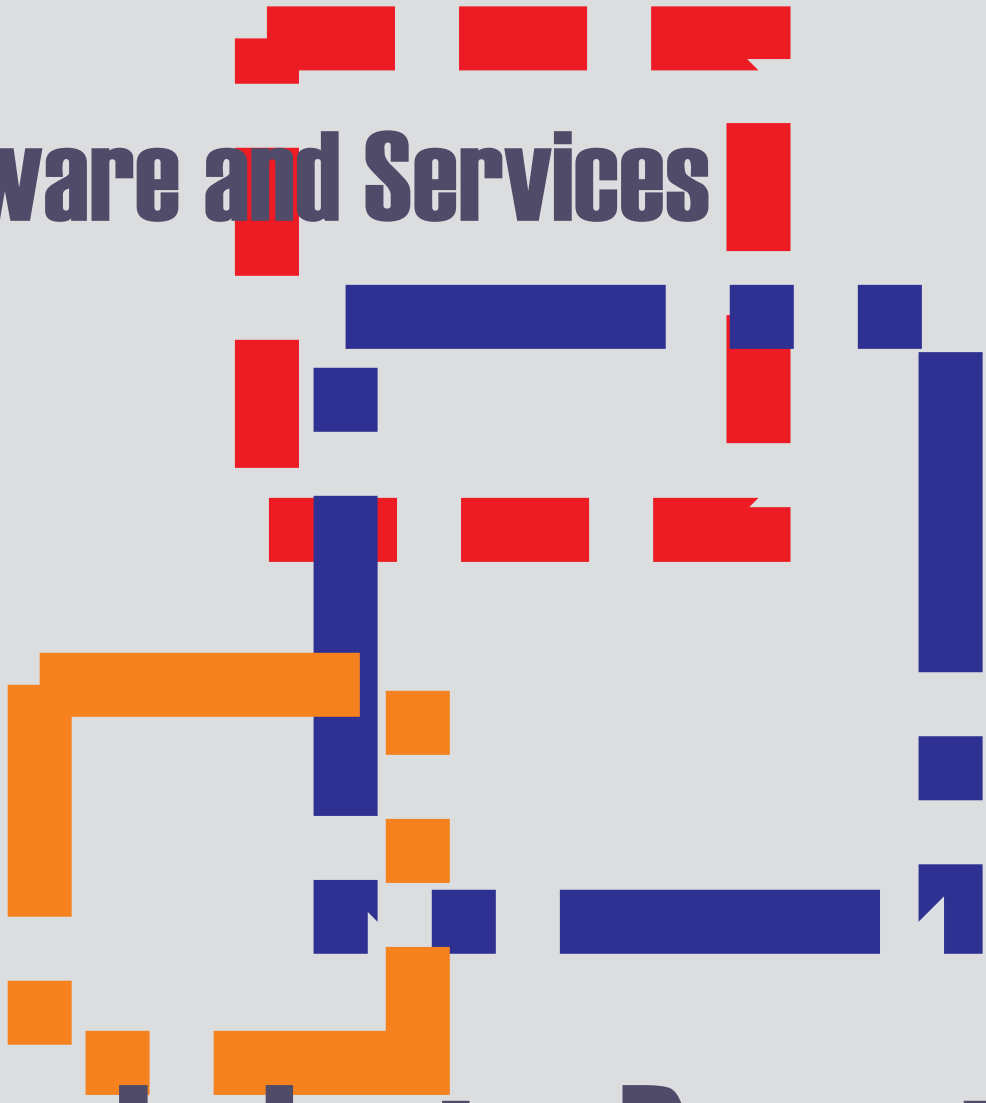
Enterprise Incubator Foundation

Armenian Information Technology Sector

Software and Services



Industry Report

2006

ARMENIAN INFORMATION TECHNOLOGY SECTOR
SOFTWARE AND SERVICES

2006 INDUSTRY REPORT

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Development of the Report: Norayr Vardanyan, EIF

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 provision of research and analytical publications 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.

The Report is based on our surveys of the sector conducted in 2004 through 2006. It covers key aspects of the industry including history, revenues, productivity, workforce, 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, timeline of key historical dates, an FDI success story, detailed statistics. Appendix 7 discusses definitions, key assumptions, and estimation methods.

The Report could not have been prepared 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

CONTENTS

Sector at a Glance 4
Competitive Advantages of Armenia 4
2003-2006 Main Indicators 5

Industry Overview 6
History 6
Industry Background 9
Revenues 13
Productivity 20
Workforce 22
Other Areas 27

Educational Sector 29
Universities 29
Students 31
Training Centers 32

Policy Developments 33

Industry Prospects 34
Outlook Scenarios 34
Recommendations 35

Appendices 39
1. Armenia, Key Facts 39
2. Science and Technology in Armenia, Timeline 43
3. FDI Case: Synopsys Inc., United States 45
4. UITE, Armenian IT Association 46
5. Enterprise Incubator Foundation 47
6. Methodology 48
7. Industry Statistics 51
8. Costs of Operating a Software Company in Armenia 56
9. Armenia on the Internet 57
10. Abbreviations 58

SECTOR AT A GLANCE

Historically, Armenia was on the forefront of high-tech research, development, and manufacturing. Since early 1950s, Soviet Armenia has been a main hub of USSR's critical scientific and R&D activities in a number of technology industry segments such as mainframe and industrial computing, electronics, semiconductors, software development, and others. Before the collapse of the Soviet Union, Armenian technology sector focused primarily on the large-scale R&D and production projects targeted at industrial and military applications. After the independence of 1991, the industry switched its focus to the software development, outsourcing, and IT services. The software and services segment really gained its momentum in 1998-2006, during which the sector grew at 30% per annum. In 2006, the share of the industry in Armenia's GDP was 1.3%, which is comparable to that of India (1.4%) and Germany (1.3%).

In recent years, the sector has witnessed major inflow of foreign investors who have located in Armenia to capitalize on the young and highly qualified workforce. Around 63% of the industry's output is exported to over 20 countries, mainly USA, Europe, and CIS. The major specializations include embedded software and semiconductor design, custom software development and outsourcing, financial applications, multimedia design, Internet applications, web development, MIS and system integration. In particular, Armenia has outstanding achievements in semiconductor design software and IP solutions. Foreign companies specialized in chip design place their R&D facilities in Armenia to benefit from the talented and creative workforce pool and highly competitive wage rates.

COMPETITIVE ADVANTAGES OF ARMENIA

- World-class R&D capabilities in computer science, physics, and mathematics,
- Well-educated and talented workforce with a high degree of technical skills and English language proficiency,
- Strong university programs with specializations in IT and sciences,
- Highly competitive cost of labor and low operating costs,
- Solid Government support of the sector and commitment to improve the investment climate,
- Strong and successful Diaspora in Europe and North America,
- Extensive experience with large multi-national companies,
- Sound laws and regulations for IP protection.

2003-2006 MAIN INDICATORS

	2006	% from Industry	2003	% from Industry	% change 2006/2003	CAGR 2006/2003
Operating Companies						
Industry total	160	100%	110	100%	45%	13.3%
Local firms	112	70%	86	78%	30%	9.2%
Foreign branches	48	30%	24	22%	100%	26.0%
Industry Revenues, millions of U.S. dollars						
Industry total	$84.2	100%	$37.7	100%	123%	30.7%
Local firms	$36.7	44%	$15.8	42%	132%	32.4%
Foreign branches	$47.6	57%	$22.0	58%	116%	29.3%
Industry average revenue per company	$0.53	100%	$0.34	100%	54%	15.4%
Local firms	$0.33	62%	$0.18	54%	78%	21.3%
Foreign branches	$0.99	188%	$0.92	267%	8%	2.7%
Domestic market	$30.9	37%	$13.5	36%	129%	31.8%
Exports	$53.3	63%	$24.2	64%	120%	30.1%
Packaged software	$29.2	35%	$11.9	32%	145%	34.9%
Services	$55.0	65%	$25.8	68%	113%	28.7%
Productivity (weighted average output per employee), U.S. dollars						
Industry total	$18,700	100%	$11,800	100%	58%	16.6%
Local firms	$16,600	89%	$9,600	81%	73%	20.0%
Foreign branches	$24,100	129%	$18,300	155%	32%	9.6%
Packaged software	$20,500	110%	$11,700	99%	75%	20.6%
Services (excluding ISPs)	$21,800	117%	$12,500	106%	74%	20.4%
Human Resources (persons)						
Industry total	4,690	100%	2,980	100%	57%	16.3%
Technical professionals	3,390	72%	2,120	71%	60%	16.9%
Management and administrative	1,300	28%	860	29%	51%	14.8%
Local firms	2,300	49%	1,440	48%	60%	16.9%
Foreign branches	2,390	51%	1,540	52%	55%	15.8%
Students in IT related specialties at Armenian universities	6,840	100%	3,920	100%	74%	20.4%

INDUSTRY OVERVIEW[1]

Armenia is one of the leading information technology nations among the neighboring CIS and Middle East countries. This potential was formed when Soviet Armenia has become a key science, R&D, and high-tech manufacturing location of the former USSR. At the peak of its growth in 1987, science and technology sector in Armenia employed, according to various estimates, around 100,000 specialists. The collapse of the Soviet Union, regional conflicts, and devastating earthquake in the north of the country brought enormous economic hardships to Armenia. The consequences for the high-tech sector were significant: the majority of science and R&D institutions had to curtail or shut down operations leaving thousands of people jobless.

Independence of 1991 created completely new opportunities for the industry and particularly for entrepreneurs and IT professionals. Focus of the industry shifted from major manufacturing operations to the software and services segment, which has witnessed substantial growth during 1998-2006. Today, Armenian IT industry is one of the most dynamic and promising sectors of the economy. Past successes, qualified professionals, and Armenian entrepreneurial spirit position the industry to be successful in the years to come.

HISTORY

There are two principal stages in the development of Armenia's technology sector: period under the Soviet rule and post-Soviet independent Armenia. During the first stage, Armenia was a major center for R&D and production in the areas of computer science and electronics. This potential has been created back in the 1950s when several major R&D and semiconductor manufacturing plants were established. These institutions operated for the Soviet Government and concentrated primarily on medium and large scale industrial and defense applications. Many organizations had in-house software development departments focusing on automation of accounting and other organizational functions. During the second stage, tech sector concentrated on outsourcing and offshore software development. During this period, potential of IT industry has been recognized by a larger number of investors, policy makers, and professionals. Armenia has become a location of choice for several multinational companies to outsource R&D, operations, and software development. Armenian Government declared support of the ICT sector as a key priority for its economic development policy.

[1] If not otherwise specified, all numbers are for the year 2006. Industry figures for 2003 are based on EIF's 2003 IT Industry Report.

SOVIET ARMENIA (1920 - 1990)

The roots of the industry can be traced back to the period before and during World War II when a heavy industrial expansion was underway in the USSR. This required educated technical specialists in different fields of the economy leading to the establishment of two primary educational institutions in Armenia: Yerevan State University (YSU) in 1920 and Yerevan Polytechnic Institute (currently State Engineering University of Armenia, SEUA) in 1933. Armenian Academy of Sciences (currently National Academy of Sciences, NAS) was formed in 1935. Foundation of YSU, SEUA, and NAS was a starting point in the long history of the development of science and technology in Armenia.

Era of computers and software development has begun in 1956 with the launch of Yerevan Scientific Research Institute of Mathematical Machines (YerSRIMM). The institute was specifically created by the decision of the Soviet Government to design and build electronic computers and related equipment. Already in 1959, YerSRIMM designed a first generation computer "Aragats" running on vacuum tubes; in 1961, a second generation computer "Razdan" on semiconductor elements was ready. During early 1960s, institute focused on the development of small and medium scale computers, and by the end of 1960s, it moved to the design of mainframes, automated control systems, as well as operating systems, networking and application software. YerSRIMM was the leading institution of the former USSR specialized in the development of microprogrammed computer systems "Nairi", which received more than 40 patents and was presented at 20 international exhibitions. YerSRIMM 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. The institute was well known for the development of IBM-360/370 compatible ES series of computer systems widely used in scientific and industrial applications throughout the Soviet Union. A significant achievement of YerSRIMM was a project to design a telecommunication system for the mission to the moon. In 1980s, YerSRIMM alone employed around 10,000 people, more than twice the size of the whole IT workforce today.

A number of production companies were established oriented towards R&D and manufacturing of electronics and semiconductor devices. "Transistor" semiconductor R&D and manufacturing plant (1958) was a USSR leader in the production of transistors and amplifier diodes. In 1964-65, "Sirius" radioelectronics plant making radio-electronic components and "Posistor" microelectronics factory producing diodes and hybrid integrated circuits were constructed in the city of Abovyan. Institute of Microelectronics, Scientific Research, and Technology (1966) was developing microelectronic circuits, automated measurement devices, and other advanced electronic devices. Yerevan Telecommunications Research Institute (YeTRI) established in 1978 was involved in the production of integrated circuits and other products based on silicon thin film technology. In 1986, Ashtarak semiconductor and electronics manufacturing plant was constructed with total

investment of $120 million. The plant focused on the production of semiconductor wafers, circuit boards, solar cells, and other electronic devices. Another major manufacturing facility, "Mars" integrated circuits and electronics plant ($300 million investment) was built in 1988 to make printed circuit boards and integrated circuits.

After the liberalization of the Soviet economy in late 1980s, a number of 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 the time were accounting and financial applications targeted at the local customers, hardware assembly and sale, and some outsourcing services. The first private IT company in Armenia, "Armenian Software", was established in 1987. As of 1990, there were around 40 large technology oriented 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.

INDEPENDENT ARMENIA (1991 - 2006)

On September 21, 1991 Armenia declared independence from the Soviet Union. Break-up of USSR and start of the era of personal computers led to the collapse of the Armenian technology sector that for many years has been concentrated primarily on large-scale manufacturing and R&D. The fact that major client of the industry - the giant Soviet military-industry complex - was no longer available exerted great pressure on the industry to shift its focus from large-scale military applications to market and customer driven solutions and services. Thus, gradually new companies have 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.

In 1990s, a new age in the industry development started when several U.S.-based software businesses opened branches in Yerevan including Boomerang Software (internet applications), Credence Systems (semiconductor design-to-test solutions), Cylink (network security products and VPN solution), Epygi Technologies (IP PBXs), HPL Technologies (yield management software and test chip solutions), Virage Logic (advanced embedded memory IP), and others. Diaspora played a key role in the formation of Armenia's fledgling software industry and was the primary factor behind the early establishments of many foreign companies in Armenia. Starting late 1990s, the industry received a new impulse for growth stemming from successes of the previously formed companies, overall recovery of the economy, and unprecedented growth of the worldwide IT industry. The potential of Armenia's IT industry drew attention of a 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 technology fields.

Existing strong scientific and educational base formulated the significant success of the semiconductor design industry, which has grown into a large revenue generating segment within the IT industry and attracted a number of large foreign direct investments. In 2000, U.S. based LEDA Systems Inc., founded by a graduate of State Engineering University and specialized in design of integrated circuits and components, started a branch in Armenia. One of the key initiatives of the company was the formation of a specialized training center in cooperation with SEUA. At the center, students have an opportunity to receive high-quality engineering practice in the design of integrated circuits, related software and components. Armenia's considerable expertise in the field of chip design attracted Synopsys Inc., a global leader in EDA and VLSI design. The company acquired Armenian operations of LEDA Systems and Monterey Arset (systems on a chip) in 2004 and HPL Technologies in 2005. Currently, Synopsys is the largest software firm in Armenia employing more than 400 professionals.

In early 2000s, more foreign businesses launched development locations attracted by highly qualified labor force and competitive costs: CQG (analytics software and trading solutions), EPAM Systems (offshore software development), Lycos Europe (pan-European online network), Luxoft (software development and outsourcing), and others. Such major brands as Alcatel, Siemens AG, Microsoft Corporation, and Sun Microsystems Inc. operate representative offices in Armenia and are involved in various industry specific and educational initiatives. Growing importance of IT industry led the Government of Armenia to declare ICT as one of the priority sectors of Armenian economy in 2000. Other key initiatives in the policy field include preparation of Armenia's ICT Master Strategy and formation of Information Technologies Development Support Council (ITDSC) in 2001 and start of Enterprise Incubator project in 2002. Union of Information Technology Enterprises (UITE), Armenian IT association, was established in July 2000 by the private sector to consolidate industry advocacy efforts, facilitate business, and encourage advancement of research in the ICT sector.

INDUSTRY BACKGROUND

Armenian IT sector has two distinct segments of companies: firms with local ownership and branches of foreign companies. Characteristics of the businesses from each segment such as number of employees, salaries, revenues, and others are noticeably different. Industry analysis in the Report stems from and relies on this important classification of Armenian IT enterprises.

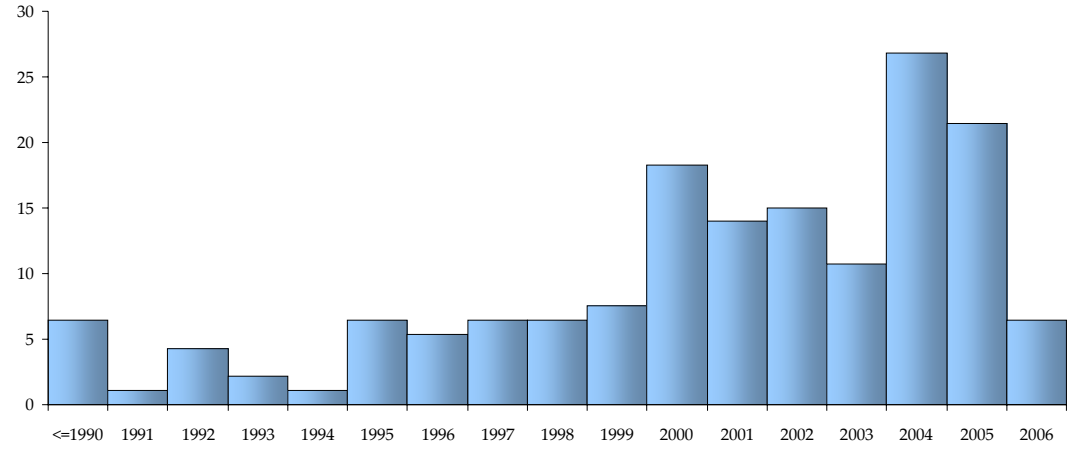
COMPANY FOUNDATIONS

Armenia's software and services industry is very young: the prevailing number of companies, nearly 80%, was founded during 1998-2006. First local private software firm was established in 1987, and within 5 years first foreign branch was launched

in Yerevan. 1991-1997 turned to be a tough transitional period for the technology sector: regional conflicts, collapsed economy, brain drain - all had considerable effects on the revival of the industry. As of 1998, around 35-40 software firms and ISPs were operating in Armenia employing, according to various estimates, nearly 1,000 specialists. Size of the workforce was notably smaller in 1998 compared to that observed in 1987 when only YerSRIMM employed up to 10,000 people.

During the last 8 years, the industry saw a sharp increase in the number of newly formed companies, both local start-ups and branches of foreign companies. More than 90% of the foreign companies were established in 1998-2006. The number of operating IT companies in 2006 reached 160 representing nearly 20% growth from 1998 to 2006. On average 18 IT businesses were launched annually in the first half of 2000s. This is in sharp contrast to 1990s when only 5 companies were formed each year. At the peak in 2004, annual number of newly started firms reached 25-30 representing growth of 26% per year. These high rates, however, may be difficult to sustain due a still major shortage of qualified developers, engineers, and project managers. So far, size of the workforce has been the primary factor limiting industry growth. Apparently, shortage of specialists will keep its priority at least until the end of the decade.

New IT Companies Formed in Armenia: 1990-2006



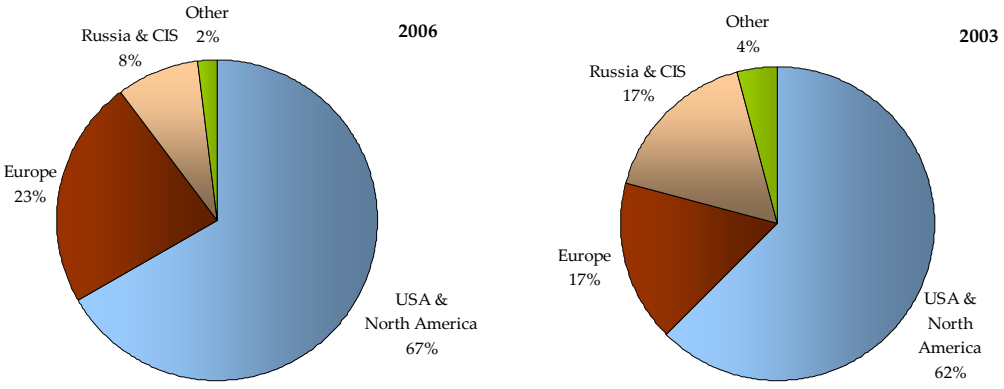
COMPANY OWNERSHIP GEOGRAPHY

In 2006, number of foreign companies in Armenia reached nearly 50 entities or 30% from the industry total. Share of foreign branches within the industry increased by 8% from 22% in 2003. Armenia's expertise in software development has been gaining more and more recognition outside the country thus fostering foreign investments in the IT sector. Compared to 2003, percentage of firms with Russian/CIS ownership decreased by 9% stressing the fact that very few software businesses have recently been formed with CIS investments. The only notable

newcomer to the Armenian IT sector was Luxoft, the largest software development firm in Russia with 2,300 employees and $70 millions in revenues[2]. On the other hand, more companies with European ownership were established during the last 3 years leading to a larger share of EU firms, which increased from 17% to 23%. Still the majority of foreign branches are from the U.S.: almost 70% of overseas firms have North American ownership, essentially the United States.

During 2004 and 2005, Armenian IT sector witnessed a major M&A within the chip design segment. Synopsys Inc., a leader in delivering solutions for semiconductor design and manufacturing, acquired LEDA Design, Monterey Arset, and HPL Technologies. The new combined development center in Armenia owned by Synopsys is currently the largest domestic software powerhouse with more than 400 employees. Other examples of acquisitions of existing Armenian companies during the last several years include two state-owned Armenian enterprises (YCRDI and Yer.ACSSRI) sold to Russian investors by the Government of Armenia, and an Armenian branch of a U.S. company, Brience, which was acquired by Germany-based Lycos Europe.

Company Ownership: Geographical Distribution



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 common 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.

[2] Source: Luxoft, http://www.luxoft.com/about/fact_sheet.html

DIASPORA

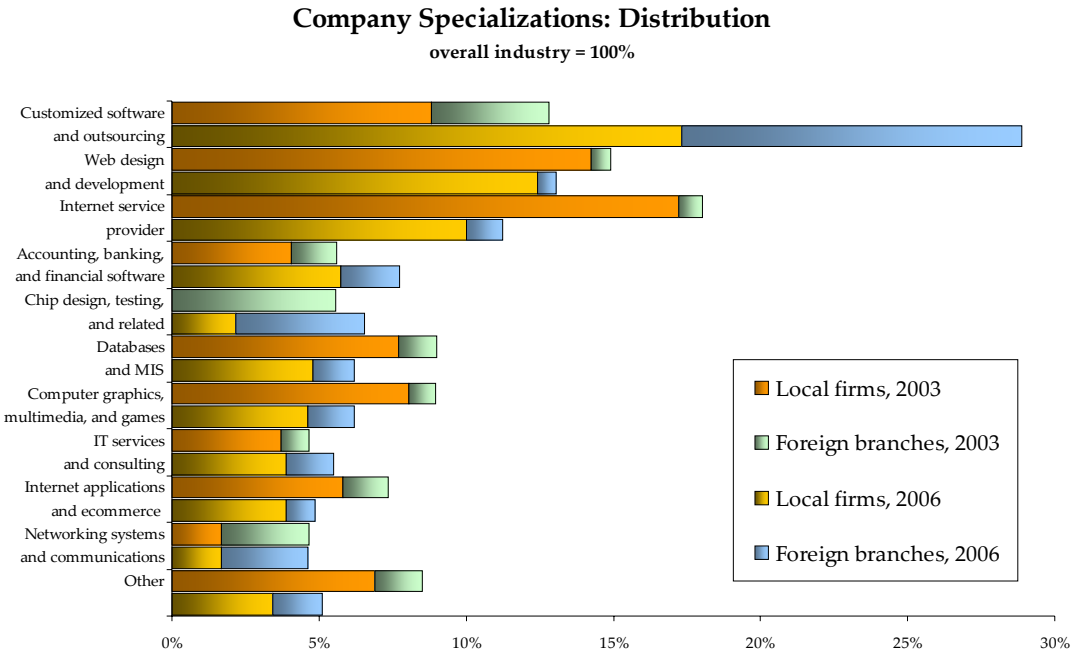
Diaspora is considered one of the major competitive advantages of Armenia in terms of access to foreign markets and expertise. The majority of foreign branches operating in Armenia are established through direct involvement of Diaspora Armenians. Diaspora representatives are usually well disposed towards 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 customized software, web development, and ISP; together they represent more than 50% of all fields. Since 2003, number of companies involved in customized software development and outsourcing increased more than twice. Primary gainers were local firms, which are now also active in the chip design area. Obviously, during the last years local firms have gained enough skills to offer advanced software solutions and services such as IC design. Rise in outsourcing services is a result of better domestic expertise and increased penetration of the outsourcing markets.

In addition, IT firms are pursuing opportunities in the Internet related areas such as web design and development, provision of Internet services, and Internet applications. 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 e-commerce growth in Armenia. Despite the low value-added nature of web development, it still plays an important role in the industry because of many small companies offering web design services.

Generally, local firms are more diversified than foreign branches, which can be explained by the small size of many domestic industry sectors where local firms are active. Foreign companies are specialized primarily in customized software and outsourcing and chip design (more than 50% of all branch specializations).



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 AJAX, 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 for handheld platforms. Open source development is becoming increasingly popular among young professionals and students, as well as IT businesses.

REVENUES

In 2006, Armenian software and services sector generated around $84 million in total revenues resulting in 30% CAGR during 1998-2006[3]. This turnover figure constitutes 1.3% of Armenia's $5 billion nominal GDP in 2006. It is close to the share of IT sector in GDP for such countries as India (1.4%) and Germany (1.3%)[4]. During

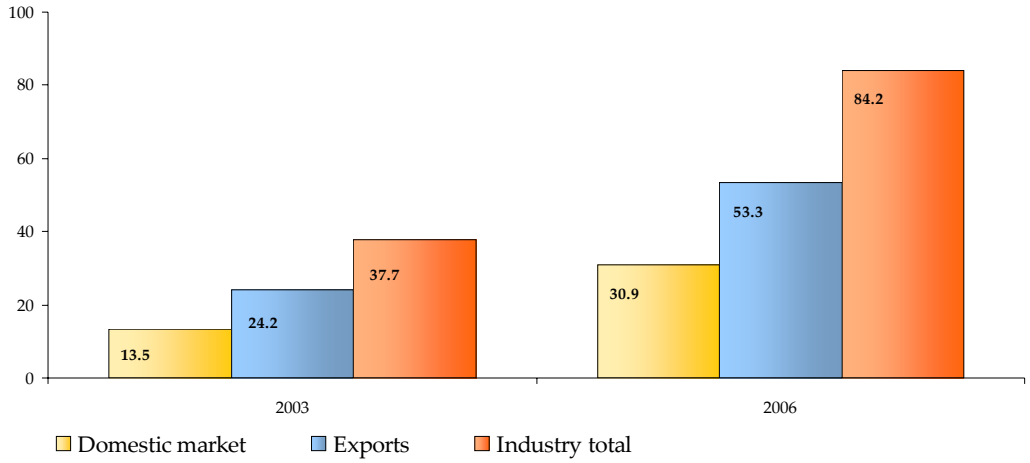
[3] In 1998, total turnover of tech industry's software and services segment was around $10 million. Source: USAID ICT Assessment Report, July 2000.

[4] Source: McKinsey & Company / Armenia 2020, Key Levers for Productivity Improvement in Armenia, 2003.

2003-2006, industry showed constant growth consistent with the economy's overall expansion rate. Dollar figures, however, should be used with caution due to a large appreciation of the Armenian currency, Dram, at 12% per annum. Armenia's real GDP grew on average at 13% CAGR from 2003 to 2006[5], which may be considered a better benchmark for IT industry's *real* growth rates. Industry's contribution to the total exports rose from 3.6% to 5.3% proving the growing importance of the software sector for Armenia's landlocked economy focused on the expansion of export oriented businesses.

Armenian IT Industry Revenues

millions of U.S. dollars



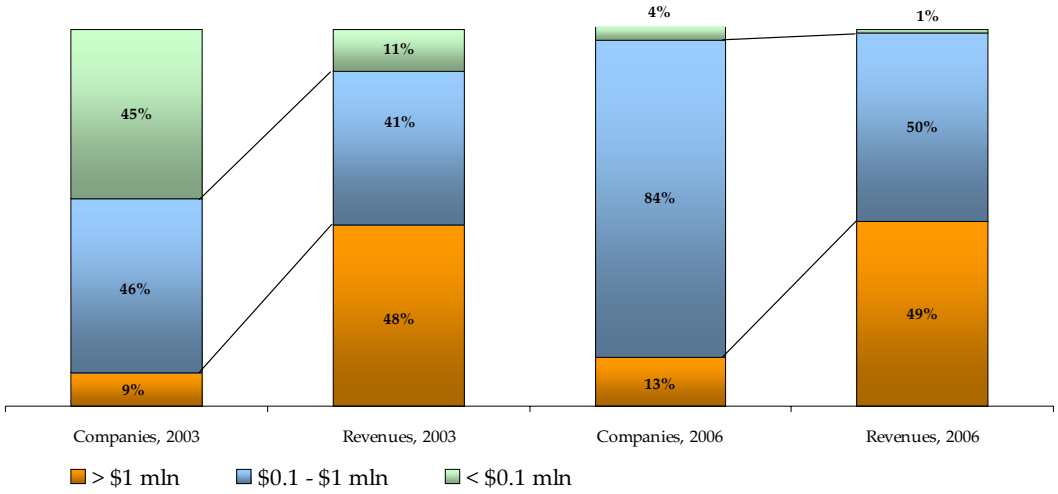
Share of local companies' revenues in the industry's total has not changed considerably in 3 years and amounts to 40-45% or $37 million. At the same time, average revenue per company for locals gained substantially, nearly 80%, while it is only 8% for branches. Local firms are now in a better shape than three years ago: they have more employees, their technical expertise and knowledge of the market is on the rise, and they are willing to implement more complex and higher-value added projects. Consistent performance of the branches is explained by the way foreign companies operate Armenia: they are primarily outsourcing centers with a specific budget and a small profit margin. This highlight the main issue of the branch outsourcing model: little value is left in the country, only operating related expenses. Nevertheless, branch model is still relevant for Armenia and has visible positive effects on the industry and overall economy. In the long run, however, models with a significant value added component are needed for the industry.

20 largest companies comprising 13% of all IT firms generated 50% of all industry revenues. In contrast, only 9% of all companies generated approximately same share of revenues in 2003. Industry is becoming less dominated by the few largest businesses. Medium size firms are gaining ground: today, nearly 85% of the

[5] Source of economic data: Central Bank of Armenia.

companies in the middle segment from $100K to $1 million. Number of small firms with less than $100,000 in revenues dropped sharply, and now they do not have any visible impact on the industry. Rising operating costs and low effectiveness of small companies make it highly difficult for companies with less than 10 employees to operate in the long term.

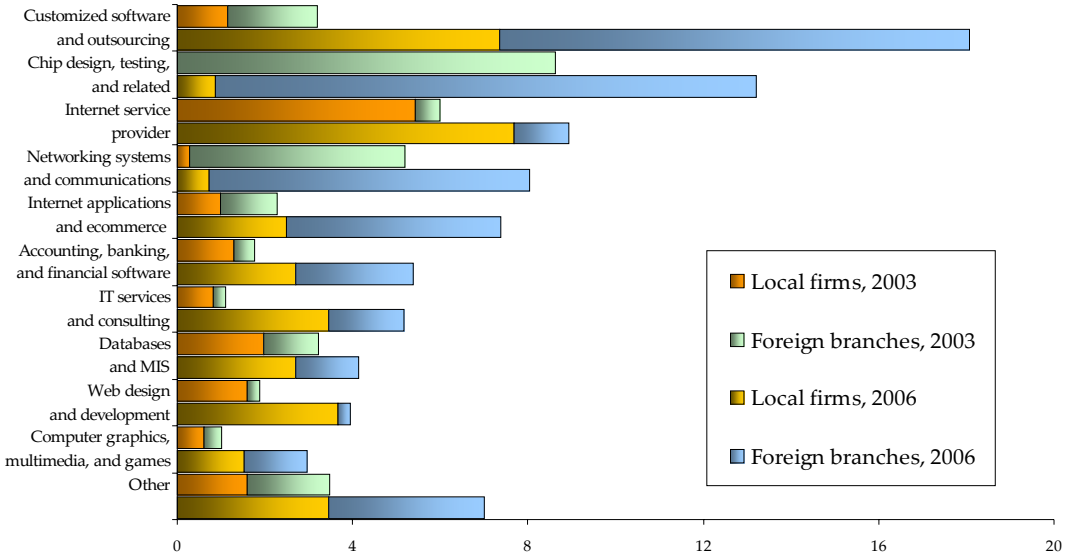
Industry Revenue Concentrations



Largest revenue contributing segment of the industry is customized development; it generates $18 millions or 22% of the industry's total. Although only eleven companies (7%) are specialized in chip design areas, the revenue generated by this segment is around 16% of the industry's turnover. Other major revenue generating sectors are ISPs, networking systems and communications, and internet applications. Compared to 2003, share of customized software revenues in the industry's total has increased more than twice. In dollar terms, revenues from this segment increased almost six times from $3.2 to $18.1 million (industry turnover only doubled in 2003-2006). Undoubtedly, outsourcing is becoming more and more important for Armenian IT sector as a key growth-boosting industry segment.

Company Specializations: Revenues

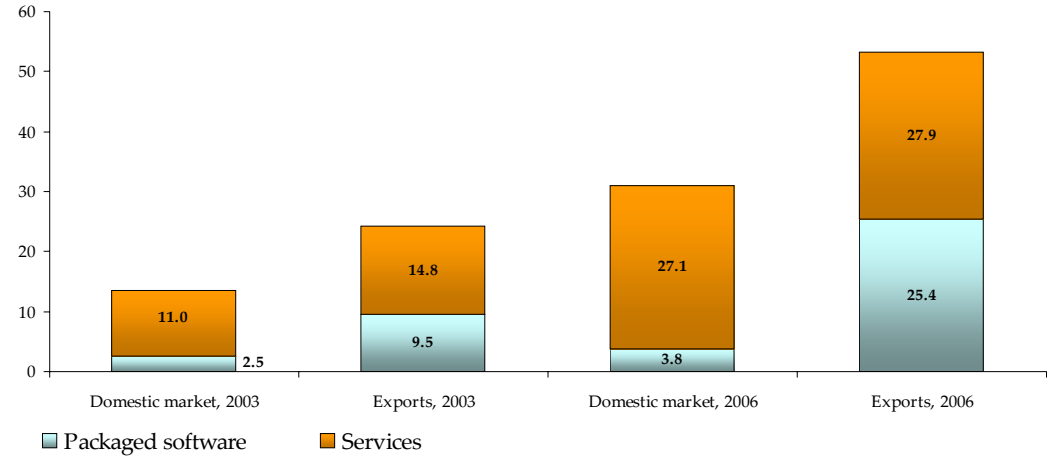
millions of U.S. dollars



In 2006, the domestic market for software and services amounted to $31 million comprising 37% of the industry's total. Share of the domestic market versus exports is almost identical for 2003 and 2006; both segments grew at the same rate of 30-31% CAGR. Reason for the difference in exports and domestic market (63% vs. 37%) is that the largest companies of the industry are branches of foreign firms, which almost completely export their products or services. In addition, many locally owned enterprises also export significant portion of their output. For example, two highly export-oriented segments, chip design and outsourcing, together generate more than 37% of the industry's overall revenue.

Domestic Market and Exports: Packaged Sofware vs. Services

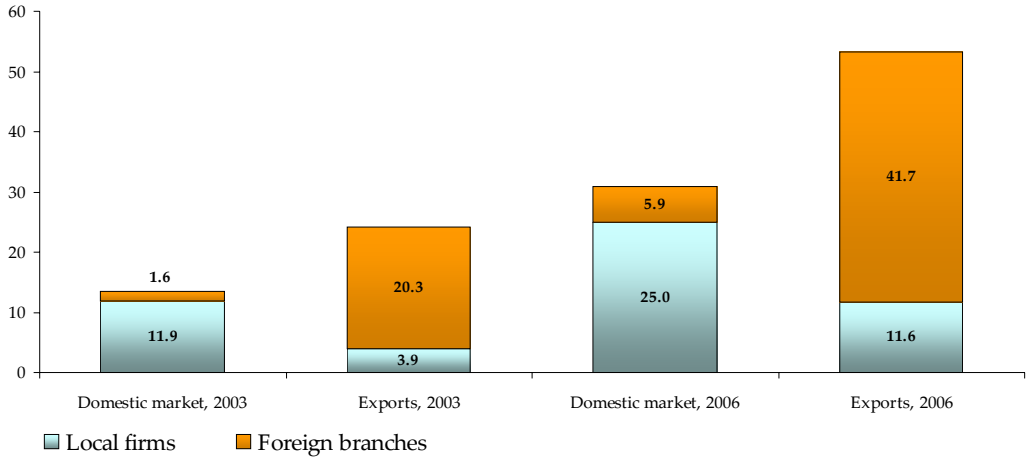
millions of U.S. dollars



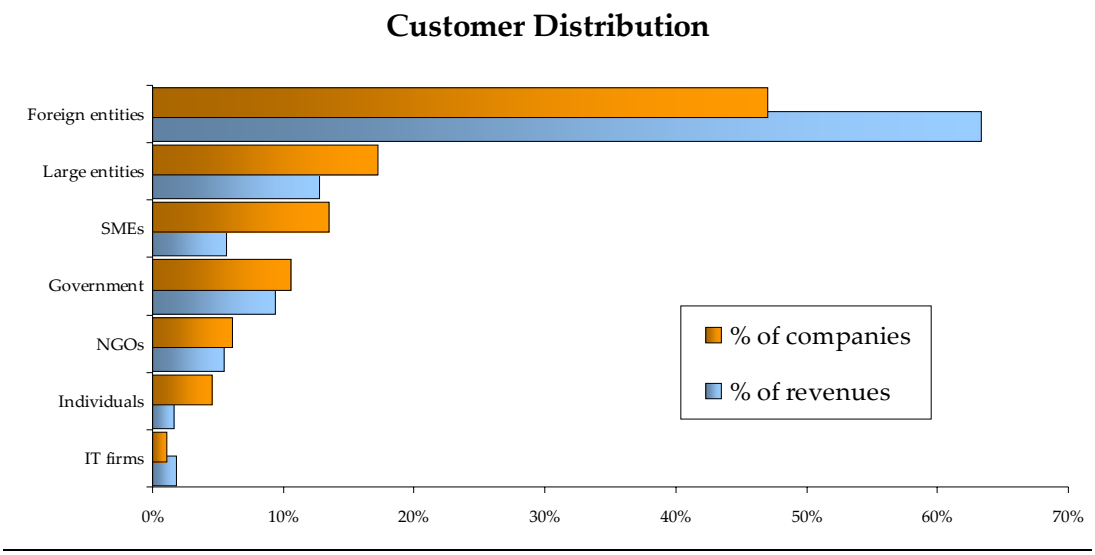
Total market for packaged software amounted to $30 million or 35% of the industry representing a small 3% increase from 2003. Services segment still dominates with its 65% share of the industry, which is even larger for the domestic market: nearly 88% of the domestic revenues come from services. A number of factors contribute to the low share of packaged software within the domestic market: low level of investments in IT by the Government and large businesses, still high piracy rates, low demand for sophisticated software tools, poor purchasing capacity of the population, and other factors. On the other hand, share of packaged software in export revenues is close to that of the services segment (47% vs. 53%), an 8% increase over 2003 (39% vs. 61%). Foreign branches involved in the development of various software tools and products are the leaders in exporting packaged software. Only the chip design segment, which is entirely focused on foreign markets, generated 25% of all export revenues.

Domestic Market and Exports: Local Firms vs. Foreign Branches

millions of U.S. dollars



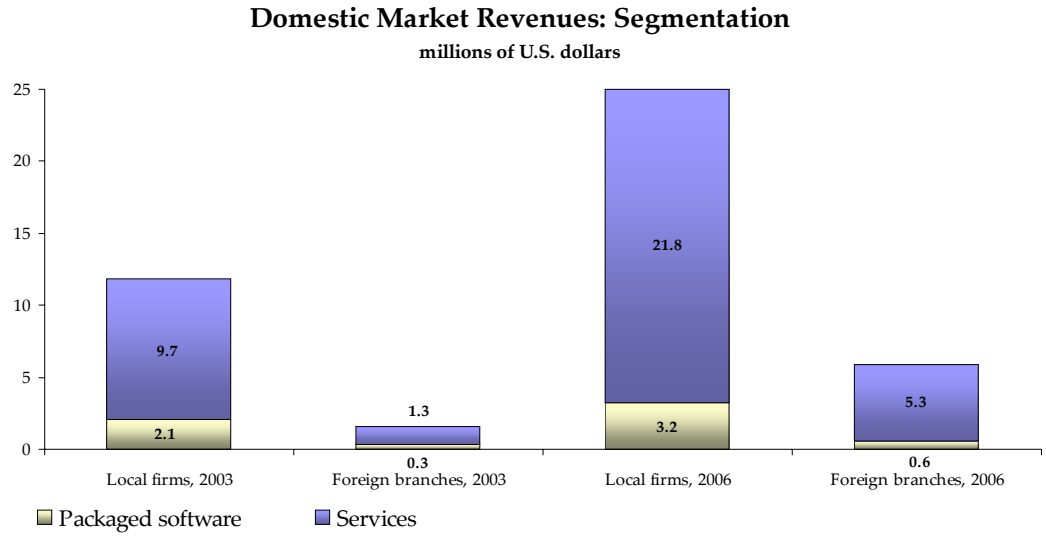
Domestic markets and exports are not distributed equally according to the company ownership geography. Domestic market is dominated by the locally owned companies with 81% share, while foreign branches account for 78% of the exports. This major difference is easily explained by the fact that almost all foreign branches are established by their parent companies as offshore software development locations. In addition, due to the small size of the Armenian market for IT products and services, foreign businesses do not show major interest in expanding their sales in Armenia. Nevertheless, comparison to 2003 demonstrates a slow shift towards a more balanced representation of local and foreign companies in both domestic market and exports. Local companies are increasingly export-oriented: their share increased by 6%; foreign branches are more active in the domestic market: their share rose by 7%.



As the above chart shows, the primary customers of the Armenian software companies, in terms of both number of clients and revenues, are foreign entities. These are essentially private companies (mainly large or sometimes SMEs) because exporting firms are rarely do business with other categories of clients. Although, small firms do implement certain projects for individual clients, these projects have no visible effect on the industry's overall picture. Within the domestic market, main customers are large companies, SMEs, and the Government. Armenian Government still does not play a major role in the market for domestic IT products and services, which is a serious obstacle for IT industry's long-term development.

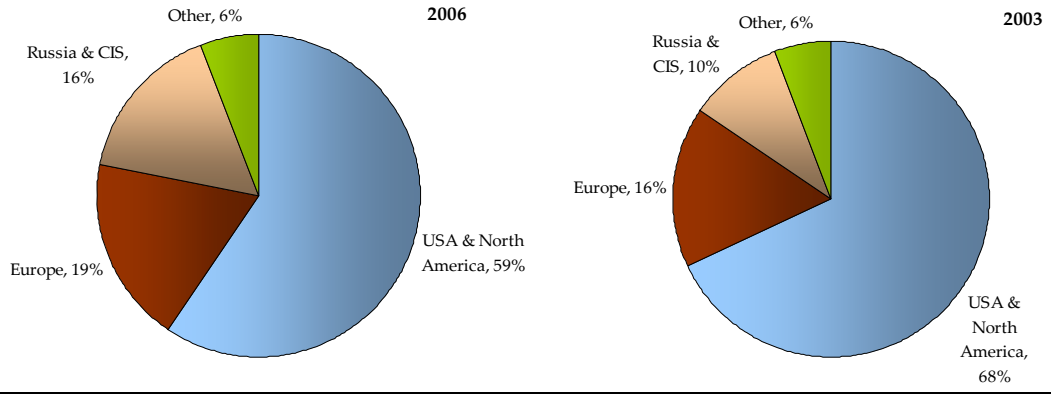
DOMESTIC MARKET

Revenues of IT companies from the domestic market reached $31 million in 2006. Services dominate with their $27 million in revenues, where sizable share goes to ISPs, $9 million. Still, revenues from the domestic market represent only 60% of those generated from the export sales. 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, low demand 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 are enterprise resource planning solutions, e-commerce, web development services, tools for healthcare industry, and distance learning programs.



EXPORTS

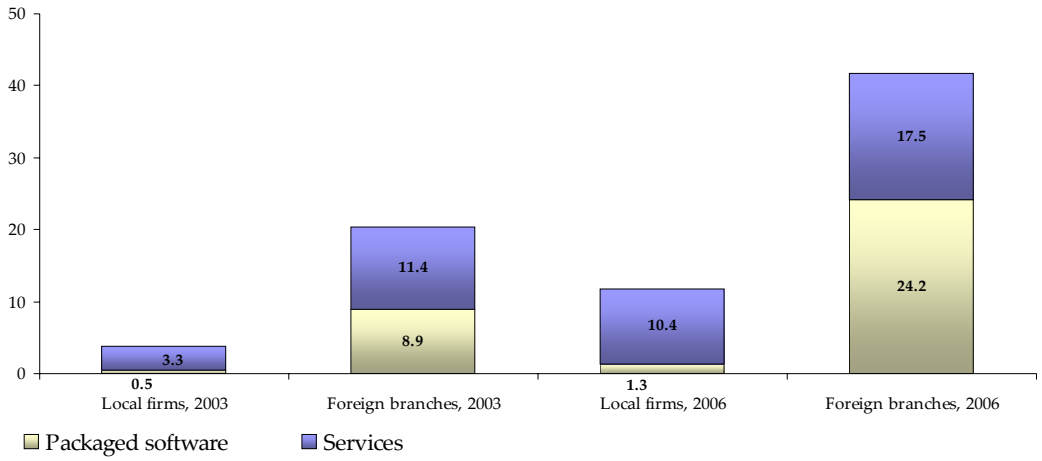
Armenian IT industry exports $52 million of products and services to more than 20 countries. Around 70% of companies are engaged in exports to a various degree: some receive only small portion of their revenues from exports, others are 100% export-oriented. The largest share of exports, nearly 60%, goes to the United States and Canada, the second largest is Europe with around 20%%, and third comes Russia/CIS with 16%. Compared to 2003, exports to Europe and Russia/CIS captured around 10% from the share of exports to North American countries.



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.

Export Revenues: Segmentation

millions of U.S. dollars

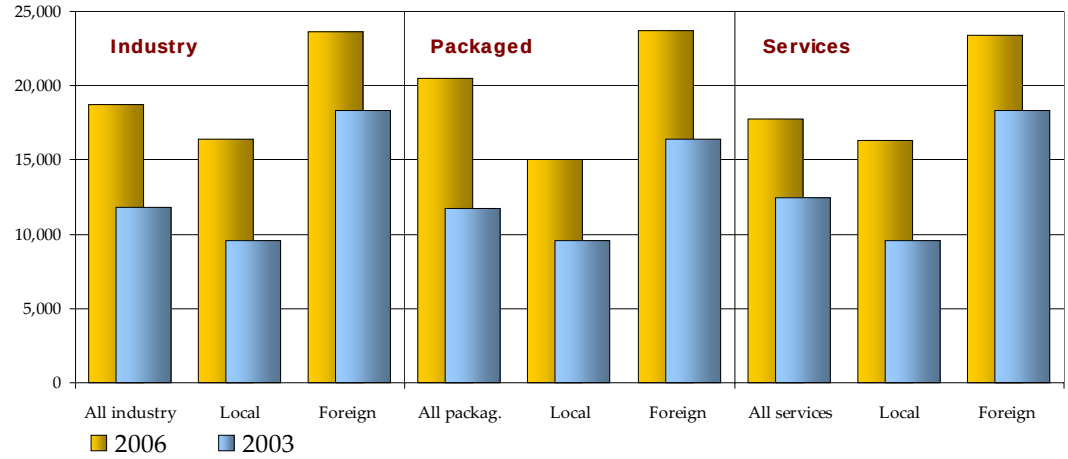


PRODUCTIVITY

Industry average productivity or output per employee in 2006 reached nearly $19,000 representing 17% CAGR from 2003. Local companies showed 20% increase, while foreign braches only 9%. Although local firms are still behind the branches by 30%, they will reach and surpass foreign companies if the current trend continues further. Similar developments occurred with the packaged versus services segments, where former grew at 21% CAGR and the latter at 13%. Although in 2003 it was less than the productivity of the services segment, today output per employee in the packaged segment exceeds that of the services by 15%. This is an important fact, which demonstrates that Armenian IT industry expands in line with the developments in major software markets where packaged segment shows much higher productivity that the services sector.

Industry Segments Productivity

output per employee excluding ISPs, U.S. dollars



As it was mentioned earlier during the discussion of industry revenues, in this case also dollar figures should be used with caution due to the large appreciation of the Armenian Dram, 12% per annum. It may be reasonable to assume that currency appreciation contributed to around 60-70% of increase in the productivity. With this assumption, productivity gains, adjusted for exchange rate fluctuations, would be around 8-9%, which is still considerable for an industry mainly engaged in low to medium-end outsourcing. For example, productivity of the software segment in the United States, the leading IT economy with significant and high-value packaged segment, rose in 2004 at 11%[6]. Nevertheless, productivity rates close to those in the developed nations are not satisfactory for Armenian IT sector, which needs much higher rates in order to sustain its growth and enter higher value-added segments. Armenia does not have the enormous workforce of India or China, and, therefore, should focus on boosting output per employee versus size of the workforce[7].

In 1998-2006, the industry witnessed an increase in nominal productivity rates somewhere around 8% CAGR, which was mostly attributed to export-oriented firms[8]. Such 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 the export-oriented firms, those mainly focused on the local market do not show significant gains in productivity.

There are several major factors responsible for the low productivity of Armenian IT companies:

- small domestic market for software and services and low demand for productivity and sophisticated tools;
- focus on low-end outsourcing services and insufficient concentration on packaged software and other higher value segments;
- shortage of high-end software engineering, project management, and business professionals;
- lack of recognized process management certifications such as CMMI, ISO 9001, and others;
- relatively poor physical infrastructure including telecommunications and internet access;
- insufficient number or lack of specialized support institutions such as venture capital funds, incubators, technoparks, and others.

[6] Source: U.S. Department of Labor, Bureau of Labor Statistics, http://www.bls.gov/

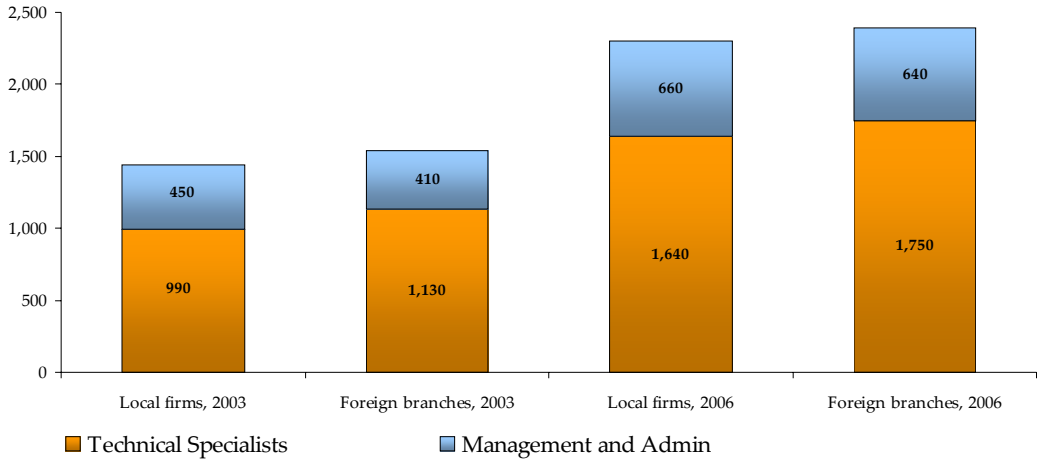
[7] This follows from the basic equation: Revenue = Output per employee x Workforce size

[8] 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.

WORKFORCE

In 2006, total workforce employed by the IT sector reached around 4,700 specialists. This represents nearly 17% CAGR from 2003 and approximately 21% from 1998[9]. Primary factor behind the recent decline in the workforce growth rate is the inadequate capacity of educational institutions that are not capable of meeting the growing demand of the IT industry in qualified graduates. Around 70% of the workforce are technical specialists such as software engineers, analysts, developers, project managers, and others. Ratio of technical staff to management/admin employees is just about the same as it was in 2003 implying that there was a little increase in an average company size. Local and foreign companies each employ approximately 50% of the total workforce; almost no change from 2003. Management and business professionals represent 15% of the total. Males and females account for 72% and 28% of the workforce respectively. Percent of females employed by the IT sector in Armenia is slightly higher compared to the U.S. (26.6%, 2005)[10] and is almost twice as that in the UK (15%, 2006)[11].

Workforce Distribution: Specialty and Company Ownership



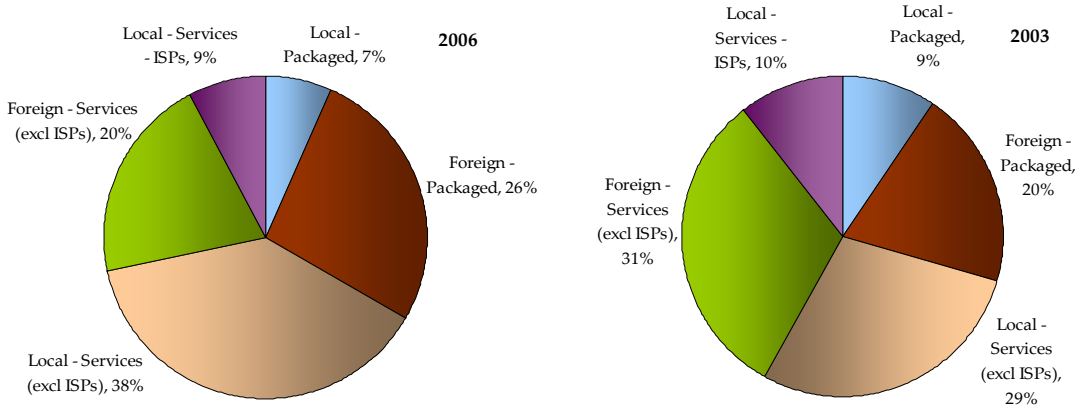
On average, an IT company employs 29 people (4700/160), a slight change from 2003, 27 (3000/110). An average Armenian IT firms has 21 technical specialists, 4-5 business people, and 3-4 support staff. Such a company, in comparison to 2003, has slightly more tech staff, almost two times more business people, and about 30% less support staff. Obviously, now companies pay more attention to management and business related issues. This is good news for the industry because the number of

[9] 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.
[10] Source: U.S. Department of Labor: Bureau of Labor Statistics, http://www.bls.gov
[11] Source: http://www.computing.co.uk , "IT industry is losing the feminine touch"

business professionals is on the rise, which presumably should lead to higher productivity, increased sales, and other positive effects for the sector. Average local company in 2006 employs 21 people, which is 20-25% more than it was in 2003. On the other hand, an average foreign braches today has around 20% less employees.

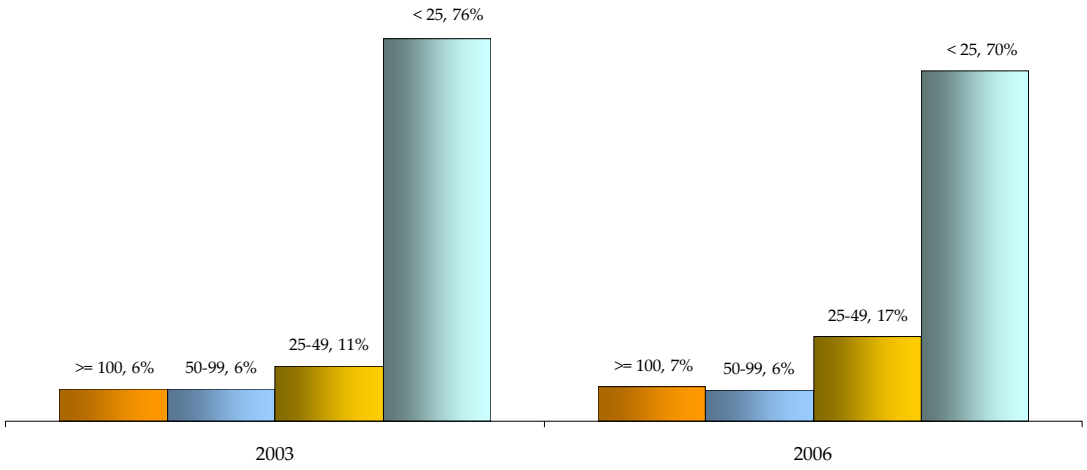
Most of the workforce, nearly 3,150 individuals, is concentrated in the services segment. Around 410 of them work for internet service providers. Workforce distribution within the services segment, as below chart shows, has changed slightly from 2003: more people work for local companies and less for foreign branches. Opposite picture is in the packaged segment.

Workforce Distribution: Segments and Company Ownership



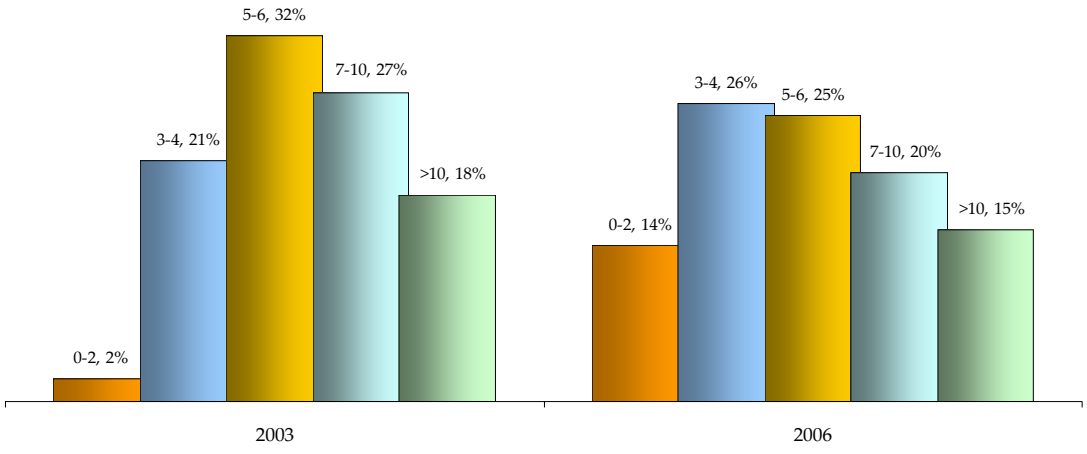
Distribution of companies according to their staff size in 2006 is very close to that of in 2003. As before, the number of specialists employed by the firms varies significantly within the industry. Only 7% of all businesses employ 100 or more specialists, while 70% has less than 25 employees. These largest 7% of companies employ more than 1,800 people constituting nearly 40% of the total workforce. On the other hand, firms with less than 25 people employ in total close to 1,300 specialists, which is around 30% of the workforce. Thus, distribution of companies according to the workforce size is skewed considerably towards small businesses, which is one of the factors negatively affecting industry's productivity.

Company Size Distribution



Around 60% of the IT workforce has over 5 years of experience, which is lower compared to 2003 figures. Today, a larger number of new graduates and students are employed by both local and foreign companies leading to a decline in average years of experience. The number of certified professionals within the industry is relatively low; only 5% of the technical staff has some type of a professional qualification from leading vendors such as Microsoft, Oracle, Sun, and others.

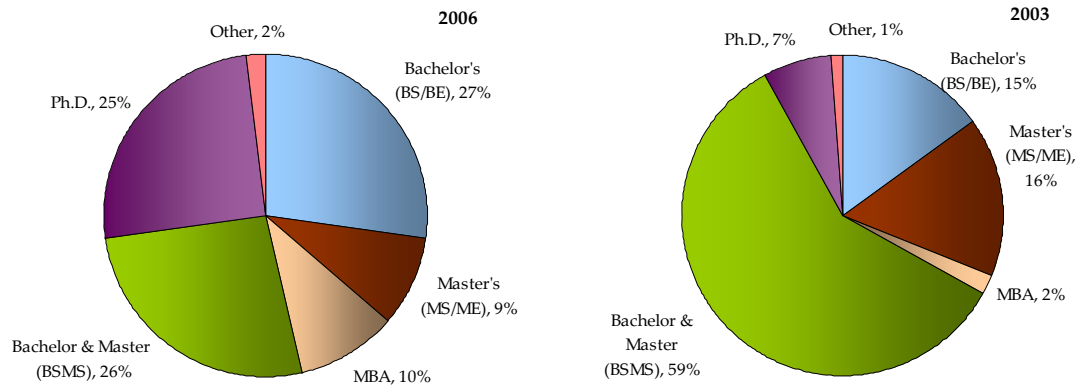
Employee Average Experience



Compared to 2003, share of employees with 5-year Bachelor & Master of Science (BSMS) degree decreased considerably, while number of those with Bachelor's and Ph.D. increased. This drastic change is the result of the adoption by major universities of a western 4-year system of education leading to new hires having primarily Bachelor's degrees. In addition, in Armenia, due to a number of reasons, it is common to acquire a Ph.D., which explains the rise in share of Ph.D.s within

the total workforce. Another important factor is the 8% increase in the number of employees with MBA and other business degrees.

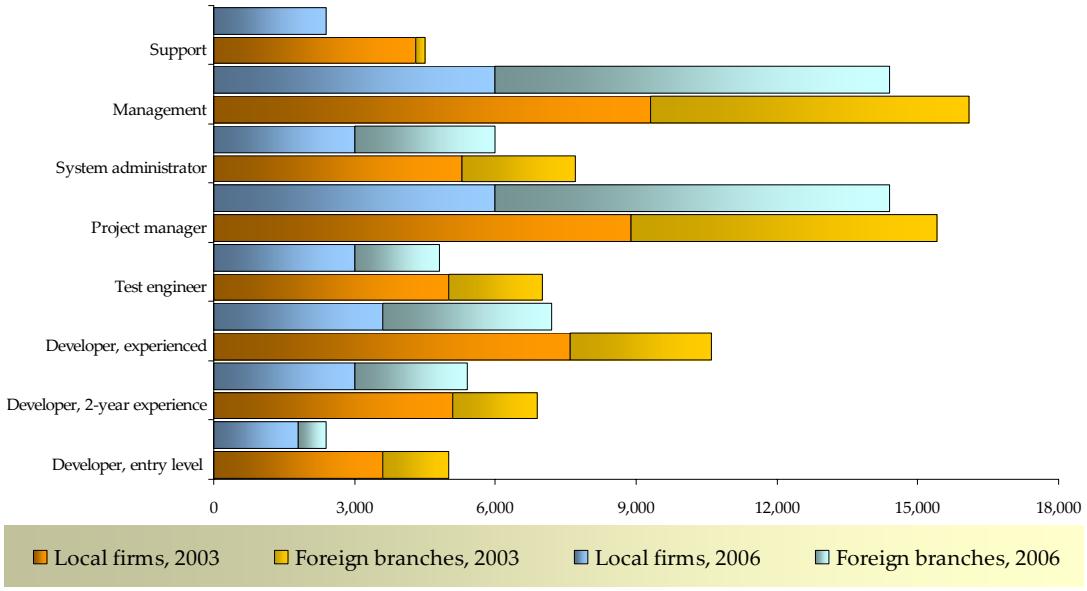
Employee Educational Background



Armenia has been chosen as an offshore development destination by the foreign companies partly because of its inexpensive and highly productive labor. However, due to low supply of qualified specialists and appreciation of the local currency (12% CAGR), salary costs have increased considerably over the last 3 years. On average, salary costs per one employee have increased at 9% CAGR for foreign branches and 19% for local firms.

Employee Average Gross Annual Salaries

U.S. dollars



Dollar salaries are of primary concern to export-oriented companies; their profit margins shrink as costs (incurred in Drams) rise at higher rates than do revenues

(received in U.S. Dollars or Euros). Armenia is still considered to be a low-cost offshore development location, where salaries are competitive with those of many IT outsourcing countries such as India, Russia, Israel, Ireland, and China. Nevertheless, economic forces behind the appreciation of Armenian Dram and poor capacity of educational institutions may have serious negative impact on the cost effectiveness of Armenian software firms and overall competitiveness of the sector.

EMPLOYEE DEVELOPMENT

On average, around 20-25% of technical and business specialists received training in 2006. Still, training budgets are very low accounting for less than 5% of the companies' total turnover. Training of the personnel, in many cases, is conducted with the help of various agencies such as EIF, USAID, and others.

There are differences for employee development 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. Employees of certain 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. Staff training is 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.

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].

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

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. CMMI and ISO certifications are becoming widely recognized in Armenia: 2 outsourcing companies have already been elaborating on the implementation of CMMI Level 3.

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. Other issues are weak commercialization mechanisms and modest cooperation between the industry and research organizations.

In 2006, around 35% of companies were involved in some kind of an R&D related activity. Total R&D expenditures amounted to nearly 10% of the industry's turnover.

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) and Yerevan State University (YSU) are the oldest and largest institutions developing engineering professionals for the computer industry. Other institutions active in the IT education include American University of Armenia (AUA), European Regional Institute of Information and Communication Technologies in Armenia (ERIICTA), and Russian-Armenian (Slavonic) University

State Engineering University of Armenia is the successor of Yerevan Polytechnic Institute established back in 1933. The university offers a number of degrees in many fields of engineering, science, and technology, and it is the primary educational institution preparing engineering specialists in Armenia. It has several branches in other cities of Armenia. Number of students today is around 11,000; estimated number of all graduates is more than 100,000. SEUA began teaching computer related courses starting from 1960 when the Department of Cybernetics, Computer Systems, and Radio Engineering was launched. Later each of these areas has become separate departments and together they now educate more than 2,500 engineering students. Today, Department of Computer Systems offers several specializations in computer and hardware design, software engineering, electronics and chip design, automated control systems, and others. SEUA conducts R&D in a variety of areas such as CAD systems, neural networks, solid-state physics, superconductivity, electromagnetic fields, circuit analysis, and other areas[13].

Yerevan State University offered its first classes in 1920. Today, it is the largest educational institution in Armenia with more than 13,000 students and estimated number of all graduates reaching 90,000. YSU offers degrees in a wide range of disciplines including biology, economics, history, languages, law, mathematics, physics, and other areas. Department of Physics and Mathematics was established back in 1924; later, in 1971, Department of Informatics and Applied Mathematics was founded. These mathematics departments offer majors in such IT related areas as algorithmic languages, cybernetics, discrete math, system programming and modeling, and others.[14]

[13] Source: SEUA, http://www.seua.am
[14] Source: YSU, http://www.ysu.am

American University of Armenia (AUA), an affiliate of the University of California, was established in 1991 as a graduate university based on the U.S. system of education. AUA offers degrees in Master's degrees in Business Administration, Computer and Information Science, Industry Engineering, Law, and other areas. AUA conducts research in such fields as business, engineering, environmental management, healthcare, law, and policy through its several research centers[15]. European Regional Institute of Information and Communication Technologies in Armenia (ERIICTA), established by the European Union, offers degrees in Software Engineering and IT Business Management. Russian-Armenian (Slavonic) University, 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 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

26 educational institutions with more than 850 faculty members are involved to a various degree in IT related education[16]. 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.

[15] Source: AUA, http://www.aua.am
[16] CAPS/USAID, "IT Workforce Supply Assessment", 2006; http://www.caps.am

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.

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:

- Interdepartmental Chair of "Microelectronic Circuits and Systems" established by LEDA Systems (acquired in 2004 by Synopsys Inc.) and SEUA. The Chair, now part of Synopsys University Program, supplies more than 60 high-quality VLSI and EDA specialists each year[17].

- Internet and web technologies laboratories established by Lycos Europe and EIF 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, mainly concentrating on the preparation of quality professionals for several companies and industry in general.

STUDENTS

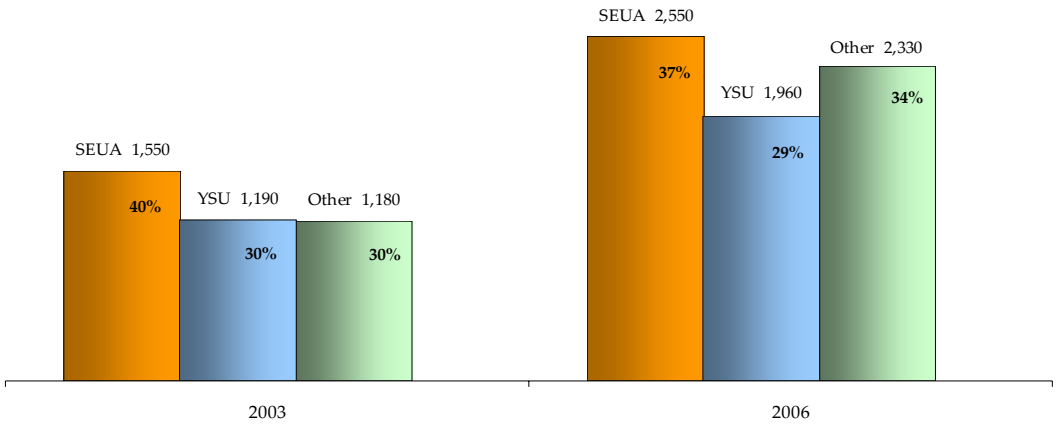
In 2006, nearly 7,000 students were enrolled in various IT related fields Armenian universities[18], a 75% increase from 2003. Around 70% of all these students study at SEUA and YSU. Foreign students from Europe, Russia & CIS, Middle East, and other countries study in Armenia, and their number is growing over time. Overall quality of the enrollees has been improving for the last 3-5 years. Admissions to IT departments are very rigorous, especially in case of SEUA and YSU. Programming,

[17] Source: SEUA, http://www.seua.am
[18] EIF estimates

information and applied mathematics, automated control systems and microelectronics are the most popular majors for applicants.

Student Distribution by Universities

IT related majors



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.

TRAINING CENTERS

There are numerous training centers in Armenia with the majority offering IT courses, including vendor specific such as Microsoft certifications. In 2006, around 7,200 individuals were trained in IT related areas[19], a 60% rise from 2003. 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 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.

[19] EIF estimate based on figures from CAPS/USAID "IT Workforce Supply Assessment" report

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), 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 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. Information technology is considered by the Government as an important area for international cooperation. Various projects are initiated in this area: the European Regional Institute of Information and Communication Technologies in Armenia (ERIICTA), which was established with the financial assistance from the European Union; Competitive Armenian Private Sector Program (CAPS), a program funded by the United States Agency for International Development and implemented by Nathan Associates in cooperation with J. E. Austin Associates.

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.

INDUSTRY PROSPECTS

Armenian IT industry has been growing at 31% CAGR from 1998 to 2006. If this trend continuous further, the industry will reach around $250 million in total revenues by 2010. However, during the last three years sector growth was greatly influenced by the appreciation of Armenian Dram. The majority of the companies, for example foreign branches, operate as cost centers or cost-based outsourcers / customized developers. Consequently, company revenues are considerably affected by operating expenses, which are incurred primarily in local currency. While nominal growth of the industry in 2003-2006 was 31%, Armenian Dram appreciated at approximately 12% CAGR. Thus, growth adjusted for fluctuations in the exchange rate would be presumably somewhere around 20-25% for 2003-2006, which corresponds to $180-210 million in sector revenues by 2010. In the below scenarios, we assume no large fluctuations in the exchange rate.

OUTLOOK SCENARIOS

In 2003-2006, workforce grew at 16-17% CAGR; productivity, after adjusting for exchange rate fluctuations, increased at 8-9% CAGR. Based on these initial conditions, we developed three industry growth scenarios for the period from 2007 to 2010.

Regression scenario assumes that workforce and productivity growth rates will be lower than those in 2003-2006: 12% and 5% respectively. In that case, the number of specialists in 2010 will reach around 7,400 people; industry will generate nearly $160 million in revenues, representing 17-18% CAGR. Increased shortage in qualified specialists, relatively slow increase in productivity, and rising operating costs will make Armenia less attractive for foreign companies and local entrepreneurs in terms of starting new IT businesses, thus contributing to the further decline in the industry's growth rates.

No-change scenario assumes that workforce and productivity will grow at the same rates as those in 2003-2006: 16% and 8% respectively. In 2010, workforce size will reach around 8,500 professionals; industry will generate $210 million in revenues, representing close to 25% CAGR. With a yearly increase in the number of IT graduates equal to the current rates of 15-20% CAGR, it is highly probable that the workforce will be capable of achieving the projected size. However, industry may face declining productivity growth rates, because the current low-end outsourcing model does not offer major long-term gains in profitability and value creation.

Expansion scenario assumes higher rates: 20% for workforce and 10% for productivity. In this case, workforce reaches 9,700 specialists in 2010; industry turnover nears $260 million, or 32% CAGR. However, with today's preconditions such as low quality of education, poor infrastructure, low-end revenue generation

model, this scenarios does not seem highly probable. Major changes to the current IT and educational sectors' development models are required in order to achieve and sustain industry real growth rates of 30% or higher.

RECOMMENDATIONS

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 reach higher than historical growth rates. Various measures, therefore, should be implemented in order to increase 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 further. 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 Synopsys and Lycos/EIF could provide additional influx of high-quality software talent.

Increase Supply of Business Specialists

Particular consideration should be given 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's and Master's 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 growth rates. A number of actions from the Government and the private sector are required to address various issues affecting productivity growth. Many external and internal factors influence productivity growth: external aspects are mostly related to the industry-wide and global issues and are of concern primarily to the Government; internal factors are affecting companies' internal operations and, therefore, important, for the private sector.

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 readiness of the Government to support its declaration of IT as a priority sector of the economy.

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

Establishment of software hubs, technoparks, incubators, and VC firms should be promoted. Epygi, Viasphere Technopark, SolarEn, 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 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 outsourcing company in Armenia 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 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 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 creation of IT infrastructures, which are not commercially profitable for any single company but which may have significant potential in creating commercial applications.

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.

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

1. ARMENIA, KEY FACTS

Republic of Armenia or "Hayastani Hanrapetutyun" in Armenian (Հայաստանի Հանրապետություն), formerly one of the fifteen Soviet republics, declared its independence on September 21, 1991. Capital and the largest city is Yerevan.

GEOGRAPHY

Armenia is located in the South Caucasus region of Eurasia continent. Border countries are Azerbaijan (east and southwest), Georgia (north), Iran (south), and Turkey (west). 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, continental with hot summers and moderate to cold winters.

POPULATION

Population is around 3.2 million as of 2002 with approximately 67% residing in cities and towns. Armenian is the official language. Armenians are fluent in Russian, and many, especially in Yerevan, are also proficient in English. The population of Armenia is highly educated with 98% literacy rate for residents over 15 years old. Educational system of Armenia has two levels, which includes secondary and higher educational institutions. The largest universities are Yerevan State University and State Engineering University. Armenia was the first country to officially adopt Christianity as its state religion in 301 A.D.

GOVERNMENT SYSTEM

Armenia is an independent democratic state with the president as the head of the state. The president is elected by the citizens of Armenia for a five-year term and maximum of two consecutive terms. Robert Kocharian was elected the President of Armenia on March 30, 1998 and re-elected on March 05, 2003. The president appoints the prime minister and members of the Government. The National Assembly, parliament of Armenia and the legislative body, has 131 members who are elected for four-year terms.

ECONOMY

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 2006 Index of Economic Freedom[20] compiled by the Heritage Foundation and the Wall Street Journal, Armenia is the 27th freest economy in the world along with Japan.

MAIN ECONOMIC INDICATORS[21]

	2003	2004	2005	2006
Gross Domestic Product, billions of U.S. dollars	$2.80	$3.56	$4.87	$6.41
Real GDP growth, % change over previous year	13.9%	10.1%	13.9%	13.4%
Inflation, annual average	4.7%	7.0%	0.6%	2.9%
Unemployment rate, end of year	9.8%	9.4%	8.1%	7.4%
Average wage, annual mean, U.S. dollars	$674	$980	$1,365	$1,846
Exports of goods, FOB, billions of U.S. dollars	$0.68	$0.72	$0.95	$1.00
Imports of goods, CIF, billions of U.S. dollars	$1.27	$1.35	$1.77	$2.20
Exchange range USD/AMD, period average	578.80	533.45	457.69	416.04

BUSINESS ENVIRONMENT

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 carry forward indefinitely 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,

[20] Source: the Heritage Foundation, www.heritage.org/research/features/index.
[21] Source: the Central Bank of Armenia, www.cba.am.

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.

Key Indicators for Opening and Operating a Business in Armenia[22]

Indicator	Armenia	Europe & Central Asia	OECD Countries
Starting a Business: Time (days)	24	32.0	16.6
Starting a Business: Cost (% of national income/person)	5.1	14.1	5.3
Registering Property: Time (days)	4	102.0	31.8
Registering Property: Cost (% of property value)	0.4	2.7	4.3
Hiring Cost (% of salary)	17.5	26.7	21.4
Firing Costs (weeks of wages)	13.0	26.2	31.3
Enforcing Contracts: Time (days)	185.0	408.8	351.2
Enforcing Contracts: Cost (% of debt)	14.0	15.0	11.2

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).

TELECOMMUNICATIONS INFRASTRUCTURE

The primary provider of telecommunication services in Armenia is Armenia Telephone Company or ArmenTel, which is owned by one of the Russia's largest mobile operators VimpelCom (NYSE: VIP). ArmenTel's channels include fixed line communications network, cellular phone network (GSM 900), international and satellite channels. Second GSM operator Viva Cell started its operations in July 2005.

[22] Source: The World Bank's Doing Business database, http://www.doingbusiness.org

Armenia is connected to the global telecommunication networks via 1,200 digital circuits including satellite, fiber optic, and radio channels. Satellite communication is provided by two earth stations via Intelsat and Express. Fiber optic communication is implemented through TAOS (Trans Armenia Optical System), which connects to GOPH (Georgian Optical Highway) and then to Russian and European channels via BSFOCS (Black Sea Fiber Optic Cable System). Current phone network allows calls to more than 200 countries and geographical locations[23]. A number of ISPs offer internet access services including dial-up, DSL, fiber optics, ISDN, radio modem, satellite, Wi-Fi, and WiMAX.

BANKING, CURRENCY, PAYMENTS[24]

There are 21 commercial banks operating in Armenia providing services through 300 branches (December 2006). The official currency is Armenian Dram (currency code AMD). The average exchange rate for 2006 was 416 Armenian Drams to 1 United States Dollar. All banks and the majority of hotels accept credit cards such as Visa and MasterCard.

INTERNATIONAL ORGANIZATIONS

Armenia has a membership in a number of international organizations, agreements, and treaties including Commonwealth of Independent States (CIS), Council of Europe (CE), Economic Commission for Europe (ECE), International Monetary Fund (IMF), Interpol, International Atomic Energy Agency (IAEA), International Civil Aviation Organization (ICAO), International Fund for Agricultural Development (IFAD), International Organization for Standardization (ISO), International Telecommunications Union (ITU), Organization for Security and Cooperation in Europe (OSCE), United Nations (UN), Universal Postal Union (UPU), World Bank (WB), World Health Organization (WHO), World Intellectual Property Organization (WIPO), World Trade Organization (WTO), and others.

MISCELLANEOUS

Power Supply: 220 V / 50 Hz.
Telephone Calls: country international dialing code is +374; for Yerevan +374 10.
Time Zone: Greenwich Mean Time (GMT) plus 4 hours.
Weights & Measures: metric system.
Working Hours: common hours are 9:00 to 18:00 with lunch from 13:00 to 14:00. Saturdays and Sundays are not working days.

[23] Source: ArmenTel, http://armentel.com/eng/international/
[24] Source: Central Bank of Armenia, http://www.cba.am

2. SCIENCE AND TECHNOLOGY IN ARMENIA, TIMELINE

Year	Soviet Armenia organization established or event occurred
1920	Yerevan State University (YSU)
1924	Department of Physics and Mathematics at YSU
1933	Yerevan Polytechnic Institute (State Engineering University of Armenia, SEUA)
1935	Armenian branch of USSR Academy of Sciences
1942	Yerevan Physics Institute
1943	Armenian Academy of Sciences (National Academy of Sciences, NAS)
1946	Byurakan Astrophysical Observatory
1955	NAS Institute of Mechanics
1956	Yerevan Scientific Research Institute of Mathematical Machines (YerSRIMM)
1957	Institute of Informatics and Automation Problems
1958	"Transistor" semiconductor R&D and manufacturing plant
1959	First generation computer "Aragats" on vacuum tubes at YerSRIMM
1960	NAS Institute of Radiophysics and Electronics Department of Cybernetics at SEUA
1961	Second generation computer "Razdan" on semiconductors at YerSRIMM
1963	Development of microprogrammed computers "Nairi" at YerSRIMM
1964	"Sirius" radioelectronics plant in city of Abovyan
1965	"Posistor" microelectronics factory in city of Abovyan
1966	Institute of Microelectronics, Scientific Research, and Technology
1967	NAS Institute of Physical Research
1971	NAS Institute of Mathematics Department of Informatics and Applied Mathematics at YSU
1972	Department of Radio Engineering at SEUA
1973	ES-1030 computer (IBM 360/370) at YerSRIMM
1976	"Nairi-3" computer with shared usage capabilities at YerSRIMM
1978	Yerevan Telecommunications Research Institute ES-1045 computer (IBM 360/370) at YerSRIMM
1979	Department of Calculating Techniques (Computer Systems) at SEUA
1980	NAS Institute of Applied Problems of Physics
1981	"Nairi-4" computer (PDP compatible) at YerSRIMM
1984	ES-1046 computer (IBM 360/370) at YerSRIMM SEUA branches in cities of Kapan and Goris
1986	Ashtarak semiconductor and electronics manufacturing plant ($120 million investment)
1987	First Armenian private IT firm "Armenian Software"
1988	"Mars" integrated circuits and electronics manufacturing plant ($300 million investment)
1990	NAS engineering center "Mashtots" (atomic optics, thin film physics)

Year	Independent Armenia organization established or event occurred
1991	Armenia declares independence on September 21 American University of Armenia (AUA)
1992	Yerevan Automated Control Systems Scientific Research Institute (YerACSSRI) Arminco (leading ISP in Armenia)
1994	MSHAK (Armenia's leader in CNC systems and tools)
1995	HPL (U.S., yield management software; acquired by Synopsys in 2005) ArmenTel (Armenia's leading telephone company)
1997	Russian-Armenian (Slavonic) State University
1998	Acquisition of ArmenTel by Greek telecom OTE Credence Systems (U.S., semiconductor design-to-test solutions) Representative offices: Alcatel, Siemens AG
1999	Virage Logic (U.S., advanced embedded memory IP)
2000	Union of Information Technology Enterprises (UITE, Armenian IT association) Viasphere Technopark (U.S., commercial technology park) LEDA Systems (U.S., digital standard cells and I/O libraries; acquired by Synopsys in 2004) Epygi Technologies (U.S., IP PBXs)
2001	"Microelectronic Circuits and Systems" chair at SEUA in cooperation with LEDA Systems ICT Master strategy and Information Technologies Development Support Council (ITDSC) European Regional Institute of Information and Communication Technologies in Armenia (ERIICTA)
2002	Enterprise Incubator Foundation Lycos Europe (Germany, pan-European online network)
2003	EPAM Systems (U.S., global offshore software development firm)
2004	Synopsys Inc. (U.S., world leader in semiconductor design software) CQG (U.S., analytics software and trading solutions)
2005	VivaCell (second mobile operator in Armenia) Luxoft (Russia's leading software development firm)
2006	Microsoft Corporation, representative office Acquisition of ArmenTel by Russian mobile operator VimpelCom

3. FDI CASE: SYNOPSYS INC., UNITED STATES

Synopsys, Inc. (NASDAQ: SNPS) is a world leader in delivering semiconductor design software, intellectual property (IP), design for manufacturing (DFM) solutions and professional services that companies use to design systems-on-chips (SoCs) and electronic systems. Founded in 1986, Synopsys is headquartered in Mountain View, California. In 2006, company generated revenues of $1.1 billion and employed 5,100 people worldwide.

The company established its presence in Armenia in 2004, shortly after Armenia's declaration of IT as a priority sector of the national economy. Since then, Synopsys Armenia has become one of the largest company sites outside the U.S. providing R&D and product support in areas of EDA, DFM, and development of semiconductor IP. Currently, the company employs more than 400 qualified Armenian engineers serving as the industry's flagship and one of the largest IT employers in Armenia. Synopsys Armenia's main activities include development of EDA tools, design of standard cell libraries, IPs and ICs, support to IC fabrication, university programs, and charitable activities.

Reasons for selecting Armenia as the company's major offshore development office include

- Cost-effective market environment,
- Stable, democratic, and market oriented Government,
- Development of Information Technology industry is a key economic objective,
- Reliable electricity, water, and transportation system (short driving distances within Yerevan, capital of Armenia),
- Strong tradition of the engineering excellence,
- Availability of skilled and talented engineers and software developers.

Key facts about company's operations in Armenia:

- Synopsys is the largest IT employer in Armenia with more than 400 employees.
- In the past two years, the company has nearly tripled the number of engineering jobs in the Armenian branch.
- Armenia is among Synopsys' largest sites outside the United States and is the fastest growing one.
- Armenian engineers had delivered several releases of software and chip designs that generated revenue for Synopsys.
- Synopsys is now investing in a new state-of-the-art consolidated site.
- Company's Educational Center provides world-class engineering education and training to around 240 students.

Synopsys heavily invests in IT education and implements a number of pioneering and successful programs with the major Armenian universities including State Engineering University of Armenia, Yerevan State University, American University of Armenia, and Moscow Institute of Electronic Technologies. As a good corporate citizen, the company undertakes unparalleled efforts in consistently promoting public interest towards the IT industry through sponsorship of Presidential Awards for the best students, professional contests among young professionals and students, media campaigns, charity and volunteer activities.

http://www.synopsys.com

4. UITE, ARMENIAN IT ASSOCIATION

The Union of Information Technology Enterprises (UITE) is the primary IT Association in Armenia. It was formed in 2000 as a non-profit association of ICT companies operating in the Republic of Armenia. UITE was established by the private sector to consolidate industry's advocacy efforts, facilitate business, and encourage advancement of research in the ICT sector. Member firms are involved in offshore development, Internet applications, e-commerce, IT services, chip design, and other areas. Several UITE members are global players with office locations all over the world. From May 2004, UITE is a member of World Information Technology and Services Alliance (WITSA).

UITE is involved in a variety of activities such as:

- advocacy of member interests,
- organization of trade shows and programming contests,
- workforce development through custom training programs,
- design of online information and collaboration portals on IT sector,
- conducting industry surveys and research,
- assisting its members with business development.

UITE leads a number of policy related initiatives aimed at the development of ICT sector in Armenia. As part of these initiatives, the association formed seven working groups, which will formulate Armenian ICT sector development strategic plans and activities. Groups cover different areas vital to the sector development including regulatory environment and advocacy, ethics, global marketing and promotion of the industry, education and workforce development, telecommunications infrastructure, domestic ICT market development.

One of the key events organized by the association is the annual DigiTec Expo technology tradeshow, which was first held in September 2005 in Yerevan. The exhibition attracts a variety of domestic and foreign businesses, educational institutions, and other organizations active in the ICT sector. 2005 and 2006 events together hosted nearly 100 exhibitors and welcomed around 30,000 visitors from

various countries. Several major corporations participated in the tradeshow including HP, Microsoft, Mitsubishi Electric, National Instruments, Synopsis, Sun Microsystems Inc., and Virage Logic.

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5. 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.

Enterprise Incubator provides a comprehensive package of services via its two major components:

Business Services focuses on assisting Armenian technology firms in a variety of areas including business development, marketing and promotion, management, accounting and finance, legal, and other areas vital to the success of a company. Business Services unit helps existing companies in growing their businesses within Armenia and internationally, facilitates the development of start-ups, and assists local entrepreneurs in building their ideas into successful businesses. As part of our assistance, we help companies to improve professional and business skills of the employees and managers via provision of short-term advanced trainings and seminars and creation of learning partnerships within the industry and the universities.

Facility Services component provides high-end facilities to existing technology companies and newly created start-ups. Options included in the base package are high-quality office space, shared meeting and conference rooms, shared resource center with access to literature and other information resources, high-speed Internet connection, receptionist and security, cleaning and utilities, parking, and 24/7 access to the building. Our facilities are located at the premises of the Russian-Armenian (Slavonic) University, one of the major educational institutions in Armenia.

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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6. 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 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 and 2006. All monetary units are in the United States dollars.
Report uses information and data from EIF studies and surveys conducted in cooperation with the following Armenian companies: Broncoway, Development Programs, Economy and Values Research Center, and Finconsult.

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, multimedia applications; chip and IP design; 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.

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

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. Our calculations do not include hardware and high-tech companies, as well as temporary donor-funded software projects for the Government.

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 a better picture of the productivity, it complicates the forecasting of the industry's growth. Therefore, industry projections are estimated using the first set of figures. Productivity calculations for 2006 were made only for software development companies because significant differences exist between these firms and ISPs in terms of how their revenues are generated. Productivity numbers could be also weighted by either company revenues or their employee size. However, in this case we would get output per employee numbers that are slightly biased towards the more productive companies in the first case and less productive in the second.

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.

7. INDUSTRY STATISTICS

Industry Revenues, millions of U.S. dollars	2006	% from Industry	2003	% from Industry	% change 2006/2003	CAGR 2006/2003
Industry	$84.2	100%	$37.7	100%	123%	30.7%
Local firms	$36.7	44%	$15.8	42%	132%	32.4%
Foreign branches	$47.6	57%	$22.0	58%	116%	29.3%
Domestic market	$30.9	37%	$13.5	36%	129%	31.8%
Local firms	$25.0	30%	$11.9	32%	110%	28.1%
Packaged software	$3.2	4%	$2.1	6%	52%	15.1%
Services	$21.8	26%	$9.7	26%	125%	31.0%
ISPs	$7.7	9%	$5.2	14%	48%	14.0%
Foreign branches	$5.9	7%	$1.6	4%	269%	54.5%
Packaged software	$0.6	1%	$0.3	1%	100%	26.0%
Services	$5.3	6%	$1.3	3%	308%	59.8%
ISPs	$1.3	2%	$0.6	2%	117%	29.4%
Exports	$53.3	63%	$24.2	64%	120%	30.1%
Local firms	$11.6	14%	$3.9	10%	197%	43.8%
Packaged software	$1.3	2%	$0.5	1%	160%	37.5%
Services	$10.4	12%	$3.3	9%	215%	46.6%
Foreign branches	$41.7	50%	$20.3	54%	105%	27.1%
Packaged software	$24.2	29%	$8.9	24%	172%	39.6%
Services	$17.5	21%	$11.4	30%	54%	15.4%
Packaged software	$29.2	35%	$11.9	32%	145%	34.9%
Local firms	$4.5	5%	$2.7	7%	67%	18.6%
Foreign branches	$24.8	29%	$9.3	25%	167%	38.7%
Services	$55.0	65%	$25.8	68%	113%	28.7%
Local firms	$32.2	38%	$13.1	35%	146%	35.0%
Foreign branches	$22.8	27%	$12.7	34%	80%	21.5%
Domestic market	$30.9	37%	$13.5	36%	129%	31.8%
Packaged software	$3.8	5%	$2.5	7%	52%	15.0%
Services	$27.1	32%	$11.0	29%	146%	35.1%
Exports	$53.3	63%	$24.2	64%	120%	30.1%
Packaged software	$25.4	30%	$9.5	25%	167%	38.8%
Services	$27.9	33%	$14.8	39%	89%	23.5%

	2006	% from Industry	2003	% from Industry	% change 2006/2003	CAGR 2006/2003
Number of Companies						
Industry	160	100%	110	100%	45%	13.3%
Local firms	112	70%	86	78%	30%	9.2%
Foreign branches	48	30%	24	22%	100%	26.0%
Company Ownership Geography						
Industry	160	100%	110	100%	45%	13.3%
Armenia	112	70%	86	78%	30%	9.2%
USA & North America	32	20%	15	14%	113%	28.7%
Europe	11	7%	4	4%	175%	40.1%
Russia & CIS	4	3%	4	4%	0%	0.0%
Other	1	1%	1	1%	0%	0.0%
Exports Geography						
Industry	53.3	100%	24.2	100%	120%	30.1%
USA & North America	31.7	59%	16.5	68%	92%	24.3%
Europe	9.9	19%	4	17%	148%	35.3%
Russia & CIS	8.6	16%	2.3	10%	274%	55.2%
Other	3.2	6%	1.4	6%	129%	31.7%
Productivity (output per employee excluding ISPs), U.S. dollars						
Industry	$18,700	100%	$11,800	100%	58%	16.6%
Local firms	$16,400	88%	$9,600	81%	71%	19.5%
Foreign branches	$23,600	126%	$18,300	155%	29%	8.8%
Packaged	$20,500	110%	$11,700	99%	75%	20.6%
Local firms	$15,000	80%	$9,600	81%	56%	16.0%
Foreign branches	$23,700	127%	$16,400	139%	45%	13.1%
Services	$17,800	95%	$12,500	106%	42%	12.5%
Local firms	$16,300	87%	$9,600	81%	70%	19.3%
Foreign branches	$23,400	125%	$18,300	155%	28%	8.5%

Workforce Distribution	2006	% from Industry	2003	% from Industry	% change 2006/2003	CAGR 2006/2003
Industry	4,690	100%	2,980	100%	57%	16.3%
Technical specialists	3,390	72%	2,120	71%	60%	16.9%
Management and administrative	1,300	28%	860	29%	51%	14.8%
Packaged software	1,540	33%	870	29%	77%	21.0%
Local firms	310	7%	280	9%	11%	3.5%
Foreign branches	1,230	26%	590	20%	108%	27.7%
Services	3,140	67%	2,110	71%	49%	14.2%
Local firms	2,120	45%	1,160	39%	83%	22.3%
ISPs	350	7%	310	10%	13%	4.1%
Foreign branches	1,020	22%	950	32%	7%	2.4%
ISPs	60	1%	20	1%	200%	44.2%
Local firms	2,300	49%	1,440	48%	60%	16.9%
Technical specialists	1,640	35%	990	33%	66%	18.3%
Management and administrative	660	14%	450	15%	47%	13.6%
Foreign branches	2,390	51%	1,540	52%	55%	15.8%
Technical specialists	1,750	37%	1,130	38%	55%	15.7%
Management and administrative	640	14%	410	14%	56%	16.0%

Salary Levels (gross annual), U.S. dollars	Local firms, 2006	Foreign branches, 2006	Local firms, 2003	Foreign branches, 2003	Local firms, CAGR 2006/2003	Foreign branches, CAGR 2006/2003
Industry	$6,100	$9,200	$3,600	$7,100	19.2%	9.0%
Developer, entry level	$3,600	$5,000	$1,800	$2,400	26.0%	27.7%
Developer, 2-year experience	$5,100	$6,900	$3,000	$5,400	19.3%	8.5%
Developer, experienced	$7,600	$10,600	$3,600	$7,200	28.3%	13.8%
Project manager	$8,900	$15,400	$6,000	$14,400	14.0%	2.3%
Test engineer	$5,000	$7,000	$3,000	$4,800	18.6%	13.4%
System administrator	$5,300	$7,700	$3,000	$6,000	20.9%	8.7%
Support	$4,300	$4,500	$2,400	$2,400	21.5%	23.3%
Management	$9,300	$16,100	$6,000	$14,400	15.7%	3.8%

Specializations, % of firms	Industry, 2006	Local firms, 2006	Foreign branches, 2006	Industry, 2003	Local firms, 2003	Foreign branches, 2003
Customized software and outsourcing	28.9%	17.3%	11.6%	12.8%	8.8%	4.0%
Web design and development	13.1%	12.4%	0.6%	14.9%	14.2%	0.7%
Internet service provider	11.3%	10.0%	1.3%	18.0%	17.2%	0.8%
Accounting, banking, and financial software	7.8%	5.8%	2.0%	5.6%	4.0%	1.5%
Chip design, testing, and related	6.6%	2.2%	4.4%	5.6%	0.0%	5.5%
Databases & MIS	6.2%	4.8%	1.4%	9.0%	7.7%	1.3%
Computer graphics, multimedia, and games	6.2%	4.6%	1.6%	9.0%	8.0%	0.9%
IT services and consulting	5.5%	3.9%	1.6%	4.6%	3.7%	0.9%
Internet applications and ecommerce	4.9%	3.9%	1.0%	7.3%	5.8%	1.5%
Networking systems and communications	4.6%	1.7%	2.9%	4.7%	1.7%	3.0%
Other	5.1%	3.4%	1.7%	8.5%	6.9%	1.6%

Specializations, Revenues, millions of U.S. dollars	Industry, 2006	Local firms, 2006	Foreign branches, 2006	Industry, 2003	Local firms, 2003	Foreign branches, 2003
Customized software and outsourcing	$18.1	$7.3	$10.7	$3.2	$1.1	$2.1
Chip design, testing, and related	$13.2	$0.9	$12.3	$8.6	$0.0	$8.6
Internet service provider	$8.9	$7.7	$1.3	$6.0	$5.4	$0.6
Networking systems and communications	$8.0	$0.7	$7.3	$5.2	$0.3	$4.9
Internet applications and ecommerce	$7.4	$2.5	$4.9	$2.3	$1.0	$1.3
Accounting, banking, and financial software	$5.4	$2.7	$2.7	$1.8	$1.3	$0.5
IT services and consulting	$5.2	$3.4	$1.7	$1.1	$0.8	$0.3
Databases & MIS	$4.1	$2.7	$1.4	$3.2	$2.0	$1.2
Web design and development	$4.0	$3.7	$0.3	$1.9	$1.6	$0.3
Computer graphics, multimedia, and games	$3.0	$1.5	$1.4	$1.0	$0.6	$0.4
Other	$7.0	$3.4	$3.6	$3.5	$1.6	$1.9

8. COSTS OF OPERATING A SOFTWARE COMPANY IN ARMENIA

Annual Costs of Operating an Outsourcing Office in Armenia, Small Scale			
Employees	**Persons**	**Salary**	**Total**
Developer, entry level	3	$5,000	$15,000
Developer, 2-year experience	5	$6,900	$34,500
Developer, experienced	5	$10,600	$53,000
Project manager	2	$15,400	$30,800
Test engineer	1	$7,000	$7,000
System administrator	1	$7,700	$7,700
Support	2	$4,500	$9,000
Management	2	$16,100	$32,200
Total staff expenses	21		$189,200
Infrastructure and other	**Units**	**Monthly cost**	**Total**
Office space, 8 sq.m. per person (utilities included)	168 sq.m.	$20	$40,320
Internet, dedicated 128 kbps symmetric DSL	1	$2,000	$24,000
Other, $200 per person	1	$4,200	$50,400
Total infrastructure and other expenses			$114,720
Total operating costs			**$303,920**

Annual Costs of Operating an Outsourcing Office in Armenia, Large Scale			
Employees	**Persons**	**Salary**	**Total**
Intern	10	$600	$6,000
Developer, entry level	30	$5,000	$150,000
Developer, 2-year experience	30	$6,900	$207,000
Developer, experienced	20	$10,600	$212,000
Project manager	7	$15,400	$107,800
Test engineer	6	$7,000	$42,000
System administrator	3	$7,700	$23,100
Support	10	$4,500	$45,000
Management	3	$16,100	$48,300
Total staff expenses	119		$841,200
Infrastructure and other	**Units**	**Monthly cost**	**Total**
Office space, 10 sq.m. per person (utilities included)	1,190 sq.m.	$25	$357,000
Internet, dedicated 512 kbps symmetric fiber	1	$7,700	$92,400
Other, $400 per person	1	$47,600	$571,200
Total infrastructure and other expenses			$1,020,600
Total operating costs			**$1,861,800**

9. ARMENIA ON THE INTERNET

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24. www.president.am, President of the Republic of Armenia
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26. www.spyur.am, Armenian business directory and yellow pages
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10. ABBREVIATIONS

CAD	–	Computer Aided Design
CAGR	–	Compound Annual Growth Rate
CIS	–	Commonwealth of Independent States
CMMI	–	Capability Maturity Model Integrated
DSL	–	Digital Subscriber Line
EDA	–	Electronic Design Automation
EIF	–	Enterprise Incubator Foundation
ERP	–	Enterprise Resource Planning
FDI	–	Foreign Direct Investment
GDP	–	Gross Domestic Product
ICT	–	Information and Communications Technologies
IC	–	Integrated Circuit
I/O	–	Input/Output
IP	–	Intellectual Property
ISDN	–	Integrated Services Digital Network
ISP	–	Internet Service Provider
IT	–	Information Technology
M&A	–	Mergers and Acquisitions
MIS	–	Management Information Systems
NGO	–	Non-Governmental Organization
PBX	–	Private Branch Exchange
R&D	–	Research and Development
US	–	United States
USSR	–	Union of Soviet Socialist Republics
VC	–	Venture Capital
VLSI	–	Very Large Scale Integration
Wi-Fi	–	Wireless Fidelity, wireless network
WiMAX	–	Worldwide Interoperability for Microwave Access, wireless broadband network