EIF Enterprise
Incubator
Foundation

Armenian Information Technology Sector

Software and Services

State of Industry

2003

ARMENIAN INFORMATION TECHNOLOGY SECTOR
SOFTWARE AND SERVICES

REPORT ON THE STATE OF THE INDUSTRY

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PREFACE

Enterprise Incubator Foundation is a business development and incubation agency supporting technology companies in Armenia. Our objectives are to improve competitiveness of Armenian IT companies in the global marketplace, build linkages with business communities in key technology markets, improve access of local companies to knowledge and information on best practices and experience, and assist Armenian firms with attracting local and foreign investors. An important part of our strategy is the provision of research and analytical materials about Armenian IT industry. The goal of this Report is to help better understand Armenian IT sector, recognize its main needs, as well as gain insights on possible solutions to its key problems.

This Report is the product of our recent needs assessment survey finished in the first half of 2004 and our two-year experience with the Armenian IT sector. The Report covers key aspects of the industry including historical developments, revenues, productivity, workforce and educational sector, policy developments, and others. In addition, we discuss industry outlook and present our recommendations on most important areas, which require reforms in order the industry to continue and expand its growth. Appendices section contains information about Armenia, its business environment, and development institutions and NGOs active in the IT sector. Appendix 5 discusses definitions, key assumptions, estimation methods, and details of the industry research.

The Report is not intended to provide significant insights to those already familiar with the industry. Rather the objective of the Report is to bring together information, opinions, and views from a variety of sources into one concise and consistent framework that could be used as a definite source of information for those interested in Armenia's IT sector. We believe that this work is a major step towards building an internationally competitive IT industry with robust company base, talented workforce, and high quality educational institutions.

We would like to thank the team of Development Programs Ltd., which conducted the needs assessment survey on our behalf. We appreciate valuable comments and feedback by our colleagues from McKinsey: Avetik Chalabyan and Jens Dinkel. The study could not have been undertaken without numerous interviews with managerial and professional staff of IT companies, faculty and students of educational institutions, representatives of development organizations, NGOs, training centers, and others. We are immensely grateful to all these individuals for their time and help.

Sincerely,

Bagrat Yengibaryan
Director of Enterprise Incubator Foundation

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SUMMARY

Armenian information technology industry with its software and services segment[1] has been one of the most dynamic and promising sectors of the economy in the last decade. Before the collapse of the Soviet Union, Armenia was considered a leading IT and electronics center with more than a dozen of large R&D institutes and manufacturing companies as of 1985. After the break up of the USSR by the end of the 1980s, the sector witnessed significant crisis, which, however, has been overcome as new companies evolved in the mid-1990s.

Starting from around 1997, the industry received a new impulse for growth when a number of start-ups emerged in the local market and several western companies established development centers in Armenia. By 2003, the number of operating IT companies has reached around 110[2]. In 2000, the Government of Armenia declared development of information and communication technologies as one of the priorities for the Armenian economy, which followed by the creation of the ICT Master Strategy and ICT development implementation plan to establish Armenia as a regional ICT hub.

INDUSTRY REVENUES

Industry revenues for the years 1998-2003 grew at 30%[3] and reached $38[2] million in 2003. Nearly two thirds of the total industry revenues are accounted to some 25 foreign companies operating in Armenia. More than half of them have US ownership, while others are mostly Russian or European.

IT services and products are being exported to more than 20 countries, which is one of the signs of maturity reached by the industry. The largest share of exports, 68%, goes to the United States and Canada; the second largest market is Russia and CIS with 16%; third comes Europe with 10%. Domestic market constitutes $13.5 million and exports are more than $24 million, and both are dominated by the services segment. Local companies play major role in the local market, while foreign branches account for major share of exports. The domestic market remains small, though it showed positive growth during the last few years. It is expected to grow even faster when businesses and Government realize the benefits that IT can bring in terms of efficiency and new opportunities.

PRODUCTIVITY ANALYSIS

Our analysis revealed that Armenian software companies involved in the provision of IT services have relatively high productivity compared to that of the US software services companies. Productivities of local and foreign firms in the services segment are 41% and 79% of that of the US services segment. The reason for the difference between local and foreign companies is that the local firms perform lower value services, and they lack brand name recognition experienced by the foreign companies. Contrary to the services segment, average productivity of packaged software companies is 17% of that of the US packaged software companies.

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[1] "Software and services" and "IT sector / industry" are used interchangeably in this Report.
[2] See Appendix 5 for assumptions and estimation methods.
[3] If not otherwise specified, all growth rates are CAGR (Compound Annual Growth Rate).

In 1998-2003, the industry witnessed an increase in the productivity rates somewhere around 5-7%, which was mostly attributed to export oriented firms. Companies active in the export market generate higher revenues and charge higher rates. In contrast to export oriented companies, firms focused on the domestic market do not show significant gains in productivity.

HUMAN RESOURCES

The total workforce employed by the IT sector is around 3,000 individuals, which represents approximately 25% growth during 1998-2003. The workforce is almost evenly shared between the local and foreign companies. Around two thirds of the workforce is concentrated in the services segment of the industry.

Annual average salaries of experienced developers range from $3,000 to $7,200, and for team leaders or project managers, the range is $6,000-$14,000. Salary levels depend on the experience of the employees and whether it is a local or foreign company. Salaries are competitive compared to most of the major IT outsourcing countries like China, India, Ireland, Israel, and Russia.

The number of students enrolled in various IT related fields at 14 educational institutions is approximately 3,900. This number has grown during last decade because of the opportunities and benefits that the IT industry offers to young professionals. However, the educational sector capacity is going to be one of the major constraints for the continued growth of the industry.

INDUSTRY OUTLOOK

During its major expansion in 1998-2003, the industry has witnessed around 25% increase in the workforce and around 5-7% rise in productivity, which resulted in higher than 30% industry growth. If appropriate reforms are carried out by the Government in cooperation with the donors and the Diaspora, the industry may keep its growth trend and reach $250 million in revenues and 14,000 in workforce by 2010. At the same time, Armenian IT industry is capable of reaching revenues in the range of $300-400 million. However, such high growth rates of 35-40% could be achieved only with 25-30% annual increase in the workforce and around 7-8% rise in productivity. To continue current high growth of the industry and achieve even higher rates require substantial efforts by the Government, educational and private sectors, as well as significant support from the donor community and the Diaspora.

2003 MAIN INDUSTRY INDICATORS

General Characteristics

Number of operating companies	110
Number of foreign companies	24
Growth in number of companies, 1998-2003	24%

Industry Revenues, million

Total turnover	$37.7
Turnover of local companies	$15.7
Turnover of foreign branches	$22.0
Average revenue per company	$0.34
Average revenue per local company	$0.18
Average revenue per foreign branch	$0.92
Domestic market	$13.5
Exports	$24.2
Packaged software	$11.9
Services	$25.8
Revenue growth, 1998-2003	30%

Productivity

Industry average compared with US industry average	28%
Local companies compared with US industry average	23%
Foreign branches compared with US industry average	43%
Packaged software compared with US packaged software	19%
Services compared with US services	54%

Human Resources

Total workforce	3,000
Technical professionals	2,100
Management and administrative	900
Workforce growth, 1998-2003	24%
Average number of employees per company	17
Average number of employees per local company	11
Average number of employees per foreign branch	35
Average annual salary range for experienced developers	$3,600 - $7,200
Number of students in IT related specialties	3,900

INDUSTRY OVERVIEW

Armenia is one of the leading information technology nations among the neighboring CIS and Middle East countries. Its IT industry has been one of the most dynamic and promising sectors of the economy in the last decade. Past successes, qualified professionals and Armenian entrepreneurial spirit position the industry to be successful in the years to come.

GENERAL CHARACTERISTICS

HISTORICAL DEVELOPMENTS

Armenia was one of the major centers for R&D and production in the areas of computer science and electronics in the former Soviet Union. This potential has been created back in the 1950s. At that time, several major R&D and semiconductor manufacturing companies were founded. These institutions operated for the Soviet Government and concentrated primarily on industrial and defense applications.

The leading R&D institute in Armenia focused on computer-related problems was Yerevan Scientific Research Institute of Mathematical Machines (YSRIMM). It was created in 1956 to design and build computers and related equipment[4]. By the end of 1960s, YSRIMM was already designing various computers, mainframes, automated control systems, as well as operating systems, networking and application software. The institute designed and produced at its own production plant dozens of computers, some of which were compatible with PDP of Digital Equipment and IBM mainframe series. A significant achievement by the institute was a project to design a telecommunication system for the mission to the moon. In the 1980s, YSRIMM alone employed around 10,000 people, almost three times the size of the whole IT workforce today. In 1957, another major research institution, Institute for Informatics and Automation Problems was created as part of the National Academy of Sciences. Research was also carried out at the major universities and other institutions.

A number of manufacturing companies were established after Armenia developed its scientific and R&D capacity. One of the largest electronics companies was "Posistor", an R&D and production holding with its parent company "Sirius". Posistor was one of the leading companies in the electronics industry of the former USSR. It manufactured various electronic components and devices. As of 1985, there were more than a dozen of large radio-electronics R&D institutes and production companies in Armenia. During this period, Armenia was considered a leading center of electronics and information technologies of the Soviet Union.

Break up of the USSR by the end of the 1980s and start of the era of personal computers led to the collapse of the whole Armenian technology sector. Gradually, new companies evolved to fill emerging opportunities locally and in foreign markets. The potential created during previous years was the major force, which enabled entrepreneurs and investors to start new business ventures in the fields of high-tech and IT.

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[4] In 1992, it was split into two separate private companies.

The first private IT company in Armenia, "Armenian Software", *www.armsoft.am*, was established in 1987. During this period of economic liberalization, many new firms have been created to provide system integration and custom software development services. These companies focused mostly on services to the domestic market with very few of them doing business with foreign clients. Major areas of specialization at that time were accounting and financial applications targeted at the local customers, hardware assembly and sale, and some outsourcing services.

Starting from around 1997, the industry received a new impulse for growth stemming from the successes of the previously established companies, overall recovery of the economy, and unprecedented growth of the worldwide IT industry. The potential of IT industry drew attention of larger number of investors, policy makers, and professionals. The industry started offering higher paying jobs to the young generation encouraging them to pursue careers in the IT field. A number of local companies were established to offer services to the growing local IT market and to serve foreign clients. Western companies such as Credence Systems (*www.credence.com*), Epygi Technologies (*www.epygi.com*), HPL Technologies (*www.hpl.com*), LEDA Design[5], Lycos Europe (*www.lycos-europe.am*), Virage Logic (*www.viragelogic.com*), and others established development centers in Armenia. Existing strong scientific and educational base was a major factor behind the significant success of the chip design industry, which has grown into a large revenue-generating segment within the IT industry and attracted a number of large foreign direct investments.

DEVELOPMENT STAGES OF ARMENIAN IT INDUSTRY

1956-1987: Period under the Soviet rule with state institutions working on large-scale projects for the communist government. Many industrial and other organizations had in-house software development departments focusing on automation of accounting and other organizational functions.

1987-1997: First private packaged software company ("Armenian Software") was founded in 1987 to provide solutions to the financial and banking sectors. First branches of foreign companies were established, many concentrating in chip design and related areas.

1997-Present: During this period, potential of IT industry has been recognized by a larger number of investors, policy makers, and professionals. Previous success stories encouraged establishment of new local and foreign companies. The Government of Armenia declared development of ICT as one of the priorities for the Armenian economy.

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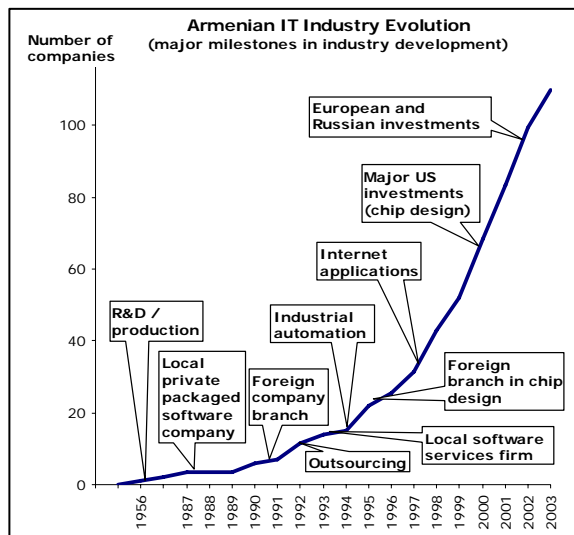
[5] LEDA was acquired in October of 2004 by Synopsys Inc.,
www.synopsys.com/news/announce/press2004/snps_acqleda_pr.html

COMPANY FOUNDATIONS

Armenian IT industry is quite young despite the old traditions and long history of computer and software design. While the first state institution specialized in IT was established back in 1956, the average age of Armenian IT companies is 6 years. First local private firms were established by the end of the 1980s, and by the mid-1990s first foreign companies were set-up. During the 10 years between 1987 and 1997, the successful foundation for the future growth of the industry has been laid out. In the last few years, the industry saw a sharp increase in the number of new companies, both local start-ups and branches of foreign companies. 84% of the foreign companies were established within the last 6 years.

Company Foundations by years

Based on a sample of 93 companies
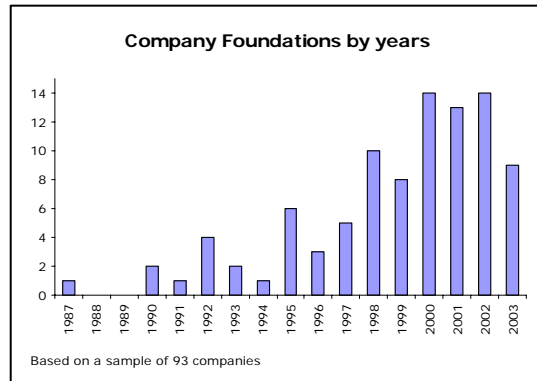
The number of operating IT companies in 2003 achieved around 110, which represents nearly 25% growth during 1998-2003. The number of registered companies cited in different sources varies significantly reaching 250 firms. The reason for such high estimates is that during the recent growth of the IT sector, the industry drew attention of would-be entrepreneurs who established a number of start-ups, many of which have stopped operations shortly after the registration. In addition, many companies that are specialized in a variety of technology related fields but not necessarily software and services, include software development in the list of their speciliazations.

COMPANY OWNERSHIP GEOGRAPHY

The number of foreign companies in Armenia is 24. More than half of these firms, such as Virage Logic, HPL Technologies, Epygi Technologies, and LEDA Design, have US ownership. Companies with Russian ownership are a recent phenomenon. In one of the cases a completely new company (ABM Soft, *www.abmsoft.com*) with Russian capital was established to conduct both business and technical functions locally. In another case, a Russian outsourcing company (VDI, *www.vdiweb.com*) established a development center in Armenia. There are also companies from Germany (Lycos Europe), Switzerland (Xalt, *www.xalt.com*), United Arab Emirates (Systrotech, *www.systrotech.am*), and other countries.

Company Ownership by Foreign Countries

Russia & CIS 17%

Europe 17%

Other 4%

USA 62%
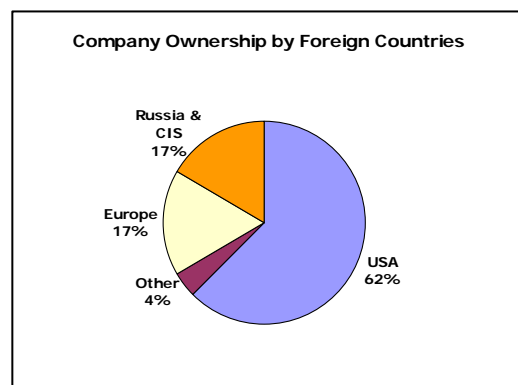
There are several cases of acquisitions of the existing Armenian companies. Three of these cases include two state-owned Armenian enterprises (YCRDI, *www.ycrdi.am*, and Yer.ACSSRI, *www.yercsi.am*), which were sold to Russian investors by the Government, and an Armenian branch of the US company, Brience, which was sold to Lycos Europe.

In the majority of cases, the foreign branches are pure development centers for the parent companies. Foreign companies usually set-up small development centers and, as there is an effectively operating team in place, start increasing the number of employees and moving higher value-added activities to Armenia. It is not uncommon when the whole cycle of a company's technical activities including R&D, design, coding, testing, and support is eventually moved to Armenia. In addition, some companies have also started relocating parts of their business-related functions such as marketing and customer support to Armenia. Practice of sending local professionals to the customer sites outside of Armenia to provide implementation and customer support has been widely used.
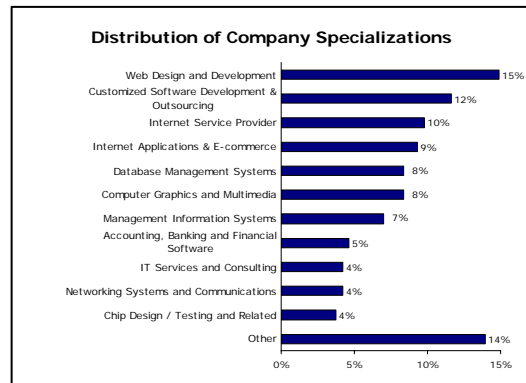
DIASPORA

The majority of the foreign branches are established through direct involvement of Diaspora Armenians. The US and Russia have major concentrations of Armenian Diaspora: not surprisingly, more than 70% of foreign companies represent these two countries.

Diaspora is considered one of the major competitive advantages of Armenia in terms of access to foreign markets and expertise. Diaspora representatives are usually well disposed towards Armenia and are willing to contribute to its development. Companies with top management or owners of Armenian descent are better suited to evaluate the risks and understand the culture. Local companies also benefit from Diaspora when selling their services abroad. Poor marketing skills and knowledge of target markets is a serious obstacle for the local companies. Having better understanding and being close to the target markets, representatives of Diaspora are better suited to sell or create connections. In many cases, they serve either as the final customers of the product or as liaisons between Armenian and Western companies.

SPECIALIZATIONS

The most widely practiced specializations are web design and development, customized software development and outsourcing, provision of Internet services, and internet applications & e-commerce. These four specializations make almost 50% of all specializations by IT companies. The majority of foreign companies are specialized in customized software development and outsourcing, chip design and testing, and networking systems and communications.

Distribution of Company Specializations

Specialization	Percent
Web Design and Development	15%
Customized Software Development & Outsourcing	12%
Internet Service Provider	10%
Internet Applications & E-commerce	9%
Database Management Systems	8%
Computer Graphics and Multimedia	8%
Management Information Systems	7%
Accounting, Banking and Financial Software	5%
IT Services and Consulting	4%
Networking Systems and Communications	4%
Chip Design / Testing and Related	4%
Other	14%

Local companies are pursuing opportunities mostly in the Internet-related areas such as web design and development, Internet applications, provision of Internet service, and computer graphics and multimedia. Strong focus on internet-related areas may be explained by the relatively high and increasing demand for internet services; low barriers to entry by groups of young entrepreneurs; and expectations of development of e-commerce in Armenia.

Other sectors, where local companies are active, are mostly related to providing services and customized development. Generally, local firms tend to be very diversified, which is explained by the small size of the majority of the industry sectors.

Distribution of Local Company Specializations

Web Design and Development	17%
Internet Service Provider	16%
Internet Applications & E-commerce	10%
Computer Graphics and Multimedia	10%
Database Management Systems	9%
Customized Software Development & Outsourcing	9%
Management Information Systems	7%
IT Services and Consulting	5%
Accounting, Banking and Financial Software	5%
Industrial Automation	1%
Other	5%

Distribution of Foreign Company Specializations

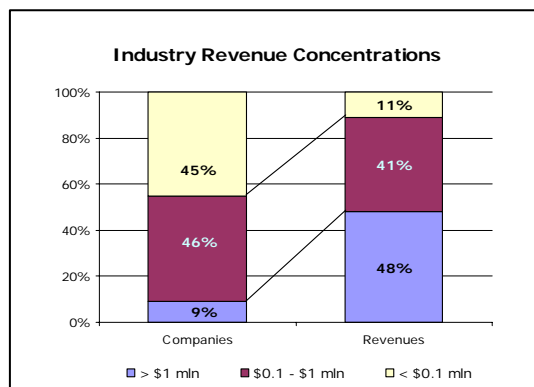|	
Customized Software Development & Outsourcing	23%
Chip Design / Testing and Related	16%
Networking Systems and Communications	11%
Internet Applications & E-commerce	7%
Web Design and Development	7%
Management Information Systems	7%
Systems Software	5%
Programming Languages and Tools	5%
IT Services and Consulting	5%
Database Management Systems	5%
Accounting, Banking and Financial Software	5%
Internet Service Provider	2%
Industrial Automation	2%
Computer Graphics and Multimedia	2%

TECHNOLOGIES

Armenian companies and professionals use a variety of technologies and have experience with stand-alone, as well as client-server and net-centric applications. Companies involved in embedded systems design and testing extensively employ C/C++ and assembly languages. Java and .Net technologies are more popular with companies focused on the creation of net-centric solutions. Internet technologies, such as JSP, ASP, PHP, ColdFusion, HTML, DHTML, XML, and Flash are widely applied. Other languages and technologies include Visual Basic, Delphi, Perl, popular database systems such as Microsoft SQL Server, MySQL, Oracle, and Informix. Applications are developed for Windows, Solaris, Linux, and recently for handheld platforms. Open source development is becoming increasingly popular among young professionals and students, as well as IT businesses.
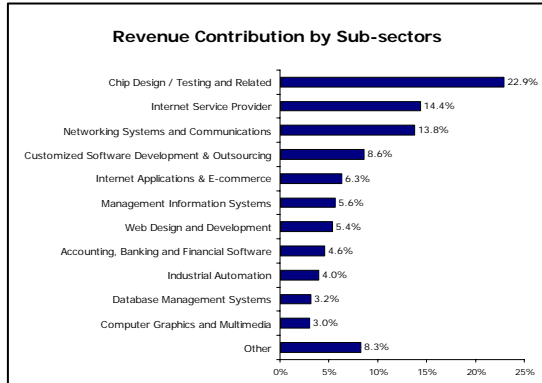
INDUSTRY REVENUES

In 2003, Armenian IT sector generated around $38 million, which corresponds to nearly 30% growth during 1998-2003[6]. Foreign companies accounted for nearly two thirds of the industry turnover or $22 million. Average revenue per company was $340,000; it was $920,000 and $180,000 per foreign branch and per local company respectively. Ten largest companies, which constitute only 9% of the total number of firms, generated 48% of all revenues; 55% of companies generated 89% of revenues.

Industry Revenue Concentrations

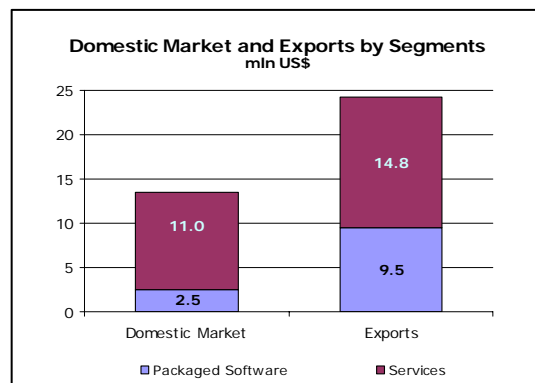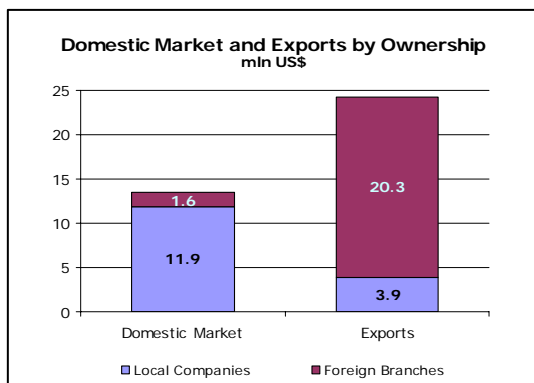|	Companies	Revenues
< $0.1 mln	45%	11%
$0.1 - $1 mln	46%	41%
> $1 mln	9%	48%

□ > $1 mln   ■ $0.1 - $1 mln   □ < $0.1 mln

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[6] In 1998, total turnover of the software and services segment of the industry was around $10 million. Source: USAID ICT Assessment Report, July 2000, *www.dec.org*.

Although only eight companies are specialized in chip design, testing and related areas, the revenue generated by this sector is nearly a quarter of the whole industry turnover. Other major revenue generating sectors are ISPs, networking systems and communications, and customized software development.


Revenue Contribution by Sub-sectors

Sub-sector	Percentage
Chip Design / Testing and Related	22.9%
Internet Service Provider	14.4%
Networking Systems and Communications	13.8%
Customized Software Development & Outsourcing	8.6%
Internet Applications & E-commerce	6.3%
Management Information Systems	5.6%
Web Design and Development	5.4%
Accounting, Banking and Financial Software	4.6%
Industrial Automation	4.0%
Database Management Systems	3.2%
Computer Graphics and Multimedia	3.0%
Other	8.3%

In 2003, the domestic market constituted $13.5 million, whereas exports were $24.2 million, or 36% and 64% from the total industry revenues respectively. The reason for big difference in exports and domestic markets is that the largest companies of the sector are branches of foreign firms, which almost completely export their products. In addition, many locally owned enterprises also export significant portion of their products and services abroad. Total market for packaged software amounted to $12 million. Both domestic market and exports are dominated by the services segment, which constitutes 82% of the domestic market and about 61% of the exports respectively.

Domestic Market and Exports by Ownership
mln US$

	Local Companies	Foreign Branches
Domestic Market	11.9	1.6
Exports	3.9	20.3

Domestic Market and Exports by Segments
mln US$

	Packaged Software	Services
Domestic Market	2.5	11.0
Exports	9.5	14.8

Domestic markets and exports are not distributed equally according to the company ownership geography. Domestic market is almost completely dominated by the locally owned companies, 88%, while foreign branches account for nearly 84% of all exports. Almost all foreign branches are created by their parent companies mostly for outsourcing of the software development. As a result, only 12% of the domestic market is captured by the companies with foreign ownership.

DOMESTIC MARKET

The local market for packaged software is quite small, constituting around $2.5 million or 7% of all industry revenues. Total sales of foreign branches in the domestic market are $1.6 million and are generated mostly from services. Services segment dominates the domestic market: 82% of the revenues of the locally owned companies from the domestic sales are generated from IT services; it is 80% for foreign branches

**Domestic Market by Segments and Ownership**
mln US$
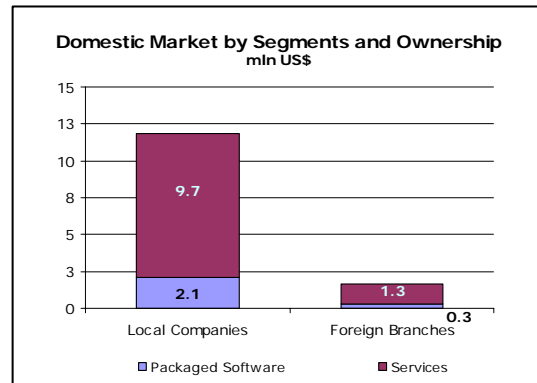
The small size of the domestic market is the result of rather low demand for software and IT services from businesses and the Government. A number of factors are responsible for this low demand including low employee wages, high software piracy rates, little or no understanding of the need for productivity enhancement tools, financial constraints, and other factors. Because of the low domestic demand, there is no inducement for Armenian IT companies to develop packaged software or offer new and higher quality services. The majority of the software packages sold on the domestic market include accounting and financial software for large enterprises and banks. Other products and services with the largest demand include enterprise resource planning solutions, e-commerce, web development services, tools for healthcare industry, and distance learning programs.

EXPORTS

Armenian IT industry exports $24.2 million of products and services to more than 20 countries. The largest share of exports, 68%, goes to the United States and Canada; the second largest market is Russia and CIS with 16%; third comes Europe with 10%. However, Europe is second to North America by the number of clients.

Geographic Distribution of Exports

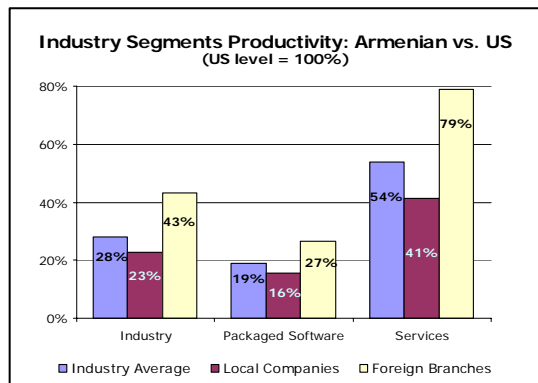**Geographic Distribution of Clients**
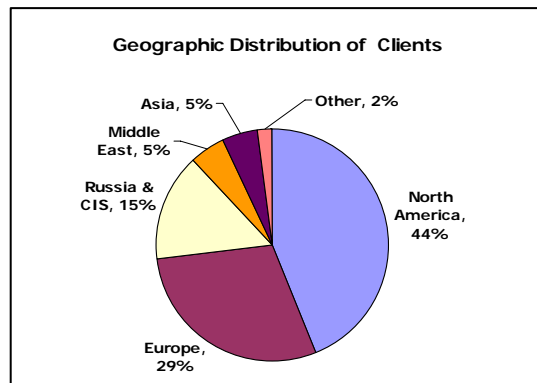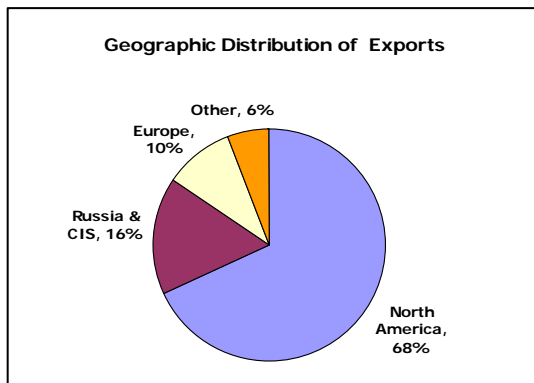
Nearly 65% of IT companies are exporting their products or services. The largest part of exports or 61% are attributed to services, while the remaining is packaged software. Foreign companies export more than 90% of their sales and account for the largest part of Armenia's IT exports. Local companies produce 16% of the exports or $3.8 million, while foreign branches produce 84% or $20.3 million.
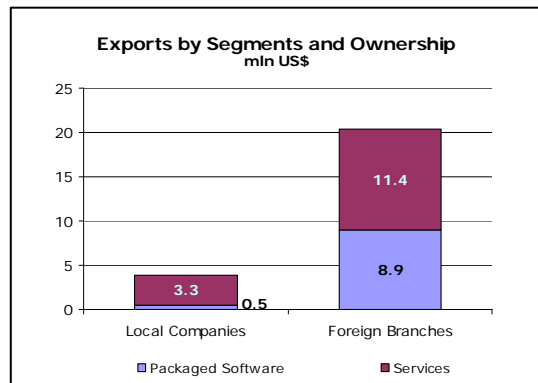
Factors hindering growth of exports include still insufficient knowledge about Armenia and its IT industry by the international business community; language issues, which are, however, less important now as the young generation is becoming more proficient in English and other foreign languages; long distance from the key IT markets (at this point, only 10 local companies have some kind of presence abroad).

Exports by Segments and Ownership
mln US$

	Packaged Software	Services
Local Companies	0.5	3.3
Foreign Branches	8.9	11.4

PRODUCTIVITY

Productivity estimates for the Armenian IT companies were made based on the annual revenues generated by the companies per employee. Analysis, which was conducted separately for local and foreign companies, shows that PPP-adjusted productivity of local companies stands at 23% of the US average levels and productivity of the foreign companies is at 43% of US levels. As the chart shows[7], industry average productivity was at 28% of the US productivity levels. The productivity of an average Armenian IT services company is at 54% of that of an average US services company productivity, while packaged software segment operates at levels of productivity close to 20% of that of the US software packaged segment[8].

Industry Segments Productivity: Armenian vs. US
(US level = 100%)

	Industry Average	Local Companies	Foreign Branches
Industry	28%	23%	43%
Packaged Software	19%	16%	27%
Services	54%	41%	79%

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[7] Sections in the chart: industry, packaged software, and services – should not be compared with each other. While, for example, the chart shows that the packaged software productivity for local companies is significantly lower than that of their services segment, in absolute terms these rates do not differ as much from each other. Comparisons, therefore, should be made within the sections only.

[8] Complications in estimating productivity for foreign branches arise because we had to use turnover figures of the Armenian branches instead of those of their parent companies. Therefore, productivity rates for foreign branches within industry and packaged software segments as it is depicted in the chart may be underestimated. We suggest that the rates of the services segment be used as a base for productivity of foreign branches.

High productivity of the services sector compared to that of the US services segment can be explained by the following major factors:

- low capital requirements allow easy entry and exit by entrepreneurs and foreign firms,
- the former coupled with the non-regulated nature of the industry creates competitive environment for companies, and finally
- services are not subject to piracy, which seriously impedes growth in productivity rates.

It should also be noted that the average productivity in the services segment is elevated by the high productivity of foreign branches concentrated in the services area. Productivity of these companies is at 79% of that of the US services segment levels. On the other hand, productivity of local services firms is at 41% of US service companies' productivity. The reason for 38% difference in the rates is that the local companies perform lower value-added services for both local and foreign clients, and they lack the brand name recognition experienced by the foreign companies.

In 1998-2003, the industry witnessed an increase in the productivity rates somewhere around 5-7%, which was mostly attributed to export-oriented companies[9]. It is apparent that export-oriented firms had productivity gains higher than the industry average. Companies find ways to the foreign markets, thus becoming able to generate higher revenues and to charge higher rates as they build their reputation among the existing and new customers. Additionally, software professionals, project managers, and companies in general become more experienced as they participate in larger and more advanced projects.

In contrast to export-oriented companies, those that are mainly focused on the local market do not show significant gains in productivity. They grow primarily through the increase in the number of employees. The major problem for the low productivity of Armenian IT companies is that no significant value is created within Armenia because of the following factors:
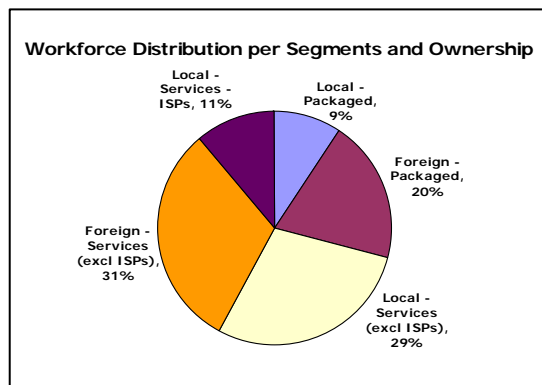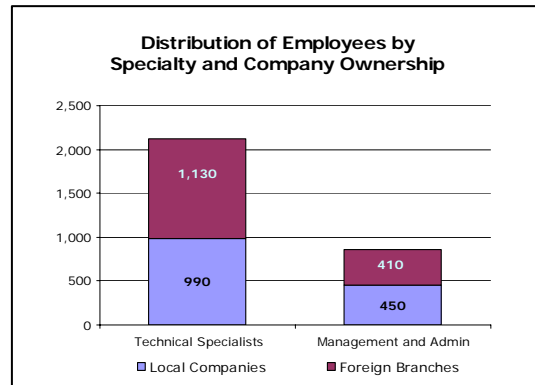
- Locally owned companies are either focused only on the domestic market, which is limited and does not present high-volume and/or fee opportunities. Or they provide small-scale customized development and outsourcing to small or medium sized international companies, which does not provide high value or returns;
- Foreign branches act only as outsourcing centers and are paid operating expenses plus an insignificant margin over costs. No sizeable value, therefore, is retained in Armenia.

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[9] Due to unreliability of historical data, as well as significant changes in the industry structure, growth in productivity is difficult to estimate. Therefore, rates provided here should be used with caution.

HUMAN RESOURCES

WORKFORCE

According to our estimates, the total workforce employed by the IT sector in 2003 was around 3,000 professionals, which represents nearly 25% growth in 1998-2003[10]. More than 70% of the total workforce is technical specialists such as software engineers, analysts, developers, project managers, and others. In addition, around 1,000 technical professionals are employed by the locally owned companies, while nearly 1,150 specialists work for foreign branches. Management and

Distribution of Employees by Specialty and Company Ownership

administrative staff constitute less than 30% of the total workforce. In total, about 1,450 individuals or 48% of the workforce is employed by the locally owned companies and 1,550 or 52% work for foreign branches.

Workforce Distribution per Segments and Ownership

Distribution of Companies per Number of Employees

On average, an IT company has 17 employees, from which 14 are technical and 3 are managerial and administrative specialists[11]. Local companies have on average 11 employees with 8 technical and 3 non-technical staff. Foreign branches, on the other hand, employ on average 35 people with 31 technical and 6 non-technical staff. Most of the workforce, around 2,100 individuals or 71%, is concentrated in the services segment of the industry. From these, around 330 or 11% of the workforce, work for internet service providers.
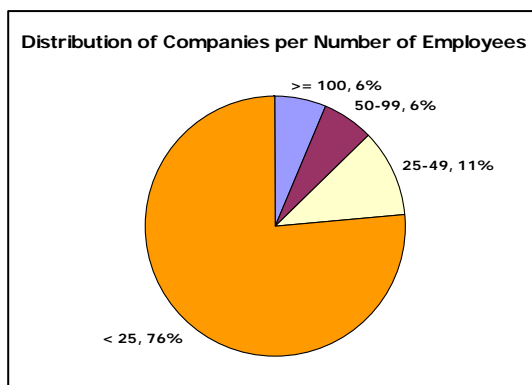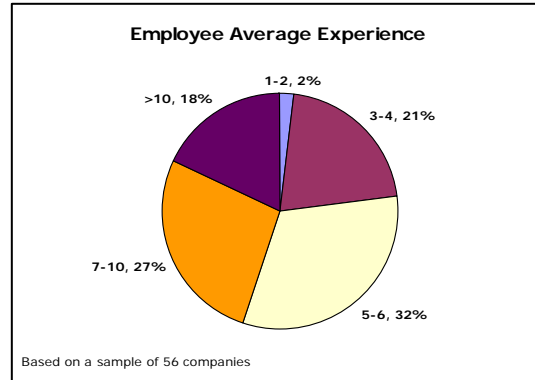
The number of specialists employed by companies varies significantly within the industry. About 6% of companies employ 100 and more specialists, while 76% has less than 25 employees. These 6% or 7 companies employ 1,250 people or 42% of the entire workforce. 17% or 19 companies employ from 25 to 99 people, which in total is around 850 individuals or 29% of the workforce. 84 firms, or 76%, with less than 25 people employ about 880 individuals, or 30% of the workforce.

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[10] Reliable and consistent historic data on workforce were not available. Substantial differences exist among various sources, which cite figures in the range from 500 to 1,500 for the year 1998. We decided to use 1,000, which creates relatively consistent picture of the industry's historical growth.

[11] See Appendix 5 on how the average company size was estimated

Over 75% of the IT workforce has over 5 years of experience. About 60% of employees have 5-year Bachelor & Master of Science (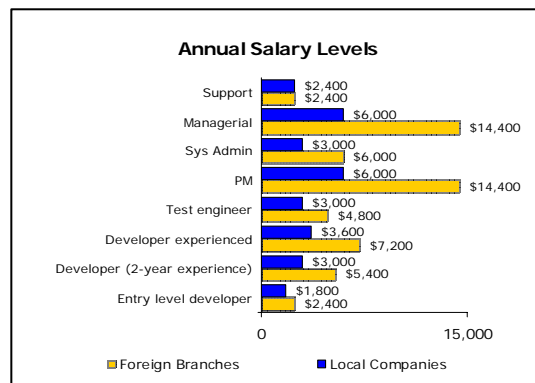BSMS) degrees with another 38% having Bachelor's, Master's, or Ph.D. degrees. These are mostly technical specialists with few having majors in economics, finance, and other areas. About 2% of the workforce holds business degrees.

Employee Educational Background

Other, 1%
Ph.D., 7%
Bachelor's (BS/BE), 15%
Master's (MS/ME), 16%
MBA, 2%
Bachelor & Master (BSMS), 59%

Based on a sample of 56 companies

Employee Average Experience

1-2, 2%
3-4, 21%
>10, 18%
7-10, 27%
5-6, 32%

Based on a sample of 56 companies
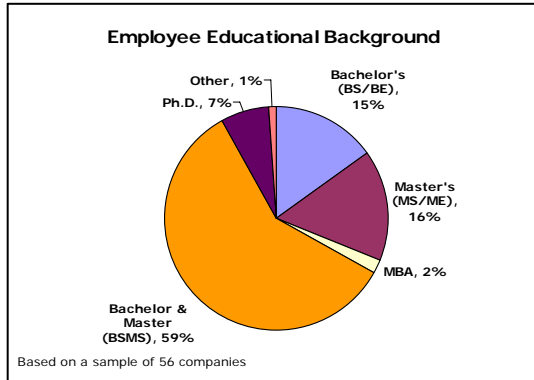
Armenia has been chosen as an offshore development destination by the foreign companies partly because of its inexpensive and highly productive labor. Annual average salary for experienced developers (more than two years of experience) is around $3,600 in local and $7,200 in foreign companies; developers with two years of experience get $3,000 and $5,400 respectively. Team leaders and project managers earn on average $6,000 in local and $14,000 in foreign companies. Some of the exceptionally good technical managers may earn up to $20,000 yearly. Salaries for entry level positions range from $1,800 to $2,400 annually. These salaries are competitive compared to most of the major IT outsourcing countries like India, Russia, Israel, Ireland, and China.

Annual Salary Levels

	Local Companies	Foreign Branches
Support	$2,400	$2,400
Managerial	$6,000	$14,400
Sys Admin	$3,000	$6,000
PM	$6,000	$14,400
Test engineer	$3,000	$4,800
Developer experienced	$3,600	$7,200
Developer (2-year experience)	$3,000	$5,400
Entry level developer	$1,800	$2,400

☐ Foreign Branches   ■ Local Companies

Many of the companies practice non-paid internships when selecting fresh graduates. It is common to host interns and to train them and use for low value-added jobs and then select the best for permanent positions. New employees usually do not start working at full capacity for periods longer than two months. For many companies this is a limiting factor hindering growth and making employers complain about the quality of education. This issue is common also for companies in India where fast growing companies cannot bill for new employees for the first 3-6 months[12].

EMPLOYEE DEVELOPMENT
Significant differences for employee development exist among locally owned companies and foreign subsidiaries. Branches, as part of their strategic management, constantly train their employees both in Armenia and at the head offices. In addition, they have built resource centers and libraries to assist employees in training and knowledge management.

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[12]   India: The Growth Imperative, McKinsey Global Institute, September 2001; *www.mckinsey.com/knowledge/mgi/India*

Employees of a number of foreign branches are offered employee stock options and other non-salary incentives. Branches normally enjoy low turnover rates and high employee commitment.

In contrast, although local companies accept training as an important part of the development, few are able to provide training on a permanent basis. Most of the training needs are greatly affected by the availability of funds and training personnel. One of the options is free or low-cost trainings offered by the development or government programs, which, however, are mostly targeted at general industry needs rather than a specific company's requirements. Salary levels lower than those adopted at the foreign branches and lack of proper employee incentive plans were for many years major factors behind the high turnover rates at the local firms. Recently, however, various forms of incentives are becoming more widespread at the local companies. During the last 2-3 years turnover rates have decreased substantially, which was the result of higher job and salary stability, better working environment, emergence of strong teams within the companies, and other factors.

EDUCATIONAL SECTOR

Armenia has a strong tradition of higher education, where universities put great stress on training students in the fundamentals and in educating them to understand the entire engineering process. Today this tradition is enhanced with new ideas and approaches, which are the results of Armenia's adoption of free market principles.

UNIVERSITIES

State Engineering University of Armenia (SEUA), *www.seua.am*, and Yerevan State University (YSU), *www.ysu.am*, are the oldest and largest institutions developing engineering professionals for the computer industry[13]. SEUA offers specializations in computer and hardware design, software design and development, electronics and chip design; YSU provides majors in algorithmic languages, discrete math, system programming and modeling.

American University of Armenia (AUA), *www.aua.am*, an affiliate of the University of California, offers degrees in Master of Business Administration and Master in Computer and Information Science. European Regional Institute of Information and Communication Technologies in Armenia (ERIICTA), *www.eriicta.am*, established by the European Union, offers degrees in Software Engineering and IT Business Management. Russian-Armenian (Slavonic) University, *www.rau.am*, established by the initiative of Armenian and Russian Governments, provides majors in mathematics and math modeling, system programming, electronics and microelectronics. A number of other colleges and universities established recently are developing rapidly to meet existing and future demand of IT specialists.

Current educational system, except for a few universities, is inherited from the former Soviet Union. After the independence, however, demand for professionals has changed significantly, which resulted in discontinuation of many fields and specializations and emergence of new ones. While the 5-year degree system practiced by Soviet educational institutions is still widespread in Armenia, a number of universities recently have adopted

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[13] SEUA is the successor of Yerevan Polytechnic Institute, which was established in 1933; YSU was founded in 1919

the western style two-level educational system with Bachelor's and Master's degrees. Many universities offer post-graduate education and PhD.

The main issue faced by the educational sector is inadequate funding: tuition fees and government support are not sufficient for the majority of educational institutions. At the same time, many universities have no intention to raise tuition fees because they are already high for an average Armenian student. Other issues faced by many schools are lack of textbooks and professional literature, outdated library, limited availability of computer equipment and Internet connection.

FACULTY AND TEACHING METHODS

14 educational institutions participated in our research employ around 460 faculty members[14]. Most of them are concentrated in YSU and SEUA with the remainder spread throughout other twelve universities. The majority of educational institutions consider their curricula and teaching methods being up-to-date and meeting industry requirements. Many professors develop their classes using experience of leading European, Russian, and US universities and with their assistance. In some cases, local IT professionals are invited to help faculty in aligning the curricula to the latest industry trends and requirements. Today, more and more institutions recognize that besides technical skills students need to be proficient in business areas as well. Different business courses are offered at a number of universities including marketing, management, business ethics, law, and other subjects. Teaching of foreign languages such as Russian and English are also considered extremely important for developing high-quality engineering and managerial cadre.

Despite the recent improvements in the educational system, current teaching methods are considered by many as inadequate in the attempt to meet the IT industry's demand for high-quality human resources. In addition, two major interrelated issues: low wages and aging faculty – result in the faculty size being constant or decreasing over time while the student body growing each year.

STUDENTS

Approximately 75,000 individuals, ages 17-23, or 2.3% of the total population, are students of higher educational institutions[15]. In 2003, approximately 3,900 students were enrolled in various IT related fields at 14 educational institutions. Around 70% of all these students study at SEUA and YSU. 87% attend public institutions and 13% attend private universities[16]. 81% of students are from Yerevan and 19% are from the regions and abroad. Foreign students from Europe,

Distribution of Students by Universities

Other, 1,180, 30%

SEUA, 1,550, 40%

YSU, 1,190, 30%

Based on a sample of 14 educational institutions

Russia & CIS, Middle East, and other countries study in Armenia, and their number is growing over time. Overall quality of the enrollees has been improving for the last 3-5
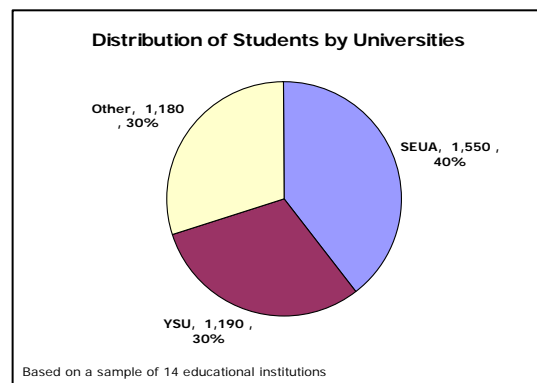
[14] "Educational Sector" section discusses only institutions, their departments, faculty, and students associated with IT majors. All figures and descriptions, therefore, apply to IT specializations only.

[15] UNESCO Institute for Statistics, Global Education Digest 2004, *www.uis.unesco.org*.

[16] Information in this section is based on interviews with 474 students from 11 educational institutions.

years. Admissions to IT departments are very rigorous, especially in case of SEUA and YSU. Programming, information and applied mathematics, automated control systems and microelectronics are the most popular majors for applicants.

Student Language Skills

Based on a sample of 474 students representing 11 educational institutions
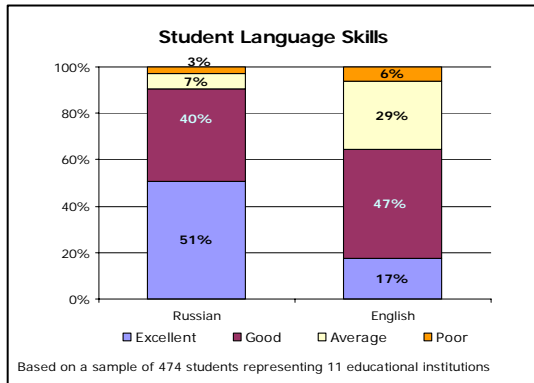
Language skills are deemed by students as very important for the successful career and professional development. Around 64% of the students participated in our research considered their English as excellent or good, while around 91% thought that their Russian is excellent or good. These figures suggest that Armenian universities and secondary schools need to provide better and more rigorous teaching of English as a foreign language.

Overall, around 30% of the students believe that the courses taken prepare them well for the IT industry, while over 40% considered courses not meeting the current demands of the sector. In general, universities ensure satisfactory level of professional skills, teach students to think analytically and work independently. Nevertheless, students acquire major part of necessary knowledge and skills during the employment. Currently, around 55% of the students are employed; more than 70% of those work for IT companies. As a rule, top students get jobs during their 2nd and 3rd years of bachelor studies.

In general, the representatives of IT firms regard the current number of students as adequate to meet industry's demand in technical specialists. At the same time, they point that the overall quality of the graduates does not meet the needs of the industry. Many graduates require on job training in order to become qualified for full time positions.

COOPERATION WITH INDUSTRY

Cooperation between the industry and the educational institutions was rather weak for a number of years. However, this trend has changed recently. Examples of such cooperation are LEDA Design, which founded microelectronics department at SEUA and together with Cadence Design Systems provided $25 million worth of semiconductor design software and services to the department; Lycos Armenia, which established in cooperation with EIF two centers for internet technologies at SEUA and YSU. Students graduating from these educational facilities are accepted by the companies for employment. At this point, industry and university cooperation does not go further than teaching and training, which main goal is to prepare quality professionals for several companies and industry in general.

TRAINING CENTERS

Approximately 18 training centers in Armenia provide IT related courses. In 2003, the number of individuals trained and trainers were approximately 4,500 and 190 respectively.

The most popular courses taught at the centers are computer basics, graphics and design, programming languages, software engineering, and network administration.

Most training centers try to keep abreast of IT industry trends. Some of them cooperate with various organizations, universities, local and foreign companies. The majority of the training centers are interested in increasing their capacity to handle more trainees, which, however, is difficult to implement due to the lack of

Most Popular Courses

Network Admin, 6%
Software Engineering, 11%
Programming Languages, 17%
Computer Basics, 44%
Graphics and Design, 22%

space and equipment. Representatives of the training centers believe that lowering tuitions, increasing marketing to and recruiting from universities should have a positive impact on their growth perspectives.
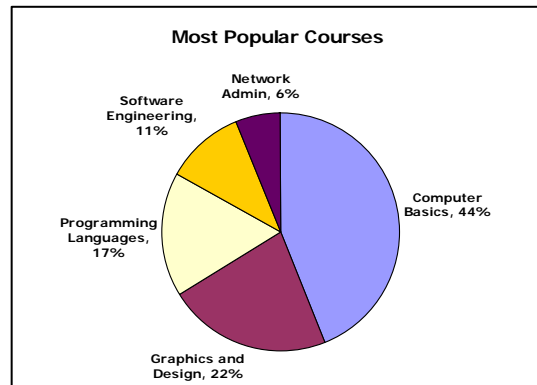
OTHER AREAS

MANAGEMENT PRACTICES

Significant difference exists between locally owned companies and branches of foreign firms on how companies' management is carried out. The majority of branches do not engage in common management practices such as business development, marketing, and strategic management: these activities are accomplished by the head offices. In addition, foreign companies, when compared to locally owned firms, employ more advanced project management practices and use better documented and designed methodologies. The reason is that, in most cases, processes employed by the parent companies are simply copied to the Armenian branches.

After the collapse of the planned Soviet economy, commonly accepted management practices have only recently entered Armenian business community and IT sector in particular. As a result, many local software companies do no have sufficient experience and knowledge of the best management practices widely employed by western companies. The major reasons are the lack of high-quality managers with appropriate education and background, newly developing market economy, insufficient experience with international clients.

However, as companies grow and develop, their management grows to be more and more sophisticated. Western practices are becoming part of the day-to-day management of local software firms. While several years many marketing and project management functions were conducted by a company's director, now the majority of firms has separate departments dedicated to marketing, HR, operations, and other areas. Companies accept larger number of business graduates and pay more attention to management training and professional development.

RESEARCH AND DEVELOPMENT

Historically major research has been carried out in specially created institutions mostly for defense and industrial projects financed by the Government. Departments at the universities focused on smaller-scale research programs. After disintegration of the Soviet Union, government funding has sharply decreased, which in turn forced these institutions to look for new sources of funding to finance their research activities. Several private companies have been created on the basis of state-owned research institutions to develop and market commercial products and to perform smaller-scale research activities. Now, around one fifth of the private companies are involved in some sort of research activities. This research, however, is mostly of applied engineering and company specific nature and is directed at quick creation of intellectual property. In case of foreign branches, the results of their research are transferred to the parent companies in their respective countries and, therefore, do not normally create competitive advantages for Armenia.

Public research is conducted mostly by the major universities (SEUA and YSU) and by institutes within the National Academy of Sciences. Research is carried out in the fields of computer aided design, theory of algorithms, discrete mathematics and combinatorics, cognitive algorithms and expert systems, software engineering, networking, distributed processing, pattern recognition, math logic, computational methods and signal processing systems, and others. Generally, in recent years there was a shift towards applied as opposed to the fundamental research, which raises concerns over the long-term viability of research by universities and research institutions.

Institutions involved in R&D activities are faced with several issues. The major one is the level of funding, which although has been growing in recently, nevertheless is still considered as insufficient. Gross domestic expenditure on R&D (GERD) was around 0.32% of GDP[17] in 2002. This negatively compares to R&D expenditures in more advanced economies that normally have spending levels at 1-3% of GDP[18]. Other issues are weak commercialization mechanisms and modest cooperation between the industry and research organizations.

TELECOMMUNICATIONS INFRASTRUCTURE

The provider of telecommunications services in Armenia is Armenia Telephone Company or Armentel, *www.armentel.com*, which major shareholder is the Greek company OTE. Armentel has a monopoly on all local and international telecommunications services. Armentel's channels include fixed line communications network, cellular phone network (GSM 900), international and satellite channels. Current network allows phone calls to more than 200 countries. Satellite communication is provided by two earth stations via Intelsat and Express systems. Fiber optic communication to major international networks is provided through Trans Armenia Optical Network (TAOS) and other channels via Russia and Iran.

Internet services market has been growing very rapidly in the recent years. In 2003, the number of ISPs reached more than 20 firms. The number of internet users has also been

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[17] We make comparison for the whole economy because separate data on IT R&D is not available. R&D expenditure in 2002 was $7.7 million; source: National Statistical Service, *www.armstat.am*.

[18] Government rhetoric and their R&D expenditure, Frank Gannon, EMBO reports, VOL 4, No2, 2003.

consistently growing in the last few years reaching up to 80,000 users in 2003[19]. Connection to the Internet is made through various means: dial-up, ISDN, satellite, DSL, or leased lines. Currently, the prices for high-speed internet connection are higher in Armenia compared to those of other IT exporting countries such as China, India, and Russia.

POLICY DEVELOPMENTS

In 2000, The Government of Armenia declared development of information and communication technologies as one of the priorities for the Armenian economy, which followed by a number of specific actions to bring this decree into effect. In 2001, the Government jointly with the World Bank, USAID, foundations, academic institutions, and private enterprises developed the ICT Master Strategy and ICT development implementation plan to promote IT and establish Armenia as a regional ICT hub. In May 2001, the Government approved the ICT Development Concept Paper and Action Plan prepared by the Ministry of Trade and Economic Development in accordance with the recommendations outlined in the ICT Master Strategy.

In July 2001, Information Technologies Development Support Council of Armenia (ITDSC), *www.itdsc.am*, chaired by the Prime Minister was established by the decree of the President of Armenia. The mission of the Council is to act as a bridge between the Government and the private sector and to serve as a connecting link between the Diaspora and Armenia. The goals of the Council are to assist the Government and the private sector in building strong and viable IT industry and developing Armenia into an advanced information society. In 2002, Enterprise Incubator Foundation, *www.eif-it.com*, was established by the Government of Armenia and the World Bank to support the development of information technology industry in Armenia. EIF is the largest development initiative within the IT industry in Armenia[20]. Information technology is considered by the Government as an important area for international cooperation. Various projects are initiated in this area, the largest being the European Regional Institute of Information and Communication Technologies in Armenia (ERIICTA), *www.eriicta.am*, which was established with the financial assistance from the European Union.

While today the Government is more active in the IT sector than several years ago, many companies, nevertheless, expect substantially higher involvement of the Government in the sector development. Expectations include such activities as fostering the use of locally made software by other sectors and, by that, increasing the demand for domestic IT products and services, improving the legislative framework including reforms in tax regulation, providing larger support to universities, eliminating monopoly on telecommunications services, and supporting IT firms with financing and international marketing.

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[19] Towards a knowledge economy, e-readiness assessment, Armenia, H. Hakobyan, L. Galstyan, S. Vardanyan, 2003, Yerevan.

[20] See Appendix 1: "About Enterprise Incubator Foundation" for more information about EIF.

COMPETITIVE ADVANTAGES OF ARMENIA

The following are the competitive advantages that Armenian IT industry has relied upon and should exploit heavily in the future:

- World-class R&D capabilities in computer science, physics, and mathematics

- Well-educated and talented workforce with a high degree of technical skills

- Strong university programs with specializations in computer and related sciences

- Highly competitive cost of labor

- Solid Government support of the sector

- Continued robust growth of the industry

- Strong and successful Diaspora in Europe and North America

- Extensive experience with large multi-national companies

- Sound laws and regulations for IP protection

CONCLUSION

At the end, we present our view on the IT sector's development prospects for the next 5-6 years, discuss barriers to the industry expansion, as well as provide our recommendations for supporting further growth of the industry.

INDUSTRY DEVELOPMENT PROSPECTS

Armenian IT industry is capable of reaching revenues in the range of $300-400 million by 2010. Such high growth rates of 35-40% per anum could be achieved with 25-30% yearly increase in the workforce and around 7-8% rise in productivity. So far, in 1998-2003, the industry has witnessed around 25% increase in the workforce and around 5-7% rise in productivity, which resulted in nearly 30% industry growth. These rates may be sustained and raised in the future only if appropriate reforms are implemented by the Government, educational and private sectors. We discuss actions required for ensuring the high-growth rates of the industry in the Recommendations section, while here we present the outlook for workforce, productivity, and industry development.

WORKFORCE
Supply of IT professionals has been growing over time, which may continue into the future as the industry's demand for specialists rises over time. Higher demand for professionals will create significant competition among companies, which, in turn, will induce firms to provide better employment conditions. Already, the IT profession is highly respected and popular among younger generation. Each year a larger number of individuals apply to IT related specialties, and, at the same time, the universities increase the admission quotas. In addition, more educational establishments start offering IT specializations and new institutions with such specializations emerge. These trends will allow the workforce to grow somewhere in the range from 15% to 20%. These percentages correspond to around 400-600 specialists in 2004, 500-700 in 2005, and 600-800 in 2006. According to our estimates, in 2003 the educational sector supplied around 700-800 graduates in IT related specializations. Assuming that part of the graduates goes to work for other sectors or switch professions, educational system will be able to support 15-20% workforce growth in 2004-2006. In addition, as admission quotas are increased and more institutions start offering IT majors, the supply of graduates will increase as well. Therefore, we may expect that 15-20% workforce growth may be sustained until 2010.

PRODUCTIVITY
Development of the domestic IT market is a key contributing factor towards the rise in productivity of the local IT firms and rapid growth of the industry. So far, the market for local packaged software was primarily in the field of enterprise solutions, and this trend will continue in the next 4-5 years. The domestic market for IT products and services will be shaped by the way other sectors of economy develop. The example of the banking industry shows that as industries expand they start using more products and services from the local IT companies. The development of the banking sector can be, to some degree, projected to that of the other sectors of the economy, which indicates a rise in the demand for local software products from other sectors of the economy. However, domestic market is not large enough to support the high growth in productivity, which requires larger-scale and complex projects for the companies in the services segment and much higher number of

customers for the firms in the packaged software segment. As a result, export-oriented companies will be, as it is now, the major contributors to the growth in productivity and industry revenues.

As the industry develops, the local companies will seek more opportunities in the foreign markets. As companies engage in a larger number of projects with foreign customers, they will gain experience and build reputation. Higher quality products and better-known brand names will allow local firms to sell more products and services to foreign clients and charge higher rates for their work. Hence, the export-oriented local companies may be able to gain high productivity gains of 7-10% per year. This trend will slow down, however, as the local companies reach optimal levels of productivity, which we consider should be close to that of the foreign branches. At the same time, companies focused on the domestic market and new firms entering the industry will slow down the overall industry productivity growth, which may stay in the range of 3-7% or lower.

INDUSTRY OUTLOOK

In this section, we provide three industry expansion scenarios: slow growth, continued growth, and benchmark. They present different growth trends based on the level of the Government, as well as donor community and Diaspora, involvement in the industry development.

Slow growth scenario assumes no or insignificant support of the Government to the sector development, which results in declining workforce and productivity growth rates. If no major reforms are carried out by the Government, we expect that the educational sector will support on average 15% annual expansion of the IT workforce. At the same time, the productivity growth rate may decline to around 3% as new companies emerge and more inexperienced specialists enter the workforce. The industry would grow at 18% annually and reach $120 million in revenues with total workforce of around 7,900 by 2010.

Continued growth scenario assumes that the Government, donors and the Diaspora are actively involved in the sector development. These efforts ensure that the current high-growth trend is sustained into the future as well. These assumptions: workforce and productivity grow at 25% and 5% respectively – support industry growth of 31% per anum. For this scenario, the expected size of the industry and the workforce in 2010 are $250 million and 14,000 respectively.

Under the b*enchmark* scenario, we assume that the Government, donor community, and the Diaspora will work in tandem with the private and educational sectors to substantially increase the quality and supply of the IT professionals, improve Armenia's telecom infrastructure, enhance marketing and investment opportunities, as well as provide assistance in other important areas. Substantial and effective support to the sector may result in the workforce and productivity growing at 25-30% and 7-8% respectively. The industry, in that case, would grow at around 35-40% and reach $300-400 million in revenues and up to 19,000 in workforce.

RECOMMENDATIONS

In this section, we recommend a set of actions that should be undertaken to ensure further high growth of the Armenian IT industry. Recommendations are arranged into two sections: workforce and productivity – two factors that determine the industry growth trends. Recommendations are intended for the Government, and representatives of the educational and private sectors. The role of the Government is extremely important and a substantial involvement from its part is assumed and expected.

WORKFORCE

Supply of qualified workforce is a substantial impediment to the industry growth. The current number of professionals entering IT workforce will not allow the industry to keep and, moreover, reach higher than historical 30% growth rates. Various measures, therefore, should be implemented in order to increase the supply of IT workforce to not only sustain high rates witnessed by the industry in the recent years, but also support even larger expansion of the sector.

Increase Supply of IT Graduates

Admission of students to IT related departments of existing universities should be raised. Infrastructure of existing educational establishment should be improved in order to increase their capacity and overall quality. At the same time, existing universities may not be able to meet the long-term demand in graduates. Therefore, new educational establishments specialized in IT related disciplines may be required to fulfill this demand. In addition, university-industry educational initiatives similar to those started by LEDA and Lycos/EIF could provide additional influx of high-quality software talent.

Increase Supply of Business Specialists

At the same time, special attention should be paid to the supply of business professionals. Current educational system does not have the capacity to fulfill the industry's and the economy's long-term needs in high-quality managers and business specialists. Universities should start offering Bachelor and Master level business majors similar to those provided at western educational institutions. Ideally, business schools providing top undergraduate and graduate education should be established.

Improve Faculty

High-quality software professionals should be attracted to teach at leading universities. This effort requires that the current compensation level of professors be revised. At the same time, software specialists willing to enter teaching positions must be trained in latest teaching methods and techniques.

Provide Continuous Education

Opportunities for continuous education should be significantly expanded. Training centers are one of the places where IT and business professionals would be able to continuously update their knowledge and develop their skills. Universities should start offering classes not only for full-time students, but also to all individuals who are interested in particular classes or majors.

PRODUCTIVITY

Productivity is the second factor, which has to be improved significantly to enable the industry development. Emergence of new companies and entrance of a larger number of inexperienced specialists into the workforce result in declining productivity growth rates, which, in turn, makes it difficult to sustain historical industry growth of 30%. A number of actions from the Government and the private sector are required to address various issues affecting productivity growth. These issues are grouped into two main categories: external and internal. External aspects are mostly related to the industry-wide and global issues and intended primarily for the Government. Internal factors are aimed at companies' internal operations and intended for the private sector.

External Issues

Improve Business Environment and Infrastructure

The Government should introduce various incentives for both foreign and local investors in IT and high-tech areas. Such incentives could be in the form of reductions in profit and other taxes, tax incentives and matching grants to IT companies to invest in employee development, as well as similar incentives for companies in other sectors of economy to invest in IT solutions. Such policies would be one of the major drivers for accelerating industry growth and demonstrate the readiness of the Government to support its declaration of IT as a priority sector of the economy.

The Government should also support the creation of excellent high-speed internet and telecom infrastructure with widely available broadband network services. This will both attract FDI and enable IT firms to enter services segments requiring high-speed connections.

Establishment of software hubs, technoparks, incubators, and VC firms should be promoted. Viasphere Technopark, *www.viasphere.com*, SolarEn, *www.solaren.com*, and EIF are the first organizations in the country focused on building infrastructure and commercialization mechanisms. The case of Viasphere Technopark, the first technopark and high-tech VC firm in Armenia, proves that this model could very successfully facilitate creation of new businesses, particularly in high value-added areas.

Shift to Higher Value-added Products and Services

Private companies should shift their focus to packaged software and larger and more complex projects, which offer higher profit generation opportunities. More importance should be placed on the projects having significant design elements or involving solutions to complex problems, e.g. in the areas of math and engineering. Since no single company has a critical mass of programmers and managerial staff (500+ employees) to compete in the middle or high-end outsourcing markets, industry-wide consolidation efforts may be a necessity. Partnerships and alliances are also required to serve the ever-growing complexity of the projects.

There is a serious need to increase R&D spending to remain competitive and to create new opportunities. Significant part of the industry was based on the R&D potential built during the Soviet period. Increased R&D spending should partly come from the government budget and partly from private sources. Public-private partnerships are to be strengthened in order to create mechanisms and incentives for the private companies to invest into the R&D conducted by universities and research institutions.

Increase Domestic Market Size

A strong and sophisticated domestic market is important for building a competitive and growing industry and promoting exports. Limited domestic demand for software applications will prevail for the next several years if no radical policies are implemented by the Government to promote utilization of IT solutions by all the sectors of the economy. The Government itself should be one of the prime consumers of sophisticated and large-scale IT solutions. Local companies should be given priority over temporary project offices of foreign companies in implementation of government projects, including those financed by USAID, WB, and other donors. The Government should also support dissemination of IT for the wider population in Yerevan and regions of Armenia, e.g. through local e-governance projects, computerization of schools, libraries, and other public establishments. And finally, the Government should take the leading role in sponsoring the creation of IT infrastructures which are not commercially profitable for any single company but which may have significant potential in creating commercial applications. Examples of such infrastructures would be internet payment systems, open source maps of Yerevan and Armenia, and morphological dictionary of Armenian language.

Improve Access to Foreign Markets

There is a need to focus on extensive and targeted marketing and country promotion. Companies and the public institutions need to exercise excellent marketing communication; participate in overseas exhibitions and forums; create joint representations abroad; and create an Armenian brand name. Strong country brand name should be created by the joint efforts of the Government, industry associations, public institutions, private companies, and the Diaspora.

Being one of the strongest competitive advantages of Armenia, the Diaspora was so far crucial in the development of the Armenian IT industry. Diaspora, particularly in Europe, should be better utilized to create both new sales opportunities and attract FDI. Diaspora representatives should be involved in policy and industry development and invited to conferences and forums in Armenia to create strong linkages with Armenian companies and public institutions.

Industry associations, public organizations, and private companies need to collaborate with counterparts worldwide. Such collaboration will help establishing international linkages, building an image of Armenia in the global markets, and providing access to unique skills and high value-added projects. Cooperation with other CIS countries (Belarus, Russia, and Ukraine) may be one of the strategies to jointly build regional leadership.

Internal Issues

Improve Management Practices

Private firms should pay special attention to the general company management, as well as management of the software development projects. Many firms are managed by people with technical background who do not have sufficient managerial knowledge and experience. Companies should involve more business graduates in their management. They should also involve experienced project managers to improve software development processes. Reverse "brain drain" through attracting Armenian professionals working abroad would be another option to acquire the best world practices. High salaries may be compensated by the latest project management, marketing, and technology expertise that such professionals can bring to the companies, thus making them competitive in the world

markets. Such practice was successfully used by Ireland, which, similar to Armenia, had large pool of professionals working abroad.

Companies should focus on the improvement of internal processes, introduction of documented practices, procedures, and standards. They should start acquiring widely recognized software process maturity certifications, i.e. CMM/CMMI or ISO. For the companies outsourcing to foreign markets obtaining such certifications will be a major step towards access to larger and more lucrative projects.

Enhance Employee Development
Local companies should concentrate on training and employee development, for which budgets and strategies should be established. Better utilization of the personnel will enable companies to increase output and perform activities with a higher and more consistent quality. Again, the Government should create tax incentives for the companies to invest heavily in employee development.

APPENDICES

APPENDIX 1: ABOUT ENTERPRISE INCUBATOR FOUNDATION

Enterprise Incubator Foundation or EIF is a business development and incubation agency operating in Yerevan, Armenia. EIF was established by the Government of Armenia within the framework of the World Bank's "Enterprise Incubator" project to support the development of Information Technology sector in Armenia. Our objectives are to improve competitiveness of Armenian IT companies in the global marketplace, build linkages with business communities in key technology markets, improve access of local companies to knowledge and information on best practices and experience, and assist Armenian firms with attracting local and foreign investors.

EIF provides a comprehensive package of services via its three interrelated components:

Business Services unit focuses on assisting local technology firms in a variety of areas including business development, marketing and promotion, networking, management, accounting and finance, legal, and other areas vital to the success of a firm. Business Services unit helps existing companies in growing their businesses within Armenia and internationally, facilitates the development of IT start-ups, and assists local entrepreneurs in building their ideas into successful businesses.

Skills Development component promotes the improvement of professional and business skills of IT sector to develop and build on local technical and managerial capacities. It also supports the creation of learning partnerships within the industry and the universities by initiating specific projects to foster mutually beneficial relationships among technology private companies and universities to re-establish links between private and educational sectors, and to make the educational process more in line with the IT market requirements.

Facility Services component provides high-end facilities to existing IT companies and start-ups. Options included in the base package are office space, shared meeting rooms, shared resource center with access to literature and other information resources, high-speed Internet connection, receptionist and security, 24/7 access to the building.

EIF signifies the development of long-term relationships with organizations and individuals worldwide interested in mutually beneficial business collaboration. We work closely with many technology companies in Armenia and may serve as a major channel to creating successful partnerships with Armenian enterprises. We will be pleased to assist individuals and companies interested in developing partnerships or investing in Armenia to identify the best opportunities available.

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APPENDIX 2: ABOUT ARMENIA

Republic of Armenia or "Hayastani Hanrapetutyun" in Armenian, is a country located in the Caucasus on the crossroads from Europe to Asia. It was one of the fifteen republics of the former Soviet Union and declared its independece in 1991. The capital of Armenia is Yerevan. Land area is approximately 29,800 square kilometers or 11,500 square miles. Armenia is a mountainous region with the average elevation above sea level of 1,800 meters or 5,900 feet. The climate is sunny, dry and continental with hot summers and moderate to cold winters. Population is about 3.2 million as of 2002. Approximately 67 percent of the residents live in cities and towns. Armenian is the official language. Armenians are also fluent in Russian, and many, especially in Yerevan, are proficient in English too. The population of Armenia is highly educated with 98% literacy rate for residents over 15 years old. Armenia is an independent democratic state with the president as the head of the state. The National Assembly, the parliament of Armenia, is the legislative body.

Major industries: beverages, building materials, chemical and petrochemical, construction, electric motors, electric power production, electronics, food and food processing, forging pressing machines, furniture, diamond cutting, watch industry, health care, hosiery, instruments, jewelry, knitted wear, metal-cutting machine tools, mining, non ferrous metallurgy, shoes, silk fabric, software development, tires, tobacco, tourism, watches, wood working. According to the 2004 Index of Economic Freedom[21] compiled by the Heritage Foundation and the Wall Street Journal, Armenia is the 44th freest economy in the world along with France. Armenia is a member of many international organizations including Council of Europe, International Monetary Fund, International Atomic Energy Agency, International Organization for Standardization, Organization for Security and Cooperation in Europe, United Nations, World Bank, World Health Organization, World Intellectual Property Organization, World Trade Organization, and others.

2003 MAIN ECONOMIC INDICATORS[22]

Gross Domestic Product	$2.8 billion
Real GDP growth, % change over previous year	13.9%
Inflation, annual average	3.6%
Unemployment rate, end of the year	9.8%
Average wage, annual average	$770
Exports of goods, FOB	$678 million
Imports of goods, CIF	$1,270 million

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[21] Source: the Heritage Foundation, *www.heritage.org/research/features/index*.

[22] Source: the Central Bank of Armenia, *www.cba.am*.

APPENDIX 3: BUSINESS AND LEGAL ENVIRONMENT

TAXATION

The following are major taxes in Armenia, which are considered rather low compared to those adopted in many other countries:

- multilevel *personal income tax* has the maximum rate of 20%;
- *value added tax (VAT)* is 20%;
- *corporate tax* rate is 20%; and
- *employee social security taxes* with the rate of 3% are imposed on employees; a specific scale is applied for employers.

Armenia offers several incentive programs for foreign investors. In particular, it provides 2-year long tax holidays for foreign investments over $1 million, no duties on statutory capital and raw materials, no barriers on investment entry, and a 5-year protection clause in the law on foreign investments. Additionally, companies operating in Armenia have an option to indefinitely carry forward their losses.

There are incentives available to exporters such as no export duty and VAT refunds on goods and services exported. The implementation of the latter, however, has been difficult for a number of reasons. Imports of a few IT products are free from customs duties and taxes. VAT is levied on some products, such as computers, when they enter the country. According to the Armenian customs code, the value of contents of computer software is not included in the customs value, which is limited only to the value of the carrier media. This provision is in accordance with WTO/GATT customs valuation agreements.

INTELLECTUAL PROPERTY RIGHTS

Armenia has started reforming its intellectual property regime in the last ten years. It has created a modern system that protects intellectual property rights. Currently, intellectual property related matters in Armenia are regulated by the Civil Code, law on copyright and neighboring rights, law on patents, law on trademarks, service marks and appellations of origin, law on protection of topographies of integrated circuits, and law on protection of the economic competition as well as by a number of international treaties. Armenian legislation on intellectual property has been harmonized with the requirements of the Agreements on Trade Related Aspects of Intellectual Property Rights (TRIPS Agreements). Since February 2003, Armenia has been a member of the World Trade Organization (WTO).

APPENDIX 4: DEVELOPMENT INSTITUTIONS, ASSOCIATIONS, AND NGOS

Development institutions are quite active in the IT sector and provide substantial support to a number of projects, many of which have become very successful. Partial list of international organizations involved in the IT sector and their major supported projects are:

- *Eurasia Foundation, www.eurasia.am*: training centers for authorized certification courses, information systems for municipalities, Open Source Armenia project;
- *European Union (EU), www.europa.eu.int*: European Regional Institute of Information and Communication Technologies in Armenia (ERIICTA), e-Caucasus project;
- *German Development Cooperation (GTZ), www.gtz.de, www.prosme.am*: export promotion of Armenian IT companies;
- *International Research and Exchanges Board (IREX), www.irex.am*: internet public access sites, internet access and training program (IATP);
- *Open Society Institute (OSI), www.osi.am*: Global Internet Policy Initiative (GIPI), community telecentres at schools & libraries, Armenian OCR, Armenian search engine, Armenian Open Office, Armenian-English text translation tool;
- *Project Harmony, www.projectharmony.am*: Armenia school connectivity program;
- *United Nation Development Program (UNDP), www.undp.am*: information society & democratic governance, regulatory framework related to e-governance, Armenian Freenet, national e-governance system, e-visa system, external assistance database (IADA), online guide to Armenian export products;
- *United States Agency for International Development (USAID), www.usaid.gov/am*: Armenia IT master strategy, ARCA electronic payment systems, management information system for Tax Administration, State Registry System for registration of legal entities;
- *World Bank, www.worldbank.org.am*: "Enterprise Incubator" project, e-Government related programs, SiliconArmenia project, e-Armenia Foundation.

There are two major associations supporting the development of Armenian IT industry:
- *Armenian High-Tech Council of America (AHTCA), www.armentech.org*, unites many US entrepreneurs and executives in high-tech area with the goal of promoting and supporting the creation and development of technology-based businesses, assisting in the development of professional training programs, promoting the education of high school and university students in Armenia.
- *Union of IT Enterprises (UITE), www.uite.org*, is an association of Armenian IT companies, which unifies Armenian software, hardware, IT training, and ISP companies.

A number of NGOs are actively involved in the IT sector development and promotion. Among them are IT Foundation, Internet Society, and e-Armenia Foundation. Main focus of their efforts include raising public awareness of IT industry, government lobbying, arranging trainings and seminars, and developing e-government and e-education systems. NGOs closely collaborate with many of donor organizations such as Eurasia Foundation, OSI, USAID, and World Bank.

APPENDIX 5: METHODOLOGY

In this section, we describe how we have estimated various industry figures, what sources of information and data were used, our assumptions, possible issues with gathering and analyzing information and data, as well as other aspects important for understanding the value and limitations of this Report.

INFORMATION AND DATA

While developing the Report, we had to rely on the data provided by the industry representatives during their interviews. Although we believe that information and data gathered during these interviews were mostly reliable, however, not all of the companies provided all the information we required. Since in a number of cases, we did not have data at all, we had to extrapolate various figures based on what we had at hand.

We understand that because of the unavailability and, in some cases, unreliability of the data, the Report is based, to some extent, on our estimates and analysis. However, based on our experience with the industry, estimates provided in other reports and publications, and other sources, we believe that the Report offers fairly reliable description of the industry, its main trends and characteristics, as well as overall prospects.

Unless otherwise specified: all information and data in this report are based on EIF estimates and analyses and are for the year 2003; all growth rates are CAGR (Compound Annual Growth Rate); all monetary units are in US dollars.

The majority of numerical information in the Report is provided as point approximations. However, due to the limiting factors mentioned above, all the numbers in this Report should be interpreted as ranges: the amounts and quantities may vary up to 20% or more from their stated value.

DEFINITIONS

Software and services segment of the information technology industry is defined as the cluster of companies engaged in software development and maintenance; provision of software related services, consulting and integration; development of graphics, animation, and multimedia applications; chip and IP design; development of industrial automation tools; and provision of internet services. While companies included in our research may engage in a number of other activities within the technology sector, software and IT services component of their operations is part of their primary business. Respectively, only software and services segments of those companies were used in estimating industry figures.

Company within the context of Armenian IT industry is defined as a legal entity or a team of individuals. The reason behind this definition is that Armenia has a number of informal programming groups, which although are not legal entities, nevertheless constitute a reasonably large segment within the industry. We did not consider IT projects such as e-government systems implemented by temporary project offices of foreign companies.

Locally owned or local companies are defined as enterprises that have operations in Armenia, and at least 51% of their equity is owned by citizens or permanent residents of Armenia or locally owned firms. *Foreign branches or companies* are defined as enterprises that have

operations in Armenia, and at least 51% of their equity is owned by foreign citizens, residents, or firms.

Packaged software is defined as fully functional software programs or elements that could be used in a larger software product for sale, resale, or lease including ERP and similar systems. S*ervices* is defined as development of customized solutions, integration and consulting services, which are not commonly resold or leased to other clients.

ASSUMPTIONS AND ESTIMATION METHODS

Number of existing companies varies depending on the source of information from 100 to 250 firms. It is estimated that around 200-300 companies are registered with specializations in software and services areas. However, many of these firms do not actually operate in the IT field or not at all. Hardware manufacturers and retailers, as well as high-tech companies that do not have significant software operations were not counted as well. To the total quantity of companies that we have known, we added some percentage that would reflect those companies (or teams) about which we do not have any information. These could include teams that are not registered as legal entities, companies operating in the regions, and others.

Industry revenues were estimated, when we did not have data from the companies, based on the number of employees, average salary levels, as well as non-wage related costs, and respective profit margins. We tested our assumptions against reliable revenue figures from several companies, and, therefore, we believe that our industry revenue estimates provide reasonable approximation to the actual amounts. As we discussed above, our calculations do not include hardware and high-tech companies, as well as temporary donor-funded software projects for the Government. *These revenues may be significant and explain varying revenue figures provided in different reports, which cite amounts in the range from $30 to 50$ million.*

Productivity was estimated based on the annual revenues per employee. Two set of figures are calculated: one was mere a division of all industry revenues by the total workforce; second was annual revenue of each company per its employee, which was then averaged for the total industry. While the second estimation provides better picture of the productivity, it complicates the forecasting of the industry's growth. In addition, productivity calculations for 2003 were made only for software development companies because significant differences exist between these firms and ISPs in terms of how their revenues are generated. *PPP (Purchasing Power Parity)* adjustments were done for conversion of productivities of Armenian companies into US dollars when comparing with respective productivities of US companies. PPP adjustment coefficient of 5 was used in all productivity calculations.

Workforce was estimated, when we did not have data from the industry, based on the average number of employees per company. Average figures were calculated using a sample of local and foreign companies, where the outlier companies with largest and smallest staff were excluded. This method allows estimating average employee quantities that better reflect the actual state of the industry.

For *forecasting industry growth,* we assumed that the local and international demand for the products and services from Armenian companies keeps with the supply, and, therefore, we did not consider directly the demand side in our forecast.

DESCRIPTION OF NEEDS ASSESSMENT SURVEY

In the first half of 2004, EIF has accomplished a major needs assessment survey of the Armenian information technology sector, which covered a number of areas important to the development and growth of the industry including business and legal environment, educational framework, human resources, managerial capacity, marketing channels, product development, and others. The survey was conducted by Development Programs Ltd., *www.dp.am*, with the assistance of Sophia Muradyan and other members of EIF team. The survey included private companies, educational institutions, training centers, development organizations, NGOs, and freelance developers.

The survey covered 74 companies. Quantitative data was received from 63 companies.

During the study, 660 individuals were interviewed:
- Managers of 69 companies;
- 65 representatives of educational institutions;
- Managers of 11 training centers;
- Representatives of 11 development institutions, associations, and NGOs;
- 18 unemployed specialists;
- 12 non-registered software developers;
- 474 students.

APPENDIX 6: ABBREVIATIONS

CAGR	–	Compound Annual Growth Rate
CIS	–	Commonwealth of Independent States
DSL	–	Digital Subscriber Line
EIF	–	Enterprise Incubator Foundation
ERP	–	Enterprise Resource Planning
FDI	–	Foreign Direct Investment
GDP	–	Gross Domestic Product
ICT	–	Information and Communications Technologies
IP	–	Intellectual Property
ISDN	–	Integrated Services Digital Network
ISP	–	Internet Service Provider
IT	–	Information Technology
NGO	–	Non-Governmental Organization
PPP	–	Purchasing Power Parity
R&D	–	Research and Development
US	–	United States
USSR	–	Union of Soviet Socialist Republics
VC	–	Venture Capital