

# ***e-SKILLS IN EUROPE***

## **ROMANIA**

### **COUNTRY REPORT**

JANUARY 2014

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# 1 Overview

Between 2003 and 2009 the number of software and IT service companies increased by 8,000 in Romania, which is an indicator of the growing ICT labour market in the country. The situation has offered good opportunities for ICT graduates and professionals to find jobs. At the same time, European Computer Driving Licence (ECDL) Romania set up a network of 370 training centres and issued over 20,000 certificates and 53,000 skill cards. The ECDL was especially important for e-skills development in the public sector, which had long suffered from a substantial lack of staff digital literacy.

Since 2003 the training offer for vocational education and training (VET), continuous vocational training (CVT) and higher education has strongly diversified, with a trend towards more practical oriented training for ICT. All study programmes in the framework of the Romanian Ministry of Education are evaluated and approved by quality assurance agencies (ARACIP for secondary education and ARACIS for higher education) according to specific criteria and performance indicators.

Since 2007, there have been various projects funded by Structural Operational Programmes – mostly for human resource development (POS DRU), enabling ICT qualification improvement of persons occupied in various sectors, including administration, education, transport and agriculture. The need for qualification enhancement measures is partly due to the spread of e-commerce, e-procurement (which is now compulsory for the public sector and for private companies using public funds) and e-government. All this requires highly skilled ICT application developers and users. That is why study programmes for ICT in high schools and universities have become more and more demanded year by year. Training for teachers and students has been intensified through Structural Funds projects.

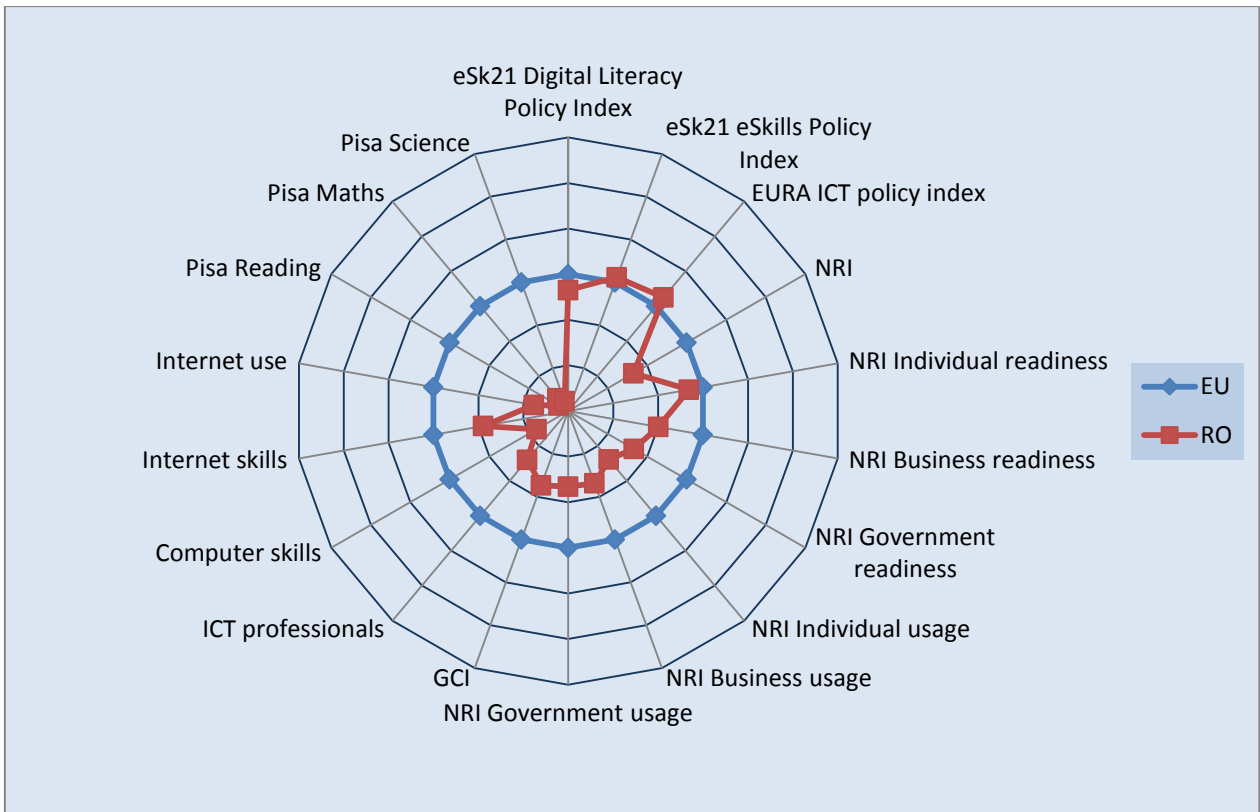
A number of major challenges and obstacles exist. The education system in Romania is still not adapted properly to the knowledge-based economy. It is undergoing a deep transformation induced by the qualification approach brought by EQF and the National Qualification Framework (CNC), both for secondary and higher education (CNCIS). The goal is for curricula to focus on practical matters and applications rather than on transfer of theoretical knowledge; closer ties with the societal and economic sectors are sought.

Due to the lack of national policies on e-skills development and the lack of a modern education strategy, EU-initiated measures such as the eSkills Week and philanthropist-funded schemes such as the BiblioNet programme tend to be the only initiatives focusing explicitly on e-skills. These initiatives have reached thousands of young people and hundreds of organisations, but are not properly integrated in strategic policy making. They increase awareness on ICT-related skills required on the labour market of the future, and try to go some way towards preparing individuals for it, e.g. through free courses on e-aptitudini.ro and ICT knowledge competitions.

A number of national stakeholders (ARACIS, ARACIP CNCIS, professional associations) and partners from the education system (schools, universities) are working on new approaches to address the e-skills challenge and to implement these through funded projects.

## 2 Indicators on innovation, competitiveness and ICT skills

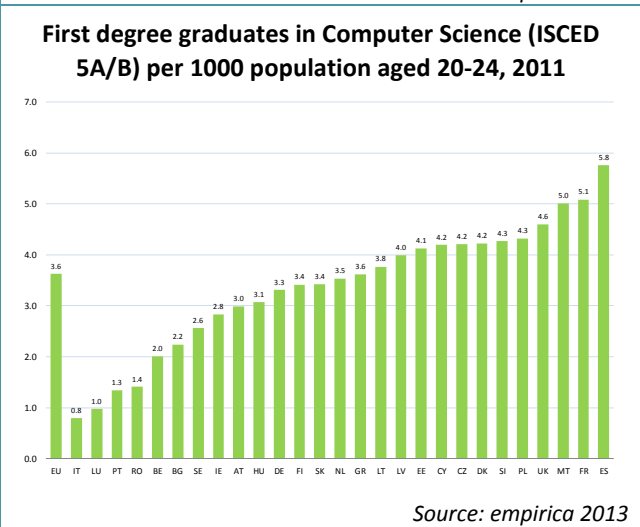
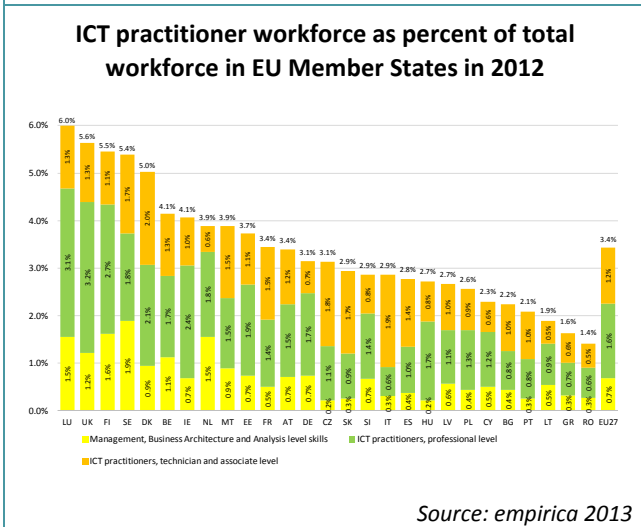
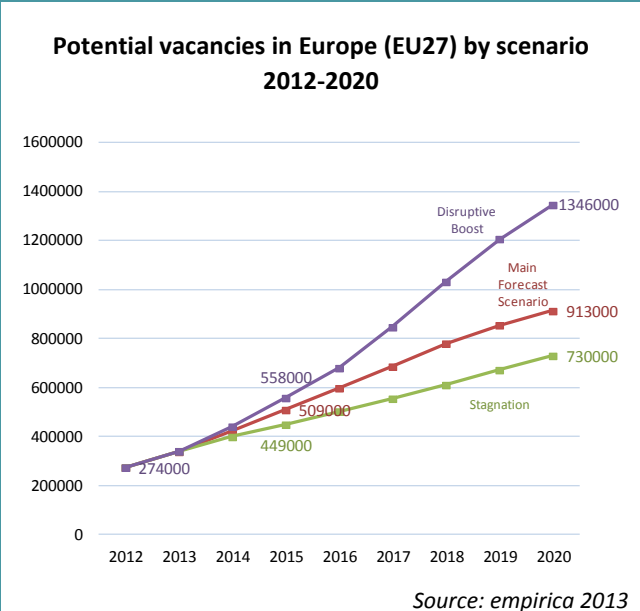
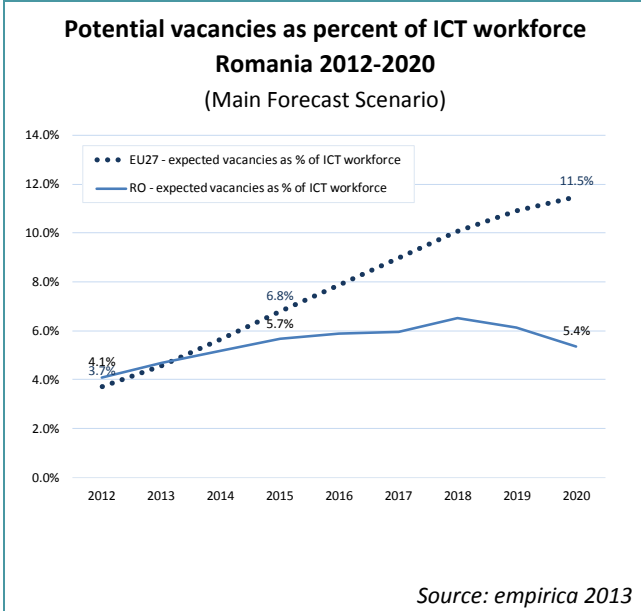
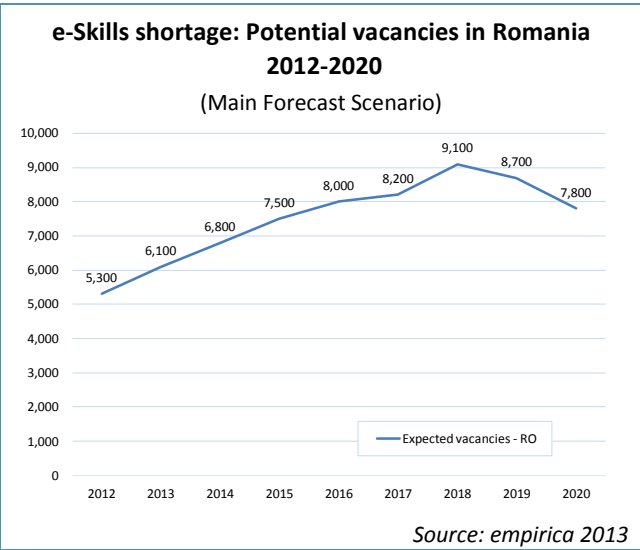
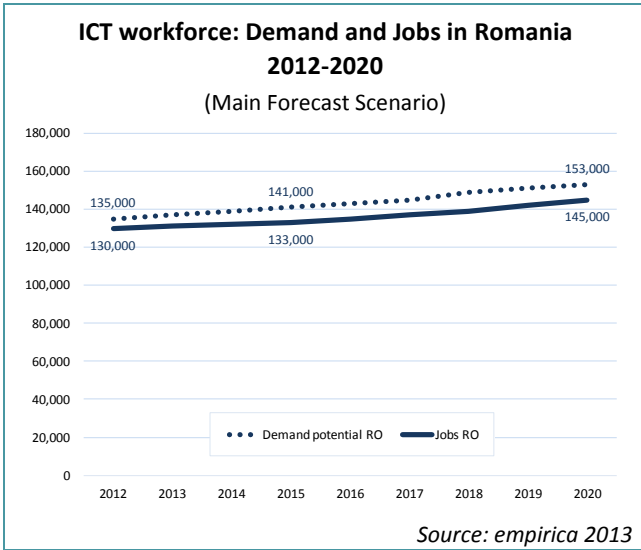
Romania						
	Score 2009/2010	Rank 2009/2010	Score 2011/2012	EU27 Rank 2011/2012	Change (Rank)	Comment
eSkills21 study: 'e-skills' index 2010	2.5	10				Max.: 5.0
eSkills21 study: 'Digital literacy' index 2010	2.5	15				Max.: 9.0
EuRA e-skills index	3.5	12				Max.: 5.0
ICT practitioners in % of total employment 2012			1.40%	27		EU average: 3.43%
Digital literacy skills of the population 2009/11:						
• Individuals with high level of computer skills	9%	26	10%	27	↓	EU average: 28.52%
• Individuals with high level of Internet skills	2%	27	7%	25	↑	EU average: 13.67%
• Individuals using the Internet (last three months)	33%	27	40%	25	↑	EU average: 71.33%
Global Competitiveness Index (GCI) 2010/12	4.1	24	4.08	26	↓	Max.: 5.61 EU median: 4.52
Networked Readiness Index (NRI) 2010/12	4.0	25	3.81	25	↔	Max.: 5.6. EU median: 4.5
• Individual readiness	5.55	22	4.93	18	↑	
• Business readiness	4.47	24	3.98	22	↑	
• Government readiness	3.99	21	3.4	26	↓	
• Individual usage	3.16	23	4.02	27	↓	
• Business usage	4.28	25	2.98	25	↔	
• Government usage	3.99	21	3.25	24	↓	
PISA scores (2009) in:						
• Mathematics	427	25				EU median: 493
• Science	428	25				EU median: 498
• Reading	424	25				EU median: 489



### 3 E-skills demand and supply forecasts 2012 – 2015 - 2020

Romania			
	RO	Rank EU27	EU27
ICT practitioner workforce 2012	130,000	14	7,403,000
ICT practitioner workforce 2012 as percent of total workforce	1.4%	27	3.4%
Assumed excess demand 2012	5,300	13	274,000
Forecast excess demand 2015	7,500	13	509,000
Forecast excess demand 2020	7,800	14	913,000
Forecast ICT practitioner jobs 2015	133,000	13	7,503,000
Forecast ICT practitioner jobs 2020	145,000	13	7,950,000
Workers 2012 - Management, business architecture and analysis level	25,000	12	1,477,000
... as percent of total workforce	0.3%	23	0.7%
Workers 2012 - ICT practitioners, professional level	59,000	13	3,393,000
... as percent of total workforce	0.6%	26	1.6%
Workers 2012 - ICT practitioners, technician and associate level	46,000	13	2,532,000
... as percent of total workforce	0.5%	26	1.2%
Growth core ICT workforce 2001-2010	n/a	n/a	3.0%
Growth core ICT workforce 2008-2010	0.5%	18	2.6%
Growth core ICT workforce 2011-2012	6.1%	11	3.9%
Growth broad ICT workforce 2011-2012	6.4%	9	1.8%
ISCED 5A/B first degree graduates in Computer Science, 2011	2,013	10	113,000
... graduates per 1000 population aged 20-24	1.4	24	3.6
... graduates 2011 as percent of 2006 (= peak EU)	58%	26	88%
Vocational training graduates in Computer Science, 2011	384	17	67,000

Sources and notes: see annex.



## 4 Policy and major stakeholders initiatives

The national **e-Romania Strategy** aims at state modernisation through boosting uptake of ICT by citizens, companies and the public sector. ICT spending on set-up of online public services was € 90 million in 2010 and € 190 million over the period 2011-2013. e-Romania is to allow citizens to communicate with a unified administration; information will be conveyed electronically between all the concerned institutions.

The new **Government Programme 2013-2016** includes ambitious plans for ICT-related development of the country, such as the following:

- Extension of training programmes for Romanian citizens in ICT user skills, with emphasis on disadvantaged groups;
- Integration of innovative Web 2.0 methods in education and development of online educational learning resources for use throughout the education system;
- Provision of continuous ICT training programmes for teachers;
- Organisation of national competitions for educational eContent in schools;
- Achieving full computerisation of educational establishments and services.

Policy action for improving the country's **ICT infrastructure** is in much demand. The **Intermediary Organism for the Promotion of Information Society in Romania** (OIPSI) funded a total of 678 projects with an overall budget of € 306.94 million. A major share of the budget was spent on hooking up 2,446 schools to broadband Internet.

In 28 communities new authorised training centres for IT competences were set up in Public Internet Access Points (PIAPs) as part of the **Knowledge Based Economy** (EBC) project. 10% of these employ professional training staff. In future, experts that helped in setting up the centres will continue assisting them, e.g. by training local staff of these centres in competence building and certification. This is expected to support communities to strengthen their human resources, arguably the most important factor in self-sustaining regional development. See next section for a description of the Knowledge Based Economy project.

Romania benefits from financial support from the **Structural Funds**, especially for programmes that help modernise the economy, equip human resources with the skills required for a knowledge-based economy, and address structural problems on the labour market.

The **Sectoral Operational Programme Human Resources Development** (SOP HRD) is the basis for major reforms in the human resources field, co-funded through the European Social Fund within the framework of "Convergence" objective for the programming period 2007-2013. Embedded in the **National Development Plan 2007-2013** and in line with the Priorities of the **National Strategic Reference Framework**, SOP HRD is an important instrument in supporting economic development and structural change, including development of e-skills. Investments in human capital are intended to contribute to long-term increases in productivity. A highly qualified labour force is essential for a competitive and dynamic economy; this includes the capability to respond flexibly to market changes and to the possibilities opened up by new technologies. Romania's active labour market policy has the goal to increase the adaptability of labour force.

**Use of ICT in school education** is not very developed in Romania when compared to other EU Member States. To mitigate the situation, training programmes for teaching staff which take place in the context of the SOP HRD will include a compulsory ICT module, aiming at developing digital competences and the ability to use ICT in teaching activities. These approaches of the SOP HRD will provide the ground for complementary actions under Priority Axis 3, "ICT for private and public sectors" of the other Sectoral Operational Programme, i.e. the "SOP Economic Competitiveness".



The “**Economy Based on Knowledge**” programme ran until 2012. It comprised measures for boosting ICT usage in rural schools and libraries. Overall, 1,000 teachers and librarians from 229 schools participated in the project, thereby increasing take-up of digital technologies in the educational process. Participants engaged in training measures in how to combine traditional and interactive, ICT-enabled teaching methods including Open Educational Resources and the Web 2.0.

In the absence of strong policy-leadership by the government, the ICT industry has played an important part in the e-skills domain in Romania. While the Ministries for Information Society and the Ministry of Education have been fully supportive for e-skills initiatives, private stakeholders (companies such as Intel, Microsoft, HP, IBM, Siveco, and NGO’s, such as APDETIC, a member of Digitaleurope, Junior Achievement, Irex) have taken the lead and conducted a series of successful programs and national awareness campaigns dedicated to students and SME’s (2010, 2011 and 2013).

The European **e-Skills Weeks** have been welcomed as an opportunity to design responses to the perceived gap in ICT practitioners in the country and to the mismatch between the established educational system and the present needs for qualified specialists in the e-skills domain. In particular, Romania's ICT industry used the e-Skills Week to create awareness about e-skills in general and to promote careers in ICT to Romania's young people. Conferences, seminars and online courses were organized, and pupils as well as students were invited to make on-site visits to ICT companies. The biggest e-Skills Week campaign took place in late 2009 / early 2010 and was organised locally by APDETIC, the **Association of Producers and Distributors of ICT Equipment**.

**Oracle Academy Romania** has already supported 95,000 students and trained over 1,900 teachers in ICT user skills as well as generic programming skills used across all of the ICT sector. In 2012, the Oracle Academy announced a new Java curriculum which was first piloted successfully in the U.K. and Romania. The company is operating several global support centres in Romania, by which it has created about 2,000 jobs. Oracle claims that its efforts in education have supported Romania to develop the skilled workforce that has been central to its recent economic expansion.

**Siveco**, a leading educational software company, manages 28 centres all over Romania for training people in ICT skills. About 5,000 certifications have been awarded since 2009.

Internship programmes offered to ICT students mainly by transnational companies are another important source of ICT practitioner skills in the country. The most relevant are:

- The **HP Internship Programme** is dedicated to last year college students. It includes a wide job offer in different departments like software development, consulting, outsourcing, logistics, procurement and sales in Bucharest and Cluj-Napoca. It combines theory and practice and provides integration in the real business world for hundreds of students each year.
- The **IBM Internship Programme** aims to expose students to IBM culture and values, support business development and encourage graduate careers. The main benefits for students are career development planning, technical, foreign languages and soft skills acquiring and full time employment opportunities after successfully completing the programme. Competencies cover business analytics and optimization, enterprise applications, product lifecycle management and application development and maintenance.

Romania has also benefited from philanthropists who have helped fund investments in ICT infrastructure and related training measures. The **BiblioNet** programme is one of the most important investments for facilitating public Internet access and providing ICT user skills to users of public libraries in Romania. BiblioNet is a 5-year project with a budget of \$ 26.9 million, financed by the Bill & Melinda Gates Foundation and coordinated by the International Research & Exchanges Board Foundation (IREX). Through a competitive selection process, more than 1,600 public Romanian libraries will receive computers for public Internet access and over 3,000 librarians will attend training lectures on technology resources.

**E-centers** are free information technology access points, established in the framework of the "Unlimited Potential" social responsibility programme from Microsoft, in cooperation with public administration and a number of local non-governmental organisations in Romania. Training programmes help develop ICT skills, exploit opportunities for online business, and support rural development.

#### Summary Assessment of Romanian e-Skills Activities: ●●

Very little policy activity apart from participation in the European e-Skills Week, to which Romanian stakeholder have shown strong commitment.

#### Summary Assessment of Romanian Digital Literacy Activities: ●●●

The Knowledge Based Economy project (KBE) has proven to be very effective in spreading ICT user skills among the Romanian population, making good use of resources by targeting people who can act as multipliers: teachers, librarians, entrepreneurs and public sector workers.

#### Summary Assessment of Romanian e-Leadership & Digital Entrepreneurship activities: ●

No initiatives identified.

Like in the precursor study<sup>1</sup> the assessment of the information gathered resulted in two activity indices, one for digital literacy and one for e-skills computed for each country. These were computed based on data from 2009 and 2013. The e-leadership skills activity index was computed only for 2013, as no data had been collected on this topic in 2009. In the following the focus will be on the e-skills activity index; we first mapped the e-skills activity index values against the Networked Readiness Index (NRI)<sup>2</sup> for each of the 27 Member States.

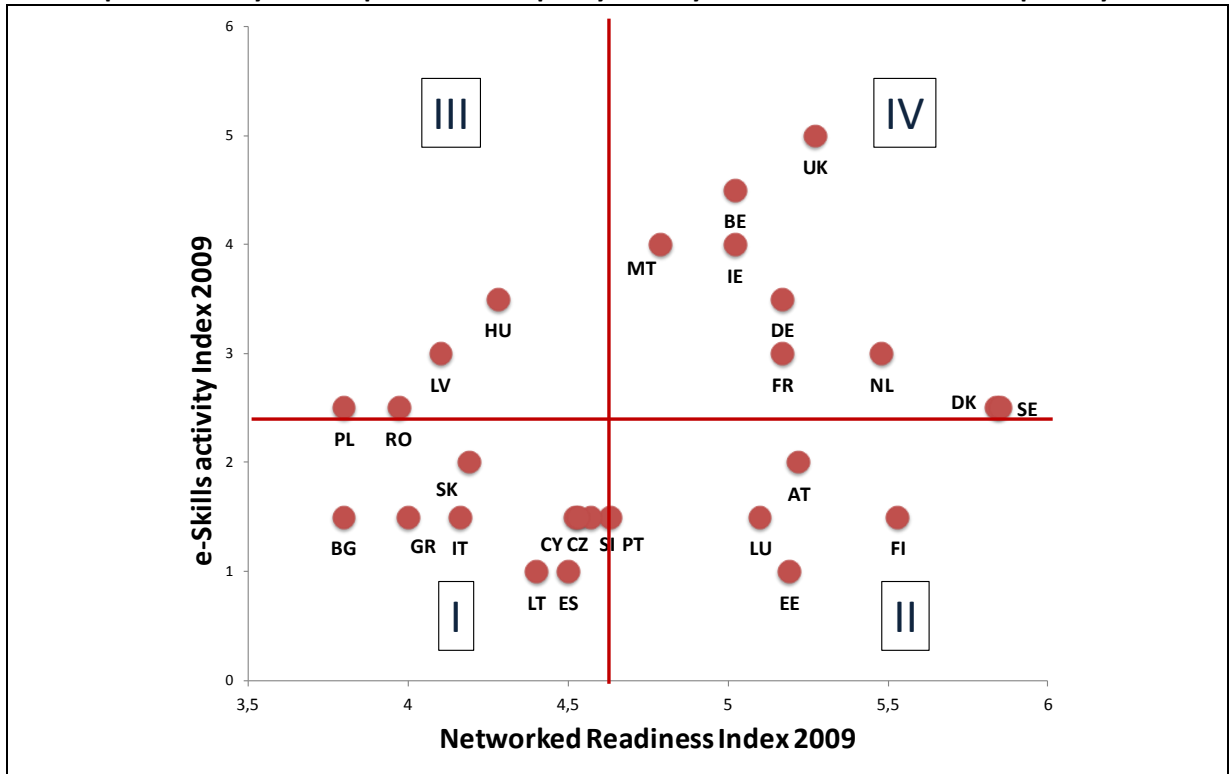
This allows for putting the results of the e-skills policy and activity analysis in the different countries in the wider context of each country's propensity to exploit the opportunities offered by ICT using data which can be obtained from the country values on the Networked Readiness Index (NRI).

The following figure allows a comparison of the results from this exercise for 2009 and 2013. In the graphical illustrations four quadrants are shown which are built by using the European averages on the NRI and those on the e-skills policy activity index for the respective years in order to group the countries into four main clusters.

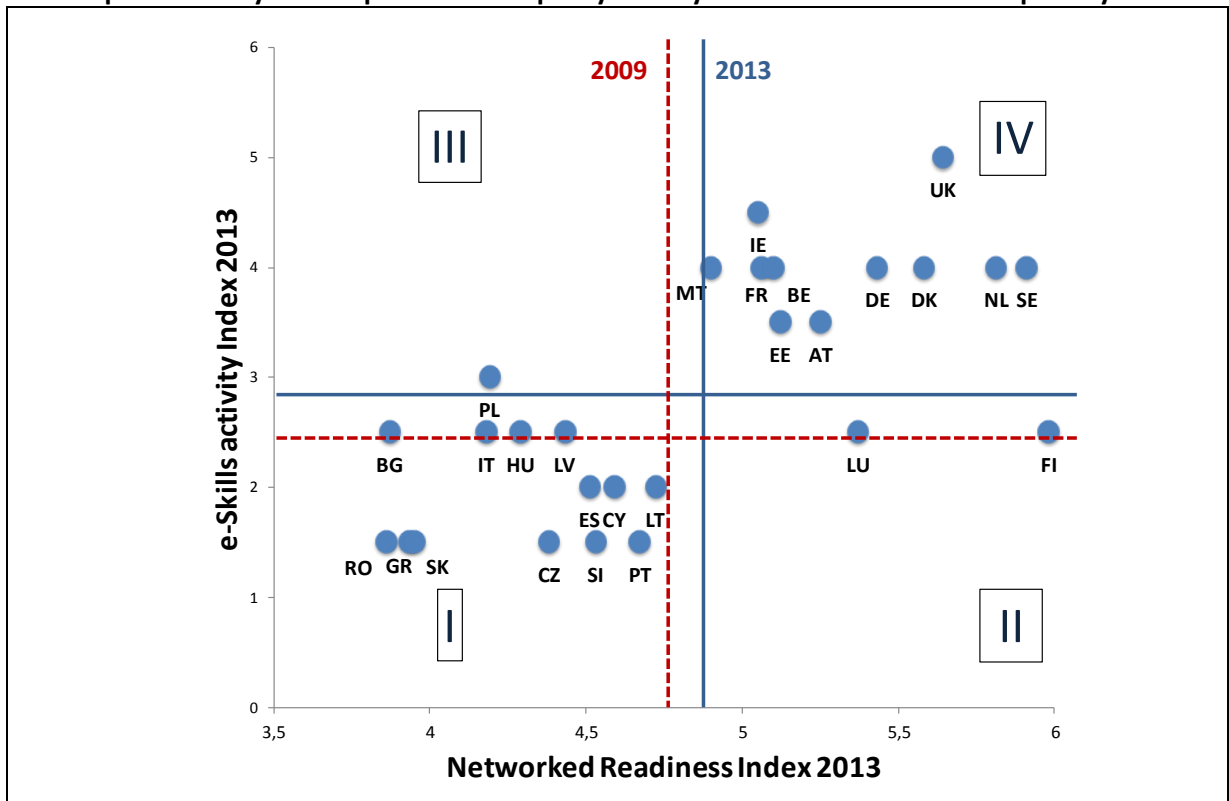
<sup>1</sup> Hüsing, T. and Korte, W.B. (2010) "Evaluation of the Implementation of the Communication of the European Commission 'e-Skills for the 21st Century'", URL: [http://ec.europa.eu/enterprise/sectors/ict/files/reports/eskills21\\_final\\_report\\_en.pdf](http://ec.europa.eu/enterprise/sectors/ict/files/reports/eskills21_final_report_en.pdf)

<sup>2</sup> The World Economic Forum's Networked Readiness Index (NRI) measures the propensity for countries to exploit the opportunities offered by ICT. It is published annually as part of the Global Information Technology Report. The NRI is a composite of three components: the environment for ICT offered by a given country (market, political and regulatory, infrastructure environment), the readiness of the country's key stakeholders (individuals, businesses, and governments) to use ICT, and finally the usage of ICT amongst these stakeholders. For further information on the NRI see [www.weforum.org/issues/global-information-technology](http://www.weforum.org/issues/global-information-technology).

European country landscape on 'e-skills policy activity' versus 'ICT innovation capability' 2009



European country landscape on 'e-skills policy activity' versus 'ICT innovation capability' 2013



Overall and for e-skills related policies and initiatives a strong increase of activity levels over the five-year time span can be identified. The unweighted average e-skills policy index score increased from 2.4 to 2.9 between 2009 and 2013. This is encouraging news.

Our analysis revealed that in 2009 three of the four quadrants are well populated by different countries with only 7 countries belonging to the group of top performers both, in terms of e-skills policy index as well as NRI, and 11 Member States constituting those best described as low activity countries (bottom left quadrant).

Five years later the situation has changed significantly; we are now faced with a situation which can be described as a dichotomy in Europe on these indicators: top performing countries as opposed to countries with low activity levels and NRI performance, with only three countries (Poland, Luxembourg and Finland) in transition phases between these clusters.

The group of top performers has grown from 7 to 11 with Sweden, Denmark, Austria and Estonia entering this cluster to which the United Kingdom, the Netherlands, Belgium, Ireland, Malta, Germany and France already belonged in 2009. However, the group of low activity countries is still substantial in terms of numbers of countries with 13 EU Member States – almost 50% showing a below average performance on the NRI and on the e-skill skills policy activity index.

EU Member States fall into two very distinct groups: 41% of the Member States are top performers, almost 50% are low activity countries, and 11% located between these two clusters.

While the former have been successful on the e-skills front and capable of exploiting ICT to become innovative and more competitive the latter group of low activity countries still has a rather long way to go to achieve both.

A look at the Member States' positions in the NRI ranking (Networked Readiness Index) reveals that again, those countries with high NRI positions also show high e-skills policy activity levels. The countries moving up in terms of migrating into the 'top performers' cluster include Sweden, Denmark, Austria and Estonia, as well as the Netherlands and France which managed to further increase their e-skills policy activity level.

Countries at the risk of losing ground include Hungary, Latvia and Romania which dropped down into the first cluster of countries, i.e. those lagging behind.

#### European country clusters on 'e-skills policy activity' versus 'ICT innovation capability' 2013

<b>I : low NRI + Low level of e-skills policy activity</b>	<b>II : High NRI + low level of e-skills policy activity</b>
Romania, Greece, Slovakia, Czech Republic, Slovenia, Portugal, Spain, Cyprus, Lithuania, Bulgaria, Italy, Hungary, Latvia	Luxembourg, Finland
<b>III : Low NRI + high level of e-skills policy activity</b>	<b>IV : High NRI + high level of e-skills policy activity</b>
Poland	United Kingdom, Ireland, Sweden, Netherlands, Denmark, Germany, Belgium, France, Malta, Austria, Estonia

## 5 Selected multi-stakeholder partnerships

The following is a list of multi-stakeholder partnerships of major relevance to the e-skills issue:

- **Knowledge Based Economy Project (KEP):** This is the long-term government programme for developing the knowledge society in Romania, designed and operated by the Ministry of Communications and Information Society and partly funded by the World Bank. During the set-up process in 2009, the KEP organised free intensive courses for using ICT in school and businesses in all 255 communities partaking in the project. After successfully completing the course, more than 5,000 people received authorised certificates from CNFPA (The National Council for Adult Vocational Training). Addressed especially to teachers, librarians, entrepreneurs and public servants, the courses were designed and customised using as basic indicators the socio-professional profile of the beneficiaries, their needs, the degree of knowledge regarding the use of computer and digital resources. 28 new vocational training facilities for teaching digital skills were opened in rural communities. The KEP project was awarded as one of the three best projects for digital inclusion in Europe by the e-Inclusion Awards 2012.
- **Education for the Information Society:** This is the Romanian ECDL initiative. The country's Education Ministry in 2011 signed an "Information Society Education" agreement with ECDL Romania through which both parties agreed to work together in order to raise competence levels in ICT use for current Internet users as well as for first time computer users. The initiative seeks to implement a framework and infrastructure for quality standards in computer use training by means of ECDL certification. Certification procedures are to be implemented in all participating education institutions, which are to become accredited ECDL testing centers. Individuals who need ICT skills in their daily work, including teaching staff, are enabled to obtain a certificate with which they can demonstrate their skills on the labour market.
- **Educational Process Optimised in View of the Knowledge Society Competences:** The purpose of this project is to adapt educational processes at high-school level to the competence requirements of the knowledge society, as outlined in the EU's Lisbon strategy. Through a number of integrated educational steps, inter- and trans-disciplinary, directed towards the development of competences required by modern society and through the complementary and innovative use of ICT, the project motions to increase access to quality education. The specific objectives of the project revolve around modernising the education system by means of a trans-disciplinary programme for development of teaching, learning, assessment and examination tools in digital format, making best use of having the latest ICT equipment and tools. An eLearning solution was developed by SIVICO, the most important Romanian software company, consisting of education programmes for mathematics, sciences and human studies and supporting applications for multi-touch interaction devices through which collaborative learning is assisted. Initially, the solution was pilot tested in 500 high schools nationwide; starting in 2013, the solution is being introduced in the School Decision Programme at national level. Key stakeholders include SIVICO Romania, the Ministry of Education, Research, Youth and Sport, and the National Defence University "Carol I".

## 6 Success of e-skills policies and activities in meeting the objectives of the EU e-skills agenda and other relevant European initiatives

The extent to which policies, initiatives and multi-stakeholder partnerships have been successful in helping meet the objectives of the EU e-Skills agenda and other relevant European e-Skills initiatives as seen by national experts is further described below along key actions and action lines of the EU e-Skills strategy and other relevant EU initiatives.

### ***“Longer term cooperation”***

The Sectoral Operational Programme HRD was elaborated under coordination of Ministry of Labour, Family and Equal Opportunities. The following organizations were involved in the consultations: the Ministry of Economy and Finance, National Agency of Employment, Ministry of Education, Research and Youth, Ministry of Internal Affairs and Administrative Reform, Ministry of Development, Public Works and Housing, Ministry of Agriculture and Rural Development, Ministry of Public Health, National Institute for Statistics, National Institute for Scientific Research in the field of Labour and Social Protection, AntiPoverty Commission and Promotion of Social Inclusion, National Adults Training Board, National Agency for Equal Opportunities, Ministry for Small and Medium Sized Enterprises, Trade, Tourism and Liberal Professions, other line ministries and agencies. Other partners, such as social partners, civil society organisations, public administration and other relevant stakeholders were also involved in consultations.

Formal certification and credits delivery are to be introduced for all types of training. Modes of delivery should include conferences, seminars and modular courses, on job training, training in partnership with companies, outreach training.

### ***“Human resources investment”***

Investments are needed for increasing initial VET attractiveness for employers and learners and for making it an important tool for equipping young people with key competences they will require throughout life. Most of the efforts made so far for developing initial VET have focused on the needs of young persons. However, the enhancement of VET schools has to deliver continuous vocational training for the adult population as well to properly meet the needs of adults and older workers and for upgrading skills and competences to meet evolving labour market demands. Specific actions are needed for targeting the professional development of vocational teachers and trainers. This will require increased effectiveness of partnership in planning and delivering VET, enhanced capabilities of VET schools in delivering continuous vocational training and adult education, integration of ICT related competences in the initial VET curriculum, provision of career guidance and entrepreneurial guidance. It should also develop effective links to the labour market and support stakeholders buy-in.

### ***“Attractiveness of ICT jobs”***

In a context of high structural unemployment and low average wages, ICT practitioner jobs are generally considered to be highly desirable.

### ***“Employability and e-inclusion”***

Missing knowledge on electronic means for business is an obstacle for the SMEs' development. Digital skills have to be improved through a training program sustained and promoted at national level. Increasing competitiveness and employability of the labour force shall be also ensured by providing continuous vocational training to 538,000 people (260,000 in training and retraining

courses and 278,000 in upgrade skills courses). Apart from this, approx. 30,000 people must benefit from training in advanced technological and engineering sectors, environment, ICT a/o. In addition, adaptability shall be supported by promoting training on managerial skills for 15,000 people, as well as entrepreneurship for 30,000 people. They should benefit from training on how to set up business and business plan, on marketing of products and services etc.

### ***"Lifelong acquisition of e-skills"***

Continuous Vocational Training still remains a major challenge in general, since participation in continuous training is at the lowest level in Europe: 1.1% in 2001, 1.1% in 2002, 1.3% in 2003, 1.5% in 2004 and 1.6% in 2005. Lifelong learning and promoting adaptability of workers and enterprises represent the main objective of Sectoral Operational Programme HRD. Actions to increase rates of participation in vocational training and for catching up on missing basic education make up a significant part of the programme. Participation of workers, mainly with low level of qualification, was identified as very low.

The development of the National Qualification Framework for Higher Education represents another important instrument. It has to facilitate further education and training, in support of lifelong learning, through increased transparency of qualification description. Actions involved are methodology updating and designing of IT management solutions for it; creation of instruments to define qualifications, as well as procedures for their validation; capacity building improvement etc. ESF will support only actions related to qualifications in higher education (vocational qualifications are excluded). The ESF support in regard to staff development is supposed to address the university decision makers and managers, policy makers (staff of the Agency for Quality Assurance in University Education, National Authority for Qualifications in Higher Education and Partnerships with social and economic environment etc.), quality evaluators, other relevant stakeholders.

### ***"Closing the e-Skills gap"***

According to the demographic trend, the forecasted decrease of school children by 20% in 2013 (as compared to 2005) will trigger serious effects in respect to the recruitment of teaching personnel. The smaller number of pupils will allow the workforce in education and initial training to be cut by 10%. Despite this, there is a growing shortage of qualified teaching personnel in particular in highly sought-after domains (e.g. ICT, foreign languages) which are in much demand on the labour market.

Researched and prepared by:



**empirica Gesellschaft für Kommunikations- und  
Technologieforschung mbH, Bonn, Germany**

Oxfordstr. 2

53111 Bonn, Germany

e-Mail: [info@empirica.com](mailto:info@empirica.com)

For the European Commission  
DG Enterprise and Industry





## Annex: data sources

	Source
eSkills21 study: 'e-skills' index 2010	eSkills21 study carried out by empirica. Report available at <a href="http://goo.gl/WKV7r">http://goo.gl/WKV7r</a>
eSkills21 study: 'Digital literacy' index 2010	
EuRA e-skills index	EU-RA 2009: Financial and fiscal incentives for e-Skills: State of play in Europe. Synthesis report. <a href="http://www.e-skills-funding.com/images/stories/PDF/synthesisreport.pdf">http://www.e-skills-funding.com/images/stories/PDF/synthesisreport.pdf</a>
ICT practitioners in % of total employment 2012	LFS data made available by Eurostat
Digital literacy skills of the population 2009/11:	Eurostat, database "isoc_ski"
• Individuals with high level of computer skills	
• Individuals with high level of Internet skills	
• Individuals using the Internet (last three months)	
Global Competitiveness Index (GCI) 2010/12	The Global Competitiveness Report 2011-2012: <a href="http://www.weforum.org/reports/global-competitiveness-report-2011-2012">http://www.weforum.org/reports/global-competitiveness-report-2011-2012</a>
Networked Readiness Index (NRI) 2010/12	The Global Information Technology Report 2011-2012: <a href="http://www.weforum.org/issues/global-information-technology">www.weforum.org/issues/global-information-technology</a>
• Individual readiness	
• Business readiness	
• Government readiness	
• Individual usage	
• Business usage	
• Government usage	
PISA scores (2009) in:	OECD, <a href="http://www.oecd.org/pisa/">http://www.oecd.org/pisa/</a>
• Mathematics	
• Science	
• Reading	

Indicator	Source	Further remarks
ICT practitioner workforce 2012	Eurostat Labour Force Survey. Some imputations and assumptions not in the original data but done by empirica apply	The definition can be looked up in the final report, Gareis et al. 2014: E-SKILLS: MONITORING AND BENCHMARKING POLICIES AND PARTNERSHIPS IN EUROPE.
ICT practitioner workforce 2012 as percent of total workforce		LFS based, number of ICT practitioners / number of workers in all occupations
Assumed excess demand 2012	Empirica, IDC	This is calculated using the percentage of vacancies per existing job and is based on a survey carried out in 2012. As some countries were not covered, several assumptions apply
Forecast excess demand 2015		Forecasts are scenario based and the methodology can be found in the final report (see above). Forecast of demand in the six largest countries (DE, UK, FR, IT, ES, PL) is based on country specific economic scenarios, for the 21 smaller countries only an aggregate scenario was developed and figures allocated according to ICT employment shares.
Forecast excess demand 2020		
Forecast ICT practitioner jobs 2015		
Forecast ICT practitioner jobs 2020		
Workers 2012 - Management,	Based on Eurostat Labour Force	LFS based, definitions can be looked up in the final

business architecture and analysis level	Survey, some definitions and calculation by empirica. Some imputations and assumptions not in the original data but done by empirica apply.	report.
... as percent of total workforce		
Workers 2012 - ICT practitioners, professional level		
... as percent of total workforce		
Workers 2012 - ICT practitioners, technician and associate level		
... as percent of total workforce	Based on Eurostat Labour Force Survey, some definitions and calculation by empirica. Some imputations and assumptions not in the original data but done by empirica apply.	ISCO-88 groups 213 and 312. Due to the break in series in 2010/11 only partly comparable to later data.
Growth core ICT workforce 2001-2010		
Growth core ICT workforce 2008-2010		
Growth core ICT workforce 2011-2012		ISCO-08 groups 25 "ICT professionals", 35 "Information and communications technicians".
Growth broad ICT workforce 2011-2012		Equals the "ICT practitioner workforce"
ISCED 5A/B first degree graduates in Computer Science, 2011	Eurostat, database "educgrad_5"	This figure represents a count of first degrees in ISCED 5A and first qualifications in 5B. See discussion of this indicator in the final report.
... graduates per 1000 population aged 20-24	Eurostat, databases "educ_grad5" and „demo_pjangroup"	Graduates as above. The denominator is used to make data comparable but there is no age restriction in the number of graduates. Some imputations and assumptions may apply.
... graduates 2011 as percent of 2006 (= peak EU)		
Vocational training graduates in Computer Science, 2011	Eurostat, database "educ_grad5"	Number of Computing graduates in Upper secondary education (level 3) - pre-vocational and vocational programme orientation and Post-secondary non-tertiary education (level 4) - pre-vocational and vocational programme orientation. Some imputations and assumptions may apply.