Regional: Scaling Up Private Sector Participation in the Infrastructure Sector in the Central and West Asia Region

Assessment and Market Mapping of the Information and Communication Technology Sector in Armenia

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For the Asian Development Bank

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ASSESSMENT AND MARKET MAPPING OF THE INFORMATION AND COMMUNICATION TECHNOLOGY SECTOR IN ARMENIA

November 2023
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ABBREVIATIONS

ADB      Asian Development Bank
AI       Artificial Intelligence
AMD      Armenian Dram
ANIF     Armenian National Interests Fund
EIF      Enterprise Incubation Foundation
GDP      Gross Domestic Product
GoA      Government of Armenia
IT       Information Technology
ICT      Information and Communication Technology
ITU      International Telecommunication Union
OECD     Organisation for Economic Co-operation and Development
R&D      Research and Development
RA       Republic of Armenia
SDG      Sustainable Development Goal
SRC      State Revenue Committee
VC       Venture Capital
WCIT     World Congress on Information Technology

NOTES

ADB does not guarantee the accuracy of the data included in this publication and accepts no responsibility for any consequence of their use. The mention of specific companies or products of manufacturers does not imply that they are endorsed or recommended by ADB in preference to others of a similar nature that are not mentioned.
Information and Communication Technology (ICT) has become a key driver of economic growth in Armenia. This report provides a detailed assessment and market mapping of the country’s ICT sector. It also discusses best practices for government support and explores potential investment opportunities.

To achieve these objectives, extensive research was conducted, which included 21 interviews with top management of major Armenian ICT firms, business incubators, venture capital funds, and line ministries. The research covered a wide range of topics, including global trends and their impact on the Armenian market, expectations, main challenges and required support, and the influence of relocation. It tested hypotheses with sector representatives on potential investment opportunities for the Asian Development Bank.

The report identifies potential areas for growth in Armenia’s ICT sector, such as software development, IT outsourcing, and e-commerce. It also examines factors that affect the sector’s growth, including the availability of skills, supportive government policies, access to finance, and the state of digital infrastructure.

Additionally, the study provides an overview of the current macroeconomic situation in the ICT sector in Armenia and how it has been impacted by the Russian invasion of Ukraine. It highlights the challenges faced by the sector and discusses how the government could help enhance the ICT ecosystem.

The report aims to serve as a resource for policymakers, entrepreneurs, investors, and other stakeholders interested in understanding the ICT sector in Armenia and exploring potential investment opportunities.
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Executive Summary

This report considers the current state of the Information and Communication Technology sector of Armenia. It looks at global trends, identifies challenges, discusses best practices of government support, and provides an overview of the current macroeconomic situation in the sector and how it was impacted as a result of the Russian invasion of Ukraine. It also aims to identify potential investment opportunities in ICT for the Asian Development Bank (ADB). During the research, 21 interviews with top management of major Armenian ICT firms, business incubators as well as venture capital funds and line ministries were conducted. Subjects discussed during interviews covered a wide range of topics, from global trends and their impact on the Armenian market to expectations, main challenges and required support as well as the influence of relocation. During interviews, hypotheses on potential investment opportunities for ADB were tested with sector representatives.

The definition of ICT used in this paper complies with the definitions of OECD and Eurostat, which is also used by Statistical Committee of Republic of Armenia.1 According to this definition, the ICT sector includes the following subsectors: ICT production, ICT services (with telecommunication) and ICT trade. According to the International Telecommunication Union (ITU), core indices to track the performance of the ICT industry are the proportion of workforce included in the ICT sector and value added in the ICT sector. Another important measure, to identify the current state and development potential of high technologies is % of GDP expenditure on R&D. As strong examples of government support to ICT three countries were selected: Estonia, Israel and Ireland. The cases consider specific initiatives to encourage R&D expenditure and educational projects as well as country level strategies and projects.

Armenia declared in 2001 ICT as a priority sector, and established an Information Technology Support Council, which was the main state body responsible for the development of ICT in Armenia. In 2019, the responsibilities of ITSC were transferred to the Ministry of High-Tech Industry. The ministry has adopted the “High-Tech Industry Development Strategy for 2020-2025”, under which six different targets are set for the sector development. Among these targets, the most important ones for the ICT sector are building a start-up ecosystem (including different projects such as National Venture Fund, “Armenian Virtual Bridge”, grants for start-ups). The main legislative act is the law on “State Support in the Information Technology Sector”, which introduces the supporting mechanism called “IT Certificate”. IT certificate presupposes tax

1 ADB recognizes the “Republic of Armenia” as Armenia
benefits including 1) Corporate Income Tax exemption (CIT rate is 18% in Armenia) for 5 years and 2) Personal Income Tax reduction to 10% (PIT rate in Armenia is 21%). International donor organizations implement various projects in the ICT sector. One of the most important initiatives for the Armenian ICT market was the establishment of EIF (Enterprise Incubation Foundation), which implements a large part of the projects financed by donors in the ICT industry, and provides grants for start-ups. Overall, donor organizations are mainly engaged in infrastructure development and educational projects.

Because of the demographic situation, the number of students in educational institutions in Armenia is decreasing. While in 2016 the overall number of students was 72,517, in 2022 the number had decreased by 20% to 57,608. However, due to the higher wages in the ICT industry and better career development opportunities, ICT-related specializations have become more and more popular. As for 2021, the number of bachelor students learning Information and communication technologies in state universities was 4,386, which is 7.6% of all students in state educational institutions. In terms of student enrollment, ICT-related specializations have shown 29% of increase in 2021 compared to 2017. However, the situation is the opposite when it comes to master’s programs. For the period 2017-2021, the number of students in master’s programs declined by 17.5%. Only 618 people (out of 9,729) in 2021 were studying for their master’s degree in the field of ICT. The relatively small number of students in master’s programs might be explained by two main reasons: 1) low quality of academic education; 2) impossibility to combine education and work (majority of students start working in the ICT sector since 3rd or 4th year).

According to the State Revenue Committee of Armenia (SRC), in 2021 the total turnover of the ICT sector was 985.1 billion AMD, and for the first and second quarters of 2022 turnover was 358.1 billion AMD. In 2021, the ICT sector’s contribution to GDP was 4.7%. In terms of the ICT sector’s contribution to GDP, Armenia outperforms countries such as Croatia, Poland, Romania, the Russian Federation, and Slovakia. As of 2021, the contribution of “IT services without telecommunication” to total turnover in ICT was 54%. Based on SRC and Armstat data (intermediate consumption), we calculated that added value was 331.2 billion AMD or 4.7% of GDP. The ICT sector plays an important role in employment in Armenia. According to SRC there are 35,287 hired workers in the ICT sector as of Q2 2022, which is 15% more than in Q1 2022. According to the Statistical Committee of Armenia, as of 2020 (the latest available data), ~44% of hired workers in the ICT sector are female. According to EIF, this number is ~40%. The majority of hired workers are engaged in “IT services without telecommunication” subsectors, which is hiring 72% or 25,673 workers. It should be noticed that the average wage in the ICT sector is 3 times higher than the Armenian average, while in “IT services without telecommunication” it is 3.8 times higher.

Export of ICT goods and services: According to the Central Bank of Armenia (CBA), in 2021 export of ICT services amounted to $382.4 million, which is 7.8% higher than in 2020, while the import of ICT services is $43.6 million, and it is growing at a slower pace than ICT services exports. The
situation is the opposite with ICT goods. While the export of ICT goods is $15 million, the import of the latter amounted to $270 million. According to SRC data, as of Q2 2022, there are 3,054 enterprises in the ICT industry (ICT production, ICT trade, IT services without telecommunication, Telecommunication), 85% of which in “IT services without telecommunication” subsector. ICT industry players paid 83,9 billion AMD to the budget of Armenia, in the form of different taxes.

Based on in-depth interviews and desk research, we identified 5 main specializations of ICT companies: 1) Customized software; 2) IT services and consulting; 3) mobile application development; 4) web design and development; 5) system design and automatization.

To assess the situation with cybersecurity in Armenia, we looked at the “Global Cybersecurity Index”, published by ITU. According to this index, Armenia is in 90th position out of 182 countries. Moreover, to look at Armenia’s ranking in the international arena certain sum-indices of the Global Competitiveness Index and Global Innovation Index were considered.

One of the major changes that emerged during the last 2 years was the rise of “platform outsourcing”. Such platforms as Toptal and Upwork give the opportunity to software developers from all over the world to implement small projects, thus replacing outsourcing companies.

Considering highly diverse concepts about the ICT industry in Armenia as well as changes in the last 2 years, five types of entities have been outlined: 1) Armenian branches of multinational outsourcing firms; 2) Local outsourcing firms; 3) Individual Entrepreneurs (developers) on global platforms; 4) Multinational Product Companies; and 5) Local Product Companies. According to our estimates, the dominant role in the ICT industry is played by outsourcing companies, but their role is decreasing year by year. Usually, Armenian outsourcing companies deliver such services as infrastructure solutions, application services, and IT-related business processes for the international market. However, it should be noted that among outsourcing firms both the added value is lower and global competition is more intense.

Respondents mentioned that the most considerable entry barriers in the ICT industry are related to attracting and retaining qualified personnel, as well as gaining entry into global markets. Respondents mentioned that issues with global marketplaces, especially connected with collection of payments, are a major challenge and entry barrier for Armenia’s ICT industry.

One of the most notable changes that has had a significant influence on Armenia’s ICT sector is the Russian invasion of Ukraine and its consequences. Most of the businesses and specialists that relocated were engaged in the ICT sector.

The main objective of this paper is to identify investment opportunities for ADB, which we believe should be based on a vision of a “shift from outsourcing to own product development”. The
The proposed investment strategy is based on intrapreneurship and fund of funds. The model presupposes cooperation between three parties: ADB, venture capital firms and outsourcing companies (technological partners). In the frames of the model, every party has its own roles: 1) Venture capital firms test the viability of the start-up idea; 2) ADB along with venture capital firms invests in tested start-ups; 3) Outsourcing companies provide technological solutions for start-ups.

Moreover, potential equity and debt investment opportunities for ADB in the ICT sector were assessed. To this end, a series of in-depth interviews was conducted with representatives of major ICT firms in Armenia. The list of companies interviewed is presented in Annexes.

Respondents mentioned that IT companies usually do not need financial resources for capital investments. IT companies usually take short-term loans to cover OPEX costs and for cash flow management. Requirements from ADB such as feasibility studies for projects, financial due diligence, ownership structure description, environmental and social aspects could potentially delay the financing process and make financial assistance unattractive for IT companies. However, those companies that seek to involve an institutional partner could potentially seize the opportunity of financing from ADB. The distinctive feature of the IT sector is a dynamic and flexible process of decision making. According to respondents, involvement of such a large organization as ADB assumes establishment of complex business processes and corporate governance systems and could make their companies less competitive than those that work with VCs.

Yet companies that seek to expand either through capital investments or investments in human resources might be potentially interested in debt financing from ADB. This hypothesis was partially confirmed during in-depth interviews. It is important to note that ADB could perhaps consider provision of working capital loans, as this might also be attractive for ICT companies to cover operating costs. Still, it is necessary to indicate that the financing terms and conditions would need to be suitable and affordable for ICT companies.

Moreover, those companies that work with international donor organizations, NGOs and government agencies could be interested in equity investment from ADB. Involvement of ADB could increase the credibility and reputation of such companies.

Summing up the results, we can state that companies that a) are looking to expand through capital expenditures or investments in human capital, and b) have experience of cooperation with international financing institutions as clients could be interested in debt or equity financing provided by ADB.
1. ICT Global Market Overview

1.1 Global Evolution of ICT Industry

It is generally accepted\(^2\), that the modern ICT history has started since the last decades of 20\(^{th}\) century. In 1968 the company Intel was founded, after 3 years in 1971, the company introduced the first ever microprocessor chip: Intel 4004\(^3\), which had a revolutionary impact on ICT market.

By the end of 19\(^{th}\) century, some prototypes of the computers had been designed; however, they were not even close to computers that we know. In 1936, Adam Turing proposed the so-called “Turing Machine”, which was the foundation of computing and computer theories. However, some of the biggest breakthrough innovations were made in 1973, when the first ever desktop micro-computer, with a keyboard and a mouse was produced, which allowed more people to use the computer and ICT technologies.

The ICT revolution has been facilitated with the rise of the Worldwide Web and modern internet, starting from the end of the 20\(^{th}\) century, in the 1990s. The global penetration of the internet has been rising over time, and became established in recent years. According to World Bank data\(^4\), in 2000 only 6.7% of the world’s population was using the internet. For the last 20 years, this number has grown by ~9 times, and in 2020, 59.9% of the population were internet users. Currently, in total numbers there are more than 5 billion people in the world which use the internet. The majority of “unconnected” people are from developing countries in Southern and Eastern Asia, and in Africa.

Social media is a big phenomenon, whose development was strongly tied with the rise and spread of the internet and the emergence of smartphones, expanding mobile coverage and increased affordability of data. Currently, according to DataReportal, as of July 2022, 17 social media platforms have more than 300 million active users. The “leading” platform is Facebook, which was founded in 2004, with more than 2.9 billion monthly active users. More detailed ranking is the following graph\(^5\):

\(^3\) The story of the Intel® 4004. Intel
\(^4\) Individuals using the internet (% of population) (2023) World Bank Open Data.
\(^5\) Global Social Media Statistics - DataReportal – global digital insights (2023) DataReportal
Along with social media, one of the most significant developments in ICT history has been the launch of easily usable search engines. The combination of social media and easy-to-use search engines have dramatically changed the way businesses, communities, even state authorities operate.

One of the most notable trends, which was mentioned during in-depth interviews as well, is the rise of cloud computing. According to Gartner, cloud spending will reach $500 billion this year, and grows by ~20.4% annually\(^6\), and by 2025 cloud spending will exceed traditional IT spending. Cloud is considered to be the next key catalyst for innovation. The highest share in overall spend has the **software as a service (SaaS)** platform, followed by **cloud-based infrastructure services** and **desktop as a service (DaaS)** platforms.

COVID-19 crisis, as well as security challenges, have increased the urgency to enhance cybersecurity. One of the most important issues, in this context is **remote work cybersecurity risks** as more employees use personal devices for two-factor authentication, as well as use such platforms as Zoom or Microsoft Teams on their mobile devices. Moreover, along with rising cloud computing, cloud security threats are emerging. As a consequence of more complex cyber-attacks, currently the biggest cybersecurity risks are believed to be **cloud vulnerability, ransomware and personal data protection**.

The United Nations’ “Sustainable Development Goals” recognize the role of ICT, emphasizing, “The spread of information and communication technology and global interconnectedness has great potential to accelerate human progress, to bridge the digital divide and to develop knowledge societies\(^7\).” The ICT industry might assist in achieving all 17 SDGs; however the role of ICT is particularly relevant in:

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\(^6\) Robinson, D. (2022) *Cloud spending will near $500 billion this year,* The Register\(^6\) - Biting the hand that feeds IT. The Register  
\(^7\) ITU Council :: sustainable development knowledge platform. United Nations
SDG #4: Quality Education
ICT is changing education, improving it globally and it allows students to get online classes from the best educational institutions worldwide, teachers to prepare for classes and enhance their skills. This is a huge opportunity, especially for those who live in remote areas of the world.

SDG #6: Clean Water and Sanitation
ICT can assist with smart water management, lower-cost management of water, automation of processes.

SDG #7: Affordable and Clean Energy
IT-related solutions might be a key for ensuring access to energy for all and developing renewable energy. These solutions might be smart grids, smart buildings, etc.

SDG #8: Decent Work and Economic Growth
ICT skills have been changing the workforce, enhancing the productivity of the workforce and creating more value added. Moreover, ICT penetrated almost all sectors of economy, and digital technologies are transforming the way businesses operate.

SDG #9: Industry, Infrastructure and Innovation
ICT might play a key role in building and maintaining smart infrastructure, promoting automation and accelerating innovation.

SDG #11: Sustainable Cities and Communities
ICTs offer solutions to innovative urban planning (using high-level technologies and technological solutions to obtain a socio-economic, environmental, architectural or other effect) and urban management.

Moreover, if we consider the role of ICT more broadly, we can state that high-level technologies will drive the fourth industrial revolution (4IR). If the first revolution used water and stream power, the second used electric power which led to creation of mass production, the third used electronics, some components of information technologies to atomize the production the 4IR will use the digital power and other “products” of the ICT, which will lead to full transformation of society, economy and other important aspects of the life. The 4IR represents the combination of physical assets and high-level technologies mostly the Internet of Things, artificial intelligence, 3D printings, cloud computing etc., which may act upon the information they get. These developments would make decisions of businesses, governments more evidence based, which will lead to increased standards of living.
1.2 Global Macroeconomic overview of the ICT sector

Considering specifics of the ICT sector and multiple concepts of it, definitions of Armstat, Eurostat and OECD are also used.

ICT sector includes the following economic activities as per NACE rev. 2, according to the United Nation’s “International Standard Industrial Classification of All Economic Activities”:

- **Manufacturing**
  - C26.11 – Manufacture of electronic components
  - C26.12 – Manufacture of loaded electronic boards
  - C26.20 – Manufacture of computers and peripheral equipment
  - C26.30 – Manufacture of communication equipment
  - C26.40 – Manufacture of consumer electronics
  - C26.80 – Manufacture of magnetic and optical media

- **Trade**
  - G46.51 – Wholesale of computers, computer peripheral equipment and software
  - G46.52 – Wholesale of electronic and telecommunications equipment and parts

- **Services**
  - J58.21 – Publishing of computer games
  - J58.29 – Other software publishing
  - J61 – Telecommunications
  - J62 – Computer programming, consultancy and related activities
  - J63.1 – Data processing, hosting and related activities; web portals
  - J95.1 – Repair of computers and communication equipment

According to the ITU (International Telecommunication Union), which is a special agency of the UN specialized in the ICT sector, the core measures to track the ICT sector performance are:

- ICT1 – Proportion of total business sector workforce involved in the ICT sector
- ICT2 – Value added in the ICT sector

*Value added* for a particular industry represents its contribution to national GDP. It is calculated as the difference between production (gross output) and intermediate inputs.

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8 **Standard International Trade Classification Revision 4 - UNSD (2008), United Nations**
9 **Core ICT indicators - ITU (2005), ITU**
According to the Deloitte estimates, in 2020 the market size of the world ICT industry in 2020 was accounted to be $3.8 trillion, where $1.8 trillion was the contribution of information technologies, and $1.9 trillion accumulated the communications technologies. In this context, it’s worth mentioning the most promising and leading subsectors of the ICT industry, which are the following:

<table>
<thead>
<tr>
<th>Industry</th>
<th>Market Size 2020</th>
<th>CAGR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cyber Security and data privacy</td>
<td>$270 billion</td>
<td>7.7% 2020-2026 period</td>
</tr>
<tr>
<td>Artificial Intelligence</td>
<td>$110 billion</td>
<td>21.7%, 2020-2024 period</td>
</tr>
<tr>
<td>Smart Edge Computing</td>
<td>$43 billion</td>
<td>24%, 2021-2027 period</td>
</tr>
<tr>
<td>5G and fiber internet</td>
<td>$176 billion</td>
<td>156%, 2020-2025 period</td>
</tr>
</tbody>
</table>

Another important measure to track the development of the ICT industry is ICT export, which might relate to both services and production. According to the World Bank, in 2021, the total amount of ICT services exports was $747.8 billion. Overall, exports of ICT services make up 15.8% of the world’s total services exports. For instance, travel services, amounted to be 23% of world’s total services export in 2019 (last pre-COVID-19 year).

The World Bank reports that as for 2019 (the last available data), high-technology exports (according to World Bank, high-technology exports are products with high R&D component) amounted to be $2.85 trillion. This indicator has been steadily increasing since 2016, and for the period 2016-2019 it has grown by 27.8%. The leading economies in high-technology exports were the People’s Republic of China; Hong Kong, China; Germany; the Republic of Korea; and Singapore (high-technology exports are about goods, while ICT exports are services). Armenia exported high-level technology of the value of $45 million in this period, which is ~1.5% of total goods exports of Armenia.

According to the Atlas of Economic Complexity, in 2020 the leaders of ICT exports were:

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12 https://data.worldbank.org/indicator/TX.VAL.TECH.CD
Another important indicator used to measure the development of the ICT sector is connected with R&D activities. UNESCO Institute for Statistics\textsuperscript{14} calculated, that 2.63\% of world’s GDP had been spent on research and development. Gross domestic expenditures on R&D, are mainly concentrated on four sectors: business enterprise sector, which is dominating in all economies (in the United States [US] it is 63.1\%, in Japan and the Republic of Korea 78.9\% and 76.9\% respectively etc.), higher education spending, government spending and private non-profit sector. According to the Global Innovation Index, top R&D spending sectors as share of top global R&D spenders in 2018-2019 (the latest report) are:

\textit{Figure 3} R&D spending sectors, \%

<table>
<thead>
<tr>
<th>Sector</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Software and ICT services</td>
<td>14,4%</td>
</tr>
<tr>
<td>Automobiles</td>
<td>15,6%</td>
</tr>
<tr>
<td>Pharmaceuticals &amp; biotechnology</td>
<td>18,8%</td>
</tr>
<tr>
<td>ICT hardware and electronic equipment</td>
<td>23,5%</td>
</tr>
<tr>
<td>Other</td>
<td>27,7%</td>
</tr>
</tbody>
</table>

Source: Global Innovation Index, ITU

\textsuperscript{14} Research and development (2020) UNESCO UIS
The unequivocal leader is Israel, which spends more than 2 times the world average, 5.44% of the country’s GDP on R&D. The key development for Israel’s R&D was the legislative act of the “Law for Encouragement of R&D activities” aiming to encourage the development of science based, export-oriented industries and boost employment.

The main focus of the program is to give financial support to companies, both large corporations and SMEs, which match the required criteria. These companies might receive matching funds to develop science-based products, export-oriented products. The subsidy of the government might reach up to 50% for corporations on R&D expenditure, and up to 60% for start-ups. More, on the Israeli government initiatives will be discussed in the next subchapters.

Armenia spent 0.22% of its GDP on R&D, as for 2020, which is -12 times lower than world’s average. It should be noted that for the last 10 years, the spending varied between 0.18-0.25%, thus recent economic changes have not influenced the government’s spending on R&D activities.

Even though peer regional countries (CIS, Baltic countries), spend more than Armenia, they do not spend as much as the world’s average either.

**Figure 4 R&D Expenditure as % of GDP in 2020, %**

![Graph showing R&D expenditure as % of GDP in 2020 for different countries.](image)

*Source: World Bank data*

### 1.3 Digital Trends

It is not a surprise that ICT is probably the fastest growing industry in the world, and as already mentioned above, the industry has become the driver for the fourth industrial revolution. Various futurists and economists indicate that in the near future, humanity will experience more innovations that in the past 100 years combined.
Satya Nadella, the CEO of Microsoft emphasized, “Each year about 10 billion new microcontroller-equipped devices are plugged into the global economy, so the world is becoming a giant computer”

Experts from McKinsey anticipate\(^\text{15}\), that there are 10 trends, which have the biggest importance, and attract the largest amount of venture capital. These trends include:

<table>
<thead>
<tr>
<th>Trend</th>
<th>Description</th>
<th>Investment</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Next-level process automation and virtualization</strong></td>
<td>Industrial Internet of Things, 3-D printing optimizes the daily routine tasks for the businesses, improve efficiency, enhance productivity. It is expected, that in 2030 about 10% of manufacturing will be taken by 3-D or 4-D printing.</td>
<td>$105 billion in 2020</td>
</tr>
<tr>
<td><strong>Future of Connectivity</strong></td>
<td>This trend is mostly connected with 5G networks and the Internet of Things and will allow to have very fast connectivity across longer distances and will support different segments of economy including manufacturing (wireless control), to energy supply. McKinsey believes, that if the use cases would be implemented in just 4 sectors (retail, mobility, manufacturing, healthcare) the global GDP will grow from $1.2 trillion to $2 trillion by 2030.</td>
<td>$3 billion in 2020</td>
</tr>
<tr>
<td><strong>Distributed Infrastructure</strong></td>
<td>This trend refers to cloud and edge computing and will help businesses to increase their speed and agility, save costs, and strengthen cybersecurity.</td>
<td>$31 billion in 2020</td>
</tr>
<tr>
<td><strong>Next-generation Computing</strong></td>
<td>This trend is about quantum and neuromorphic and will help scientists, businessmen, even society to find answers to problems which remained unanswered for years. This might be momentous for such industries as chemicals, pharmaceutical industry and increase the level of cybersecurity</td>
<td>$2 billion in 2020</td>
</tr>
<tr>
<td><strong>Applied Artificial Intelligence (AI)</strong></td>
<td>This trend might utilize algorithms to make machines to recognize and act according to relevant patterns – make computers to become closer to</td>
<td>$55 billion in 2020</td>
</tr>
</tbody>
</table>

Assessment and Market Mapping of the Information and Communication Technology Sector in Armenia

The future of programming

Software 2.0 – trend of replacing programmers, software developers with neutral networks, which use machine learning, AI algorithms. This will provide a way easier method for organizations to optimize and modify their codes. This is relevant for automotive industry (autopilot cars), entertainment industry and financial services.

<table>
<thead>
<tr>
<th>Trend</th>
<th>Description</th>
<th>2020 Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trust architecture</td>
<td>This trend reflects a very important topic – cyberattacks. Trust architectures provide structures for verifying devices and data flows across networks, applications, and includes distributed-ledger technologies.</td>
<td>$60 billion</td>
</tr>
<tr>
<td>Bio revolution</td>
<td>This is a combination of biological science and advanced technologies such as computing, AI, automation. This will have a huge impact on economies and will affect industries such as healthcare, agriculture, energy etc.</td>
<td>$30 billion</td>
</tr>
<tr>
<td>Next-generation materials</td>
<td>This trend might be critical for sustainable economies in future, and refers to producing smart materials (such as graphene, nanomaterials), which is important for pharmaceutical industry, energy etc.</td>
<td>$0.9 billion</td>
</tr>
<tr>
<td>Future of clean technologies</td>
<td>Demand for clean-energy generation is rapidly growing, which includes smart-storage systems, smart-energy distribution, and fusion energy. These will influence on power, transport and logistics, infrastructure, water systems management.</td>
<td>$90 billion</td>
</tr>
</tbody>
</table>
Thus, it might be constituted that, the most significant technologies and trends in the future will reflect artificial intelligence, and big data.

**Artificial Intelligence** - Typical applications of AI include autonomous driving, computer vision, decision-making and natural language processing (NLP). AI holds the benefit of being adaptable to very heterogeneous contexts just like humans. In the industrial sector, AI application is supported by the increasing adoption of devices and sensors connected through the Internet of Things production machines, autonomous vehicles and devices carried by humans, which generate enormous amounts of data. AI is expected to enable the automation of knowledge work, or tasks that require judgement or creative problem solving. AI-based solutions can potentially increase productivity by 40-50 per cent for 290 million knowledge workers globally by 2025.

**Figure 5 Branches of AI**

- **Machine Learning** – deep learning, supervised, unsupervised
- **Natural Language Processing** – Content extraction, machine translation, question answering, classification etc.
- **Expert Systems**
- **Vision** – Image recognition, machine vision
- **Speech** – Speech to text, text to speech
- **Planning, Robotics**

**Big data** is the second pillar of the process of companies transferring digitally their businesses, which allows them to collect and analyze the data, which usual databases are not able to analyze. With the help of big data, decision making in various enterprises will be changed dramatically. Using data, decision makers are enabled to rapidly test a hypothesis and track performance. Some researchers even anticipate, that big data, will change management culture, shifting it towards evidence-based decision making. The biggest value that big data might add is:

- Creating transparency
- Improve the performance of the labor
- Segment population to customize actions
- Support human decisions, based on automated algorithms
- Innovating new business models, products and services

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1.4 Government Support to ICT sector development: International Best Practices

To describe the best practices of government support to the ICT sector, three countries: **Israel, Estonia and Ireland** will be discussed.

**Israel** is similar to Armenia with its historical, political and geographical background. **Estonia** as well as Armenia was a part of the USSR, and has the most advanced ICT industry in post-Soviet countries and is a success case for all post-USSR countries in the context of high technologies. **Ireland** has become the biggest tech hub in Europe (ICT value added in GDP is 14.3\(^{17}\)), and the impact of government incentives cannot be underestimated. Currently, Ireland is a benchmark for countries who intend to excel in ICT.

### 1.4.1 Israel

**Table 1 Main economic indicators of Israel**

<table>
<thead>
<tr>
<th>Indicator</th>
<th>2019</th>
<th>2020</th>
<th>2021</th>
</tr>
</thead>
<tbody>
<tr>
<td>GDP ($ billion)</td>
<td>397.93</td>
<td>407.1</td>
<td>481.59</td>
</tr>
<tr>
<td>GDP Per Capita ($)</td>
<td>43,951</td>
<td>44,177</td>
<td>51,430</td>
</tr>
<tr>
<td>Annual GDP growth (%)</td>
<td>3.8</td>
<td>-2.2</td>
<td>8.2</td>
</tr>
<tr>
<td>Exports of goods and services ($ billion)</td>
<td>117.44</td>
<td>114.12</td>
<td>143.05</td>
</tr>
<tr>
<td>High-technology exports ($ billion)</td>
<td>12.56</td>
<td>12.96</td>
<td>N/A</td>
</tr>
</tbody>
</table>

(Source: World Bank data)

The Israeli government has always put the knowledge economy, and particularly the ICT sector as the priority for the country’s development. The focus of the government, and the significant policies to support the sector are the following:

- Intensifying the flow of well-educated immigrants in 1980-1990s mostly from Soviet Union
- Heavy investment in education, especially in STEM, to provide necessary human capital (In 2018, 15.8% of total government expenditure was on education)
- Investment incentives for FDI inflow
- Investment in R&D (Israel is the leader by this indicator, spending 5.44% of GDP on R&D)
- Investment in defense technologies and the military (Israel’s expenditure on the military was 5.44% of GDP in 2020)
- Venture capital, incubator programs to transfer research into businesses

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\(^{17}\) GDP by sector - CSO - central statistics office (2021) CSO
The Israeli government introduced the “Law of Encouragement of Capital Investments”, which was passed in 1959 and has been revised multiple times since then (the last reform was in 2016). According to this law, if a company meets relevant criteria, it might get one of the following tax regimes:\textsuperscript{18}

**Preferred Enterprise Regime (PFE)** – the main criteria are to be engaged in biotechnology or nanotechnology, to contribute to development of productive capacities of Israel and to improve the balance of payments (to be export-oriented). The revenue of the company shouldn’t be more than 75% from one country and 25% of the revenue should be generated from a country that has at least 14 million population. The PFE corporate tax rate is 7.5% for operations in the main development area and 16% for operations outside the main development area.

**Special Preferred Enterprises (SPFE) regime** – is the taxation regime for large enterprises that have more than 1 billion ILS annual revenue and are engaged in R&D, invest in productive assets. Main criteria concern R&D staff (20% of employees), investments of venture capital and creating new employment opportunities. The corporate tax equals to 7.5% for their development area and 12% for activities outside of the development area.

**Preferred Technology Enterprise (PTE) regime** – the company should be engaged in technological sector; R&D expenses should be more than 7.5% of its annual revenue (at least 75 million ILS) and an approval from National Authority for Technological Innovation is required. Under this regime the company enjoys 7.5% corporate tax for their main development area and 12% for the activities outside of the development area.

The culture of innovation, along with the government policy and support, cultivated the ICT sector of Israel to a “Start-Up Nation” level. One of the major reforms that accelerated the growth of the ICT sector, was the founding of the Office of the Chief Scientist (OCS), within the Ministry of Economy.

In 2015, the government of Israel has changed the structure of OCS, transferring it into Israel Innovation Authority (National Authority for Technological Innovation), to encourage innovation for inclusive growth. Under this body, the frameworks for funding research and innovation were located, such as R&D Fund, Technical Incubators Program, Magnet (Consortium) program. OCS managed all international R&D relations of Israel. If the mission of OCS was the creation of the ecosystem, the focus of Innovation Authority will be: 1) Maintain Israel’s position in competitive global innovation marketplace, 2) Inject Innovation to all sectors of economy.

\textsuperscript{18} Worldwide tax summaries online. PwC
**R&D fund** is the main instrument of high-tech industry development, and it provides 20-50% of grants for approved R&D projects. Large companies, which have the willingness to launch R&D centers in Israeli peripheries might get subsidies of 65-75% of their R&D expenses, for 2-3 years.

**Magnet Consortia** program’s objective is to promote technology transfer from academia to industry and to bring new ideas and knowledge to industry. Research institutions/research groups get 100% of their approved budget (80% state subsidy, 20% private sector company).

**Technological Incubators** program is aimed to transform innovative ideas into start-up companies in their very early stages. The state provides grants up to 85% and the incubator covers another 15%, so that the entrepreneurs will not require any financial resources.

In 2000, Israeli Ministry of Education, founded **Machshava Israeli National Computer Science Teaching Center**, which became a professional home for all computer science teachers and professors of Israel, with the main goal of professional development of teachers, as well as creating a community of computer science teachers.

The country has taken some serious steps in simplifying **work permits** for specialists, **capital market reforms and investment incentives** (Law for the Encouragement of Capital Investments).

Israel has 4 bi-national funds with the US (BIRD), Canada (CIIRDF), Singapore (SIIRD), and the Republic of Korea (SIIRD).

BIRD is considered to be the most important and impactful fund, with the aim to support collaborations between the US and Israeli innovative companies and ideas for joint product development.\(^{19}\) The fund provides up to 50% grants of approved budgets. For the period of 2002-2018 grants of a total of $170 million were given to the following sectors: energy, water & environment, healthcare IT, cybersecurity, agro technology.

SIIRD works with the same principle\(^{20}\) (joint collaboration between Singaporean and Israeli companies in high-tech sectors, providing grants for 40-50% of costs). The fund enables an opportunity to find a partner by submitting the Partner Search Request form. Since its establishment, the fund facilitated research spending of more than $239 million and approved 182 joint research projects.

\(^{19}\) *Impact study* (2020) BIRD Foundation

\(^{20}\) *Siird.com*. Singapore-Israel Industrial Research & Development
1.4.2 Estonia

Table 2 Main economic indicators of Estonia

<table>
<thead>
<tr>
<th>Indicator</th>
<th>2019</th>
<th>2020</th>
<th>2021</th>
</tr>
</thead>
<tbody>
<tr>
<td>GDP ($ billion)</td>
<td>31.05</td>
<td>30.65</td>
<td>36.26</td>
</tr>
<tr>
<td>GDP Per Capita ($)</td>
<td>23,397</td>
<td>23,054</td>
<td>27,280</td>
</tr>
<tr>
<td>Annual GDP growth (%)</td>
<td>4.1</td>
<td>-3</td>
<td>8.3</td>
</tr>
<tr>
<td>Exports of goods and services ($ billion)</td>
<td>22.99</td>
<td>21.82</td>
<td>29.2</td>
</tr>
<tr>
<td>High-technology exports ($ billion)</td>
<td>1.73</td>
<td>2.15</td>
<td>N/A</td>
</tr>
</tbody>
</table>

Source: World Bank data

Estonia is recognized as one of the leading digital nations of the world, sometimes it is even referred to as “the first truly digital nation” and “Baltic tiger” due to its business-friendly environment. The role of ICT in Estonian economy is huge. According to Eurostat\(^\text{21}\), the share of ICT in Estonian GDP is \(-6\%\), (the second highest result in EU after Sweden) and the ICT industry employs \(4.75\%\) of the total workforce (the second-best result in EU after Sweden). In 2020, \(18\%\) of total exports from Estonia were composed of ICT services\(^\text{22}\) and amounted to a total of \(-$4\) billion.

The strategy of Estonian government is to fully digitalize the public services, economy and society, which includes e-governance, e-industry and intelligent transport systems. Currently Estonia is considered to be the most digitalized country in Europe. The country was the first to introduce digital ID cards: a nationwide program called e-citizen. According to OECD, Estonia spends approximately 1.1% to 1.3% of the state budget on digitalization.

One of the most important initiatives that was implemented by the Estonian government was the Tigre Leap project, which aimed to equip all schools of Estonia with computers, train Estonian teachers with basic IT skills and update the school curricula. Tigre Leap+ followed the Tigre Leap program, including the creation of electronic educational materials, in-service training, and support of teacher cooperation and experience exchanges. The main focus of which was to make e-learning a natural part of daily tutorial work, curricula, and teacher training.

Estonia has one of the most liberal taxation systems in the world, where 0% corporate tax is imposed on profits and tax declarations can entirely be submitted online via e-residency.

Science and education are key factors in the National Reform Programme. Primary objectives include increasing tertiary educational attainment as well as raising the participation rate in

\(^{21}\) Database - Eurostat

\(^{22}\) The Atlas of Economic Complexity by @harvardgrowthlab. The Atlas of Economic Complexity
lifelong learning activities among adults. Estonia’s basis and structure for research and development ("R&D") are also further developed with the research, development and innovation strategy called “Knowledge-based Estonia”, as well as national R&D development plans (Government of Estonia, 2019).

Estonian government adopted 3 strategic documents Green Paper on Industrial Policy, ICT Development Programme and Digital Agenda 2020, which focus on the development of ICT sector, tackling the biggest challenges of the sector, facilitating the usage of ICT and development of smart solutions in Estonia. As many European countries, the main challenge for Estonia is the shortage of qualified labor, so that the government implemented projects aiming to solve this problem, such as adult retraining program “Choose IT” and Digital Literacy Training for Industry employees, support for hiring from abroad “Bringing 2,000 IT specialists to Estonia” and ProgeTiger program.

Bringing 2,000 IT specialists to Estonia program aims to tackle the biggest challenge of the ICT industry: shortage of qualified labor. The government aims to provide up to €4 million in subsidies for remuneration of highly qualified foreign specialists (their remuneration rate should be not less than €1,500).

ProgeTiger program aims to encourage preschool, general and vocational education teachers to use technology such as robotics and programming. About 98% of educational institutions were given the chance to use technologies and start ICT education at a very young age.

1.4.3 Ireland

<table>
<thead>
<tr>
<th>Indicator</th>
<th>2019</th>
<th>2020</th>
<th>2021</th>
</tr>
</thead>
<tbody>
<tr>
<td>GDP ($ billion)</td>
<td>399.12</td>
<td>425.89</td>
<td>498.56</td>
</tr>
<tr>
<td>GDP Per Capita ($)</td>
<td>80,886</td>
<td>85,422</td>
<td>99,152</td>
</tr>
<tr>
<td>Annual GDP growth (%)</td>
<td>4.9</td>
<td>5.9</td>
<td>13.5</td>
</tr>
<tr>
<td>Exports of goods and services ($ billion)</td>
<td>510.59</td>
<td>558.39</td>
<td>672.27</td>
</tr>
<tr>
<td>High-technology exports ($ billion)</td>
<td>39.35</td>
<td>42.49</td>
<td>N/A</td>
</tr>
</tbody>
</table>

Source: World Bank data
Ireland is considered to be a global technology hub, as 16 of the top 20 global technology firms, 9 of the top US ICT companies and other leading IT companies are located or have branches in Ireland. Ireland’s digital economy accounts for 14.3% of total country GDP. The government heavily invests in R&D, in 2020 it allocated 1.23% of the country’s GDP.

One of the reasons for this is that Ireland has one of the lowest corporate tax rates in Europe with 12.5%. This is the 3rd lowest taxation rate in the EU and 4th lowest in OECD developed countries. 

The government also provides 25% co-financing on qualifying R&D expenditures, so that the total tax is effectively reduced by 37.5%. The government has also introduced very favorable tax rates to exploit intellectual property, which amounts to be 12.5%. This rate is considered to be one of the lowest ones in Europe, aimed at making Ireland attractive for multinational ICT companies. Overall, it can be stated that the taxation system is one of the main reasons for the high development of the ICT sector in Ireland.

Today Ireland has three major policies for the development of ICT sector: “Harnessing Digital. The Digital Ireland Framework”, which is the national digital strategy; “Connecting Government 2030”, which is an ICT strategy for public services; “Ireland’s Industry 4.0”, which aims to support digital transformation of high-technology manufacturing. Ireland’s industry 4.0 strategy contains 18 strategic actions to be implemented by 2025:

1. Establish a new coordination mechanism: Future Manufacturing Ireland, to ensure coherence and optimal delivery of RD&I supports across centres with a dedicated focus on advanced manufacturing/Industry 4.0.
2. Raise awareness and understanding amongst manufacturing firms and their supply chains of the concept Industry 4.0 and the potential business benefits and opportunities to be derived from engaging in Industry 4.0 activities.
3. Support the activation of enterprise-led Industry 4.0 clusters, through the use of the Regional Innovation and Technology Clusters Fund
4. Provide clear communication and guidance to firms at all stages of their Industry 4.0 journey, mapping where current digital capability and technical expertise may be found, and signposting public supports available for supporting the industry 4.0 transformation.
5. Provide access to firms to Industry 4.0 demonstrators to allow them to experiment with individual Industry 4.0 platform technologies and the integration of Industry 4.0 digital technologies in configurations simulating those in manufacturing and supply chain firms.
6. Provide support to firms to develop Industry 4.0 pilots in-house that would also act as exemplars to other firms

7. Provide access to external expertise to support firms:

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23 Ireland’s industry 4.0 strategy 2020–2025. DETE
• to evaluate the value capture opportunities, implementation challenges and financial costs and estimate the potential return on investment of Industry 4.0 technology adoption.
• to develop firm-level Industry 4.0 related roadmaps, including: technology; standards adoption; skills; regulation; and investment roadmaps

8. Utilise existing State programmes to support firms to invest in implementation of Industry 4.0, including:
   • Direct to firm RD&I grant support through the agencies.
   • The Future Growth Loan Scheme.

9. Develop options for the establishment of an accelerated capital allowance scheme to incentivise firm investment in Industry 4.0 capital

10. Support the development of strategic leadership and management skills in Industry 4.0

11. Provide direct supports to firms to upskill their existing employees in adopting Industry 4.0 technologies, systems and standards.

12. The Regional Skills Fora will be available to facilitate engagement between enterprise and the Education and Training system to respond to identified needs.

13. Utilise the expertise and supports in the public RD&I system to upskill firm employees in Industry 4.0.

14. Assess the skills requirements for Industry 4.0 and signpost to appropriate provision.

15. Provide support for SMEs and publicly funded researchers through existing funding allocations to engage at international Industry 4.0 standards fora.

16. Develop a plan for Ireland to engage more strategically in international activities and RD&I collaborative initiatives around Industry 4.0, so as to add to capabilities, increase profile in Industry 4.0, and shape the future agenda and opportunities arising.

17. Provide industry-led consortia with opportunities to compete for funding focused on deployment of Industry 4.0 technologies through for example the Disruptive Technology Innovation Fund and Regional Enterprise Development Fund.

18. Establish an Industry 4.0 Stakeholder Forum to oversee implementation of the Strategy, and report on an annual basis to the Minister for Business Enterprise and Innovation.

One of the most important initiatives to support high-level technology sector, was the introduction of Knowledge Development Box in 2016. The initiative aimed at incentivizing companies to invest in innovative solutions and generate intellectual property by offering them a corporate tax rate of 6.25% (2 times less than usual corporate tax rate).

The government has also introduced RD&I grants, which is a direct support mechanism from Ireland’s Foreign Direct Investment Agency. The agency facilitates up to 25% for innovative projects that undertake experimental development.

One of the initiatives of Irish government was a marketing initiative with a dedicated website Tech/Life Ireland, which aims to solve one of the biggest challenges of ICT sector: shortage of
staff. The goal of Tech-Life Ireland is to transform Ireland to the top global destination for a career in technology and to attract 40,000 professionals.

Ireland empowers its education sector, especially focusing on STEM. The country has the highest STEM graduates (31.5) in 1,000 among OECD countries. The government introduced **STEM Education Policy Statement 2017-2026**, with ambitious targets such as increasing students taking STEM subjects for Leaving Certificate 20%, females +40% and introduction of new primary maths curriculum (+creative and computational thinking and coding) etc.

“Harnessing Digital. The Digital Ireland Framework”\(^{24}\) has 4 directions, which include:

- Dimension 1 – Digital transformation of businesses.
- Dimension 2 – Enhance digital infrastructure
- Dimension 3 – Enhance digital skills
- Dimension 4 – Digitization of public services

The strategy introduced a workstream framework to achieve the goals, which include:

<table>
<thead>
<tr>
<th>Dimension 1</th>
<th>Dimension 2</th>
<th>Dimension 3</th>
<th>Dimension 4</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Comprehensively support enterprises across all aspects of their digital transformation</strong></td>
<td>Drive increased gigabit and 5G connectivity, including international connectivity. This will include complementing commercial investment in infrastructure with Government-led initiatives and through facilitating other enablers as appropriate.</td>
<td>Provide digital skills through an agile, responsive skills system – ensuring a comprehensive and inter-connected cluster of skills policy responses to meet the challenges and realise the opportunity of Ireland’s digital transformation.</td>
<td>Further digitalization of public services, leveraging the substantial progress made during the pandemic, and with a particular focus on the health system and schools.</td>
</tr>
<tr>
<td><strong>Pursue a coherent, integrated and proactive approach to the economy’s digital transition, through a robust eco-system and strong enablers.</strong></td>
<td>Address the energy and circular economy challenges from digital technologies through suitable approaches and principles.</td>
<td>Deliver Digital Skills for wider Society, to enable all cohorts of people to engage with and benefit from digitalisation.</td>
<td>Recognising the importance and value of public service held data, develop and fully implement a Public Service Digital Strategy, to ensure such data is harnessed and used safely and effectively</td>
</tr>
</tbody>
</table>

\(^{24}\) *Harnessing Digital - the Digital Ireland framework* (2022) Search for services or information
Prioritize Ireland’s cyber security capacity, expertise, and infrastructure, reflecting the growing importance of cyber security.

1.5 Key Findings

- Considering specifics of the ICT sector and multiple concepts of it, definitions of Armstat, Eurostat and OECD are also used. ICT industry includes ICT manufacturing, ICT trade and ICT Services (with telecommunication) activities.
- According to ITU, core measures to track the performance of ICT are proportion of total business sector workforce involved in the ICT sector and value-added in the ICT sector.
- Based on Deloitte estimations, in 2020 the market size of the world ICT industry in 2020 was accounted to be $3.8 trillion, where $1.848 trillion was the contribution of information technologies, and $1.909 trillion accumulated the communications technologies.
- According to the World Bank, the total amount of ICT services exports was $747.8 billion in 2021, while high-technology exports was amounted to be $2.85 trillion. The leaders of ICT services export are: the US (14%), Ireland (8.3%), the United Kingdom (7.95%), Germany (6.81%) and India (5.56%), while Armenia’s share in ICT services total export was 0.02%
- 2.63% of the world’s GDP is spent at R&D activities. Israel spends 5.44% of its GDP at R&D, while Armenia spends only 0.21%. By this indicator, Armenia falls behind almost all peer countries (CIS and Eastern Europe).
- According to McKinsey, there are 10 trends in high-level technologies that will have significant impact in the nearest future, including: next-level process automation and visualization, future of connectivity, distributed infrastructure, next-gen computing, applied artificial intelligence, future programming, trust architecture (cybersecurity), next-gen materials, clean technologies.
- The development of ICT sector in Israel, is a result of such incentives as repatriation of educated Jews from USSR, heavy investments on STEM education, investment incentives for FDI inflow, investments on R&D. For country-level management and policy making in the ICT industry a special body - Israel Innovation Authority (National Authority for Technological Innovation).
- Tax incentives, introduced by Israeli government for the development of ICT sector includes different regimes, such as: preferred enterprise regime – for companies engaged in nano and bio technologies, which meet set criteria; special preferred enterprise regime – for large companies, included in R&D activities; preferred technology enterprise regime – for technological companies, which expense on R&D prevails 7.5% of revenue.
• One of the most important incentives, proposed by Israeli government are grants for R&D. Different initiatives and funds, such as R&D fund, Magnet Consortia provide state grants (up to 50%) for approved programs

• Estonian government main initiatives on the development of ICT sector are connected with STEM education. Tigre Leap and Tigre Leap Plus programs aimed to provide necessary equipment to all Estonian schools, updating school curriculum as well as creation of electronic educational materials, in-service training, and support of teacher cooperation and experience exchanges

• Moreover, Estonia provides one of the most liberal taxation regimes. However, the country faces the problem of shortage of labor force. Estonian government introduced different initiatives such as “Bringing 2,000 IT specialist to Estonia” or “Choose IT” projects.

• Favorable taxation regime has been one of the most important factors for the development of Ireland’s ICT industry. Ireland has one of the lowest corporation tax rates in Europe at 12.5%. This is the 3rd lowest taxation rate in the EU and 4th lowest in OECD developed countries.

• One of the most important initiatives, to support high-technology sector, was the introduction of Knowledge Development Box, aimed at incentivizing companies to invest in innovative solutions and generate intellectual property by providing them corporate tax rate at 6.25%. The government has also introduced RD&I grants (up to 25% support for the innovative projects that undertake experimental development)
2. Current Positioning of ICT Sector

2.1 State Programs in the ICT Sector

ICT is announced by the Government as one of the priority sectors of Armenian economy in 2000. By the decision of the President of RA, under the coordination of the Prime Minister of RA, in 2001, Information Technology Support Council was established, the strategic objectives of which were to support to the dialogue and become a liaison between the private sector representatives, state authorities, NGOs and international donor organizations. On June 2019, the responsibilities of ITSC were given to the Ministry of High-Tech Industry of RA, which is “a central body of executive authority that develops and implements the Government’s policy in the spheres of communication, information, information technology and information security, postal services, licensing, granting of permits and military industry25”.

For the period 2008-2018, the ICT sector of Armenia had been developing according to the “ICT Sector Development Strategy for 2008-2018, approved by the Government. The main objectives of the strategy were 1) to form an innovative and digital society in Armenia, 2) to involve Armenia in the global knowledge economy, 3) make the ICT one of the leading sectors of economy. Among the key goals of the strategy increasing the level of computer saturation and access to internet in all sectors of economy, creating new techno parks and incubators, establishing a large venture fund, expanding local market volumes for domestic ICT products and services, boosting the inflow of FDI to Armenia were indicated. The Ministry of Economy of RA was in charge of implementation and control of the actions underlined in the strategy, for the period of 2008-2017.

In 2020, the Government has adopted “High-tech industry development strategy for 2020-202526”. The priority subsectors in high-tech industry according to the strategy are:

<table>
<thead>
<tr>
<th></th>
<th>Priority subsectors in high-tech industry of RA</th>
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<tbody>
<tr>
<td>1</td>
<td>Artificial Intelligence</td>
</tr>
<tr>
<td>2</td>
<td>Data Science</td>
</tr>
<tr>
<td>3</td>
<td>Cybersecurity</td>
</tr>
<tr>
<td>4</td>
<td>Quantum Systems</td>
</tr>
</tbody>
</table>

5. Nanotechnologies
6. Robotics
7. Internet of Things
8. Modern Communication Technologies
9. Optics and Laser Technologies
10. Radioelectronics and Microelectronics
11. Bioengineering
12. DNA sequencing
13. Superconductors
15. Energy Storage Technologies
16. High Precision Machining
17. Blockchain technologies
18. Aerospace Technologies

Source: High-Tech Industry Development Strategy

The strategy has set 6 targets, among which are making high-tech industry the locomotive of Armenian economy, development of startup engineering ecosystems, increasing the export of high-tech products and services, digitization of economy and public management systems, expanding high-tech infrastructure and access to the infrastructure, development of the military industry. The strategy stresses out the importance of building an ecosystem for the development of the high-tech industry, which includes upgrading the educational system, growth of startup ecosystem (national venture fund, “Armenian Virtual Bridge”, co-financing grants, support to startups), development of infrastructure and legislation.

The Government Programme of RA for 2021-2026 also stresses the importance of high technologies for the economy and security of Armenia. According to the programme, by 2026 the GoA plans to have 35,000 people who are employed in the high-technology industry, creating more than 16,000 jobs in the sector, raising the sectoral turnover to as high as 500 billion AMD, so the value added in GDP will reach 6-7%. As for 2021, sectoral turnover in ICT amounted to ~350 billion AMD, so the contribution to GDP is ~4%. The government also plans to develop a strategy for the development of high-tech industry in Armenia. The actions, envisaged by the Government Program for reaching the set targets, are:

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- Enhancement of technology education in high-tech sector

- Expand the opportunities of involvement of financial resources to start-ups, support their access to world market, including state support programs

- Support of actions aimed at immigration of technological potential

- With the introduction of grant programs creation of value and technological solutions all sectors of economy

- Implementation of acceleration and educational programs in order to provide inflow of technological knowledge from world’s best scientific research centers, educational and technological institutions

- Capacity building for existing technology centers, techno parks, accelerators and incubators as well as establishing new centers in marzes of Armenia

- Establishment and empowerment of engineering and industrial zones based on the experience of “Engineering City”

- Support to the presence of Armenian IT companies in prestigious and popular international events, exhibitions

- Promotion of effective cooperation between private sector and higher education institutions for providing qualified specialists

- Capacity building programs for sectoral companies

Currently, Ministry of High-Tech Industry implements various programs, aimed at supporting ICT sector, establish an ecosystem of innovations as well as introduced economic measures to counter the impact of COVID-19.

17th state support initiative28 aimed at support high-tech companies and entrepreneurs. In the frames of this initiative, 3 types of grants are provided: 1) innovation grants – up to 10 million AMD, for organizations/entrepreneurs, officially operating in Armenia for at least 2 years (the budget of the program is 330 million AMD), 2) Grants for sustainable companies – up to 20 million AMD. The budget of the second program is 460 million AMD, 3) Co-financing program up to 30 million AMD.

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Overall, these programs were crucial for high-tech industry, during active lockdown and economic restrictions period. 117 companies applied for the 1st program (23 grant agreements signed) and 143 companies applied for the 2nd program (41 grant agreements signed).

2.2 Regulatory Environment and Taxation Regime of the ICT Sector

Armenia’s vision since gaining independence has always been to adopt business-friendly legislation and taxation regime. The membership in World Trade Organization has accelerated the regulatory reform process, aimed at building a more investment-friendly ecosystem in the country. The fundamental documents, which regulate the corporate environment in Armenia, are: RA Constitution, Civil Code, Labor Code, RA Law on Foreign Investments, Law on Standardization, Law on Licensing, Law on Protection of Economic Competition.

Laws, which regulate the business environment in Armenia, might be divided into:

- **Corporate Legislation** – Laws on Joint Stock Closed Companies, Limited Liability Companies, State Registration of Legal Entities
- **Fiscal Legislation**, which will be discussed after
- **Financial Sector Regulations** – Law on Central Bank of Armenia, Laws on Banks and Banking, Credit Organizations, Investment Funds, Insurance etc.
- **Natural Resources** – Law on “Exploration of Natural Resources”

Armenia is part of 20 Investment Related Instruments29, such as TRIPS, TRIMS, GATS (4th protocol, 5th protocol), UN Code of Conduct on Transnational Corporations, Doha Declaration, World Bank Investment Guidelines. Moreover, Armenia has signed and ratified European Convention of Human Rights, 44 bilateral investment treaties.

Armenia, along with the Russian Federation, Kazakhstan, the Kyrgyz Republic, and Belarus, is a member of Eurasian Economic Union (EAEU) and has signed and ratified Treaty on the Eurasian Economic Union. The membership presupposes an internal market of goods and services, capital and labor, a common customs tariff, and a single policy of customs regulation.

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29 IIA navigator. Armenia | International Investment Agreements Navigator | UNCTAD Investment Policy Hub
2.2.1 Regulatory Environment of the ICT sector

In Armenia, the main legislative act for the regulation and support of the ICT industry is the law on “State Support in the Information Technology Sector\(^{30}\)”, adopted in December 2014, and updated in April 2019. The law introduces the supporting mechanism called “IT Certificate”, which presupposes tax benefits including:

- Corporate Income Tax exemption (CIT rate is 18% in Armenia) for 5 years
- Personal Income Tax reduction to 10% (PIT rate in Armenia is 21%).

The certificate is issued and granted to companies by a special Commission established by the Government. The law introduces various requirements for the companies, to get the certificate, such as the staff number should be no more than 30, 70% of the revenue should be generated in the subsectors declared in the law.

To get the certificate, companies should be engaged in:

- **Software development**, including the creation, testing, modification of software, creation of application programs, development of system software, databases, websites, software-hardware transformation, adaptation of applications
- **Digital and IT consulting**, including the development and design of integrated IT systems, trainings
- **Computer systems management**, including in-network management, creation of computer science, maintenance of technical data
- **Data Processing**, including distribution of information in the network, database management and related activities, web hosting services, etc.
- **Activities with web portals** including activities with websites, the creation and maintenance of databases and websites on the Internet
- **Educational, Research** activities in the ICT sector

2.2.2 Taxation Regime in Armenia: ICT Sector Specificity

The fiscal system of Armenia is regulated by the “Tax Code of the Republic of Armenia”, which was updated in 2018, with some significant changes which might be crucial for the ICT industry of Armenia.

The main tax rates in Armenia are presented afterward\(^{31}\):

\(^{31}\) Worldwide tax summaries online. PwC
Table 5 Tax rates in Armenia

<table>
<thead>
<tr>
<th>Tax</th>
<th>Rate of the Tax, %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corporate Income Tax</td>
<td>18</td>
</tr>
<tr>
<td>Personal Income Tax</td>
<td>21 (20 from 2023)</td>
</tr>
<tr>
<td>Value-Added Tax</td>
<td>20</td>
</tr>
<tr>
<td>Withholding Tax on Dividends/Interest/Royalties for Residents</td>
<td>N/A</td>
</tr>
<tr>
<td>Withholding Tax on Dividends/Interest/Royalties for Non-Residents</td>
<td>5/10/10</td>
</tr>
<tr>
<td>Headline corporate capital gains tax rate</td>
<td>Subject to the CIT rate</td>
</tr>
<tr>
<td>Headline individual capital gains tax rate (%)</td>
<td>10 or 20 (depends on property type, customer)</td>
</tr>
<tr>
<td>Headline net wealth/worth tax rate</td>
<td>N/A</td>
</tr>
</tbody>
</table>

*Source: PWC*

Businesses with annual sales of less than 115 million AMD are eligible to pay turnover tax. The rate of turnover tax is set at 1.5-5%.

Armenia introduced a new tax code in January 2018, which involves some significant developments in the taxation regime. There was no legislation on transfer pricing, and since 2020, the transfer pricing regulations entered into force in Armenia. Transfer pricing refers to the determination and justification of the price for the transfer of goods and services between affiliated companies in different taxation regimes. Companies whose transactions exceed 200 million AMD, are required to give Transfer Pricing reports.

2.3 International Donor Organizations Interventions in ICT Sector

International donor organizations recognize the role and importance of the ICT sector for the development of emerging economies. As for the developing part of the world, ICT provides a unique opportunity to fight against poverty, support the private sector, and facilitate access to high-quality education and public health services. International donor organizations, which operate in Armenia have implemented various projects in ICT and ICT-related sectors (such as education, infrastructure development etc.)

World Bank established one of the biggest technology business incubators and IT development agencies in the region, Enterprise Incubator Foundation within the framework of “Enterprise Incubator” project. EIF has implemented various projects, research in IT sector; moreover, EIF offers financial support to start-ups. EIF gives grants in different stages of growth of the

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32 Uplifting Armenian Economy Through Entrepreneurship (2021) Enterprise Incubator Foundation
company, in the scope of the **“Support to SME Development in Armenia” (EU-SMEDA)”** project, which is implemented by GIZ, and co-funded by European Union. Grants in the frames of EU-SMEDA project, are not the first experience of EIF and international donors in direct financing of the start-ups. In 2013-2015, EIF along with World Bank and Government of Armenia announced Innovation Match Grants (IMG) and Regional Match Grants (RMG), as a supporting tool for technology-driven enterprises, start-ups as well as traditional sectors to adopt new technologies. The grant scheme, in IMG program was 5-25 million AMD, and in RMG up to 50 thousand EUR. Overall, 80 start-ups and SMEs received $2.5 million grants in the frames of the programs, introduced by various donor organizations and EIF.

Another venture accelerator fund, which targets achieving Sustainable Development Goals, is **ImpactAim**[^33], which is established by **UNDP**, as a component of SDG Innovation Lab. ImpactAim, supports start-ups with a focus on a specific sector (agriculture, climate change etc.) and sustainable and tech-based solutions. ImpactAim includes several accelerators, such as **AgriTech**, (implemented jointly with Armenian State Agrarian University), which targets science and technology-based start-ups, which offer solutions for agriculture, **GovTech**, which is aimed to empower women entrepreneurship, **Climate Change Technology Accelerator**, focusing on the adoption of climate change, in cooperation with ISTC, EIF, Ministry of Environment and ADB Ventures.

European Union, GIZ, are implementing two start-up academy projects, called **SAP Start-up Factory and Armenia Startup Academy**. SAP factory, which is realized with Business Angels Network of Armenia, supports B2B start-ups in go-to market, by providing mentorship and technical support to selected start-ups. Armenia Startup Academy, with its pre-acceleration and traction programs helps startups to have access to global markets too.

Regional development has always been one of the focuses of international donor organizations. The World Bank, along with the Government of Armenia and Enterprise Incubator Foundation has established two technology centers in Gyumri and Vanadzor. **Gyumri Technology Center and Vanadzor Technology Center (operated by EIF) aimed** at promoting the IT industry in marzes of Armenia, establish IT infrastructure, capacity building in both technical and business areas, encouragement of entrepreneurship. The centers implement two types of activities: promotion of entrepreneurship in the IT sector and educational programs.

One of the core dimensions of international donor organizations activities in Armenia is establishment of laboratories. Generally, laboratories are established in cooperation with universities and educational institutions.

[^33]: *Accelerate. invest. measure. ImpactAim Venture Accelerator*
Armenian National Engineering Laboratories (ANEL) is located in National Polytechnic University of Armenia, and is founded by EIF, Government of RA and USAID. ANEL is equipped with 30 specialized laboratories both for research and for education, where students can get fundamental knowledge with the hand-on practice, interactive way and modern technologies. ANEL covers major specializations of university: Cybernetics, Radio engineering and Communication systems, Power Energy, Electrical engineering, Transport, Mechanical and Machine Building engineering.

Another laboratory, which is functioning in National Polytechnic University of Armenia, is mLab ECA, which is a joint program of World Bank, Government of Finland and Nokia Corporation, which is the first mobile app laboratory in the region aimed to promote the mobile solutions in global markets. The lab offers incubation services for mobile start-ups, various trainings.

USAID, Microsoft Corporation and EIF established branch of Microsoft Innovation Center, which implements several projects to support IT industry of Armenia, including training programs (programming fundamentals, programming in C#, Python Programming etc.), training program on Data Science to support technology-driven solutions for SMEs.

Another important initiative, funded by USAID, is Armenia Workforce Development Activity. The main objective of the program, which started in 2021, is to provide with necessary skills and competences to 10,000 people aged 15-29, demanded in labor market and ensure 7,000 of them have better working opportunities and find employment in ICT, agriculture or hospitality industry.

Besides the support of the private sector, international donor organizations are active in the sphere of digitization of services provided by public bodies. The Government of Armenia, public bodies have started the 4th series of Public Sector Modernization Project, which is commissioned by World Bank. The overall budget of the project is ~$29.5 million and includes 3 main components:

<table>
<thead>
<tr>
<th>Name of Component</th>
<th>Specific Activities</th>
</tr>
</thead>
</table>
| Component 1 – Modernization of the public administration | 1) Improve the efficiency of the civil service administration  
2) Improve the efficiency and compliance of justice services and judicial processes  
3) Support the modernization of systems of the new Ministry of Interior |
| Component 2 – Digital services delivery | 1) Modernization of the tax and customs administration systems aimed at improving the efficiency of revenue mobilization |
| Component 3 – Data management and digital infrastructure | 1) Enhance the efficiency and security of digital infrastructure  
2) Improve the resilience to cyber threats of the Borrower’s digital infrastructure and assets  
3) Improve the application of data science, machine learning and artificial intelligence in GovTech |

| 2) Strengthening of central government service delivery  
3) Support of local governments through the piloting of activities related to re-engineering databases, data infrastructure and computing systems |

*Source: World Bank*

### 2.4 STEM Education in Armenia

Traditionally, Armenia has strong positions and heritage in STEM, engineering. During Soviet times, the center of technological research and production was centered at the *Yerevan Scientific Research Institute of Mathematical Machines*, known as Mergelyan Institute, which designed Razdan general-purpose digital computers family, Araks computer. Such factories as ArmElectro, Hrazdanmash, Electron made early computers, radio electronics, semiconductors. These initiatives transferred Armenia into electronics hub in the USSR, and boosted STEM education in Armenia.

According to the Statistical Committee of RA, there are **55** higher educational institutions, operating in Armenia; 23 of them are state universities; 32 are private universities. Because of the reforms in the educational sector of Armenia, the number of private universities is reducing, as the quality of education, provided by private universities are being criticized usually.

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34 Statistical Committee of RA
Armenia faces some demographic challenges, which have their serious impact both on education, and on private sector. The population of the country is declining, because of low fertility rates, high migration, and declining number of births. Armenia is among the countries, which are considered to be among rapidly aging. According to UN projections, in 2030, 24% of the country’s population will be elderly and retired people. As a consequence of these, the number of students in Armenian educational institutions is steadily declining. If, in 2016 the overall number of students was 72,517, in 2022 the number decreased by 20%, and amounts to 57,608.

The same trend can be observed, with the number of enrolled students. As of 2021, 15,117 students were enrolled in state universities; however, the situation was much worse in 2018, when the number of enrolled students was 8,200. Currently, one of the most significant challenges that higher educational institutions face in Armenia is the shortage of applicants. According to the Ministry of Education, Science, Culture and Sports of RA, in 2022 9,729 applicants enrolled in higher educational institutions, while 14,158 places in universities remained unfilled.
Despite the fact that social sciences and humanitarian fields continue to be dominating, popularity of STEM and IT-related specializations among school leavers is increasing with acceleration. This is explained by the overall growth of the ICT industry, high demand for ICT specialists and attractive remuneration rate. As for 2021, the number of bachelor students learning Information and communication technologies in state universities was 4,386, which is 7.6% of all students in state educational institutions for that period.

**Figure 8 Number of enrolled students in higher educational institutions**

**Figure 9 Distribution of students in state higher educational institutions**
As mentioned above, the ICT and ICT-related specializations become more and more popular, due to various reasons, such as the increasing popularity of IT-related jobs, higher wages in IT sector compared to other sectors, better opportunities of career development. In 2017, only 889 applicants were enrolled in state universities with the ICT specialization; however, the number has grown by 29% in 2021. The trend of admission to ICT and STEM specializations is as follows:

![Figure 10 Enrollment by STEM and ICT specializations, number of students](image)

*Source: Statistical Committee of Armenia*

As the Figure 10 shows, Information and Communication Technology specializations are predominant, which is another challenge, that high-tech companies of Armenia face, as the specializations which require fundamental knowledge of sciences supply much less workforce than ICT specializations and such industries as EDA, chip design feel the shortage of labor force much more, than ICT companies do.

As for 2021, 9,729 people are studying for their master’s degree in state educational institutions of Armenia, and the trend is the same as bachelor’s degree. For the period 2017-2021, the number of students in master’s programs declined by 17.5%. Only 618 people, in 2021 study for their master’s degree in the field of ICT, 363 in Engineering, 112 in Physics, 155 in Mathematics and Statistics. This is one of the phenomena that was revealed during in-depth interviews. While ICT-related specializations are very popular for bachelor’s, very few people continue their studies in master’s programs. Part of the respondents think that it is because the low quality of academic education in Armenia, and during 4 years of bachelor programs students lose their interest on academic education, while there is an opinion, that majority of students start to work by the end of third course and see no sense to get master’s degree.

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35 ArmstatBank. Statistical Committee of Armenia
Currently, **Yerevan State University (YSU)**, **American University of Armenia (AUA)**, **Russian-Armenian Slavonic University (RAU)**, **National Polytechnic University of Armenia** are the main educational centers in ICT and ICT-related specializations.

**Yerevan State University (YSU)** – is the oldest and largest university of Armenia, established in 1919. Currently, the number of students in YSU exceeds 18,000. The university has 21 faculties. Main departments, which prepare workforce for the ICT industry, are Faculty of Informatics and Applied Mathematics, Faculty of Mathematics and Mechanics. The bachelor program of Faculty of Informatics and Applied Mathematics includes Information and Applied Mathematics, Computer Science, Information Security programmes. The Faculty of Mathematics and Mechanics offers Mathematics, Mechanics, Actuarial and Financial Mathematics, Applied Statistics and Data Science programmes. YSU is a big research center and hosts the Information Technologies Educational and Research Center, and offers continuing education, discrete programs, scientific research. The center also offers master’s degree programs.

**American University of Armenia (AUA)** – was founded in 1991, and provides high-quality education for undergraduate, graduate as well as VET courses. AUA offers undergraduate degrees in 7 fields of study, among which: BS Computer Science, BS Data Science, BS Engineering Studies, along with graduate degrees in Computer and Information Science and Industrial Engineering and Systems Management. ICT and ICT related fields of study are managed by Akian College of Science & Engineering, which is also a research center. The college currently implements joint research projects with Mentor Graphics, Coca-Cola (developing a platform to automate and manage “Bottle Washer Caustic Solution Filtration System”, has collaboration with Harvard University (design and production of short intramedullary nails), launched STEMGen project to increase the quality of science and math teaching in schools.

**Armenian-Russian (Slavonic) University (RAU)** – was established in 1997, based on the agreement between Armenia and the Russian Federation. Since 2012, the university has formed institutes, which consolidated similar departments and faculties. The Institute of Mathematics and Informatics brings together the departments of system programming, cybernetics, applied mathematics. The Institute offers bachelor’s program in Applied Mathematics and Informatics and master’s program in 6 various specializations: Intellectual Systems and Robotics, Mathematics and Programming Information Security (together with Kaspersky Laboratories), Applied Statistics and Data Science, System Programming, Machine Learning, Mathematical Modelling. The university also hosts the Institute of Physics and Engineering, which offers degrees in Electronics and Nano electronics, Information and Communication System.

**National Polytechnic University of Armenia (NPUA)** – is the main educational center for technical specializations. NPUA along with the central campus in Yerevan has 3 branches in marzes of Armenia: in Gyumri, Vanadzor and Kapan. The structure of NPUA consists also of college, high school and kindergarten. Currently, more than 8,000 students are studying in NPUA,
more than 800 professors (more than 500 of them are PhD, 100 are doctor of sciences). NPUA has 4 institutes and 1 faculty: Institute of Information and Telecommunication Technologies and Electronics, Institute of Mining, Metallurgy and Chemical Technologies, Institute of Energy and Electrical Engineering, Institute of Mechanical Engineering, Transportation Systems and Design and Faculty of Applied Mathematics and Physics. NPUA is a big scientific research center and hosts Armenian National Engineering Laboratories (ANEL) and Microsoft Innovation Center Armenia.

Despite the fact that STEM education is getting more and more popular, the education system needs major reforms. **ICT companies highlight the mismatch between the supply and demand of the skilled workforce as the main factor,** that hinders the growth of ICT sector. The educational institutions, their curriculum is not adopted to the quickly changing industry, as according to in-depth interview participants, the technologies and equipment in Armenian universities are outdated, most of the state universities do not have access to the most recent professional literature and courses (some of them use Soviet-time literature), professional development of teaching staff is at a low level. The solution of this challenge consists of 2 ways:

- **To hire specialists (especially senior level) from abroad** – numerous Armenian companies are trying to find proper specialists in CIS countries, and Iran Islamic Republic, where fundamental knowledge of STEM is strong.

- **To establish their own educational platforms** – Such companies as Synopsys, PicsArt, Digitain launched their academies, and try to grow human resources for their needs by their own educational platforms and programs.

However, it should be noted that there are several educational incentives, such as **Armath Laboratory**, which is an educational program for children in technology and entrepreneurship trying to solve this problem. Armath has 613 labs in all Armenia, where 17,000 students are currently enrolled. **12% of graduates** have founded their start-ups. In this context, **TUMO Center for Creative Technologies** should also be mentioned. TUMO provides technology and design programmes for around 15,000 teenagers in Armenia.

### 2.5 Competitive Advantages of Armenia

IT is the most **labor productive sector of Armenia**. The qualified and comparatively affordable workforce has been the most crucial competitive advantage of the country since the industry formulation. Moreover, Armenia offers the following competitive advantages and opportunities relative to the other peer countries:
### Competitive Advantages

- Presence of leading international players such as Synopsys, Mentor Graphics, National Instruments, AMD, NVidia, Oracle of ICT industry in Armenian market.
- Strong traditions and heritage in Electronics and Mathematics. Armenia used to be a big technical hub in Soviet times, with such institutions as Yerevan Computer Research and Production Institute, Armelectro, Electron factories. See more detail in chapter 3.1.
- Availability of qualified human resources, able to solve complex issues.
- Newly formed startup and venture capital ecosystem. See more detail in chapter 4.4.
- Favorable conditions for business. ICT is considered a strategic industry for Armenia; thus ICT companies enjoy tax benefits (0% of corporate tax for 5 years, 10% of personal income tax by IT certificate).
- Strong links with Armenian diaspora, and thus to more advanced economies and ecosystems. See more detail in chapter 4.2.
- Double tax treaties with 48 countries, bilateral investment treaties with 44 countries.

### Weaknesses

- Competitive market drives the already high salaries in the sector to new heights, which makes the profit margin of IT companies lower YoY.
- Demographic issues – supply of labor is decreasing YoY, which makes salaries in the sector higher.
- Shift from outsourcing to own product development model, requires new knowledge and skills, which are mostly lacking.
- Problems in education system – mismatch between supply and demand of qualified staff is the key factor that hinders the development of the ICT industry.
3. ICT Sector development in Armenia

The development history of ICT industry in Armenia might be divided into 2 main periods: Soviet times and independent Armenia. As discussed in Chapter 2, the presence of numerous research centers, institutions, which had been establishing since 1950s accumulated experience and traditions in ICT and high-tech industry of Armenia, which eventually led to lay the cornerstone of ICT industry in independent Armenia.

Soviet Armenia

The rise of ICT industry in Armenia started from 1920s, in parallel with the industrialization period of USSR. This process required a quality labor force, especially ones with engineering specializations, and led it to the establishment of National Academy of Sciences in 1935 and Yerevan Polytechnic Institute in 1933. However, serious developments in this sector particularly in software development had started in 1950s, especially with the establishment of Yerevan Scientific Research Institute of Mathematical Machines. The institute was meant to build and design electronic computers and related equipment. During the first years of establishment, the institute was mainly focused on development of small and medium scale computers, then in 1970s on automated control systems, mainframes, operating systems application software. The flagships of the Institute were the “Nairi” computers system, which received more than 40 patents, IBM-360/370 compatible, ES series of computer systems, which were actively used in scientific and industrial applications throughout USSR. One of the most important achievements of the institute was the development of telecommunication system for the mission in the moon.

During this period, Armenia has become an internationally recognized electronic, semiconductor design and manufacturing hub. “Transistor” semiconductor R&D and manufacturing plant was a leader in the production of transistors and amplifier diodes, “Sirius” Radioelectronics plant was famous for electronic advanced devices production. In 1978, Yerevan Telecommunication Research Institute was established, which was manufacturing integrated circuits and other advanced production based on silicon thin film technology, then there were huge investments in establishing Ashtarak semiconductor and electronics manufacturing plant and Mars integrated circuits and electronics plant. Overall, as of 1990 there were ~40 large R&D institutions and production facilities in Armenia.
These developments contributed to the formation of strong mathematics and fundamental sciences traditions in Armenia, establishment of necessary infrastructure as well as putting Armenia in the map of software and hardware developing countries. Overall, these institutions, accumulated experience and knowledge became the basis of ICT industry of Armenia.

Independent Armenia |

The break-up of the USSR dramatically affected technology sector of Armenia, as Armenian companies lost their biggest client – Soviet military industry complex. Starting era of personal used computers, along with USSR breakdown, lead to the collapse of high-technology industry of Armenia. The main dimension of the industry in Armenia, was large-scale manufacturing and R&D in Soviet times, so they had to adjust to new realities and develop market and consumer driven services and solutions.

The recovery of the industry was mainly connected with foreign investment, especially in the 1990s when US-based software companies (Boomerang Software, Cylink, Epygi Technologies, Virage logic etc.) opened their offices in Yerevan. It is noteworthy, that Armenian diaspora in the US, played a crucial role in establishment of these offices in Yerevan. Since the boom of IT in early 2000s, more ICT industry giants turned their attention to Armenia. Huge experience in semiconductor and chip design in Armenia facilitated the attraction of foreign investment and bringing key industry players to Armenia.

One of the most important developments in the sector, was Synopsys Inc. entrance into Armenian market, through acquisition of Armenian LEDA Systems, Monetary Arset and HPL Technologies. Since the establishment of Armenian office, Synopsys has been one of the largest software firms in Armenia, with strong R&D component, employing more than 1,000 people. The success of Synopsys encouraged other EDA companies to set up offices in Armenia. In 2008, Mentor Graphics (currently Siemens) acquired Ponte Solutions (US-based developer of solutions for manufacture and semiconductor design company, founded by ethnic Armenians) and established their presence in Yerevan, National Instruments started an engineering and R&D office in Yerevan, which offers turn-key solutions for various industries.

Another major development, in Armenian ICT industry was emerging software outsourcing services. Armenia was attractive for foreign companies and investors for the availability of quality labor force, and relatively low costs. With the raise of venture capital in Armenia, start-up ecosystem had been developing, and successful Armenian start-ups are emerging. This model presupposes development of an ICT product, which is another model of development. These models will be discussed in the chapter. In parallel with this, global ICT players, such as Microsoft Innovation Lab, Cisco Systems, Rocket Systems, VMware launched their operations in Armenia.
Nearly 6.5% of annual growth in the total workforce employment (for 1998-2000), established around 90 new companies in ICT, 6% of growth in annual turnover (in 1998 turnover of ICT industry was $10 million), led the Government of Armenia to declare ICT as one of the priority sectors of Armenia in 2000. Another major policy development for the ICT sector was the establishment of Information Technologies Development Council in 2001, which was replaced by Ministry of High-Tech Industry of RA. In 2002, Union of Information Technology Enterprises was founded, which became a platform of cooperation between Armenian IT companies. UITE holds the annual Digitec Summit and Digitec Expo, the biggest technology-oriented events in South Caucasus region. In 2019, due to the efforts of UITE, Armenia held World Congress on Information Technology, the largest IT conference for entrepreneurs and innovators.

### 3.2 ICT Sector Current Performance

*Note: the sector with the largest weight declared in the given sector is considered as the “sector”*

Statistical data on ICT in Armenia are published by two agencies: Statistical Committee of Armenia (ArmStat), responsible for official statistics of the country, and State Revenue Committee (SRC).

ArmStat uses OECD and Eurostat methodology (collects data on resident branches of Armenian ICT companies) but omits some companies (mostly small and micro businesses), thus getting smaller coverage (no thorough assessment of market is performed).

Considering these limitations and following the OECD methodology, we have relied mostly on State Revenue Committee (SRC) data. SRC kindly consented to provide data on companies registered in SRC which are engaged in any ICT activities. Based on these data we have attempted to provide an alternative analysis of turnover/output both in the ICT sector (net) and subsectors (net) for 2019-2022. If SRC data are considered using the ArmStat approach, i.e. without estimating net ICT share, the resultant figure is greater. It is also understandable that, although SRC data are based on thorough recording and disclosures, they do not reflect possible shadow either

Enterprise Incubator Foundation (EIF) had been publishing data on ICT industry, conducting marge surveys of industry players, however they ceased doing it in 2019.

According to the State Revenue Committee of RA, in 2021 total turnover of ICT sector was $985.1 million or 496,278 billion AMD. The CAGR for 2019-2021 period was amounted to be 7.1%
For the 1\textsuperscript{st} and 2\textsuperscript{nd} quarters of 2022, total turnover of ICT sector was \textbf{358,075 billion AMD or 764,7 million}.

In the structure of total ICT industry turnover, ICT services have a dominant role. As of 2021, ICT services, made up -54% of total turnover, which in absolute volumes is $528.8 million.

However, because of such crucial developments, the most significant of which was the Russian invasion of Ukraine, relocation of Russian Federation-based IT businesses and specialists to Armenia’s ICT subsector resulted in $447 million turnover generated in the 1\textsuperscript{st} and 2\textsuperscript{nd} quarters of 2022.
Based on SRC data it can be said that real growth/decline in 2021 vs. 2020 by subsectors was:

- ICT production: -29%
- ICT trade: 20%
- ICT services (without telecommunications): 39%
- Telecommunications: 2%

It is obvious, that the leading subsector of ICT industry in Armenia is ICT services (without telecommunication). Let’s look at the structure of ICT services subsector

**Figure 13 Structure of ICT services subsector as of Q2 2022, %**

![](image)

*Source: SRC*

Based on the presented data, it can be stated, that Computer Programming, Consultancy and Other activities are the driving force behind ICT industry of Armenia. However, data processing activities along with software publishing have recorded the biggest growth rate for the last 2 years.

### 3.2.1 ICT Contribution to GDP

Considering the specifics of this sector, we identify ICT output with ICT turnover, except in ICT trade subsector; added value is estimated based on this.

Furthermore, considering that Armstat data does not cover the whole ICT industry, the calculations were performed using SRC data. Note that whereas ArmStat uses total turnover/output for companies for which ICT is a dominant business, we have considered only net ICT turnover/output based on SRC data.

According to SRC and Armstat data (Intermediate Consumption), **added value in ICT in 2021 was, 331.2 billion AMD constituting 4.7% of Armenia GDP.** As of 2019, ICT constituted 3.2% of Armenia GDP, while in 2020 3.8%.
If we look at the structure of value added by ICT subsectors, the picture is the following:

<table>
<thead>
<tr>
<th>ICT Subsector</th>
<th>Added Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>ICT Production</td>
<td>782 million AMD</td>
</tr>
<tr>
<td>ICT Trade</td>
<td>17,484 billion AMD</td>
</tr>
<tr>
<td>ICT Services</td>
<td>312,885 billion AMD</td>
</tr>
</tbody>
</table>

*Source: SRC*

Due to several reasons, many Armenian companies incorporate affiliates abroad and a considerable part of added value remains in foreign books (this issue is covered in detail in the next chapter).

By ICT share in GDP Armenia has solid performance, compared to other peer countries. Considering the rate of growth in this sector, significant improvement can be expected in upcoming years.

**Figure 14 ICT Contribution to GDP, 2021, %**

![Graph showing ICT Contribution to GDP](image)

*Source: SRC, Eurostat, National Statistical Bodies, Armenia Calculations*

### 3.2.2 Employment in ICT Sector

According to SRC, from 2019 to Q2 2022 average quarterly number of hired workers in ICT in Armenia grew by 65% to reach 35,287. Average quarterly growth from Q1 2016 until Q1 2018 was 4%, for this period, however if before Q2 2022 the growth rate was 3-6%, in Q2 the rate was 13%, mainly due to ICT specialists’ relocation from the Russian Federation following the Russian invasion of Ukraine.
The main contributor to the impressive growth of the number of hired workers is the “ICT services without telecommunication” subsector. As of Q2 2022, this sector had the greatest share in the structure of ICT workforce – 73%, followed by telecommunication sector 21%.

In absolute values, ICT services subsector, as of Q2 2022, employed 25,673 workers.

The figure below shows the structure of hired labor by subsectors as of Q2 2022.

**Figure 15 Number of hired workers and its growth rate in ICT sector**

![Graph showing number of hired workers and growth rate in ICT sector](Source: SRC)

**Who are considered hired workers in ICT?**

*To get a reasonably accurate estimate of the number of hired ICT workers, all companies were considered in the operations of which the share of any of ICT subsectors is the greatest. Employees paid during that month were included in calculations (e.g. employees on maternity leave were excluded) regardless of character of contract (employment or civil).*
As revealed before, the biggest contributor to the development of ICT sector is ICT services, especially “Computer Programming, Consultancy and Other Activities”, which has the largest share in ICT services, and as for Q2 2022, it employs 63.7% of total hired workers.

![Figure 17 Number of Hired Workers and Growth Rate in Computer Programming, Consultancy and Other Activities](image)

(Source: SRC)

This number of hired workers in “Computer Programming, Consultancy and Other Activities” has been steadily growing. The average quarterly growth rate for 2019-2022 Q2 is 5%. However, in Q2 2022, the number of hired workers has increased by 21%, which is another impact of the Russian invasion of Ukraine. Taking into account the fact that other subsectors of ICT have not recorded this type of growth, it may be assumed, that overwhelming majority of relocated specialist are employed in this subsector.

According to the Statistical Committee of Armenia, as of 2020 (the latest available data), **44% of hired workers in the ICT sector are female**. According to EIF, this number is **40%**. It is significantly higher than the world average (~20%), and in many advanced countries (including the US).

However, this number might be misleading as this number includes women in marketing, customer service and HR departments. Unfortunately, there are no detailed statistics on the gender situation for software developers, engineers, management staff etc.

**Synopsys** is the leader of Armenian ICT industry, in terms of employment, which has 1,107 hired workers, followed by **EPAM** and **Picsart**, which have 1,098, and 818 hired workers respectively as of July 2022.

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38 *Employment (2020)*. Statistical Committee of Armenia
It is notable, that as a result of the Russian invasion of Ukraine, a lot of ICT services companies relocated to Armenia, and 5 of them (highlighted in figure below) are currently among top-20 employers of Armenia.

**Figure 18 Top-20 biggest employers in IT, number of employees**

<table>
<thead>
<tr>
<th>Company</th>
<th>Employees</th>
</tr>
</thead>
<tbody>
<tr>
<td>Synopsys</td>
<td>1107</td>
</tr>
<tr>
<td>EPAM</td>
<td>1098</td>
</tr>
<tr>
<td>Picart</td>
<td>818</td>
</tr>
<tr>
<td>DataArt</td>
<td>698</td>
</tr>
<tr>
<td>Veeam Software</td>
<td>697</td>
</tr>
<tr>
<td>ClinChoice</td>
<td>438</td>
</tr>
<tr>
<td>Energize Global Services</td>
<td>380</td>
</tr>
<tr>
<td>ServiceTitan</td>
<td>319</td>
</tr>
<tr>
<td>BostonGene Technologies</td>
<td>282</td>
</tr>
<tr>
<td>Synergy</td>
<td>273</td>
</tr>
<tr>
<td>ArctX</td>
<td>239</td>
</tr>
<tr>
<td>Instigate Mobile</td>
<td>239</td>
</tr>
<tr>
<td>Krisp</td>
<td>233</td>
</tr>
<tr>
<td>ArmSoft</td>
<td>233</td>
</tr>
<tr>
<td>VMware</td>
<td>233</td>
</tr>
<tr>
<td>Quantori</td>
<td>233</td>
</tr>
<tr>
<td>Cognizate</td>
<td>232</td>
</tr>
<tr>
<td>VOLO</td>
<td>231</td>
</tr>
<tr>
<td>TeamWork</td>
<td>227</td>
</tr>
<tr>
<td>DevSoft</td>
<td>219</td>
</tr>
</tbody>
</table>

*Source: SRC, Modex*

Comparison of the number of hired ICT workers with similar data from EEA, Belarus and Ukraine shows that Armenia is behind almost all countries except North Macedonia and Bosnia and Herzegovina (microstates are not counted). **However, in terms of share of hired ICT workers in total employed workforce, Armenia, with 4.4% in 2021, outperforms even such countries as Poland, Ukraine and Greece.**

**Figure 19 Share of hired ICT workers in total employed workforce, %**

*Source: SRC, Eurostat, National Statistical Bodies*
According to SRC, as of July 2022, there were **5,924 foreign citizens** employed in the ICT sector. 84% (4,949 employers) of foreigners are from the Russian Federation, 4% from Iran Islamic Republic, 2% from Belarus.

Most of these Russian citizens (4,653 out of 4,949) moved to Armenia due to growing insecurity in the Russian Federation that resulted from the Russian invasion of Ukraine. Relocation in the ICT sector happened in two different forms: 1) relocation of Russian Federation-based ICT companies with their staff; 2) relocation of ICT specialists, hired by Armenia-based firms. The figure below shows companies with the highest share of relocated personnel.

**Figure 20 Firms with most relocated personal, number of employees**

<table>
<thead>
<tr>
<th>Company Name</th>
<th>Employees</th>
</tr>
</thead>
<tbody>
<tr>
<td>Veeam Software</td>
<td>676</td>
</tr>
<tr>
<td>DataArt</td>
<td>406</td>
</tr>
<tr>
<td>EPAM</td>
<td>390</td>
</tr>
<tr>
<td>BostonGene Technologies</td>
<td>277</td>
</tr>
<tr>
<td>Teamwork</td>
<td>221</td>
</tr>
<tr>
<td>Quantori</td>
<td>219</td>
</tr>
<tr>
<td>DevSoft</td>
<td>213</td>
</tr>
<tr>
<td>ManyChat</td>
<td>125</td>
</tr>
<tr>
<td>Align Technology</td>
<td>114</td>
</tr>
<tr>
<td>Keywords Sperasoft</td>
<td>98</td>
</tr>
<tr>
<td>HazelTree Arm</td>
<td>70</td>
</tr>
<tr>
<td>Synopsys</td>
<td>57</td>
</tr>
<tr>
<td>DevArt</td>
<td>56</td>
</tr>
<tr>
<td>NVIDIA Armenia</td>
<td>52</td>
</tr>
<tr>
<td>Eftech Lab</td>
<td>51</td>
</tr>
<tr>
<td>JetBrains</td>
<td>46</td>
</tr>
<tr>
<td>Xtensive</td>
<td>42</td>
</tr>
<tr>
<td>Wrike Armenia</td>
<td>33</td>
</tr>
<tr>
<td>ServiceTitan</td>
<td>29</td>
</tr>
<tr>
<td>Nasa2</td>
<td>28</td>
</tr>
</tbody>
</table>

Source: SRC, Modex

Note: Blue – relocated firms, red – local firms, green – Armenia-based firms with relocated teams

### 3.2.3 Wages in ICT Sector

To track the development of remuneration rate in the ICT sector, two sources are looked at: Statistical Committee of RA, and State Revenue Committee of RA.

However, these two sources have their own problems. As for SRC, the data is not representative, as high-paid subsectors are combined with low-paid ones (such as Computer Programming Consultancy and Other activities with Repair of Computers and Other Equipment), however it is quite accurate for separate subsectors. Armstat omits some companies, so the coverage of data is small. Moreover, the data on ICT Trade and ICT Production is included in the Trade and Manufacturing sectors.
According to the Statistical Committee of RA, mean monthly average salary in Information and Communication Technology (classification J as NACE Rev.2) is 733,035 AMD\(^9\), and in Information Technology sector (J58.2; J62; J63.1) 899,265 AMD. It is important to highlight, that average salary in ICT (with telecommunication) is 3 times higher than Armenian average, while in IT (without telecommunication) it is 3.8 times the Armenian average. The dynamics of remuneration rate in ICT is presented below.

Figure 21 Salary level in ICT and ICT without telecom as of June 2019-2022, AMD

<table>
<thead>
<tr>
<th>Year</th>
<th>ICT</th>
<th>ICT without Telecom</th>
</tr>
</thead>
<tbody>
<tr>
<td>2019</td>
<td>435,989</td>
<td>578,753</td>
</tr>
<tr>
<td>2020</td>
<td>448,240</td>
<td>608,391</td>
</tr>
<tr>
<td>2021</td>
<td>534,572</td>
<td>679,409</td>
</tr>
<tr>
<td>2022</td>
<td>733,055</td>
<td>899,265</td>
</tr>
</tbody>
</table>

Source: Armstat

Salaries in the ICT sector of Armenia are still lower than in European peers, but YoY they become more and more comparable.

<table>
<thead>
<tr>
<th>Country</th>
<th>Average Monthly Salary</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ireland</td>
<td>$5,500</td>
</tr>
<tr>
<td>Estonia</td>
<td>$2,900</td>
</tr>
<tr>
<td>Armenia</td>
<td>$1,700</td>
</tr>
<tr>
<td>Latvia</td>
<td>$1,700</td>
</tr>
<tr>
<td>Romania</td>
<td>$1,900</td>
</tr>
</tbody>
</table>

Source: Glassdoor and statistical bodies of the countries

As revealed before, the locomotive of Armenian ICT industry is “Computer Programming, Consultancy and Other Activities” subsector. According to the SRC data, average remuneration rate in this subsector, as of Q2 2022, is amounted to be 991,683 AMD. This is the highest average salary in the ICT sector, followed by “Software Publishing”, where average wage is 523,000 AMD

The dynamics of remuneration rate growth for the 2019-2023 period is the following:

---

\(^9\) Remuneration and number of employees (2022). Statistical Committee of Armenia
Figure 22 Salary level and growth rate in “Computer Programming, Consultancy and Other Activities” subsector and growth rate, AMD

Source: SRC

As we can see, the salary in this subsector has been growing, at 4% on average for the considered period. Only in Q4s, wages are growing at a faster pace, which obviously is connected with New Year bonuses. However, in Q2 2022 compared to Q1 2022, the growth rate was 15%, which is obviously the result of relocated companies and specialists in this subsector.

3.2.4 Business Demographics in ICT Sector

*Note: Companies, where ICT had the biggest share in turnover are considered

**Note: During the analysis of the numbers of enterprises by sectors, organizations that declared one of the mentioned sectors are considered regardless the fact that they have hired employees or not during the specified period

***Note: During the analysis of organization size, only those organizations that have declared the mentioned sectors and have registered hired/contractual employees have participated

According to the State Revenue Committee of RA, for the period of January-June 2022, there are 3,054 enterprises, which are engaged in the ICT sector. The majority of ICT businesses (85%) are engaged in “ICT services without telecommunications”, followed by ICT trade with 8%, and the share of ICT production and telecommunication is 1.2% and 5.8%, respectively.

It is noteworthy that in 2021 number of enterprises in the ICT sector was 2,366. Thus, for the Q1 and Q2 2022, the number of companies has risen by 29%, compared to the 2021. The structure of ICT companies for the Q1 and Q2 2022 is the following:
According to the law on “Small and Medium Enterprises\textsuperscript{40}” differentiation of entities is made based on their size defined by the average annual number of employees:

<table>
<thead>
<tr>
<th>Size</th>
<th>Up to 9</th>
<th>10-49</th>
<th>50-249</th>
<th>250+</th>
</tr>
</thead>
<tbody>
<tr>
<td>Micro</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Small</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Medium</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Large</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

SRC and Armstat do not provide detailed information on the main specialization of the ICT companies. However, based on in-depth interviews and desk research (mostly relying on EIF research), we identified 5 main specializations of ICT companies: 1) Customized software; 2) IT services and consulting, 3) mobile application development; 4) web design and development; 5) system design and automatization.

As of Q2 2022, only 2,721 companies, which stated ICT as their main activity sector, had registered employees. 79% (2,156) of those are micro enterprises, the majority of which have up to 5 employees. The structure of ICT businesses by their size is the following:

\textsuperscript{40} On State Support for Small and Medium-Sized Enterprises (2000) Arlis
3.2.5 ICT Services Import and Export

According to latest available official statistical data, in 2021 total ICT services exports from Armenia amounted to $328.4 million\(^*\). (Figure 25 ICT Services Export and its Share in Total Exports, $ million, %)

![Figure 25 ICT Services Export and its Share in Total Exports, $ million, %](source)

According to official data, in 2017-2021 exports of ICT services at current prices almost doubled, with 13\% CAGR. As of Q1 2022, Armenia exported ICT services for $120.1 million, showing -37\% of growth compared to the same period in 2021. Taking into account the fact that the total exports of Armenia in Q1 2022 compared to Q1 2021 increased by -28\%\(^*\), we can state that during the period under review growth in ICT services exports surpassed growth of total exports.

As of 2021, ICT services exports made up 22.8\% of total services exports in Armenia. International peer review based on official data shows ICT services exports from Armenia to some EEU countries by absolute volume, and European countries by share of ICT services in total services exports.

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\(^*\) Balance of Payments – Central Bank of Armenia

\(^\star\) Statistical Committee of RA, External Trade Database - [https://www.armstat.am/en/?nid=160](https://www.armstat.am/en/?nid=160)
According to the CBA, in 2021 total imports of ICT services amounted to $43.6 million. Thus, Armenia is a net exporter of ICT services. The import of ICT services has been increasing at a slower pace than ICT services export, and represents only 0.7% of total Armenia imports.
3.2.6 ICT Goods Import and Export

According to the UNCTAD\textsuperscript{43}, ICT goods categories and composition is the following:

<table>
<thead>
<tr>
<th>ICT00</th>
<th>Total ICT Goods</th>
</tr>
</thead>
<tbody>
<tr>
<td>ICT01</td>
<td>Computers and Peripheral Equipment</td>
</tr>
<tr>
<td>ICT02</td>
<td>Communication Equipment</td>
</tr>
<tr>
<td>ICT03</td>
<td>Consumer Electronic Equipment</td>
</tr>
<tr>
<td>ICT04</td>
<td>Electronic Components</td>
</tr>
<tr>
<td>ICT05</td>
<td>Miscellaneous</td>
</tr>
</tbody>
</table>

Unlike ICT services, exports of ICT goods are very limited, the highest result during the period from 2017-2021 having been reported \textbf{in 2021 – $15 million, up by 3.2 times from 2017 (at current prices), with 0.5\% share (2021) in total exports.}

\textbf{Figure 28 ICT goods export and its share in total exports, $ million, \%}

\begin{figure}[h]
\centering
\includegraphics[width=\textwidth]{figure28.png}
\caption{ICT goods export and its share in total exports, $ million, \%}
\end{figure}

\textit{Source: UN Comtrade, UNCTAD Stat}

\textsuperscript{43} ICT goods categories and composition - UNCTADSTAT
However, more than 68% of total ICT goods export are provided by only 6 goods, which are the following:

**Table 7 ICT goods export main categories**

<table>
<thead>
<tr>
<th>HS Commodity Code</th>
<th>Commodity Name</th>
<th>Export Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>852990</td>
<td>Reception and transmission apparatus, for use with the apparatus of heading</td>
<td>$1,273,427</td>
</tr>
<tr>
<td>851762</td>
<td>Machines for the reception, conversion and transmission or regeneration of voice, images or other data, including switching and routing apparatus</td>
<td>$1,457,857</td>
</tr>
<tr>
<td>851830</td>
<td>Headphones and earphones, whether or not combined with a microphone, and sets consisting of a microphone and one or more loudspeakers</td>
<td>$1,545,755</td>
</tr>
<tr>
<td>852580</td>
<td>Television cameras, digital cameras and video camera recorders</td>
<td>$1,602,596</td>
</tr>
<tr>
<td>854140</td>
<td>Photosensitive Semiconductor Devices, Including Photovoltaic Cells; Light-emitting Diodes</td>
<td>$2,097,172</td>
</tr>
<tr>
<td>852290</td>
<td>Parts and Accessories, Except Pickup Cartridges, For Sound Reproducing, Sound Recording, and Video Recording or Reproducing Apparatus</td>
<td>$2,326,340</td>
</tr>
</tbody>
</table>

*Source: UN Comtrade*

International peer review based on the World Bank and UNCTAD data, shows that Armenia outperforms only EEU countries (Kazakhstan, the Kyrgyz Republic) by share of ICT in total exports and lags behind all peer Eastern European countries, in terms of both absolute values and share of ICT goods in total goods export.

**Figure 29 ICT goods export and its share in total goods exports, $ million, %**

*Source: UNCTAD Stat, World Bank data*
Unlike exports where ICT services have a high share, the dominant component of imports is ICT goods. According to the official statistics, in 2021 Armenia imported ICT goods\textsuperscript{44} with total amount of $270 million.

![Figure 30 ICT goods import and its share in total imports, $ million, %](source: UNCTAD Stat, World Bank Data)

### 3.2.7 ICT Taxes

According to SRC, in 2019-2021 taxes declared by ICT businesses reported an essential increase – more than 24.5%, which is explained, on one hand, by economic growth of this sector, on the other by decrease of shadow.

![Figure 31 Structure of declared taxes by ICT sector, million AMD](source: SRC)

\textsuperscript{44} Bilateral Trade Flows by ICT goods categories. UNCTAD Stat
In 2021 declared ICT taxes grew by 17.3% YoY, whereas turnover grew by 22% (according to SRC). Overall, in 2021 ICT businesses declared AMD 83.9B worth of taxes, which according to our estimates is 5.3% of total taxes payable to the government.

**Income tax** was the dominant component of total taxes declared by ICT companies in 2021 with a 48.3% share, followed by VAT (44%), corporate profit tax (5.7%) and turnover tax (1.8%).

By subsectors, “ICT services without telecommunications” has been the leader since 2019 by the amount of declared taxes with a 48.8% share in 2021. The share of telecommunications was 31.8% that of ICT trade – 19.1% and ICT production – 0.3%.

Figure 32 Declared ICT taxes by subsectors, million AMD

<table>
<thead>
<tr>
<th>Year</th>
<th>ICT Production</th>
<th>ICT Trade</th>
<th>ICT Services without Telecommunication</th>
<th>Telecommunication</th>
</tr>
</thead>
<tbody>
<tr>
<td>2019</td>
<td>24 482</td>
<td>27 504</td>
<td>15 112</td>
<td>306</td>
</tr>
<tr>
<td>2020</td>
<td>27 041</td>
<td>30 086</td>
<td>14 078</td>
<td>319</td>
</tr>
<tr>
<td>2021</td>
<td>26 697</td>
<td>40 993</td>
<td>16 037</td>
<td>192</td>
</tr>
</tbody>
</table>

Source: SRC

Note that during the period under review declared taxes have decreased in ICT production and Telecommunication by 40% and 1% respectively. Taxes paid by ICT services without telecommunication and ICT Trade have grown by 36% and 14% respectively.

### 3.3 Cybersecurity in Armenia

Cyber-attacks have become a serious issue both for enterprises and governments. The landscape of cybercrime is evolving and adapting to new realities. The COVID-19 crisis accelerated this process, as more businesses went online. Armenia has not adopted yet “National Cybersecurity Strategy”, however in “Armenia National Security Strategy” some issues concerning information security are addressed. In particular, the strategy outlined that the main goal of Armenia’s information security policy is *to balance and protect the interests of the individual, society and the state.*

Main challenges, that Armenia face in cybersecurity is the imperfection of legislative basis and state policy regulating information security sector, legislation that ensures protection of critical

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information as well as insufficient funds, lack of proper expertise and knowledge, legacy hardware and software, which are a high risk for cybersecurity.

According to the “Global Cybersecurity Index\(^46\)”, which is published by International Telecommunication Union, Armenia is in 90\(^{th}\) position out of 182 countries, with total score of 50.47.

**Figure 33 Global Cybersecurity Index**


International peer review shows, that Armenia falls behind all peers, but some CIS countries (the Kyrgyz Republic, Tajikistan, and Turkmenistan). Global Cybersecurity Index introduces 5 pillars (Legal, Technical, Organizational, Capacity Development, Cooperation). The table below explicates pillars and Armenia scores for each of them (the maximum score is 20).

**Table 8 Pillars of Global Cybersecurity Index**

<table>
<thead>
<tr>
<th>Pillar</th>
<th>Description</th>
<th>Armenia Scores</th>
</tr>
</thead>
<tbody>
<tr>
<td>Legal</td>
<td>Measuring laws and regulations on cyber-crime and cybersecurity</td>
<td>12.87</td>
</tr>
<tr>
<td>Technical</td>
<td>Measuring the implementation of technical capabilities through national and sector specific agencies</td>
<td>13.86</td>
</tr>
<tr>
<td>Organizational</td>
<td>Measuring national strategies and organizations implementing cybersecurity</td>
<td>4.87</td>
</tr>
<tr>
<td>Capacity Development</td>
<td>Measuring awareness campaigns, training, education and incentives for cybersecurity capacity development</td>
<td>7.85</td>
</tr>
<tr>
<td>Cooperation</td>
<td>Measuring partnerships between agencies, firms and countries</td>
<td>11.02</td>
</tr>
</tbody>
</table>

\(^46\) Global Cybersecurity Index (2020) International Telecommunication Union, Development Sector
These results show that Armenia is underperforming in “Organizational” and “Capacity Development” pillars, which are potential areas for growth whereas has some relative strengths in “Technical” pillar.

Based on components of Armenia’s cybersecurity, there are only 587 secure Internet servers\(^\text{47}\) per 1 million people (ranked 104\(^\text{th}\) in the world) and there is a Distributed Denial of Service (DDOS) attack rate of 1 Tbit/sec\(^\text{48}\) (ranked 117\(^\text{th}\) in the world).

The situation with cybersecurity has become a more serious issue since 2020, when Armenia experienced a series of massive cyber-attacks (phishing, spear-phishing, attacks using email, social messengers and networks, DDoS attacks). Personal data of thousands of Armenian citizens, data and documents of the official bodies, including the electronic document management system used for interagency communication within the Armenian government, were made publicly available, and many government websites were defaced, breached or taken offline for extended periods.

According to the World Bank data,\(^\text{49}\) 77% of the population in Armenia use the internet, which is more than the world average, surpassing it by 17%. However, one of the most significant issues for cybersecurity in Armenia is the situation with critical infrastructure, in particular with internet gateways. Armenia has 2 international gateways passing through Iran Islamic Republic and Georgia. However, more than 90% of internet in Armenia is supplied through one exit (via Georgia), which makes the internet resilience very vulnerable. Internet is mostly supplied from the Trans-Asia-Europe fibre-optic cable via Georgia. Additional international service is available by microwave radio relay and landline connections to other countries of the Commonwealth of Independent States, the Moscow international switch, and by satellite. Armenia has only one IXP (Internet Exchange Point), which is relatively sufficient for small population. Mobile coverage is at a very high level. According to ITU “ICT Access Survey” data, the coverage of 3G and 4G connection. However, there are still no 5G deployments in Armenia.

Overall, it might be said that Armenia is doing relatively well on critical infrastructure, however more investments on internet gateways will make it more resilient.

\(^{47}\) World Bank Data, Secure Internet Servers
\(^{48}\) CyberGreen Stats, https://stats.cybergreen.net/
\(^{49}\) Individuals using the internet (% of population). World Bank Open Data
3.4 Armenia in International Rankings

In order to show Armenia’s ranking on international arena, certain sum-indices of the Global Competitiveness Index and Global Innovation Index were considered; sub-indices were selected to complement rather than overlap with each other.

Global Innovation Index

Global Innovation Index is an annual ranking of countries, tracking the development of innovation and its trends. The INSEAD University and World Business Magazine started it in 2007. GII is published by World Intellectual Property Organization.

Global Innovation Index is comprised of two sub-indices each of which in turn is comprised of a number of pillars:

**Innovation Input Sub-Index**
- Institutions
- Human Capital and Research
- Infrastructure
- Market Sophistication
- Business Sophistication

**Innovation Output Sub-Index**
- Knowledge and Technology Outputs
- Creative Outputs

According to the Global Innovation Ranking, Armenia ranks 69th, behind all considered countries, including Georgia, peer EU countries and the Russian Federation.

![Global Innovation Index Rankings, 2021](image)
As for the Global Competitiveness Report, Armenia ranks **59th by ICT Adoption**, lagging behind both Georgia and EEU members Russian Federation and Belarus. Notably, even so Armenia outperforms Ukraine and Croatia. It should also be noted that the latest version of “Global Competitiveness Index” was published in 2020, and Global Innovation Index was published in 2021.

**Figure 35 ICT Adoption (Global Competitiveness Index)**

As regards the **Human Capital and Research** pillar of the Global Innovation Index: in 2019 Armenia ranked 94th out of 129 economies, lagging behind all peers, including Azerbaijan.

**Figure 36 Human Capital and Research (Global Innovation Index)**

The picture is the same also for “Business Sophistication” pillar, where Armenia brings up the rear, with overall rank of 98th out of 129. Having said that, Armenia is 51st by the share of knowledge-intensive workers in total employed labor force (29.5%).
Unlike other pillars, Armenia ranks relatively high by “Knowledge and Technology Outputs”, outperforming Georgia, overall 64th out of 129.

Armenia ranks relatively high also by “Creative Outputs”: 49th among the total 129. Remarkably, by one of components of this particular pillar – by “Wikipedia edits/mn pop.” – Armenia is the 2nd in the world with a score of 88.9 – the result of the Wikipedia Armenian content development program.
Overall, analysis of the Global Innovation Index methodology and results (Armenia rankings) shows that in terms of inputs Armenia’s positions are weaker than in terms of outputs; in other words, Armenia is able to deliver relatively high results with low inputs.

3.5 Key Findings

- The history of development in the ICT industry of Armenia might be divided into 2 main phases: Soviet Armenia and independent Armenia.
- Strong heritage of Soviet Armenia in deep technologies (such institutions as Yerevan Scientific Research Institute of Mathematical Machines), especially in Mathematics provided the basis for formation of ICT sector of Armenia.
- The rise of the ICT sector in independent Armenia is strongly connected with 1) US-based software firms’ entry into Armenian market; 2) M&A operations from US based firms (acquisition of LEDA Systems, Monetary Arset, HPL Technologies by Synopsys etc.); 3) Emerging software outsource services from Armenia. As a result of these developments, Armenia originated product companies began to appear.
- The turnover of ICT sector in 2021 was amounted to be 496.3 billion AMD or $985 million. In the structure of the turnover “ICT services without telecommunication” have the biggest contribution (about 54%).
- Based on the data of SRC and Armstat (Intermediate Consumption), in 2021 was 331.2 billion AMD or 4.7% of Armenia GDP. Compared to peers, Armenia outperforms such countries as the Russian Federation, Croatia, Poland.
- Due to number of reasons, many Armenian companies incorporate affiliates abroad and a considerable part of added value remains in foreign books. Thus, the potential value added of ICT sector is higher.
- According to SRC, from 2019 to Q2 2022 average quarterly number of hired workers in ICT in Armenia grew by 65% to reach 35,287. The vast majority of hired workers (73%) are engaged in “ICT services without telecommunications” sector.
- In Q2 2022, compared to Q1 2022 the number of hired workers in the ICT sector increased by 21%
- According to Armstat, mean monthly average salary in Information and Communication Technology (classification J as NACE Rev.2) is 733,035 AMD, and in Information Technology sector (J58.2; J62; J63.1) 899,265 AMD, which is higher than Armenia average by 3 and 3.8 times respectively.
- According to SRC “Computer Programming, Consultancy and Other Activities”, has the highest compensation rate in ICT subsector. As of Q2 2022, it is amounted to be 991,683 AMD, with 15% growth rate compared to Q1.
• According to SRC, as of July 2022 there are 3,054 registered companies in the ICT sector (85% in “ICT services without telecommunication” subsector). 79% of firms that have registered hired workers are micro enterprises.

• According to official data, in 2017-2021 exports of ICT services at current prices almost doubled, with 13% CAGR, reaching $382.4 million in 2021, which is -22.8% of total services exports.

• Unlike ICT services, exports of ICT goods are very limited, the highest performance during the period from 2017-2021 having been reported in 2021 – $15 million, up by 3.2 times from 2017 (at current prices), with 0.5% share (2021) in total exports. However, 68% of exports make only 6 commodity group.

• According to the official statistics, in 2021 Armenia imported ICT goods with total amount of $270 million, which is 5% of total merchandise exports of Armenia.

• According to SRC, in 2019-2021 taxes declared by ICT businesses reported an essential increase – more than 24.5%, reaching 83,920 billion AMD in 2021. In the structure of taxes income tax and VAT have predominant positions with 48.3% and 44% respectively.

• “ICT services without telecommunication” is the leader in terms of tax declaration, with 48.8% in 2021, followed by “Telecommunication” subsector with 31.8%.

• According to the “Global Cybersecurity Index” Armenia is in 90th position out of 182 countries, with total score of 50.47. Armenia falls behind all peers, but some CIS countries (the Kyrgyz Republic, Tajikistan, and Turkmenistan).

• Armenia is underperforming in “Organizational” and “Capacity Development” pillars, which are potential areas for growth whereas has some relative strengths in “Technical” pillar.

• One of the most significant issues for cybersecurity in Armenia is the situation with critical infrastructure, in particular with internet gateways. More than 90% of internet in Armenia is supplied through one exit (via Georgia), which makes the internet resilience very vulnerable.

• According to the Global Innovation Ranking, Armenia ranks 69th, behind all considered countries, including Georgia, peer EU countries and the Russian Federation.

• Analysis of the Global Innovation Index shows that in terms of inputs Armenia’s positions are weaker than in terms of outputs; in other words, Armenia is able to deliver relatively high results with low inputs.
4. Current Profile of the ICT Sector

4.1 ICT Sector Mapping

As noted in chapter 3, as of Q2 2022 there are 3,054 active business entities in Armenia, 85% of which in “ICT services without telecommunication” subsector (as per NACE Rev 2: J58.2, J62 and J63.1). In other words, “ICT services without telecommunication” subsector represent ~1.9% of non-financial business economy.

11% of business entities (or 333 of them) have not registered employees.

Figure 40 ICT businesses by number of employees, Q2 2022 (% of total)

One of the major changes that ICT sector, in particular “ICT services without telecommunication” has faced for the last 2 years is the rise of “platform outsourcing” phenomenon. Such platforms as Toptal and Upwork bring together software developers from all over the world with companies, seeking to reduce project costs. Thus, “platform outsourcing” gradually is replacing outsourcing firms, especially when it comes to relatively small projects. Some of our respondents mentioned that currently it is hard to find a software developer that works for one employer only.
The increasing number of individual entrepreneurs is more evidence of the development of this phenomenon. According to SRC, as for Q2 2022, there are **2,717 individual entrepreneurs** engaged in “ICT services without telecommunication”: 2,524 of which in “Computer Programming, Consultancy and Other Activities” subsector. This might be an impact of relocation following the Russian invasion of Ukraine.

**Figure 41 Number and growth rate of individual entrepreneurs in “ICT services without telecommunication”**

Source: SRC

Considering the specifics of IT services business, the following types of entities have been outlined:

a. **Armenian branches of multinational outsourcing firms**

b. **Local outsourcing firms**

c. **Individual Entrepreneurs on global platforms**

d. **Multinational product companies**

e. **Local product companies**

According to our estimates, **the dominant IT business is Armenia is currently outsourcing, however the share of latter is decreasing.** Among outsourcing firms both added value is lower and global competition is more intense. Most of the respondents mentioned that a serious factor, which makes product companies more attractive for employees, is **stock options.** It is important to highlight that the number of local outsourcing companies, trying to develop their own product is steadily increasing. However, according to some of the respondents Armenian outsourcing companies are specialized in **providing complex solutions**, and will remain competitive despite growing wages in ICT, labor shortage and tough global competition.

One of our hypotheses was, **the decreasing role of software developers because of low-code and non-code trends emerging in Armenian market.** Most of the respondents mentioned, that
Currently, less technological knowledge is needed for coding, however, the role and demand of software developers will not change in Armenia soon. The overwhelming majority of respondents highlighted that **Saas and cloud solutions** seem to be the future of the IT industry.

Another development phenomenon that in outsourcing subsector is arising is **activation of M&A deals and consolidation process** (the latest example was SFL acquisition by DataArt). As noted above, the wages in IT services are exponentially increasing (which is the biggest cost of any outsourcing company), platforms are taking over small projects. Respondents indicated that **M&A has 2 potential objectives – 1) access to the market and 2) access to sector**. As a result of these trends the profit margin of Armenian companies is decreasing, and there is no way to **stay competitive but expanding**. New outsourcing destinations **such as India, the Philippines, and Indonesia** are emerging, where labor force is not limited and is more affordable.

Nevertheless, even where Armenian companies become global players (Digitain, Soft Construct, PicsArt), some of them begin to use Armenian branches for internal outsourcing needs while more added value is created in overseas business units. At macroeconomic level, this model has its own problems as **value added created by Armenian-origin companies stay in foreign books**. However, part of the respondents emphasized, that this limitation is compensated by the fact, that after exit founders of such companies mostly **invest in Armenia**.

Overall, the classification of ICT companies is the following:

<table>
<thead>
<tr>
<th>LOCAL</th>
<th>GLOBAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>VOLO</td>
<td>EPAM Systems</td>
</tr>
<tr>
<td>Instigate Mobile</td>
<td>Energize Global Services</td>
</tr>
<tr>
<td>VX Soft</td>
<td>FMDKL Europe</td>
</tr>
<tr>
<td>Esterox</td>
<td>Macadamian AR</td>
</tr>
<tr>
<td>FIDEM</td>
<td>Optim Armenia</td>
</tr>
<tr>
<td>Codics LLC</td>
<td>E-Worlds Systems Limited Armenia branch</td>
</tr>
<tr>
<td>Preezma</td>
<td>DataArt</td>
</tr>
<tr>
<td>InScope</td>
<td>WaveAccess</td>
</tr>
<tr>
<td>Individual Entrepreneurs (Programmers) on Remote Platforms</td>
<td>ArcTX</td>
</tr>
<tr>
<td></td>
<td>SoftShark</td>
</tr>
</tbody>
</table>
One issue, that combines all types of companies, is the shortage of labor force. Some of respondents mentioned, that currently they are trying to hire from other CIS countries such as Kazakhstan, the Russian Federation, and Belarus. However, the most interesting approach was hiring specialists from Iran. One respondent highlighted, that they hired HR specialists with knowledge of the Persian language to find specialists in Iran. One of the biggest advantages of Iranian workers, is the strong basis of fundamental Mathematics, which is often lacking in Armenia. Armenian companies, in their turn might offer access to the newest technologies, which are not available in Iran. On the other hand, some of the respondents think that hiring from abroad is not a long-term solution as for the most of foreign employees Armenia is only a transit country. The other approach to solve this issue is to establish corporate educational programmes and academies. Some of the large IT companies, such as PicsArt, Synopsys and Digitain chose this path. Representatives of some IT companies outlined plans to move part of the operations and launch new offices in India, the Philippines, or Viet Nam and to move part of the operations. These countries are attractive for Armenian IT companies due to large labor force supply and relatively low cost of labor.

4.1.1 Biggest IT Companies in Armenia

In order to determine major IT players the number of employees and amount of taxes paid were considered (publicly available).

It should be noted that profit tax is paid in March-April for the previous year. Thus, relocated companies (such as Veeam Software which is the 5th major employer) are not yet in the list of 1000 taxpayers for 2022. Overall, 48 companies engaged in “ICT services without telecommunication”.

The following table reveals the biggest players in ICT services industry (J58.2; J62 and J63.1 as per NACE Rev. 2 – that’s why such companies as Digitain, SoftConstruct are not included)
<table>
<thead>
<tr>
<th>N</th>
<th>Name</th>
<th>Activity</th>
<th>Paid Taxes as of 2022 Q2 (mln AMD)</th>
<th>Number of Employees</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Synopsys</td>
<td>J62.01.0</td>
<td>3,855</td>
<td>1,107</td>
</tr>
<tr>
<td>2</td>
<td>EPAM Systems</td>
<td>J62.01.0</td>
<td>1,347</td>
<td>1,098</td>
</tr>
<tr>
<td>3</td>
<td>PicsArt</td>
<td>J62.01.0</td>
<td>2,151</td>
<td>818</td>
</tr>
<tr>
<td>4</td>
<td>DataArt</td>
<td>J62.09.0</td>
<td>950.6</td>
<td>698</td>
</tr>
<tr>
<td>5</td>
<td>ClinChoice</td>
<td>J63.11.1</td>
<td>368.7</td>
<td>438</td>
</tr>
<tr>
<td>6</td>
<td>Energize Global Services</td>
<td>J62.01.0</td>
<td>988.7</td>
<td>380</td>
</tr>
<tr>
<td>7</td>
<td>ServiceTitan</td>
<td>J62.01.0</td>
<td>1,025</td>
<td>319</td>
</tr>
<tr>
<td>8</td>
<td>Synergy</td>
<td>J62.01.0</td>
<td>321.1</td>
<td>273</td>
</tr>
<tr>
<td>9</td>
<td>Instigate Mobile</td>
<td>J62.01.0</td>
<td>400.1</td>
<td>239</td>
</tr>
<tr>
<td>10</td>
<td>ArctX</td>
<td>J62.09.0</td>
<td>231.8</td>
<td>239</td>
</tr>
</tbody>
</table>

Source: SRC

**Synopsys Armenia** is the Armenian branch of one of the world’s largest software programming firms, Synopsys, with $47.28B market cap. Synopsys entered Armenian market in 2004 by acquiring Monterey Arset and Leda Design (total staff – 130). Later on two more companies were acquired – HPLA in 2005 and Virage Logic in 2010. Synopsys specializes in electronic design automation and semiconductor research.

**EPAM Armenia** is the Armenian branch of EPAM Systems, one of the biggest software development companies in the world, with $20.78 BB market cap. EPAM entered Armenian market in 2014 and has 2 offices: in Yerevan and Gyumri as well as training center.

Founded in 2012 by serial IT entrepreneur Hovhannes Avoyan, **PicsArt** is a popular image editing and social app. As of the end of 2019 the app had about 150M monthly active users from 185 countries and 6 offices in 5 countries. In 2015-2016 the company raised a total of $45M investments, including from Sequoia Capital. After raising $130M from SoftBank in 2021, PicsArt became unicorn.

**Energize Global Services** was founded in 2007, and currently has offices in Boston, Yerevan and Sophia. The company offers IT solutions for financial organizations, including operational programs for banks, NFC-based contactless payment systems, etc.

**Synergy International Systems** is one of the oldest IT companies in Armenia. Founded in 1997, it has its headquarters in Washington, DC and R&D in Armenia. Since its foundation, the company has implemented projects in more than 70 countries, including: e-governance system for criminal cases in Rwanda, forest and wildlife management system in Peru, USAID-funded e-governance system for wholesale energy market in Armenia.
**ServiceTitan** is the first Armenian unicorn, which offers end-to-end solutions for plumbing, garage door, HVAC, electrical and other field service companies. The company was founded by 2 ethnic Armenians in the US in 2012 and as of 2021 reached $ 8.3 BB valuation. ServiceTitan was ranked 11th on the Forbes’s ranking of the world’s best private cloud computing companies.

**Instigate** has several brands, including Instigate Mobile, Instigate Design, Instigate Robotics, etc. The company also has a training center for future staff. Offices are located in Armenia (Yerevan, Gyumri, Vanadzor) and Artsakh, as well as in the US, Germany, and even in Georgia.

**DataArt**, which is a global software development company, operating in more than 20 countries entered Armenian market in 2021, by acquiring SFL. Currently, Armenian office has 698 employees, including 406 relocated specialists.

**ClinChoice** is a full service CRO company offering high-quality solutions to pharmaceutical, biotechnology medical device and consumer product companies. Headquarters of ClinChoice is in Washington, and the company is operating in 6 more countries. ClinChoice has over 3,000 employees worldwide, completed more than 1,000 Phase I-IV clinical projects, supported over 100 innovative drug registration.

**ArctX** is a software development company, headquartered in Yerevan. The company offers services in spheres of marketing, creative economy as well as providing software solutions. ArctX has its own 2 products: HolaPay (e-payment solution) and Blipy (receiving push notification on phone and act on them in real-time).

### 4.1.2 Foreign Presence of IT Services Companies

It is common knowledge that many Armenian IT services firms (usually those, which have their own product) have affiliates incorporated abroad, which results in part of generated added value remaining in foreign books. As of 2018, that part was estimated to be 132 billion AMD. Currently, it is impossible to calculate that part, as EIF ceased to publish total value added created by Armenian companies (regardless of office location).

We have proposed four hypotheses (which were later tested and verified via in-depth interviews) as to why Armenian IT companies choose this strategy:

1. Armenian companies incorporate affiliates abroad (the US, the UK, the Netherlands, etc.) to attract investments more easily. Currently, Armenia based start-ups might raise maximum 2-3 rounds.
2. Armenian companies incorporate affiliates abroad (the US, the UK, the Netherlands, etc.) to protect their intellectual property more effectively.
3. Armenian companies incorporate affiliates abroad to have tax benefits.
4. Armenian companies incorporate affiliates abroad to have access to bigger markets, and most advanced knowledge

It is important to note, that Armenia-based companies work with foreign affiliates on contractual bases (service provision or borrowing), where Armenian companies are the contractors. Thus, we might constitute, that local offices of Armenian IT services companies, have become internal outsourcing companies.

Relatively small number of Armenian companies have patentable product, and they are not facing issues with protection of intellectual property. Moreover, during in-depth interviews respondents didn’t raise this topic. Therefore, this hypothesis was proven wrong.

As for tax benefits, according to respondents, this is not the key issue while incorporating affiliates abroad. Armenia offers an ever more favorable tax climate when compared to the states of California, Delaware and Wyoming. However, we should remember about “Transfer Pricing” introduction, full implementation of which might change the situation.

In this period of growth, most of the Armenian IT companies do not consider higher taxes in the US as a bottleneck, compared to funding opportunities, technology and market access. However, it might become an issue in later stages, when dividends should be paid to owners or when founders will decide to exit.

**Table 10 Taxation of Profit and Dividends in the United States and Armenia**

<table>
<thead>
<tr>
<th></th>
<th>California</th>
<th>Wyoming</th>
<th>Delaware</th>
<th>Armenia</th>
</tr>
</thead>
<tbody>
<tr>
<td>Federal profit tax rate</td>
<td>21%</td>
<td>21%</td>
<td>21%</td>
<td>18%</td>
</tr>
<tr>
<td>State profit tax rate</td>
<td>8.84%</td>
<td>0%</td>
<td>8.7%</td>
<td>-</td>
</tr>
<tr>
<td>Federal income tax on dividends</td>
<td>20%</td>
<td>20%</td>
<td>20%</td>
<td>5%</td>
</tr>
<tr>
<td>State income tax on dividends</td>
<td>13.3%</td>
<td>0%</td>
<td>6.6%</td>
<td>-</td>
</tr>
<tr>
<td>Medicare</td>
<td>3.8%</td>
<td>3.8%</td>
<td>3.8%</td>
<td>-</td>
</tr>
</tbody>
</table>

**Table 11 Capital Gain Taxes in the United States and Armenia**

<table>
<thead>
<tr>
<th></th>
<th>California</th>
<th>Wyoming</th>
<th>Delaware</th>
<th>Armenia</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>20%</td>
<td>20%</td>
<td>20%</td>
<td>0%*</td>
</tr>
<tr>
<td>------------------------</td>
<td>------</td>
<td>------</td>
<td>------</td>
<td>------</td>
</tr>
<tr>
<td>Federal income tax rate</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>State income tax rate</td>
<td>13.3%</td>
<td>0%</td>
<td>6.6%</td>
<td>-</td>
</tr>
<tr>
<td>Medicare</td>
<td>3.8%</td>
<td>3.8%</td>
<td>3.8%</td>
<td>-</td>
</tr>
<tr>
<td>Total</td>
<td>37.1%</td>
<td>23.8%</td>
<td>30.4%</td>
<td>0%</td>
</tr>
</tbody>
</table>

Thus, this hypothesis somehow was proven wrong, as tax benefits are not one of the main reasons for Armenian companies to incorporate US affiliates. However, some representatives of ICT companies emphasized the importance of making similar Armenia laws to Delaware (especially taking into account the experience of Chancery court of Delaware). Moreover, some of the respondents which represent a group of companies, mentioned that it will be more effective to introduce **consolidated taxpayer** concept, under which taxes of all group companies will be consolidated and paid by one entity, as well as incentive to be eligible to pay wages in USD, which will allow to mitigate exchange rate fluctuations.

Regarding **attracting more investment**, the hypothesis was confirmed. Start-up ecosystem of Armenia has been steadily developing, and currently **sector representatives emphasize**, that it is possible to **raise up to 3 rounds through Armenian VCs**. The situation has significantly changed since COVID-19, when huge amount of money was injected into economy. However, Armenian start-ups incorporate US affiliates to attract more investments, which is explained by following factors:

- After a certain level is reached, (we suppose it to be 2-3 rounds at its best) Armenia-based angel investors and venture funds **are no longer able to meet investment needs** of technology companies.
- It is easier for foreign venture funds to work with US-based companies, as in case of unfavorable developments they will not have to face the challenge of unfamiliar laws or deal with Armenian courts.

It is important to mention, that this is not only an Armenian phenomenon. The majority of start-ups at some stage incorporate affiliates in the US, to attract investments. The only difference is the number of rounds that companies pass in their local markets. We assume that in Armenian market, it is possible to go through up to three founding rounds.
Access to market and technologies along with investment opportunities are main reasons for Armenian companies to register business entities in the US. Delaware and Silicon Valley are the main global hubs, where the most advanced technologies and business ideas meet. Majority of respondents highlighted, that Armenian IT companies have deep technological knowledge, however, lack such skills as sales, marketing, business development etc. Access to such knowledge and networking (which is mostly based in Silicon Valley or Delaware) might be a stimulus for expansion of IT companies. Moreover, there was an opinion, that the biggest support for IT start-ups would be the chance to spend time in Silicon Valley in order to develop these skills and network.

In addition, there is one more factor forcing Armenian companies to incorporate foreign affiliates – country reputation. Despite the fact, that IT sector has been steadily developing, Armenia is yet to be popularly recognized as a technology country.

Overall, it might be stated, that foreign affiliates of Armenian companies are engaged in the following functions:

- Financial and investor relations
- Sales and marketing
- Combination of both

Companies concentrating their marketing and sales functions in their foreign affiliates say that they are having hard times finding local specialists that would be competent enough both in tech products sales/marketing and structure of target markets. Also being incorporated in the US helps to collaborate with advertising and marketing service providers more easily. Moreover, some of the respondents mentioned, that the biggest weak spot of Armenian IT companies, is their unfamiliarity with business processes and it is a potential support dimension to Armenian IT companies.

4.2 Role of the Armenian Diaspora in the Development of the ICT Sector

It is common knowledge that countries which have a big number of expatriates (“Diaspora”) seek to use this competitive advantage for both foreign policy and economic development. Diasporas are communities of migrants, who retain a sense of connection with their homeland. The largest Diasporas in the world are – Chinese (35 million people), Russian (25 million people), Indian (25 million people), Ukrainian (12 million people), Armenian (10 million people), and Jewish (8 million people). Diasporas influence national economies in several ways, such as through remittances to family members, foreign direct investments, entrepreneurial activities, transfer of knowledge and skills. Diaspora serves as an important economic resource, especially in emerging economies.
Diaspora played a key role in the formation of IT industry in Armenia. The majority of branches of foreign companies in Armenia are established due to the efforts of Diaspora Armenians. Companies with owner or top management of Armenian descent understand better the corporate culture of Armenia. The role of Diaspora was huge in the market entry of such companies as **LEDA Systems, Synopsys, Mentor Graphics etc.** In this regard, the case of **ServiceTitan** is remarkable. The company was founded in 2007 in Glendale by Ara Mahdessian and Vahe Kuzoyan, businesspeople of Armenian descent. In 2019, ServiceTitan opened an office in Yerevan, which is currently employing more than 300 specialists and is among the top 1000 biggest taxpayers of Armenia. Another major project, which is more connected with deep technologies and was launched by Diaspora Armenians, is **Fast Foundation**, which is engaged in educational, research activities as well as commercialization of generated ideas.

One of the most important educational initiatives, which was accomplished by Diaspora Armenians was the establishment of **Tumo Center of Creative Technologies**. Tumo is designed for teenagers (12-18 years old), with the focus on self-education and project labs. The educational programme includes such topics as web development, 3D modelling, programming, robotics etc. With the launch of Tumo, the image of Armenia, as a technological advanced country has dramatically improved, and the model of Tumo was “exported” to such countries as France, Italy, the Russian Federation, Ukraine, and Germany.

One of the biggest initiatives by Armenian Diaspora, which helped to put Armenia on the technology map, is the support in organizing tech forums, congresses. One of the first tech congresses in Armenia “**Armtech Congress**” was organized by Diaspora Armenians, especially due to the efforts of Anthony Moroyan. The role of the Armenian Diaspora was huge in bringing the **WCIT summit** to Yerevan in 2019, which was the biggest and the most prestigious tech forum in the history of independent Armenia.

Overall, according to the representatives of IT companies, the biggest benefit that IT industry might get from Armenian Diaspora is the transfer of advanced knowledge and skills, especially in business, sales and marketing, as well as global networking opportunities. Being close to target markets, Diaspora representatives might be a liaison between Armenian IT companies and customers. Existence of the Diaspora, many representatives of which are top-level professionals in the ICT industry (Aleksis Ohanyan – co-founder of Reddit; Noubar Afeyan – co-founder of “Moderna Therapeutics”; Katherine Safarian – senior VP of Pixar Animation Studios; Vahe Torossian – corporate VC of Microsoft etc.) and their deep ties with Armenia, is a huge competitive advantage for the country. One of respondents mentioned, that diaspora resource is not yet leveraged, however it is a game changer for Armenian IT market. Armenian diaspora plays a very important role for start-up ecosystem as well. Respondents mentioned that due to the

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50 Programs. Fast Foundation
global networking opportunities of diaspora it is possible to attract investments from international venture funds, not only in seed or pre-seed stages but in further changes also.

4.3 Impact on the ICT Sector of the Russian Invasion of Ukraine

The Russian invasion of Ukraine in February 2022 hit economies hard around the world, including in Armenia. The Russian Federation is the main trade partner of Armenia, and economic shocks in Russian markets have direct impacts on Armenia. This trend is visible in the context of inflation rate (inflation rate as of August 2022 compared to August 2021 is -9.1%), exchange rate dynamics (AMD appreciation against USD is the second highest in CIS region), decrease of remittances inflow (in Q1 2022 remittances decreased by 13% compared to Q1 2021).

However, new development opportunities have arisen from this recession. Primarily, it is necessary to note the influence of businesses and specialists’ relocation phenomenon. Inflow of Russian citizens resulted in positive changes of de-facto population of Armenia. According to Statistical Committee of RA, de-facto population of Armenia has increased by -41 thousand as of July 2022 (based on information on natural growth and border crossing). Decrease by 54.4 thousand in June-July 2022 in population with Armenian passports was compensated by -67.6 thousand increase in population with Russian passports. However, the most serious influence on economic development of Armenia had the relocation of businesses. According to the Minister of Economy of RA, because of the Russian invasion of Ukraine, -300 large enterprises and 2,500 small businesses with Russian capital have registered in Armenia.

Undoubtedly, the majority of businesses and specialists relocated to Armenia are engaged in the ICT industry, as the wave of closing offices in the Russian Federation applied to the ICT sector mostly. As mentioned in previous chapter, currently, there are 5 relocated IT companies, which are among the top-20 biggest employers in the ICT sector. Overall, according to SRC data, for the period of March-June 2022, 3,613 enterprises and individual entrepreneurs registered in “IT services without telecommunications” subsector.

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51 Minister: As a result of relocation, 300 large companies with Russian capital were registered in Armenia (2022) Finport.am
Overall, top-10 biggest relocated IT companies are:

**Figure 42 Top-10 relocated ICT firms**

<table>
<thead>
<tr>
<th>Company</th>
<th>Employees</th>
</tr>
</thead>
<tbody>
<tr>
<td>Veeam Software</td>
<td>676</td>
</tr>
<tr>
<td>BostonGene Technologies</td>
<td>277</td>
</tr>
<tr>
<td>Teamwork</td>
<td>221</td>
</tr>
<tr>
<td>Quantori</td>
<td>219</td>
</tr>
<tr>
<td>DevSoft</td>
<td>213</td>
</tr>
<tr>
<td>Manychat</td>
<td>125</td>
</tr>
<tr>
<td>Align Technology</td>
<td>114</td>
</tr>
<tr>
<td>Keywords Sperasoft</td>
<td>98</td>
</tr>
<tr>
<td>HazelTree Arm</td>
<td>70</td>
</tr>
<tr>
<td>DevArt</td>
<td>56</td>
</tr>
</tbody>
</table>

*Source: SRC*

It is important to emphasize that overwhelming majority of these companies are product companies, however such companies as **EPAM** and **DataArt** (which are major outsourcing companies) employ 390 and 406 relocated personal respectively.

Inflow of Russian specialists to Armenia is confirmed by the data provided by SRC. The growth of employment in “IT services without telecommunication” subsector is the following:

**Figure 43 Employment in IT services without telecommunication, number of employees**

*Source: SRC*
It is obvious, that 15% growth in Q2 2022 (compared to Q1 2022) is the direct effect of relocation, as for the period 2018-2021, and average quarterly growth rate in employment in “IT services without telecommunication” subsector is 5%.

One of the major benefits, which the relocation phenomenon brought to IT industry of Armenia, is the increase of quality of local staff. According to the representatives of relocated firms, the quality of specialists in the Russian Federation is much higher than those in Armenia. One of the respondents, which represented a relocated company described a situation, where the company was hiring a senior developer from local market, and after testing some of the candidates, which had relevant experience they assessed their skills as maximum middle developers. This is a direct consequence of labor shortage, as most software developers are headhunted for about 2-3 times in a year, and during this process along with salary, developers get promotion. The relocation of qualified specialists, especially senior level, might result in professional growth of local developers. The majority of representatives of IT companies noted that one qualified senior developer facilitates skills enhancement and professional development of ~5 junior specialists for a year. Taking into account this fact, some of the respondents even suggested exempting relocated senior specialists from taxes.

One of the most important benefits that relocation might bring to Armenia is more interest in Armenia from international funds and investors. Along with relocation of such companies as Miro, Yandex and EPAM or Avito Armenia becomes more attractive for the investors of those companies who invested in both expansion and growth stages.

Moreover, despite the fact that the competition for local staff has become more intense, some respondents mentioned that relocated staff has become available for Armenian companies. Respondents also mentioned, inflow of advanced technological knowledge and corporate culture that relocated companies have brought.

### 4.4 Start-Up Ecosystem in Armenia

Armenian startup ecosystem ranks 60th in 2022 Global Start-Up Ecosystem Index by StartupBlink Research Center. Armenia ranks 16th in Eastern Europe, moreover Yerevan ranks 244th out of 1,000 cities with most developed start-up ecosystem moving 38 lines up from 2021.

According to Dsight in 2021-H1 2022 Armenian start-ups raised more than $1 billion in investment in 26 deals. Two deals, worth $700 million brokered by ServiceTitan accounted for almost 70% of all deals.

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52 Startup ecosystem of Yerevan. Startupbink
53 Research Center and the biggest database in Eurasia with a focus on venture market
Table 12 Top-5 deals with Armenian startups 2021-H1 2022

<table>
<thead>
<tr>
<th>Start-Up</th>
<th>Deal’s Value</th>
<th>Investors</th>
<th>Industry</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Service-Titan</td>
<td>$700 million</td>
<td>Sequoia Capital, Tiger Global</td>
<td>Business Software</td>
<td>Cloud-based service management platform for PropTech companies</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Management</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PicsArt</td>
<td>$130 million</td>
<td>SoftBank Vision Fund, Sequoia</td>
<td>Business Software</td>
<td>Web-based app for video and photo editing</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Capital</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Disqo</td>
<td>$85 million</td>
<td>Sageview Capital, March Capita</td>
<td>Advertising and</td>
<td>CX platform helping brand owners to monitor user experience</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Marketing</td>
<td></td>
</tr>
<tr>
<td>Codesignal</td>
<td>$50 million</td>
<td>Index Ventures, Menlo Ventures</td>
<td>Business Software</td>
<td>Cloud-based software to check the level of technical skills</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sololearn</td>
<td>$24 million</td>
<td>Drive Capital, Learn Capital</td>
<td>EdTech</td>
<td>Training platform for programmers</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Source: Dsight

30% of deals came to the software for business segment, followed by fintech and medtech.
Distribution of VC deals by their segment is the following:

Figure 44 Distribution of VC deals, by segments, % of total

Source: Dsight

According to Dsight, there are 500 start-ups currently in Armenia, 50 of which have already designed product. Artificial Intelligence is believed to be a priority for start-up development,
followed by business software, Blockchain web3, HRtech, design motion, gaming and biotech/agrotech.

Currently, there are **3 big associations of business angels** (BANA, AICA, STAN) as well as **8 local venture capital firms** (Granatus Ventures, Hive Ventures, SmartGate VC, Himk Capital, Big Story VC, Hye Ventures, 3S Ventures, Formula VC). Moreover, Armenian start-ups get their investment from international venture capital firms, such as Sequoia Capital, Tiger Global, SoftBank, RTP Global and more.

Moreover, there are dozens of incubation and acceleration programs. **More than 18 global corporations have launched innovation hubs in Armenia** such as Microsoft Innovation Center, SAP Start-Up Factory, Orion Worldwide Innovations. It is noteworthy, that in 2022 the largest accelerator in the world in pre-seed stage **Founder Institute** started working in Armenia. It is no surprise, that Forbes Asia, named **Armenia “World’s Next Tech-Hub”**.

Government of Armenia puts together comfortable conditions for IT business development. As we discussed before, **IT Certificate** is the main tool to support start-ups, obtaining which companies enjoy tax benefits. In addition, several programs to boost start-ups are implemented, such as **Export Development Grants** – part of the World Bank financed programs, along with Ministry of Economy, with a budget up to $1.8 million; **“Entrepreneur + State”** – program backed by Armenian National Interests Fund (ANIF), supporting SMEs (including IT sector) with $0.5-$4 million grants.

However, there are some issues with Armenian start-up ecosystem, which need to be discussed as well. First of all, it is **conservative policy of Central Bank**, which hampers the development of fintech start-ups as well as banking sector. Moreover, according to the Forbes, local investors are not ready to invest in start-ups in its growth stage (maximum in seed stage). We discussed this hypothesis with various representatives of the IT sector, and majority of them supported it.

Armenian start-up ecosystem needs investors, which might give **not only financial resources but entrepreneurial experience and networking as well**. As we discussed before, a lot of Armenian entrepreneurs lack business skills, which is a serious barrier for commercializing technical knowledge and skills of them.

Obviously, the most significant problem for further strengthening of Armenian start-up ecosystem is **shortage of human resources**. In **STEM Education** subchapter, we discussed the main problems of academic education in Armenia.

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In addition, small market size of Armenia and absence of end-market is another issue for start-ups. Large corporations of Armenia tend not to become a “start-up buyers”, while start-ups see foreign companies and funds as main end-customers.

### 4.4.5 PESTLE Analysis of IT Industry and Market Entry Barriers

It is no surprise that the overwhelming majority of IT sector representatives mentioned that the most notable market entry barriers are connected with human resources. **Shortage of qualified human resources** and **problems with attraction of them** are the most fundamental entry barriers for IT industry of Armenia. Moreover, the respondents also mentioned the problem of **brain drain**. It should be mentioned that the lack of human resources refers not only to technological staff but marketing, sales and business development too. That’s why a lot of respondents mentioned that **Armenian companies are more competitive in B2B than B2C industry, where the importance of such people is very high**.

Another major entry barrier and challenge for Armenian IT industry is **gaining entry into global market and global value chains**. A very considerable barrier, for Armenian companies is **working with marketplaces** which are related to collection of payments. In this regard it is a most pressing concern for the state to come to terms with Paypal and Stripe, so that the latter start to work with Armenia-based companies.

The development of VC environment in Armenia, as well as Government prioritizing the ICT sector and international organizations focusing on the sector brought to naught such entry barriers as limited access to financial resources, lack of support from government.

#### Table 13 PESTLE Analysis of IT Industry

<table>
<thead>
<tr>
<th>POLITICAL</th>
<th>ECONOMIC</th>
</tr>
</thead>
<tbody>
<tr>
<td>• ICT is announced by the GoA as one of the priority sectors of Armenian economy</td>
<td>• ICT value added in GDP is growing: 4.7% in 2021, while in 2020 and 2019 was 3.8% and 3.2% respectively</td>
</tr>
<tr>
<td>• Government Programme 2021-2026, focusing on enhancement of productivity in ICT, expanding employment opportunities, increasing its share in GDP</td>
<td>• ICT turnover in 2021 was $985.1 million. The CAGR for 2019-2021 period was amounted to be 7.1%</td>
</tr>
<tr>
<td>• Ministry of High-Tech Industry of Armenia, which implements various grant programs in the ICT industry, and already launching a national venture fund</td>
<td>• Development of VC industry: In 2021-H1 2022 Armenian start-ups raised more than $1 billion in investment in 26 deals.</td>
</tr>
</tbody>
</table>

---

56 USD-AMD exchange rate according to CB of RA: In 2021, USD/AMD rate was 503.77
<table>
<thead>
<tr>
<th>Focus of international donor organizations (UNDP, USAID etc.) on ICT industry, in particular on human resources development, acceleration/incubation programs</th>
<th>Employment: From 2019 to Q2 2022 average quarterly number of hired workers in ICT in Armenia grew by 65%</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Employment: From 2019 to Q2 2022 average quarterly number of hired workers in ICT in Armenia grew by 65%</td>
<td></td>
</tr>
<tr>
<td>• Export: In 2017-2021 exports of ICT services at current prices almost doubled, with 13% CAGR, reaching $328.4 million</td>
<td></td>
</tr>
<tr>
<td>• Relocation: Russian Federation-based IT companies and specialists moved to Armenia, which has already significantly impacted Armenia’s IT industry</td>
<td></td>
</tr>
</tbody>
</table>

### SOCIAL

- **Demography:** Armenia is an aging country, and will face serious problems with employment, as new labor resources (today’s 18-22 years age group) are 39% less than for example age group of 28-32 years old. Thus, labor resources of Armenia and in the ICT sector are decreasing.
- **Education:** The impact of the demographic situation is obvious for education as well, where number of enrolled students are decreasing year by year.
- **Education:** STEM and IT-related specializations are becoming more and more popular. In 2021, the number of bachelor students learning IT in state universities was 4,386, which is 7.6% of all students in state educational institutions

### TECHNOLOGICAL

- **R&D Expenditure:** R&D expenditure in GDP of Armenia is increasing (0.21% as of 2020)
- **EDA and Chip Design:** 2 of 3 biggest EDA companies have presence in Armenia, which implement R&D activities as well.
- **AI Research and Industrial Internet of Things:** Armenia’s strong heritage in advanced mathematics might make the country as a global hub for AI research and IIOT.
- **Commercialization of research:** Activation of VC industry, introduction of national venture fund as well as relocation of investors are becoming a serious factor for commercialization of research.

### LEGAL

- Supporting mechanism “IT Certificate”, which presupposes tax benefits: a) Corporate Income Tax exemption for 5 years; b) Personal Income Tax reduction to 10%.
- **Patentable technologies:** Armenian companies mentioned that they are not facing issues with protection of patents yet

### ENVIRONMENTAL

- **Start-Ups:** More funding opportunities for ventures focusing on environmental start-ups.
- **Sustainable Development Goals:** International donor organizations introduce support mechanisms (such as ImpactAim venture accelerator focusing on climate change by UNDP).
4.4 Key Findings

- One of the most notable trends in “IT service without telecommunication” is the rise of “platform outsourcing” phenomenon, which gradually occupies the market of small projects.

- Currently, five types of business entities have been revealed in ICT market: (i) Armenian branches of multinational outsourcing firms; (ii) Local outsourcing firms; (iii) Individual Entrepreneurs on global platforms; (iv) Multinational product companies; (v) Local product companies.

- The dominant subsector in IT, according to our estimates, is outsourcing, which has lower added value, and where global competition is intense. There is an opinion that Armenia’s uniqueness is the ability to solve complex problems so such issues as raising salaries and shortage of labor force are not a big threat. Currently, according to our estimates, the share of outsourcing is decreasing.

- Companies, which have their own product usually, incorporate foreign affiliates (mostly in the US), which resulted in part of value added generated by Armenian firms to remain in foreign books. However, there is a perception that it is not a big issue for Armenia as after exit founders keep on investing in Armenia.

- According to our hypotheses, Armenian companies incorporate foreign affiliates for the following reasons: to attract investments more easily; to protect their intellectual property more effectively; to have tax benefits; to be closer to and work more easily with international marketplaces; to have access to bigger markets and most advanced knowledge. The hypotheses on attracting more investment, having access to bigger markets and most advanced knowledge were confirmed.

- Armenian Diaspora played a key role in the formation of IT industry of Armenia, in particular in bringing global IT companies to Armenia. According to the representatives of IT companies, the most significant benefit from Diaspora is the transfer of the most advanced knowledge and skills as well as networking opportunities.

- Consequences of the Russian invasion of Ukraine for the IT industry have included the relocation of businesses and specialists. For the period of March–June 2022, 3,603 individual entrepreneurs and business entities have registered in IT services without telecommunication subsector; the growth rate of hired workers in Q2 2022 compared to Q1 2021 is 15%.

- Relocation phenomenon might seriously increase the quality of IT personal in Armenia; however, it makes the competition for talents in local market more intense.

- Armenian startup ecosystem ranks 60th in 2022 Global Start-Up Ecosystem Index by StartupBlink Research Center. In Eastern Europe Armenia ranks 16th, while Yerevan ranks 244th out of 1,000 cities with most developed start-up ecosystem.

- in 2021-H1 2022 Armenian start-ups raised more than $1 billion in investment in 26 deals, however, two deals, worth $700 million brokered by ServiceTitan accounted almost 70% of all deals. 30% of deals came to the software for business segment, followed by fintech and medtech.
- There are **3 big associations of business angels** as well as **8 local venture capital firms**. Moreover, Armenian start-ups get their investment from international venture capital firms, such as Sequoia Capital, Tiger Global, SoftBank, RTP Global and more.

- Along with dozens of incubation and acceleration programs, there are more than 18 global corporations, which have launched innovation hubs in Armenia. In 2022 the largest accelerator in the world in pre-seed stage **Founder Institute** started working in Armenia.

- Policy of Central Bank, lack of investors with entrepreneurial experience and global networking, shortage of human resources, small market size along with absence of “end-market”
5. Investment Model

5.1 Investment Opportunities for ADB

*Shift from outsourcing model to own product development.*

As we revealed in previous chapter, the dominant subsector in IT sector of Armenia is **outsourcing**. However, this subsector is very vulnerable and has several problems. Let’s look at the main challenges, that Armenian outsourcing firms are facing currently.

**Demography |**

As of January 1, 2021, de-jure population of Armenia was 2.96 million people, and if we look at the population pyramid of Armenia, it is obvious that Armenia will face serious problems with employment, as new labor resources (today’s 18-22 years age group) are 39% less than for example age group of 28-32 years old.
Year by year the labor resources in Armenia are decreasing. According to Armstat data, work resources in 2021 were decreased by 78.9 thousand.

Figure 45 Work resources in Armenia, number of working age population

Source: Statistical Committee of RA
It should be noted that since 2011, the number of 20–59-year-olds in the total de jure population has been decreasing year by year, while the share of 60+ age groups has increased (19% in 2021, 18% in 2019, and 14.7% in 2011). As a result, the workload and wages of remaining labor resources are growing year by year.

**Figure 46 Wages in “IT services without telecommunication”, AMD**

<table>
<thead>
<tr>
<th>Year</th>
<th>Wages (AMD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2019</td>
<td>595,970</td>
</tr>
<tr>
<td>2020</td>
<td>611,273</td>
</tr>
<tr>
<td>2021</td>
<td>705,884</td>
</tr>
<tr>
<td>2022</td>
<td>937,286</td>
</tr>
</tbody>
</table>

*Source: Statistical Committee of RA*

It’s common knowledge, that the biggest expense of outsourcing companies is **salary cost**. Thus, the demographic situation, which results in higher salaries, makes Armenian outsourcing companies non-competitive, especially against the new emerging markets.

**Exchange Rates**

For the period 2015-2019, AMD was one of the most stable currencies in the CIS region. However, the situation changed in 2020-2022 because of externalities such as the COVID-19 pandemic and the Russian invasion of Ukraine. In 2020 AMD depreciated against USD by 8.9%, but in 2021 AMD recovered. Consequences of the invasion have been significant, and as of August 31 2022 AMD had appreciated by 16% against USD compared to August 2021.

Exchange rate fluctuations have seriously affected exporting companies (which generate revenue in USD), including IT services outsourcing companies. Representatives of IT services companies highlighted that because of these factors **small and medium companies (up to 30 employees) are at risk of ceasing their operations** or should be acquired as the profit margin is decreasing dramatically.
New Outsourcing Destinations

Representatives of IT services companies indicate, that currently majority of IT companies consider shifting some of their operations to “new destinations”, emphasizing especially India, the Philippines, Viet Nam, and Malaysia. One of the respondents even mentioned that “In total we have ~25-30 thousand software developers in Armenia, which is less than number of hired workers in 3-4 large Indian outsourcing companies”. However, as we revealed there is a persuasion that Armenian companies provide complex technological solutions, thus part of the respondents find impossible to move such operations as product design, engineering or product development from Armenia in the nearest future. Moreover, respondents emphasized the importance of having foreign offices in young countries, in terms of access to new markets.

A.T. Kearney identifies top-50 destinations providing IT, BPO and software services outsourcing, and Armenia is not even included in this ranking. Ranking is based on four components: financial attractiveness; people skills and availability; business environment and digital resonance.

Figure 47 Country rankings according to “Global Services Location Index”

It should be noted that these countries remain in the top positions, as financial attractiveness of them is very high. However, if we set digital resonance as the main criterion, none of them will be in top-15. Statistical evidence also supports this hypothesis. According to SRC, as of Q2 2022 there are 25,283 hired workers in IT services without telecommunication subsector (J.62; J63.1; J58.2 as NACE rev. 2). The figure below shows the number of workers in “ICT services” subsector, proving that in terms of affordable labor force these countries are more attractive than Armenia.

57 https://www.kearney.com/digital/article/-/insights/the-2021-kearney-global-services-location-index
Taking into account these important factors, as well as the opinions of ICT industry representatives, we can say that outsourcing companies face serious challenges and are becoming less competitive. Thus, investment opportunities are designed under “shift from outsourcing model to product development” vision.

5.1.1 Investment Model Essentials

The investment model designed in this paper is the mix of two different investment strategies: corporate venture building and fund of funds. The hypothesis on feasibility of this model was tested during in-depth interviews with IT sector players, and ~90% of respondents confirmed viability of this model. Let’s first understand what each of these strategies represent.

Corporate Venture Building |

In general, venture builders are organizations, which build startups and support them in the entire value chain. They are fully dedicated to the development and growth of ventures they are involved in and become co-founders of it. Venture builders usually do not provide financial resources to startups, but they have all necessary resources and expertise to scale up startups (infrastructure, human resources). The support provided by venture builders is much more than accelerators and incubators offer. Venture builders are deeply involved in the development process of startups and the main function of them is to accompany ventures “from the seed phase to the last stage”.

Figure 48 Number of workers in “ICT Services” by countries, thousand people

<table>
<thead>
<tr>
<th>Country</th>
<th>Number of workers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Armenia</td>
<td>25,3</td>
</tr>
<tr>
<td>Philippines</td>
<td>1,430</td>
</tr>
<tr>
<td>Viet Nam</td>
<td>400</td>
</tr>
<tr>
<td>Indonesia</td>
<td>998</td>
</tr>
<tr>
<td>Malaysia</td>
<td>340</td>
</tr>
<tr>
<td>India</td>
<td>4,470</td>
</tr>
</tbody>
</table>

Source: National Statistical Offices, ILO
Core activities of venture builders are:

The culture of venture building is a European phenomenon. The most known venture builder in Europe is **Rocket Internet (Germany)**. According to Venture Builder Map (https://venturebuilder-map.slash.co/), there is one venture builder in Armenia: **Slash Digital**.

*Intrapreneurship – a model that provides opportunities to employees to act like entrepreneurs within a company (internal sourcing)*

There are two ways of developing business ideas into a product: **internal sourcing and external sourcing**.

In general, **talent pool** is concentrated in large corporations. Corporate venture building (CVB) is a symbiosis of intrapreneurship and large corporations. Large corporations establish **independent separate entities**, which usually becomes a hub for internal and external innovations and business ideas. Projected process of internal sourcing is the following: 1) employees of outsourcing companies with start-up ideas apply to CVB; 2) CVB tests the viability of the start-up; 3) in case of viability – technological partner provides **full technical and service support** for the implementation, in return for equity. The process is almost identical for **external sourcing**, with only one sufficient change – anyone with a start-up idea might apply to CVB.
The model of corporate venture building is visualized below:

As mentioned before, CVB and intrapreneurship are widespread practices among large enterprises, which seek to be innovative and stay ahead of changes in the market. Let’s have a look at the most successful intrapreneurship and CVB examples worldwide.

**Intrapreneurship Examples**

- **Google** is an excellent example of involvement in intrapreneurship. Google’s policy allows employees to spend 20% of their time on personal projects.
- Some of the key Google products such as **Gmail, Google Classes, Google News** originated due to this 20% policy.
- One of the largest investment banks **Société General** has famous internal intrapreneurship program called “**Internal Startup Call**”. Société General employees have already launched ~70 startups.
- **Meta** intrapreneurship program is based on its famous hackathons. These hackathons led to such innovations as **Like** button or **Mark as Safe** option.
**Fund of Funds**

The second essential of the investment model is the **fund of funds (FOF)** investment vehicle. In general, FOF is described as “fund that invests in other types of funds”. The main objective of FOFs is to achieve diversification and to reduce risks as much as possible. The biggest advantage of FOFs, which is the cornerstone of our investment model, is the **professional management of the funds and portfolio**. Thus, investors rely on the professional experience of fund managers, so FOFs have **co-investment logic** as well. During in-depth interviews, policymakers in the ICT industry (Ministry of Economy, Ministry of High-Tech Industry) indicated the importance of having FOF in Armenia, which will co-operate with foreign funds. Moreover, the state has started the process of establishment of **national venture fund**, has already chosen the **fund manager**. The aim of this fund is to invest in Armenian startups with co-financing from the state. Thus, the logic of co-investment with professional management of the funds is persisted.

### 5.1.2 Investment Model

The proposed investment model implies **co-operation between four parties**: ADB, **Venture Capital Firms**, **Outsourcing Company** and **Start-Up**.

We identified, that despite the fact that IT outsourcing companies are facing serious challenges, outsourcing is still the **dominant IT business in Armenia**, where talent pool is mainly concentrated. However, Armenian IT services companies do not practice neither **intrapreneurship** nor **corporate venture building**.
Thus, ADB, along with venture capital firms, establishes a **fund of funds (symbiosis)**. ADB should **set criteria** to choose relevant venture firms and participate in start-ups, which will have **corporate venture building component**. ADB and venture capital firm might both **invest in start-up**, or ADB might **pop-up the money raised by venture**. Venture firms should 1) **meet the criteria** ADB sets, 2) **invest in start-ups with CVB component**.

Under the model, **start-up shares equity with technological partner and fund of funds**. Overall equity will be shared in this way:

According to our model, **a symbiosis of ADB, venture firms and outsourcing companies** will give opportunities to outsourcing companies’ employees to approach with their start-up ideas.

**The role of venture firms** will be to test the viability of suggested start-up idea, to build financial models. As we mentioned before, the ecosystem of venture capital in Armenia is enhancing, and currently there are few venture firms, which have relevant experience and knowledge to understand the potential of suggested ideas.

**Outsourcing firms – technological partners**: In the next stage, after the idea is tested, outsourcing firms are meant to give technological solutions for startups, as they have relevant experience and human resources. In return, technological partners receive equity.
**ADB** might share the risks with technological partner and venture firm by different ways: 1) co-investing with venture firms in start-ups which match the criteria; 2) by paying (usually by big discounts) technological partners for their services; 3) during in-depth interviews many respondents mentioned the **importance of having go-to market, business development, marketing and sales** qualified specialists which ADB might find and pay for working in start-ups, 4) adding scientific component with hiring researchers from different spheres. During in-depth interviews, Armenian venture firms mentioned, that currently one of the trends is **computational biology**.

Let’s have a look at SWOT analysis of proposed investment model, which was discussed during in-depth interviews with sector representatives.

<table>
<thead>
<tr>
<th>INTERNAL FACTORS</th>
<th>EXTERNAL FACTORS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>STRENGTHS</strong></td>
<td><strong>WEAKNESSES</strong></td>
</tr>
<tr>
<td>➢ Minimized risks, as ventures are tested by professional fund managers</td>
<td>➢ According to different respondents’ employees in outsourcing companies have <a href="#">non-entrepreneurial mindset</a></td>
</tr>
<tr>
<td>➢ Using the unique potential of concentrated talent pool in outsourcing firms</td>
<td>➢ Outsourcing companies in Armenia do not practice intrapreneurship and CVB, not to lose human resources</td>
</tr>
<tr>
<td>➢ State interest in increase of product companies, which create more added value</td>
<td>➢ The first such practice to institutionalize venture building</td>
</tr>
<tr>
<td>➢ Cooperation of different types of institutions and firms, which mitigates potential risks</td>
<td></td>
</tr>
<tr>
<td><strong>OPPORTUNITIES</strong></td>
<td><strong>THREATS</strong></td>
</tr>
<tr>
<td>➢ Not only internal sourcing but also <strong>external sourcing</strong> might be used</td>
<td>➢ Further fluctuations with exchange rate</td>
</tr>
<tr>
<td>➢ The symbiosis could be open <strong>not for Armenian startups but for the regional countries as well</strong></td>
<td>➢ Economic and political instability in Armenia</td>
</tr>
<tr>
<td>➢ Relocation of Russian IT specialists, with new business ideas</td>
<td></td>
</tr>
</tbody>
</table>

One of the most notable weaknesses of the model is that according to many representatives of IT companies (both product and outsourcing companies), employees of outsourcing companies **have different mindset – tend not to have entrepreneurial activity**. Thus, the model will not only concentrate on internal sourcing of business ideas but **external sourcing as well**. Moreover, taking into account modest human resources in Armenia, it is suggested to **open this opportunity for international market regardless of country and citizenship of entrepreneur**.
Thus, outsourcing firms might give technological solutions not only for start-ups established by employees but for other ideas, which are tested by venture firms too.

In conclusion, it should be constituted, that **taking into account successful international experience, as well as unique features of the model, this investment opportunity is a second chance for the majority of Armenian outsourcing companies.**

### 5.1.3 Industrial Internet of Things: Overview

Industrial internet of things might be a big dimension for investment in Armenia. IIoT is defined as development of systems comprising networked smart objects, cyber-physical assets, associated generic information technologies and optional cloud or edge computing platforms, which enable real-time, intelligent, and autonomous access, collection, analysis, communications, and exchange of process, product and/or service information, within the industrial environment, so as to optimise overall production value.

The curve of technology life cycle, consists of the following stages:

- **research and development stage,**
- **ascent stage,** when the technology is being introduced to the market and gradually gain strength,
- **maturity stage,** when the technology becomes widespread and usual practice, and
- **decline stage,** when the use of technology is gradually diminished also due to introduction of new, more advanced ones.

Taking into account, the limited financial resources for R&D stage, we believe, that Armenia should focus on **ascent stage (disruptive interventions which have already passed R&D stage).**

According to Mckinsey\(^5^8\), potential economic value, that the IoT could unlock by 2030 is very large and might reach from $5.5 trillion to $12.6 trillion. As of 2020, IoT captured about $1.6 trillion value.

The B2B sector is where the majority of IoT value could be created (65%). During in-depth interviews, majority of respondents mentioned, that **Armenian high-tech companies should concentrate on B2B products,** as it doesn’t require large investments on marketing as B2C does. Moreover, the economic value that might create IoT is concentrated on certain sectors. The biggest share, is the industrial internet of things (~26%), followed by health sector (~10-14%).

**Armenia’s Strengths |**

\(^{5^8}\) The Internet of Things: Catching up to an accelerating opportunity (2021). McKinsey & Company.
• Strong heritage in mathematics – as we discussed before, Armenia was one of the biggest mathematics hubs in Soviet times, with such institutions as Institute of mechanics and mathematics, S. Mergelyan Yerevan Scientific Research Institute of Mathematical Machines, Institute of informatics and automation problems, Separate Institute of Mathematics

• Armenia has **strong traditions in R&D and production of appliances, tools and instruments for measurement and testing**. Among the goods manufactured in Armenia were thermostats, oscilloscopes, spectrum analysers, hydrometers, aerometers, electro-technical instruments and meters, high precision instruments and tools, instruments and apparatus for physical and chemical analysis, etc. These goods were mainly produced for industrial applications and not for mass production.

• **Large presence of diaspora** in physics, multidisciplinary chemistry, biotech and mathematics, as well as in other STEM directions

• Armenia has necessary skills in applied mathematics (and data sciences in general) and physics. Despite the fact, that after collapse of Soviet Union the capacities of R&D institutions have decreased, they still have a huge potential.

• The IIoT opens plenty of opportunities in automation, optimization, intelligent manufacturing and smart industry, asset performance management, industrial control. Taking into account these opportunities, we can state that IIoT might be a **unicorn sector for Armenian economy**.

5.2 Equity and Debt Financing Transactions in ICT Industry for ADB

Under the frames of the project, Ameria CJSC tested identifying potential equity and debt investment opportunities for ADB in the ICT sector. For this end, series of in-depth interviews were conducted, with representatives of major ICT firms in Armenia. The list of companies interviewed is presented in Annexes.

In the context of debt transactions, it is important to note that IT companies **usually do not need financial resources for capital investments**. Usually, if IT companies take loans, it is meant to cover operational expenses. Thus, these **loans are short term** (up to 1 year in most cases) and there is no sense to apply to such international organizations as ADB for short-term loans. However, companies could consider loans to cover operational and development expenses with more than one year tenure and at more affordable terms than currently offered by the local banks, which could be of interest for ADB.

Moreover, according to respondents, **complex requirements for ADB assistance** such as feasibility studies for projects, financial due diligence, ownership structure description, environmental and social aspects are a major hardship for IT companies. Respondents mentioned
that even if ADB offers lower interest loans, costs (both direct and indirect) for preparing required documents makes this opportunity unattractive.

In the context of equity investment, it is important to understand the specificities of IT corporate environments and how IT companies raise money. Generally, we can distinguish between 5 rounds of venture capital funding, and in each of the rounds the types of investors vary.

One of the most considerable peculiarities of the IT sector is a dynamic and flexible corporate environment, especially when it comes to decision making. For this reason, most of the respondents believe that involvement of ADB would make the process of decision making slower, as IT companies should meet certain requirements (corporate governance system, more complex business processes etc.) of ADB. According to IT sector representatives, early-stage and mid-stage companies prefer working with venture capital firms, which are well aware of the specifics of IT.

Moreover, most of the respondents considered ADB or other development institutions, banks to have a very bureaucratic corporate system, which is a serious hardship for IT sector companies.

One of the hypotheses was that companies which have experience of cooperation with international organizations, NGOs, and the public sector (such as Synergy) will be interested to have ADB as a shareholder and will be interested in equity financing from ADB. During the interviews, this hypothesis was partly confirmed. According to the respondents, having ADB as a shareholder would make such companies more attractive and more influential in the public sector.

Summing up the results, we might state that those companies that seek to expand through capital expenditure or human capital may need financing from ADB. This hypothesis was partially confirmed during in-depth interviews. Moreover, it should be noted that ADB provides working
capital loans, which might also be attractive for IT companies to cover OPEX costs. However, it is important to point out that the collaboration must be based on very affordable terms (e.g., shared due diligence costs).

In summary, companies might be interested in debt or equity financing from ADB if they a) want to expand through capital expenditure or investment in human capital; b) have experience of cooperation with international organizations as clients.
### Appendix 5.1 List of In-Depth Interviews

<table>
<thead>
<tr>
<th>Date</th>
<th>Company/Institution Subsector</th>
<th>Position</th>
</tr>
</thead>
<tbody>
<tr>
<td>15/08/2022</td>
<td>EDA and Chip Design</td>
<td>General Manager</td>
</tr>
<tr>
<td>15/08/2022</td>
<td>Mobile App/Own Product</td>
<td>CEO and Founder</td>
</tr>
<tr>
<td>16/08/2022</td>
<td>Venture Builder</td>
<td>Head of Business Development</td>
</tr>
<tr>
<td>16/08/2022</td>
<td>Global Company / Innovation Lab</td>
<td>Country Manager</td>
</tr>
<tr>
<td>17/08/2022</td>
<td>Own Product</td>
<td>CEO</td>
</tr>
<tr>
<td>17/08/2022</td>
<td>Outsourcing</td>
<td>Managing Director</td>
</tr>
<tr>
<td>17/08/2022</td>
<td>Research Center</td>
<td>Founding CEO</td>
</tr>
<tr>
<td>22/08/2022</td>
<td>Sectoral NGO</td>
<td>President</td>
</tr>
<tr>
<td>22/08/2022</td>
<td>Own Product</td>
<td>Co-founder</td>
</tr>
<tr>
<td>23/08/2022</td>
<td>Relocated Company / Own Product</td>
<td>General Manager</td>
</tr>
<tr>
<td>23/08/2022</td>
<td>Group of Companies</td>
<td>CEO</td>
</tr>
<tr>
<td>25/08/2022</td>
<td>Gaming Industry</td>
<td>Advisor to CEO</td>
</tr>
<tr>
<td>25/08/2022</td>
<td>EDA and Chip Design</td>
<td>Strategic Business Director</td>
</tr>
<tr>
<td>26/08/2022</td>
<td>Business Incubator</td>
<td>CEO</td>
</tr>
<tr>
<td>26/08/2022</td>
<td>Own Product</td>
<td>CEO</td>
</tr>
<tr>
<td>01/09/2022</td>
<td>Ministry of Economy</td>
<td>Deputy Minister</td>
</tr>
<tr>
<td>05/09/2022</td>
<td>Global Company / Own Product</td>
<td>CEO</td>
</tr>
<tr>
<td>05/09/2022</td>
<td>Venture Capital Firm</td>
<td>Partner</td>
</tr>
<tr>
<td>Date</td>
<td>Entity</td>
<td>Position</td>
</tr>
<tr>
<td>------------</td>
<td>---------------------------------------------</td>
<td>------------------</td>
</tr>
<tr>
<td>08/09/2022</td>
<td>Venture Capital Firm</td>
<td>Partner</td>
</tr>
<tr>
<td>12/09/2022</td>
<td>Global Company / Own Product</td>
<td>Managing Director</td>
</tr>
<tr>
<td>12/09/2022</td>
<td>Ministry of High-Tech Industry</td>
<td>Deputy Minister</td>
</tr>
</tbody>
</table>

### Appendix 5.2 Main Economic Indicators Comparison

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Armenia</th>
<th>Ireland</th>
<th>Israel</th>
<th>Estonia</th>
</tr>
</thead>
<tbody>
<tr>
<td>GDP ($billion)</td>
<td>13.861</td>
<td>498.559</td>
<td>481.591</td>
<td>36.262</td>
</tr>
<tr>
<td>GDP Per Capita ($)</td>
<td>4,670</td>
<td>99,152</td>
<td>51,430</td>
<td>27,280</td>
</tr>
<tr>
<td>Annual GDP growth (%)</td>
<td>5.7</td>
<td>13.5</td>
<td>8.2</td>
<td>8.3</td>
</tr>
<tr>
<td>Exports of goods and services ($ billion)</td>
<td>4,885,736</td>
<td>672,256,570</td>
<td>143,053,755</td>
<td></td>
</tr>
<tr>
<td>High-technology exports ($ million)</td>
<td>37,562</td>
<td>42,490,854</td>
<td>16,089,827</td>
<td>2,680,431</td>
</tr>
<tr>
<td>High-technology exports (% of manufactured exports)</td>
<td>7</td>
<td>26</td>
<td>28</td>
<td>20</td>
</tr>
<tr>
<td>ICT service exports (% of service exports)</td>
<td>22.8</td>
<td>59.6</td>
<td>55.6</td>
<td>21.0</td>
</tr>
<tr>
<td>R&amp;D Expenditure (% of GDP)</td>
<td>0.21</td>
<td>1.23</td>
<td>1.79</td>
<td>5.44</td>
</tr>
</tbody>
</table>
### Appendix 5.3 Local Venture Funds

<table>
<thead>
<tr>
<th>Name</th>
<th>Founding Year</th>
<th>Description</th>
<th>Focal Stages</th>
<th>Industry Focus</th>
<th>Portfolio Companies</th>
</tr>
</thead>
<tbody>
<tr>
<td>HIVE Ventures</td>
<td>2014</td>
<td>International fund investing in Armenian founded start-ups</td>
<td>Early Stage</td>
<td>IT, Big Data &amp; Analytics</td>
<td>21</td>
</tr>
<tr>
<td>SmartGate VC</td>
<td>2017</td>
<td>Silicon Valley based fund with an Armenian rep office</td>
<td>Pre-Seed</td>
<td>AI, IoT, Blockchain, DeepTech</td>
<td>18</td>
</tr>
<tr>
<td>Granatus Ventures</td>
<td>2013</td>
<td>One of the first Armenian VC funds</td>
<td>Early Stage</td>
<td>Social, Mobile, Analytics, Cloud Technologies</td>
<td>14</td>
</tr>
<tr>
<td>BigStory VC</td>
<td>2021</td>
<td>Launched by Krisp and Podcastle AI co-founders, the fund invests in Armenian founding teams</td>
<td>Early Stage</td>
<td>Business Software, MedTech, DeepTech, EdTech</td>
<td>7</td>
</tr>
<tr>
<td>Formula VC</td>
<td>2012</td>
<td>Backing early-stage start-ups in Armenia and surrounding regions</td>
<td>Early Stage</td>
<td>SaaS, IoT, AI</td>
<td>5</td>
</tr>
<tr>
<td>Hye Ventures</td>
<td>2021</td>
<td>Invests in Armenian start-ups and seeks to build Armenia’s tech ecosystem</td>
<td>Pre-Seed, Seed, Series A, Series B</td>
<td>Consumer, Enterprise, Fintech, Frontier Tech, Healthcare, PropTech</td>
<td>N/A</td>
</tr>
<tr>
<td>3S Ventures</td>
<td>2022</td>
<td>Focused on start-ups founded in Armenia or elsewhere by Armenian diasporas</td>
<td>Pre-Seed, Seed</td>
<td>AI, Blockchain, SaaS, Fintech</td>
<td>N/A</td>
</tr>
<tr>
<td>Himk Capital</td>
<td>2021</td>
<td>Invests in Armenian-founded start-ups and those operating in Armenia</td>
<td>Seed, pre-Series A</td>
<td>B2B SaaS, E-Commerce, AI/ML, Field Services, Agriculture, Food, Energy, Renewables, Blockchain, Crypto, Cybersecurity</td>
<td>N/A</td>
</tr>
</tbody>
</table>
### Appendix 5.4 Angel Investors

<table>
<thead>
<tr>
<th>Name</th>
<th>Founding Year</th>
<th>Description</th>
<th>Industry Focus</th>
<th>Membership</th>
<th>Portfolio Companies</th>
</tr>
</thead>
<tbody>
<tr>
<td>BANA (Business Angel Network of Armenia)</td>
<td>2017</td>
<td>Ecosystem for entrepreneurs and investors, Armenia’s first angel investor club. They invest in start-ups that have traction and/or MVP</td>
<td>N/A</td>
<td>45</td>
<td>20</td>
</tr>
<tr>
<td>AICA (Angel Investor Club of Armenia)</td>
<td>2018</td>
<td>The club brings together professionals from across Armenia, from the Russian Federation, Germany, the United States, Austria, and Denmark.</td>
<td>Biotech, Digital Healthcare, IT, Blockchain, Artificial Intelligence, Biometrics, Construction, Real Estate Development, Renewable Energy, Banking, FinTech</td>
<td>45</td>
<td>11</td>
</tr>
<tr>
<td>STAN (Science and Technology Angel Network)</td>
<td>2018</td>
<td>FAST Foundation founded the club. Brings together science and technology investors who support teams from an idea through the seed stage</td>
<td>Artificial Intelligence Solutions</td>
<td>36</td>
<td>7</td>
</tr>
</tbody>
</table>

### Appendix 5.5 ICT Share in GDP by Countries

<table>
<thead>
<tr>
<th>Country*</th>
<th>ICT/GDP, %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ireland</td>
<td>14.3</td>
</tr>
<tr>
<td>India</td>
<td>13.0</td>
</tr>
<tr>
<td>Republic of Korea</td>
<td>10.8</td>
</tr>
<tr>
<td>United States</td>
<td>9.0</td>
</tr>
<tr>
<td>Japan</td>
<td>8.7</td>
</tr>
<tr>
<td>Malta</td>
<td>7.7</td>
</tr>
<tr>
<td>Belarus</td>
<td>7.4</td>
</tr>
<tr>
<td>People’s Republic of China</td>
<td>7.0</td>
</tr>
<tr>
<td>Bulgaria</td>
<td>6.6</td>
</tr>
<tr>
<td>United Kingdom</td>
<td>6.2</td>
</tr>
<tr>
<td>Country</td>
<td>Score</td>
</tr>
<tr>
<td>---------------------</td>
<td>-------</td>
</tr>
<tr>
<td>Hungary</td>
<td>6.1</td>
</tr>
<tr>
<td>Estonia</td>
<td>6.0</td>
</tr>
<tr>
<td>Saudi Arabia</td>
<td>5.5</td>
</tr>
<tr>
<td>Latvia</td>
<td>5.4</td>
</tr>
<tr>
<td>Canada</td>
<td>5.1</td>
</tr>
<tr>
<td>Singapore</td>
<td>5.1</td>
</tr>
<tr>
<td>Finland</td>
<td>4.9</td>
</tr>
<tr>
<td>Armenia</td>
<td>4.7</td>
</tr>
<tr>
<td>Croatia</td>
<td>4.5</td>
</tr>
<tr>
<td>France</td>
<td>4.4</td>
</tr>
<tr>
<td>Germany</td>
<td>4.4</td>
</tr>
<tr>
<td>Slovakia</td>
<td>4.3</td>
</tr>
<tr>
<td>Belgium</td>
<td>4.2</td>
</tr>
<tr>
<td>United Arab Emirates</td>
<td>4.1</td>
</tr>
<tr>
<td>Russian Federation</td>
<td>3.9</td>
</tr>
<tr>
<td>Norway</td>
<td>3.8</td>
</tr>
<tr>
<td>Romania</td>
<td>3.7</td>
</tr>
<tr>
<td>Slovenia</td>
<td>3.7</td>
</tr>
<tr>
<td>Austria</td>
<td>3.7</td>
</tr>
<tr>
<td>Poland</td>
<td>3.6</td>
</tr>
<tr>
<td>Lithuania</td>
<td>3.5</td>
</tr>
<tr>
<td>Italy</td>
<td>3.4</td>
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References


Bilateral Trade Flows by ICT goods categories. UNCTAD Stat. Available at: https://unctadstat.unctad.org/wds/TableViewer/tableView.aspx


Core ICT indicators - ITU (2005). Available at: https://www.itu.int/ITU-D/ict/partnership/material/CoreICTIndicators.pdf

Database - Eurostat. Available at: https://ec.europa.eu/eurostat/data/database/


Global Social Media Statistics - DataReportal – global digital insights (2023) DataReportal. Available at: https://daterreportal.com/social-media-users


ICT goods categories and composition - UNCTADSTAT. Available at: https://unctadstat.unctad.org/EN/Classifications/DimIctProducts_Ict_Hierarchy.pdf

IIA navigator. Armenia | International Investment Agreements Navigator | UNCTAD Investment Policy Hub. Available at: https://investmentpolicy.unctad.org/international-investment-agreements/countries/9/armenia

Impact study (2020) BIRD Foundation. Available at: https://www.birdf.com/impact-study/


Individuals using the internet (% of population). World Bank Open Data. Available at: https://data.worldbank.org/indicator/IT.NET.USER.ZS


Minister: As a result of relocation, 300 large companies with Russian capital were registered in Armenia (2022) Finport.am. Available at: https://finport.am/full_news.php?id=46659&lang=3

Ministry of High-Tech Industry. Available at: https://hti.am/main.php?lang=3&page_id=761


Programs. Fast Foundation. Available at: https://www.fast.foundation/en/community

Remuneration and number of employees (2022). Statistical Committee of Armenia. Available at: https://www.armstat.am/file/article/sv_07_22a_01.pdf


Robinson, D. (2022) Cloud spending will near $500 billion this year, The Register® - Biting the hand that feeds IT. The Register. Available at: https://www.theregister.com/2022/04/20/gartner_cloud_spending/

*Siird.com*. Singapore-Israel Industrial Research & Development. Available at: https://www.siird.com/


*Startup ecosystem of Yerevan*. Startupblink. Available at: https://www.startupblink.com/startup-ecosystem/yerevan-am


*Uplifting Armenian Economy Through Entrepreneurship* (2021) *Enterprise Incubator Foundation*. Available at: https://startups.eif.am/en/

*Worldwide tax summaries online*. PwC. Available at: https://taxsummaries.pwc.com/