

e-Skills for Cloud Computing, Cyber-security and Green IT

A call for action!

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Foreword by DG Enterprise and Industry – why are e-skills important – where are we heading

Cloud computing is expected to play a very important role in the ICT domain over the next 10 years. The commercial uptake of cloud computing has advanced considerably. Already now, cloud computing often plays a decisive role in the planning of projects that need to be scalable without losing efficiency or reliability.

Cloud computing is an ICT technology with immense business potentials. To realise these, and to enable productivity gains, innovation and growth through cloud computing, ICT practitioners' e-skill base is crucial. If Europe is to succeed in commercial gains from cloud computing it will not least depend upon a coherent strategy for the development and upgrading of practitioners e- skills. European enterprises must have access to an e-skilled workforce and European ICT practitioners should have the right incentives and training opportunities to constantly develop and update their e-skills to meet the requirements in industry.

As one of the seven flagships initiatives of the European Strategy 2020, the communication "Digital Agenda for Europe" was adopted in May 2010. The communication sets out to define the key enabling role that the use of ICT will have to play if Europe wants to succeed in its ambitions for 2020.¹ Despite the recession, the demand for e-skills increases in the long term, especially for higher-level strategic e-skills for

innovation. E-skilled practitioners and managers are needed in all sectors, and not only in the ICT sector.²

From a policy perspective, the key challenge is to ensure that European education and training systems are sufficiently responsive to meet the future demand for e-skills in Europe.

The European Commission DG Enterprise therefore commissioned a study to Danish Technological Institute and Fraunhofer Institute to analyse how cloud computing impacts the demands for ICT practitioners e-skills, and to assess how these skill needs can best be met to the benefit of European SMEs and start-ups. The European Union must remain an attractive place to live and do business. To this end, it is necessary to continue to work at providing a rich science and technology environment and the availability of a breadth and depth of skilled labour force performing well in the latest information and communication technologies.



Mr Michel Catinat

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¹ <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:52010DC0245:EN:NOT>

² http://ec.europa.eu/enterprise/sectors/ict/files/european_eSkills_2009conference_report_en.pdf

Need for a new debate: eSkills for the cloud generation

After years of discussions and forecasts about the potential of cloud computing, the genuine value of cloud computing has now materialised. Cloud computing is at the centre of business decisions in the private as well as in the public sector. The shift to cloud computing will in fact be a key transition point for SMEs in Europe. Beyond legal issues and questions of security around cloud solutions, the key issue for Europe is whether the ICT practitioner skill base is ready.

Though numerous studies and surveys have been conducted on cloud computing, none of them has focused specifically on the skill requirements that could potentially be a vital part of European competitiveness and innovation in ICT-using companies. Consequently, the European Commission launched this project on future e-skill requirements for two important target groups, i.e. ICT practitioners and entrepreneurs, and selected Danish Technological Institute in partnership with the Fraunhofer Institute to investigate future skill requirements to maintain Europe's competitiveness.

The key focus areas of the study were:

1. Competitiveness and innovation – How does the cloud add value in SME's?
2. E-skill requirements – What is the future role of ICT practitioners?
3. Training and education – How to meet future requirements for ICT practitioners

In this context, we do not provide a detailed understanding of the technology behind cloud computing, rather a description of how it influences companies and e-skill requirements.

Looking a few years ahead, the future of ICT will be characterised by a pervasive cloud computing infrastructure as a basic backbone for companies, and in conjunction with other technologies and trends, such as mobile and social media, this will enable innovative business models and alternative service applications. Accordingly, this will place the ICT practitioners in a pivotal position in SMEs. E-skills are thus crucial for competitiveness, innovation and growth in the ICT sector as well as in related sectors. There is a need to address the e-skill needs of the cloud generation of ICT practitioners. Does Europe have the required e-skills for the cloud world?

"There is no escaping from the cloud revolution; the question is simply when it will happen!" – Participant, IBM Multipurpose Cloud Computing Centre, Poland

¹ http://files.eun.org/eskillsweek/manifesto/e-skills_manifesto.pdf



Definition of cloud computing

Cloud computing is the delivery of computing as a service rather than a product, whereby shared resources, software, and information are provided to computers and other devices as a metered service over a network.

Infrastructure – in this most basic cloud service model, cloud providers offer computers – as physical or more often as virtual machines. IaaS providers supply these resources on demand from their large pools installed in data centres.

In the platform as a service model, cloud providers deliver a computing platform and/or solution stack including operating system, programming language execution environment, database, and webserver. Application developers can develop and run their software solutions on a cloud platform without the cost and complexity of buying and managing the underlying hardware and software layers.

In the software as a service model, cloud providers install and operate application software in the cloud and cloud users access the software from cloud clients. The cloud users do not manage the cloud infrastructure and platform on which the application is running. This eliminates the need to install and run the application on the cloud user's own computers simplifying maintenance and support. What makes a cloud application different from other applications is its elasticity.



Definition of e-skills

The concept of e-skills refers to a broader categorisation of ICT skills, other skills, knowledge and competences necessary for optimising the use of ICT and working in a knowledge economy context.

Typology used by the European eSkills Forum:

ICT practitioner skills

The capabilities required for researching, developing, designing, managing, producing, consulting, marketing, selling, integrating, installing, administering, maintaining, supporting, and servicing ICT systems.

ICT user skills

The capabilities required for the effective application of ICT systems and devices by the individual ICT users. User skills cover the utilisation of common software tools and the use of specialised tools supporting business functions within industries other than the ICT industry.

E-business skills

The capabilities needed to exploit opportunities provided by ICT, notably the internet. E-business skills are strategic and related in particular to innovation management, rather than pure technology management skills, which are part of ICT practitioner skills.

Cloud computing on a global scale – facts and forecasts

Looking ahead, cloud computing is considered a key growth area for the ICT sector and as a key enabler of growth in ICT-using industries.



2013

The cloud computing marketplace will reach \$16.7B in revenue by 2013 according to a new report from the 451 Market Monitor, a market-sizing and forecasting service from The 451 Group. Including the large and well-established software-as-a-service (SaaS) category, cloud computing will grow from a revenue of \$8.7B in 2010 to \$16.7B in 2013, a compound annual growth rate (CAGR) of 24%.

2014

Deloitte is predicting cloud-based applications will replace 2.34% of enterprise IT spending in 2014 rising 14.49% in 2020. The overall conclusion is that Enterprise spending for on-premise solutions will fall, as cloud computing reduces the need for licenses, hardware and software.

2015

Gartner is predicting that the cloud system infrastructure (cloud IaaS) market will grow by 47.8% through 2015. According to IDC, by 2015, about 24% of all new business software purchases will be of service-enabled software with SaaS delivery being 13.1% of worldwide software spending. IDC further predicts that 14.4% of applications spending will be SaaS-based in the same period.

2016

Strategy Analytics predicts the SaaS market will reach \$1.2 billion in 2011 and grow to \$3.7 billion by 2016, with a five-year compound growth rate (CAGR) of 25.8 per cent. The ability to integrate business applications on smartphones, tablets and other wireless devices is predicted to accelerate SaaS adoption in the corporate business environment.

2020

Forrester forecasts that the global market for cloud computing will grow from \$40.7 billion in 2011 to more than \$241 billion in 2020. The total size of the public cloud market will grow from \$25.5 billion in 2011 to \$159.3 billion in 2020.

To place these forecasts into a perspective and understand the expectations a key questions is how does cloud computing actually add value?

Primarily because cloud computing consists of scalable ICT solutions delivered as a service whether it is infrastructure, platforms or software. Cloud solutions can be integrated into both core and non-core processes of companies. Core processes are directly linked to the business, for instance through customer management or production management, whereas non-core processes are only indirectly linked, for instance human resource management or pay roll systems. In effect, this means that cloud computing provides value to companies in four distinct areas:

Business revenue and growth

Cloud services allow the business to focus on business because the enterprise can now reduce the need to provide low-business value via high-cost labour to support commodity IT services. Companies can also reduce the amount of money spent on non-differentiated services and can allocate resources to value creating activities. Finally, cloud solutions provide a platform for collaboration that eventually accelerate time to value and reduce time to start up and complete projects.

Agility and flexibility

Cloud services provide greater flexibility on architecture and sourcing options and can be scaled up and down as needed, which then maximises efficiency and adds additional capacity when needed. The introduction of cloud solutions that integrate suppliers and customers in core business processes in real time

also means that the boundaries between the companies and the vendors and customers are blurring. The social enterprise is therefore another perspective related to the agile and flexible company using cloud solutions.

Cost reduction

Cost reduction is specifically related to reduced energy consumption and a more general shift from capital expenditure to operational expenditure. Cost reduction can also have a perspective related to employment because cloud provides the option of simplifying IT management.

Innovation

Business value is also related to innovation. Cloud computing means that SMEs avoid the need to handle time-consuming upgrades in-house, as users outsource the operation and maintenance of software and as upgrades take place automatically, the need for redesign of datacentres or IT upgrades is decreasing. Therefore, ICT practitioners can potentially focus on deploying applications or delivering new projects that drive business benefits and innovation.

Employees and managers can now conduct all types of business from wherever they choose, and this leads to a stronger emphasis on a service delivery approach to IT. Consequently, cloud solutions must be flexible and rely on service delivery. This way of creating business value means that ICT departments need to focus on the core business and not just the supporting processes. It also means that ICT practitioners will have a direct impact on business through orchestrating, aggregating and delivering services when and where they are needed.

Different SMEs – different needs

The potential is clear and the forecasts are promising, yet the readiness of European SMEs for the transition remains underexplored. The exploration of readiness must be considered taking into account the diversity of SMEs in terms of sectors, markets and operational models to explain how these promising forecasts will actually play out in SMEs.

The group of SMEs covers more than 23 million companies in Europe. Moreover, SMEs represent a great diversity of companies ranging from high-tech businesses to start-ups tuned towards international markets, more traditional companies, such as crafts companies, to family businesses. SMEs can be segmented in many different ways. However, cloud computing is not about SME segmentation. Cloud computing is more about evolving business models and how companies can pursue new opportunities through ICT. However,

any business model adopted has a strong impact on strategies for skill development, as the challenges SMEs face when coping with human resources management differ accordingly.

Three elements are important for the segmentation of SMEs, namely internationalisation, knowledge intensity and added value.

- Internationalisation: cloud solutions deliver connected scalable services and provide even small companies with global market opportunities without upfront investments.
- Skills: the number of employees with higher education as a proxy for knowledge intensity.
- Added value: gross value added per employee as a measure of the level of advanced product or services.

The figure below shows a distinction between three types of SMEs in terms of skills, internationalisation and added value.⁵ When assessing the skill need of ICT practitioners, these levels should be considered. The adoption of cloud computing by enterprises can also be segmented into three levels. The most advanced usage not only uses cloud solutions but also designs and develops applications critical to the core business. Companies that are medium level adopters use off-the-shelves cloud solutions, but have specific needs related to, for instance, logistics or data storage. The third category of companies with limited use of ICT does not have specific needs. Nevertheless, these companies



Cloud solutions offer companies an opportunity to exploit a pervasive virtual infrastructure that will support new applications and collaboration in enterprise networks in various configurations. However, there is a difference between what business managers know, what they want, and what ICT practitioners do.

Business managers' interest in cloud computing is primarily related to business growth and agility; whereas ICT practitioners focus on the technical aspects of cloud computing and how cloud computing can replace existing ICT infrastructures and technical functions. However, gaining true benefits from cloud computing requires a much tighter

connection between ICT practitioners and their role in business transformation. Innovative ICT practitioners collaborate with their business management to look beyond ICT cost calculations to the business agility that cloud computing enables – situating ICT in the core business. This potential is far from fully exploited and that is a skills issue.

The future role of the ICT practitioner

Forward-thinking ICT practitioners must deploy cloud computing as a business development tool, not just for IT but also to support business transformation and how the company can create value.

Interviews with about 100 European experts from industry, academia and start-ups made in the course of the project a clear message about the future core skills for ICT practitioners related to cloud computing. Thus, ICT practitioners in European SMEs will need skills related to security, business orientation, service level management, problem and risk management and system and service integration.

The following skills are expected to become the most demanded skills in a near cloud-enabled future:

Security

By far, security is predicted to become one of the key skills due to increase in the amount of data and the critical character of data stored in the cloud.

Service orientation

Once fully implemented and operational, the monitoring of service levels and on-going adjustments in service provision will become a key to seamless business operations.

Business orientation

Cloud computing turns the ICT practitioner into a business integrator as cloud computing is all about business solutions breaking down the traditional divide between ICT functions and the rest of the organisation. An ICT practitioner must therefore understand the overall business activities of a company to enable cloud computing to contribute to value creation.

System and service integration

When companies implement a myriad of minor cloud solutions to replace one large in-house system, integration of systems and services grows in importance.

Problem and risk management

Mitigating problems and risks are primarily related to ensuring a safe and efficient transition for SMEs from local to cloud systems.

The evolution of cloud computing presents both a great number of new security challenges. Skills related to security strategy development and daily management of security are part of the core skills of the ICT practitioner. The professional profile of the ICT practitioner also includes service-related skills.

Service skills comprise different elements such as facets formulation of service level agreements to actually delivering on-target and high-quality services. Whereas service delivery has always been the focal point of the work of the ICT practitioner, service level management has traditionally been seen as the responsibility of the CIO. As software, platforms and infrastructure increasingly move to the cloud, the ICT practitioner must be able to assess the service provided by cloud

vendors against the service requirements of the enterprise.

In essence, the ICT practitioner needs to be able to support the organisation and define the proper balance in the interplay between different efficient and safe cloud solutions whilst ensuring a simple user interface.

Although cloud computing has significant advantages for SMEs, embracing this technology without ensuring an accompanying adjustment of skills among ICT practitioners and entrepreneurs could prove risky. Cloud computing undoubtedly changes the role of the ICT practitioner, but instead of introducing an entirely new set of professional skills, it rearranges the importance of functions and skills already in the practitioner's toolbox.

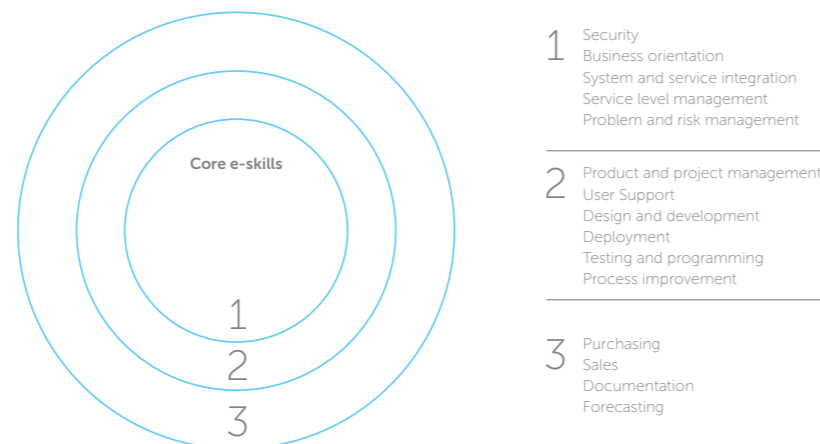


Figure – E-competences grouped according to projected future

The SME perspective

SMEs often find it difficult to overcome traditional existing external and internal barriers and obstacles for skill development, among which the most common are:

- limited financial resources;
- lack of training programmes and methods suited to the size and needs of such companies;
- lack of knowledge of training offers;
- employees' lack of motivation for further training;
- risks that trained employee may leave the company after the training completion.

Despite all these barriers, SME managers are increasingly aware that the skills of workforce are crucial for improving a firm's innovation capacity.

European cloud pioneers



Europe is not short of entrepreneurship and start-ups, but Europe is short of start-ups that grow and innovate at international competitive levels. Cloud computing is one of the answers to this paradox as cloud computing provides three important elements to start-ups. First, it means that the need for investing in ICT capital is scalable to the needs of the start-up.

Second, cloud computing services are still being developed, which leaves some room for ICT start-ups. Third, cloud computing adoption is currently taking off, meaning that there is an immature market with excess demand.

For start-ups innovating around cloud services, cloud computing holds the key to promising business opportunities and presents a supportive environment for development. Currently there are a number of promising European start-ups that are pioneers in both technology and business models. These companies are now building businesses on top of the legacy of the first generation of cloud computing.

Development and design skills?

Just as SMEs are different, skill requirements also differs in relation to cloud solutions. For example, there is a difference between SMEs or start-ups that use standard solutions and more advanced SMEs that build their businesses around in-house developed applications. For the latter, this approach not only requires identification of the skills; advanced adopters of cloud solutions also need skills related to design and development, design architecture, application design, and solutions deployment.

For the majority of start-ups, cloud computing is implemented as a utility for everyday management. For these companies cloud computing is a pathway to significantly improving their communication and business processes at a low cost. All they need is a laptop and an internet connection. Only a basic level of a broad range of ICT skills is required. However, whether developing a business around cloud computing or using it as a utility, ICT skills are not sufficient.

Understanding the core business of the start-up, how it operates as well as having knowledge about the cloud concept and available cloud solutions are important assets, as they can also form the basis for the development of innovative service solutions around the core business concept. Cloud or no cloud, an entrepreneurial mind-set – including passion, motivation, risk-willingness and die-hard belief in one's own success – is always central to in succeeding as an entrepreneur.

One fundamental difference between the start-up and the SME is that the entrepreneur is required to play a role in most of the company's activities, i.e. not only in ICT-related activities.

There are four critical success factors for successful cloud-driven entrepreneurship:

- ICT skills;
- Business-skills;
- Knowledge of the cloud concept and solutions; and
- An entrepreneurial mind-set.

Interview with Petteri Vainikka, VP Marketing, Enreach Solutions Ltd, Finland

Do cloud entrepreneurs need special skills? *"Many argue that the software business is much more turbulent and fast paced than other industries (thus requiring special skills), but I dare to disagree. As information moves faster, all industries are affected. They will all need new skills."*

What skills do cloud based companies need? *"When it comes to skills required for software business success, there are essentially two kinds (neither of which is in any way unique or different to those required in any other business):*

1. *Business skills. This is the same for any business, and can be summarised as consisting of marketing, sales, strategy, and 'doing the math'.*
2. *Engineering skills. This means having the skills to implement the business opportunity, i.e., to turn the vision into actual revenue.*

In both areas, an education offer exists on both sides of the Atlantic. For some reason, however, most software innovation tends to originate in the US."

Training the next generation of IT practitioners – European leading practise

Vendors, not-for-profits, and universities have all begun to offer certificates related to IT skills and cloud computing. To gather insight into the best practises across Europe, the project conducted eight case studies with particular focus on SMEs and entrepreneurs as part of the study.

Key Findings

Industry-led training is often criticised for not being vendor neutral but fostering the business of a certain company.

The shift to cloud computing, security or green IT is clearly a business decision. Development of curriculum needs to consider this and integrate technical know-how and business skills.

In the fast-changing world of IT, certificates have become a de-facto standard for certain job families in the ICT security profession.

Participants highlighted that they would welcome better alignment between cloud, security and green IT certifications.

Education systems are often criticised for being slow to adapt, but the formal education systems need to strike a balance between the medium term viability of the skills embedded in the programmes they offer, and the ever changing requirements of industry

All case studies highlighted the importance of global networks and, in particular, strong links to the US R&D communities. The US is seen as a clear leader in cloud computing.

The vendor industry and third sector course providers operate in partnership with both private and public educational providers.

Moving Europe's e-skills agenda ahead

Vendor neutrality is important for the job mobility of IT practitioners.

Courses focus too much on technical skills. Leaders need to speak the language of boardrooms.

Strong certificates need to respond to and shape the market.

The future needs holistic thinking between cloud, security and green IT from course providers

Industry can fill an important gap that is always going to be there in rapidly changing technology fields such as ICT if proper lifelong learning policies are in place.

Strive to lead, as the US is soaring ahead.

The business case behind cloud courses is in building strong collaborative partnerships.

It is early days for cloud computing courses, but it is promising that different players have been quick to respond. There is much work to be done to ensure that European IT professionals can and will acquire the skills necessary to ensure that Europe remains competitive in the IT and cloud computing environment.

The study analysed eight leading training courses for cloud computing, security and green IT. All courses have recently experienced growing demands

"It was great to get an insight into how cloud technologies work and to apply the skills learnt during this virtual internship in my final years of studies. It has helped me prioritise what skills I need for the job market after I graduate."

– Participant, IBM Multipurpose Cloud Computing Centre, Poland

Cisco Networking Academy – Security

Certifications, Global

The CCNA Security course from Cisco Networking Academy provides a pathway for individuals who want to prepare for new roles in network security or enhance their CCNA-level skill set. CCNA Security integrates practical skills into the technical curriculum to create a learning experience for success in future educational, entrepreneurial, and occupational endeavours.

Cloud Computing Security Knowledge Course (CCSK), Alexandra Institute, Denmark

In 2010, the Alexandra Institute allied with the Cloud Security Alliance. Together, the two organisations designed the industry's first user certification programme for secure cloud computing. The CCSK is a low-cost certification that establishes a robust baseline of cloud security knowledge. Combined with existing professional certifications, it helps provide necessary assurance of user competency.

CompTIA Green IT, Global

The CompTIA Green IT Certificate provides students with the knowledge and know-how to implement and put environmentally sound techniques into practice in an organisation's IT infrastructure.

The International Information Systems Security Certification Consortium, Inc. [(ISC)2®], Systems Security Certified Practitioner (SSCP®), UK/US

The International Information Systems Security Certification Consortium, Inc., (ISC)2®, is the global leader in training and certifying information security professionals throughout their careers. Its certifications have won numerous awards and global recognition. The course "Systems Security Certified Practitioner" (SSCP) is ideal for those working in cloud environments.

Multipurpose Cloud Computing Centre, Poland

Wroclaw University of Technology is the first university to become part of IBM's Multipurpose Cloud Computing Centre – a global initiative available to all institutes of higher education from 2010. The university has created a new academic curriculum, making cloud-focused courses available to more than 1500 students.

British Computer Society (BCS) - The Chartered Institute for IT, intermediate certificate in the EU Code of Conduct for Data Centres, UK/Global

This certification allows ICT practitioners to learn how to develop an organisation's green strategy by effective use of energy by software, ICT systems and support infrastructure, both mechanical and electrical systems within the data centre.

CEFRIEL, Apprenticeship „Centralised system for cloud computing”, Italy

This programme aims to offer 25 young graduates the opportunity to combine classroom training at master level and professional experience as the programme is designed and organised in collaboration with leading companies in the ICT sector and the municipality of Milano.

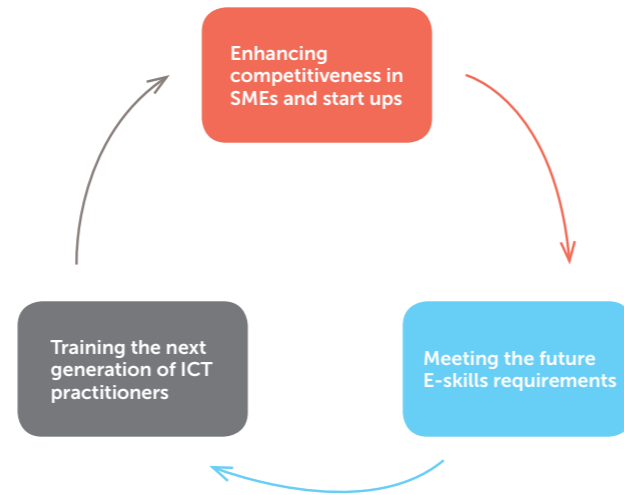
Microsoft Cloud Services Training and Certification, Global

Microsoft Cloud Computing Services provides a set of new curricula, training resources and skill mapping in regards to their training and certification. Microsoft has incorporated skilling for the cloud into a roadmap that corresponds with associated cloud roles, this is then being utilised in collaboration with academic institutions as an engine for growth in this field.

Call for Action

Cloud computing has become an essential factor in the provision of ICT systems in small and large enterprises. This has again linked e-skills closely to competitiveness, innovation and growth in Europe as the uptake of cloud computing depends on ICT practitioners and their skills.

Therefore, policy actions must adopt a systemic approach that ties together in a coherent strategy targeting SMEs and start-ups, the existing workforce and their e-skill requirements, as well as the next generation of ICT practitioners.



Enhancing European competitiveness through SMEs and start ups

Actions based on knowledge and facts

Designing actions, campaigning and monitoring trends to create factual knowledge about cloud computing uptake are necessary. The key questions are what kinds of cloud solutions are being adopted? What characterises the SMEs? What are the barriers for uptake?

Cloud computing uptake, barriers and differences between SMEs will provide valuable knowledge for evidence-based actions and campaigns targeting SMEs. The European Commission plays an important role in monitoring the uptake and the intersection of e-skills, cloud computing and SMEs complementary to the efforts of national ministries for industry and innovation policy.

Break down barriers that hinder SME uptake of cloud solutions

Cloud technology offers new opportunities to SMEs. Barriers that hinder the uptake of cloud solutions among SMEs must be addressed, while at the same time creating awareness of how cloud solutions can enhance SME competitiveness and effectiveness. The primary stakeholders

are the Member States and industry associations.

Different SMEs – different needs

Cloud computing is still unknown territory for the majority of European SMEs. Dissemination of cloud examples from a business perspective is needed and must be integrated into SME initiatives at national and local levels. The communication of best practice and pioneering companies has two target groups, i.e. managers and ICT practitioners, and the channels to reach these groups differ.

Outreach and dissemination strategies must distinguish between advanced and mature SMEs on the one side and less advanced SMEs on the other side to carry forward the message of cloud computing opportunities. This should also be reflected in the communication towards SMEs. A granular SME approach that has a narrow subsector perspective, which the SMEs can relate to, will enhance the impact of the communication.

What works for start-ups?

What do we know about successful start-ups? There is a need for data on start-up programmes and their impact on growth and employment creation. The European Commission could support the dissemination of successful Member State

programme interventions. The design of start-up programmes should mirror the strengths and specific characteristics of national and regional innovation systems to have maximum impact and avoid duplication.

The recommendation is to increase and support networks between entrepreneurs, universities, RTOs, chambers of commerce (which play a major role in some countries), innovation partners, and business angels. Primary stakeholders are both at European level and Member State level, but industry associations could operate the initiative. The European Commission could play an enabling role in disseminating promising practices across Member States.

Meeting future e-skill requirements

European competence framework must adopt technological developments

From a user perspective, a common competence framework is important to ensure transparency, alignment, and guidelines for employers and employees. This means that the required quality for a common framework includes robustness against changes over time as

well as ability to absorb new skills. The study revealed difficulties in using the European e-Competence Framework (e-CF) for business related ICT skills. The role of ICT practitioners is changing and a common framework is necessary to absorb these changes. The European Commission is action-oriented in development and promotion of a European competence framework, and it is important that such a framework can embrace changes in skill profiles for ICT practitioners.

Furthermore, since ICT certifications are an important avenue to upgrading ICT practitioners' skills it is important to ensure that the various e-skills framework that are developed over time can be aligned to the European qualification frameworks and the national implementation of these to ensure that lifelong learners do not get stuck in educational dead-ends.

Continuous monitoring of e-skill requirements

Because of the disruptive nature of cloud technology, and because cloud adoption has only recently reached European enterprises, continuous monitoring of its impact is imperative.

Previous efforts have concentrated on assessing the impact of global sourcing on ICT jobs. Global sourcing is still highly relevant, but cloud computing adds another aspect to the discussion around sourcing. Forecasting in this respect also needs to include short-term and medium-term demand and critical uncertainties regarding the potential impact of cloud as a disruptive technological trend.

This recommendation primarily concerns the European Commission and the involved partners in the e-CF framework and other related skill frameworks as well as those policy makers involved in developing and supporting public ICT-related innovation policies.

Lifelong learning as a key element

Technologies such as cloud computing have a major impact on skill changes in the labour market- and thus on employability and labour market mobility. Lifelong

learning offers companies and individuals opportunities to cope with technological change. Nevertheless, lifelong learning is not the obvious reality and pathway to be pursued by all. In particular for SMEs in traditional sectors the business case for investing in cloud computing has to be made. For individuals it can also be a matter of incentive, such as adults with family responsibilities not least taking or having the time to invest in training in connection with cloud computing and e-skills.

Monitoring of training investments, adopted training models, and the impact on actual e-skills capabilities are necessary components to ensure efficiency and effectiveness in lifelong learning investments. Monitoring must be a collaborative effort between the Member States and the EU, also to ensure policy learning between Member States and to pave the way for evidence-based policy-making.

Training the next generation of ICT practitioners

Training and education is an important part of the supply-demand equation, but more emphasis could be placed on training outputs and outcomes as part of evidence-based e-skills strategies. It is therefore recommended that Member States in cooperation with the European Commission develop appropriate output and outcome-based indicators and integrate these into the monitoring of e-skills measures. Longitudinal data can contribute substantially to targeted policy interventions and quality development at the institutional level. The primary stakeholders are Member States and educational institutions.

Promotion of non-vendor specific certifications to secure open standards and platforms.

Certificates must be based on global standards. This also means continuous adaptation of courses and curricula to the changing job roles for ICT practitioners. The EU Commission is in a central

position to disseminate ever evolving and emerging training needs as well as relevant educational and training best practice.

The EU Commission plays an enabling role in ensuring widely recognised qualifications and paving the way for internationally recognised certifications.

Bridging the gap between the speed of change in ICT technologies and the response to changing skill needs

Bridging the formal supply and industry certifications is vital for a dynamic and relevant offer of ICT education and training programmes. One of the key findings in the analysis of skills is that skills related to ensuring secure ICT systems across European SMEs rank close to the top today. Moreover, these skills are projected to climb even further up the ladder of importance to become the far most desired skills just a few years from now. This reflects the issues in the technology section around security and data protection. Cloud computing raises concerns in SMEs, and education and training that match these concerns are not fully available. It is important that education and training offers be developed within the ordinary as well as the continuing education and training systems that integrate the crosscutting functionalities of cloud computing, cyber security and green IT.

For the more technologically specific courses that may have a short shelf life, vendor neutral certifications can be a valuable solution to a comprehensive education and training programme pertaining to all the different aspects of cloud computing.

Casestudies

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Cisco Networking Academy: The 'World's Largest Classroom

The Cisco Networking Academy offers both online and classroom-based courses using a blended learning approach involving interactive tools, instructor-led classes, stimulation and virtualisation and hands on learning activities. The Cisco Certified Network Associate (CCNA) is one of the four networking certificates most in demand, as 58 % of CIOs polled for the "Hiring Index" ranked network administration as the technical skill set in greatest demand within their IT departments, further demonstrating the marketability of professionals with the CCNA credential.⁷

The Cisco Networking Academy offers a diverse curricula portfolio:

A great opportunity for educational institutions to stay on the forefront of the skill needs in the industry

Cisco collaborates with public and private institutions including schools, universities, businesses, non-profits, and government organisations, ensuring that the programme content is top-notch quality and that instruction content fits real world needs.

Certification - an important driver, both for students and employers

The courses are constantly aligned with international Cisco certifications, and the results of the students' training are generally certified, which makes the programme very attractive - international certification is highly valued by employers; and students are well aware of this fact.



Microsoft Cloud Services: Starting with Customers

The skill paths defined in cloud courses in Microsoft Learning are focused on future customer and business needs in the context of Microsoft products and solutions. Microsoft's certification programme offers an array of products and services at varying levels corresponding to participants' previous skills. Course offers are provided in collaboration with both commercial training and academic institutions as an engine for growth in this field.

Continuous Adaptation

Microsoft Learning will introduce new certifications over the next year that integrate cloud skills into IT functions. As it does today, it will continue to focus on the security skills of the solutions on which it is certifying. Instead of stand-alone credentials focused on security, Microsoft learning chooses to embed security as a continuous theme and topic in all solutions taught and validated in their training and certifications.

Working towards cloud skills among entrepreneurs and the young

Microsoft supports a broad base for customer readiness in cloud. For example, Microsoft offers a global programme called BizSpark that helps software start-ups succeed by giving them access to Microsoft software development tools, connecting them with key industry players, including investors, and providing marketing visibility to help entrepreneurs starting a business. Microsoft DreamSpark is a global programme that provides students and educators with Microsoft software programs free of charge.



Danish Technological Institute (DTI) is an independent, not-for-profit institution approved by the Danish authorities to provide technological services to business and the community. The institute's mission is to promote growth by improving interaction and encourage synergy between research, business, and the community.

The institute, founded as an independent institution in 1906, is one of the oldest of its type in the world. The institute has more than 850 employees, making it one of the world's largest private institutions to supply approved technological services such as consultancy, tests, certification, and training for companies and public-sector organisations.

The Centre for Policy and Business Analysis at Danish Technological Institute has 25 employees. The primary focus of the centre's activities is to contribute to evidence-based policy-making through analyses and evaluations within three broad themes:

- information society and technology policies;
- education, lifelong learning, and labour market policies; and
- innovation systems and competitiveness.

In the design of policy studies and evaluations, the centre often uses interdisciplinary methods, both quantitative and qualitative, and semi-experimental models that can assist in bridging research, policy formulation and innovation in the business environment. Strategic implications for business and policy formulation are often discussed and facilitated through web-tools and scenario methods to link policy and practice.



Fraunhofer is Europe's largest application-oriented research organisation. Our research efforts are geared entirely to people's needs: health, security, communication, energy and the environment. As a result, the work undertaken by our researchers and developers has a significant impact on people's lives. We are creative. We shape technology. We design products. We improve methods and techniques. We open up new vistas. In short, we forge the future.

The contribution to the e-skills study was conducted by the Stuttgart-based Fraunhofer Institute for Industrial Engineering (IAO). The basis for all work undertaken at the Fraunhofer IAO is a deep conviction that business success in a globalised arena is contingent on an ability to leverage new high-tech potentials profitably. In order to optimally exploit these opportunities, companies must be capable of developing and implementing customer and employee-oriented technologies faster than their competitors can.

Work organisation concepts must be simultaneously innovative and anthropocentric. A systematic design, in other words, is the outcome of pooled management and technical expertise. This holistic perspective when it comes to project processing ensures that equal consideration is given to commercial success, employees' interests and social consequences.



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