Ministry of Foreign Affairs

THE ARMENIAN ICT ECOSYSTEM

Commissioned by the Netherlands Enterprise Agency

>> *Sustainable. Agricultural. Innovative. International.*

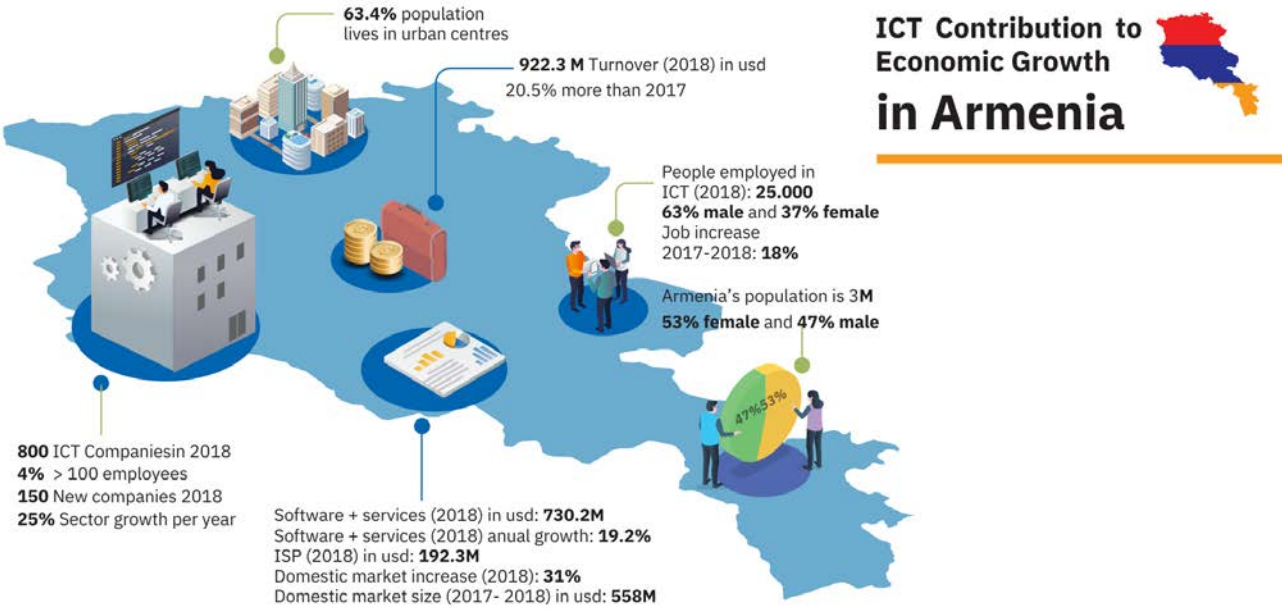
The Armenian Ict Ecosystem

Progress, Challenges And Opportunities In The Digital Landscape Of Armenia

A study conducted by Interliaise, commissioned by the Embassy of the Netherlands and the Dutch Enterprise Agency

2021

Contents



ICT Contribution to Economic Growth in Armenia

Armenia Global Rankings 2020

Position UN e-Government Development Index (index): **67**
Global inovation index (of 131) 2021: **69**
Upperincome countries: **15**
Network readiness index (of 134): **55**
Quality match science and education (of 134) 2018: **33**
Human Development Index (2017): **83**
ICT service imports rank 2018: **92**

Computer software spending 2018: **86**
ICT service exports: **18**
Increase online transactions with a bank card in 5 years: **10 X**
Online transactions with a bank card in 2014: **338 billion AMD**
Online transactions with a bank card in 2019: **25 billion AMD**
Online transactions igrowth in q1 2020: **14.6%**

01

EXECUTIVE SUMMARY

Shaping innovation and national digital ecosystems are important for the development of a thriving digital economy. Innovation and digital employment is likely to increase as a result of the development of these ecosystems. **This study aims to provide an insight into the Information Communication Technology (ICT) eco-system in Armenia.**

During its Soviet period in the 1950's, Armenia was already a center for computer science, advanced R&D, semiconductor and computer manufacturing, and software development. Not to mention that it had a highly educated technical workforce. After their independence in the 1990's, the Armenian government identified the IT sector as main driver for economic growth. With the help of government, international organizations, investors, and Armenian diaspora, the sector has developed a high tech regional hub with a growth of over 20% per year over the last 20 years. Today, the Armenian technology industry is made up of over 1300 ICT companies, many of them multinationals.

The STEM programs (science, technology, engineering and mathematics) in Armenia have produced highly educated technical specialists. Between the affordable professional assistance, low cost location and government support, Armenia is a favorable climate for IT ventures. Armenian IT companies are well-known for their success in R&D, semiconductors, software development, and IT services. At the same time, an increasing number of innovative Armenian technology startups are established and getting funded by international investors.

The government has worked hard on reforms and in recent years, the Armenian investment climate has performed well on the international indexes.

Despite a booming IT sector, good regulatory environment and infrastructure, and internet coverage for 98% of the population, Armenia still has serious steps to make before digitalizing its economy. When it comes digitalization, the public has not yet taken advantage of digital opportunities and the Armenian government is making very limited use of digital resources. Although Armenia has over 30,000 software engineers available, there is a shortage of senior technical specialists mainly resulting from a mismatch between education and business requirements.

In the face of the global digital revolution, Armenia must come to terms with the realities of IT investment in competitiveness. There is a new sense of urgency for the country to bring together all of its necessary resources to modernize and revitalize, not only its formal relations with potential investors, but also the underlying narrative.

This calls for the need to shape and nurture innovation and national digital ecosystems with the aim of accelerating a digital economy. More importantly, the development of IT encourages industries, digital employers and communities to use digital technology. The perks of IT development include better access to services, enhanced communications, and increased economic opportunities.

Armenia adopted a new Digitalization Strategy in 2021, aimed at ensuring a higher quality of public service delivery, efficiency and transparency of the public administration system. The Digitalization Strategy also offers benefits such as: development of broadband and telecommunication infrastructure, increase of competitiveness of the private sector, decision-making necessary for economic growth and development of digital skills workforce.

02

INTRODUCTION TO THE REPORT

2.1 What is an ICT Ecosystem?

The ICT ecosystem encompasses: policies, strategies, processes, information, technologies, applications, and stakeholders. Together, these make up a digital environment for the country's people, government, and enterprises. Most importantly a digital ecosystem focuses on people – diverse individuals-, who create, buy, sell, regulate, manage and use technology.[1] What do companies, governments, and regulators do to enhance their contribution? In this investigation we answer these and other questions by developing the idea of the ICT sector as an evolving ecosystem.

This study examines six broad areas to understand the opportunities and challenges in Armenia's digital ecosystem. These areas are called "Pillars" and can be divided into six categories –

1. Role of the government
2. Entrepreneurship
3. Knowledge
4. ICT Infrastructure
5. Digital Society.
6. Security and trust

1 Open ePolicy Group Berkman Center for Internet & Society https://cyber.harvard.edu/epolicy/roadmap.pdf

Role of the government

The role of the government examines the government's strategy and measures planned for a systematic approach to shaping the digital transformation of Armenia in order to achieve economic growth.

Entrepreneurship

Explores the role that digital entrepreneurship plays in increasing economic opportunity , efficiency, trade, competitiveness, and global economic integration. It examines the IT sector, the digital talent pool, the tech startup environment as well as the telecom market dynamics

Infrastructure

Describes the digital infrastructure in Armenia in terms of network coverage, network performance, and available internet bandwidth.

Knowledge

A healthy digital economy requires a supply of ICT skills that matches the current demand and an ecosystem that promotes technological innovation. The high yield of professionals with an extensive knowledge of ICT are trained by the innovative education system in Armenia

Digital society

Digital Society examines the progress, adoption and integration of use of Information and Communication Technologies (ICT) at home, work, education in Armenia.

Security and trust

Security and trust looks at the measures, regulations, standards and practices that prescribes how the government, businesses and organizations manage, protects, and distributes information.

Figure 2 – ICT Ecosystem.

2.2 About this study

This study has been commissioned by the Embassy of the Netherlands and the Dutch Enterprise Agency (RVO). In 2021 this study was carried out by ICT Armenia, a collaboration between Dutch and Armenian ICT consultants. The objective of this study is to provide an insight on the Information Communication Technology (ICT) ecosystem in Armenia and to identify opportunities for private and public organizations from the Netherlands to contribute, cooperate or to invest in ICT in Armenia.

The study is part of the approach of the Dutch embassy in helping Armenia to achieve the objectives of its Digital Agenda, which has been identified as the main strategy to drive economic development in Armenia.

This study may also assist Dutch organizations, institutes, their private sector, and government agencies to identify potential areas of collaboration with Armenia in order to strengthen its national digital ecosystem. (A list of opportunities has been added to this). This study expounds on findings from previous papers on Information Communication Technology in Armenia added with field research (2021) done by the ICT Armenia team.

This study is divided into ten chapters, the first of which is an introduction. The remaining sections cover the following areas: introduction, including Methods and techniques for the report, an "about Armenia" section, and the main section which is divided into 6 pillars (Government, Entrepreneurship, Knowledge, Infrastructure, Digital Society and Security and Trust). Each pillar covers a part about the Armenian IT Ecosystem, its strengths and weaknesses, and the investment opportunities that countries, such as the Netherlands, may have.

2.3 Methodology – Way of Working

The study took place between October 2021 and March 2022. It included desk research, consultations with the Armenian ICT related organizations and individuals, and four weeks of in-country interviews as well as polls and surveys with ICT employees, students and digital citizens.

The desk research resulted in over 300 different sources of which nearly 90 different sources have been mentioned in the footnotes on most of the pages included in this report. A list of sources is included along with list of figures at the end of this report. The sources cover a span of information between the years 2000 and 2022 but the majority of the sources are from or after 2018. (Due to Covid-19, sources from 2020 and 2021 are more challenging to find but we managed to cover them in the report as well.) The in-country interview research has been done by 2 native Armenian team-members and involve a total of 26 interviews with stakeholders from civil society, academia, the private and public sectors, international development organizations, and the government. Next to these interviews, we performed

4 online surveys with 470 responses. Amongst the survey participators were: students, IT employees, and household members. In addition, offline surveys on 23 households and 14 interviews with IT students and employees have been done. For in-person interviews with professionals in the Armenian ICT sector, Digitec 2021 was attended. Digitec is an annual event for the Armenian high-tech industry and the largest tech exhibition in the trans-Caucasus region.

We noticed that the information that we obtained from desk internet sources and the interview research were sometimes contradictory, as all sources have their point of view on a subject. We tried to provide an impartial insight on all of the information available to us in the period of our research.

Finally, rather than act as an authoritative source on the country's digital ecosystem, the study is intended to be a rapid assessment of opportunities and challenges tailored to RVO's programmatic priorities and thus may not cover all Armenian programs and projects in-depth. It provides a state of insight on the issue at hand, and overview of challenges and investment opportunities in Armenia for both local and Dutch companies.

We hope that you find the report informative on how to be part of Armenia's digital revolution journey and that it encourages you to start thinking differently about the country's issues at hand.

Nadia Gombra

Project leader

Interliaise

Consultanty for ICT & Sustainable Development

2.4 Acknowledgments

We would like to express our gratitude to the Armenian IT specialist, ICT companies, universities, and organizations who participated in our research. We would also like to thank all of the students, IT employees, and internet users that participated in our surveys. The Netherlands embassy in Yerevan and Dutch enterprise agency are also to be recognized for their contribution to the preparation of our Report. A special thanks to:

Vahan Hovsepyan	ICT industry expert, | Advisor to the Minister Ministry of High-Tech Industry of RA
Anna Rafaelyan	Overall ICT sector research, data input and analysis
Mariam Essayan	Overall fieldwork and support

For further information about opportunities in the ICT in Armenia, the organizations below can be contacted.

Netherlands Embassy in Yerevan	➲ Temporary number: +374 55 280891 ➲ E-mail: jer@minbuza.nl ➲ Website:https://www.netherlandsandyou.nl/your-country-and-the-netherlands/armenia/about-us/embassy-in-yerevan
Netherlands Enterprise Agency (RVO)	➲ Telephone: +31 70 379 80 00. ➲ Website: https://www.rvo.nl/onderwerpen/persoonlijk-advies-buitenland
Dutch- Armenian chamber of commerce	➲ Telephone: +31 6 5558 5533 ➲ Telephone: +374 15 525 525 ➲ Email: info@dacoc.nl ➲ Website:http://dacoc.nl
Enterprise Armenia	➲ Tel.: +374 11 208 105 ➲ E-mail: onewindow@isc.am ➲ Website: enterprisearmenia.am

03

ABOUT ARMENIA

3.1 Geopolitical positioning

Armenia is a landlocked country of Transcaucasia, located just south of the great mountain range of the Caucasus. To the north and east Armenia is bounded by Georgia and Azerbaijan, while its neighbors to the southeast and west are, respectively, Iran and Turkey. According to the world factbook, Armenia views itself as part of Europe; geopolitically, it can be classified as falling within Europe, the Middle East, or both.

The capital of Armenia is Yerevan.

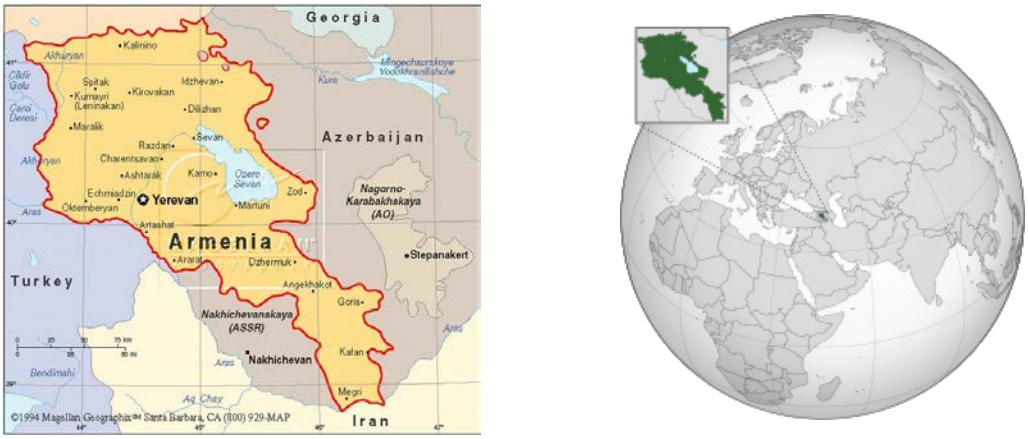


Figure 3 Geographical position of Armenia

Source https://historysshadow.files.wordpress.com/2013/02/armenia_map.jpg and Armenia - Wikipedia

Armenia has only two open trade borders - Iran and Georgia - because its borders with Azerbaijan and Turkey have been closed since 1991 and 1993 as a result of Armenia's ongoing conflict with Azerbaijan over the separatist Nagorno-Karabakh region. Armenia lost control over the region in the 2020 conflict.

Armenia is a member of the Commonwealth of Independent States (or CIS). In 2013, Armenia announced its commitment for joining the EAEU (Eurasian Economic Union) which eventually came into force in 2015. In November 2017, Armenia signed a Comprehensive and Enhanced Partnership Agreement (CEPA) with the EU, this agreement came into force in 2021.

In spring of 2018, the former President of Armenia (2008-18) Serzh Sargsian, of the Republican Party of Armenia (RPA), tried to extend his time in power by becoming prime minister thus prompting popular protests that became known as the "Velvet Revolution". Sargsian was thereafter forced to resign. The leader of the protests and Civil Contract party, chief Nikol Pashinyan, was elected by the National Assembly as the new prime minister on 8 May 2018. Pashinyan's party prevailed in an early legislative election in December 2018, and he was reelected as prime minister.

3.2 Demographics

The country's population has declined due to increased emigration since the break-up of the Soviet Union. The population of Armenia declined from its peak value of 3.6 million in 1992 to roughly 3 million in 2022. Despite this, the rates of emigration and population have recently increased as there has been a moderate influx of Armenians returning to Armenia. Armenia has a large diaspora, with about 8 million Armenians living throughout the world. The largest communities outside of Armenia are in Russia, Iran, France, the U.S, and Canada.[2]

63% of the population lives in the capital Yerevan (Erevan). Other main cities are Gyumri, Vanadzor, and Vagharshapat. Most Armenians speak Russian. For business purposes in the technology sector, the English language is used more frequently. 40% of Armenians know basic English, and only 4% have advanced proficiency in English. The main religion (92.6%) is Armenian Apostolic or the Armenian Orthodox Church, it is one of the most ancient Christian institutions in the world.

2 Source: Armenia Country Report 2022 https://bti-project.org/en/reports/country-report/ARM

3.3 Armenia's economy at a glance

Armenia is an upper middle-income country with a Gross Domestic Product per capita of USD 4,693 in 2021, USD 426 dollar higher compared to 2020. (USD 4,267.). The GDP per Capita in Armenia is equivalent to 32 percent of the world's average. Armenia's economy expanded rapidly between 2017 and 2019, with the annual GDP growth rate averaging 6.8 percent. However, in 2020 the COVID-19 pandemic and the military confrontation with neighboring Azerbaijan derailed Armenia's economic expansion and resulted in a sharp 7.4 percent decline. Traditionally, Armenia was focused on agriculture but nowadays the agriculture business is only 20% of Armenia's GDP.

The average monthly wage in Yerevan in 2021 was 200.000 drams (approximately 415 USD). In the IT sector, the average (monthly) salary is higher compared to the averages in Armenia. The average IT salaries are for junior technical specialist (USD 260 – USD 386), middle technical specialist (USD 401 – USD 583) and senior technical specialist (USD 588 – USD 744) per month.

Armenia is quite dependent on Russian commercial and governmental support, as most key Armenian infrastructure is Russian-owned and/or managed, especially in the energy sector. Remittances from expatriates working in Russia are equivalent to about 12-14% of GDP.

3.4 Armenia's investment climate

Introduction

The government of Armenia officially welcomes foreign investment. The Ministry of Economy is the main government body responsible for the development of the investment policy in Armenia.

The government has announced its commitment to addressing deficiencies that prevent Armenia from obtaining a higher ranking. Via Armenia's membership of the World Bank Group, Armenia participates in the Multilateral Investment Guarantee Agency (MIGA), which is part of the World Bank Group. The Armenian National Interests Fund and Investment Support Center are responsible for attracting and facilitating inward foreign direct investment.

Corruption

Armenia's ability to counter, deter, and prosecute corruption has historically been hindered by the lack of robust enforcement of official disclosure laws meant to prevent corrupt officials from entering and retaining positions of authority and influence. Nevertheless, the Armenian government's commitment to eradicating corruption continues. The government's anti-corruption agenda is outlined in a 2019–2022 strategy and implementation plan.

According to Transparency International's 2020 Corruption Perceptions Index, Armenia made the second-best improvement in the world and received a score of 49 out of 100, ranking it 60th among 180 countries. This reflects an improvement of 17 places over 2019.

Foreign direct investment

Main foreign investors invest in banking, energy, pharmaceutical, information technology, and mining sectors. According to the US department of state 2021 Investment Climate Statements: Armenia report, the banking system in Armenia is sound and well regulated, but the financial sector is not highly developed.[3]

Armenia has attractive regulations that provide foreign investors with an opportunity to not only be protected from unfavorable legislative changes but also to effectively take advantage of favorable legislative regulations. Although Armenian legislation offers protection for intellectual property rights, enforcement efforts and resources to record have room for improvement.

3 CONCEPT On Investment Policy of the Republic of Armenia https://www.mfa.am/filemanager/Statics/35_en.pdf

Law on foreign investments created a solid foundation for attracting foreign investments to Armenia via the regulation of legislative, economic, and organizational issues aimed at foreign investors' rights, legal interests, and property protection.

The main legal act regulating the investment sphere in the Republic of Armenia is the RA "law on foreign investments" which was adopted in 1994.[4] Through the reforms of the RA legislative field, the goal is to create an environment that promotes digitalization. The reforms are based on the reduction of corruption risks and administration, the revision of legislative provisions, the expansion of the use of digital signature and identification cards, and involvement in the private sector. The shared objective of these reforms is to make the legislative field favorable for the IT sector and the future digital economy.

A regular analysis will be performed by the EEU (Eurasian Economic Union), EaP (Eastern Partnership), and the EU (European Union) in order to assure that the criteria for the defined principles and the Armenian transformation into the digital economy are met.

Following the World Bank's "Doing Business in 2020" report, Armenia implemented the following reformations for doing business such as: protecting minority investors by increasing shareholders' rights and roles in major corporate decisions or clarifying ownership and control structures. Paying taxes has been made easier by including benefits such as VAT tax refunds. Online submissions of customs declarations have also been allowed, making Armenian export faster.[5]

4 Investment Policy Review of Armenia https://investmentpolicy.unctad.org/publications/1218/investment-policy-review-of-armenia

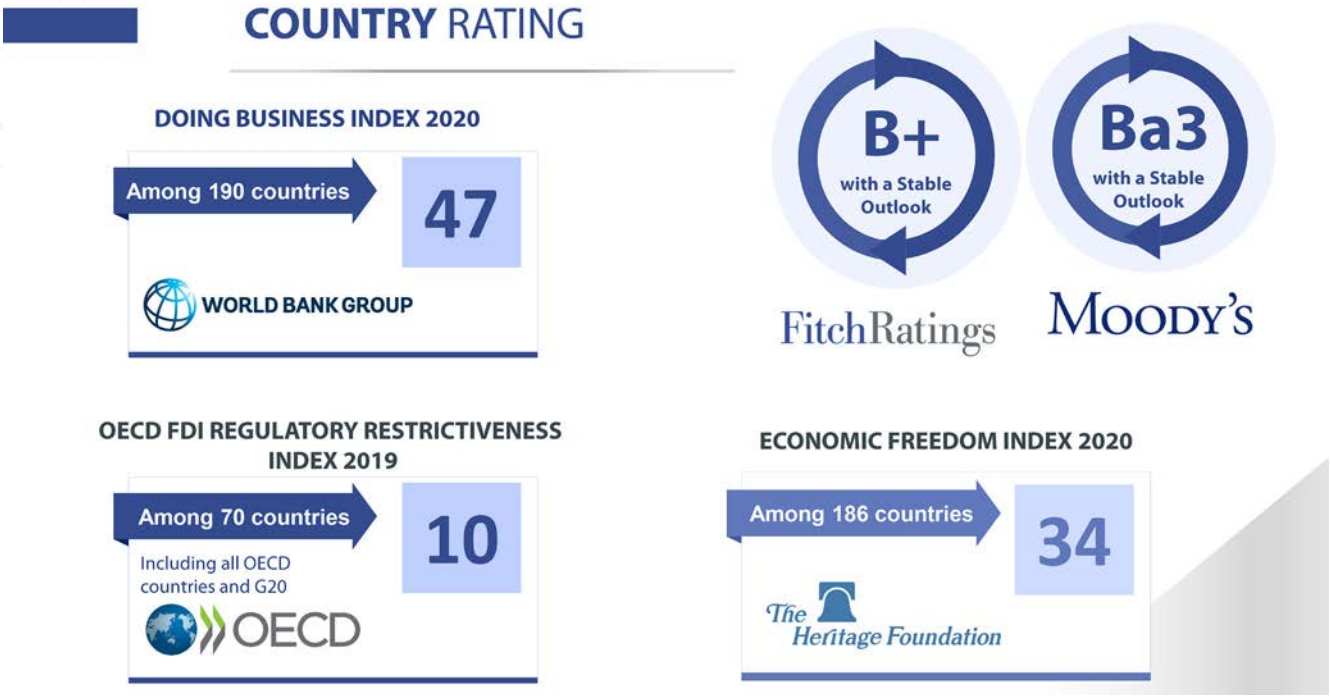
5 https://internationalwealth.info/en/offshore-investments/general-overview-and-analysis-of-investment-and-banking-systems-in-armenia-azerbaijan-georgia/

Armenia's business environmental rankings

MEASURE	YEAR	INDEX/RANK
TI Corruption Perceptions Index*	2020	60 of 180
World Bank's Doing Business Report	2020	47 of 190
WIPO -Global Innovation Index	2020	61 of 131
U.S. FDI in the partner country ($M USD, historical stock positions)	2019	USD 6 million
World Bank GNI per capita	2019	USD 4,680
OECD FDI regulatory restrictovenss index -Among 69 countries	2019	10 of 69
The Heritage Foundation, Economic freedom index	2022	58 of 177
Fitch Long-Term Foreign-Currency Issuer Default Rating (IDR)	2022	B+ positive outlook
Moodies Global Credit Research	2022	BA3 stable outlook
Eastern Europa rank technology Startup ecosystem	2022	16
Global rank technology Startup ecosystem	2022	60

Figure 10: Key Metrics and Rankings.

Within Armenia, the Enterprise Armenia (enterprisearmenia.am) is responsible for Armenia's investment climate and attraction to potential investors. Enterprise Armenia can be reached 24/7.



Source https://enterprisearmenia.am/en/show-pdf/uypfnL0H_ICT-sectors.pdf

Figure 4 - Country rating - doing business index 2020.

Challenges when doing business in Armenia

Armenia presents a variety of opportunities for investors, and the country's legal framework and government policy aim to attract investment, but the investment climate is not without challenges -

- Armenia has a small market and poses relative geographic isolation due to closed borders with Turkey and Azerbaijan.
- Laws are continuously being updated in order to fight corruption.
- In 2020, COVID-19 and the intensive fighting in the Nagorno-Karabakh conflict dented Armenia's economic output and investment profile.
- Investors note that the financial sector is not highly developed.
- Several investors (including U.S representatives) have raised concerns about the quality of dialogue and consultation between the private sector (business community) and the government.[6]
- Several investors (including US representatives) have raised concerns about the quality of dialogue and consultation between the private sector (business community) and the government.

Armenia's international agreements. (As per 2018.)

- Armenia has signed bilateral agreements on reciprocal promotion and protection of investments with 40 countries.
- Armenia has free trade agreements with most CIS states.
- Armenia is also a signatory of the International Convention of Investment Disputes (ICSID) and the CIS Multilateral Convention on the Protection of Investor Rights.
- In May 2015, Armenia signed a Trade and Investment Framework Agreement with the United States.

6 Doing Business in Armenia – Armenia - Information Technology | Privacy Shield

- Since 2015, Armenia has been a member of the Eurasian Economic Union, a customs union that brings Armenia, Belarus, Kazakhstan, Kyrgyzstan, and Russia together in an integrated single market.
- In November 2017, Armenia signed a Partnership Agreement with the European Union, which , in part, aims to improve Armenia's investment climate and business environment.
- Armenia has BITs (Bilateral Investment Treaties) in force with several countries including the Netherlands.
- Armenia is a signatory to the Commonwealth of Independent States Multilateral Convention on the Protection of Investor Rights.
- Armenia became a member of the EAEU in January 2015, together with Belarus, Kazakhstan, Kyrgyzstan, and Russia.
- In 2017, Armenia became a member of the Comprehensive and Enhanced Partnership Agreement (CEPA)
- Armenia is also a member of the WTO, the World Trade Organization.[7]

Armenia's legal system and juridical measures

- Competition and Antitrust
- Expropriation
- Dispute Settlement
- International Commercial Arbitration and Foreign Courts
- Bankruptcy Regulations

7 Source - https://www.eif.am/eng/researches/report-on-the-state-of-the-industry/

Investment Incentives

- Armenia offers incentives for exporters (e.g export duty and VAT refund) and foreign investors. (VAT deferral and exemptions from customs duties for investment projects vary).
- The Alliance FEZ (Free Economic Zone, 2013) and Hrazdab FEZ, (2018) focus on high-tech industries.
- Armenia has signaled an interest in developing logistics hubs, including one in Gyumri, to facilitate goods trade.
- Further advantages for foreign investors include: zero terms in mandating local employment and a straight forward process for visas, residence, or work permits.[8]
- Armenian Free Economic Zone (FEZ)

The first Armenian Free Economic Zone (FEZ) was established in 2012 to contribute to increasing export volumes, creating new jobs, and ensuring sustainable economic development by attracting foreign direct investments and introducing advanced technologies.

Responsible Business Conduct

There is not a widespread understanding of responsible business conduct (RBC) in Armenia, but several larger companies with foreign ownership or management are introducing the concept though these are primarily limited to corporate social responsibility efforts. Currently, some civil society groups and business associates are playing a more active role to promote RBC and develop awareness.

Armenia is a member of both the UN Convention against Corruption and the OECD Anti-Corruption Network for Eastern Europe and Central Asia. Armenia has also signed the Istanbul Action Plan.[9]

8 http://www.investinarmenia.am/en/investment-incentives

9 Doing Business in Armenia: Overview Doing Business in Armenia: Overview | Practical Law (thomsonreuters.com)

The Armenian standardization body

The Armenian standardization body takes its roots in former Soviet times. As a State Government body, the Institute "Armstandard" was established in 1998.[10]

KEY TAKEAWAY: ABOUT ARMENIA

- Armenia is a former Soviet higher middle income country, landlocked between Georgia, Azerbadjan, Iran, and Turkey.
- Armenia's population has declined due to increased emigration since the break-up of the Soviet Union.
- The 2018 Velvet Revolution in Armenia was a turning point for democratic development. The new government is in the process of reforming the country and adhering to international agreements.
- Armenia has attractive regulations that provide foreign investors opportunity and protection for foreign investors. The cournty has achieved respectable international rankings.

The National Institute of Standards maintains a *national fund of standards* of the Republic of Armenia which contains International (ISO), Interstate (GOST), Regional (EN), Armenian (AST), and other state standards.

10 https://www.sarm.am/en/about_sarm

04

PILLAR
ROLE OF THE GOVERNMENT

4.1 ICT a priority sector for the Armenian government

In 2000, the Government of Armenia declared the ICT sector a priority in the development of the Armenian economy and took action in order to bring this priority into effect. This first resulted in partnerships with the World Bank, the USAID, universities, foundations, and private enterprises to develop the ICT Master Strategy and the ICT development plan.

The action plan based on both strategies was approved by the Government in 2001 and it was followed by the adoption of a new 10-year industry development. The Ministry of Economy was the Government body responsible for the new implementation and the strategy focuses on:

- Building infrastructure
- Improving the quality of IT graduates
- Creating venture and other financing mechanisms for (start-up) companies[11]

World Bank Blogs posed the question: "How can developing countries make the most of the digital revolution?". Combined with the Armenian actions above, digitalization is a crucial point for the sustainable growth of a country and the transformation process. This process demands the several foundations which include: solid managerial and technical skills, policies and regulations (also for privacy and cyber security) for a digital economy, a communication structure, and strong educational institutions that are positioned for a digital economy. There should be clear roles for the government, business and development partners as well as competent institutions to lead the transformation process. The digital transformation process should promote a local ICT services industry that supports a vibrant transformation ecosystem.

11 Armenia to Improve Public Sector Performance through Digital Solutions, with World Bank SupportMarch 3, 2022, https://www.worldbank.org/en/news/press-release/2022/03/03/armenia-to-improve-public-sector-performance-through-digital-solutions-with-world-bank-support

4.2 Actions taken by the government

Within the *Digitalization Strategy for 2021-2025* and its action plan, the following actions are taken[12] -

1. Actions on Gov 2 Give cooperation

- Co-operation with the Asian Development Bank to develop the national industrial strategy.
- Organization of elements by the Government for ICT stakeholders to create synergies, e.g. the ArmTech Congress and the annual DigiTech Business Forum.
- Investments made by the EU, as the EU is a key reform partner in Armenia since the Velvet Revolution in 2018.

2. Actions on Sustainable Development Goals

- *The SDG Innovation Lab,* an innovation hub for the Government, aims to accelerate the implementation of the SDGs and their alignment with Armenian national priorities.
- To monitor SDG progress, in which SDG Barometer is operational.
- The SDG Innovation Lab maintains close cooperation linkages with international partners. (E.g. the EU, World Bank, or the Asian Development Bank.)

12 ARLIS, ARMENIA'S DIGITALIZATION STRATEGY, 2021

Partnership with the Armenian Government –

- Enterprise Incubator Foundation (EIF), one of the largest IT development agencies, was established by the Government and the World Bank in 2002.[13]
- Enhanced Partnership Agreement (CEPA) - Relations between the European Union and Armenia are based on the EU-Armenia Comprehensive and Enhanced Partnership Agreement (CEPA), a modern, ambitious Agreement, which was signed on November 24th 2017.

  This Agreement provides a framework for Armenia and the EU to work together for the benefit of the citizens of Armenia.[14]

4.3 ICT Agenda 2021-2025

The term "Digital Agenda" is used to describe all of the measures required or planned for a systematic approach to shaping the digital transformation of a country. The Armenian government approved the country's Digitalization Strategy and ICT Agenda 2021-2025 in February of 2021.

The strategy envisages digital transformation of the Government, the economy and the society through the introduction and development of aspects such as:

- Innovative technologies
- Cyber security
- Data policy
- E-services and e-government systems
- Coordination of digitalization processes
- Creation of common standards of a digital environment

13 https://www.worldbank.org/en/news/press-release/2022/03/03/armenia-to-improve-public-sector-performance-through-digital-solutions-with-world-bank-support

14 https://openknowledge.worldbank.org/bitstream/handle/10986/35852/South-Caucasus-GovTech-for-Armenia-A-Whole-of-Government-Approach-as-a-Key-Foundation-for-the-Digital-Economy-in-Armenia.pdf?sequence=1&isAllowed=y

- Initiatives promoting the use of digital technologies in the private sector of the economy
- Development and implementation of programs promoting the use of electronic tools by the public

Armenia's digital agenda is also aimed at ensuring high quality of the following systems such as: public service delivery, efficiency and transparency of the public administration system, development of broadband and telecommunication infrastructure, increase of competitiveness of the private sector, decision-making necessary for economic growth, and the development of digital skills workforce.

Our interviews revealed that Digital Agenda's conditions are now in the beginning process of implementation. Two main issues in the Republic connected with the implementation are the lack of expertise and resources along with the partial privacy regulation. The government aims to solve this by tendering for international expertise, sending staff to training courses abroad, implementing online courses, and engaging foreign trainers.

During our interviews we enquired about the progress regarding the Digital Agenda 2021-2025:

- A Digital Agency will be created, with the assistance of Estland digitalization experts.
- The creation of the National Cybersecurity Center was awarded to a Canadian consultant to act as an advisory body.
- A working group will be created for standards/regulations. International Standards will be researched and implemented what suits to Armenia.

4.4 Challenges for the Armenian government

The challenges that we were able to identify are largely due to a general lack of coordination, a lack of capacity, knowledge and fundings to implement the strategic actions needed on, cyber security, data policy and e-services and e-government systems, coordination of digitalization processes, and creation of common standards and digital environment.

KEY TAKEAWAY: ROLE OF THE GOVERNMENT

- In 2000 the government of Armenia declared the ICT sector as priority for economic growth and laid out the basic conditions which were infrastructure, education quality, and the lack of financing mechanisms.
- Partnerships with the World Bank, the USAID, universities, foundations, and private enterprises will assist in developing the ICT Master Strategy and the ICT development plan.
- The Digital Agenda for 2021-2025 includes the following objectives such as: digital transformation of the government, the economy and the society. Achieving these objectives will ensure the introduction and development of innovative technologies, cyber security, data policy, e-services and e-government systems, coordination of digitalization processes, creation of common standards and digital environment.

05

PILLAR ENTREPRENEURSHIP

The ICT sector, workforce, and entrepreneurship in Armenia.

The Armenian IT sector performance

With its favorable climate for direct foreign investments in ICT, Armenia offers numerous competitive advantages over its regional counterparts. This includes world-class research and development capabilities, a highly educated workforce, IP protection laws, and regulations that meet international standards. These factors have benefited Armenia in carving a niche as an ICT hub.

Armenia promotes itself with the following advantages of the IT sector:

- World-class R&D capabilities in engineering, computer science, physics, and mathematics.
- Well-educated and talented workforce with technical skills and English language proficiency.
- Strong university programs in IT and related sciences.
- Highly competitive labor costs and low operating costs.
- Upcoming government support.
- Sustainable and continuous growth in the IT sector.
- Strong and successful diaspora in Europe and North America

The Armenian ICT industry in numbers

In this report, we provide the information available to us in March 2022. According to the EIF[15] , the share of the IT sector in the GDP of Armenia is is growing every year. After having reached a peak of 7.4 percent in 2018, the share of ICT industry of Armenia's total GDP was 5.1 % in 2020.

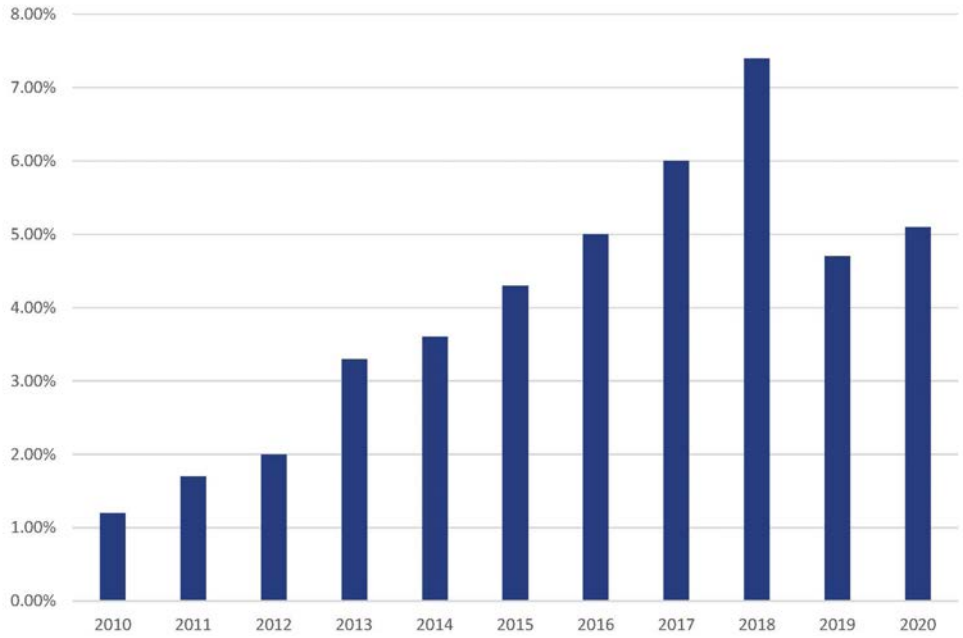
Over the last few years the industry is growing at approximately 20% annually. However, growth in 2019 and 2020 was somewhat lower, due to the start of

15 Enterprise Incubator Foundation, State of Industry Report, 2018, Customized Software and Services (Economic indicators)

Covid-19 and the tensions with Azerbaijan. In 2020 the growth was only 2.8%. In 2019, the total turnover of the ICT sector amounted to about 309.9 billion AMD and 318,133 billion AMD in 2020. That year, production accounted for 2.14 trade for 41.5 services 274.5 (Telecommunications 126,5 and Information technology 142.3). Production in 2020 decreased by 40.3%, trade decreased by 20%, while services increased by 8.1% compared to 2019.

The share of small companies (<100KUSD profit) was 62.8% in 2018. Large companies make up only 5.8% of all operating companies and medium-sized companies make up 31.4% in 2018.[16] By the end of 2021, 25,000 Armenians were directly or indirectly employed in the IT sector, which increased to 4,000 more citizens employed since 2020 (This number may vary due to the amount of people who work informally in the sector).

These numbers may continue to increase, driven by the arrival of thousands of new foreign high-skilled IT workers following Russia's further invasion of Ukraine.



Source - https://www.evnreport.com/economy/the-it-sector-in-armenia-is-forming-a-middle-class

Figure 5 – the share of the IT sector in the GDP of the Republic of Armenia in 2010-2020

16 https://finport.am/full_news.php?id=45498&lang=3

ICT MARKET OVERVIEW	
In 2020, the total turnover of the ICT sector (Downturn in 2020)	328.1 billion AMD.
total turnover of the Software and Services sector 2018	730.2 million USD
The 2020 IT sector growth compared to 2019.	+ 2.8%
Software and services average annual growth	32,6%
IT production in 2020 compared to 2019, decreased	-40.3%
IT Trade 2020 decreased by	-20%
IT services increased in 2020 by	+ 8.1%.
The ICT industry is growing per year (despite the effects of COVID-19 and regional hostilities.)	+ 20%
The share of small companies (<100KUSD profit) in 2018.	62,8%
Share of Large companies 2018	5,8%
Share of medium-sized companies in 2018 compared to 2017	31.4% (Decreased by 3.4%)
The Compound Annual Growth Rate of the market	27% or more per year
Cash inflows in the IT sector amounted in 2017	to 7% of Armenia's GDP
Cash inflows in the IT sector for 2020	71,405 rate 102.000 drams.
ICT services exports doubled between 2009 and 2017	US$212 in 2017
Companies that generate revenue from their products and services.	41%
% of ICT companies founded between 2000-2018.	95%
Number of ICT companies in 2021	1300
The number of local companies investing in scientific research has increased due to the increase in tech start-ups	from 85% to 87%.

PEOPLE WORKING IN ICT	
People actively employed in ICT (2021)	15000
Professionals engaged in ICT (2021)	25000
Share companies 25-100 employees	13%
Share companies >than 100 employees	4 %
Share companies <than 25 employees	80%
The average monthly wage in the ICT sector	$900

Positive Economic Spillovers from Ukraine Conflict: The Ukraine conflict and sanctions on Russia have triggered a substantial migration of Russian, Ukrainian and Belarusian citizens to Armenia. A large proportion of the migrants are believed to be highly educated professionals, particularly from the information and communications technology sector.

5.2 The development of the Armenia's ICT sector

The competitive advantages of Armenia, can be found in its history.

In the early 1950's Armenia was on the forefront of high-tech research, development, and manufacturing focused primarily on industrial and military applications of the Soviet Union.

The development of science and technology in Armenia started during the period of industrialization in the USSR, when the need for educated technical specialists led to the establishment of science and technology in Armenian institutions such as Yerevan State University (YSU) (est.1919) and Yerevan Polytechnic Institute (est.1933) Armenian Academy of Sciences (NAS) (est.1935). In 1956 Yerevan Scientific Research Institute of Mathematical Machines (YerSRIMM) was created

by the Soviet Government to design and build electronic computers and related equipment as well as telecommunication and network software. It employed 10,000 specialists.

Additionally, a number of production companies were established for R&D and the manufacturing of electronics/semiconductor devices. At the peak of its growth in 1987, the science and technology sector in Armenia employed, according to various estimates, around 100,000 specialists. The collapse of the Soviet Union caused the majority of science and R&D institutions to close, leaving thousands of people jobless and forced them to leave the country for better opportunities.

After the independence of 1991, a new age in the industry development started when several U.S.- based software businesses opened branches in Yerevan. Diaspora played a key role in the formation of Armenia's software industry and was the primary factor behind the early establishments of many foreign companies in Armenia. These companies included Boomerang Software (internet applications), Credence Systems (semiconductor design-to-test solutions), Cylink (network security products and VPN solution), Epygi Technologies (IP PBXs), HPL Technologies (yield management software and test chip solutions), Virage Logic (advanced embedded memory IP), and others.

The potential of a new Armenian IT industry was recognized by entrepreneurs, investors, and policy makers. As a result of globalization and with strong government and international support, the Software development, outsourcing, and IT services, gained momentum between 2000 and 2010. In In that period the sector grew at 27% per year.[17]

17 ENTERPRISE INCUBATOR FOUNDATION ARMENIAN INFORMATION TECHNOLOGY SECTOR

5.3 Armenian ICT companies

Armenia became a location of choice for several multinational companies to outsource R&D, operations, and software development. The potential of Armenia's IT industry drew attention of a larger number of investors, policy makers, and professionals. The industry started offering higher paying jobs to the younger generation, encouraging them to pursue careers in the technology fields.

The majority of IT Software development and services companies in Armenia started as foreign branches and as development centers for the parent companies, for the most part. These were usually established as small development centers that first formed effective teams and as they began to increase their employee numbers, they then moved on to activities of greater value to Armenia.

Existing strong scientific and educational bases formulated the significant success of the semiconductor design industry. It eventually grew into a large revenue generating segment within the IT industry and attracted a number of large foreign direct investments. Armenia's considerable expertise in the field of chip design attracted Synopsys, a global leader in Electronic design automation (EDA) which contains nearly 600 employees, making it one of the largest IT companies in Armenia.

There have been significant developments, as many of these companies are eventually moving the entire cycle of a company's technical activities to Armenia, including R & D, design, coding, testing, and other functions. In addition, some companies have begun to relocate portions of their business-related functions, such as marketing and customer support, to Armenia.

IT companies in Armenia are now in the phase of changing from an outsourcing model for foreign companies to a center of technological development. However, ICT services exports remain Armenia's best strategy to achieve higher exports and create well-paid jobs, according to the World Bank.

Software products such as planning solutions, e-commerce, web development services, and tools for the healthcare industry, are also increasingly in demand in the domestic market.

In 2022, approximately 500 Russian tech companies have reportedly relocated or opened branches in Armenia following Russia's further invasion of Ukraine.

IT companies specialization

According to the latest EIF state of the industry report[18] , In 2018, the total turnover of the Armenian Software and Services sector amounted to around 730.2 million USD, indicating an average annual growth of 19.2 percent. Average annual growth in the industry amounted to 32.6 percent from 2010 through 2018. According to Enterprise Armenia's data, over 17% of IT companies are specialized in customized software, with another 15% in web design and development.[19]

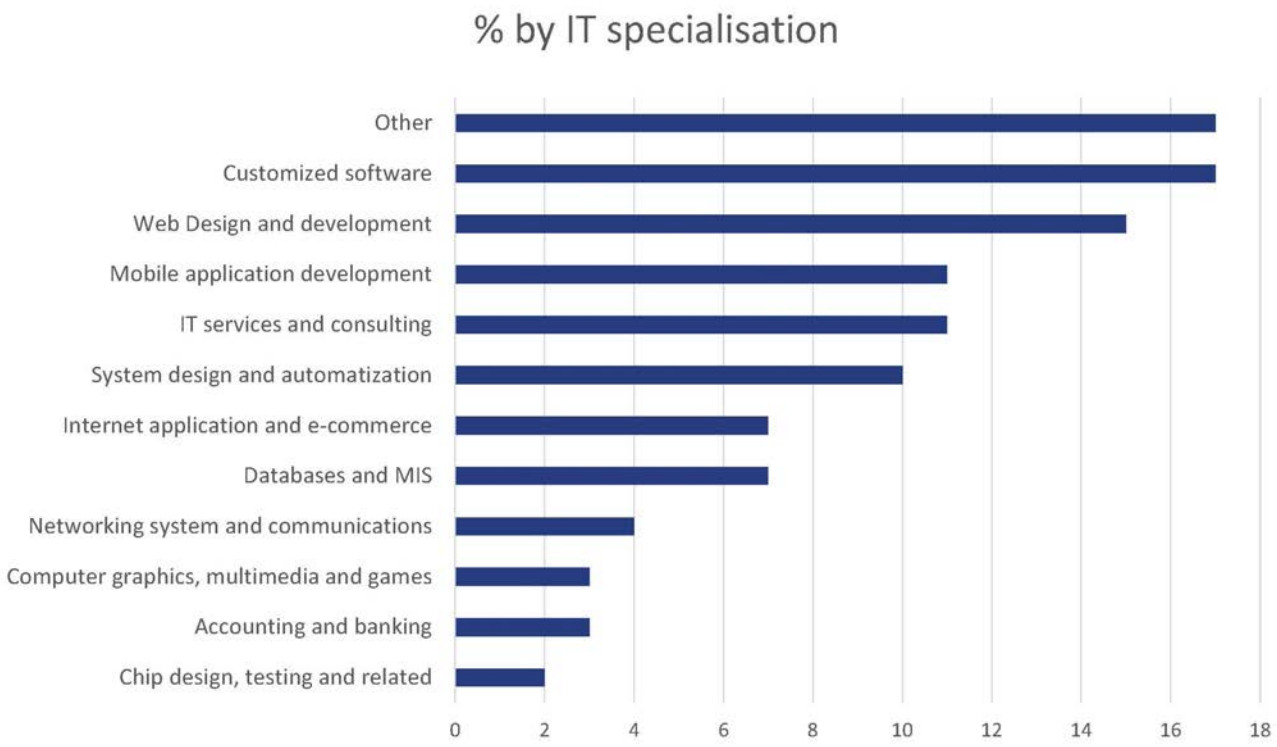


Figure 6 : Enterprise Armenia, High-Tech and ICT (Sector brief overview), The main specialization of ICT companies, 2020

18 State of the Industry report 2018 https://www.eif.am/files/2595/Armenian-IT-Industry-Report-/EIF-ICT-ENG-2019.pdf

19 State of the Industry report 2018 https://www.eif.am/files/2595/Armenian-IT-Industry-Report-/EIF-ICT-ENG-2019.pdf

Emerging technologies

Emerging business areas are coming into view or already in development, including data science, artificial intelligence, quantum computing, and electronic design automation. These areas are of particular interest to Armenia as ICT companies continuously explore opportunities to sustain aggressive growth.

Top IT Companies in Armenia

The largest IT companies in terms of revenue are SoftConstruct (gambling software) , Digitain (Gaming), Synopsys (EDA), and Picsart (editing and design tool). Piscart is one of the most successful Armenian startups, backed by the top venture capital firms with a total amount of funding of 45 million USD.[20] A list of the top 100 companies of Armenia is available at ITisArmenia.

Multinational IT firms

Major multinational IT firms that established operations and opened representative offices in Armenia include: Synopsys, Adobe , DISQO, Optym, Xilinx, D-Link, National Instruments, Intel, Cisco, IBM, Oracle, VMWare, ServiceTitan, VOLO, Microsoft, Oracle, Salesforce, BostonGene, Microsoft Corporation, Alcatel, Siemens AG, and Sun Microsystems Inc.

R&D companies in the Armenian ICT sector

The number of local R&D companies increased from 85 percent in 2017 to 87 percent in 2018. That was due to the increase in the number of newly established local technology companies.

The Armenian Government generally offers R&D tax incentives to reduce the innovation-related costs of the companies. More info on R&D can be found in Pillar 2, Education and Knowledge, innovation, and R&D[21]

20 https://www.trade.gov/country-commercial-guides/armenia-information-and-telecommunication-technology

21 pnaea739.pdf (usaid.gov)

Armenia's Tech startup environment

Armenia's start-up ecosystem is still very much in its early days. A dedicated government agency for *SME development (the ISC)* supports local entrepreneurs through services and capacity-building activities. The EU4Business SMEDA, funded by the EU, is a project that supports the improvement of the business and investment climate for SMEs in Armenia.

The Armenia *Startup Academy* offers a high-quality program incorporating innovative instruments, methods, and topics as well as access to a pool of high-profile mentors to facilitate the business success of participating startups. The *Gyumri and Vanadzor Technology Centres,* provide incubation services for technology start-ups.

2021 was a record year for start-ups globally in the rise of remote work during the Covid-19 pandemic. A change in attitude toward the importance of geographic location helped start-ups and Armenian-based technology start-ups to receive over $200 million in investments. One of Armenia's first start-ups, *Picsart,* reached a valuation of greater than $1 billion after its most recent funding round in 2021.

Products built by Armenian start-ups are no strangers to the leaderboards on Product Hunt, but what was more noteworthy were the awards they received in the platform's 7th annual Golden Kitty Awards, an awards ceremony that celebrates the most innovative products across a wide range of categories. Armenia is emerging as a new technological hub, especially for startups. According to StartupBlink's startup ecosystem index of 2022, the Armenia Startup Ecosystem ranks at number 60 globally (+ 5 spots since 2021) and ranks 16 for startups in Eastern Europe.[22]

Below are some notable startups in different expertise areas

22 Startuplink - Armenia Startup overview https://www.startupblink.com/startup-ecosystem/armenia

ADVERTISING TECHNOLOGY	ARTIFICIAL INTELLIGENCE	AUGMENTED REALITY	CONSUMER PRODUCTS & SERVICES
Disqo	Develandoo	Arloopa	Embry Tech
Aarki	Develandoo	Arize Platform	GG Taxi
SmartClick AI	PUBLIQ		
	ZERØ		
	Disperse		
	Embry Tech		
	Chessify		

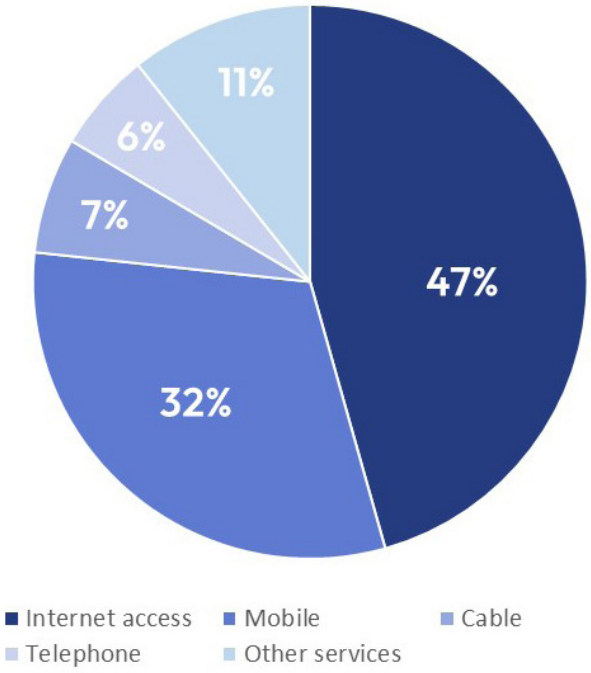
BIG DATA ANALYTICS	AUDIO & VOICE	E COMMERCE	DEVELOPER TOOLS
Globanet	2hz	Eworld	10Web
DataOwl			XCloud Networks
Webb Fontaine			Grovf
IntelinAir			UCraft
Disqo			TeamViewer
All me			
All me			
SmartClick AI			

Armenian Telecommunications sector

Armenia was one of the first post-Soviet countries to privatize its telecommunications sector and the country's telecom sector. These sectors have experienced tremendous growth ever since its liberation in 1998. When Telecom Armenia CJSC ("Armentel") was founded in 1995 as a subsidiary of Russian company Veon (VEO Armenia), much was expected of the new company.

In 2020, Armenia's telecommunications sector accounted for 3.7% of GDP. The revenue from telecommunications in 2020 amounted to 126.5 billion AMD, 4.5% less than in 2019. In 2020 the number of employees in the telecommunications sector was 26,711 , meaning that the telecommunications sector also has a significant impact on the labor market as well.[23]

It should be noted that in comparison to other markets in the Armenian economy, the telecommunications and communications market is highly competitive. The sphere of the telecommunication and communication services of Armenia consists of the following:[24]



Source - https://www.eif.am/eng/researches/report-on-the-state-of-the-industry/

Figure 7 Chart Representation of Telecommunication sector share of the country's business.

23 https://www.evnreport.com/economy/how-the-crisis-affected-armenia-s-telecommunications-sector

24 https://www.eif.am/eng/researches/report-on-the-state-of-the-industry/
https://beststartup.asia/12-top-armenian-e-commerce-companies-and-startups-of-2021/
https://www.privacyshield.gov/article?id=Armenia-information-technology

Three mobile operators cover almost 100% of Armenia's populated areas: Beeline, Vivacell-MTS and Ucom. (The fixed-line broadband internet market is controlled by Beeline, Ucom and Rostelecom Ucom is an Armenian company, while the other two are Russian-owned.)

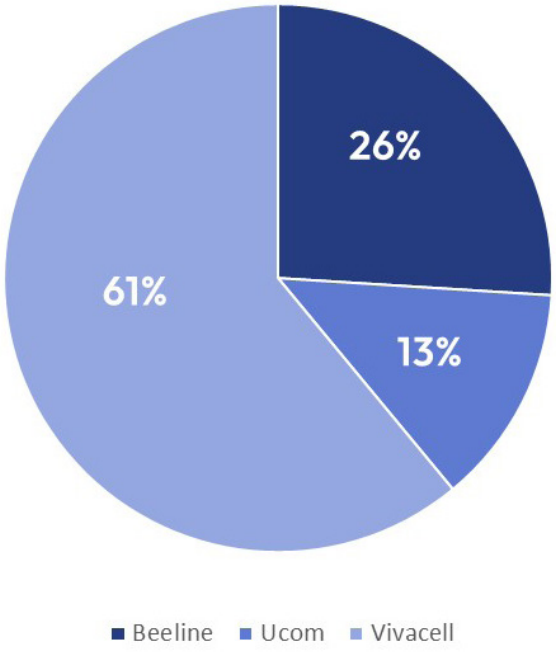


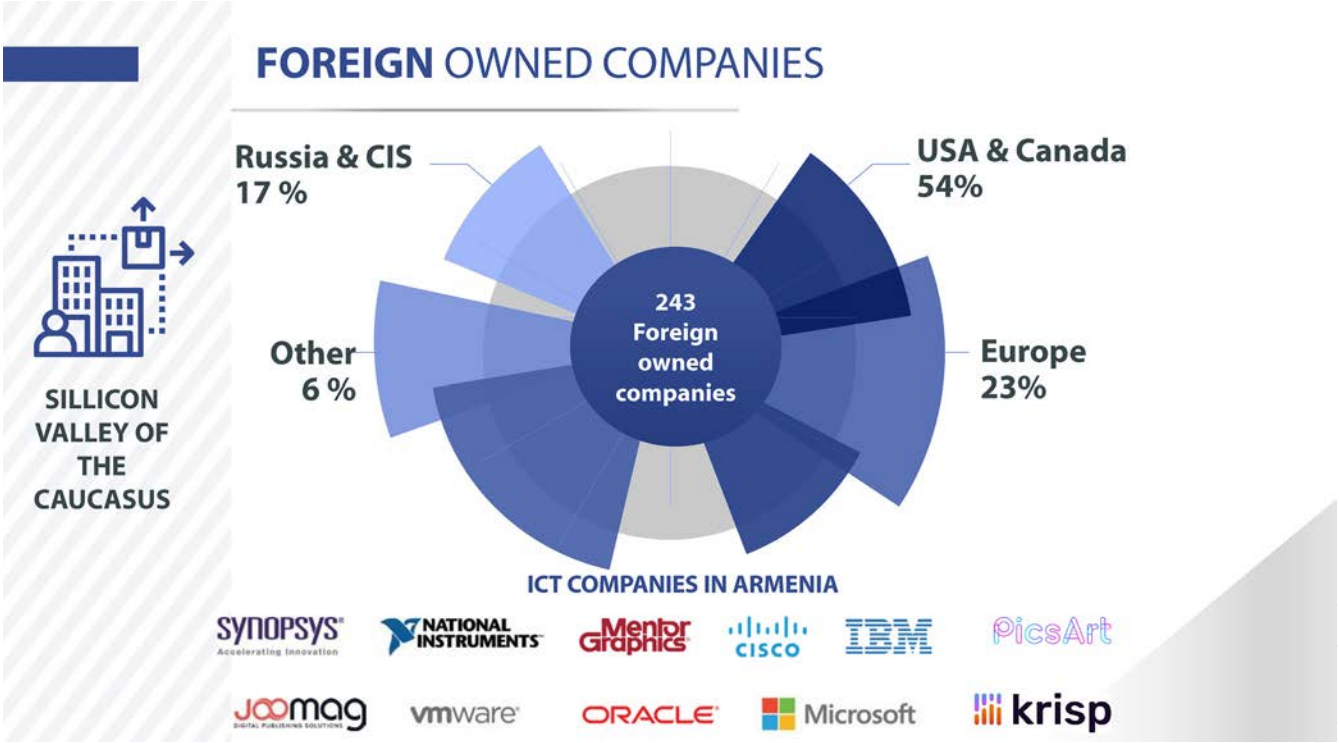
Figure 8 major telecomoperators

Source: https://www.evnreport.com/economy/how-the-crisis-affected-armenia-s-telecommunications-sector

5.4 Investment in the Armenian ICT sector

As investment institutions are still in the stage of formation in Armenia, considerable foreign investment in Armenia occurred in the high-tech sector. International high-tech companies have established branches or subsidiaries in Armenia to take advantage of the country's pool of qualified specialists in electrical, computer, and optical engineering as well as software design.

The data for 2018 shows that 243 foreign-owned companies, or 30.4 percent of the industry total, were in operation in Armenia. In 2005, these companies represented only 25 percent of Armenian ICT companies.



Source https://enterprisearmenia.am/en/show-pdf/uypfnL0H_ICT-sectors.pdf

Figure 9 : Enterprise Armenia, High Tech ICT Sector Brief Overview, 2020,

Armenia has a strong linkage with many countries through its diaspora. A strategy has been made in 2019 by the Government to mobilize the diaspora potential e.g. trade, industry, and research but also on scientific, technological, and financial resources.

Armenia's first venture capital firm, Granatus Ventures, https://www.granatusventures.com, was established in 2011. This fund is important for Armenian IT companies because, in addition to developing IT infrastructures in Armenia, it aims to promote the innovative initiatives of Armenian IT companies.

In 2018 it initiated the Science and Technology Angels Network, uniting investors and entrepreneurs of Armenian descent living abroad who provide financing, consulting, and mentoring to start-ups in Armenia. Banks as a rule do not give loans to startups because of higher risks and the absence of methodology to evaluate the proposed business models and plans. Venture funds do not play a significant role in financing startups. Angel investors are a rare phenomenon in Armenia.

Though the government tries to develop a mechanism for financing IT startups in their seed round, the financing problems in rounds A and B are a big challenge. She Investment, is an Investment readiness program for women-owned firms founded in 2022.

International attention

Armenia has hosted a number of major industry events that draw international attention. The 2019 World Congress on Information Technology drew an estimated 2,500 participants from over 70 countries.

5.5 Important stakeholders in IT sphere in Armenia

Enterprise Incubator Foundation (EIF)

EIF helps to support the development of the information and communication technology sector in Armenia by creating a productive environment for innovation, technological advancement, and company growth. The EIF was established in 2002 within the framework of the World Bank's "Enterprise Incubator" project. Its supporting activities cover every aspect of sector development from ICT-related legal matters, business matters, and educational reforms to investment channeling as well as creation of funding schemes for startups. EIF acts as a cross-point for all entities in the sector. This includes public and private institutions, international organizations and government agencies, major multinationals and small startups. EIF brings them together to act jointly towards the ultimate goal of ICT/High-Tech excellence.

Union of Information Technology Enterprises (UITE)

UITE is a key player in developing the IT-sphere in Armenia. The Union represents the voice of all IT companies in Armenia and uses all resources to conduct the technological sector development in Armenia by managing different projects and events. UITE plays also a crucial role in developing the educational system for the IT-sphere. UITE developed and implemented the program *Technical Laboratories in Every School* or the "chain of laboratories", as Armath calls it. UITE was established in 2000 as a business association to represent the collective interests of companies in the fields of Information Technology (IT) in addition to Information and Communication operating in Armenia.

CyHub Armenia

CyHub Armenia is a joint initiative of IBM, CISCO, National Polytechnic University of Armenia (NPUA), Innovative Solutions and Technologies Center (ISTC), Yerevan Computer Research and Development Institute (YCRDI), Armenian Government, the World Bank, and Enterprise Incubator Foundation. CyHub aims to increase the competitiveness and cybersecurity level along with development of skills in specialists. In doing so they plan to demonstrate cybersecurity, advanced research lab for detecting, and prevent cybersecurity issues in the country.

European Business Community (EBA)

The main objective of EBA is to support representatives of the European Business Community in Armenia and facilitate the integration and cooperation between Armenia and the European Union.[25]

The Armenian Trade Network

The Armenian Trade Network was established in 2011 and its objective is to connect Armenian chambers of commerce and business entities within the diaspora.

DWV in Armenia - German Business Association

German Business Association connects German companies with potential Armenian partners.[26]

25 https://openknowledge.worldbank.org/bitstream/handle/10986/33027/Realizing-Armenias-High-Tech-Potential.pdf

26 https://www.opengovpartnership.org/members/armenia/

Armenian-Indian Center for Excellence in Information Communication Technologies

is a joint project of the governments of Armenia and India implemented by EIF. The center enables ICT professionals to take more than 450 internationally recognized accreditation exams (Cisco, CompTIA, EMC, HP, LPI, Oracle, Microsoft, VMware, IBM etc.) through Pearson VUE. Along with the training activities, the center can also carry out high-end R&D activities in the state-of-the-art R&D lab.

Important ICT Partnerships and initiatives

- **Armenian National Engineering Lab** (ANEL) (2012) Partnership of the Government, USAID, universities, the EIF, and National Instruments to meet the engineering industry's demand for qualified specialists and graduates.
- Intel (2012) business expansion in Armenia.
- IBM (2013) cooperation in education and R&D.
- IBM (2014) cooperation in the digital services sector.
- Microsoft (2015) **Center for Mobile and Cloud Development** at the Microsoft Innovation Center and mLab ECA.
- **Innovation Solutions and Technologies Centre** (2016) IBM, USAID and EIF.
- National Instruments (2016) establishment of **Engineering City.**
- Philip Morris (2017) scientific-educational ecosystem and research center.
- **Digital Armenia Foundation** (2017) Established to create a unified digital environment for all management areas based on contemporary information technologies.
- **International center of Tumo** (2018) launched in Paris. It is located at the Forum des Images Center, in the main part of the Les Halles district of Paris. It provides free-of-charge education to about 1500 youngsters 12-18 years old.

5.6 Challenges and gaps in the Armenian IT sector

Literature research and our interviews found that there are challenges worth notifying in the Armenian ICT sector. *EIF* noted in their 2010 state of the industry report[27] that the main issues include the shortage of highly qualified workforce and the otherwise lack of graduates in the IT field. According to 44% of IT companies, difficult access to financial resources and lack of support from state and non-governmental organizations hinders the growth of the software and services sphere.

According to World Bank, the IT-sphere demands 2000 new specialists annually, but realistically about only 450 students graduate once their education is finished. Governmental issues, taxes (tax advantage only applies to small companies), customs procedures, access to financial resources and access to the international markets are absolutely necessary to grow the IT sphere. The fact that Armenia is not well known unfortunately gives it a lack of credibility.[28] The *Global Entrepreneurship Monitor (GEM) study Armenia 2020*[29] added to the above that the graduates of IT faculties do not fully meet the required market standards, resulting in a mismatch between education and the private sector. (More information can be found in Pillar 2.)

There are several financial funds available but they mainly finance startups and not companies in other stages of development.

Our interviews with stakeholders confirmed the above challenges, stipulating that the shortage of senior It specialists is a result of a mismatch between education and the market and the increase of Tech startups. The size of the domestic market also poses a challenge as there is no growth potential. There is need to attract ICT expertise from abroad along in order to combat the lack of resources and

27 https://www.eif.am/eng/researches/report-on-the-state-of-the-industry/

28 https://asue.am/amberd/publication/analytics/it-sector-achievements-and-problems

29 Global Entrepreneurship Monitor (GEM) study 2020 Armenia

provide time for proper training of junior specialists. This way futher shortage can be prevented. (See also Pillar 2 – education.). The following challenges were mentioned as reasons for the gaps:

- Lack of government entrepreneurial programs and provision of financing to entrepreneurship.
- In the rural areas, few IT and entrepreneurial skills developed among women.
- A small domestic market due to the low speed of digital development.
- IT sector concentration is only in Yerevan, wheras other regions yield very little business activity.
- Most tech companies are foreign-owned or companies working only for international outsourcing clients.
- Challenges in competitiveness as the Armenian IT community has not yet matured to the same level of professionalism as other countries.
- Armenia's IT sector runs behind the western world's digital development such as cloud services, cybersecurity, e.g.

According to 44% of IT companies, it is difficult for them to obain access to financial resources and there is a lack of support from state and non-governmental organizations, thus hindering the growth of the software and services sphere.

KEY TAKEAWAYS: – IT SECTOR

- Armenia was already a technology center in its soviet period during the 1950's, employing over 100,000 technical specialists.
- Software development, outsourcing, and IT services have gained momentum between 2000 and 2010. In that period the sector grew at 27% per year.
- Armenia was one of the first post-Soviet countries to privatize its telecommunications sector. In 2020, Armenia's telecommunications sector accounted for 3.7% of GDP.
- Many international high-tech companies have established branches or subsidiaries in Armenia in order to take advantage of the pool of qualified specialists.
- Main issues for ICT companies include: shortage senior technical experts and access to finances.

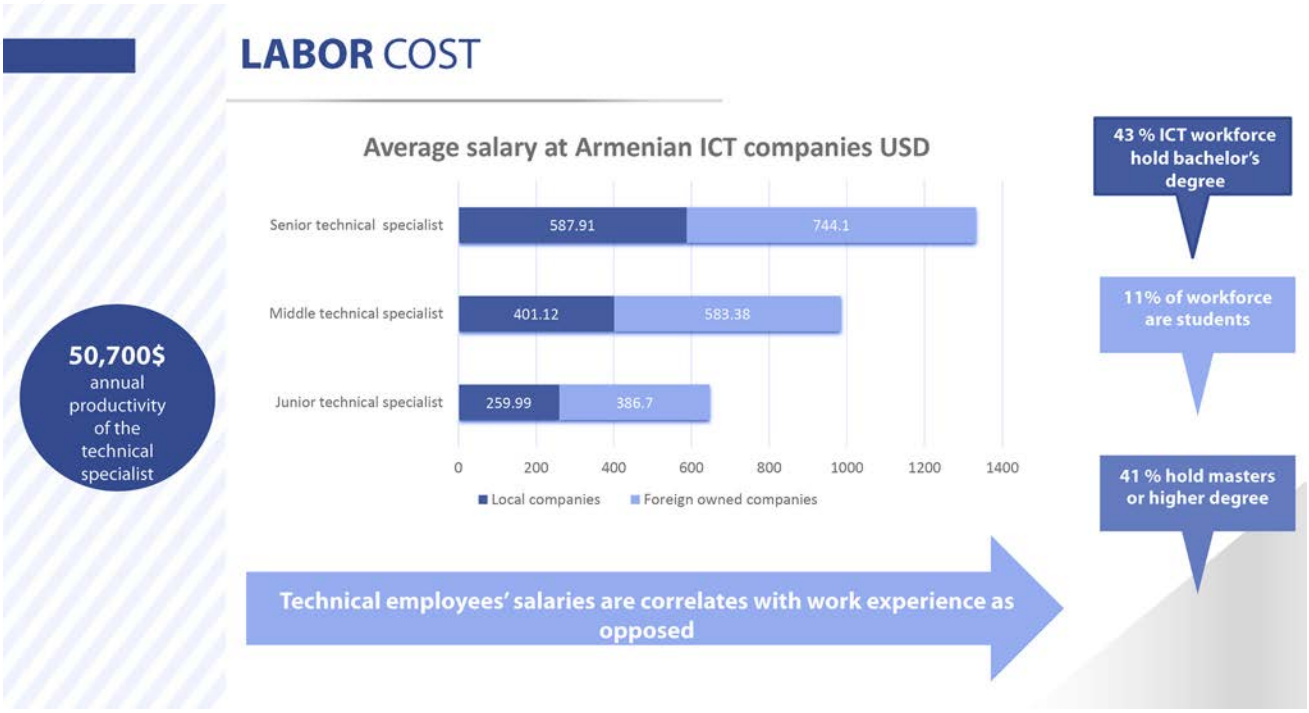
5.7 Workforce in the Armenia ICT sector

Introduction

According to the Enterprise Incubator Foundation, 2018, Armenian ICT Sector -State of Industry Report), the ICT Workforce Structure, the technical workforce is one of the most competitive advantages of the Armenian IT Sector.

Armenia is still regarded as a low-cost location for the outsourcing of software development with salaries that are competitive with those of many IT-outsourcing countries, such as India, Russia, Israel, Ireland, China, and Central Europe.[30]

Salaries in the ICT Armenian sector



Source - https://enterprisearmenia.am/en/show-pdf/uypfnL0H_ICT-sectors.pdf

Figure 10 Average salary at Armenian ICT companies, USD. (2020)

30 https://www.ictergezocht.nl/blog/188_wat-verdient-een-icter-het-complete-salarisoverzicht/

	AVERAGE ARMENIAN DEVELOPER'S SALARY, USD PER HOUR	AVERAGE SALARY IN THE US, USD PER HOUR
Java	$10	$57
PHP	$8	$45
Python	$9	$58
JavaScript	$9	$48
NodeJS	$8	$40
ReactJS	$9	$44

Figure 11 SalaryExpert, PayScale, YouTeam

Source: https://youteam.io/blog/software-development-outsourcing-to-armenia/

In 2020 the number of people employed in the IT sector was 14,755 of which only 95 were employed in the public sector, while 14,680 were employed in the private sector. Students represent approx. 11% of the Armenian ICT workforce.[31] The sector is expected to grow to 30,000 by 2025.

31 https://www.privacyshield.gov/article?id=Armenia-information-technology

Workforce Distribution by sector:

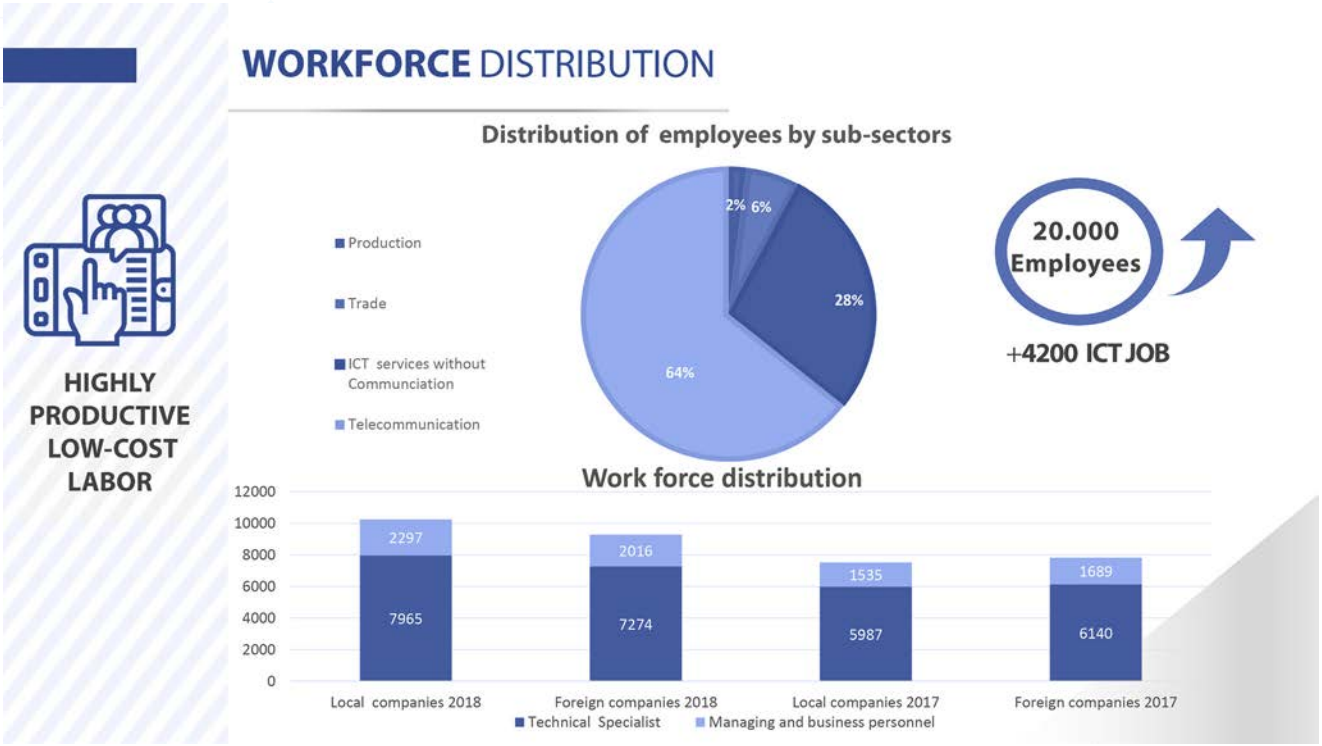


Figure 12 Workforce distribution. (2020)

Source - https://enterprisearmenia.am/en/show-pdf/uypfnL0H_ICT-sectors.pdf

Gender ratio, equality and social protection in the ICT sector in Armenia

Following EVN, the ICT workforce ratio in Armenia is 68% male and 32% female and increased female employment offers great potential to the economy of Armenia.

Women in ICTs

USAID has been promoting Armenian women's participation in the economy for over two decades, helping them unleash their potential in areas that span from agriculture and hospitality to textiles and IT. As one of the fastest-growing sectors in the Armenian economy, IT presents a real opportunity for women to become innovation leaders and to make major contributions to the country's overall economic advancement. According to World Bank estimates, Armenia loses as

much as 14 percent of its potential GDP due to unequal opportunities* for women to participate in employment and entrepreneurship. USAID has supported female Armenian IT entrepreneurs through multiple activities, including the establishment of three innovative technology centers.[32] [33]

We surveyed 85 IT workers and enquired in our interviews with industry representatives from the industry about working conditions and equality. Our interviewees indicated that in Armenia, specifically in the ICT sector about 41% of the workforce is female. On the other hand, the technical jobs in the sector are dominated by males at a whopping 85%. This is also culturally related, as most women are simply not choosing a technical job. Fortunately, the quantity of women in this sector is increasing, possibly due to the incentive of high salaries in the IT sector.

Social protection and equality

The Armenian law protects the rights of workers and they are also free to join independent unions. Armenia works together with several donors to implement social protection programs. These donors include the EU and USAID.

Examples of these programs are:

- Labor Code- which is considered to be largely consistent with international standards.
- Collective bargaining.
- Minimum wage.
- Health inspection.

The purpose of the Employers Union is to defend rights and interests of ICT employer. The surveys and interviews show that most companies offer Health insurance packages. Furthermore, we found that employees, in general, do not feel

32 The IT Sector in Armenia Is Forming a Middle Class - EVN Report

33 https://www.usaid.gov/armenia/press-release/usambassador-meets-with-women-from-armenian-it-industry

unequally treated on basis of sex or sexual preferences at the workplace. However, LGBTQ is not a subject that is publicly discussed or demonstrated.

KEY TAKEAWAY: WORKFORCE

- Armenia's workforce is highly educated in mathematics and computer science.
- Armenia is regarded as a low-cost location for the outsourcing of software .development, with skills and salaries that are internationally competitive.
- 15,000 people are directly employed in the IT sector, indirectly 25,000 of which 68% are male and 32% female.
- The Armenian law protects the rights of workers.

5.8 Opportunities for Dutch companies in The Armenian ICT sector

According to the CBI, the Netherlands has one of the highest percentages of IT vacancies in Europe (roughly 53% in 2020) but they have proven difficult to occupy due to a lack of equal opportunities. Armenia, on the other hand, does offer opportunities for Dutch companies in software development, system administration, security engineering, and data engineering. However, according to the article, "Can the Armenian IT Sector Compete with the World?", Armenia has not yet reached the maturity of other countries.[34]

With the right conditions several activities can be carried out in Armenia such as: semiconductor design, research and development, AI (Artificial Intelligence), IoT (internet of things), and robotics.

34 Can the Armenian IT Sector Compete with the World? https://evnreport.com/creative-tech/can-the-armenian-it-sector-compete-with-the-world/

06

PILLAR KNOWLEDGE

The backbone of the Armenian ICT sector.

Education

Armenians are highly educated and very skilled in mathematics and natural sciences. Armenians are also taught with a strong sense of national traditional values. Part of this is coming from Armenia's Soviet heritage. Before independence, schooling was free of charge, and universities, research institutes, and industry were part of the Soviet value chain. Between 1920 and 1986, 250,000 students were trained in the nation's universities. Adult literacy rates in Armenia (following UNICEF) are 99% + of the total population.

Following the EIF state of the industry report,[35] in 2018 approximately 78,747 students were enrolled in varying specialization studies at Armenian universities and a total of 10,070 students (12,8%) were enrolled in departments related to informational and high-tech specializations.

Armenia is known for its STEM educational programs (a teaching approach that combines science, technology, engineering, and math). Armenian universities have consistently supplied the labor market with a highly skilled workforce. Armenian graduates are known for their competitiveness, particularly in the field of ICT. This has prompted several international companies to set bases in the country. Many foreign students move to Armenia in order to get a higher education and the skills necessary for employment. They generally prefer medicine, economics, and computer science specializations.[36]

There are 24 public state universities and 37 private universities in Armenia, the majority of which are based in Yerevan. Several universities also have branches in the regions. Next to the universities, there are also several institution centers operating in the field of ICT.[37]

35 https://www.eif.am/eng/researches/report-on-the-state-of-the-industry/,

36 https://www.eif.am/eng/researches/report-on-the-state-of-the-industry/

37 https://www.eif.am/eng/researches/report-on-the-state-of-the-industry/

Overview of education institutions in Armenia.[38]

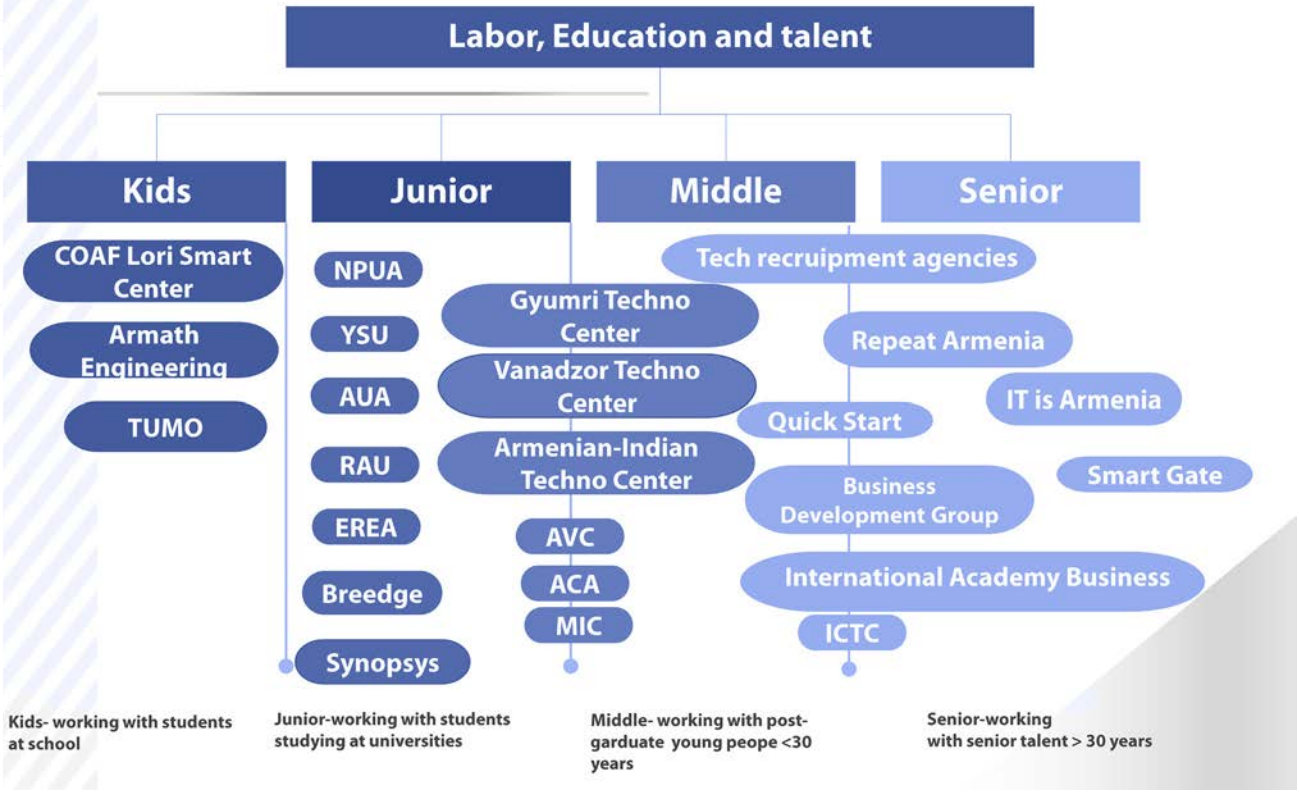


Figure 13 – Overview of education institutions in Armenia.

The challenges after the independence

The education system of the Soviet Union (5-year system) is still functional at some universities. Other universities have transitioned into a two-tiered system that offers both undergraduate and graduate degree programs.

One of the main issues was the so-called "Brain drain", meaning that a lot of scientists and other highly educated people have left the country to look for better opportunities abroad. Following literature sources, Armenia's education sector also faced some large challenges. These were mainly related to the non-cooperation between the universities and institutions on one side and the private sector on the other side, resulting in a mismatch between education and workforce needed.

38 https://enterprisearmenia.am/en/show-pdf/uypfnL0H_ICT-sectors.pdf

The result was that the private sector trained relevant specialists within their resources.[39]

In addition to the above-mentioned disconnection between higher education and the labor market, other challenges in the high-tech education include: lack of financing, professional staff shortage, lack of textbooks and specialized literature, no project-based activities, a strict separation between theory and practice, and old school lectures who do not adopt into the new needs like project management or technological trends.

Rural areas

Another main challenge are the Armenian rural areas, as almost all universities and training institutes are in the capital Yerevan and 2-3 other cities, causing an additional disadvantage for the rural areas.

After combining the literature research with the sector interviews conducted by us, we can conclude that the main challenges are:

1. The mismatch between education and job market needs.
2. The education is outdated.
3. The expert staff is not taught/trained following the current requirements.
4. It is difficult to find highly qualified specialists, also due to low financing and the english language skills of students and specialists are generally not sufficient.

The answer to the challenges

Armenia's answer to this was to have universities increase their offerings of programs relevant to the ICT sector. Some have also opened research laboratories and work together with international partners, local industry associations, and leading U.S. multinational companies that include: Microsoft, IBM, and National Instruments.

39 https://armeniasputnik.am/20191011/tt-volorty-zarganum-e-shat-arag-sakayn-mez-mot-nkatvum-e-kadrayin-sov-aram-mkhitaryan-20733754.html (Armenia Sputnik News Agency, Article 2019.)

Next to the universities, the government also took actions to improve education and reduce the mismatch between education and the needs of the job market.

The main improvements (time window for the next 10-15 years) are:

1. New curricula for secondary education.
2. Raise teacher salaries as an incentive to attract new teachers.
3. Cooperation with private sector representatives to reduce the current mismatch.
4. Lifelong training and offerings of online courses.
5. Alignment of national education with the Sustainable Development Goals. (SDGs.)
6. National education guidelines are being developed following the UNICEF framework and the Council of Europe frameworks for democratic culture.
7. Co-operation between education and research.
8. Consolidation of education institutions to improve the quality of education.

In the 2019 GII (Global innovation index), Armenia ranked 111th in educational investment. The share of GDP accounted for by education increased to 2.8% in 2019 (from 2.3% in 2017) because of the priority the government has given to reforming the education system.[40]

Government actions on Education

- The Ministry of Education, Science, Culture, and Sports (MoESCS) is preparing a set of reforms to reduce the mismatch between education and the job market.
- Development and implementation of new curricula for secondary education.
- National education guidelines are being developed using the UNICEF framework and the Council of Europe frameworks for democratic culture.

40 https://unece.org/fileadmin/DAM/ceci/icp/Capacity_building/IPO_launch/IPO_2020_3_ARMENIA.pdf
https://www.eif.am/eng/researches/report-on-the-state-of-the-industry/
EVN Report, How to Transform High-Tech Education in Armenia - EVN Report

Opportunities

The opportunities* as seen by the stakeholders are based on training programs, exchange programs (for students and professors), new curriculums that respond to current needs and a coordination program between the educational institutes and the private sector to optimize job market needs specific rural areas.

The main stakeholders or potential implementing partners in these areas are:

- COAF which has small centers in many rural areas and can contribute to the implementation.
- IT Centers in Vanadzor and Gyumri can also be viewed as partnering centers.
- Reg is ready to a partnership by offering their new methods of Teaching IT skills.
- ISOC offers to collaborate with one of their established programs for rural areas.

KEY TAKEAWAY: EDUCATION

- Armenians are highly educated, very skilled in mathematics and natural sciences, combined with a strong science base and national traditional values.
- Armenia is known for its STEM educational programs (a teaching approach that combines science, technology, engineering, and math) in universities.
- Armenia has 24 (public) state universities and 37 private universities, the majority of which are based in Yerevan.
- The“Brain drain” and low financing towards Armenia’s education sector has posed large challenges.

6.2 Innovation

Great tech talent but weak entrepreneurial skills

The unique education and the tech talent of the Armenian workforce (E.g. Robotica, engineering, software, etc) have provided Armenia with strong fundamentals in the technology sector. With the right focus on innovation by the government, universities and the private sector, the country has the potential to bring this to the next level. There is a need on emphasizing the improvement of entrepreneurial skills in order to maintain continuous innovation in new activities, development of new products and services, new business units, and ensure that the products and services produced in Armenia meet international quality standards.

It is worth noting that Armenia has not yet been able to generate significant revenues from selling or licensing intellectual property abroad, hence there is a massive opportunity to be the pioneer company in achieving this milestone. The recently enacted laws on patents and industrial design can strengthen the requirement for substantive examination before rights registration and introduces the concept of a short-term patent.

Entrepreneurial culture in Armenia

The Armenian Government in power after the 2018 Velvet Revolution considers entrepreneurial activities pivotal for ensuring a vibrant private sector and perceives those as the main drivers for achieving accelerated economic development.

An entrepreneurial study conducted in 2020 by Global Entrepreneurship Monitor (GEM) Armenia, shows a high level of entrepreneurship in the country where 20% of the adults are engaged in early-stage entrepreneurship and 28% are engaged in any early-stage or established business (Both are the top 10 among 50 GEM countries). The same study mentioned the need for action in entrepreneurial education, R&D transfer, and governmental programs, including entrepreneurial

finance. Studies, in general, say that Armenia is in the bottom-10 countries by share of the most productive business services sector in entrepreneurship.

Innovation opportunities for Armenia

The government's digital agenda, mentions that the government "aims to make Armenia high tech and industrial country" with radically new technological solutions. Following the Orbeli Center, suggestions for this new approach are creating *National Venture Investment Funds*. Investments in innovation (start-ups), Such as *National Venture Investment Funds* should be managed by the Government but are established by private sector investments.[41]

According to a 2020 Worldbank study Realizing-Armenia's-High-Tech-Potential, [42]Armenia has several special characteristics (e.g., distinctive health characteristics, data, geology, population characteristics, geography, and industrial mining history) that provide the opportunity to develop niche high-value added activities and vertical applications which allows it to position itself in digital health, biotech development and bioscience research. Biotech solutions, cleantech, and seismic engineering are examples of vertical applications that pose a rich potential for Armenia's software and hardware development community. Armenia can build on a strong foothold in electronic design automation and a strong heritage in mathematics and computer science.[43]

With the right private sector investment and investment in tertiary research, Armenia could position itself for pure AI research. Others, like fabless semiconductor design and intellectual property development, are attractive prospects, but they come

41 Orbeli Center, ICT Sector In Armenia, Development Perspective https://books.google.co.ke/books?hl=en&lr=&id=gfohEAAAQBAJ&oi=fnd&pg=PA251&dq=Orbeli+Center,+ICT+-Sector+In+Armenia,+Development+Perspective+&ots=MAhyzAKums&sig=xwbMMdMcHLEc6eoF0m-X-SnaRHM&redir_esc=y#v=onepage&q&f=false

42 (Realizing-Armenia's-High-Tech-Potential. pdf (worldbank.org))

43 (Realizing-Armenias-High-Tech-Potential.pdf (worldbank.org))

with extremely high start-up costs, a large distance to market, and tight export regulations which would only hold Armenia back. Last but not least, quantum computing presents an opportunity for Armenian firms to actively participate in evolving global chains, rather than lagging.

Innovation challenges

Building an effective national innovation system is a strategic objective for the Armenian government but there are several hurdles to overcome:

- Financing the national innovation system, including education, companies, and start-ups.
- The poor linkage between education and the business sector not only results in a mismatch (see part 1- education) but also results in not being able to innovate to the fullest.

Opportunities to support innovation

- Development of technological centers in Yerevan and other regions
- Contribution partners to the cooperation between technological companies and education.
- Technical assistance to help the private sector comply with the EU's General Data Protection Regulations and meet international standards.

6.3 Research and development (R&D)

Following Wikipedia[44] Armenia's research intensity accounted for just 0.19% of GDP in 2018. This ratio has remained stable for the past few years, even though, in absolute terms, research expenditure was 20% higher (AMD 14.3 billion, or ca US$ 29.9 million) in 2018 than in 2014

44 (Science and technology in Armenia - Wikipedia)

According to the assessment of experts, Armenia lags behind most of the countries in R&D development, mainly because:

1. There are no adequate government subsidies or support for new firms to acquire technologies or for the creation of new technology-based ventures
2. There is not enough support for engineers and scientists to have their ideas commercialized through new and growing firms
3. Systemic issues such as the lack of competition, transparency, limited access to financing, and tax and customs procedures that all affect the Armenian ICT sector as well.

To ensure that Armenia continues to have a rich stock of highly qualified talent, several actions have been taken like the opening of laboratories and innovative technology centers in addition to the cooperation with local industry associates and international partners* as mentioned in Part – Education.[45]

Another R&D incentive is that, for the most part, it is the government that offers R&D tax incentives to support related activities. Such tax incentives are an effective way of reducing R&D-related costs. Tech entrepreneurship with tech startups will receive attractive tax incentives (0% income tax, 10% flat payroll tax).

*When started, the majority of these international companies were purely development centers for the parent companies. After they began to increase their employee numbers they then moved on to activities of greater value to Armenia. Nowadays, it has been a common practice to eventually move the entire cycle of a company's technical activities to Armenia, including R & D, design, coding, testing, and other functions.[46]

45 https://www.frontiersin.org/articles/10.3389/fonc.2021.782581/full?&utm_source=Email_to_authors_&utm_medium=Email&utm_content=T1_11.5e1_author&utm_campaign=Email_publication&field&journalName=Frontiers_in_Oncology&id=782581&fbclid=IwAR2XQZXPPXbmhBdRo1Ry3qt2IPNpt-Nuud2kwFgWKyFQX0KZaXbvc9nYOJI

46 International Trade Administration, Information and Telecommunication Technology, 2021, Overview, https://www.trade.gov/country-commercial-guides/armenia-information-and-telecommunication-technology Global Entrepreneurship Monitor (GEM) study 2020 Armenia https://www.eif.am/eng/researches/report-on-the-state-of-the-industry/"

KEY TAKEAWAY: KNOWLEDGE

- Armenia has several *special characteristics* that provide the opportunity to develop niche *high-value-added activities* and vertical applications and position itself in digital health, biotech development and bioscience research.
- Armenia can build on a strong foothold in *electronic design automation* and a strong heritage in mathematics and computer science.
- The Government offers R&D tax incentives to support related activities, such tax incentives are an effective way of reducing R&D-related costs.
- There is a strong need for action in entrepreneurial education, R&D transfer, and Governmental programs, including entrepreneurial finance to achieve that potential.

07

PILLAR ICT INFRASTRUCTURE

7.1 Introduction

ICT infrastructure is known to play an important role in the economic development and growth of any country; fast reliable connections are a prerequisite for areas like IT and banking. It is the cornerstone of the most productive elements of Armenia's economy. As such, the Armenian government's strategy to build a more robust ICT infrastructure is driven by the need to enable access to fast and reliable connections.

The ICT infrastructure of Armenia, has become the bedrock of ,not only the ICT sector, but the foundation of the country's business environment for both local and global companies. However, the digitalization will require improvement in the broadband connections nationwide and one of the main challenges facing the reliability of internet connection is that the Armenian ICT infrastructure backbone is not redundant (International fiber optic links).

7.2 History, facts, and figures

Armenia was one of the first post-Soviet countries to privatize its telecom sector. In 1995 Telecom Armenia CJSC was founded as Armentel and has been actively developing since it was founded.

In 2009, Orange Armenia (mobile communication) and Ucom (Internet connection and IP television) entered the market. In 2013 amendments to the Law on Electronic Communication removed the requirements that ISPs (Internet Service Providers) need in order to obtain a license. Currently, the telecommunication (including broadband Internet) market is reasonably diverse, with three main mobile service providers which are: Beeline, Ucom (Armenian), and Rostelecom as well as dozens of other ISPs. According to EIF, an Internet connection is available in more than 90% of the country. According to the International Telecommunications Union (ITU), in

2020, Armenia had a fixed broadband penetration rate of 14.5 percent and a mobile broadband penetration rate of 83.5 percent.

In 2021, Telecom Armenia, the telecommunication company, started with the construction of a next-generation network (NGN). This is a technology that provides homes and businesses with fiber-optic internet, phone, and TV services, specifically in the Davidashen administrative district of Yerevan. Developments around 5G networks have not yet started.[47]

Facts and figures

- As of 2012, ca. 90% of all main lines are digitized while the remaining 10% is in a modernization process.
- Together, EIF and Worldbank provided free Internet access in 344 rural areas. (Project "Supply and Installation of Wireless Internet Access Devices in Villages of Republic of Armenia".)[48]
- In 2020, there were 4 million mobile connections wheras in 2018 where there were approx. 588,000 (and declining) fixed phone users.[49]
- In 2020, the number of subscribers for Internet access in Armenia was 3,087,300, an increase of 0.2% compared to the previous year. At the same time, the number of mobile subscribers was 3,493,000, decreasing by 5.6% compared to the previous year.
- *.am* is the Internet country code (Internet domain) and top-level domain (ccTLD) for Armenia. The registry for .am is operated by ISOC-AM, the local chapter of the Internet Society. *.am* enjoys international popularity due to the connection to AM radio, the ability to form English words ending in "am", and over 65,000 Internet hosts in Armenia.

47 https://journals.sagepub.com/doi/abs/10.1177/000276420104401000 7

48 https://www.tandfonline.com/doi/abs/10.1080/13216597.1996.9751833?journalCode=rico20

49 EIF, State Report, 2018, 3. Key Findings https://telecom.arka.am/en/news/telecom/team_llc_to_introduce_in_yerevan_new_generation_network/

7.3 Internet Backbone

The backbone can be seen as the data highway. It consists of highspeed routes, often fiber or satellite links, strategically interconnected computer networks, and core routers of the internet. These data routes are hosted by commercial, government, academic, and other high-capacity network centers. They are also hosted by the internet exchange points and network access points that exchange internet traffic between the countries, continents, and across the oceans.[50]

Datacentres

Armenia has five data centers, run by four organizations. GNC-Alfa CJSC (two facilities) and other organizations include GNC-Alfa Armenia-Georgia Border Bagratashen, Armenian Datacom Company, and Armonico. Cities in Armenia with data center facilities include Yerevan and Vanadzor.

None of Armenia's facilities are carrier-neutral, offer to host of individual servers, or have rack cabinets or remote services. Armenia has currently not arranged tier 3 or tier 4 data centers. Following the input received during one of the interviews with stakeholders, the government is now planning to open 2 Data Centers whose infrastructure will be high standard and independent.

Internet Registry

Each network is managed as a single administrative domain called an Autonomous System (AS). There are over sixty thousand AS numbers (ASNs) worldwide. RIPE NCC Armenia Regional Internet Registry is responsible for allocating and registering the ratio of blocks of internet number resources to internet service providers (ISPs) and other organizations in its geographical service region.

50 https://en.wikipedia.org/wiki/Internet_backbone

Internet exchange point (IXP)

The AIX is the Armenian Internet exchange point (IXPs) which allows member internet service providers (ISPs) to exchange data. Most IXPs are independent not-for-profit associations. Armix is a member of the Amsterdam internet exchange (AIX).

Internet (or backbone) Service Providers

A service provider that provides networks (that are the backbone of the internet) usually negotiate interconnection agreements that are governed by the principle of settlement-free peering. Armenia's national backbone is comprised of E3 or STM-1 lines via microwave units across the whole country. GNC-Alfa aka (Rostelecom Armenia) is the largest independent internet and data provider in Armenia with 1,500 km fiber-optic cable infrastructure, covering 70% of Armenia. Armenia has four ISPs that maintain the fiber-optic backbone networks that connect to the international internet.[51]

Highspeed international routes

Fiber-optic cables (FOC) are capable of quickly transmitting large amounts of data over long distances. One of the main challenges facing the internet connectivity reliability is that the Armenian ICT infrastructure backbone is not redundant (international fiber optic links) for two major reasons[52]:

- The majority is operated by one private company, which makes Armenia's internet very vulnerable.
- There are no sufficient alternative route, which in turn, has led to big intermittent outages due to errors or breakdown of the fiber optics in Georgia over the last few years.

51 https://en.wikipedia.org/wiki/European_Internet_Exchange_Association

52 https://en.wikipedia.org/wiki/Backbone_network

85% of the long-distance traffic to and from Armenia is transmitted through Caucasus Online which is the 100% owner of the Caucasus cable system, a 1,200km submarine fiber-optic cable laid on the bottom of the Black sea. It transits internet traffic from Europe to the south Caucasus region. Onward connectivity is provided through its terrestrial backbone, a 600-kilometer fiber optic cable along the railway, through its 100% subsidiary Georgian Railway Telecom (GRT) which connects to partners in the South Caucasus region such as Georgia, Armenia, and Azerbaijan, Iran, and Iraq[53].

The Georgia-Russia Optical Fibre Submarine Cable System was established in 1999 and connects Novorossisk in Russia and Poti in Georgia. The System is jointly owned and operated by Rostelecom (Russia), FOPTNET (Georgia), and DanTelco (Denmark). In February 2019, the Armenian ISP Ucom signed a memorandum of understanding with ISPs in Iran and Qatar to build an internet transit link between the Gulf states and Europe through Armenia. Other (international) services are available by microwave radio relay and landline connections to other countries of the commonwealth of the independent states, the Moscow international switch, and by satellite. There is also a limited fiber-optic connection through Iran, which mostly serves as a backup[54].

Figure 13 – Cable map.

53 Submarine Cable Map https://repec.cepr.org/repec/cpr/ceprdp/DP17318.pdf

54 https://freedomhouse.org/country/armenia/freedom-net/2021

Ownership

After an investigation by hetq (www.hetq.am) the conclusion has been made that the telecommunication sector in Armenia is controlled for the most part by foreign (mainly Russian) companies and international holding companies formed by governments as well as companies registered in various offshore zones. Also, Armenian government officials and their relatives own shares in the telecommunication sector.

ICT & Telecom Governance

The Information Communications policy in Armenia is determined by the Ministry of Transport and Communications. The telecommunications sector is regulated by the Law on Electronic Communication, adopted in 2005. The practical application of legal acts, laws, and regulations in this area is introduced and monitored by the Public Services Regulatory Commission (PSRC), which 'is an independent national regulator in the field of telecommunications. The ICT Sector Development Support Council makes decisions on the allocation of radio frequencies, as well as the issuance of network licenses.

Armenia is a member of the European Telecommunications Satellite Organization, the International Telecommunications Satellite Organization, the International Telecommunication Union, and the International Amateur Radio Union. Armenia has also ratified the Convention on Cybercrime and the Constitution and Convention of the International Telecommunication Union.[55]

55 https://heinonline.org/HOL/LandingPage?handle=hein.journals/gwlr72&div=61&id=&page=

7.4 Opportunities

During our interviews with the stakeholders, we learned that a multi-stakeholder initiative is working on a plan to deploy a new undersea fiber optic cable to Bulgaria, Romania, or both in order to connect to the EU to create a fast and reliable route to Europe. Stakeholders of the workgroup include, Georgia and Armenia states, regulators, industrial organizations, EU and EIB, EBRD. The project is currently in the negotiation phase.

Expanding national broadband (2023/2024)

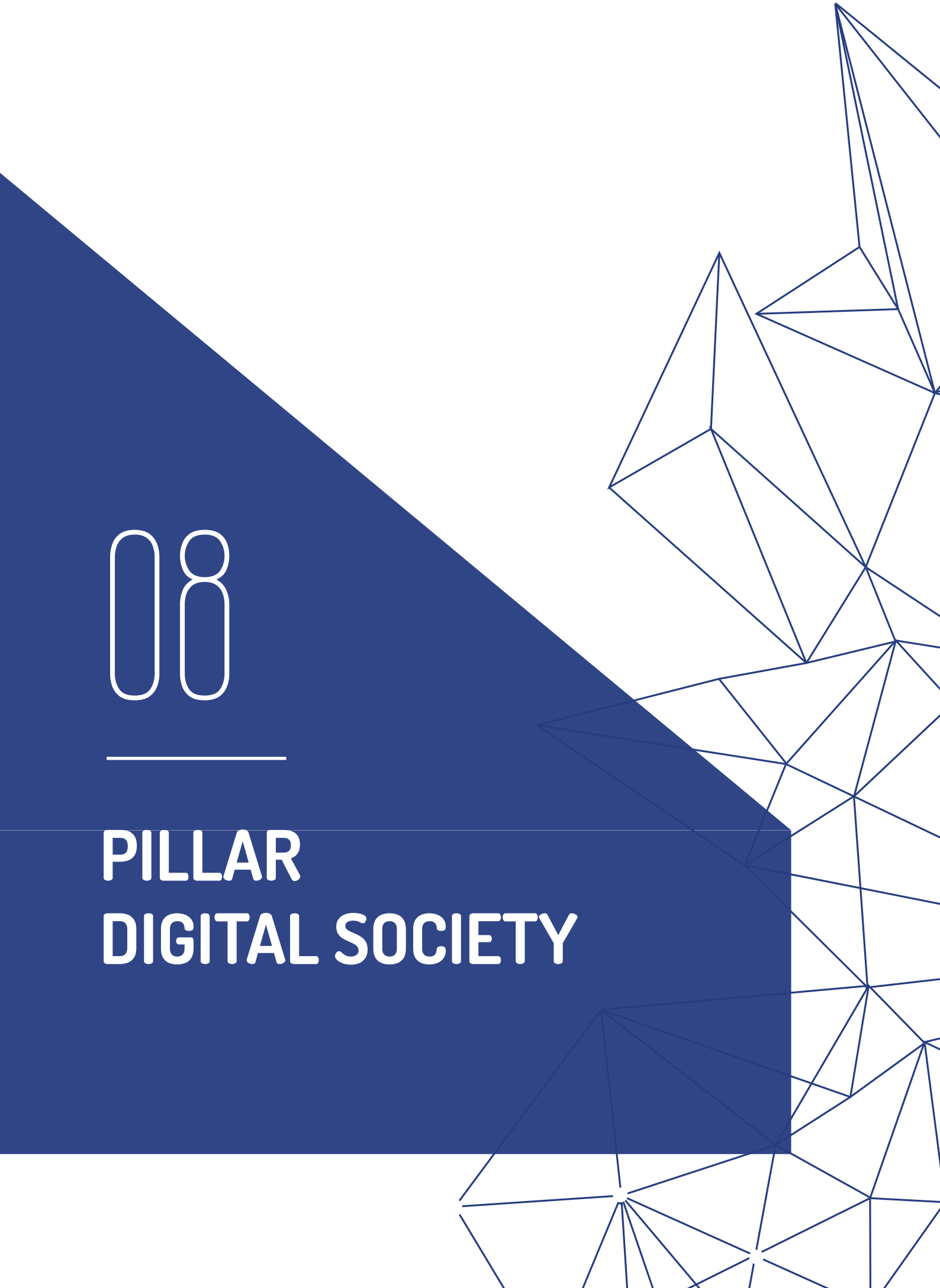
Further digitalization will drive demand for high-quality internet connections with rapid upload and download speeds of up to 100 mbps to homes. Armenia aims to create a strong broadband infrastructure, particularly in underserved and unserved areas of the country.

Opportunities for Dutch Companies

There are opportunities in the areas of investment, consultancy, construction, operations, and maintenance of broadband infrastructure including: cables, wireless networks, fiber optics & satellite pops, tier 3 and 4 data centers, green data centers, etc.

KEY TAKEAWAYS: DIGITAL INFRASTRUCTURE IN ARMENIA

- The cornerstone of Armenia's digital infrastructure is **"access for all to fast reliable connections"** – resulted in a high Internet penetration of ca. 85%-95%.
- The sector is mainly controlled by foreign companies and Armenian government officials.
- The capital of Armenia, Yerevan is connected to the Trans-Asia-Europe fiber-optic cable.
- Development of the NGN (Next Generation Network) has been started up in 2021.
- Armenian companies introduced 4G technology for wireless communications back in 2011, the first among CIS countries and, at the time of its introduction, the 10th in the world.
- 3 mobile operators covering almost 100% of Armenia's populated areas.



08

PILLAR
DIGITAL SOCIETY

8.1 Introduction

Digitalization has a tremendous impact on people, markets, and the economy. Digitalization plays a decisive role in developments in the labor market and requires continuous updates. This also applies more to professions outside the ICT sector, which also require digital skills. At the same time, risks, disadvantages, and vulnerabilities are also becoming more visible and increase the importance of digital resilience.

Digital agenda objectives for the Armenian digital society

The government plans to implement educational programs for all ages and social groups of the Armenian society. These measures include:

- Organizing digital skills courses for people in cities and rural areas.
- Educational IT programs for women and girls.
- Creation of a database filled with digital skills specialists to encourage employment in the state digital services.

Actions taken

- A Computer for All Program (2010) – Aims at increasing the population's computer usage and legal software at affordable prices.
- ISOC Armenia has created a "Digital Literacy in Rural areas" program, which aims to provide training courses with experts specialized in various areas of digital literacy to teach different segment groups of the project the necessary digital skills. They are currently looking for funding partners to implement the program.[56]

56 https://www.eif.am/eng/projects/computer-for-all/

- In 2022, the UAE opened the Samsung Innovation Campus to teach children and teenagers (10-19) about digital literacy development as well as how to improve their digital skills.[57]

8.2 Internet usage in Armenia

- We used secondary research (desk research) to analyze both the accessibility and rate of internet usage by the Armenain people. The study also covers how the internet was being used.
- 96% of the population have access to the Internet
- 60.7% of the population (1.8 million) use social networks, 97.5% of them by mobile phone.
- Mobile phones (69%) and laptops (17%) are the most popular to access the internet.
- Internet applications (E.g. WhatsApp, Viver, Messenger, Telegram, and Signal) have partly replaced the SMS function over the last 5 years.
- Lower-income groups use less internet
- Only 50% of the people older than 65 use the internet.
- 8% of the population has never used the internet.
- Regular broadband internet subscriptions cost between $9 and $10 per month.

Internet in Armenia has become vital service. As a result, internet volume in Armenia has increased and new investments by the operators are needed for the expansion of the network bandwidth. Due to lack of skills, awareness, or technological capability, lower-income groups in Armenia use less internet. This creates a risk

57 https://pubsonline.informs.org/doi/abs/10.1287/isre.12.3.240.9709

(together with the elderly) of losing access to a social or economic network and opportunities.[58]

According to the World Bank (2020) vital includes -

- Sourcing critical information online (37%)
- Carrying out virtual work-related communications (31%)
- Publishing one's content (16%)[59]

Digital skills of the population

Digital skills comprise of both the internet skills of citizens and the advanced skills of specialists. Digital literacy encompasses a wide range of skills, all of which are necessary to succeed in an increasingly digital world. The ability to use computer programs effectively is a mandatory job requirement and even necessary for mundane daily tasks.

Achieving a digital society in Armenia requires the development of key digital skills among all age groups of the society and the modernization of the public sector and economy.

Rural Areas

According to the NGO Internet Society (ISOC) Armenia Chapter, a huge number of the population in rural areas of Armenia lack digital knowledge and skills and lack an understanding of cyberspace. Basic digital knowledge includes: updating systems, security, and identity safety Safe *.am* is an initiative aimed to empower citizens to use the internet and mobile technologies safely. Safer Internet is another program that educates Armenian citizens on how to surf the internet safely.

58 https://www.ucom.am/en/news/2021/05/17/gurgen-khachatryan-telecom-and-the-future-in-armenia/413

59 https://blogs.worldbank.org/europeandcentralasia/internet-use-armenia-how-might-connectivity-shape-access-opportunity

Internet access

90% of Armenian households have access to the Internet. Free Wi-Fi access and Wi-Fi hotspots are available in most shopping malls, cafés, schools, and universities in Yerevan. There are public Wi-Fi hotspots in other major cities, though not to the same extent as in Yerevan.[60]

Costs and connections in Armenia

- There were 3.78 million mobile connections in Armenia in January of 2021, and the minimum price per minute is 4.99 AMD (Beeline network).
- Internet connections are considered affordable in Armenia. According to official statistics, the 2020 wages have risen, while average prices for internet remained at the 2019 level.
- Regular broadband internet subscriptions (speed max 50 MB/sec) cost between $9 and $10 per month, while mobile plans, with 3 GB (speed Max 25MB/Sec) of data per month included, are available between $3.50 and $4 per month.[61]

Inclusion / Digital divide

Inclusion refers to the equitable access to opportunities and resources for people who might be excluded, marginalized, or vulnerable.

According to World Bank survey data from 2020, there is "no significant difference in the levels of internet access by income group but low-income groups cannot always afford high-speed broadband and mobile connections". During the COVID-19 pandemic, major ISPs and MSPs (mobile service providers) offered free access to online educational and government resources. This includes video conferencing platforms such as Skype and Zoom.

60 https://www.sciencedirect.com/science/article/pii/S2405959521001764

61 https://freedomhouse.org/country/armenia/freedom-net/2019

There is a minor digital divide between large population centers and more rural areas. The quality of service may be limited outside of cities due to a lack of competition between providers.[62]

We interviewed people from different household types and civil society organizations about their skils of people in rural areas. These interviews revealed that:

- There is a big difference in the rural areas between the digital skills of people.
- The Internet connection is sufficient in the rural area but some groups lack devices or income.
- To enable digital participation for these groups, the groups require different approaches which may vary from teaching basic digital skills, to providing specific expertise (e.g. self-employment).[63]

Persons with disabilities

The Armenian government guarantees a broad set of ICT accessibility rights including equal access to information and telecommunications/ICT facilities and services for all persons.

However, our interviews* found that especially in rural areas persons with disabilities have difficulties in participating in digital transformation processes, especially to get physical access to training facilities.

Cybersecurity survey

We conducted a survey (polls) and interviews among 110 IT workers, students, and consumers about their knowledge of cyber security and or cyber hygiene. The survey revealed that:

62 https://datareportal.com/reports/digital-2020-armenia

63 International Telecommunication Union, 2021, ICT accessibility policy and regulatory framework overview in the CIS region, "https://www.itu.int/dms_pub/itu-d/opb/phcb/D-PHCB-ICT_ACCESS_CIS.01-2021-PDF-E.pdf"

- The age group above 50 does employ cyber security.
- 50% of the age group below 40 knows how to protect themselves.
- 50% do not know whom to contact in case of a cyberattack.
- 40% have not received cyber security training at work (43% work in an IT department.)
- 30% keeps the software up to date, uses antivirus software, and browses the web safely.

Internet usage of Small and Medium Enterprises (SMEs)

An EVN report shows that 50% of SMEs use IT to optimize business procedures in sales, customer relations, and accounting, while the use of technologies in other operations is even lower. When interacting with the government, SMEs use digital platforms mainly to pay taxes. In the business-to-business domain, only 20 percent of SMEs do online contracting and use digital payments for transactions. Moreover, a significant number of companies never use IT for any transactions with other businesses (63 percent) or public authorities (55 percent).[64]

8.3 e-Government services

In 2010, the Government of Armenia established the e-Governance Development Strategy. The Government has since initiated and implemented several projects to modernize e-governing, financed through both the State Budget and financial aid by international organizations (i.e. EU, UN, and The World Bank).

The goal is to ensure effective communication between citizens, businesses, and the Government (www.e-gov.am). In 2017, the Digital Armenia Foundation was established to create a unified digital environment across all public administration areas based on contemporary information technologies.

64 https://www.itu.int/en/ITU-D/Statistics/Pages/ICTprices/default.aspx

Objectives for 2025

- All government websites and electronic systems will have common standards and architecture as well as accessibility for disabled citizens.
- Services provided by state and local self-government bodies will be digitized online, in particular licenses and permits.
- State-local self-government bodies will communicate electronically, and the need for in-person visits will be limited.
- Armenia will be included in the list of the top 25 countries by the UN e-Government Development Index (Currently in 67th position, will improve by 42nd position).

The EU has funded a three-year project – E*U4Armenia: e-Gov Actions (2017-2020)* – that aims to establish a governmental interoperability platform, enabling a simplified and standardized secure connectivity between all organizations of the public administration of Armenia. This project will increase transparency, public control, and predictability of e-governance services. The EU is the main promoter of e-governance in Armenia.[65] To date, EU support includes;

- The introduction of an electronic document-management system known as "Mulberry" (paperless ministry concept).
- e-system for tax statements.
- Electronic civil status system.
- Vehicle registration system and a driver's license issuing system.
- e-Citizen portal, www.e-citizen.am
- The introduction of electronic signatures.

Furthermore, an ongoing project is developing a single interoperability platform for the services provided by the government. They will also be establishing a single window for all state border crossing points. Another new project aims to provide a "front desk" to the Governmental Interoperability Platform (GIP), enabling citizens

65 https://www.eeas.europa.eu/eeas/eu-armenia-relations-factsheet_en

and businesses to receive services online.[66] *European Council, Facts and Figures about EU-Armenia relations*[67]

The World Bank also continues to support Armenia's public administration reform. They will help professionalize the civil service by improving the public financial reporting and access to enhanced e-government systems.

Achievement in E-Government (2020)

- A whistleblowing platform (azedarach. am) was developed and launched in May 2019 in support of Armenia's enhanced anti-corruption efforts.
- The e-Consular System was launched in mid-May 2018.
- The platform of systematic collection and processing of citizen feedback on public services is being developed to enable the collection of user feedback for services delivered - both electronically and face-to-face.
- Registry of Legal Entities - www.e-register.am
- Real Estate Cadastre – www.e-cadastre.am
- Duties Payment
- www.e-payments.am - Report corruption risks

Launched in 2017, the BizProtect digital platform (www.bizprotect.am) allows business representatives to report corruption risks and other problems encountered in the business sector, while also ensuring their security.

66 https://eufordigital.eu/discover-eu/eu4armenia-e-gov-actions/

67 https://www.consilium.europa.eu/media/44397/685-annex-5-a-armenia-factsheet.pdf

KEY TAKEAWAY: DIGITALIZATION AND E-GOVERNEMENT

- The digitalization of society is slow, as people and companies do not see the necessity. (This also hinders e-commerce and online freelancing improvement.)
- 40% of Internet users do have sufficient cyber security knowledge.
- There is a lack of devices and digital skills among senior citizens and in rural areas.
- The internet is most often used to access communications and media services.

8.4 E-commerce in Armenia

The term electronic commerce (e-commerce) refers to a business model that allows businesses and individuals to buy and sell goods and services over the internet from any electronic device that can surf the web. E-commerce has a huge impact on digital transformation and economic development as it helps businesses to gain access to a wider market. Additionally, it helps consumers to get access to more services and products.

E-commerce take up in Armenia

In Armenia the demand for IT services in the domestic market is increasing, however, there are several factors that hinder its growth, including: small size of the domestic market, low wages, low demand for productivity enhancement tools, financial constraints, high software piracy rates, and other factors make growth in this sector a slow process. The Integration of digital technology, take-up of selected technologies by enterprises and e-commerce, and the usage of ICT services by the Armenian population is mainly not taking off because people and SMEs don't see the need.

Armenia is also behind on using products and services such as: enterprise resource planning solutions, e-commerce, web development services, and tools for the healthcare industry.

- According to EU4Digital experts, e-payment and pre-delivery payment services are issues holding back the development of e-commerce in the Eastern Partner countries, who are used to cash-paying after delivery.
- E-commerce is mainly used by specific demographic groups like youth and people with middle and higher incomes with digital skills and access to the internet.
- Some businesses, including leading supermarkets, have begun offering online ordering and local delivery fulfillment. Parcel handling companies,

freight consolidators, and the postal service are becoming more adept at getting orders to customers, particularly for purchases from abroad.

- Armenian consumers widely use Amazon, Alibaba express, eBay, and other online platforms for purchasing international goods like household appliances, books, mobile phones, computers, clothes, footwear, goods for children, and perfumes.
- Orders from abroad have shown strong growth in B2B e-commerce like web services. Service as a service (saas) is also expanding as a result of high-tech and finance and banking sectors.

However, e-commerce is far from day to day use for many Armenians, due to a lack of digital knowledge, disposable income, trust, delivery infrastructure, and various other reasons.

Online transactions

According to the Central Bank of Armenian statistics, online transactions with a bank card have increased more than ten times during the last 5 years from 25 billion AMD to 338 billion AMD during the pre-pandemic 2019. During Covid-19, online transactions in Armenia grew by 14.6% during the first 6 months of 2020.[68]

To get an insight into e-commerce usage in Armenia, we surveyed Armenians about buying products and services online. The poll produced 148 responses from all age groups. The survey concluded that the main services bought online are tourism, education, and health following 29%, 24%, and 26%, respectively. The main products bought online were groceries (32%) and books (29%).

31% of the respondents mentioned that they only buy Armenian products online and 67% mentioned that they also buy international products. The methods of payment for online buying are Visa/Master Card (66%) and Paypal (12%). When using the same services or products, 84% of the responses mentioned that they prefer Armenian companies above international companies. For device purchases

68 https://www.trade.gov/country-commercial-guides/armenia-market-overview

55% of the respondents own a mobile device and 34% of the respondents own a laptop. Instagram and Facebook are mostly used as online shopping services.

International e-trade

In international trade in general, particularly for Armenia, the 2 main obstacles to cross-border trade are:

- Paper-based documentation for commercial transactions and cargo documents. (The European market is very strict on documents and requirements and often uses E-systems).
- Local eCommerce platforms are not adapted for cross-border trade. (E.g. the products are not listed in Euro or do not have an English name).

To overcome all these obstacles, and to increase the flow of e-commerce between Armenia and the EU, the *EU4Digital initiative* created a virtual warehouse for the German E-bay, which was successfully tested during an eCommerce pilot.[69]

Some key findings from the eCommerce pilot include:

- The virtual warehouse allowed for a significant increase in the number of Armenian sellers on the German E-bay site.
- The virtual warehouse also helped to improve the flow of e-commerce between Armenia and the EU, as German sellers were more likely to find Armenian products that met their needs.

69 Article: Armenian on Itel.am
Selling Armenian socks to Germany: EU4Digital bringing EU markets closer through e-commerce support. iTel.am | Armenian Startups, IT news, web and telecom - itel.am

Web-based freelancing

The European training foundation observed that online freelancing is widespread in IT and creative industries among Armenian platform workers. Their searches identified about 10,000 members in a major Facebook group, which includes IT specialists, designers, legal experts, etc. Freelancing and platform work have increased in recent years as a result of increasing digitalization and the global transformation of jobs. Web-based work is mostly done through global platforms, such as Upwork (3,000 registered users from Armenia).[70]

Local job platforms

ENCRO is the first Armenian freelance platform that provides jobs for the freelancing world, while Jobs. am is one of the most recognized career platforms which went online in 2016. Unfortunately, the Armenian Labor Code does not recognize platform work or freelance work.

Online Payment methods

Armenian digital payment sector is well developed to serve local customers. Armenian online banking meets the technological demand of international online banking standards, including cyber security.[71] Payment methods used are:

- Online banking.
- Traditional cards, including the Arca card, Visa, and MasterCard.
- Mobile money.
- Digital platforms.

70 https://www.etf.europa.eu/sites/default/files/2021-06/platform_work_armenia_1.pdf.

71 https://www.computer.org/csdl/proceedings-article/icsc/2014/4003z014/12OmNzhnaeP

As of July 1st , 2022, a new regulation (by Armenian's Central Bank) has come into force for transations above AMD 300,000. (These transactions should be made digitally)

Fintech payment methods

- Idram & IDBank is the leading fintech platform in Armenia, which combines both an e-wallet and banking experience in one app.
- Mobidram is an Armenian digital payment service provider that offers a full range of mobile money transfer solutions.
- Payoneer (US), is an alternative payment option to bank transfer.
- PayPal in Armenia is not fully available, due to the market size. Armenians can only send funds and receive refunds.
- Apple Pay is available.[72]

Note - our interview revealed that for the international fintech industry, the Armenian e-commerce market is in use, but currently not interesting, due to its market size.

Local eCommerce Regulation

Armenian legislation regulates key aspects of eCommerce in the country. Relevant authorities include the Civil Code, Law on Trade and Services, Law on Consumer Rights Protection, and Law on Implementation of Cashier Machines. Weak enforcement of intellectual property rights in Armenia creates impediments to the further development of eCommerce.

E-commerce actions of the government

- Regular analysis to ensure digital integration in the regional and world markets.
- The formulation of new legislation for eCommerce, in recognition of its growing importance.

72 Top 5 Most Useful Digital wallets In Armenia 2022 | Armenia-Guide

- The development of legislation to facilitate the collection of value-added tax for international online transactions.
- Armenia is participating in relevant discussions under the auspices of the Organization for Economic Cooperation & Development. (OECD)

8.5 Gaps and challenges

- A large part of the population does not have access to e-services, resulting in constraining the development of the digitalization process.
- Inefficient government processes and slow development with regards to online services.
- No integrated Government Financial Management Information System (GFMIS).

The UNECE adds the lack of innovation strategies or the national innovation policy framework to the above gaps, while the World Bank mentioned that there is no exchange of innovation policy issues and experiences on a subnational level.[73]

Targeted projects (government)

- Armenia E-Society and Innovation for Competitiveness Program.
- A computer for All programs.[74]

73 IPO_2020_3_ARMENIA.pdf (unece.org)
Following the World Bank, https://thedocs.worldbank.org/en/doc/231381587037432221-0080022020/render/ArmeniaProjectPagersApril2020.txt

74 **Armenia** The E-Society and Innovation for Competitiveness (EIC) Project https://www.worldbank.org/en/news/loans-credits/2010/11/30/armenia-the-e-society-and-innovation-for-competitiveness-eic-project.

8.6 Opportunities

Opportunities for companies could improve upon providing cloud services, e-commerce platforms, and fintech services for the Armenian market. One of the main issues at hand is that the market is small and services have to be localized for a local market.

After evaluating the interviews, the need was expressed for educational programs with a focus on the rural areas. The main topics of interest would include: e-commerce, entrepreneurship, digital innovation, train SME's, training centres in foundation of e-commerce and promotion of e-commerce adoption among SMEs (in rural areas) in Armenia. By encouraging an education in these areas, Armenia could better support SME's to expand their business and commercial activities to new geographical areas.

KEY TAKEAWAY: E-COMMERCE

- The Integration of digital technology, take-up of selected technologies by enterprises and e-commerce, and the usage of ICT services by the Armenian population is mainly not taking of, because people and sme's don't see the need.
- To overcome trade obstacles, and to increase the flow of e-commerce between Armenia and the EU, a virtual warehouse for the German E-bay, which was successfully tested during an eCommerce pilot.
- Using these (e-commerce) technologies can result in economic growth and building resilience for the future but the main challenge also is the development and implementation of (and connection to) an international payment system.
- Due to the limited e-commerce market, big international providers like NFC, Apple of PayPal do not have access to Armenia, expectations are that these foreign companies will enter the market when Armenia's e-commerce activities are increasing.

09

PILLAR
SECURITY AND TRUST

Cybersecurity and data protection

Introduction

Cybersecurity is key to trusted and sustainable digital transformation. Cybercrime domains include Data theft, espionage, and surveillance – security risks such as online scams and phishing, data-harvesting malware, disruptive malware/ ransomware. Cybecrime also covers the exploitation of vulnerabilities of systems, networks, applications used by businesses, governments, and schools to support staff who work remotely.

Countries with weak regulation, poor security standards, and a lack of expertise are particularly at risk. The World Economic Forum's Global Risks report 2022 identifies misinformation and cyberattacks as two of the biggest risks worldwide. According to estimates, cybercrime resulted in global losses of around 6 trillion US dollars by 2021.

Cybersecurity skills are becoming very important in the digital economy and winners and losers will be determined by who has these skills. The EU General Data Protection Regulation (GDPR) that came into effect in May 2018 requires much more attention to be paid to data security in every data-processing or information system, but due to the skills shortage, many organizations find themselves struggling with compliance.

Another problem in this area is that the skills required for security professionals are changing at a faster pace than usual within advanced-technology fields, due to the changes introduced by the new digital technology.

9.2 Key findings and challenges

Armenia has the potential to become a valuable asset in the cybersecurity market, despite its slow in take-up of cybersecurity. This is unfortunately a result of the lack of sanctions to enforce laws protecting privacy.

There are several initiatives for education and awareness to promote cybersecurity skills but the awareness of the citizens of the protective measures is still low. ICT is necessary against cyber-attacks, the development of proper mechanisms, consistency for the cyber incident and crisis management at the national level. Armenia does not have an officially recognized national (and sector-specific) cybersecurity framework for implementing internationally recognized cybersecurity standards.

Cyberattacks in Armenia

According to the digital security incidents against the Armenian Civil Society in 2019 – 2020 report, Armenia faces diverse internal and external cyber threats such as: political powers in Armenia, Russian cyber espionage groups, Azerbaijani hackers, global cyber-criminal gangs, website hacks, DDoS, Phishing, Malware, cyberbullying, online harassment, misinformation, defamation, and conspiracy groups.

Armenia is a slow Cybersecurity uptake

Despite cyberthreats and incidents, cyber security has not been taken up in the IT industry or the educational system in Armenia. Several stakeholders indicated that the main reason for that is that the government has not implemented regulations and measures which force companies to secure and protect data, which ultimately results in companies as well as students not seeing it as a priority.

9.3 Data protection in Armenia

Big Data and digital platforms create new economic and social opportunities, but also bring with them risks in terms of privacy. Data-driven practices in private and public sectors should also be managed fairly and transparently. Civil rights should be safeguarded and public values must be firmly anchored. The OECD encourages governments to implement measures for data protection, such as privacy strategies that adopt laws protecting privacy with adequate sanctions and remedies, and complementary measures. These include education, awareness-raising, and skills development.[75]

The Personal Data law

Personal data protection is a developing sphere in the Republic of Armenia. The EU General Data Protection Regulation (Regulation (EU) 2016/679) (GDPR) is not applicable in Armenia. However, the Armenian data protection legislation reflects most of GDPR's main principles and rules. The first step in regulating data protection was the adoption of the Law of the Republic of Armenia of 13 June 2015 No. 49-ZR on the Protection of Personal Data or the Personal Data Law. It protects citizens' right to privacy concerning the processing of personal data, bringing Armenian law in line with European standards and international obligations.

The Law guarantees the rights of natural persons (data subjects) and imposes mandatory requirements on personal data processors, authorized persons, and third parties. Armenia has ratified the Convention for the Protection of Human Rights and Fundamental Freedoms 1950 (European Convention on Human Rights). Therefore, Article 8 of the European Convention on Human Rights applies to personal data protection in Armenia. Amendments to the Labor Code of the Republic of Armenia of 2004 to enhance the protection of employees' data and regulation of their processing by the employer were conducted. Currently, the regulations are

75 Microsoft Word - Modernising priv framework.docx (oecd.org)

being reprocessed by the government, and new regulations and amendments will be adopted to the existing ones.

Personal Data Protection Agency

Data privacy is regulated by the Personal Data Protection Agency. The Personal Data Protection Agency publishes tutorials to instruct users on how to protect their data on social media and their smartphones. The agency began publishing the tutorials in 2016, but only recently made them public on its Facebook page.[76]

Opportunities for Armenia in cybersecurity

Estimates show that there are currently 3.5 million unfilled cybersecurity positions in the world labor market and a high demand for cybersecurity solutions. Cybersecurity is a technical field that requires strong quantitative skills. Experts must be proficient in the core academic disciplines of science, technology, engineering, and math (STEM). STEM is an important component of education and excellence in Armenia.[77] Training Armenia IT specialists into cyber security experts could be an opportunity for Armenia to develop in the cybersecurity products and services sector, offering solutions such as: security-by-design and privacy-by-design, security code auditing, and cryptography. This will cater to a new high-demand international market. This would require the promotion cybersecurity education as well as incentives to attract students and experts.[78]

76 http://ndl.ethernet.edu.et/bitstream/123456789/47638/1/Jeroen%20Van%20Den%20Hoven_2008.pdf#page=314

77 https://onlinelibrary.wiley.com/doi/abs/10.1002/poi3.246

78 https://heinonline.org/HOL/LandingPage?handle=hein.journals/rutcomt43&div=12&id=&page=

9.4 Armenian Digital Agenda on cybersecurity

The digital Agenda Strategic Objectives on cybersecurity include

- The development of a comprehensive cyber security policy and action plan, which will include the establishment of a cyber security center, risk management, and rapid response mechanisms in natural disasters, emergencies, and war.
- Close cooperation with the interdepartmental and private sector, localization of international experience, as well as observation of international cyber security standards. Interstate cooperation membership in international security structures are key to the corresponding modernization of cyber security technologies and the continuous development of threat responses.
- The establishment of a center of excellence in cyber security.[79]

Actions undertaken

Armenian authorities and law-enforcement bodies have been demonstrating readiness to address cybersecurity issues and take measures. From our interviews, we learned that the government currently is in the process of investigating international regulations on cybersecurity and how to implement them in Armenia as well as start with the help of international advisory consultancies. However, a lack of capacity among government personnel is slowing the process.

Agreement between Cisco Systems and Armenia

Armenia and Cisco Systems signed an agreement to create data processing centers and organize courses for different specialists in the field of technology.[80]

79 https://www.worldbank.org/en/news/press-release/2022/03/03/armenia-to-improve-public-sector-performance-through-digital-solutions-with-world-bank-support

80 https://www.mdpi.com/1999-5903/13/8/186

CyHub Armenia

Cybersecurity hub in Armenia is a joint initiative of IBM, CISCO, National Polytechnic University of Armenia (NPUA), Innovative Solutions and Technologies Center (ISTC), Yerevan Computer Research and Development Institute (YCRDI), Armenian Government, the World Bank, and Enterprise Incubator Foundation. CyHub aims to increase the competitiveness and cybersecurity level as well as the skills development of specialists, cybersecurity demonstration & advanced research lab for detecting, and solving/preventing cybersecurity issues in the country.

UATE and Ministry of High-Tech Cybersecurity Course

The Ministry of High Tech is cooperating with industry Organization UEICT and has created Cybersecurity courses, partially funded by the government.[81] Their aim is to provide basic knowledge and skills in all areas of cybersecurity. The program was open to 100 Armenian citizens in 2020.[82]

Civil society CERT AM

An officially recognized Computer Emergency Response Team has been formed (CERT-AM) and acts as a contact point, help desk, training, and data collection for cyber security incidents for the Armenian civil society. NGOs, human rights activists, activists, journalists, and independent media providing IT security analysis, audit, and courses.[83]

National Cyber Security Center of Excellence

By 2022 The National Cyber Security Center of Excellence will be established, which will be the cyber security of state systems, provide protection of personal data, and promote the development of cyber literacy.

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81 Armenia's Digitalization Strategy 2021-2025, Basic conditions of digitalization, Cybersecurity, 2021, https://www.arlis.am/DocumentView.aspx?docID=149957

82 https://www.taylorfrancis.com/chapters/edit/10.4324/9780203859483-19/cyber-security-myriam-dunn-cavelty

83 https://www.jstor.org/stable/44288905

Cybersecurity index (GCI)

The International Telecommunication Union (ITU) Global Cybersecurity Index (GCI), measures the efforts of 194 member states in enhancing cybersecurity. For the year 2020 Armenia ranked 90th, Azerbaijan 40th, and Georgia 55th.[84]

9.7 Cybersecurity Opportunities for Dutch companies

- Further implementation of the Digital Agenda conditions with a focus on cyber security development.
- Opening of security centers this year and the actions (tenders and collaboration agreements) are needed for this.
- Training courses in cyber security, E-government, ICT strategies, and ICT procedures and regulations.

Opportunities in cybersecurity include: consultancy on sector-specific cybersecurity frameworks for implementing internationally recognized cybersecurity standards, international benchmarking exercises or referential for cybersecurity policy development, implementing a national cybersecurity strategy, policy and roadmap.

Cybersecurity educational programs are in collaboration with Armenian partners. Cybersecurity outsourcing facilitate the development of cyber security specialists to fit the demand for the Dutch cybersecurity market.

84 https://content.iospress.com/articles/information-polity/ip170058

KEY TAKEAWAY: SECURITY AND TRUST

- Armenia has the potential to become an interesting player in the cybersecurity market, however, is slow in take-up of cybersecurity as a result of the lack of sanctions to enforce laws protecting privacy
- The EU General Data Protection Regulation (GDPR) is not applicable in Armenia. However, Armenian data protection legislation reflects most of GDPR's main principles and rules
- There are several initiatives for education and awareness to promote cybersecurity skills but the awareness of the citizens of the Protective measures is still low.

10

CONCLUSION AND LIST OF OPPORTUNITIES

Conclusion

Armenia is a regional leader in IT and high-tech industry and one of the most open investment locations in the commonwealth independent states (CIS) region with equal opportunities for foreign and domestic investors.

Of 11 million Armenians, only 3 million live in Armenia, making the diaspora one of the largest in the world. This diaspora is essential to the country as a source of not only personal remittances but also FDI, ideas, and contacts.

Although engaging with the diaspora has triggered some innovation, such as in ICT services, its potential is underexplored, giving ample room for effective public support as part of an overall effort to promote innovation and experimentation for sustainable development.

After the collapse of the Soviet Union, Armenia began transition to a market economy in 1990–1991 and started to rebuild and restructure the economic system. The government of Armenia made significant constitutional, fiscal, and legislative reforms and continues to do so. As such, Armenia has made impressive progress on protecting minority investors, paying taxes, and trading across borders. Today Armenia has respectable rankings on many global indices, measuring the country's business climate and has traditionally fared well in the World Bank's Ease of Doing Business report.

The technology sector is the main factor driving growth in the Armenian economy. Starting as a destination for small development centers for international parent companies in late 90's, the Government of Armenia declared the ICT sector a priority followed by 10-year industry development in partnerships with the World Bank, the USAID, universities, foundations, and private enterprises. This allowed them to lay out the conditions to create a sustainable ICT sector, build a telecom, regulate banking infrastructure, improve the quality of IT graduates, and create venture and other financing mechanisms for (start-up) companies

This led to a mature IT sector with world-class R&D capabilities, a talented workforce, and strong university programs. In the last 20 years the sector continues to show a constant growth in the number of companies and total turnover. With over 1,000 companies and a large turnover, many multinationals and international companies moved their entire cycle of a company's technical activities to Armenia. These crucial activities include R & D, design, coding, testing, and other functions such as marketing and customer support. In the 21st century the industry is moving from an outsourcing model for foreign companies to a center of technological development.

Armenia's start-up ecosystem is still very much in its early days. 2021 was a record year for start-ups globally in the rise of remote work during the Covid-19 pandemic. A change in attitude toward the importance of geographic location also greatly helped Armenian-based technology start-ups to receive over $200 million in investments. Products built by Armenian start-ups are no strangers to the leaderboards and received awards cross a wide range of categories.

The Armenian IT services are mainly an export product and remain Armenia's best strategy to achieve higher exports and create well-paid jobs, according to the World Bank report.

In the local IT market, the demand for business software and financial services is developing. There is still a low level of demand for data and intelligence in private sector and academia. There is always a need to translate data into valuable insights and innovative products. Aspects such as privacy, accessibility, security and the reliability of the data are not high on the agenda. In general, emphasis is needed on improving entrepreneurial skills in order to ensure continuous innovation in new activities, developing or launching new products and services, setting up new business units, and ensuring the products and services produced in Armenia meet international quality standards.

Armenia's STEM educational system (science, technology, engineering, and math) in universities that have consistently supplied the labor market with a highly skilled workforce. However, one of the main challenges are that outdated educational programs and a mismatch between education and job market need, make it difficult to find qualified technical specialists. Often companies need to train graduates

intensively. There is a need for updated educational programs, new curriculums, upgrading of professors and a coordination program between the educational institutes and the private sector.

Despite the fact that internet connection is available in more than 90% of the country, Armenia fixed broadband penetration rate remains low at 14.5 percent. With over 4 million subscribers most, but not all people use mobile internet (83.5 %).

The digitalization of society is slow as people and companies do not see the necessity. This hinders the uptake of e-commerce and online services as well as the opportunity for the development of the local IT market. A lack of devices and digital skills also unfortunately exclude senior citizens and people in rural areas from participating in the digital society.

40% of internet users not aware of cyber security, they are left vulnerable to cyber criminals. The internet is most often used to access communications and media services. 85% of the long-distance traffic to and from landlocked Armenia is transmitted through one route in Georgia via sea cable to Europe, which makes the internet vulnerable. A multi-stakeholder initiative is working on a plan to deploy a new undersea fiber optic cable to Bulgaria or Romania to connect to the EU. This will create a fast and reliable route to Europe.

The Armenian government approved the country's Digitalization Strategy in February 2021. The strategy envisages digital transformation of the government, the economy and the society through the introduction and development of innovative technologies, cyber security, data policy, e-government systems, coordination of digitalization processes, and the creation of common standards.

These circumstances provide strategic opportunities for Armenia's private sector in high-tech global value chains. They provide opportunities in training services, specifically for future cyber security specialists. Offering cyber security products such as cybersecurity-by-design, security code auditing and cryptography will prove to be valuable in the future.

Other opportunities include collaboration with local companies for consultancy, construction, operations, and maintenance of broadband infrastructure such as: cables, wireless networks, fiber optics, and satellite pops, data centers, green data centers, etc.

List of opportunities

Opportunities in consulting, training, and technical assistance

Key issues that we identified related to the government are standardization with international standards, general lack of coordination, capacity and an underdeveloped institutional setup for digitalization.

The government aims to create an infrastructure for data collection, provide essential services (e-government), and develop national information and cyber security capabilities according to international standards.

The Armenian government has expressed their intention to involve international expertise.

The related opportunities are in IT consulting and include: developing and implementing cloud computing infrastructure, creating processes and strategies, providing technical assistance (to design strategies, concepts and methodological guides) and training the staff to reach a higher level in ICT procedures, data privacy and cybersecurity.

Opportunities for outsourcing and access to workforce and high-tech skills

Armenia has a lot of advantages for Dutch IT companies that are looking for an outsourcing destination or representation office for software development, system administration, security engineering and data engineering.

The country's engineering, computer science, physics, mathematics research and development capabilities are on par with the best in the world. Armenia has a well-educated and competent staff with technological abilities, strong university programs in IT and associated fields with specializations.

There is an availability of over 30,000 well-educated software engineers with labor expenses that are highly competitive and with operating costs that are a fraction of the cost in the Netherlands.

Opportunities in venture investments in innovation and start-ups

The Armenian Startup Ecosystem is a regional Leader in innovation, ranked at number 60 globally. Armenia is popular for leisure, software and data, ecommerce, and retail start-ups. Many Armenian startups receive funding from international investors.

There are several organizations and websites specialized in direct investments in start ups in Armenia, e.g. Invest in Armenia is an independent organization that assists international companies that are interested in investing in Armenia.

Opportunities for educational institutions

Armenia currently faces challenges in its technology education. Specifically, on universities methodologies, professors, tools and its approaches are outdated. There is a need for trainings programs and new curriculums for students and professors that respond to current needs. Institutions need knowledge injection of modern technology application deployment strategies, but also knowledge on building infrastructures, secure them, and make them as efficient and robust as possible.

There are several opportunities for international science, technology initiatives, educational programs, internships, student exchange programs, research, and teaching opportunities in Armenia. Other opportunities include the international collaborations and development of partnerships with leading companies, research institutes and universities in Armenia.

Opportunities for cloud services, network providers and system integration

Further digitalization will drive the demand for high-quality internet connections with rapid upload and download speeds of up to 100 mbps to homes. Armenia aims to create a strong broadband infrastructure, particularly in underserved areas of the country. Currently a multi-stakeholder initiative is working on a plan to deploy a new undersea fiber optic cable to Bulgaria or Romania to connect to the EU.

This provides opportunities in the areas of investment, consultancy, construction, operations, and maintenance of broadband infrastructure. (E.g. cables, wireless networks, fiber optics & satellite pops, tier 3 and 4 data centers, green data centers, etc.)

Providing e-commerce services (E-Commercializing of local retail and service providers)

Armenia currently has a low level of e-commerce use. To develop the country on e-commerce, companies have to transition to digital work, including providing e-commerce services. Other problems observed are that most of the Armenian inhabitants currently do not see the value of e-commerce and its related services such as foreign payment service. Unfortunately some companies are simply not interested in Armenia due to its low level of e-commerce connectivity.

Opportunities are for e.g. hosting companies, e-commerce platforms and payment providers (Armenia complies with international banking regulations) to provide services to Armenian retailers.

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GLOSSARY

DIMENSION	DESCRIPTION
Power infrastructure resilience	Power availability for the entire population
Cable infrastructure resilience	% of the population within 10km of a fiber network
Mobile	Network coverage MCI composite indicator (3G,4G,5G)
Internet exchange point (IXP)	A physical data location where Internet infrastructure companies networks connect
Top-Level Domains	Number of Country Code Top Level Domains registered
Link resilience	% of ISPs peering at local IXPs
Quality of service	Latency measured to the nearest speed test serve
Cybersecurity	Secure Internet Servers per 1 million people
Chokepoint potential	HHI Index for the mobile market
Affordability	How affordable is mobile broadband for the country
DATA	facts and statistics collected together for reference or analysis.
Cyber attack	A cyber attack is a type of criminal activity that is carried out using computers and the internet
Regulation	A regulation is a law or rule that is created by a government agency or regulatory body in order to control or oversee a particular industry or activity.

DIMENSION	DESCRIPTION
Communication	Communication is the process of exchanging electronic information
Armix	
Internet Backbone	The internet backbone is the main network that connects all other networks and devices together. It is made up of high-speed fiber optic cables and is the largest and fastest network in the world.
Privatize	Privatize is to transfer an industry or property from the public sector to the private sector. The term is most often used in reference to the transfer of state-owned assets to private companies
Foreign Direct Investment	Investment by foreign companies in the economies of other countries.
Power infrastructure resilience	Power availability for the entire population

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