Competitiveness Enhancement and Enterprise Development II (CEED II)

ICT Education in Moldova: Meeting Industry Needs

AGENDA FOR ACTION

Final Report

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22 June 2012

Contents

1 Executive Summary

The CEED II project, funded by USAID, has commissioned this short study to examine the skills issues affecting the ICT sector. The project examined around 20 research reports, conducted 20 interviews with all parties, and organized an Interim Workshop and final Executive Briefing.

The sector is constrained by a shortage of skills, which is seriously affecting its growth:

- Microsoft, Linux, Java, SQL, Oracle skills (and others) are in demand
- Also non-technical skills such as business communications, team-work and project management
- Foreign languages, especially English, are needed
- The total skills shortage is estimated at around 1000 people
- But the problem is much more about quality rather than quantity of skills

There are 1200 businesses in the sector employing 6000 people in IT plus 14500 in Telecoms, together generating around 9.5% of national GDP. It is estimated that there are another 1000 people in the informal freelance economy. The IT sector (not counting telecoms) contributes $131M to GDP, plus around $40M in exports.

ICT has been introduced in secondary schools, but expansion is currently stalled for budgetary reasons. At university level, the volume of graduates has expanded from 1620 to 2233 over the last two years. But the equipment, curricula and teaching resources are all weak, in need of substantial updating.

This Agenda for Action classifies the issues and recommendations under four themes:

1. **Physical assets** such as IT labs. We propose a management, maintenance and budgeting system to replace hardware over five years, software over three years, with end of semester routine maintenance. All new equipment should be properly licensed with immediate effect.
2. We propose a formal annual process for updating **curricula** with full industry involvement. Collaboration with foreign universities, academic exchanges for staff and students, twinning arrangements, internships for staff and students should all be encouraged. In due course, ICT should be extended downwards in the school system, eventually to primary schools.
3. The **teaching workforce** too needs professional development. We recommend introduction of a performance management system, eventually linked to pay. We propose also the full implementation of the Bologna Process, including full use of learning outcomes, competences, and action learning.
4. The main recommendations under the **Governance of Education** theme concern completion of the Education Code, and its implementation. Key elements concern quality assurance, namely the responsibilities of each university for its internal quality, coupled with the establishment of an external QA agency. Engagement between universities and business must be improved and formalized, including seats on Senate and other management bodies and external examiners.

The new ICT Education Council under the Ministry of Education provides an ideal vehicle to progress this Agenda for Action.

2 Introduction

2.1 Background

For some time now, the ICT sector in Moldova has felt its growth constrained by a shortage of critical technical and business skills. The industry has developed from tiny beginnings to its present status where it is making a still small but significant and growing contribution to national GDP, exports, employment, and tax revenues. Despite the introduction of ICT in schools and the expansion of ICT in universities, there is a continuing problem regarding the supply of personnel to meet industry growth, particularly regarding quality and skill-sets.

Moldova enjoys a favorable geographic and cultural position to address both European and CIS markets. The government is committed to the expansion of ICT for economic development, employment, and social reasons, and to bring improved government services to citizens and businesses. These factors combine to demonstrate the growth potential of the sector.

The CEED II project, funded by USAID, has established this initiative to review this issue, and to make recommendations to improve the situation.

2.2 Macro-economics

The domestic IT market (not counting Telecoms) was worth $131M in 201, an increase of 2.4% on the previous year, but still not as high as the 2008 peak of $148M.[1]

Hardware dominates at $97M, but the labor-intensive software and services segments contribute $34M.

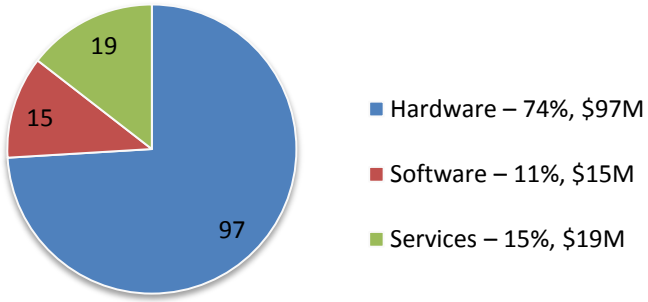

Figure 1 Domestic IT Market 2011, mln USD

This IDC figure for 2008 is considerably higher than the earlier ATIC estimate for IT products (including software but probably not services).[2]

Exports are additional to this domestic market at $31M for 2010, showing a ten-fold growth over the last seven years. There is a further unrecorded freelance export market estimated at 30 to 50% in excess of this recorded figure.

Even so, these exports are an insignificant and declining proportion of the world off-shore market of $41B, currently forecast to grow at 15% pa. This emphasizes the potential opportunity for Moldova, and the critical importance of fixing this skills issue.

On the supply side, around 1200 companies employ 6000 people in IT and 14500 in Telecoms, together generating some 9.5% of national GDP.

[1] IDC White Paper: Competitiveness Assessment of the Moldovan IT Market – Nov 2011.
[2] ATIC Policy White Book: ICT Sector in Moldova - 2009

There are 33 universities and 48 colleges but only 16 universities and 9 colleges have ICT courses.[3] There were 2233 graduates in ICT in 2011, an increase of 200 over 2010 and 600 over 2009.

2.3 Objectives of the project

The objectives of the project can be summarized as:

1. Assess the current education situation in Moldova from K-12 to higher education
2. Review existing initiatives in this area
3. Study industry skills needs and trends
4. Define the skills gap
5. Identify strategies and actions
6. Prepare a Road Map (Action Plan)

2.4 Methodology

This issue has been well researched. The team has studied a lengthy list of materials from Moldova and elsewhere. A list of the main items appears in Annex A.

The team has conducted 20 interviews, many with several people. A full list appears in Annex B. In addition, there were many informal discussions around the ICT Summit on 15-17 May 2012. The team would like to thank all those who contributed their time and advice.

An Interim Workshop was held on 19 June 2012 at the Ministry of Information Technology and Communication, attended by 32 representatives of government, academia, business and others. Small working groups reviewed the key issues and potential solutions. The main purpose of the workshop was to expose the issues to all stakeholders and to begin building a consensus for implementation. The findings have been taken into account in this final report.

A short Executive Briefing has been arranged for 22 June 2012 at the Government Building to present this Final Report and Agenda for Action.

2.5 Project team

A small team of international and local experts was engaged by USAID CEED II to conduct this assignment:

- John O'Sullivan BSc, FBCS, CEng, FCMA. Previous experience: Personnel & Resources Director - British Aerospace; Group IT Director - British Telecom; Industrial Adviser - UK Department of Trade & Industry; relevant work in UK, EU, Canada, Turkey, The Gambia, Afghanistan
- Dr. Anatol Gremalschi - Program Director – Institute for Public Policy; University Professor – Computer Science; former Minister of Education
- Andrei Sedelkov MBCS; ICT market, strategy, and policy consultant. Co-author: ICT Policy White Book; Moldovan ICT sector Value Chain Analysis; Training Needs Analysis.

[3] CEED II: Draft Plan of Actions

3 Demand for ICT Skills

3.1 Current headcount

Around 1200 companies employ 6000 people in IT and 14500 in Telecoms, with the total headcount around 20,500 (ICT Policy White Book, ATIC 2007). Companies engaged in database-related activities employ 18% of the ICT labor force, while other software companies employ about 14%.

About 15% of all ICT specialists are employed in the manufacturing sector, while wholesale companies account for only 4% of them. It has to be mentioned here that these numbers include only ICT specialists working in companies with ICT as their main activity. However, a significant share of ICT specialists are working in the ICT departments of businesses in other sectors (financial services, public administration, energy, wholesale). The National Bureau of Statistics does not quantify the number of employees of ICT companies separately, while grouping it with the transport subsector.

A functional breakdown among ICT companies shows that overall we could consider that around 85% of the companies' staff are technical professionals (e.g. software engineers, analysts, developers, architects) and 15% are working in management, business, and support roles.

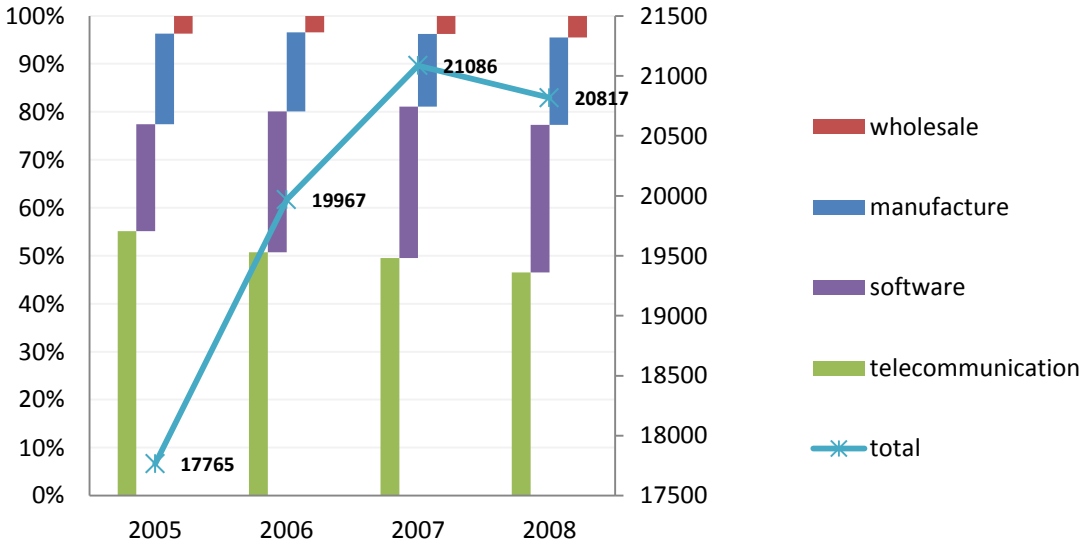

Figure 2 Distribution of the employed by types of ICT activities and total number of employees.
Source: ATIC calculation based on NBS data

The sector has demonstrated significant growth in employment in three years from 16,500 people in 2005 (ATIC, 2007). While the growth was unevenly distributed across the subsectors, software has demonstrated the most rapid growth of 68% (ATIC, 2007), and continues to grow, consistent with global ICT growth, with a doubling of Moldovan IT exports over the last two years:[4]

Table 1 Value of Moldovan IT exports

Year	2005	2006	2007	2008	2009
Computer and information services, $m	3.64	7.97	14.27	26.27	29.75

[4] BNM 2011

3.2 Estimate of freelance workforce in Moldova

In addition, there is an unrecorded informal workforce. According to oDesk.com, the world's largest online workplace[5] (about 50% market share, enabling businesses to hire, manage and pay a flexible online workforce), an additional 1200 full time equivalent jobs (May 2012) can be attributed to Moldova's ICT workforce, which is 35% higher than last year (870 FTE, June 2011). This headcount is not officially counted or taxed and is receiving their remuneration in the form of work remittances (est. $11m -$20m per annum, 2012). Doubling this for other websites and channels might bring us another unofficial and uncounted 2400 specialists (40% of the 6000 recorded) in the ICT sector, bringing the country exports up to $40m per annum.

By contrast, Moldova's freelancers worked approximately 56% of the total time worked by Romanian freelancers. Taking into consideration that Romania has a significantly larger human resource pool, and that its ICT labor market is more mature than in Moldova, this shows that most ICT professionals in Romania are employed in formal local and international businesses.

Although these freelancers' revenues are really hard to track and tax, these numbers demonstrate an additional pool of human resources already existing on the local market that could help solve Moldova's skills shortage.

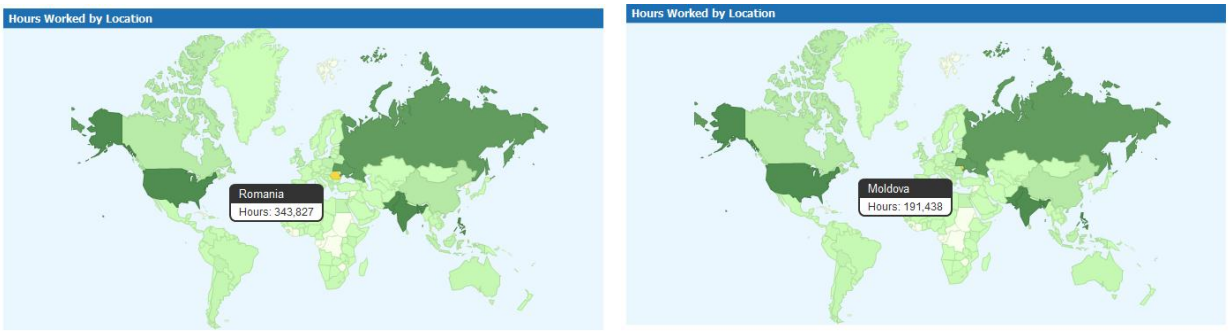

Figure 3 Hours worked in Moldova vs. Romania, May 2012
Source: oDesk.com

3.3 Skill sets

Software development and services subsector is the emerging growth area of the ICT industry in Moldova. The professional ICT community has not fully formed yet. This implies that there is no common view or standards for particular qualifications, job roles, and corresponding skill sets for the occupations in IT that the education system and business could follow. The existing official framework for occupational classification (CORM), classification of fields for professional and specialty training in higher education (*Nomenclatorul domeniilor de formare profesionale si al specialitatilor de pregatirea cadrelor in institutiilor de invatamant superior*) and qualifications framework (*Cadrul calificarilor*) barely follow the demands of the market.

The Private Sector Demand on ICT Skills study commissioned by the USAID CEED project in 2007 identified skills used within the sector that, with some limitations, are still valid today, as the most recent interviews with companies show. It reported that the largest group (20%) involved in ICT activity

[5] http://www.marketwire.com/press-release/odesk-announces-record-number-jobs-contractor-earnings-on-worlds-largest-online-workplace-1584510.htm),

has a mixed position with a wide range of skills and levels involved for every position. Software developers represent the second largest group, counting 17% of employees. Analysts, web designers, and content managers hold the last positions in the ranking by structure, with less than 5%. Among those positions with mixed duties, software development, database development, and network administration skills could be mentioned. The practice of mixed functions is typical for many IT companies, especially for small businesses.

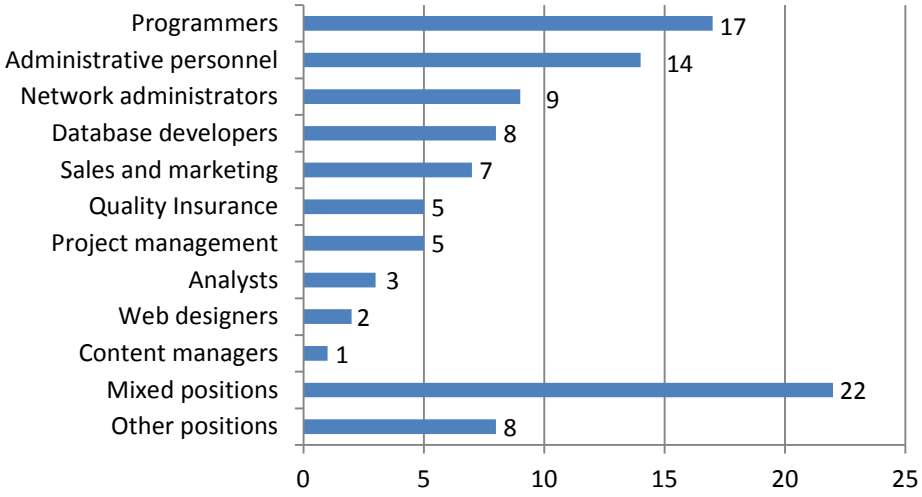

Figure 4 IT staff currently employed and its skills
Source: Private Sector Demand on ICT Skills In Moldova, USAID CEED, 2007

Skills shown in the chart below were mentioned by managers as essential for their IT staff. Security and networking were named by a majority of respondents as important for their business.

Technology-wise Microsoft and Linux have about equal billing among major enterprise platforms, 23% vs. 19% respectively. On the database scene, SQL skills at 21% prevail over Oracle (12%). This year interviews with companies have shown companies still have Oracle in their short list, while the importance of SQL has declined. SAP was also mentioned.

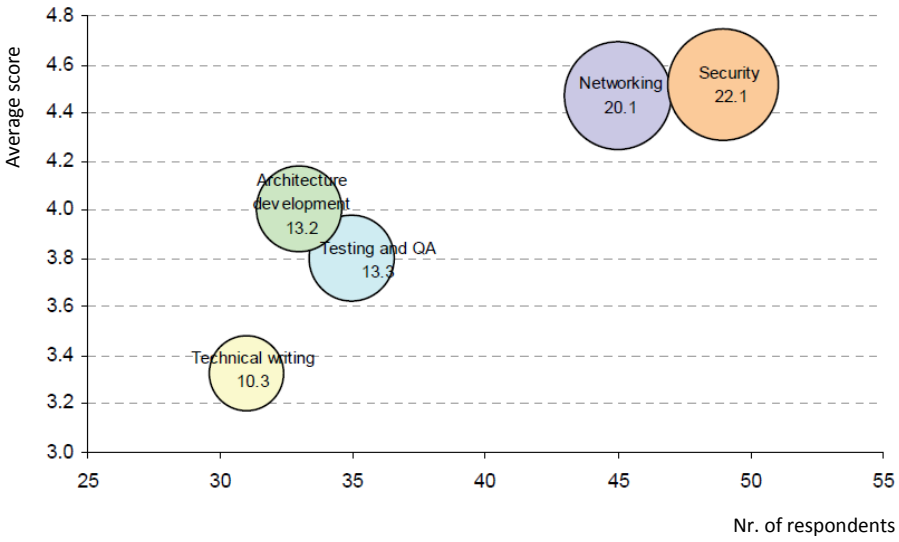

Figure 5 Demand for specific ICT skills
Source: Private Sector Demand on ICT Skills In Moldova, USAID CEED, 2007

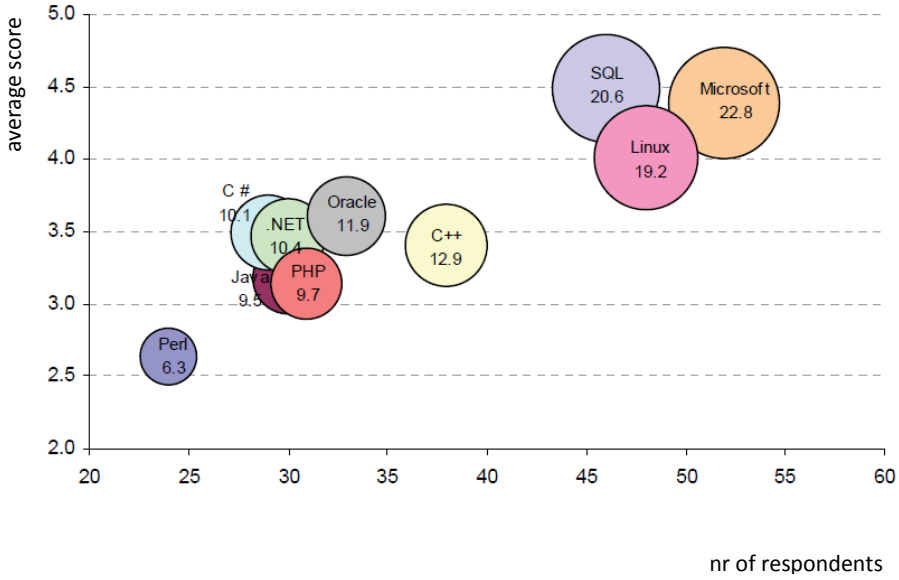

Figure 6 Demand for specific ICT skills – programming languages, databases, platforms
Source: Private Sector Demand on ICT Skills In Moldova, USAID CEED, 2007

3.4 Non-ICT skills

Non-ICT skills, also called as soft skills, are actually ones that define a company's competitive edge. Among those mentioned in 2007 as important were: accounting (14%), project management (14%), marketing (13%) and management (12%). However, the most recent interviews with companies show a significant shift to recognizing English language and other foreign language skills as essential. Stakeholders interviewed commonly recognize that foreign languages such as English, French, Spanish, Italian and Russian are extremely important for developing high-quality ICT professionals, starting from data entry analysts working for a particular language market and ending with those who aim for management positions within companies. Communications, teamwork, and project management are high on today recruiter's wish list.

3.5 Demand forecast

In terms of hard numbers, companies are usually reluctant to disclose their recruitment shortage. However, one estimate was for 200+ system administrators /system engineers and 300+ developers for one line of technology. Other technologies could be similar, with Java and Oracle specifically mentioned. If accurate, this combined shortage of 1000 personnel would add some 15-20% to the IT workforce.

Even though the number of ICT-related graduates is quite high and has already increased by 30% over just the last two years, in general, representatives of IT firms regard the current number of students as inadequate to meet the industry's demand for technical specialists. In addition, the quality of certain graduates is deemed insufficient, requiring on-the-job training to become qualified enough to fill full-time positions. Industry representatives heavily involved in the global outsourcing chain claimed that only 30% of ICT graduates are directly employable.

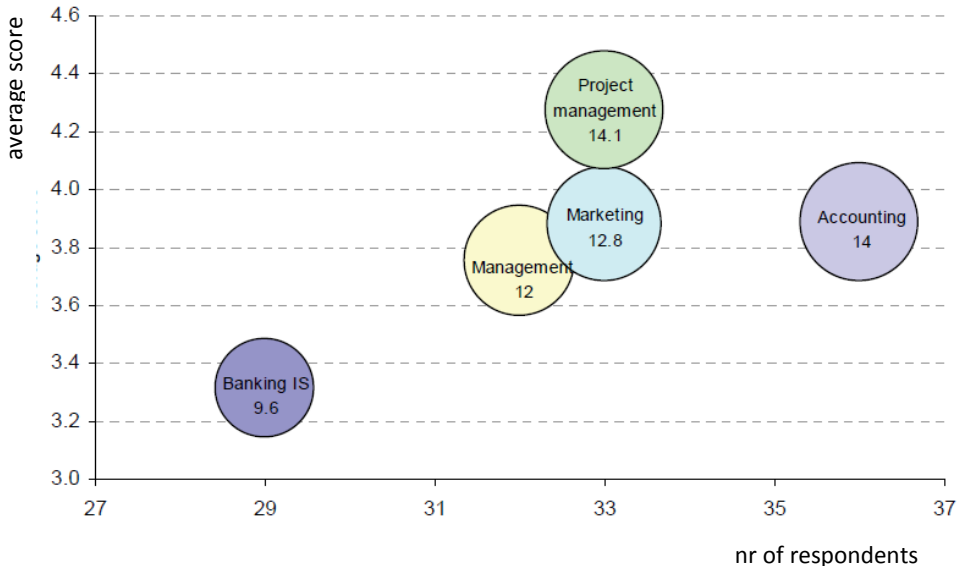

Figure 7 Demand for specific non-ICT
Source: Private Sector Demand on ICT Skills In Moldova, USAID CEED, 2007

Workforce planning and forecasting is barely established within Moldovan companies involved in IT services trading. Together with other local market players, companies experience difficulties with planning their talent pool in the short -to mid- term period. The 2007 skillset research demonstrated a strong demand for programming languages, databases, and operating systems. Most respondents (65%) agree that SQL and Java will be more and more required in the coming years. For Linux, PHP, Oracle and .Net, about 60% of respondents forecast an increasing demand, while for C programming language and Microsoft 52-54% of respondents predicted an increase. Concerning C++ and Perl, the share of those foreseeing a stable demand overcomes the share of respondents that predicted an increasing demand.

The latest interviews with industry have also demonstrated companies' commitment (about 20% of respondents) to increase their operations within next three to five years with projected headcount growth of 50%.

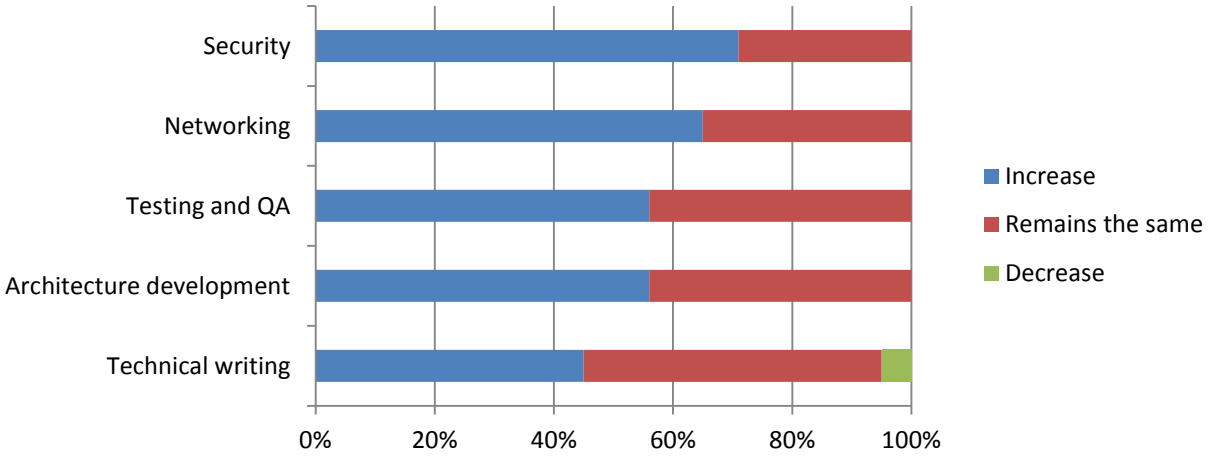

Figure 8 Forecasted demand for specific ICT skills
Source: Private Sector Demand on ICT Skills In Moldova, USAID CEED, 2007

4 Supply of ICT Skills

4.1 General Education

In the 2011/2012 academic year, 83 primary schools, 829 middle schools and 497 high schools in the Republic of Moldova had a total enrolment of nearly 380,000 pupils. According to the Framework-Plan for primary, middle school and high school education, informatics is taught as a compulsory school subject in 7th to 9th middle school grades and 10th to 12th high school grades. On parents' request and according to the school's decision, informatics may be taught earlier, since the 5th grade, as an optional subject.

The content of this subject is established by the Curriculum for Informatics as a school subject[6], developed in 1999, updated in 2006, and modernized in 2010. The Curriculum includes school syllabi for each educational level– middle school and high school levels, sciences and humanities profiles – alongside with the respective sets of manuals, teacher's guides, and educational software.

According to the above-mentioned Curriculum, the major goal of Informatics as a school subject consists in forming the informational culture and developing algorithmic thinking. To achieve such a goal, the Curriculum includes both matters aimed at developing the skills in using information and communication technologies, as well as at studying the basics of informatics as a field of sciences which comprises algorithms, modeling, programming, logics, and complex data processing.

The Framework-plan for the 2012/2013 academic year[7] provides to pupils the opportunity to study on choice several school subjects from the field of information and communication technologies: applied mathematics, informatics (2nd – 4th grades), economic informatics, physics and computer, computer and network administration.

In addition to informatics as a school subject itself, pupils may also study information and communication technology within school circles organized on pupils' and parents' request. Gifted pupils may participate in district contests, national and international Olympiads, the expenses related to preparation and participation in such competitions being covered by local and central public authorities.

To ensure proper organization of the process of teaching Informatics, the Government has undertaken a number of dynamic actions and allotted sufficient financial resources for opening in each school at least one computer classroom and providing wideband Internet access. In addition to it, about 140 schools were equipped with educational software for basic school subjects. In the 2010/2011 academic year, there was an average ratio of 100 pupils per 4,7 computers, in the urban areas – 4,1 computers, and in the rural areas– 5,1 computers per 100 pupils. 43,2% of the total number of computers had Internet access, 53,6% - in the urban areas, and 36,9% - in the rural areas.

[6] Ministry of Education of the Republic of Moldova, Ordinance no. 244 of 27th of April 2010

[7] Ministry of Education of the Republic of Moldova, Ordinance no. 170 of 27th of March 2012

	Numărul total de computere *Total number of computers*	Numărul de computere cu acces la Internet *Number of computers with Internet acces*		Computere utilizate în scopuri didactice *Computers for teaching purposes*		Numărul de computere la 100 elevi *Number of computers per 100 students*
		Total	în %	Total	în %	
Total						
2006/07	12968	4733	36,5	1170	9,0	2,4
2007/08	15680	5561	35,5	2013	12,8	3,1
2008/09	19097	6863	35,9	2940	15,4	3,9
2009/10	20920	8323	39,8	3748	17,9	4,4
2010/11	21296	9191	43,2	4052	19,0	4,7
Urban						
2006/07	5046	2207	43,7	592	11,7	2,3
2007/08	6156	2871	46,6	1019	16,6	2,9
2008/09	7429	3559	47,9	1479	19,9	3,7
2009/10	7871	4090	52,0	1822	23,1	3,9
2010/11	7964	4271	53,6	1957	24,6	4,1
Rural						
2006/07	7922	2526	31,9	578	7,3	2,5
2007/08	9524	2690	28,2	994	10,4	3,2
2008/09	11668	3304	28,3	1461	12,5	4,1
2009/10	13049	4233	32,4	1926	14,8	4,8
2010/11	13332	4920	36,9	2095	15,7	5,1

Table 2 Endowment of primary and general secondary education institutions with computers, 2010/2011 academic year

Source: Education in the Republic of Moldova 2010/2011. Statistical publication. National Bureau for Statistics, Chişinău, 2011

In general education, Informatics is taught as a school subject by about 1400 informatics teachers. At the beginning, this school subject was taught by teachers of sciences. Afterwards, when the respective specialization was initiated in universities, the number of teaching staff having the qualification of "teacher of informatics" started to increase in schools. Nevertheless, at present, from the perspective of educational background, most informatics teachers have a Sciences profile (50,8%) and only 35,7% of them have an informatics background. The lack of qualified teaching staff is also revealed by the fact that 2,5% of informatics teachers do not have higher education, 2,7% of them have studied pedagogy of primary education, and 8,3% have been trained in the field of teaching humanities.

The largest share of the teaching staff who teaches informatics has not taken part in lifelong learning courses and do not make any progress towards getting teaching degrees. As a result, most informatics teachers do not hold any teaching degree – a share of 58,3%. The share of informatics teachers who hold the first and superior teaching degrees is rather low, respectively 4,0% and 2%, and most of them are concentrated in urban communities.

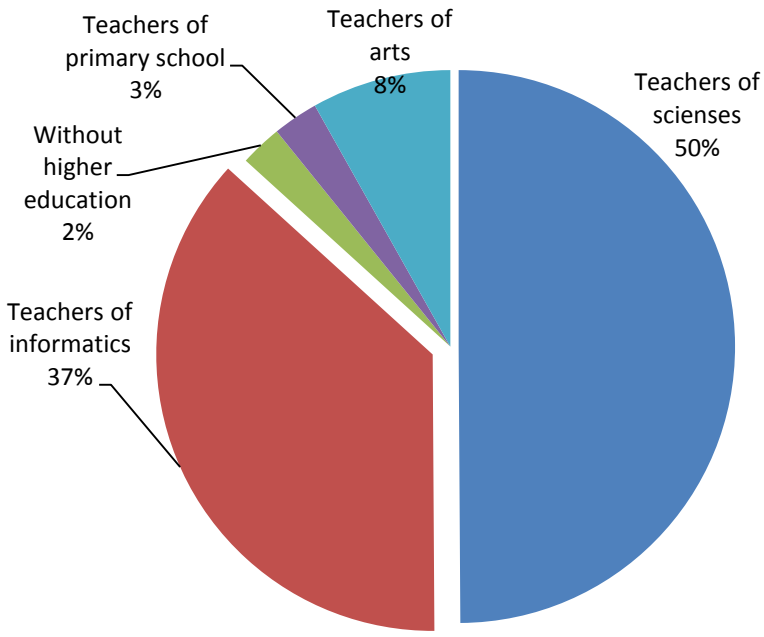

Figure 10 Distribution of informatics teachers by educational background, 2011
Source: Institute for Public Policy, 2011

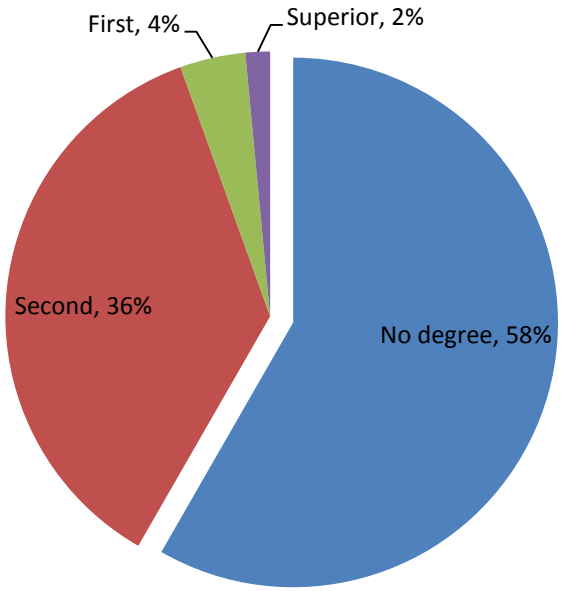

Figure 9 Distribution of informatics teachers by teaching degree, 2011
Source: Institute for Public Policy, 2011

An analysis of the scores of high school graduates during the period 2007-2011 shows that, as a whole, general school provides a relatively good basic education in the field of informatics and information technology. As far as graduates of 2009, 2010 and 2011 are concerned, their average annual score in informatics varied within the interval 7,72 to 8,36.

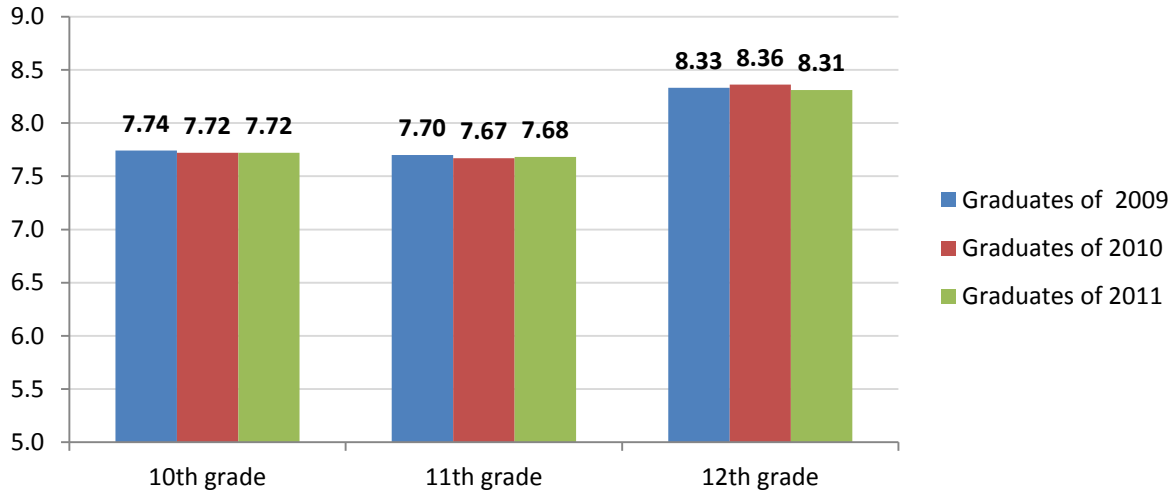

Figure 11 Average score of high school graduates, informatics, graduates of 2009-2011
Source: Ministry of Education, 2009-2011

Despite the fact that the average annual score in informatics is relatively good, very few graduates have chosen to pass a baccalaureate examination in this subject. In 2012, only 247 pupils from a total of 27,000 candidates decided to take a baccalaureate examination in informatics, and most graduates in 2012 preferred geography as a baccalaureate examination. The situation was similar in past years. However the number of graduates who opt for a baccalaureate examination in informatics is much lower than the number of candidates who apply for enrolment in ICT specializations at universities.

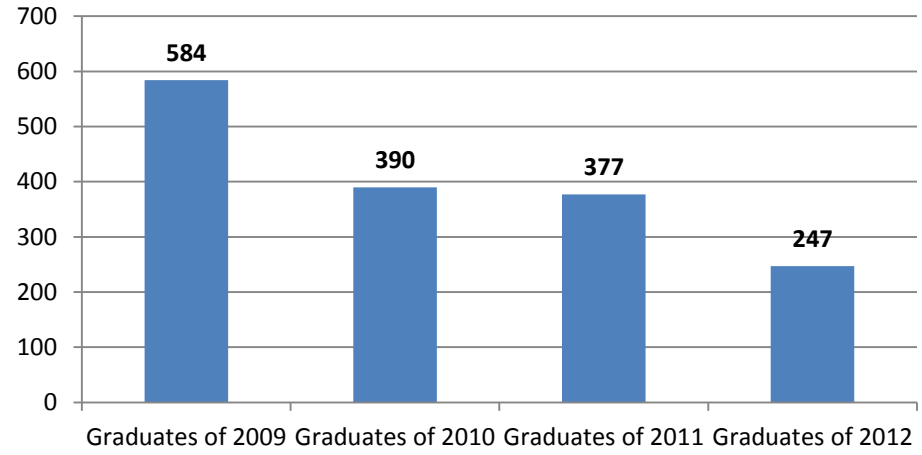

Figure 12 Number of candidates who decided to pass a baccalaureate examination in informatics, graduates of 2009-2012
Source: Ministry of Education, 2009-2012

4.2 Secondary vocational education

The system of secondary vocational education comprises 2 vocational high schools, 47 vocational schools, and 21 trade schools, with a total number of about 23,000 students. According to the

nomenclature of trades (professions) for education and training in secondary vocational education[8], approved by Decree no. 1421 of Government of the Republic of Moldova of 18.12.2006, the system of secondary vocational education is empowered to train skilled workers for nearly 340 professions/trades. In fact, during the period 2009-2011, training of skilled workers was provided for 164 trades/professions, including only 7 trades/professions in the field of information and communication technologies.

Most students of secondary vocational education are enrolled in vocational schools – 79,4%, 11% in trade schools, and 8,8% in vocational high schools. In the 2011/2012 academic year, 23,000 students were enrolled in secondary vocational education institutions, 8,4% less than during the previous academic year. The share of students coming from the rural areas is 76,2%. Most enrolled students had a middle school background – 10,600 people, and 84,3% of them are graduates of 2011.

According to statistical data, the specializations in the field of information and communication technologies are the most requested. In 2011, about 5,7% of all candidates applied for such a specialization.

Table 3 Plan for enrolment in secondary vocational education institutions, professions in the field of information and communication technologies, budget-funded education, period 2009-2011

Name of occupational fields and trades	Number of places		
	2009	2010	2011
Electro-mechanic for repairing and maintaining of calculating machines	0	0	25
Radio-mechanic for maintaining and repairing radio and television apparatuses	55	100	100
Radio-mechanic for repairing radio-electronic equipment	0	25	25
Fitter of aerial and telecommunication lines	50	50	50
Computer operator	695	695	495
Operator of copy and multiplication machines	30	30	30
Telecommunication operator	50	50	50
Total	**880**	**950**	**775**
Share in the total number of places, %	**7,2 %**	**7,0%**	**5,7%**

Source: Official Monitor, no. 96 of 26.05.2009; no. 87-90 of 04.06.2010 and no. 103-106 of 24.06.2011

According to the data of the Ministry of Education, in 2011, 861 graduates obtained a qualification in the field of information and communication technologies, 738 of them (85,7%) being from the occupational field “computer operator”. The system of vocational education practically does not provide training of skilled workers for occupational fields related to operation and maintenance of calculating and telecommunication equipment.

[8] Official Monitor, no. 199-202 of 29.12.2006, art. 1534

As a result of thorough analyses conducted in the process of developing the Draft Strategy for Development of the System of Vocational Education and Training in Moldova for 2008-2015[9] and the Draft National Development Strategy of the Republic of Moldova 2012-2020[10], the following constraints for secondary vocational education were identified:

- the system of secondary vocational education is over-centralized and inert;
- the available material resources are precarious, the equipment of most institutions is outdated and does not contribute to development of professional skills;
- the largest share of teaching aids (manuals, guides, handbooks, etc.) available in secondary vocational education institutions do not respond to present requirements, as they were developed and edited in 70'-80' of the past century;
- only 50% of the capacity of the available infrastructure is used, what leads to excessive maintenance expenditures;
- the average age of the teaching staff in secondary vocational education institutions exceeds 52;
- secondary vocational education lacks a system for initial and continuing training of foremen and instructors of vocational schools;
- vocational training provided by secondary vocational education institutions does not meet the needs of potential employers and of potential students, as it still follows the traditions of the former planned economy;
- with some exceptions, the cooperation with possible employers is formal and inefficient;
- the lack of vocational and occupational standards.

4.3 Specialized secondary education

In Moldova, there are 47 colleges, including 42 state colleges and 5 private colleges. According to the legislation in force[11], colleges are empowered to train specialists for 171 specializations, classified in 30 profiles, including 17 specializations in the field of information and communication technologies. But, in fact, training for only 6 in 17 specializations established by the legislation was provided. This fact might be explained by rapid developments of technologies which caused the disappearance of several specializations required by labor market at the end of the past century.

At the beginning of the 2011/2012 academic year, nearly 31,400 students were studying in colleges. The enrolment in colleges is done upon completion of middle school, high school, or secondary vocational education. In general, the share of students enrolled upon completion of middle school education is very high. In 2011/2012 it amounted to 84%, and such a fact compels the colleges to allot a large share of the educational time to general education subjects, sometimes to the detriment of vocational training.

The share of budget-funded places for specializations in the field of information and communication technologies amounts to nearly 10% of the total number of enrolments.

[9] Ministry of Education, http://95.65.22.221:8080/ISE/resources/stratnat/Strategia_InvProf_17.04.08_var10prefinal_ROM.pdf

[10] Government of the Republic of Moldova, http://particip.gov.md/public/files/strategia/Moldova_2020_proiect.pdf

[11] Law no. 1070 of 22.06.2000 on the Approval of the Nomenclature of specializations for training of the personnel in higher and specialized secondary education institutions. Official Monitor, no. 94 of 03.08.2000, art. 676

According to the data of the Ministry of Education, in the period 2009-2011, there was an increase of the number of graduates who obtained a qualification in the field of information and communication technologies, up to 870 people. The largest share of graduates got a qualification in the following specializations: Informatics (384 graduates), Computers (163 graduates) and Telecommunications (165).

The teaching staff of colleges amounts to about 2500 people, including 85% of teachers and only about 3% – foremen-instructors, what confirms again that general education consumes a significant share of material and financial resources allotted to specialized secondary education.

Table 4 Plan for enrolment in specialized secondary education institutions, professions in the field of information and communication technology, budget-funded education, period 2009-2011

Name of occupational fields and trades	Number of places		
	2009	2010	2011
Informatics	445	360	225
Telecommunications	240	175	100
Radio-electronic systems	115	70	25
Radio-electronic apparatuses and home appliances	90	60	40
Computers	455	130	97
Automation and Informatics	160	155	45
Total	**1505**	**950**	**532**
Share in the total number of places, %	**25.4%**	**17.0%**	**10.0%**

Source: Official Monitor no. 96 of 26.05.2009; no. 87-90 of 04.06.2010 and no. 103-106 of 24.06.2011

Table 5 Number of college graduates, specializations in the field of information and communication technologies, period 2009-2011

Specialization	Number of graduates		
	2009	2010	2011
Automation and Informatics	30	36	24
Computers	175	147	163
Cybernetics and Informatics	124	116	102
Informatics	249	279	384
Radio-electronic systems	44	42	34
Telecommunications	110	110	165
Total	**732**	**730**	**872**

Source: Official Monitor no. 96 of 26.05.2009; no. 87-90 of 04.06.2010 and no. 103-106 of 24.06.2011

The system of specialized secondary education faces, in general, the same constraints as secondary vocational education. In addition to them, colleges also face the following specific constraints[12]:

- a considerable share of human and material resources are assigned to general education, which might be provided in high schools of the communities of students' residence;
- the curriculum is excessively theorized, sometimes too complicated in relation with student age particularities;
- the share of practical lessons is insufficient, therefore students cannot acquire the professional skills required on labor market;
- the deficiencies of the National Qualification Framework and of Occupational Standards, of the Nomenclature of specializations for college education contains some specializations which are inadequate for this educational level;
- insufficient professional training of the teaching staff.

4.4 Higher education

The system of higher education in the Republic of Moldova comprises 34 higher education institutions, including 19 state institutions (2 of them provide just master degree education) and 15 private institutions. According to the legislation in force[13], higher education in Moldova, Cycle I (license degree), is empowered to provide education in 191 specializations, classified in 7 fields of professional education. In the period 2008-2011, at Cycle I, training of specialists in the field of information and communication technologies was done for 18 specializations, including 6 specializations from the general field of education Sciences of Education.

At Cycle II (master degree), the State regulates this sub-sector at the level of general educational fields, and does not have any intervention on the name of specializations. Consequently, higher education institutions may adjust their educational supply to labor market requirements. In 2011, higher education institutions of the Republic of Moldova provided master degree education for nearly 530 specializations, including 40 specializations in the field of information and communication technologies.

At the beginning of 2011/12 academic year, 103,9 thousand people were studying in higher education institutions, including 29,2 thousand students (28%) enrolled in budget-funded education and 74,8 thousand students (72%) – based on a tuition contract.

The dynamics of enrolments in higher education institutions, Cycle I, shows that the share of ICT specializations varies within the interval 7% to 8% of the total number of budget-funded places.

[12] Government of the Republic of Moldova. National Development Strategy of the Republic of Moldova 2012-2020. Draft. http://particip.gov.md/public/files/strategia/Moldova_2020_proiect.pdf

[13] Law no. 142 of 07.07.2005 on the Approval of the Nomenclature of fields for professional training and of specializations for training of the personnel in higher education institutions, Cycle I. Official Monitor, no. 101-103 of 29.07.2005, art. 476

Table 6 Plan for enrolment in higher education institutions, specializations in the field of information and communication technologies, budget-funded education, period 2009-2011

Name of the specialization (syllabi)	Number of places		
	2009	2010	2011
Informatics (education)	95	100	100
Cybernetics and Economic Informatics	45	45	40
Applied Mathematics	20	20	20
Computer Science	45	45	45
Informational Management	20	20	20
Applied Computer Science	60	60	60
Optoelectronic Systems	85	80	35
Telecommunications and Radio-communications	40	35	40
Microelectronics and nanotechnology	50	40	25
Computers	50	50	40
Information Technology	40	40	40
Automatic Control and Informatics	20	20	20
Total	**570**	**555**	**485**
Share in the total number of places, %	**7.8%**	**7.9%**	**7.0%**

Source: Official Monitor no. 96 of 26.05.2009; no. 87-90 of 04.06.2010 and no. 103-106 of 24.06.2011

In higher education, the share of students enrolled based on a tuition contract is much larger than in secondary vocational and specialized secondary education, exceeding the value of 70%. The share of ICT students is even higher - nearly 80%. In 2011, nearly 2500 candidates were enrolled in ICT specializations, Cycle I (license degree).

The statistical data related to graduates of ICT specializations show that 30%-35% of them are of the general field of education Sciences of Education. Throughout the period 2009-2011, nearly 1600 teachers have been trained in the field of teaching informatics in general education. This number overpasses by tens of times the number of vacant teaching positions in the sector of education.

Table 7 Number of graduates, licence degree (Cycle I), specializations in the field of information and communication technologies, period 2009-2011

Specialization	Number of graduates		
	2009	2010	2011
Cybernetics and Economic Informatics	101	142	120
Computer Science (Education)	280	418	460
Automatic Control and Informatics	23	30	22

Computers	80	91	119
Electronics	54	98	104
Geography and Computer Science (Education)	8	28	20
Applied Computer Science	107	128	128
Computer Science and Mathematics (Education)	0	15	39
Informational Management	127	88	118
Applied Mathematics	23	12	29
Mathematics and Computer Science (Education)	73	90	70
Pedagogy in Primary Education and Computer Science	8	10	8
Optoelectronic Systems	36	66	79
Information Technology	164	242	254
Telecommunications and Radio-communications	85	143	124
Engineering and Management in Telecommunications	98	150	120
Physics and Computer Science	20	44	32
Total	**1287**	**1795**	**1846**

Source: Ministry of Education, 2009-2011

There is no legal framework regulating explicitly the share of Cycle I graduates to be enrolled for master degree education (Cycle II), therefore, during the period 2009-2011, the enrolment at this stage of education was left to the discretion of universities, the annual number of budget-funded places for all fields of education and for the respective specializations being established to 2500. The number of Cycle II graduates in all 40 ICT specializations was very low: 14 graduates in 2009, 89 –in 2010 and 236 - in 2011, respectively, 1-5 graduates in each ICT specialization.

The large share of holders of a license degree in pedagogical specializations related to teaching ICT in general education and the small number of master degree graduates in ICT in higher education institutions impose the need for changing the paradigm for training ICT personnel in higher education institutions, as well as for reorienting the system towards providing training in the fields related to ICT industry.

The documents issued by central government[14] and the ones which are now being developed[15] point out the major constraints faced by higher education, which largely touch the training of specialists in the sector of information and communication technologies, too:

- Incoherent application of Bologna Process requirements.
- Incoherence of higher education cycles from the curriculum, managerial and technological standpoint.

[14] Ministry of Education. Consolidated Strategy for Education Development for 2011-2015. Ordinance no. 849 of 29. 11. 2010

[15] Government of the Republic of Moldova. National Development Strategy of the Republic of Moldova 2012-2020. Draft. http://particip.gov.md/public/files/strategia/Moldova_2020_proiect.pdf

- Lack of external structures of quality evaluation and assurance in higher education.
- Low level of inter-connection between the higher education, scientific research and the economic environment.
- The management of scientific research does not match the existing European models and academic needs.
- Dysfunctions in the continuing training of teachers in higher education.
- Incoherent financing of higher education compared to its actual needs.
- Dysfunctions in the achievement of actual university autonomy.
- Low degree of mobility of students and teachers.
- Incoherence between the higher education institutions' network and labor market needs, qualifications' framework and international trends of the status of higher education institutions in society.
- Low level of quality in higher education.
- Insufficient participation of universities in international projects and programs.
- Low level of motivation and accountability for the results of students' learning.
- Lack of an Occupational framework with reference to the status of graduates for each higher education cycle.
- Incoherence between the specialties trained and labor market needs.

5 Analysis

5.1 Skills gaps are confirmed

Firstly, it should be noted that the skills gaps are significant and real. Without exception, the industry representatives confirmed this view. Evidence for this assertion can be seen in:

- The blatant use of internships (where they exist) as a selection mechanism
- Even so, the bulk of recruitment is by "poaching" experienced personnel from other local employers, so driving up inflation of salaries and damaging competitiveness

The volume of shortage is difficult to estimate. One estimate was for 200 systems administrators / systems engineers plus 300 development staff, for just one line of technology. Other technologies could be similar, with Java and Oracle specifically mentioned. If accurate, this combined shortage of 1000 personnel would add some 15-20% to the IT workforce.

But the skills gap is not just technical skills. English language and other foreign language skills are needed too. So are transverse (non-disciplinary) skills of communications, teamwork and project management. Although these are sometimes called "soft skills", this is serious misnomer, as they are difficult to teach and difficult to assess.

The problem is more about quality than quantity, as university graduation has already increased by one-third over just the last two years. Some industry representatives claimed that only 30% of ICT graduates are directly employable. Even if this is exaggerated, it represents a huge waste of expenditure on higher education.

5.2 Classification of issues

For the purposes of this report, we classify the issues under four main headings or themes:

- Physical assets for teaching, ie the hardware, software, networks and their management
- Curricula
- Teachers and teaching
- Governance of the whole system, sometimes called the academic infrastructure

In practice, many of these issues are interlinked; nevertheless it is helpful to group them for analysis. This classification was presented in the Interim Workshop, and is used in the next sections and in the Action Plan that follows.

5.3 Teaching facilities

All university faculties and the college that were visited had adequate number of IT laboratories and PCs, well laid out. Although a small minority of equipment was modern, the vast majority was many years old, including some very outdated Pentium 2 and 3 machines.

The effect of such outdated hardware is that it cannot run modern IT software, modern educational materials, or access modern broadband networks or the Internet.

Almost universally, it seems that the software is pirated. This means it is not supported or maintained by the supplier, bugs are not fixed, and newer facilities are not incorporated.

Expenditure on IT labs competes with all other school and university expenditure, including salaries and building maintenance.

It is considered essential that IT labs are maintained and managed on a systematic basis, with annual budgets for hardware, software and network updating, maintenance and licenses. It is suggested that software is updated annually during the summer vacation and hardware at least every five years.

5.4 Curricula

Alongside physical facilities, we consider that university curricula should also be updated. There is no formal mechanism for industry involvement in curricula design, although informal input is obtained through internships and part-time lecturers who also work in industry.

Of course, universities have to prepare their students for a lifetime career by teaching fundamental principles rather than passing fads. Nevertheless, modern software engineering, database, network technologies, and programming languages should all be included in undergraduate courses. More specialist topics, e.g. SAP, could be covered in master's courses.

In any case, it is a requirement of the European Bologna Process (which Moldova adopted back in 2005) that universities involve employers' needs in their curricula design. Collaboration with leading European and international universities would also be beneficial.

It is recommended that the universities set up a formal annual mechanism with ATIC to review and update their ICT curricula.

It is considered that the major international vendor education schemes can be used in both schools and universities. They provide a wealth of curricula materials including lesson plans, teacher guides, some with optional certification schemes. They are regularly updated and in use throughout the world. Examples are:

- Microsoft Essentials and Advanced (suitable for schools and universities respectively)
- Intel Education Initiative
- Cisco Network Academy

5.5 Teachers and teaching

The next issue, after facilities and curricula, is teaching and teaching methods, although it can be the most difficult to remedy.

Firstly, schools and universities are not attracting the best candidates, in part because salaries are too low.

There appears to be little formal performance management or staff development process, linked to pay and promotion.

Another aspect of the Bologna Process (and the equivalent Copenhagen Process for VET) is the move to *Learning Outcomes*. Learning Outcomes are statements of what a learner has learnt, and can include knowledge, understanding, and ability to perform a task, in a real (work) situation. The use of LOs can be contrasted with a syllabus – which is input not output.

A related matter is the move from traditional lectures to a more action-oriented style of teaching, including more practical work, projects and group assignments rather than individual homework. (This is also sometimes called action learning, activity-based learning, student centered learning, experiential learning and other terms. Note the emphasis on learning rather than teaching.)

Transfer of handwritten or typed lecture notes to PowerPoint and a projector, although welcome, does not by itself transform teaching and learning methods.

Understandably, some teachers have difficulty with the rapidly changing teaching materials in ICT and/or these new ideas of teaching and learning.

We consider that the existing network of in-service teacher training centers if properly resourced could become a powerful mechanism for the professional development of teachers, at school, college and university levels.

5.6 Governance of Education

Our final theme, Governance of Education, is concerned with how the whole set-up is structured and managed. It is sometimes called the *academic infrastructure*, but does not mean the physical buildings.

The most important ingredient is the proposed *Education Code*. This has been under development in the Government and Parliament for some years and its completion, publication and implementation is long overdue. Important components of the Code are:

- Clarification of the autonomy of universities, especially the degree of financial authority
- Clarification of the role of the Academy of Science
- Clarification of the status of technical and vocational colleges, and the whole VET system

A major component of the Bologna Process is the improvement and formalization of quality assurance processes. There are two parallel elements:

- Establishing internal quality assurance functions and processes within each university
- Establishing an independent quality assurance agency in line with European norms to oversee and guarantee the academic integrity of higher education

In addition, it is recommended that universities appoint external examiners (from other universities and from business) to work alongside the internal examiners, as another quality assurance mechanism. This could start with post-graduate programs, and then extend to bachelor programs.

Equally important (and another Bologna component) is to improve and formalize engagement between universities and education. Elements of this engagement are:

- Business involvement in curricula design
- Provision of internships for both teachers and students, and visits for schools
- Provision of part-time and occasional lecturers for new and specialist topics

In order to manage this process, it is recommended that universities establish an “industry engagement” unit, and similarly that ATIC encourages its members to improve and formalize their university relations.

Specifically, the universities and ATIC should organize a joint annual process to review curricula. Another aspect would be to appoint business representatives to serve on university Senates and faculty boards.

6 Conclusions and Recommendations

6.1 Conclusions

It is clear that the problem is real and significant. Without exception, industry reports that its growth is constrained by the lack of skills, as described in Section 2.

It is not just technical skills, but also the more difficult non-technical skills such as communications, team-work and project management. The teaching of English language at schools and universities is particularly important for the ICT sector. Other foreign languages too are needed.

Moldova has made progress in introducing ICT into schools, and expanding ICT in colleges and universities. But much more needs to be done in improving the facilities.

Quality is just as important, if not more so, than quantity. Improved arrangements for quality assurance are urgently necessary.

The institutional arrangements, processes and communications to remedy matters are weak.

6.2 Constraints and Challenges

The recommendations discussed in the previous section, and tabulated in the next pages, present a formidable challenge to the leadership of education and industry. The issues have been well researched before. The task must now move from analysis to implementation. The principal challenges are:

- The leaders in government, education and business uniting in a common endeavor, with real commitment to action to transform this situation
- Management capacity in all three areas, in the face of all the usual daily activities
- Technical and financial support from donors (which in turn depends on the first two)

6.3 The Way Ahead

The new ICT Education Council established by the Ministry of Education provides an ideal vehicle to oversee implementation. Working Parties could be created, say one for each of the four themes, starting with the priority actions under each theme. As progress is made, and harmonious working relationships established, then other items could be selected for attention.

6.4 Agenda for Action

Ref.	Recommendation	Responsible	Priority/Timescale, yrs.	Cost
Theme: Teaching facilities				
A1	Resolve that every new computer installed from now on will have licensed software	ALL	0	Medium
A2	Introduce IT Lab management maintenance and budgeting process	Schools and universities	1	Low
A3	Maintain hardware and software regularly, e.g. in semester breaks		1	Low
A4	Update IT Lab hardware in schools and universities over a five year program	Schools and universities	2 - 5	High
A5	Update IT Lab software over three year program		2 - 3	High
A6	Set up outsourced IT lab maintenance service for schools at district level	Ministry of Education	2	Medium
A7	Introduce CTO function at educational institutes	Ministry of Education	2	Medium
A8	Develop and expand central resource of educational software	Ministry of Education	3	High
A9	Create environment, furniture for group work	Universities	2	Low
Theme: Curricula				
B1	Develop and introduce formal annual curricula review process with industry	Universities and ATIC	1	Low
B2	Collaborate with international university (Europe, US or Asia)	Universities	2	Low
B3	Collaborate with additional international university	Universities	3	Low
B4	Introduce one vendor education program in universities	Universities	1	Medium
B5	Introduce vendor education program in school	Ministry of Education	2	High
B6	Introduce additional vendor program in universities	Universities	3	Medium
B7	Increase English language in universities for ICT; teach ICT through English	Universities	2	Medium
B8	Increase foreign languages in schools, especially English	Ministry of Education	3	High
B9	Consider Joint Degrees, student exchange, academic exchange, twinning	Universities	2	Low
B10	Introduce typing in secondary schools	Ministry of Education	4	Low
B11	Introduce ICT in primary schools	Ministry of Education	5	high
B12	Expand ICT literacy certification schemes in schools and universities	Schools and Unis	3	Low
Theme: Teachers and teaching methods				
C1	Introduce performance management system with annual appraisal	Ministry of Education	1	Low
C2	Establish improved salary system based on performance	Ministry of Education	2	Medium
C3	Expand staff development schemes for in-service teacher training for ICT	Ministry of Education	1 - 2	Medium
C4	Upgrade existing network of teacher education centers for ICT	Ministry of Education	2	Low

Ref.	Recommendation	Responsible	Priority/Timescale, yrs.	Cost
C5	Internships for teachers in companies, say one semester every 5 years	Universities, Colleges	2	Medium
C6	Visits to industry for school pupils	Ministry of Ed, Industry	3	Low
C7	Careers information and guidance for universities	Industry	2	Low
C8	Careers information and guidance for schools	Ministry of Education	3	Medium
C9	Provide further training to teachers on action oriented teaching	Universities	3	Medium
C10	Establish ICT teacher association	ATIC ?	2	Low
C11	Academic exchanges, two way, twinning with foreign universities	Universities	2	Low
Theme: Governance of Education				
D1	Complete and adopt new Education Code	Ministry of Education	1	Low
D2	Implement Education Code: Doctoral schools	Ministry of Education	3	?
D3	Implement Education Code: VET	Ministry of Education	2	Medium
D4	Implement Education Code: University autonomy	Ministry of Education	1	Low
D5	Set up Quality Assurance departments in each university	Universities	1	Low
D6	Set up new independent Quality Assurance Agency to oversee standards	Ministry of Education	2	Medium
D7	Set up industry engagement unit in each ICT faculty	Universities	1	Low
D8	ATIC / members to appoint university liaison officer(s)	ATIC, Industry	1	Low
D9	Appoint business representatives to Senate, say 25% of senate	Universities	2	Low
D10	Appoint external examiners for ICT faculties from business	Universities	2	Low
D11	Allow tax deductions for training and donations of equipment or software	Ministry of Finance	2	Low
D12	Introduce scheme for teachers to purchase PCs at favorable terms, e.g. tax deductible or vouchers.	Ministry of Finance, Ministry of Education	3	Medium
D13	Update/abolish registers of Occupations; Professions and Apprenticeships; Secondary College cycles; University first cycles	Ministry of Labor, Ministry of Education	2	Low
D14	Introduce compulsory graduate tracking mechanism	Universities	2	Low
D15	Publish annual report, with academic and financial performance	Universities	2	Low
D16	Develop professional and occupational standards for ICT	Industry	3	Medium

Annex A List of Research Materials

Consolidated Strategy for Education Development 2011–2015; *Ministry of Education, Republic of Moldova; 2010*

Consolidated Action Plan for Education Sector (2011-2015); *Ministry of Education, Republic of Moldova; 2010*

Action Plan for the implementation of the concept of medium term state policy on training specialists with vocational secondary, post- secondary and higher education for national economy of the Republic of Moldova; *Anatol Gremalschi; 2007*

Policy Paper: Education and Human Development – Actual and Future Challenges*; IPP, UNDP; 2010*

Policy Brief: Higher education system in the Republic of Moldova in the context of the Bologna Process, 2005-2011; *2012*

SWOT Analysis of Higher Education; *Soros Foundation Moldova, IDIS Viitorul; 2012*

Policy White Book: ICT Sector in Moldova; *Moldovan Association of Private ICT Companies (ATIC); 2009*

Moldovan ICT sector value chain analysis – Selective sub-sector brief assessment; *Centre for the Promotion of Imports from developing countries (CBI), Ministry of Foreign Affairs of the Netherlands; 2011*

White Paper: Competitiveness Assessment of the Moldovan IT Market; *IDC; 2011*

Determining the need for trainings and other training activities for companies and ICT specialists within the Republic of Moldova; *Magenta Consulting; 2011*

Draft Action Plan for ICT Education; *Ministry of Education working group; 2012*

Knowledge based Economy and ICT Education in Estonia; *Praxis; 2006*

Transforming the UK into the world's leading talent hub for the video games and visual effects industries*; Next Gen., Ian Livingstone, Alex Hope; 2011*

ICT, Education Reform and Economic Growth: A Conceptual Framework*; Robert Kozma, Intel; 2008*

ICT, Education Reform and Economic Growth: The Role of the Intel Education Initiative; *Intel; 2008*

Lessons: What Can the World Learn for Educational Change in Finland?*, Pasi Sahlberg, Book review by Diane Ravitch; 2012*

The future of higher education, *BCS Chris Yapp Blog, http://www.bcs.org/content/conBlogPost/2049; 2012*

Annex B List of Interviews

Government	
Ministry of ICT	Dona Scola, Vice-Minister
	Dorin Recean, Vice-Minister
Ministry of Education	Elena Tetrov, Main Consultant, Higher Education Tatiana Gherstega, Consultant, Higher Education
	Iurie Mocanu, Head of ICT Division
Academia	
State University USM	Andrei Perjan, Dean of Maths and Informatics Faculty
Technical University UTM	Larisa Bugaian , Deputy Rector
	Ion Balmus, Dean Computers, Informatics and Micro-electronic Faculty
	Sergei Andronic, Dean Radio-communications Faculty
College of Informatics	Vitalie Zavadschi, Director Andrei Ciobanu, Deputy Director and Head of Informatics
Industry	
ATIC	Ana Chirita, Executive Director Ruxanda Plesca, Project Manager Education
Pentalog	Serghei Goloborodico
GPG	Olivier Prado, Chief Executive Office
Microsoft	Serge Shmigaliov, Business Development Manager
Cisco Network Academy	Roman Damian, local CISCO Academy Administrator
NetInfo	Alexandru Sclearuc, Director
Moldtelecom	Gabriela Popescu, HR Director Angela Cazac, HR Dept Irina Turcan, Recruitment
Moldcell	Victoria Bolboceanu, HR Manager

Endava	Helene Speight, Group Talent Manager Diana Bocaneala, Group Training Manager Christina Putuntica, Recruitment officer, Moldova Nicolai Godiac, Delivery Unit Manager, Moldova Igor Bercu, Head of Consultancy, Moldova
Allied Testing	Evghenii Galamaga, Regional director Alexander Vladimirov, Manager Training
Others	
CEED II	Doug Griffith, Chief of Party Doina Nistor, Deputy Director Ionela Ciuhrii, IT Industry Manager

Annex C Acronyms

ATIC	Moldovan Association of Private ICT Companies
BNM	National Bank of Moldova
CEED II	Competitiveness Enhancement and Enterprise Development II (USAID funded Project)
CIS	The Commonwealth of Independent States
CORM	Occupation Classifier of Republic of Moldova
CTO	Chief Technology Officer
GDP	Gross domestic product
ICT	Information and Communications Technology
IDC	International Data Corporation
IT	Information technology
USAID	United States Agency for International Development