/it-skills-salary-report-2020-global-knowledge-en-ww.pdf>)

Certification	North America	Latin America	EMEA	Asia-Pacific	Worldwide
Cybersecurity	43%	47%	41%	44%	43%
Cloud Computing	27%	29%	31%	30%	29%

Figure 1. Top Challenge areas for finding qualified talent

Coursera, in its “Global Skills report 2022”⁵ states that Europe is leading the world in skills proficiency. Europe’s competitive advantage lies in high-skill workers. Despite the economic toll of Russia’s invasion of Ukraine, Europe’s markets remain strong. Among the ten countries with the most skilled workers globally, eight are in Europe⁶. Firms seeking talent should look into these countries, while education leaders throughout the region should continue to prioritize training for high- growth, in-demand skills in business, technology, and data science.

The Digital Markets Act may open opportunities for smaller technology companies. In the spring, the European Union passed new antitrust rules to reduce the market power of American technology giants⁷. When these regulations come into force, they could open space for local firms to recruit high-skill talent. Business leaders should prepare by training this talent force now.

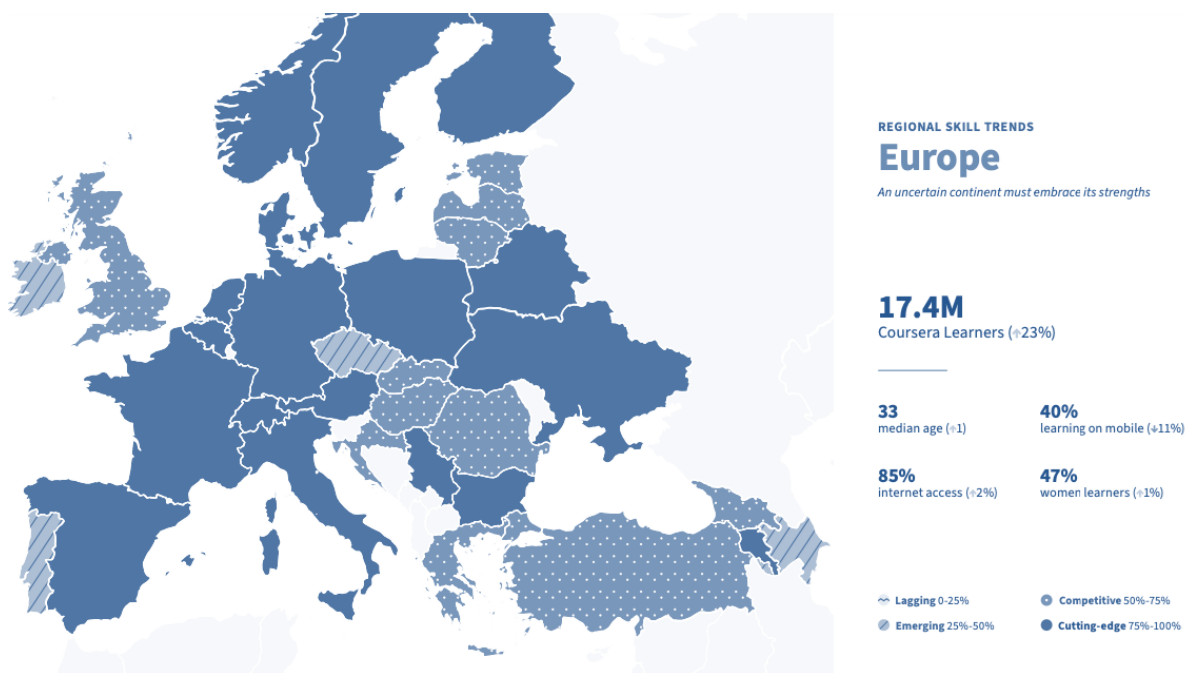


Figure 2. Europe Skills trends- Coursera skills report 2022

⁵ <https://www.coursera.org/skills-reports/global>

⁶ “The Global Talent Competitiveness Index 2021: Talent Competitiveness in Times of COVID,” INSEAD, Accenture, and the Portulans Institute.

⁷ “EU targets U.S. tech giants with a new rulebook aimed at curbing their dominance,” CNBC. 2022.

Global Rank	Rank Change	Country Name	Business	Technology	Data Science
1	0	Switzerland	99%	94%	97%
2	↑5	Denmark	94%	97%	97%
4	↑1	Belgium	98%	89%	90%
7	↑8	Netherlands	82%	90%	93%
8	↓2	Sweden	81%	87%	94%
9	↓5	Germany	92%	85%	88%
10	↑3	Bulgaria	80%	86%	95%
11	↓9	Austria	97%	74%	92%
12	↓2	Belarus	26%	99%	96%
13	↓1	Finland	65%	91%	98%
15	↓1	Italy	86%	84%	79%
16	↑9	France	68%	88%	87%
17	↓8	Norway	75%	80%	89%
19	↑11	Serbia	73%	79%	83%
20	↑7	Poland	41%	92%	80%
21	↑3	Ukraine	21%	93%	81%

Global Rank	Rank Change	Country Name	Business	Technology	Data Science
22	↑32	Armenia	44%	81%	84%
25	↑4	Spain	61%	69%	85%
27	↓11	Hungary	60%	72%	78%
28	↑8	Greece	89%	42%	69%
30	↑8	Latvia	78%	66%	53%
32	↑35	Georgia	53%	82%	49%
37	↑8	Lithuania	20%	75%	75%
38	↑10	United Kingdom	38%	60%	74%
40	↑6	Romania	46%	76%	46%
42	↑9	Estonia	25%	62%	75%
45	↓26	Croatia	64%	45%	59%
47	↑10	Turkey	52%	57%	47%
48	↓4	Slovakia	37%	55%	63%
58	↓27	Ireland	43%	38%	52%
62	↓51	Czech Republic	19%	41%	67%
66	↓38	Portugal	36%	37%	38%
74	↓5	Azerbaijan	76%	12%	25%

Figure 3. Europe Skills Top Skills Rank- Coursera skills report 2022

The question is how Europe is doing it in practice as well as how the Member States are training new professionals in key enabling technologies of Cloud computing.

50% of organisations struggle when trying to recruit qualified staff, especially for cloud computing topics. The talent is not there, and the competition is high. Cloud computing specialists with industry-recognised certifications are in high demand. According to the Global Knowledge Report for a Google Certified Professional Cloud Architect there is an average salary in the US of \$169,611 and of the same in EMEA is \$91,669 (x0,55). The main problem is that the US companies are hiring European specialists on a fully remote work setting paying (almost) US salaries, thereby making it more difficult for European companies to find cloud computing experts locally.

As with any new professional recruitment there are inherent risks of bringing on tech talent, especially professionals who are at an early stage of their career. The Bureau of Labour Statistics has consistently found that about half (50%) of college graduates leave their entry-level jobs within 2 years. This turnover can cost organizations as much as \$30,000 to backfill. And these don't include the costs of lost revenues due to understaffing and further turnover, or the cost of job advertising, recruiting, and onboarding. These risks are higher for more experienced, specialized tech talent, where salaries climb and finding qualified individuals takes even longer⁸.

How the industry deals with Cloud Computing skills shortage

According to Global knowledge, 17% of organisations will outsource their operations (IDC goes up to 40% depending on the urgency), while 56% will train their staff or hire additional staff with the necessary skills to adapt to their applications and data.

⁸ Cloud academy “Addressing the Tech Skills Gap”





Figure 4. How managers plan to handle skills gap⁹

Some companies will try to address this problem by moving to another part of the market/World, while others will absorb the challenge.

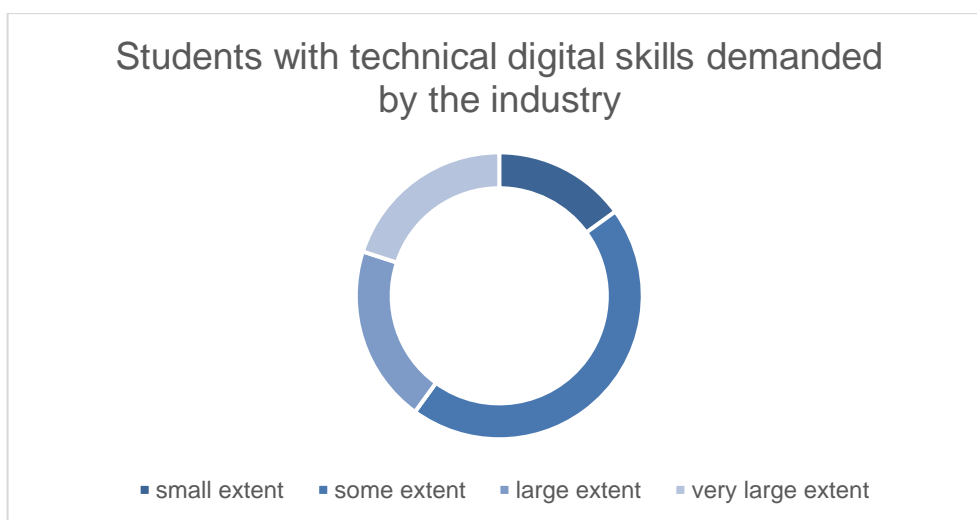


Figure 5. Students with technical digital skills demanded by the industry¹⁰

The demand for skilled tech talent has grown and supply has not kept pace. Moreover, according to the figure above, only 40% of ICT students have the right technical digital skills to meet their needs.

Recruitment in the open market is a costly and time-consuming endeavour. Upskilling a technical personal might take between 6 months and 3 years but the investment on the salary will be half of hiring an external cloud architect and their loyalty to the company is much higher and companies are able to retain their talent.

⁹ it-skills-salary-report-2020-global-knowledge-en-ww.pdf (<https://images.globalknowledge.com/wwwimages/web/salary-report/current/it-skills-salary-report-2020-global-knowledge-en-ww.pdf>)

¹⁰ Strategies to address THE DIGITAL SKILLS GAP in the EU. April 2022. Whitepaper.by AllDigital

Budget constraints might be the reason for not allocating training budget for upskilling, but this leads to a need to replace employees with necessary skills which implies an additional cost of 21% in terms of the new professional's salary¹¹.

One of the big problems regarding cloud is "Cost savings" due to the more efficient infrastructure but then one must spend a lot of money on the experts to maintain the cloud infrastructure. Therefore, at the end it might not necessarily be cheaper for the companies as cloud engineers are deemed as premium professionals (specially in SMEs). The people that have the skills are treated as "Rockstars", who have everything the companies want but these professionals should work as a team and train others, but there is still this view that they can do it all. So, once they join, they move already (talent hunters are everyday offering good opportunities to these professionals), and they do not stay long enough to make a business impact. It is far better to have a broader knowledge amongst the team so that teams could be built to solve the problems rather than focusing on finding one person who is able to solve all the problems.

Automation is an alternative to address the shortage of digital experts. Companies say they are going to go for automation and therefore need automation experts, but they don't. They are afraid of automation. Current research like the RIA H2020 Piacere¹² that enables the automation of several deployment, configuration, and management tasks, might facilitate to solve the challenges in their migration to the cloud (i.e., lack of skilled people and vendor lock-in)

The problem is that it takes a long time to get them trained with university degrees. By the time industry realises it has a problem it is often too late.

Cloud providers are pushing hard to close the skills gap and have education programmes and ambitious plans to train people. One of the challenges is vendor specific, because Cloud Service Providers sell certifications stating that the person becomes an expert in one cloud technology. When experts switch to companies which have their infrastructure based on a different provider, some of their training remains but most of it is lost. Thus, a lot of money is invested in training people, but it is a lock-in situation on a specific skill set. To address the industry demands, there is a need to have a broad scope (like a cloud licence that applies to everything). Universities, schools, and public programmes are going in that direction but it's not enough, everyone needs to move in that direction. Recently, there is an increasing attention to the role of micro-credentials due to the high proliferation of Massive Online Open Courses (MOOCs) and their impact on existing qualifications and recognition systems.

Skills gender gap

All Digital whitepaper on "EU Digital skills gap" elaborated on data from OECD Skills matter: Additional results from the Survey of Adult Skills Annex A Table 2.7, OECD Digital Economy outlook, Eurostat data ISOC_SK_DSKL_I, ICTIC Canada Q4:2021 report, the World Bank data IT:NET.BBND.B2¹³ shows how Europe has the lowest number of women in ICT even though it has one of the highest percentage in ICT specialist workforce.

11 [it-skills-salary-report-2020-global-knowledge-en-ww.pdf](https://images.globalknowledge.com/wwwimages/web/salary-report/current/it-skills-salary-report-2020-global-knowledge-en-ww.pdf)(<https://images.globalknowledge.com/wwwimages/web/salary-report/current/it-skills-salary-report-2020-global-knowledge-en-ww.pdf>)

12 Vision | Piacere (<https://www.piacere-project.eu/vision>)

13 Whitepaper "eu digital skills gap". AllDigital

Indicators	EU-27	USA	Canada	China	Japan
Population with at least basic digital skills	57%	61.5%	66.5%	61% ¹⁴	54.3%
Workforce lacking basic digital skills	37%	30.1%	32%	28.3% ¹⁵	49.2%
ICT specialists in workforce (2016)	3.7%	3.12%	3%	2.2% ¹⁶	3.8%
Percentage of ICT graduates (2018)	4.3%	8.3%	2.9%	4.7%	1.4%
Fixed broadband subscriptions (per 100 people, 2020)	36.6%	36.4%	41.8%	33.6%	93%
Percentage of women in ICT*	18.5%	31%	28%	31%	34.4%

Figure 6. Key indicators on digital skills in the EU vs other regions

More recently, IDC's research¹⁴ showed that the percentage of women in any IT department has grown up to 34% in Europe but is still behind North America and Asia. Today it is only a couple of percentage points, showing that Europe is addressing the problem, although there is still a long way to go. In terms of leadership, 37% are women and again behind the US and Asia.

	Barcelona	Londres	Madrid	Paris	Amsterdam
Web Developers	25.49	25.09	27.71	21.64	22.35
App Developers	22.16	21.93	26.16	21.89	18.41
UX/UI	50.68	37.74	50.65	47.18	32.40
CRM + ERP Consultant	25.95	30.25	20.77	20.55	22.52
Agile/Scrum	31.56	36.95	37.36	28.81	36.51
Cloud	17.63	22.08	19.27	21.41	19.40
Cybersecurity	16.51	18.26	29.17	23.18	28.11

Figure 7. Percentage of women in the sector by the city and well-established technology 2021

When it comes to **cloud computing** skills, the percentage of women who will need training to acquire the level of skills required by the industry is much higher than that of men. Results obtained in I4MS on Digital Skills and Cloud Technologies¹⁵ show that it is still between an 18% -22% within some major cities in Europe. These values are also supported by digital Hubs like 42 campuses¹⁶ which also states that

¹⁴ IDC's European Multicloud Survey, 2021 (N=925)

¹⁵ I4MS Digital Skills and cloud Technologies -Marta Portalés Oliva. Mobile World Capital Foundation

¹⁶ <https://42.fr/en/homepage/>

women participation is around 18%.

Furthermore, even if they have the same ICT training skills, a large percentage of women are in roles in companies that require technical skills not aligned with those needed for cloud computing (i.e., Web/App developers, User Experience/User Interface),

Women's participation in MOOCs now make up to 47% as of course enrolments (e.g., Coursera), a small increase from last year (45%) and two years ago (38%). Globally, women continue to lag in STEM enrolment. Getting more people, especially women, interested in jobs in the IT industry is still a major challenge.

Gaia-X Skills challenge

Gaia-X is a project initiated by Europe for Europe and beyond. Representatives from business, politics, and science from Europe and around the globe are working together, hand in hand, to create a federated and secure data infrastructure¹⁷.

Gaia-X is an initiative that develops a software framework of control and governance and implements a common set of policies and rules that can be applied to any existing cloud/ edge technology stack to obtain transparency, controllability, portability and interoperability across data and services. The framework is meant to be deployed on top of any existing cloud platform that decides to adhere to the Gaia-X standard.

A Gaia-X AISBL member states that there is a real lock-in when it comes to platform specific knowledge. Gaia-X expects this to become less of a real issue over time, as all the Gaia-X services are meant to be cloud-agnostic to be able to run on any cloud infrastructure. However, this will not weaken the role or the demand for specialists as cloud demand is quickly growing, and Europe just began moving to the cloud.

Every Gaia-X participant is aware of the skills gap, but it is not considered as one of Gaia-X's core problems. However, there are Gaia-X projects and spaces that deal with skills, education, and life-long-learning as special domains. MERLOT, POSSIBLE, DASES / Prometheus-X and some others go in that direction.

DASES¹⁸ is a collaborative platform to build the Data Space Education and Skills vertical group within the Gaia-X initiative. Currently it is hosted on Prometheus-X platform. Prometheus is an association under the French law of 1901, with the mission to promote personalized learning, lifelong training and orientation, professional integration, and research in these fields. This working group has started in early 2022.

Another interesting alternative is the MERLOT project¹⁹ (Marketplace for Lifelong educational dataspace and smart service provisioning) announced by IDSA on March 2022. The goal of MERLOT is to realize a Gaia-X lighthouse application for individual skill and competence development that integrates personal education profile data from different sources while ensuring data sovereignty. The MERLOT marketplace will be created to ensure a sustainable self-dynamic emergence of a diverse set of innovative, data-providing, yet data-sovereign smart education services. In the project, three Advanced AI Education Services demonstrate the large deployment and market potential. MERLOT thus addresses the data space competencies in the Public Sector & Education domains. The common goal is to digitalize the education sector in Europe. This will enable European citizens to have better learning outputs and gain equal access to education.

¹⁷ <https://www.data-infrastructure.eu/GAIA/Navigation/EN/Home/home.html>

¹⁸ <https://prometheus-x.org/>

¹⁹ <https://internationaldataspaces.org/educational-data-spaces-merlot-project-launched/>

CONSULTATION AND PRIORITIZATION

Cloud Computing skills training alternatives

To address the Skills gap challenge, Universities and Digital Innovation Hubs are responding to the shortage of digital experts to make sure Europe reaches at least 20 million ICT specialists by 2030.

Universities and alternative educational models

Universities are becoming the key actors of change in the digital transition: they produce the new generation of graduates who possess the skills to make use of new and advanced technologies. The unique responsibility of universities lies in training the specialists who will shape the digital transformation in the future as well as those high-skilled graduates who will work in a digitally transformed society. However, they will not ease the pain of the current market demands, as the number of ICT graduates is not high enough and their training is more theoretical than practical. Within the deliverable D3.5 a Cloud computing course offering from the main academic institutions is included. Examples like “La trobe University-Australia” that has collaborated with Amazon Web Services to offer the first Applied Cloud Technology qualification or the Cloud Computing (Hons) from Coventry University. Udacity (udacity.com) offers its School of Cloud computing with different nanodegree programs (around 4 months) to become a Cloud developer/architect, Hybrid Cloud computing engineers.

The results of the surveys conducted in the framework of the All Digital Skills Gap report²⁰ show that most industries consider that the current curricula of universities do not really cover the actual technical demands (see Figure 8). Therefore, students need additional training. This mismatch in digital skills training is due to the poor match between the skills taught to students at universities or in vocational training courses and the skills and competences needed by industry. This could be one of the factors limiting the usefulness of many initiatives aimed at reducing the skills gap. The analysis shows how some of the leading technologies prioritised by industry are not always part of university curricula. For example, courses on topics such as **cloud computing** (considered a priority by industry), or which integrate cloud computing, seem to be only partially present in university curricula, even though it represents a key technology for the future development and competitiveness of the industry at large.

As an alternative to universities, new educational models are becoming a good alternative to provide professionals with Digital skills more aligned to the current demand from the industry. One example is **42**²¹ “Integrating the latest educational innovations with the goal to empower the next leading generation of IT talent with the vision to train professionals to the jobs of tomorrow”. Data obtained from different interviews with their responsible show that the industry is already hiring 100% of the students coming from 42, even after the first year of training, with average salaries of 40K Euros as start (which is also a bit challenging to retain the students until the end of the “common-core (level 1 to 9)” and even more in the second part (Level 9 to 21). Reaching the end of the “common-core” takes around 18 months which is well aligned with the industry demand. Within the second part they could aim to obtain an RNCP title officially recognized by France Compétence (Campuses in other regions are still working on officially recognized titles).

²⁰ Whitepaper “eu digital skills gap”. AllDigital

²¹ <https://42.fr/en/what-is-42/42-program-explained/>

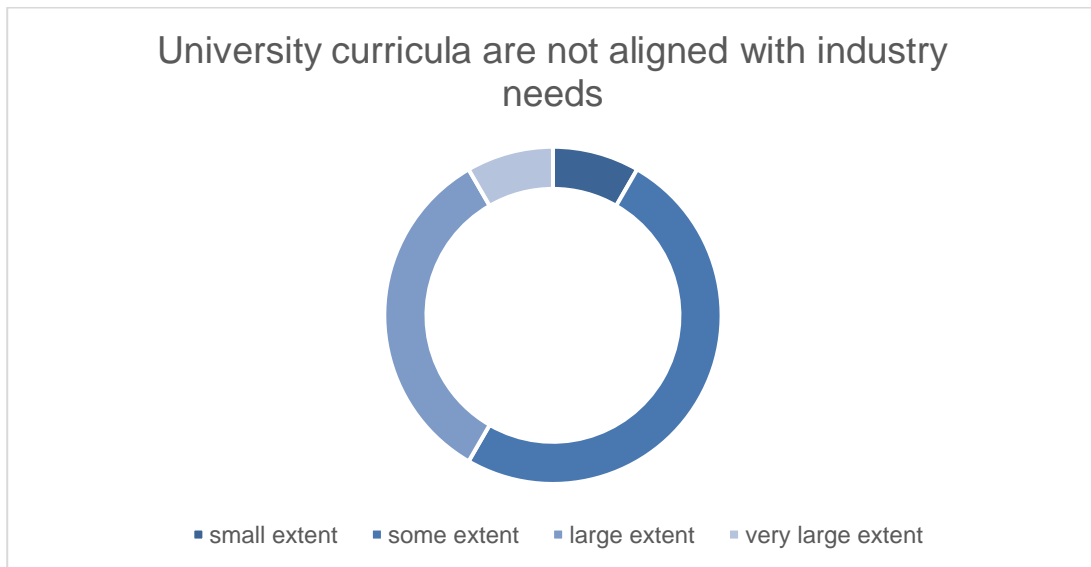


Figure 8. University curricula alignments with demands from the industry

The challenge is even greater, as the general perception is that universities are slow to adapt their curricula to keep pace with technological developments in industry (Figure 9).

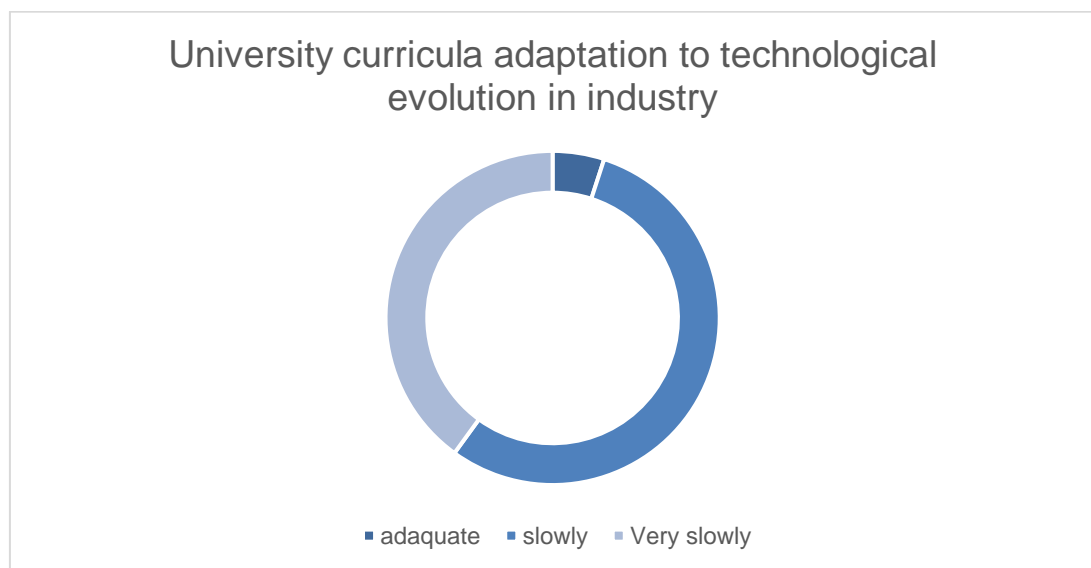


Figure 9. University curricula adaptation to technological evolution in Industry

Digital Innovation Hubs and platforms

Digital Innovation Hubs and competence centres are responsible for transferring technology and knowledge to more traditional companies and the active workforce. Digital experts make their knowledge available to support the digitalisation of traditional businesses and they make sure the employees are adequately trained to the use of advanced technologies.

The Digital Skills and Jobs Platform²² is the home of digital skills and jobs in Europe and the heart of the Digital Skills and Jobs Community. It has been created as one of the initiatives launched under the Connecting Europe Facility Programme. It will contribute to the Digital Europe Programme – an ambitious EU programme that strives to make Europe more competitive in the global digital economy through digital capacity-building and ensuring a wide use of digital technologies across the EU. Enforcing the digital skills pillar of the programme, the Platform aspires to boost the digital competencies of European society and workforce. They provide a compilation of training online courses for Cloud Computing upskilling.

Sector specific platforms like the DIGITAL SME Alliance²³ that contributes to digital upskilling with the SMEs' interests at its core. Through various activities, working groups, projects, events, and policy papers, they raise awareness about the need for SME-centred skills policy.

Massive Online Open Courses

Massive Online Open Courses (MOOCs) act as a way to obtain micro-credentials for a lifelong learning. Some examples were already included in D3.5. Cloud Academy provides a learning path to obtain independently authenticating certificates. Others, like the Cloud Native Computing Foundation (CNCF) provide different certification programs to demonstrate the competence in different domains (i.e., Kubernetes)

Industry-Recognized certifications: 93 % of IT decision-makers around the globe agree that certified employees provide added value above and beyond the cost of certification²⁴. According to Global Knowledge, certified professionals help to close organizational skill gaps, and are better at meeting client requirements, increasing productivity, reducing time to troubleshoot, and completing projects more quickly. According to Skillsoft global knowledge²⁵ the Top paying certifications are: Google Certified Professional Data Engineer, Google Certified Professional Cloud Architect, AWS Certified Solutions Architect - Associate, CRISC - Certified in Risk and Information Systems Control, CISSP - Certified Information Systems Security Professional, CISM – Certified Information Security Manager, NCP-MCI - Nutanix Certified Professional - Multi-Cloud Infrastructure, CISA - Certified Information Systems Auditor, VCP-DVC - VMware Certified Professional - Data Center Virtualization 2020, MCSE: Windows Server, Microsoft Certified: Azure Administrator Associate, CCNP Enterprise - Cisco Certified Network Professional – Enterprise, CCA-V - Citrix Certified Associate – Virtualization, CompTIA Security+.

EU response to digital skill gaps

A combination of policies, initiatives and instruments are present to address the need for skills development in the EU. The European Commission has targeted skills development through the new European Skills Agenda²⁶. The new European Skills Agenda builds upon the ten actions of the Commission's 2016 Skills Agenda. It also links to the European Digital Strategy, Industrial and Small and Medium Enterprise Strategy, Recovery Plan²⁷ for Europe and increased support for youth employment.

The European Skills Agenda includes 12 actions organized around four building blocks:

22 Platform | Digital Skills and Jobs Platform (<https://digital-skills-jobs.europa.eu/en/about/digital-skills-and-jobs-platform>)

23 European DIGITAL SME Alliance (<https://www.digitalsme.eu/>)

24 Global Knowledge, 2019 Global IT Skills and Salary Report, March 2019

25 <https://www.globalknowledge.com/us-en/resources/resource-library/articles/top-paying-certifications/#gref>

26 <https://ec.europa.eu/social/main.jsp?catId=1223>

27 https://ec.europa.eu/info/strategy/recovery-plan-europe_en

A call to join forces in a collective action:

- **Action 1:** A Pact for Skills

Actions to ensure that people have the right skills for the job market:

- **Action 2:** Strengthening skills intelligence
- **Action 3:** EU support for strategic national upskilling action
- **Action 4:** Proposal for a Council Recommendation on vocational education and training (VET)
- **Action 5:** Rolling out the European Universities Initiative and upskilling scientists
- **Action 6:** Skills to support the twin transitions
- **Action 7:** Increasing STEM graduates and fostering entrepreneurial and transversal skills
- **Action 8:** Skills for life

Tools and initiatives to support people in their lifelong learning pathways:

- **Action 9:** Initiative on individual learning accounts
- **Action 10:** A European approach to micro-credentials
- **Action 11:** New Europass platform

A framework to unlock investments in skills:

- **Action 12:** Improving the enabling framework to unlock Member States' and private investments in skills

A massive investment in skills is needed. In addition to money from enterprise and governments, the EU is prioritizing investing in people and their skills in its budget.

In parallel, the European Commission has announced the European Digital Skills Certificate (EDSC) in the Digital Education Action Plan. It is based on the European Digital Competence Framework (DigiComp). According to the feasibility study by ALL DIGITAL²⁸, the European Commission will have a pilot prototype phase in September 2022 with the launch of EDSC in 2023.

Contribution from R&D projects related to Cloud Computing

One potential contribution that could help close the skills gap in cloud computing could be the training provided by R&D projects. The reason for this is that experts and the latest developments in cloud computing technologies often work in such projects.

In addition, all projects always have a budget allocated for dissemination activities that could also be used for training activities.

²⁸ <https://all-digital.org>

Some consultations will be carried out with representatives of EU projects to understand their position on this perspective, as well as possible barriers that might prevent them from providing training to a wide audience.

One of the preliminary findings is that, although some specific training activities are already offered by EU project participants, the target audience is rather limited, and they cannot reach the general public. These contents should be made available to any technician who might need them and if possible, offer some kind of micro-credits that would allow trainees to get accreditations to justify their knowledge.

Addressing Cloud computing skills gap: classification and scoring

It is mainly depending on three aspects: the level of specialisation, the urgency, and the budget available.

Therefore, depending on the situation of the company related to the three aspects several approaches are feasible:

High Urgency, high CC Skills demands:

- **High budget:** Mostly outsourcing or hiring skilled tech talents. This is probably the situation of large companies with the need to accelerate the shift to the cloud or to drive more revenue generating activities.
- **Medium budget:** Combination of outsourcing to external companies together with ad-hoc training courses to upskill internal IT teams.
- **Low budget:** Promoting internal tech teams that go under industry-driven certification. Alternatives like Level42, Cloud Academy or CNCF might be considered.

High Urgency, Medium CC Skills demand:

- **High budget:** Large companies will probably opt for hybrid solutions like hiring a small set of external tech talents while training in parallel their own internal teams. Upskilling to build a Cloud Center of Excellence (CCoE)²⁹ could also be considered.
- **Medium budget:** Depending on the level of the skills required, they will probably opt to upskill a selected group of technical ICT staff within the company. Hiring external technical staff with a lower level of expertise (and cost) will also be considered.
- **Low budget:** Specially for medium and small companies, they will go into Digital Hubs to collaborate with other companies or use all the training resources the hub might offer.

²⁹ Understand cloud center of excellence (CCoE) functions - Cloud Adoption Framework (<https://learn.microsoft.com/en-us/azure/cloud-adoption-framework/organize/cloud-center-of-excellence>)

High Urgency, Low CC Skills demand:

- **High budget:** Usually related to the “accelerating the shift to the cloud” Ad-Hoc training courses to upskill internal groups of experts. The CCoE approach might also be considered.
- **Medium budget:** Short term Industry driven certification probably combines with improvement of technology staff competencies via in-house training (around 70% of large companies, 37% of medium size and 15% of small size)³⁰.
- **Low budget:** Intensive on-line training courses like MOOCs and collaboration with other companies at a much-limited scale.

Medium Urgency, high CC Skills demand:

- **High budget:** Might be related to “Replatform” (modernization of their Apps for IaaS) or “Rehost” (lift and shift to IaaS). Large companies will probably opt for in-house training and building CCoE teams while smaller companies will depend on the impact on their business but most with high budget will opt to hire experts.
- **Medium budget:** Combination for upskilling with less intensive in-house training together with industry-driven certification
- **Low budget:** longer on-line training courses like MOOCs or thematic “masters” and collaboration with other companies at a much-limited scale.

Medium Urgency, Medium CC Skills demand:

- **High budget:** Expand/Accelerate automation initiatives. More prone to go for in-house training and work on building a CCoE
- **Medium budget:** Hire IT engineers with relevant Master Thesis or Level 42 from academia and upskill them internally.
- **Low budget:** Hire fresh IT engineers from academia and upskill them internally.

Medium Urgency, Low CC Skills demand:

- **High budget:** Reduce the total cost of IT by simplifying IT and minimizing technical debt. Upskill IT personnel with Industry-driven certifications.
- **Medium budget:** Combination of Industry-driven certifications and micro-credentials from MOOCs courses.
- **Low budget:** Mostly only training courses to obtain micro credentials.

³⁰ Enterprises that provided training to develop/upgrade ICT skills of their personnel - Products Datasets - Eurostat (https://ec.europa.eu/eurostat/web/products-datasets/-/isoc_ske_itn2)

Low Urgency, high CC Skills demands:

- **High budget:** Collaboration with Universities to patronize Master studies including the relevant technical skills in Cloud Computing demanded by the industry.
- **Medium budget:** Engage experts from academia while doing their Master Thesis in Cloud skills relevant to the company.
- **Low budget:** Engage IT students by inviting to participate in relevant projects in the company while providing additional training.

Low urgency, Medium CC Skills demand:

- **High budget:** Collaboration with Universities to influence their Curricula to include the relevant technical skills in Cloud Computing demanded by the industry.
- **Medium budget:** Engage IT students to do their final degree project in the company while supporting them during the process.
- **Low budget:** Engage IT students by doing their practice studies in the company and provide additional training

Low urgency, Low CC Skills demand:

- **High budget:** Collaboration with different universities in the adaptation of their Curricula to include general Cloud computing topics
- **Medium budget:** Engage IT students to do their final degree project in the company
- **Low budget:** Engage IT students by doing their practice studies in the company

CONCLUSIONS

In this white paper, exploratory activities have been introduced, as well as initial findings regarding the cloud computing skills gap. A multi-source analysis has identified several current training alternatives and their potential to address the skills gap challenge.

To complete the analysis, the approaches have been taken on both the demand and supply sides.

- **On the demand side**, much of the industry is addressing the lack of professionals with cloud computing skills through external collaborations or in-house training.
- **On the supply side**, many professionals are supplementing their academic training with micro-credentials from online courses, as university curricula are slow to adapt to the technological evolution of the industry.

It is important to note that the European Union is initiating a process of certification of digital competences that will include cloud computing but with a focus on maintaining European values. Some of these activities have been presented in this whitepaper, as well as some options that have been considered interesting to bridge the digital divide.

As a corollary, a series of recommendations have been drawn up based on the three pillars that, in the opinion of experts, are fundamental for the industry: urgency, level of competence and available budget.



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