IT SKILLS ASSESSMENT IN ARMENIA

The Global Information and Communications Technologies (ICT) Unit

The World Bank

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Contents

Abbreviations

AUA: American University of Armenia

CAGR: Compound Annual Growth Rate

ERA: European Regional Educational Academy

FDI: Foreign Direct Investment

GDP: Gross Domestic Product

IT: Information Technology

NSS RA: National Statistical Service of the Republic of Armenia

RAU: Russian-Armenian (Slavonic) University

SEUA: State Engineering University of Armenia

UITE: Union of Information Technology Enterprises

WEF: Women's Economic Forum

YSU: Yerevan State University

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Acknowledgement

This report is prepared by Sandra Sargent (Senior Operations Officer) and Saori Imaizumi (ICT Innovation & Education Consultant) at the Global Information Communication Technologies (ICT) Unit of the World Bank with EV Consulting based in Armenia. The team would like to thank Bagrat Yengibaryan (Director, Enterprise Incubator Foundation) for and the peer reviewers, including Ulrich Bartsch (Senior Economist), Feyi Boroffice (Finance and Private Sector Development Specialist), Siddhartha Raja (ICT Policy Specialist), and Vigen Sargsyan (EXT, Yerevan Office) for guidance and support provided with preparation of this report.

Executive Summary

IT and High technology sectors are one of the fastest growing sectors in the economy of Armenia.

Since 2006, the sector, excluding Internet service providers, has grown with a CAGR of 22% reaching the total output of $294m in 2013. The number of companies operating in the sector has reached to about 380, the number of employees- ~8,000. About 13% of the companies operate in High-technology domain, while the rest are IT companies.

One of the driving factors of the sector growth was its attractiveness for foreign companies to establish branches in Armenia. The prime competitiveness pillar is the availability of relatively cheap and competitive human resources in Armenia. Currently, Armenia seems on the verge of losing this competitive advantage.

Due to growing number of IT companies in Armenia, demand in IT specialists will continue to increase. According to the conservative estimation, if the market and productivity continue to grow with an average rate of 18% and 1% respectively, the absorption potential of additional IT specialists will grow at a rate of 17% annually and reach ~15,000 by 2017.

The sector is undergoing a major transformation right now: there is an increasing shift from the outsourcing model to the model of own product development and entrepreneurship in the sector. This model of growth requires a higher level of knowledge, new skills (such as sales skills), entrepreneurial knowledge.

The outsourcing model mostly fostered the growth of the sector as well as attraction of international companies and FDI. The model is based on the outsourcing activities, which can be sustained because of low-cost on a global labor market and high-quality workforce, beneficial to foreign companies. Thus, the model is built on the basis of cost-competitiveness.

The current developments in the sector are towards higher value added **entrepreneurship model.** The presence of international companies, which bring sector-specific culture into the country, and international startup boom force the development of the model among IT and high-tech specialists. The further developments are expected to drive the market towards the more value-added and growth of the sector. Educational sector needs to quickly adapt and reflect these challenges in order to sustain the sector competitiveness.

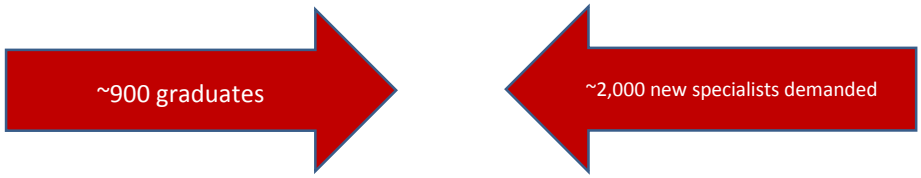
In order to sustain the growth based on the high quality labor force, the country currently faces the issue of providing sufficient supply. The increasing demand for IT skills is a global trend, but in Armenia it is more constraining due to small size of the labor force and the country and increase in competition between the local industry and multinationals. At the current point of development of the sector, this is a complex issue, as the skills gap increases with the positive dynamics and development of the industry. This implies that the shortage of the skills is increasing in parallel with the sophistication of the industry.

IT and High-technology companies view the mismatch between the supply and the demand of the skilled IT labor as a key factor that hinders the growth of the sector.

Currently, the university degree is not viewed as a crucial decision factor in recruitment by companies, indicating the diminishing role and image of higher education in the sector due to the insufficient quality of graduates. Companies consider the Master's degrees to have a limited benefit on top of knowledge gained through undergraduate studies. This observation demonstrates that Master's Degree programs in IT and High Tech are not adequately meeting market expectations. Also, there is a possibility of a limited sophistication of the IT market that doesn't yet require high end skills obtained from Master's Degree.

Overall, the higher education system in Armenia lacks the competitive dynamism and efficiency when it comes to IT skills. The quest to join European Higher Education Area pressures Armenia to reform. Armenia is undertaking reforms through the Bologna process in order to join the European Higher Education Area.

Currently, the number of graduates with IT specializations annually closely coincides with the annual demand in the overall market, but only 45% of the graduates consider or qualify to be employed in the sector, thus, creating a quantitative imbalance of workforce.



IT and High technology sector

The number of specialists demonstrates the demand only in IT and High technology sector and does not include non-IT and non-high technology companies, which are also in need of IT specialists. Thus, the actual demand in the market might be much higher than 2,000 new specialists per year.

In addition, due to the positive and fast industry dynamics there is also a qualitative skills gap conditioned by the following factors:

- Teaching programs are not correlate with the private sector standards: the private sector assessment for practical and theoretic knowledge of graduates is below average
- No effective links between university and private sector companies are in place to organize internships and recruitment procedures
- Professional standards in teaching staff is lower than desired and there is no opportunities to requalify
- Teaching staff is aging, while the younger generation with hands-on experience has little interest in academic career
- The university programs do not accentuate self-development and self-educational capabilities of graduates, essential for the dynamically developing industry
- There are limited alternatives such as certification programs to formal university degree program

- There are limited post graduate re-qualification training programs for base and senior level specialists

To address the sector issues short and long-term recommendations are suggested.

Short-term recommendations:

- A new university curriculum would benefit from the inputs of private sector to correspond to industry needs. For this purpose, it is recommended to establish special curriculum development boards and elect board members from the industry specialists and executives.
- It is recommended that the policymakers explore the possibility of increasing the quota of the students in IT-related faculties, whose tuition is funded by the Government. Provided there is additional budget, the higher number of the free student quota, which is allocated to students based on their entrance exam results, will attract more qualified candidates.
- The link between the universities and private sector should be strengthened through reinvigorating the role of mandatory internship/apprenticeship programs. The dialogue between the parties can be strengthened through creation of a new standard of internship programs - apprenticeship, mandatory for students to receive the degree.
- More young professionals from sector should be encouraged to teach in the universities through a guest lecturer programs.
- The urgent need in entry level and senior level specialists can be satisfied via creation of special certification training programs, currently limited on the market.
- Co-financing schemes for workforce development by means of training centers creation can help smaller companies to close the skill gap.
- Special matching co-financing schemes can be developed supported by the government to support establishment of special training centers co-shared by the companies.
- Widespread and targeted communication campaigns shall be organized to highlight the prospects and strong market demand for the engineering profession.
- The quantity of applicants in technical faculties is to be stimulated by information campaigns on the engineering profession, where the engineering career is presented to be at the core of modern economy.

Long-term recommendations:

- The university funding needs considerable increase as well as diversification through research grants and endowment foundations.
- The government approach to supporting skills development need to be focused on solving and comprehensive.
- The number of university-based laboratories, which are established with the help of multinationals, should be scaled up. Similar to the establishment of ANEL together with National

Instruments, USAID and Government, more laboratories need to be established on the university premises to enable the technical environment for the students.

- Creating an alternative program such as certifications and associates degree to prepare software programmers in less than 4 years will help increase the supply of labor in the medium term.
- The universities may consider revitalizing their career centers in order to support their graduates.
- If Armenia aspires to transition from outsourcing, development center destination to one of innovation centers functioning under entrepreneurship model, it has to integrate fundamental research and development practices into its university system. The development of innovation, R&D capabilities is easier to inculcate if students are accustomed to performing fundamental research from early years of their study.
- High tech accelerators can become a valuable resource for entrepreneurs.
- As the entrepreneurship model will require a more innovative and high end solutions and product development, it eventually requires high level graduate and post graduate base and radically new approaches to education and skill development to move up the innovation value chain.

OBJECTIVE OF THE STUDY

The purpose of the study is to assess the potential gap that exists between the demand and supply of qualified human resources in IT and high technology sectors. Having sufficient qualified specialists with corresponding skillset has a major impact on IT/High Technology sector growth potential and can be a core driver of further development. Armenia's IT/high technology sector is facing constraints with recruitment of the talent that can lead to a loss of the competitiveness of the sector.

The study collects and analyses data provided by the private sector on the quality and relevance of existing labour force and constraints faced by the industry during recruitment. It also reviews main impediments to closing the existing skills gap in the market. This analysis can help policy makers to:

- Examine the impact of the skills gap on the further development of the sector
- Assess the performance of IT education and training systems and workplace demand in the context of IT and High Tech Industry
- Identify the critical bottlenecks and reduce deficiencies in the overall ecosystem necessary to prepare qualified specialists

SCOPE OF THE STUDY

The study relied on secondary data, statistical data, and collected primary data through survey and interviews implemented within the following scope:

1. **Survey** on 30 companies operating in IT and high technology sectors in Armenia
2. **Interview** with 5 major higher educational institutions operating in Armenia
3. **Interview** with 5 main training centers, industry experts, several students and other stakeholders from the IT community in Armenia.

On the demand side, the study is based on the information collected through interviews and assesses the employers' satisfaction level of graduates' theoretical knowledge and practical skills, their soft skills and fluency in English, and additional generic capabilities. Valuable inputs from industry experts including Union of Information Technology Enterprises (UITE) and Granatus Ventures were also collected and analyzed in the report.

On the supply side, the survey focused on the main providers of IT education, their programs and quality of teaching staff, the estimation of the potential quantity of graduates, and the identification of key quality constraints.

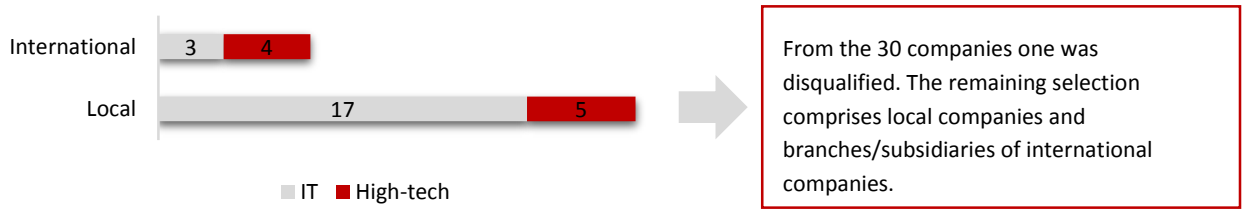
Secondary data is sourced from the National Statistical Service of the Republic of Armenia (NSS RA) and the Ministry of Education of the Republic of Armenia.

The report juxtaposes the demand and supply parameters and analyses the implications on the sector for the upcoming 3-4 years. Based on the assessment result, high-level recommendations are given to address the system constraints and support the sector's growth and competitiveness.

METHODOLOGY

A rapid assessment methodology was applied to collect both quantitative and qualitative data from companies and education institutions. The target sample for the demand side survey was executives and HR managers of the companies. It is noteworthy that the sample size of the survey comprises ~13% of total players in the sector; nevertheless, it reflects the viewpoints of the major players of the field. The selected sample includes major market players and representatives of companies of various sizes, origin, activities, and target markets. Figure 1 shows the composition of international and local companies. Majority of the companies surveyed was local companies.

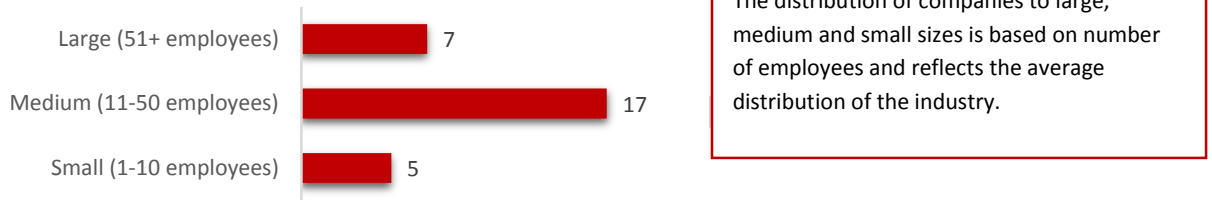
Figure 1: Number of companies participated in the survey categorized by type and origin



Source: EV Consulting company survey

As indicated in the Figure 2, large, medium and small companies were included in the sample to build an objective evaluation of the market trends and balance the outcome of the responses based on different skills gap issues faced by different size of the companies. While more IT companies are surveyed than high-technology companies, the number of employees in high technology companies exceeded.

Figure 2: Number of surveyed companies categorized by size



Source: EV Consulting company survey

Figure 3: The number of respondent companies and their total employees categorized by company type

Supply side data was collected through interviewing main representatives of educational systems in Armenia, such as all major universities which have a considerable role in IT education, along with training centers and other major parties, including university labs and career centers.

Figure 4: Number of survey participants representing IT education sector

Source: EV Consulting company survey

Data collection for the survey took place from 29 March 2014 to 29 April 2014 and included 43 interviews. Depending on the situation of the respondent, the time taken to interview and complete the questionnaire ranged between 30 to 90 minutes.

All the interviews were conducted face to face by an interviewer on the company, university or other party premises. The interviewer also administered the corresponding background questionnaires (in Appendix).

The forecasts are carried out based on the understanding of the existing plans and upcoming initiatives of major educational establishments providing IT education and companies in the upcoming 3 years.

1. OVERVIEW OF IT AND HIGH TECHNOLOGY SECTORS IN ARMENIA

1.1. INTERNATIONAL CONTEXT

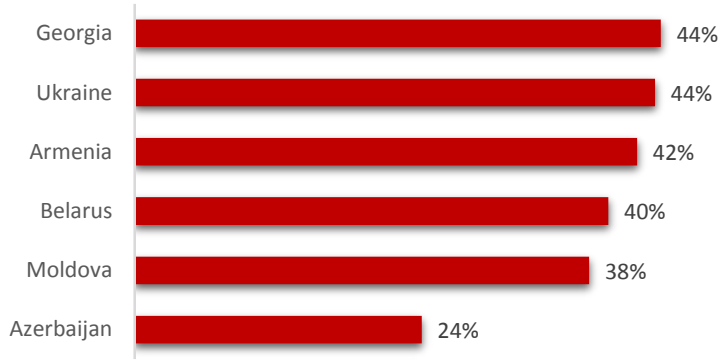
Internationally compared, Armenia has competitive workforce, relatively favorable trade environment, and increasing computer and information services exports, compared to other neighboring countries. According to the global competitiveness index, Armenia ranked 79 out of 148 countries in 2013-2014 where the Russian Federation ranked the 64th.

From the trade perspective, according to OECD's trade facilitation indicators, Armenia's trade facilitation performance is better than the averages of Europe (non OECD) and Central Asia and lower middle income countries in the areas of information availability, automation, and internal border agency co-operation. [1] On the other hand, Armenia performs less well on appeal procedures and simplification and harmonization of documents. Yet, the country exceeds in all these five areas compared to lower middle-income countries. Trade facilitation indicators identify potential areas of improvement to bring more impact of trade through improving border procedures, reducing trade costs, boosting trade flows and getting greater benefits from international trade.

In terms of education level, Armenia has higher share of population with university degrees compared to other countries. The European Training Foundation conducted a comparative study among Georgia, Armenia, and Morocco in 2012. The results show that compared to Morocco, Georgia and Armenia has higher education level due to the Soviet legacy of being a high tech hub. On average, one-quarter of the population in Georgia and Armenia has university degrees. [2]

In IT industry, Armenia performs better than other neighboring countries in terms of computer and information services export, while only around half of the population uses internet as of 2011. [3]

Figure 5: Percentage of population using Internet, 2011



[1] http://www.oecd.org/tad/facilitation/Armenia_OECD-Trade-Facilitation-Indicators.pdf

[2] http://www.etf.europa.eu/webatt.nsf/0/E811EB8749A0287BC1257C0700318D02/$file/Migration&skills_Armenia&Georgia&Morocco.pdf

[3] Data is based on the World Bank's Armenia ICT Trade Report, July 2013.

Figure 6: Computer and information services as % of all commercial services exports, 2012

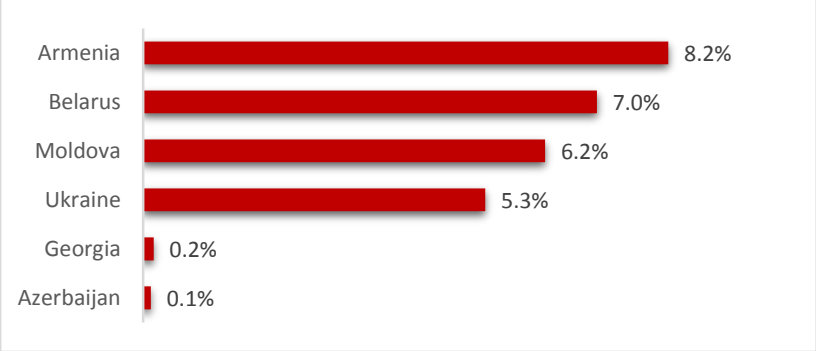
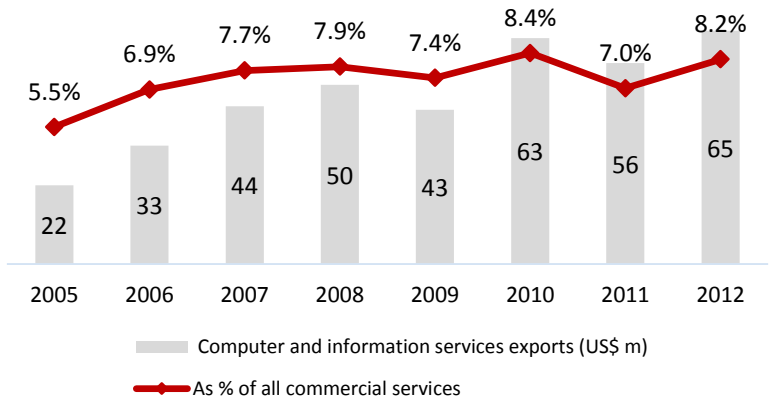


Figure 7: Armenia computer & information services exports



1.2. HISTORICAL DYNAMICS OF THE SECTOR

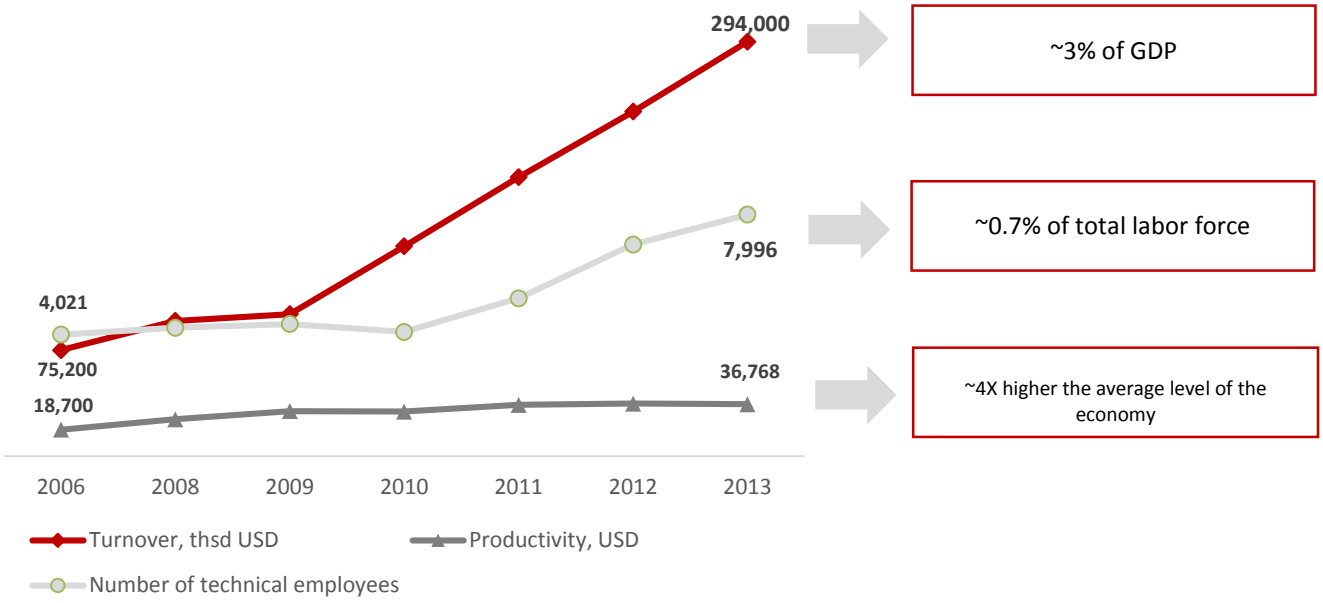
IT and High technology sectors are one of the fastest growing sectors in the economy of Armenia. The importance of the sector is growing despite its yet small output and number of workforce, comprising only 0.6% of the total employed population in Armenia.

Although the Government has declared IT sector as a priority for the economy in 2002, the support is accelerated recently through institutions such as IT Development and Support Council chaired by the PM, Enterprise Incubator Foundation backed by the World Bank funding and others.

The average labor productivity of the sector is about 4-5 times higher than the general average of the economy. The productivity has a growing trend, too, almost doubling from the level of 2006 (CAGR (Compound Annual Growth Rate) of 9%). However, the growth rate is gradually showing a sign of sector's maturing.

Since 2006, the sector, excluding Internet service providers, has grown with a CAGR of 22% reaching the total output of $294m in 2013. The sector output accounts for about 3% of the country's GDP (Note: the calculation is based on the total output of the sector divided by GDP, due to the absence of corresponding value added indicator in Armenian national statistics database). On the other hand, the share of labor force engaged in the sector is only about 0.7% of the country's total workforce.

Figure 8: IT industry turnover, labor productivity and number of employees, 2006-2013



Source: EIF, Armenian IT Industry Report, 2006-2013

The number of companies operating in the sector has reached to about 380 according to the estimates of EIF. For this study, the sector is analyzed in two subsectors: IT and High technology companies.

- **IT companies**: engaged in software and systems development, web and mobile programming.
- **High technology companies:** engaged in the development of software and hardware to design, build, and utilize engines, machines and automation structures.

The rough division of the number of companies in each sector shows that the major portion of companies is mainly IT oriented:

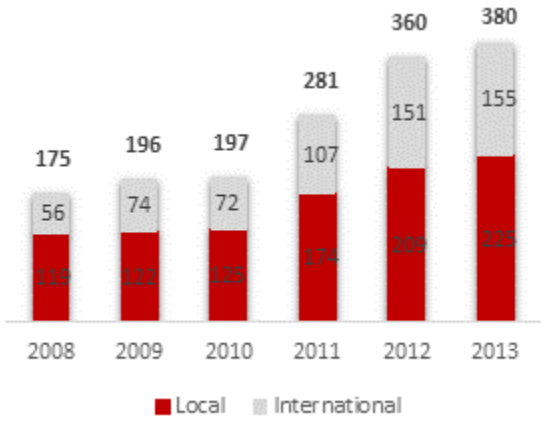
IT companies	High tech companies
~87% in the total number of companies	**~13%** in the total number of companies

Source: NSS, Armenia

One of the driving factors of the sector growth is its attractiveness for foreign companies to establish branches in Armenia. The prime competitiveness pillar is the availability of relatively cheap and competitive human resources in Armenia. Armenia seems on the verge of losing this competitive advantage.

The breakdown of the companies by local and international shows the growing share of international branches:

Figure 9: The dynamics of the company distribution in IT sector of Armenia



Since 2008, the number of IT companies doubled with overall CAGR of 20%. The growth rate of the number of international companies outpaced that of the local companies by 9 percentage points (14% compared to 23% of international companies).

Source: EIF, Armenian IT Industry Report, 2006-2013

The growth in the number of local IT companies is purported by the thriving entrepreneurial spirit in the sector. According to industry expert analysis, around 20 IT startups were founded each year in the country since year 2000.

M&A activities intensified in the industry driven by foreign companies, such as Synopsys (with the acquisition of LEDA Systems, Virage Logic and Monterey Arset), VMWare (with the acquisition of Integrien Corporation) etc., seeking talent and qualified pool of software and hardware engineers.

1.2. TRENDS AND DEVELOPMENTS

The dynamic growth of the sector is marked with a number of significant developments.

Due to the high demand in IT workforce, several training centers and laboratories were established within the premises of universities with the collaborative effort of state, non-profit, private and government sectors. Among the established training centers are Microsoft Innovation Center, mLAB ECA, Armenian-Indian ICT Excellence Center, and etc.

The creation of Armenian National Engineering Laboratory in the premises of State Engineering University, a program worth $6.2m, is remarkable in its attempt to provide modern engineering tools and equipment and invigorate the strong engineering potential of Armenia.

Gyumri Information Technology Center was launched with the objective to house state-of-art laboratories, educational centers and business incubators. Two other techno parks are planned to be established. Multinationals such as IBM and Oracle have preliminary agreements with the government to establish excellence centers in Armenia.

The establishment of the first venture capital fund, Granatus Venture Fund I, with the support of the World Bank and Government marks a crucial milestone in startup ecosystem formation.

1.4. GROWTH POTENTIAL OF THE SECTOR

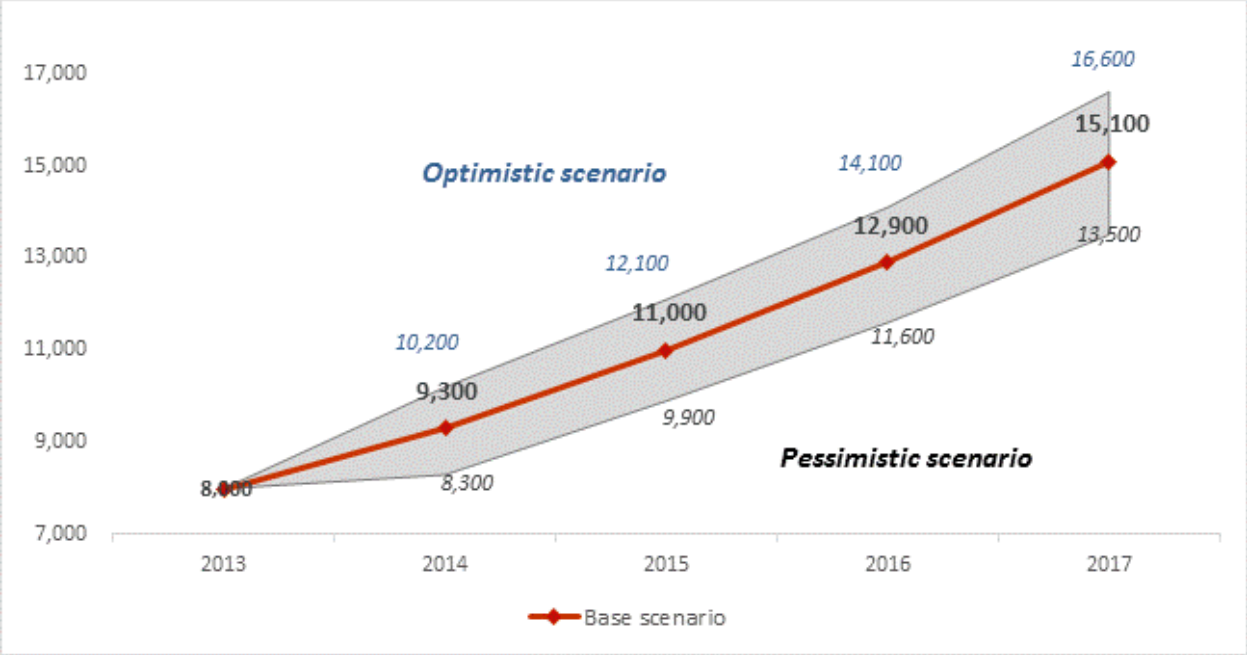
The industry has two sources for sustainable strong growth:

- Continued interest from international companies and a flow of FDI to the sector. This will require the industry to sustain its current competitive advantage of low-cost and quality workforce relative to advanced markets. The current trend is contrary, due to increasing scarce skilled workforce in the sector and rising remuneration levels.

- Rising entrepreneurial spirit in the sector and a growing number of start-ups founded locally. This will also mean that the quality human resources in the sector are keys, along with opportunities of linking towards international markets, venture funding, and etc.

The IT sector output is generally forecasted based on the IT workforce number, as the main constraint. Nevertheless, in order to assess the sector's absorption potential of human resources, the potential growth of the sector was forecasted- Base scenario - based on sector's historical performance. The base growth scenario assumes that continuation of the conservative average output growth trends is about 22% and average productivity rate is 4%. Pessimistic and Optimistic scenarios are projected to include the market volatility.

Figure 10: The forecasts of employee absorption potential in IT and Engineering sectors



Source: EV analysis

Due to growing number of IT companies in Armenia, demand in IT specialists will continue to increase.

The tendencies of growth of local and international companies on the market shape a strong message about the increasing demand of IT specialists in Armenia. According to the conservative estimation, if the market and productivity continue to grow with an average rate of 18% and 1% respectively, the absorption potential of additional IT specialists will grow at a rate of 17% annually and reach ~15,000 by 2017 (see

Figure 3). This implies that the annual number of new specialists required in the next 3 years will be ~1,000-2,000.

The quality of specialists and the level of skills will have an utmost importance. The increasing pressures on productivity also dictate the need to shift to higher value added niches for the sector. This requires new skillset for the total sector.

The sector is undergoing a major transformation right now: there is an increasing shift from the outsourcing model to the model of own product development and entrepreneurship in the sector. This model of growth requires a higher level of knowledge, new skills (such as sales skills), entrepreneurial knowledge.

The outsourcing model mostly fostered the growth of the sector as well as attraction of international companies and FDI. The model is based on the outsourcing activities, which can be sustained because of low-cost and high-quality workforce, beneficial to foreign companies. Thus, the model is built on the basis of cost-competitiveness.

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2. DEMAND SIDE ANALYSIS OF SKILLS GAP IN ARMENIAN IT AND HIGH TECHNOLOGY INDUSTRY

2.1. QUANTITATIVE DEMAND ANALYSIS OF SECTOR COMPANIES

IT and High-technology companies view the mismatch between the supply and the demand of the skilled IT labor as a key factor that hinders the growth of the sector.

There is qualitative gap of skills needed in IT and High technology sector companies and supplied by the higher education system of the country. This translates into constant quantitative need of new employees in the sector.

Survey of the IT and high technology companies showed the almost permanent need of the companies for new talent with particular technical knowledge and skillset. The survey assessed the short-term (upcoming 3-4 months) and long-term (up to 3 years) needs of the companies.

About 70% of companies had one or more vacant positions at the time of the interviews and/or were planning to have during the upcoming period of 3-4 months. Only 10% of the companies were not in search for new talent.

Long-term forecasting of growth trends cannot be accurate due to the volatility of the sector, as well as the project-based nature of most companies, however, the rough estimate of future talent estimated by the companies is about 10% growth in employees annually.

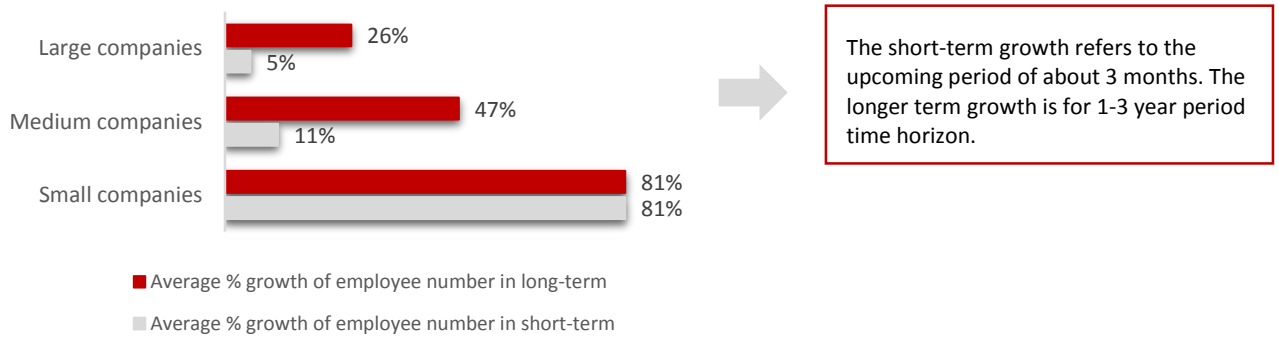
Figure 11: Total number of demanded IT specialists in surveyed companies categorized by company size

Source: EV Consulting company survey
Number of respondents: 27

According to EIF estimates, IT and High technology industry absorption potential are about 2,000 employees annually of which about 300 are not being filled and remain as a gap. This is roughly in accordance with the survey findings of about 150 current unfilled positions declared by about 10% of the sector companies.

The survey results show that the smaller companies aspire to grow at higher paces, which due to low starting base, means smaller number of employees in absolute terms.

Figure 12: Forecasted % growth of employee number in small, medium and large companies in short-term and long-term

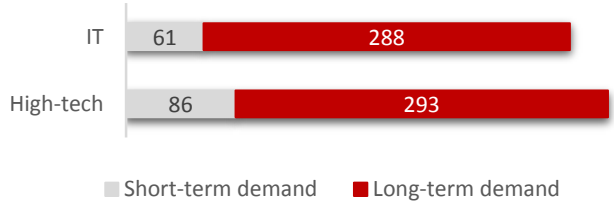


Source: EV Consulting company survey
Number of respondents: 27

The smaller companies have high growth expectations for both the short-term and the long-term perspectives. Meanwhile, the medium and large companies stick to the strategy of relatively conservative growth in short-term and more aggressive recruitment in the long-term.

The demand for new talent in surveyed High technology companies is higher compared to IT companies.

Figure 13: Number of demanded IT specialists categorized by IT and High-tech sectors



Source: EV Consulting company survey
Number of respondents: 27

Software development will remain the most widespread and demanded specialization in the upcoming 3 years

Both in the short and long-term perspective, software development in C++ and C# remains the highest demanded specialization among IT sector followed by engineers. Demand for software engineers is also estimated to increase within the next three years with a much higher speed compared with the other specializations.

Figure 14: Number of required IT specialists categorized by specialization

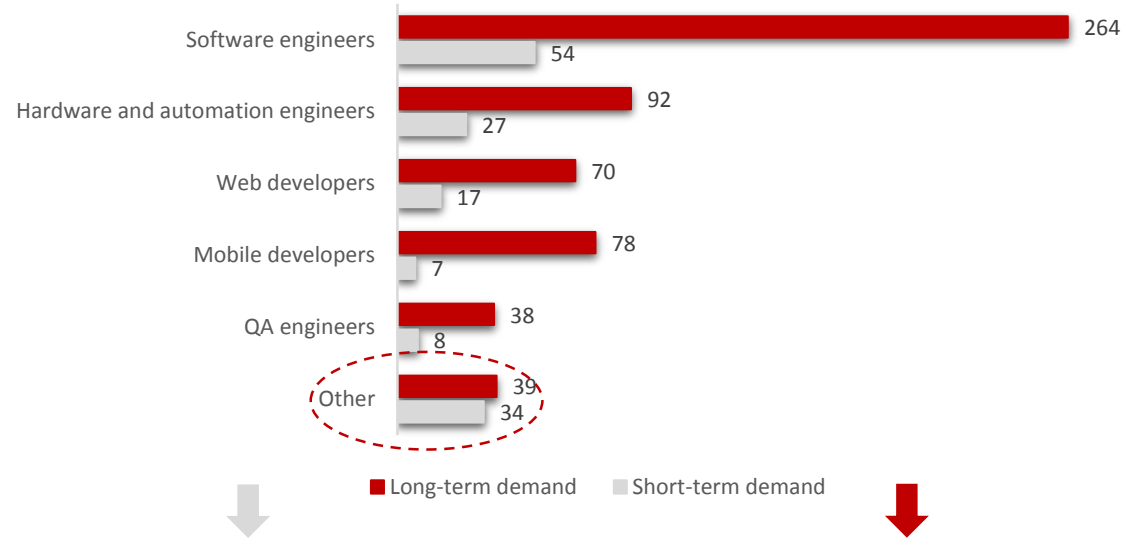


Figure 15: Breakdown of short-term "Other" category

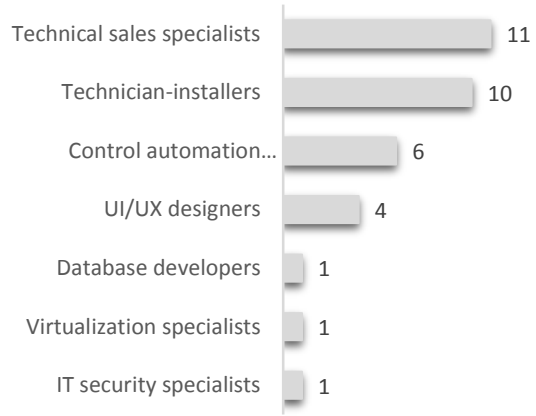
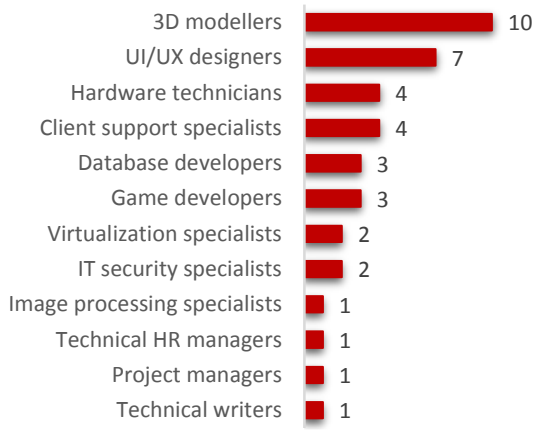


Figure 16: Breakdown of long-term "Other" category



Source: EV Consulting company survey
Number of respondents: 27

Methodological Note

As no formal breakdown of specializations exists in the sector, we constructed the following main groups of IT and engineering specializations based on the industry knowledge and company interviews:

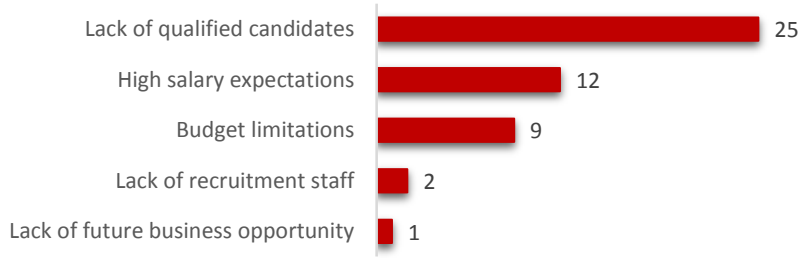
- Software development specialists: includes .NET developers, particularly specialized in C++ and C# programming language family with minor exceptions.
- Engineers: the category has the highest variety of narrow specializations due to the specifics of the sector. The category includes hardware, electronics and CAD engineers, PCB designers, etc.
- Web developer specialists: the category consists of mainly Java developers with knowledge of web-programming basics such as HTML, PHP, etc.
- Mobile developer specialists: the category includes professionals with the knowledge of relevant programming languages, such as Java, and the mobile platforms such as iOS, Android.

The main constraint of recruitment for companies is the lack of qualified candidates in the market.

There is generally large number of applicants for each job vacancy announced. However, the skills levels of the most candidates are not adequate and do not meet company requirements. The skill gap is predominantly not quantitative but qualitative. According to the sector companies, lack of qualified candidates and talent is the main constraint of recruitment. There is a mismatch in the available supply of candidates and the necessary skills demanded by the companies. The skill mismatch is mostly qualitative, as the companies mentioned that any job announcement results in numerous job applicants for the job. The number of applying job applicants is especially higher for junior positions. Based on the observations from the interviews one of the first steps to the increasing of supply of qualified labor can be increasing the quality of the existing labor pool.

According to several companies, the ratio of job applicants per position and number of hired applicants is constantly worsening, due to the increasing demand towards higher skills, in parallel with the industry dynamics. For the junior positions, this ratio can be as low as 1 hire out of 80-85.

Figure 17: Recruitment constraints in IT and Engineering companies



Source: EV Consulting company survey
Number of respondents: 29

The limited supply of qualified labor is inflating salary expectations. The current salaries still remain competitive for the multinationals. However, given that Armenia is pursuing product based rather than outsourcing based model for its development, this poses a constraint to the local industry development and growth of Armenian IT products.

As a consequence of the IT skills gap in the industry, the qualified candidates become more demanded, which impacts their salary expectations not corresponding to their knowledge and skills. In 2012-2013, the monthly net salary of IT employees varied in the range of $300-$3,500. The official level of average monthly net remuneration in Armenia for year 2013 was about $290, which is about equal to the lower level of IT sector average salary. This indicates that IT sector is a very high value added sector and the increase in the jobs of the sector will have a positive effect for the economy as a whole.

The interviews with companies revealed that the upper limit is constantly increasing and in some cases reaches up to $4,000-$4,500, which is also not supported by the corresponding knowledge or qualification, but is a result of the scarcity of qualified specialists.

The migration trend severely impacts the pool of available IT specialists in Armenia.

Currently there is a significant migration outflow from Armenia caused by economic conditions, which in particular causes a brain drain in IT and High technology industry. The majority of the interviewed companies confirm that recently retention is dropping due to the high number of emigrating employees.

Nevertheless, there is a "conditional division" of developers and engineers based on their immigration patterns:

*Impactful, creative and global career seekers***.** The careerists represent the category of people who have the ambition of professional growth as a priority and who do not see enough opportunities in Armenia with respect to career: the interviewees mentioned that the professional ambition of the specialists goes beyond the salary level. It strives towards the higher positions and impact in the global markets, which in their opinion is not likely to happen in Armenia-based companies. The leaving majority are the senior and mid-level specialists. Some of the specialists leave their Armenian companies and start a career by engaging into local startup companies, but the majority of them find employment outside the country.

Higher compensation seeker with strong personal ties with the country. There is also a group of highly skilled professionals, whose patriotism and psychological ownership of the country is superior to the careerism, thus, the patriots prefer to live and work in Armenia. There is no precise statistics on the number of migrating IT specialists, but all of the respondents unanimously perceive it to be higher than of those staying in the country.

The locally established relatively small companies face intensifying competitions in hiring local talent

Start-ups and smaller companies face market and revenue growth limitations. These companies require further start-up funding to facilitate their growth and need for new hires, in order to expand in the market and be able to work on new product development.

Armenia has a very small IT labor force due to the overall small population size, therefore, "poaching" of skilled labor represents a particular problem. The increasing remuneration levels of the labor market poses real risks for such start-ups and small companies, as their abilities to get new quality hires by providing competitive salary levels is weak.

Small companies also face the issue of lack of designated HR recruitment function in their companies.

Several companies mentioned the issue of lacking the specialized recruitment personnel, which hinders their ability to source necessary talent. The medium to big size companies generally form HR functions, with main focus on recruitment and trainings. Some other issues relating to HR functions of the companies are discussed later in the report.

2.2. QUALITATIVE ANALYSIS OF DEMAND BY SECTOR COMPANIES

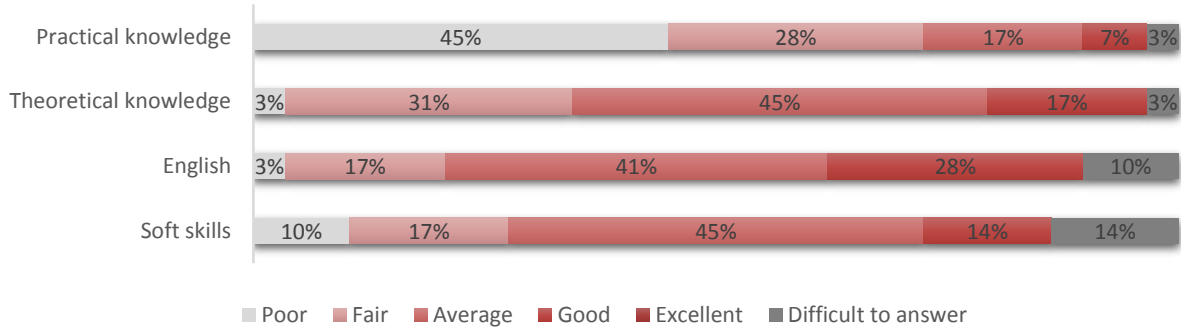
The quality gap of the skills in IT and High technology sector is due to low quality of graduates from local higher education institutions according to the sector companies.

Higher education plays a key role in developing basic skills of graduates. These skills form the basis of theoretical and practical knowledge levels of the graduates. However, local companies consider that these skills are mostly below expected average and are outdated. This relates to both the fundamental technical knowledge and the more generic soft skills of the graduates.

The interviews were conducted with the respondent companies to rate the skill level of graduates according to the following 4 knowledge/skill types:

1. **Practical knowledge** – the level of student's familiarity with the up-to-date technical tools (engineering equipment, programming languages, platforms, etc.) to apply acquired theoretical knowledge in specific projects
2. **Theoretical knowledge** – technical fundamentals required to shape the algorithmic thinking and mathematical mindset of IT professionals, learnt through lectures and available literature.
3. **Soft skills** – level of communication and self-expression, as well as the ability to work in a team
4. **Knowledge of English** – the importance of this is underlined by the fact that IT and High technology are mostly internationalized sectors with a high level of interaction with outside world.

Figure 18: Assessment of skills for graduates in IT and Engineering sectors by companies



Source: EV Consulting company survey
Number of respondents: 29

~73% of the respondents think that the practical capabilities of the graduates are far below the expected level and not satisfactory for the employment.

Unanimously, all the respondents mentioned that the majority of graduates lack practical capabilities even given high level of theoretical knowledge, due to the absence of practical activities in the universities. During the survey, it was revealed that only a small portion of graduates (~10%) with higher sense of responsibility tend to find internship projects or visit available labs at their own initiative during their studies, while the rest totally depend on the directions given by the university. The latter, according to the private sector, has to put more effort in providing practical skills via mandatory internship programs and lab work.

Underdeveloped practical knowledge and skills mean higher learning and development costs for employers further pressuring down the sector competitiveness on the global landscape.

~80% of the respondents consider the level of graduates' theoretical knowledge to be average or below the expectations, but on a higher level compared with the practical capabilities.

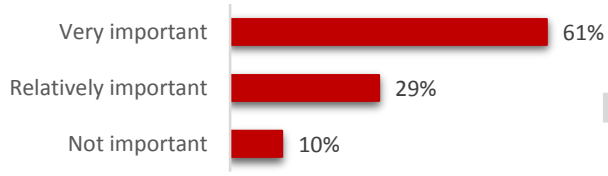
It is notable, that some executives with a longer managerial experience have slightly different opinion on the priority and importance of the theoretical knowledge. According to some of them, theory matters more than practice, as practice can be taught during on-the-job training, while the theory, if not injected into the students in early university years, will hinder the professional development during the rest of their career.

Besides the evaluation of theoretical knowledge, some of the respondents state that the ability to self-educate oneself and grasp new concepts rapidly is of higher importance. This is conditioned by a rapid industry dynamics, which suggests that any theoretical knowledge will be outdated with time, while the ability to self-educate and grasp new concepts fast is a prerequisite for the modern IT specialist. Company executives think, that the skills and know how to educate oneself should be taught in the university.

From the employer's point of view, soft skills and English knowledge of the graduates are on a more acceptable level compared with theoretical and practical knowledge.

More generic skills, such as work ethics, abilities to work in a team, etc – are a part of larger set of soft skills. The local higher education system generally does not accentuate the development of such skills in students. The graduates lack such skills as self-presentation, written or oral communication skills, interview skills, etc. However, the level of these skills among the graduates is assessed mostly as average and above (by about ~70% of respondents).

Figure 19: Assessment of soft skill importance of job candidates

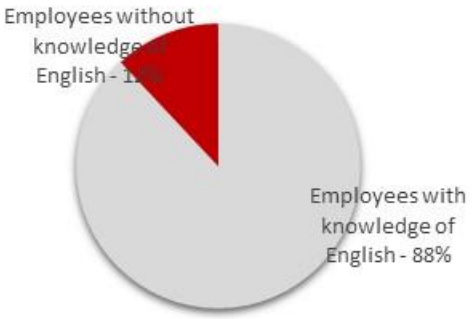


About 61% of the respondents highlighted the ultimate importance of the soft skills of interviewed candidates when making a recruitment decision, while 29% stated that it can be developed on the job

Source: EV Consulting company survey
Number of respondents: 28

Due to the availability of the up-to-date technical literature mostly online and in English, the graduates who have an objective to grow as a professional have to learn the basics of the language. About 80% of the respondents consider that the knowledge of English language is average or good and tends to improve with the professional development (see *Figure 14*).

Figure 20: Share of English-speaking employees in surveyed IT companies



Source: EV Consulting company survey
Number of respondents: 29

Considering that share of employees with knowledge of English in companies is almost 90%, the importance of this skill is rather vital.

Several companies mentioned the worsening quality of Russian language among graduates. The growing importance of Russian market in Armenia might increase the demand of this language also, whereas most companies note that the level of English knowledge is far better compared to Russian.

Companies adjust their recruiting requirements and lower standards due to the lack of qualified candidates.

Due to the qualification constraints, the companies tend to recruit junior-level graduates, which have elementary basic knowledge, their motivation and personality fit with the company culture, and train them to a certain level by means of on-the-job training. The relatively low responses about the importance of technical skills are conditioned by this notion.

The situation is worse with senior developers, due to the lack of high-level qualification training programs, whereas on-the-job requalification opportunity cost is much higher.

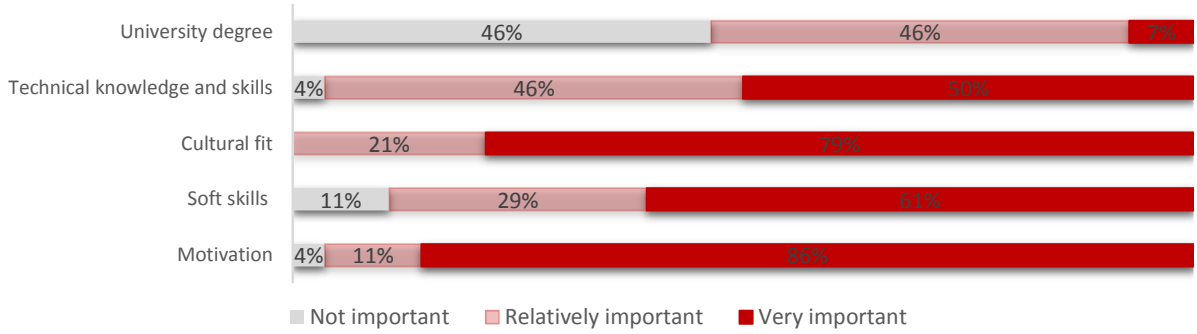
The base-level developers are more flexible, due to the combination of their work experience, which ensures particular knowledge level, and non-advanced specialization level, which is easier to transform into the narrow specialization required by each company specifics.

The requirements and evaluation of the above-mentioned criteria (see *Figure 12*), particularly regarding the technical knowledge and soft skills are adjusted due to the deficit of the qualified specialists. In opposition to the current educational system, some companies think that preparing their future employees in their own training programs is more beneficial: several respondents mentioned a preference to recruit and train young people right from school, without the intermediate interference of the university.

The university degree is not a crucial decision factor in recruitment by companies, indicating the diminishing role and image of higher education in the sector due to the insufficient quality of graduates.

Only 8% of surveyed companies considered the university degree to be of high-level importance for the recruitment process.

Figure 21: Company preference for different candidate skills and knowledge and other characteristics



Source: EV Consulting company survey
Number of respondents: 28

Due to the low satisfaction with the local educational system, the university degree is not of primary importance during the recruitment process*. Almost half of the interviewed executives mentioned that university degree of candidates is in fact no important at all, as the knowledge and skills provided in the degree programs are not sufficient for the entry to the industry.*

Due to the gaps between the university program and industry, requirements job applicants tend to learn the upgraded technical knowledge and skills mostly during the probation period in the company. Thus, the hiring executives value the cultural fit of the applicant in the company more, as by default, the technical skills are planned to be transferred to the employee on the company premises.

However, for a long-term sustainable and high-end development of IT industry, the strong university base will retain its critical importance. While company base training can provide basic IT skills, the ever-increasing sophistication of IT products will require strong multidisciplinary educational background that can be provided only on the platform of university education at graduate and postgraduate level. Based on the responses from the interviewed companies, the most desirable solution is modernizing current educational process.

A less important factor was the level of the degree in universities, e.g. the difference between Bachelor's and Master's degrees was not considered as crucial in companies.

Currently, companies consider the Master's degrees to have a limited benefit on top of knowledge gained through undergraduate studies. This observation demonstrates that the level of training for Master's Degree programs is inadequate or possibly of a limited sophistication of the IT market that doesn't require skills obtained from Master's Degree.

The Bachelor's degree is mostly a requirement as it is supposed to shape fundamental mathematical and algorithmic thinking after school. Whereas, the Master's degree is considered additional 2 years spent on knowledge acquisition, the value addition of the Master's Degree is not clear and distinct for the companies. During these times, the students can become less flexible and less prone to learning during their work practice.

Generally, the companies do not appreciate a considerable quality increment between these two degrees. Moreover, companies consider this as a factor that slows the time of graduates reaching the employment

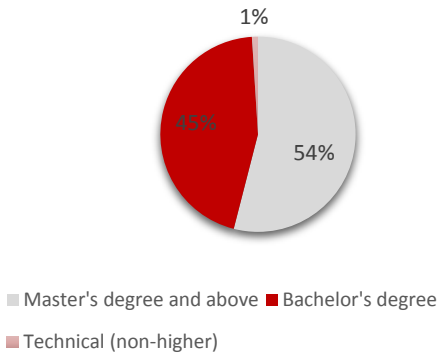
age and stifles their skills. In addition, some university representatives agree with the fact that there are curricular limitations in Master degree programs, requiring upgrading of curricula.

Only a small portion of graduates continues their studies to PhD degrees. Whereas, the degree has two roles for graduates. In addition to the conventional knowledge role of the degree, in Armenia, it also is a way of escaping the army service requirement for male graduates. Thus, the motivations for the degree are not straightforward.

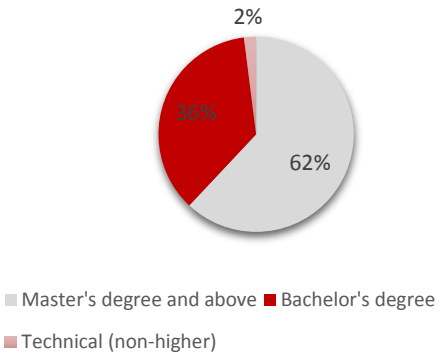
The overview of the current workforce structure shows that major portion of the employees have some level of university degree. The workforce distribution by bachelor's degree and the master's degree is about equal. In the graphs below, there is the comparison of the survey results and EIF study, which is based on a larger sample data and might provide more precise information.

Figure 22: The current structure of labor force in the sector by university degrees (survey results versus Enterprise Incubator Foundation)

Survey results



EIF study



Source: EV Consulting company survey, EIF "Armenian ICT Sector: State of Industry Report", 2012
Number of survey respondents: 29

Cultural fit in the company and the motivation of the graduates are the most important factors for recruitment decision-making, followed by soft skills and technical knowledge.

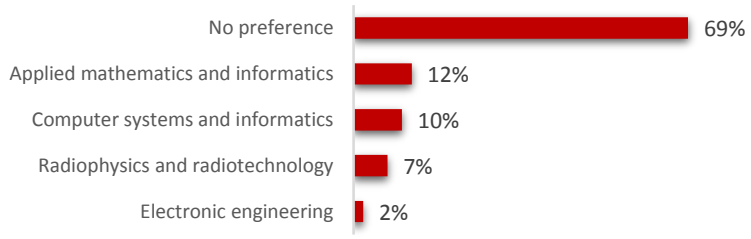
Due to the informal working environment, mostly team work on projects in sector companies, cultural fit and motivation are particularly important factors for the selection process. With the declining qualification level, the sector tends to recruit fresh graduates and spend a considerable time on training them to a relevant level. Considering the opportunity cost of the time, the importance of the cultural fit and motivation is critical, according to ~95% of the respondents.

Ability to independently find relevant information and utilize it is a critical requirement that is currently missing in the majority of graduates.

17% of the respondents are critical about the candidate's ability to use available literature and other sources for the quick self-education. Due to the rapid industry dynamics, quick adaptation skills are a prerequisite for preserving the competitiveness and are highly appreciated. Currently, the development of those skills has an individual nature and mostly correlates with the level of candidate's initiative, but the real sector representatives state that the ability to self-educate should be provided and developed by universities.

The companies do not differentiate among the faculties and major specializations of the higher education institutions, which show that no distinct value added is proposed by the different faculties.

Figure 23: Companies' preference for the major or discipline of graduates



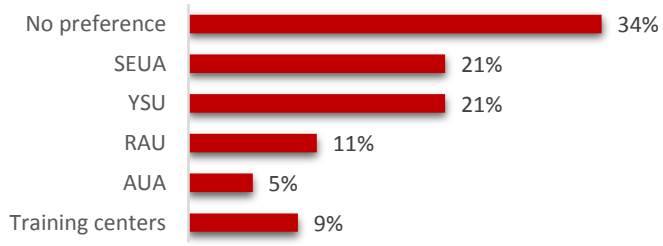
Source: EV Consulting company survey
Number of respondents: 29

The majority of the respondents stated that taking into consideration the overall low quality of the graduates and their level of practical knowledge relative to the actual employee activities, there is no significant difference between the qualifications received in different faculties. Consequently, given the presence of other required selection criteria within the job candidate, the discipline plays negligible role.

Still, given the specifics of some high tech companies, the importance and irreplaceability of precise majors, e.g. electronic engineering, is undeniable.

About 34% of the respondent companies expressed no preference in hiring graduates from particular university.

Figure 24: Company preference for recruiting from Armenian universities



Source: EV Consulting company survey
Number of respondents: 28

SEUA and YSU remain the most preferred universities in IT sector with 21% of preference each, which is partially conditioned by the large number of graduates in engineering specializations absent in other universities and training centers as well as the active presence of Synopsys Armenia Educational Department within the universities.

RAU and AUA follow with 11% and 5% correspondingly. Currently the training centers are mostly mentioned as sources for preparing beginners and are not considered an alternative to universities by the companies. Given similar conditions and choice High technology companies tend to look for more candidates from SEUA, while IT candidates mostly prefer YSU or Slavonic University.

2.3. RECRUITMENT AND HR PRACTICES IN IT AND HIGH TECHNOLOGY COMPANIES

The management sophistication of local IT and High technology companies is generally correlated with their size and origin.

The management system of local IT companies is largely in line with the general level of other Armenian companies, i.e. professional management is scarce and professional tools are of low usage. The exceptions are branches of international companies, who inherit the management systems from their HQs. Also, the size of the companies dictates the needs of better management systems.

The people management in the companies is generally the function of the key executives. In bigger companies, the human resource management is more structured and the function is centered in a special department.

The small and medium size companies do not have HR departments, as they do not see urgent need in it. The distribution of its functions is spread among employees in the company.

The recruitment is considered a technical procedure with a personality fit check component at the end. Generally, the responsibility of initial filtering lies on project leads, while the final approval of the candidate is carried out by executives. Thus, there is an opinion that non-technical HR function is not relevant unless the company grows beyond 50-60 employees, where the proper management of human resources is hardly longer possible through project leads and executives.

The motivation, professional development of employees and other functions of HR department are rarely officially tracked in medium-sized companies with no HR department. In case of high HR capabilities of CEO, strong company culture and employee alignment with the company's development strategy force the retention rates high.

The performance evaluation and compensation systems are formally structured only in the bigger size companies. The small and medium companies have the processes of more ad hoc nature.

Companies prefer to transfer the technical knowledge via on-the-job trainings, while the supporting skill development is delegated to training centers or guest lecturers.

According to the respondents, the level of graduates is low and requires additional training to reach minimum company requirements. On-the-job training provides the graduate with the necessary technical knowledge as well as the specifics of the company without spending double amount of time. Based on this notion most of the companies prefer to train their junior employees on-the-job.

Out of 29 surveyed companies, 3 have their own training centers or educational programs to prepare employees and additional 3 tend to finance or co-finance technical off-job trainings for their junior employees. The latter were able to provide average training budgets per employee, which range from $80 to $2,500 depending on the subject and duration of training program.

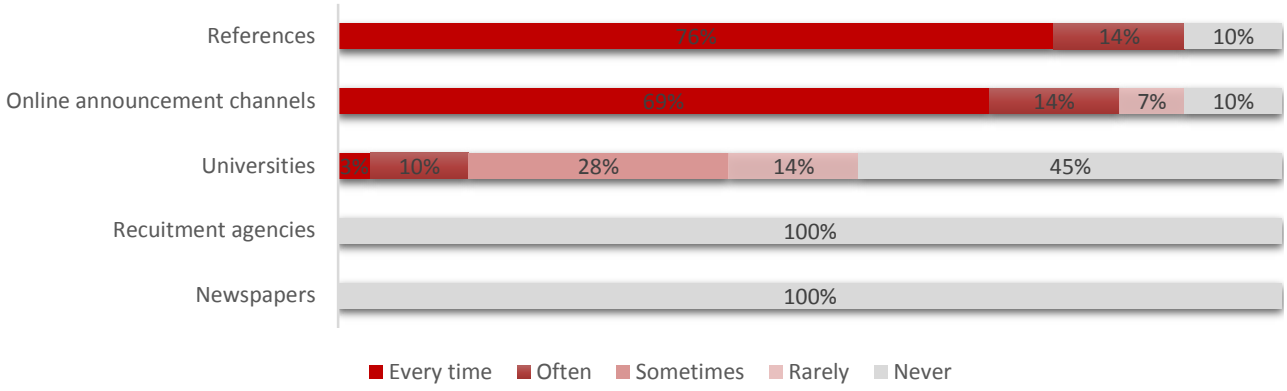
On average, up to 6 months is required for a newly hired employee in an IT company to complete the on-the-job training phase and become a qualified professional. In case of High technology companies, the average on-the-job training period lasts from 6 to 12 months. In complex cases, the preparation of a qualified specialist can last up to 3-5 years.

In the majority of cases, off-job trainings are carried out on non-technical subjects such as project management, marketing, soft skills, etc.

Due to the limited market size with a high concentration in Yerevan, references are the most popular option in recruitment process.

Out of 5 mentioned recruitment channels only 3 are utilized by the respondent companies.

Figure 25: Recruitment channels in IT and High technology sectors



Source: EV Consulting company survey
Number of respondents: 29

1. Due to the small market mainly located in Yerevan, the most popular method of hiring all level managers is the reference model through the network.
2. Online portals such as www.careercenter.am and social media are also popular. Lately specialized IT recruitment online resources such as www.itjobs.am appeared on the market.
3. Recruitment agencies and newspapers are considered irrelevant for the industry. In case of the first, the recruiter should have some technical understanding, which is generally not the case for the Armenian recruitment agencies. Regarding newspapers, potential employees do not look for job announcements in offline media, thus, the newspapers channel does not satisfy the targeting criteria.
4. University recruiting has two main options:

- *Recruitment via official relationship with the university.* Among the interviewed 29 companies ~20% had or has official relationship with the universities for the recruitment process. Nevertheless, majority of them find the experience not satisfactory and unpleasant. The feedback includes dissatisfaction with the administration procedures of joint project organization and implementation, reporting problems and low number of career center activities.
- *Recruitment through the acting company employees, lecturing in the university.* Out of 29 respondent additional 15% mentioned a recruitment practice through their employees, also employed in various universities as lecturers. The method is considered effective as prior to the recruitment the lecturer has a possibility to discover both professional and personal capabilities of the student.

5. Headhunting was also mentioned as an ineffective method for recruitment in Armenia, due to the small market and relationships among the players.

3. SUPPLY SIDE ANALYSIS OF SKILLS GAP IN IT AND HIGH TECHNOLOGY INDUSTIRES

3.1. EDUCATION SYSTEM OVERVIEW IN ARMENIA

The higher education system in Armenia lacks the competitive dynamism and efficiency.

Armenia's higher education system consists of 63 public and private institutions. First established in 1991, private universities expanded the sector, populating it with many fledgling institutions. Demand for private education was driven by a mass of students ready to pay for accessible and undemanding study. Over the past few years, demand has diminished and there are 20 percent fewer schools now than in 2003.

Despite a large number of players, the sector lacks an efficient competitive environment:

First, compared to the private universities, the state universities are privileged - providing substantial tuition subsidies and exemptions from army service for students.

Second, Armenia is not big enough to afford several universities competing in each discipline so a few have become monopoly providers of education in certain disciplines.

Third, five universities dominate the sector by virtue of their scale of enrollment. The smaller schools have correspondingly limited capacities and infrastructure development opportunities. As a result, many universities (mostly private) have become "retail outlets" for diplomas and forego competing based on quality.

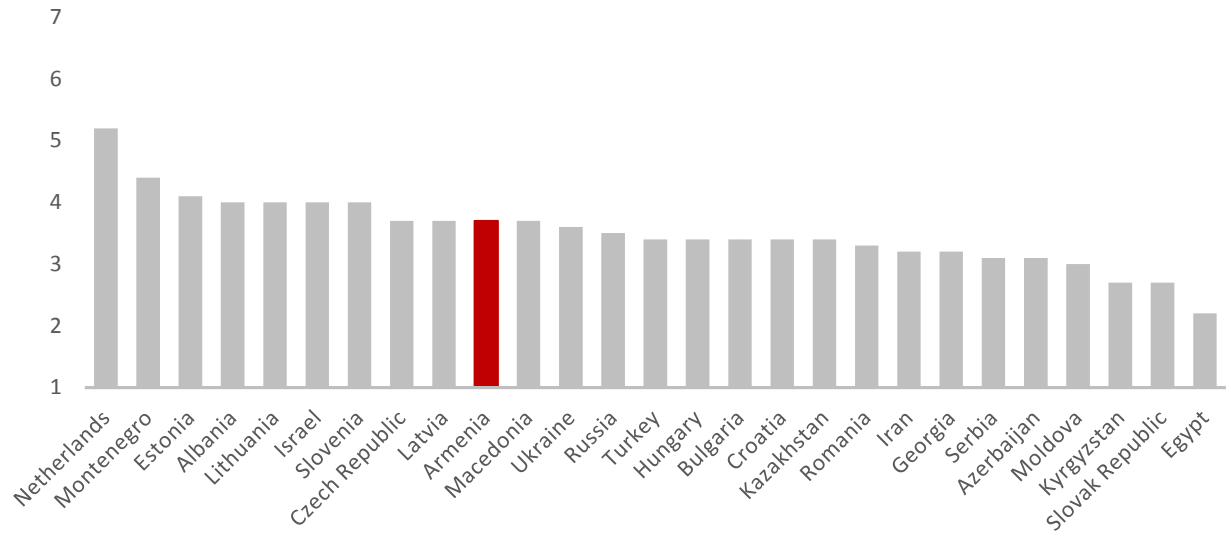
Fourth, Armenian higher educational institutions do not track their performances by international rankings, citation indices, the statistics on the career development of the graduates and other comparative indicators, which usually drive competition among universities.

Finally, the minimal connection with the global education market means the local market is a captive one. The vast majority of high school graduates cannot afford to study abroad so local universities are complacent.

The quest to join European Higher Education Area pressures Armenia to reform, but the pace is still unsatisfactory

Armenia is undertaking reforms through the Bologna process in order to join the European Higher Education Area. Enforcement of reforms, however, is questionable. Often the universities are unable to keep pace with reforms and changes are mere formalities with little impact on content, In addition, there is little awareness of the content of ongoing reforms. Consequently, the quality of the education has a room to improve, which is also demonstrated in World Economic Forum's (WEF) ranking on the Quality of Educational System.

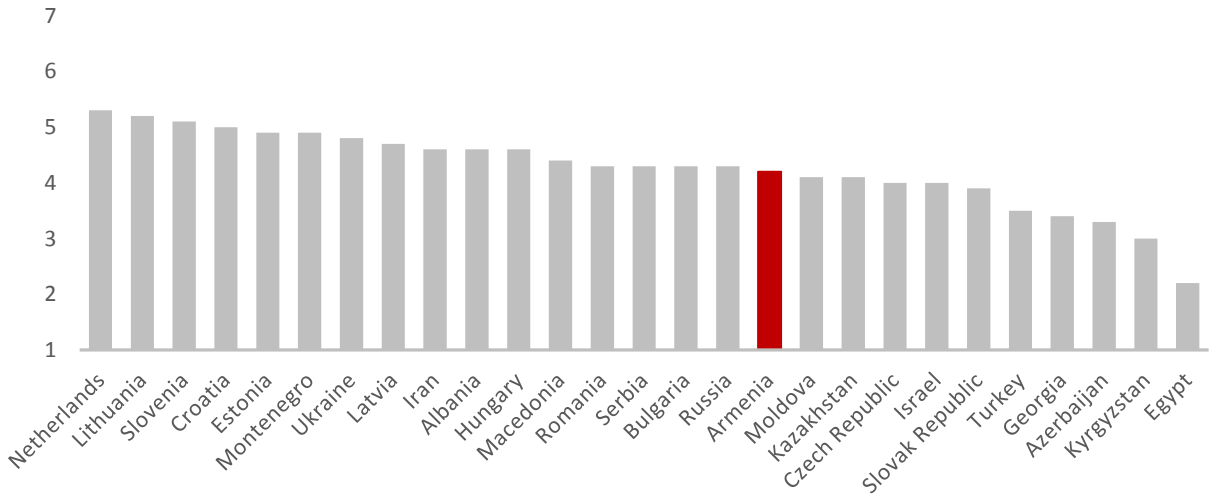
Figure 26: WEF ranking on the Quality of Educational System, 2013-2014, Score, out of 7



Source: World Economic Forum, Global Competitiveness Report, 2013-2014

Interestingly, according to World Economic Forum ranking that is based on entirely on the perception of the business executives, Armenian educational system lags behind more countries in the quality of math and science education compared with the overall educational system quality. In juxtaposition with the ambition to become a significant industry player on the international level, the below ranking suggests plenty of room for education quality improvement.

Figure 27: WEF ranking on the Quality of Math and Science Education, 2013-2014, Score, out of 7



Source: World Economic Forum, Global Competitiveness Report, 2013-2014

3.2. IT AND ENGINEERING EDUCATION SYSTEM IN ARMENIA

For the last 4 years there has been no shortage in number of graduates enrolled in IT-related faculties.

IT-related faculties are considered the technical faculties in the university providing the students with knowledge fundamentals and algorithmic mindset to enable his/her further technical specialization during the employment. The considered majors/disciplines are:

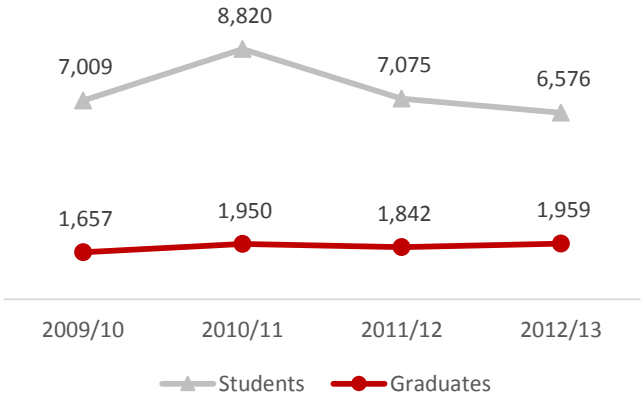
- Mathematics and physics
- Informatics and computing systems
- Radiophysics and radiotechnology
- Automation systems
- IT and Cyber security

The list of the most significant higher education institutions that provide IT and Engineering specializations is as follows:

UNIVERSITY	FACULTY
STATE ENGINEERING UNIVERSITY OF ARMENIA (SEUA)	– Computing systems and informatics – Applied mathematics and physics – Machinery engineering – Mechanics and machinery – Cybernetics – Radiotechnics and communication systems
YEREVAN STATE UNIVERSITY (YSU)	– Informatics and applied mathematics – Mathematics and mechanics – Radiophysics – Physics
RUSSIAN-ARMENIAN (SLAVONIC) UNIVERSITY (RAU)	– Applied mathematics and informatics – Electronics and nanoelectronics – Infocommunication technologies and communication systems – Construction and technology of electronic systems
AMERICAN UNIVERSITY OF ARMENIA (AUA)	– Industrial Engineering and Systems Management – Computer and information science – Computational Sciences
EUROPEAN REGIONAL ACADEMY (ERA)	– Applied information technology – Communications equipment and microelectronic circuits and systems – Informatics and applied mathematics

The actual number of the graduates in IT-related faculties has been stable since 2010; nevertheless, there is a tendency in shrinking number of students due to deteriorating demographics, which will negatively affect the number of graduates in the upcoming years.

Figure 28: Number of IT-related students and graduates



From 2010 to 2013 the number of the students enrolled in IT-related faculties is decreasing, while the number of graduates remains about the same. This indicates towards the expected decline in the number of the graduates in the upcoming several years.

Source: NSS Armenia

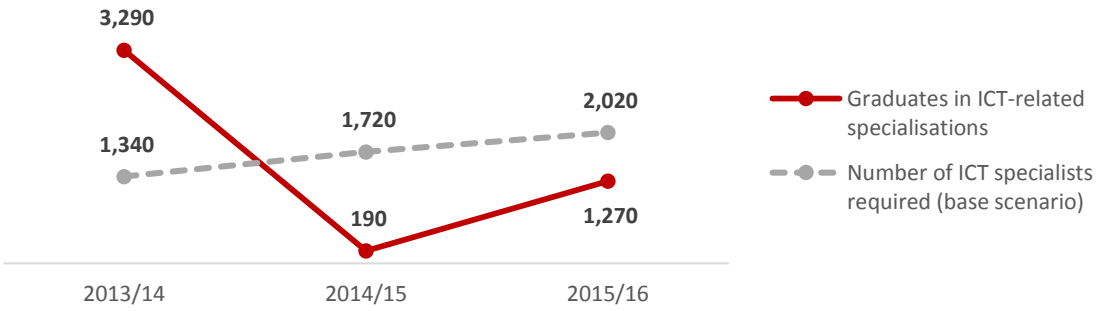
Based on the statistical data, since 2010 there have been ~2,000 fresh graduates from IT-related faculties annually, nevertheless, the market demand has not been satisfied. Among the factors causing the mismatch in the market are the massive migration, demotivation of the graduates, etc., but according to the companies, which base their opinion on the conducted tests and interviewed with the job applicants, currently the most prominent factor is the low quality of the graduated specialists.

In addition to the qualitative gap, provided the same tendency of faculty choice, the number of IT graduates will decrease starting from 2014/15 until 2022, with a slight recovery in 2016-2017.

The decrease in the number of graduates is conditioned by several factors. One of the major reasons is the significant decline in birth rates in 1990s with the lowest level registered in 2002.

Due to the educational reform, which changed the mandatory number of study years in primary and secondary schools from 10 to 12, 2011/12 academic year was marked by a very low number of admitted students to the universities.

Figure 29: Estimated number of graduates from IT-related faculties, 2013/14-2015/16



Source: EV Consulting analysis, NSS Armenia, University reports

Methodological Note

The expected numbers of graduates are estimated based on the total number of students, enrolled in IT faculties, less the total number of students admitted four years prior to the estimation year. The calculation is done under the assumption of 5% historical dropout rate.

The numbers of required specialists per year are estimated based on the base scenario of *The employee absorption potential of IT and High technology sectors (Figure 6).*

Assuming that the number of admitted students in faculties will remain constant and 95% of the students will graduate, it is estimated that the number of IT-related BSc graduates will plummet to the mark of ~200 in Armenia in 2015, with a following partial recovery – ~1,350 graduates - in 2016 and later. At the same time the growth in demand of additional IT qualified specialists of different levels is estimated to be ~1,500-1,800 per year for the upcoming 3 years. The unusually high graduate number in 2013/14 will compensate the shortage of graduates in 2014/15, but starting from 2015/16 the quantitative gap will become noticeable.

In 2018/19 and 2019/20 the number of the graduates is again expected to diminish due to the recent military reform owing to which males are bound to have a 2-year military service deferring their higher education. As the majority of the students in IT-related faculties are male, the 2-year gap will be noticeable starting from 2018/19 academic year.

Currently, there is also a shortage of graduates in quantitative terms "produced" by the local higher education system, particularly, for the sector of IT and Engineering.

Out of 5 main universities offering IT education, the largest institutions are Yerevan State University (YSU) and State Engineering University of Armenia (SEUA). Other universities include Russian-Armenian (Slavonic) University (RAU), American University of Armenia (AUA), and European Regional Educational Academy (ERA). YSU and SEUA provide the pressing majority of the graduates and have the largest quantity of students enrolled in IT-related faculties.

Table 1: Number of IT and Engineering students and graduates in the universities, 2013/2014

	YSU	SEUA	AUA	RAU	ERA
IT STUDENTS	670	1,650	100	200	90
ENGINEERING STUDENTS	1,390	1,730	50	100	40
TOTAL STUDENTS	***2,060***	***3,380***	***150***	***300***	***130***
IT GRADUATES	190	460	25	40	30
ENGINEERING GRADUATES	480	640	25	20	10
TOTAL GRADUATES	***670***	***1,100***	***50***	***60***	***40***

Source: EV Consulting university survey, University reports

During 2012-2013 academic year, there were 6,576 students in total enrolled in IT-related faculties in Armenia. In the same year 1,959 students with IT specializations graduated from the universities, which comprises ~ 8% of the total number of graduates. The graduates from humanities, economics and management as well as educational and pedagogical faculties comprised 34%, 17% and 9% respectively.

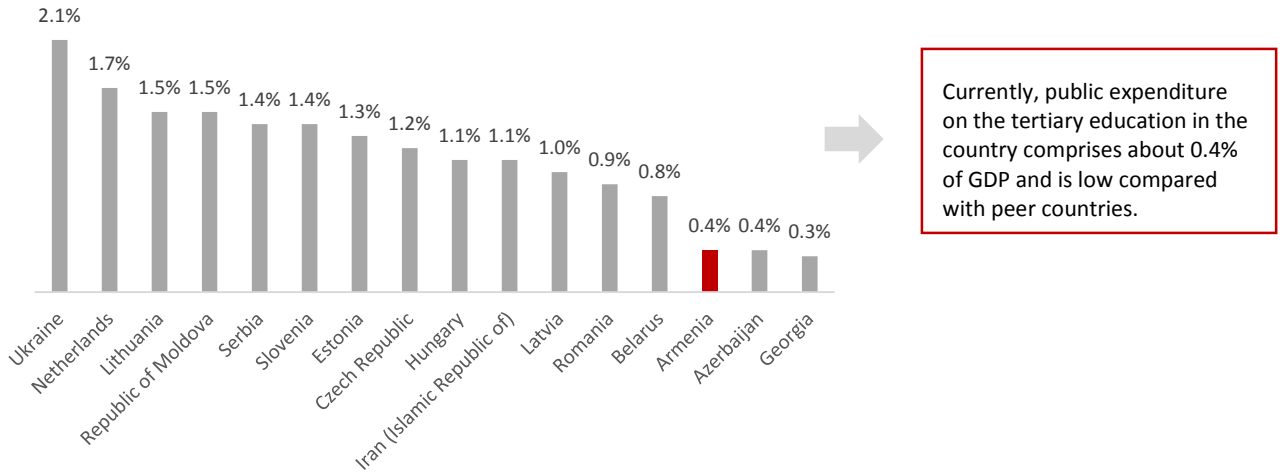
It is estimated that only ~45% of the total graduates from IT-related faculties work in the IT and Engineering sectors in Armenia (source: "Market study on HE graduate labor demand and employment in Armenia", EV Consulting, 2011). So only ~ 900 graduates considered employment in the sector, which is a lower number compared with the demand.

All three stakeholders of the system, universities, students and real sector are unsatisfied with each other and expect negative developments in the future.

The majorities of the universities consider their curricula, teaching staff and methods up-to-date and aligned with the industry requirements, while the respondent companies have opposite opinion. According to the sector, the educational system faces stagnation to the stage, where few sector players see reform possibilities. Universities on their turn find companies reluctant and uninterested in joint activities to educate future specialists.

Educational system factor analysis reveals that the lack of funding in the universities is the main cause of declining education quality, as most of the issues starting from the motivation of the teaching staff till the ability to equip laboratories with licensed technology require large amount of financing not available at the universities at the moment.

Figure 30: Public expenditure on tertiary education as % of GDP, 2011



Source: UNESCO statistical database

Moreover, lack of university funding and the imbalance between the salary ranges of academic professionals and some employed students/real sector professionals inculcates inability of professional dialogue and compromise. Currently, the average gross salary of a full-time lecturer in large universities ranges between ~$300-$500, in line with the official average salaries in Armenia. Whereas, the IT sector average salaries that students can potentially attain are much higher.

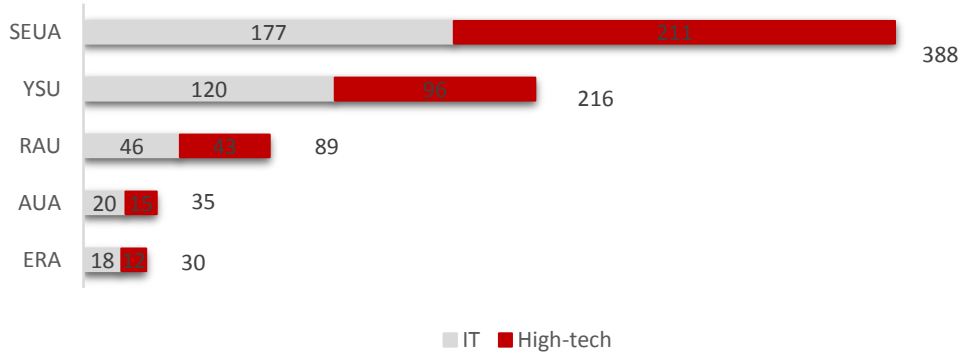
The university vision on the cooperation with private sector has its own specifics: especially in a lower management level the large universities see the cooperation mutually beneficial given external investments for the establishment of the company laboratories and R&D project execution in the university. The downside of the approach is the risk of becoming a training center for a particular company, which universities plan to mitigate by having the part of the curriculum stable and only the portion of the subjects possible to change based on the company feedback.

The ineffective dialogue between the academia and private sector together with the unfavorable economic conditions and mass migration impact the attitude of many students. The pessimistic view of the future uncertainty in the job market is highlighted among the students starting from their 2nd year of study.

There is no quantity shortage of teaching staff in IT-related faculties in Armenian universities.

There are ~760 lecturers in 5 universities, 80% of whom are concentrated in YSU and SEUA.

Figure 31: Number of teaching staff in universities by IT and Engineering specializations, 2013/2014



Source: EV Consulting university survey, University reports

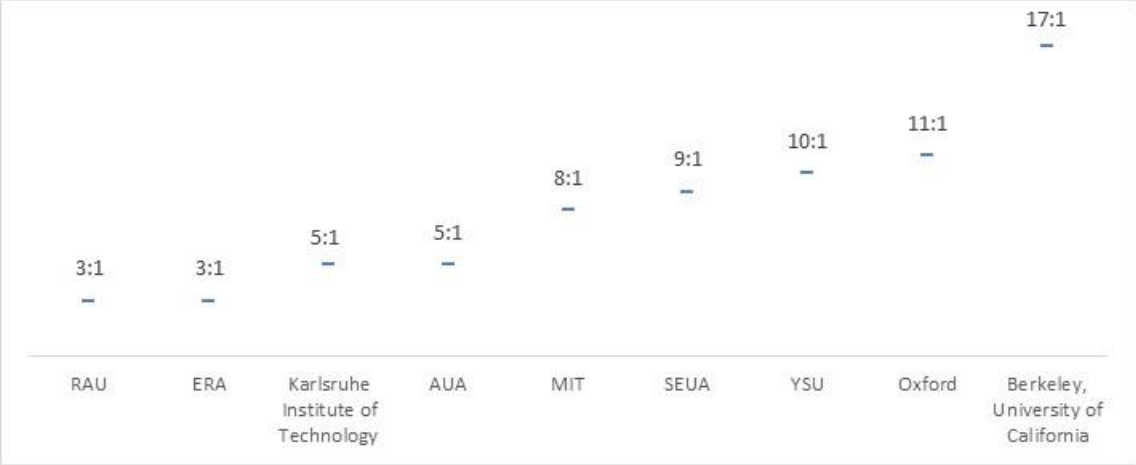
The average student-teacher ratios (*Table 1*) in Armenian universities are quite low compared to the international standards, where 12:1 is considered a healthy ratio (in the UK the lowest ratio is 10:1).

Table 2: Student-to-faculty ratio in Armenian universities

	YSU	SEUA	AUA	RAU	ERA
IT	6:1	9:1	3:1	4:1	5:1
ENGINEERING	14:1	8:1	7:1	2:1	3:1
AVERAGE	*10:1*	*9:1*	*5:1*	*3:1*	*4:1*

Source: EV Consulting analysis, University reports

Figure 32: Student-to-faculty ratio in local and Western Universities, 2014



Source: Official websites of universities

Nevertheless, in Armenian reality the low student-staff ratio is not a result of overstaffing, but a consequence of underutilization. A number of lecturers, including the younger generation, work part-time, as they combine the internship with the academic career. This is especially the case with Russian-Armenian Slavonic University, the Engineering student-staff ratio of which is extremely low.

This proves that in spite of the high number of lecturers, the underutilization of the latter negatively impacts the teaching. Thus, there is room for optimization in terms of decreasing the number of the teaching staff and increasing the quality of the lecturing and corresponding salaries. This does not refer to sector professional who should be more than encouraged to lecture part time.

The teaching staff is gradually aging, which combined with a weak links with private sector makes the teaching practice less valuable.

The average age of the lecturers is above 40 in smaller universities, and in the largest universities –50 and above.

Table 3: Average age of the university lecturers, 2014

	YSU	SEUA	AUA	RAU	ERA
AVERAGE AGE	50	56	45	~45[4]	~40

Source: University reports, EV university survey

The necessity of the existing lecturers to go through requalification programs and to adapt international teaching methodologies is undeniable, as the existing curriculum and methodological practices are already out-of-date.

Simultaneously, due to low remuneration and diminishing prestige in academic career, there is an acute deficit of younger specialists teaching in academia, with hands on practice in sector.

[4] The range of lecturer's age was very broad as there is a group of main lecturers with average age of 60, and a group of part-time young lecturers with hands-on experience in the private sector with average age of 30

As another precondition, the lecturers are required to possess higher scientific degree for teaching the lower degree course programs, e.g. lecturer with Master's degree has the right to teach Bachelor's course. This diminishes the potential pool of the candidates further.

The university survey reveals that on average, less than 1/3 of the university lecturers work or have ever worked in the sector and have hands-on experience in the industry. This, in combination with the high average age, implies that the teaching methodology is rather theoretical and does not give practical experience. Due to the teaching culture inherited from Soviet Union, many classes are not interactive and do not engage students.

Already engaged younger generation specialists tend to work part-time in the university in combination with employment in the sector. This fact has both advantages and disadvantages: the upside is the fresh intake of the innovation and alignment with the real sector dynamics, while the downside is the low concentration and lack of the academic career priority, which in some cases impacts the teaching quality.

The lecturer salaries are especially low in large universities, such as SEUA and YSU, due to larger overhead costs, laboratory expenses as well as additional costs incurred by not so popular faculties and departments, which still need financing.

This impacts the motivation of the ageing teaching staff and, subsequently, the quality of the education. Shrinking quality together with the low remuneration negatively influence the reputation of pursuing academic career accelerates the trend.

The universities do not develop student's practical capabilities necessary for entering the job market.

All the companies unanimously mentioned that graduates on average need 3-6 months in case of IT and 6-12 months in case of Engineering to learn the job specifics and become competent employees with corresponding salaries.

Universities do not teach programming languages as separate subjects, but as support tools to develop algorithmic thinking and understand technology. E.g. in one of the largest faculties C++ and C#, object-oriented programming languages mostly demanded on Armenian market at the moment and in the projected 3 years, are included in the curriculum for overall 4 semesters, but there is no practical application to it in terms of working on real projects while studying. The duration of internship programs is too short to develop hands-on skills and practical mindset with the student.

Popularity of laboratories and training centers on the university premises is just taking up, but the majority of current teaching staff is not accustomed to practical classes. With this respect graduates need more experience within company environment to gain knowledge.

Currently, the trend of establishing technology laboratories in Armenian universities is posed to facilitate the transfer of practical knowledge to the students.

There are two main models:

General educational labs: General educational labs are established on the premises of university aiming at bonding the theoretical knowledge received in the university with practical activities, to develop student's practical engineering capabilities. ANEL (Armenian National Engineering Laboratory) is an

example of general lab in 2013 September, the demand for which is gradually increasing. Utilization of general laboratories up to present has had more of a demonstrative nature, where the students had a passive role of spectators while the instructor was experimenting with the tools. Current downside of general labs is slow adaptation rate.

Specialized company labs. Company labs are established in the premises of the university (or company) at the expense of the company as supporting tools for trainings/ education. The labs are mainly aimed at preparing specialists for the investing company. It is revealed that due to the more certain future employment possibilities, company labs have high demand among the students. Synopsys Armenia Educational Department established an educational department within SEUA faculty in the premises of the company with a special lab. Smaller labs are established in YSU, RAU and ERA.

The downside of such laboratories is the narrow specialization of the trainees, which, according to some potential employers encounter difficulties when switching jobs.

There is no set process between universities and companies in terms of organizing internship projects for students, yet there are discussions to make the internships of students an efficient link between the platforms.

Currently, almost all higher education institutions include mandatory internships in their curriculum. However, in some cases, these programs have a formal nature and lack efficiency, e.g. the students do not attend the companies and pass the exams, or are entitled to pass the internship program within the department of the university. Moreover, there are deeper issues on the faculty management level, some representatives of which see the connection with the real sector only via company investments in the University for establishing R&D or training labs with the further recruitment purpose.

The survey revealed that most of the internships are not coordinated between universities and the real sector. While the companies generally need interns and seek them using different channels, the graduates and, in some cases, universities do not have set relationships with the companies to organize this flow and generally rely on personal connections to find a relevant company. Only a small number of companies carry out joint programs with the universities in the form of R&D projects or contests.

Career centers can also serve as a link between universities and the private sector. However, these currently do not operate efficiently and are in their infancy stage.

While all the respondent universities have or used to have dedicated career centers, the actual activities of job placement are of informative nature and have little impact on the employment level of graduates. In addition, career centers are understaffed and underpaid. One of the universities reported a temporary shutdown of the career center, due to lack of funding and staff.

University career centers carry out informative functions close to PR departments, i.e. the main functions of the career centers include attracting companies for campus presentations, networking events, organizing student trips to company premises, as well as disseminating vacancy announcements for

students and faculty via email. Few career centers organize trainings of resume writing or interviewing skills for the upcoming graduates. However, the attendance rate of such event is rather low - ~33%, indicating the low level of efficiency.

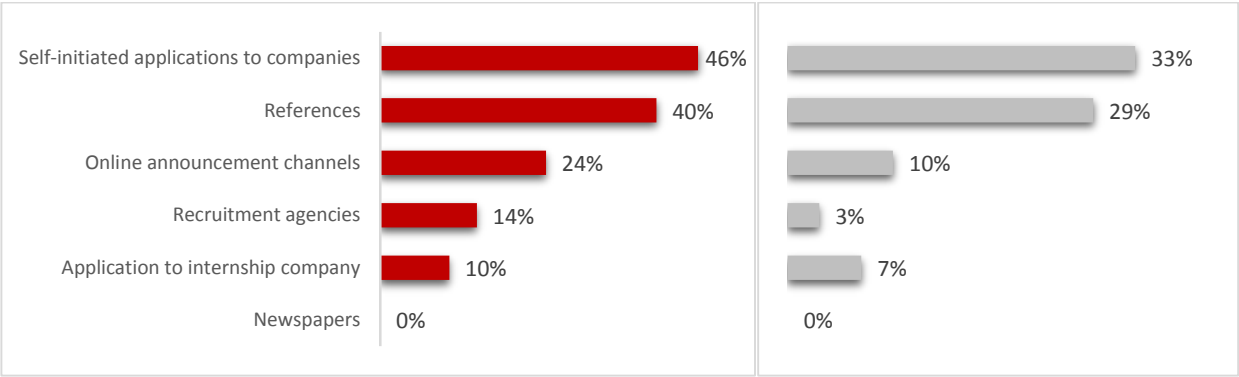
Career centers of renowned western universities have higher roles and serve as an efficient channel and component of recruitment for companies from one side and a communication channel for students to the private sector – on the other, by constantly keeping in touch with the HR departments. The function of career center includes providing HR executives with CVs of the relevant graduates for particular vacancies and active engagement in the recruitment process stages, in addition to informational and training activities. Such centers also keep track of the employment statistics of the graduates, as employment rate is the main KPI of their activities.

The local career centers do not trace the employment statistics of the graduates, generally, due to the lack of communication tools and resources, as well as the low collaboration level of graduates. As a fact, career centers are understaffed, with a *graduating student/staff* ratio of more than 500:1 and not equipped to contacting each graduate and alumni separately as well as maintain a contact database. The *graduating student/staff* ratio of career centers in more developed higher education systems is higher – from 20:1 to 200:1. Thus, being understaffed is another factor affecting the performance and development of career centers and their activities.

Average salaries of career center staff are lower than country average. This factor decreases the motivation of the career center staff to improve its performance indicators.

Currently, there is no significant gap between the job search and job announcement channels in Armenian IT and High-tech market.

Figure 33: Main methods of job search by the students (on the left) and their effectiveness (on the right, measured by receiving a job offer)



Source: EV Consulting, "Market study on HE graduate labor demand and employment in Armenia", 2011

In search of employment, graduates undertake various measures. Currently, the most popular method of job search is the self-initiated proactive applications to companies regardless of the available vacant position. With this approach, students tend to contact the target companies to present themselves and try to create a position.

The next popular methods of search are References and Online announcement channels, which coincide with the main chosen channels of candidate search by companies. Interestingly, Online announcement channels proved to be not very effective in finding employment from graduates' perspective, which can be explained by a high number of applications for a single job position. The effectiveness of the channels is measured by the success in receiving a job offer.

3.3. CASE OF SUCCESSFUL UNIVERSITY-PRIVATE SECTOR COLLABORATION:

Synopsys Educational Department

Synopsys aggressively entered Armenian market in 2004, after partnering with local firms for many years. It acquired three chip design automation companies (LEDA Systems, Monterey Arset, Virage Logic) and now is the largest software company in Armenia (600 employees) and largest Synopsys office outside U.S. Synopsys Armenia Educational Department was established before company acquisitions by Synopsys. The purpose of the project was to prepare microelectronics specialists for LEDA Systems, as the experience revealed already in 90's engineering graduates were not qualified for the employment. Initial agreement was reached with SEUA to open a special learning department as part of the faculty, where a group of students starting from 3rd year will be selected based on their excellence indicators and taught by a special curriculum aligned with the business. The physical premises were established near the company, with the objective to immerse the students into the ongoing projects ("University goes to the industry premises"). The financing of the project is totally carried out by Synopsys. The project was successfully set forth and was acquired together with LEDA Systems by international semiconductors producer Synopsys.

Later Synopsys Armenia Educational Department started cooperation with YSU, RAU and ERA but utilizing a different method, where "the industry goes to the university premises". In spite of best practices in the western culture, where the companies gather in the university premises, the methodology did not prove to be as effective as the one with SEUA.

Currently, Synopsys Armenia Educational Department continues preparing engineers for the industry. Albeit its education is considered too narrowly-specialized or practical by some industry experts, 100% of the graduates constantly get employment before the graduation.

- Up to date there are 646 engineers graduated from Synopsys Armenia Educational Department, who are extremely demanded on the market.
- 77% are employed by Synopsys Armenia, while 23% - in local and international companies such as Microsoft, IBM, etc.
- 43% of the technical workforce in Synopsys Armenia are supplied by Synopsys Armenia Educational Department

The department strives for success utilizing several principles:

1. *The number of the students in every intake is kept low.* Relatively small number of students in the classroom implies on more individual attention from the instructors as well as more project load per student.
2. *There are limited seats and only the best students are selected.* The single examination is conducted via "conveyer" method, where each candidate entering the room is questioned by a number of different instructors on different disciplines. Each discipline is represented by two instructors, who ask different questions to mitigate the subjectivity of the grading. By the end of the examination the overall grades of the candidates on each disciplines are averaged and the top students are selected.

3. *The curriculum is intertwined with the practical activities.* The acquired knowledge is utilized instantly by implementing it in the real company projects. Thus, later transferring into an actual job position in the company does not require additional efforts for the graduate to adjust.
4. *Relevant hardware and software for the practical activities are provided.* The department is well-equipped with technology (about 70 sets of Synopsys Electronic Design Automation tools), the total license cost for which amounts to a 9-digit figure. Provision of high quality practical knowledge suggest high investments, which currently the universities have difficulties to make.
5. *The lecturers are selected based on superlative characteristics and receive higher salaries compared with university lecturers.* The main two principles of the instructor's selection are the highest available qualification of the specialist in the taught discipline and the personality features. According to the Head of Synopsys Armenia Educational Department, any personality treats, which are less than superior, directly influence the quality of teaching and the outcome irrespective of the qualification of the instructor.

Recently, Synopsys Armenia Educational Department started providing preparatory courses of programming, English and other technical subjects aimed at preparing 2nd year students for the actual course. Synopsys EE attempted to engage the 1st year students into the program, but the quality of the students did not prove to be sufficient, thus, the initiative was stopped.

3.4. VOCATIONAL EDUCATION IN IT AND ENGINEERING SECTORS

The gaps in higher educational systems are partially being filled by the increasing role of the vocational training providers.

There are two types of training centers currently functioning in the country. The first type is the one supported by the government/donor or international corporations such as Microsoft Innovation Center, Armenian-Indian IT Center of Excellence and mLab ECA. The second type of vocational education is provided by private company initiatives, which in some cases are not training centers as such, but educational alternatives to universities. Examples of the mentioned private initiatives are Instigate Training Center and Synopsys Educational Department.

The objective of the first is to prepare junior specialists for Armenian IT companies, while the second pursue to satisfy own demand in engineering specialists. After the graduation from the company training center, the best graduates generally receive job offers. The rest have no legal obligations to the training company and are free to find employment in other IT companies.

IT training center services have significant demand from both the students and junior level working professionals. Their estimation of the demand in the upcoming 3 years is firmly positive.

In spite of providing paid trainings, the training centers see a constant increase of demand in their services. Students attend practical trainings to acquire basic knowledge of programming languages as well as to develop their soft skills.

There are both short-term trainings with the minimum of 6 hours activity and long-term trainings with several levels that last up to 6-7 months in total (~180 hours). The courses consist of the theoretical knowledge with its practical application in the project. Generally, the trainees are assigned a homework project.

Table 4: Characteristics and indicators training centers in Armenia

	MICROSOFT INNOVATION CENTER	ARMENIAN-INDIAN IT EXCELLENCE CENTER	MLAB ECA
TECHNICAL COURSES	Available	Available	Available
NON-TECHNICAL DEVELOPMENT COURSES	Available	Available	Available
PREREQUISITES	Basic knowledge and algorithmic thinking[5]	No requirements for beginners, minimum test score/ knowledge for advanced stages	Basic programming knowledge required for transferring to mobile programming platforms

[5] The prerequisite is for the beginner level. In order to pass to the next level, the trainee needs to complete the previous training level or have the corresponding knowledge.

ANNUAL NUMBER OF GRADUATES	~1,000	~500	~300
NUMBER OF INSTRUCTORS	9[6]	10	~50
AVERAGE AGE OF INSTRUCTORS	~27	~40	~33-35
INTERNSHIP	Available	Not available	Not available
EMPLOYABILITY RATE	80%-90%	N/A	90%

Source: EV Consulting university survey

The anticipation of the student growth is based on the fact of flexible and practical curriculum the centers provide depending on the market need. Albeit each of the centers is concentrated on a particular direction (e.g. Microsoft platform, mobile programming, etc.), they have no difficulties to shift to respond to the market changes. The current market information is available through centers' connections with companies and the instructors, ~80% of which work in a real sector and are familiar with ongoing trends. This guarantees an entry-level employment for students, thus, fostering demand of training centers.

The prerequisites for the trainings vary from center to center and from discipline to discipline. There is no competitive selection among the students, but basic knowledge of fundamentals might be required depending on the level of the chosen training. E.g., mLAB ECA provides mobile programming trainings, thus, knowledge of corresponding programming language is a precondition for working on Android, iOS or other mobile platforms.

The availability of internship programs in training centers is underway. Microsoft Innovation Center collaborates with a number of IT companies to provide a 4-5 month internship programs, during which the students execute a real project reporting to the company. Upon the successful completion of the project, the companies hire the intern on a permanent basis.

Currently training centers do not maintain official statistics on the employment of their graduates; nevertheless, informally due to the existing relationship with the companies and graduates, the information is accessible.

Microsoft Innovation Center also provides professional certification programs available from Microsoft Corporation.

Engineering educational establishments initiated by the companies prepare specialists that meet international quality standards and are almost 100% employed.

These types of educational establishments do not charge fees, but have limited seats and select only the best candidates based on their technical knowledge and mathematical/ algorithmic aptitude. Classes are small intentionally, as the management of the systems believes that the high number of students in the

[6] The number is volatile and depends on the running number of courses at the moment.

classroom compromises the quality of the graduates. The trainings last longer and replace the significant portion of the university education.

Table 5: Characteristics and KPIs of educational systems initiated by private companies

	INSTIGATE TRAINING CENTER	SYNOPSYS ARMENIA EDUCATIONAL DEPARTMENT
TECHNICAL COURSES	Available	Available
NON-TECHNICAL DEVELOPMENT COURSES	Not available	Available
PREREQUISITES	Capacity to solve technical problems, basic mathematical knowledge	Strong technical knowledge and algorithmic thinking. Strong knowledge of all technical fundamentals
ANNUAL NUMBER OF GRADUATES	~50	~80
NUMBER OF INSTRUCTORS	~30	67
AVERAGE AGE OF INSTRUCTORS	~30	~30-35
INTERNSHIP	Involvement in company projects	Involvement in company projects
EMPLOYABILITY RATE	100%	100%

Source: EV Consulting university survey, University reports

The employability rate is 100% out of which 70% and 77% of the graduates are employed in Instigate and Synopsys respectively.

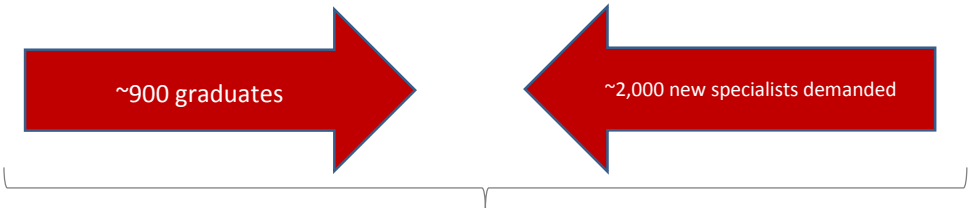
There is total absence of professional off-job training program for senior developers on the market, so the companies have no alternative but to provide on-the-job training.

Currently, there is a huge demand in professional training programs for senior-level specialists in both IT and High technology sectors. The general trend with the senior developers reveals a narrow specialization tendency, which is relevant in the employer company. Owing to the absence of such trainings, the cost of recruiting senior specialists and re-qualifying them is very high for companies. Base-level specialists tend to be raised from junior specialists within the company environment; nevertheless, the respondents confirmed that in case of training availability, the demand would be considerable.

Large international companies have opportunities and can afford re-qualifying senior level specialists abroad, particularly, in their headquarters. Nevertheless, despite the financial capabilities, the management still considers the opportunity too costly and would prefer to train the staff locally. The international trainings are more preferable after the employee has already spent some time inside the company.

4. SUMMARY AND HIGH LEVEL RECOMMENDATIONS

Currently, the number of graduates with IT specializations annually about coincides with the annual new demand in the overall market, but only 45% of the graduates consider employment in the sector, thus, creating a quantitative imbalance of workforce.



The number of specialists demonstrates the demand only in IT and High technology sector and does not include non-IT and non-high technology companies, which are also in need of IT specialists. Thus, the actual demand in the market might be much higher than 2,000 new specialists per year.

In addition, due to the positive and fast industry dynamics there is also a qualitative skills gap conditioned by the following factors:

- Teaching programs are not fit for the private sector standards: the private sector assessment for practical and theoretic knowledge of graduates is below average
- No effective links between university and private sector companies are in place to organize internships and recruitment procedures
- Professional standards in teaching staff is low and there is no motivation to requalify
- Teaching staff is aging, while the younger generation with hands-on experience has little interest in academic career
- The university programs do not accentuate self-development and self-educational capabilities of graduates, essential for the dynamically developing industry
- The university degree program is too long in comparison with the industry dynamics and stifles the development of students until those reach the workforce market
- There are no high-level training programs for base and senior level specialists to requalify

The role of higher educational system is gradually diminishing. In particular, the Master's and PhD degrees are not considered of higher value by companies, but rather additional periods spent without practical activities.

The imbalance in the sector also results in dysfunctional labor market, with remuneration levels for highly qualified labor force increasing beyond the justified limits.

Also, the quantitative balance in place at present will face a dip in the upcoming several years, due to several factors, such as:

- military reforms, enforcing the mandatory military service for male citizens before acquiring higher education. This will result in decreased applicant number for 1-2 years with corresponding number of graduates in 4-5 years.
- low student enrollment during 2018-2019 because of low birth rates in 2001 and 2002.

The sector competitiveness is on the verge of diminishing, unless policy makers take practical steps towards balancing the situation.

4.1. HIGH-LEVEL SHORT-TERM RECOMMENDATIONS AND KEY POINTS FOR POLICY MAKERS

A new university curriculum should be developed together with the private sector

The overall curriculum needs a revision and amendments to correspond the industry needs. For this purpose, it is recommended to establish special curriculum development boards and elect board members from the industry specialists and executives. The contribution of industry specialists into the curriculum development is essential to make it more relevant and catering to industry needs.

The quota of government funded students should be increased for IT specializations at universities.

It is recommended that the policymakers explore the possibility of increasing the quota of the students in IT-related faculties, whose tuition is funded by the Government. Provided there is additional budget, the higher number of the free student quota, which is allocated to students based on their entrance exam results, will attract more qualified candidates.

The link between the universities and private sector should be strengthened through transforming the role of mandatory internship/apprenticeship programs.

The global changes in university-private sector relationship are possible to implement in the short-term only by the interference of policy makers. The dialogue between the parties can be enforced through creation of a new standard of internship programs - apprenticeship, mandatory for students to receive the degree.

To address the gap of practical knowledge/experience, the Union of Information Technology Enterprises (UITE) developed and suggested a concept of mandatory internship-apprenticeship programs for students in all Armenian universities. The concept proposes mandatory part-time employment with gradually increasing number of working hours for all the students starting from their first year.

On average, the daily occupation of the students at classes is ~6-7 hours, while there is generally no everyday homework assigned. Due to this schedule, students have spare time between their mid-term and end-term exam preparations, which should be fulfilled with practical job tasks. Thus, by the time of official graduation, the specialists will already have work experience to develop their specialist qualification and actual portfolio projects to demonstrate their on-the-job capabilities.

This initiative will enable a quick transfer of professional knowledge to students from companies and knowledge sharing among the students themselves, which will naturally raise the expectation levels from the educational establishment and gradually change the teaching program.

Besides recruitment opportunities, the companies should be incentivized by additional benefits such as publicity, free or low-cost workforce etc. and monitor the progress of the student.

More young professionals from real sector should be encouraged to teach in the universities to bring in the practical skills into the classroom.

Lack of relevant remuneration and prestige in academic career should be addressed by encouraging younger professionals to involve in the teaching experience in the universities. The interest can be raised via initiating relevant R&D projects, professional trainings, guest-lecturing practices, additional bonus programs for young faculty, etc.

The presence of younger generation instructors is the main precondition for the implementation of international and up-to-date teaching standards in the universities. Moreover, the academia needs to prepare qualified replacement for the aging generation of lecturers.

The urgent need in base and senior level specialists can be satisfied via creation of special training programs, currently absent on the market.

Currently, there are no high-level qualification training programs for middle and senior developers available on the market. Due to the frequent narrow specialization of senior staff, the re-training of high-level specialists on-the-job requires considerable time and resources and represents a high cost for companies. Correspondingly, the demand of high-level qualification trainings increases, creating a niche segment for training centers.

The lack of senior staff can be addressed via providing a set of requalification trainings to base and senior level specialists, to make career transitions more affordable for companies and flexible for developers. This can be implemented through a dedicated support mechanism (technical assistance to identify the relevant niches and develop content, co-finance the infrastructure) to private training providers or by setting up publicly funded training programs. Utilizing and creating online training courses as a blended learning format can also supplement these training programs in a cost effective way.

Co-financing schemes for workforce development by means of training centers creation can help smaller companies to close the skill gap.

The skill mismatch can be addressed through enhancing the resources that smaller companies can spend on training and development. Special co-financing schemes (with matching requirements) can be developed supported by the government or international donor programs to establish special training centers within the companies. Particularly, companies meeting pre-defined requirements (size, local ownership, etc.) may be eligible to co-financing of short to medium term training courses for their employees locally and abroad. This approach may be especially useful for training senior developers, who currently have no requalification trainings available for them on the market.

In special cases co-financing may be granted also to establish corporate training centers.

Widespread and targeted communication campaigns shall be organized to highlight the prospects and strong market demand for the engineering profession.

Due to the significance of the industry within the local economy, the problem needs to be addressed urgently and intensively. The effective approach suggests increasing both the quantity and the quality of the graduates to ensure the increase of number of qualified specialists.

The quantity of applicants in technical faculties is to be stimulated by information campaigns on the engineering profession, where the engineer is presented as a person solving real life problems rather than an office clerk doing “dull coding work”. Company visits and special seminars for high school students can be very effective as the few past pilot projects showed (e.g. USAID-supported program with Ayb high school).

4.2. HIGH-LEVEL LONG-TERM RECOMMENDATIONS AND KEY POINTS FOR POLICY MAKERS

The university funding needs considerable increase as well as diversification through research grants and endowment foundations.

Currently, the Armenian IT industry is at the inflection point from where it can accelerate into rapid high value growth. Achieving next level of value addition will require significant increase in number and quality of labor force. To achieve that the government will need to provide significant investments and incentives for improving the level of IT education. Only comprehensive and focused government engagement can have sizeable impact, whereas the subscale and dispersed efforts do not result in the creation of world-class knowledge and skills can be deemed ineffective.

The intervention into the educational system via extensive public investments faces the possible strategic choice:

- *The focused approach* is based on the principle that with limited resources it is vital to target the "critical pressure points" by focused interventions and mainstreaming the results throughout the entire system. The approach puts emphasis on the creation of a small number of excellence centers that become the agents of change for the system.
- *The horizontal approach* suggests more balanced advancement in the existing educational system by opening small-scale excellence centers. Within the frame of this approach, the role of the change agent is distributed among a much larger number of institutions and the best professional resources are more spread throughout the system.

The funding diversification is to be implemented through attracting R&D grants, which may imply relocating some portion of the fundamental research funding to universities instead of Academy of Sciences of Armenia or other institutions.

Another option to obtain diversified funding is the establishment of endowment foundations. Currently, except for the American University of Armenia, no other Armenian university has an endowment fund.

The number of university-based laboratories, which are established with the help of multinationals, should be scaled up.

The establishment of laboratories in cooperation with multinationals helps exposing students to the global best practices and latest technologies. Similar to the establishment of ANEL together with National Instruments, USAID and Government, more laboratories need to be established on the university premises to enable the technical environment for the students. The spread of labs with different multinationals will help mitigate the risk of concentrating the students learning only the technologies of limited number of multinationals.

Creating an alternative program to prepare software programmers in less than 4 years will help increase the supply of labor in the medium term.

Taking into the consideration the rapid dynamics of the industry, 4 years of study to earn undergraduate degree is often considered too long for software programmers. By the time of the graduation the professional knowledge acquired in early student years is of little use.

The educational solution to the current industry speed that can be considered is introduction of globally recognized certification programs or when applicable – associate degrees. Such programs can be university based and be provided in addition to standard degree programs.

The advantages of introducing non-degree programs are its intensity as well as the shorter duration aligned with the high speed of industry development dynamics. The disadvantages are the absence of general education subjects, however this program is not intended to substitute the traditional degree based education.

Suggested accelerated degree program is not a substitute to certification or training programs provided by training centers. While the latter are aimed to provide a junior narrow specialist-coder as a short-term solution to the market demand, accelerated degree programs intend to prepare a strong technical specialist with up-to-date skills and knowledge, who has a potential of becoming a specialist fit to both outsourcing and entrepreneurial models. Currently, the value of the both programs is crucial in the sector.

The universities should transform their career centers into modern support mechanism for their graduates.

First, universities need to redefine the role of career centers by making them an important element of their service delivery process. Particularly, apart from the information dissemination, the role of the career centers in the recruitment process should be improved and highlighted, minimum wages of career center employees should be set higher, at least close to the country average and the staff/student ratio should be minimum 1:200. They need also to institute advanced performance measurement systems to track the progress and communicate to potential applicants, graduates and alumni. Publicly accessible performance data will help create transparent competitive landscape. A dedicated technical assistance program may help spread such practice in leading universities.

If Armenia aspires to transition from outsourcing, development center destination to one of innovation centers functioning under entrepreneurship model, it has to integrate fundamental, hard-core research into its university system.

True innovation requires hard-core research, world-class knowledge and expertise rather than a mass of coders with basic level of proficiency. The development of innovation, R&D capabilities is easier to inculcate if students are accustomed to performing fundamental research from early years of their study.

The integration of public research in university education can substantially enhance the role of universities. The government needs to start outsourcing R&D projects to university groups engaging students, gradually increasing the level of complexity. Particularly, declassified military problems can become an important source of research projects with real life applications requiring sophisticated skill set.

High tech accelerators can become the new type of schools for entrepreneurs.

The growth of the entrepreneurship model suggest new types of skills and knowledge in addition to the traditional approach, discussed in the report. As the new model is based on more innovation and product development, it eventually requires radically new approaches to education and skill development to move up the innovation value chain The model is crucial for the further development of the industry as Armenia

is a small country, which realistically cannot compete on the cost over the long period of time without a higher skill level.

Currently, different types of accelerators, mentorship programs are becoming the new type of educational establishments for high tech entrepreneurs. More and more young entrepreneurs in advanced economies prefer to gain practical experience of building startups in accelerators for a short period of time than spend years in business schools and other mainstream establishments.

The number of accelerators, incubators, mentorship programs and startup competitions also tends to grow in Armenia, but requires more highlight. Particularly, proliferation of accelerators and entrepreneurship programs and contests shall be supported by public money at the initial stage that will trigger private players to step in and take advantage of the trend.

Mentorship programs with Diaspora representatives of entrepreneurial ecosystem needs to be organized for better knowledge transfer. Similar to Israeli model, some Armenian entrepreneurs, successful in developed markets should be heavily involved in building the ecosystem. This should be organized by mostly public intervention with the support of local private sector.

5. APPENDIX

5.1 COMPANIES SURVEY

Questionnaire ID Nr. ____

EV Consulting contracted by the World Bank is conducting a research study of Armenia's IT sector aimed to assess the sector's need in qualified personnel and human capital. The survey will require about 20-30 minutes of your time.

CONFIDENTIALITY*: Survey responses are strictly confidential and individual responses are not identified.*

Date of the interview _____

GENERAL INFORMATION ABOUT THE COMPANY

Name of the company _____

Name of the respondent _____

Position of the respondent_____

Location of the company _____

1. **Please, state the main services/products offered by your company**
   - 1.1 _____
   - 1.2 _____
   - 1.3 _____

HUMAN RESOURCES

2. **Please, state the total number of PERMANENT employees at your company** _____
3. **Please, state the total number of NON-PERMANENT employees at your company**_____
4. **Please, state the number of your permanent TECHNICAL/MANAGERIAL STAFF**_____

5. **Please, state the share of your specialists in the total number of TECHNICAL/MANAGERIAL staff by the following factors.**

	% in total TECHNICAL/MANAGERIAL staff
5.1. Specialists with foreign education/work experience	
5.2. Specialists with good knowledge of English	

6. **Please, state the educational level of your PROFESSIONAL/MANAGERIAL staff.**

	% in total TECHNICAL/MANAGERIAL staff
6.1. Technical (non-higher)	
6.2. Higher education – Bachelor's degree	
6.3. Higher education – Master's degree	
6.4. PHD (including candidate of science and doctor of science)	

7. **Please, state what are the constraints in recruiting?**
   - ☐ 7.1. Lack of qualified candidates
   - ☐ 7.2. Lack of recruiting personnel
   - ☐ 7.3. Lack of budget
   - ☐ 7.4. Lack of attractive salary
   - ☐ 7.5. Lack of future business opportunity/contract pipelines
   - ☐ 7.6. Others_____

8. **Which recruiting channels do you use and how frequent?**

Channel	1= Never	2= Rarely	3=Sometimes	4= Often	5= Every time
8.1. Online sources					
8.2. References					
8.3. Recruiting agency					
8.4. University relationship					
8.5. Newspaper					
8.6. Other_____					

9. Do you have any preference for recruiting from certain universities or training institutions?

☐ Yes ☐No *(Pass to Q11)*

10. If yes, please state from which universities and training centers you prefer to hire and why.

University/Training Center	Reasons for preference
10.1.1.	10.2.1
10.1.2.	10.2.2.

11. Does the candidate's discipline/major of study matter when hiring?

☐ Yes ☐No

12. If yes, please state from which discipline/major of the study you prefer to hire and why.

Discipline/major	Reasons for preference
12.1.1.	12.2.1.
12.1.2.	12.2.2.

13. How important are each from the following factors, when recruiting candidates?

	1=Not important	2=Relatively important	3=Important
13.1. Subject matter knowledge/Technical skills			
13.2. Education qualification/University degree			
13.3. Attitude/Motivation			
13.4. Soft skills (communication, team-work)			
13.5.Ethics/fit with the company culture			
13.6. Other_____			

14. How many hours on average per year does your company spend on training a newly recruited candidate?

_____

15. How much budget do you spend on average per newly recruited candidate per year? _____

16. Please, describe your off-job trainings (duration, depth, etc.)

_____

_____

17. What are the main topics the off-job trainings cover?

- ☐ 17.1. Technical knowledge/skills
- ☐ 17.2. Soft skills (teamwork, communication)
- ☐ 17.3. Managerial skills/Project management
- ☐ 17.4. Sales and marketing
- ☐ 17.6. English
- ☐ 17.7. Other _____

We would like to understand your company's need for specialists and management in SHORT-TERM (coming 3-4 months) and LONG TERM (next 3 years) perspectives.

SHORT-TERM perspective

18. Does your company need to recruit new specialists in the coming 3-4 months?

☐ Yes ☐No *(Pass to Q18)*

19. If yes, state the number of employees by specialization and level your company needs in the coming 3-4 months.

Specialization	**Requirements (***education level, soft skills, experience etc.)*	**Number of employees needed in the coming 3-4 months**
19.1.1.	19.2.1.	19.3.1.
19.1.2.	19.2.2.	19.3.2.
19.1.3.	19.2.3.	19.3.3.

LONG-TERM perspective

20. What are your expectations regarding the number of your PROFESSIONAL/MANAGEMENT STAFF in the next 3 years?

	Average annual increase/decrease, %
The number of specialists will increase	
The number of specialists will decrease *(Pass to Q20)*	
The number of specialists will roughly remain the same *(Pass to Q20)*	

21. Please, state specifically what specialists you plan to hire in the next 3 years.

Specialization	**Requirements (***education level, soft skills, experience etc.)*	**Number of employees needed in the next 3 years**
21.1.1.	21.2.1.	21.3.1.
21.1.2.	21.2.2.	21.3.2.
21.1.3.	21.2.3.	21.3.3.

IT AND ENGINEERING GRADUATES

22. Please, evaluate the graduates of local universities in IT and high tech by the following factors.

	5=Excellent	**4=Good**	**3=Average**	**2=Fair**	**1=Poor**
22.1. Subject knowledge					
22.2. Practical technical skills					
22.3. Soft skills (communication, team-work)					
22.4. English					
22.5. Other_____					

23. Which skill do you expect the potential candidate to be trained at the university/training institutions before joining the workforce? And how important each skill is?

	1=Not important	2=Relatively important	3= Important
23.1. Subject matter knowledge			
23.2. Practical technical skills			
23.3. Soft skills (communication, team-work)			
23.4. English			
23.5. Other_____			

24. Which is THE MOST CRITICAL skill/knowledge that in your opinion most IT and Engineering graduates lack and need to improve.

_____

25. In your opinion what could be done to improve the quality of graduates and young specialists in IT and high tech sector.

_____

_____

_____

T**el. number of the respondent** _____

Thank you for taking the time and answering our questions!

5.2. UNIVERSITY SURVEY

Questionnaire ID Nr. ____

EV Consulting contracted by the World Bank is conducting a research study of Armenia's IT education. The interview will require about 30 minutes of your time.

CONFIDENTIALITY*: Interview results are strictly confidential and individual responses are not identified.*

Date of the interview _____

GENERAL INFORMATION ABOUT THE UNIVERSITY

Name of the university _____

Name of the respondent _____

Position of the respondent

_____

The main IT and high tech related departments and quotas at each department

Department	Quota

STUDENTS AND GRADUATES

1. **The total number of graduates with IT majors per year _____**
2. **The total number of graduates in Engineering majors per year _____**
3. **The total number of graduates per year _____**
4. **The total number of currently enrolled students in IT departments _____**
5. **The total number of currently enrolled students in Engineering departments _____**
6. **The total number of currently enrolled students _____**

7. **What are your expectations regarding the enrolment and number of your graduates from IT and Engineering departments in the next 3 years?**

_____

_____

_____

INSTRUCTORS

8. **The total number of your teaching staff _____**
9. **The total number of your teaching staff in IT department _____**
10. **The total number of your teaching staff in High Tech department _____**
11. **The average age of your instructors _____**
12. **Do you have instructors that work in private sector and have hands-on industry experience?**
    ☐ Yes ☐No

12.1 (if yes, detailed description)

_____

_____

_____

13. **In your opinion what are the main impediments for recruiting highly qualified teaching staff? (e.g. low salary of professors)**

_____

_____

_____

CURRICULUM AND STUDY PROGRAMS

14. **In your opinion, do the curriculum and study program at your university meet the demands of the private sector in preparing qualified graduates and job candidates?**

_____

_____

15. *(Only for computer science departments)* **Which programming languages do you teach?**
15.1. Describe the courses (number of hours, teaching methods etc.).

_____

_____

_____

16. Do you have internship programs for students? If yes, is it mandatory? Please, describe the internship (duration, depth etc.).

☐ Yes ☐No

16.1. (internship description)

_____

_____

_____

17. Do you have a joint program/initiative/lab with a private company?

☐ Yes ☐No

17.1. If yes, please, describe.

_____

_____

18. Do you get any input from private sector on your course materials/curriculum development?

☐ Yes ☐No

18.1 (if yes, please, describe)

_____

_____

19. Do you offer a professional skills certification program (e.g. SAP, Oracle etc.) in addition to regular degree programs?

☐ Yes ☐No

STUDENTS JOB PLACEMENT

20. Do you have dedicated career center/employee to support your students with job/internship search and placement?

☐ Yes ☐No

20.1 (if yes, please, describe)

_____

_____

21. Do you track the job placement of your students?

☐ Yes ☐No

_____

_____

22. Do you have any statistics regarding the job placement of your graduates?

☐ Yes ☐No

22.1. (if yes, please, describe)

_____

_____

_____

23. Do you teach your students' job search related skills such as resume writing, networking, job interview etc.?

☐ Yes ☐No

23.1. (if yes, please, describe)

_____

_____

_____

24. Do you know which job search channels your students use? Please, rate how often each channel is used.

Channel	1= Never	2= Rarely	3=Sometimes	4= Often	5= Every time
24.1. Online					
24.2. Personal connections/ references					
24.3. Recruiting agency					
24.4. University-Private sector relationship					
24.5. Other_____					

T**el. number of the respondent** _____

Thank you for taking the time and answering our questions!

5.3. TRAINING CENTER SURVEY

Questionnaire ID Nr. ____

EV Consulting contracted by the World Bank is conducting a research study of Armenia's IT education. The interview will require about 30 minutes of your time.

CONFIDENTIALITY*: Interview results are strictly confidential and individual responses are not identified.*

Date of the interview _____

GENERAL INFORMATION ABOUT THE TRAINING CENTER

Name of the training center _____

Name of the respondent _____

Position of the respondent _____

Main courses offered _____

1. Was the establishment of the training center a private initiative or a government/international organization initiative?

☐ Private initiative ☐ Government/international organization initiative

1.1. (Description)

_____

_____

TRAINEES AND GRADUATES

2. The total number of graduates of your center per year _____

3. The total number of graduates in IT per year _____

4. The total number of graduates Engineering per year _____

5. The total number of currently enrolled trainees at your center _____

6. The total number of currently enrolled trainees in IT _____

7. The total number of currently enrolled trainees in Engineering _____

8. What are your expectations regarding the number of your enrolments and graduates (and those who are in IT and Engineering majors) in the next 3 years?

_____

_____

9. What are the selection criteria and requirements of acceptance to your training program?

_____

_____

INSTRUCTORS

10. The total number of your teaching staff _____

11. The total number of your teaching staff in IT department _____

12. The total number of your teaching staff in Engineering department _____

13. The average age of your instructors _____

14. What is the final education degree of the instructors? (categorize in proportion among BA, MA, and PhD) _____

15. Do you have instructors who, also, teach at universities?

☐ Yes ☐No

15.1. (additional information)

_____

CURRICULUM AND STUDY PROGRAMS

16. Describe your training courses (duration, depth, study plans, main topics covered etc.)

_____

_____

17. In your opinion, do your courses meet the demands of the private sector in preparing qualified graduates and job candidates?

_____

_____

18. *(In case of software development* **) Which programming languages do you teach?**

18.1 Describe the courses (number of hours, teaching methods etc.).

_____

_____

_____

19. Do you have internship programs for trainees? If yes, is it mandatory?

☐ Yes ☐No

19.1. Please, describe the internship (duration, depth etc.)

_____

_____

_____

20. Do you have a joint program/initiative/lab with a private company?

☐ Yes ☐No

20.1. If yes, please, describe.

_____

_____

_____

21. Do you get any input from private sector on your course materials/curriculum development?

☐ Yes ☐No

21.1 (Please, provide details)

_____

_____

22. Do you offer professional skills certification programs (such as SAP, Oracle, etc.), in addition to your regular training courses?

☐ Yes ☐No

22.1. (Please, name the courses)

_____

_____

TRAINEES JOB PLACEMENT

23. Do you have dedicated career center/employee to support your trainees with job/internship search and placement?

☐ Yes ☐No

23.1. If yes, please, describe its activities.

_____

_____

24. Do you track the job placement of your trainees?

☐ Yes ☐No

_____

_____

25. Do you have any statistics regarding the job placement and career of your trainees?

☐ Yes ☐No

25.1. (If yes, please, provide additional information)

_____

_____

26. Do you teach your trainees job search related skills such as resume writing, networking, job interview etc.?

☐ Yes ☐No

26.1. (If yes, please, describe)

_____

_____

27. Do you know which job search channels your trainees use? Please, rate how often each channel is used.

Channel	1= Never	2= Rarely	3=Sometimes	4= Often	5= Every time
27.1. Online					
27.2. Personal connections/ references					
27.3. Recruiting agency					
27.4. Training center - private sector relationship					
27.5. Other_____					

T**el. number of the respondent** _____

Thank you for taking the time and answering our questions!

5.4. LIST OF THE SURVEYED PARTIES

COMPANIES

1. National Instruments, Armenian Branch
2. Symotec LTD
3. Synopsys Armenia CJSC
4. Nairi-Tech LLC
5. Artin Varoujan CJSC
6. Agnian LLC
7. Instigate CJSC
8. Ani-Test CJSC
9. CQGI MA
10. Macadamian AR CJSC
11. Flexible Applications CJSC
12. Monitis GFI CJSC
13. Plexonic
14. SFL LLC
15. Shahumyan Media LLC
16. LTXC Credence LLC
17. OMD
18. X-tech Studio
19. Idram LLC
20. Essential Solutions LLC
21. Zoom Graphics LLC
22. Mentor Graphics, Armenia
23. LynxSEL LLC
24. X –art LLC
25. Volo LLC
26. Eyesoft LLC
27. Locator CJSC
28. Seven Smarts LLC
29. LimeTech LLC

UNIVERSITIES

1. European Regional Academy
2. Russian-Armenian (Slavonic University)
3. American University of Armenia
4. Yerevan State University
5. State Engineering University of Armenia

TRAINING CENTERS

1. Instigate Training Center Foundation
2. Microsoft Innovation Center Armenia
3. Armenian-Indian ICT center of excellence
4. mLab ECA

OTHER PARTIES

1. Union of Information Technology Enterprises
2. ANEL Laboratories
3. Synopsys Armenia Educational Department
4. SEUA Career Center
5. Granatus Ventures