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Governing for Growth in Georgia

INNOVATION AND TECHNOLOGY IN GEORGIA

ANNUAL REPORT: 2017

USAID GOVERNING FOR GROWTH (G4G) IN GEORGIA

31 August 2017

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ACRONYMS

AA	Association Agreement
ADSL	Asymmetric Digital Subscriber Line
AI	Artificial Intelligence
AMD	Armenian Dinari
AR	Augmented Reality
B2B	Business to Business
B2C	Business to Consumer
BA	Bachelor of Arts
BERD	Business Expenditure on R&D
BfD	Broadband for Development
BGN	Bulgarian Lev
BPO	Business Process Outsourcing
BS	Bachelor of Science
BSTDB	Black See Trade and Development Bank
BTU	Business and Technology University
CAGR	Compounded Annual Growth Rate
CBC	Creative Business Cup
CDMA	Code Division Multiple Access
CIC	Community Innovation Center
CIS	Community Innovation Survey
COSME	Competitiveness of Enterprises and Small and Medium Sized Enterprises
DCFTA	Deep and Comprehensive Free Trade Area
DSC	Differential Scanning Calorimeter
EaP	Eastern Partnership – EU cooperation initiative
EBRD	European Bank for Reconstruction and Development
ECA	Europe and Central Asia
EDGE	Enhanced Data GSM Environment
EEN	Enterprise Europe Network
EIB	European Investment Bank
EIF	European Investment Fund
EPI	Economic Prosperity Initiative
EQE	Education Quality Enhancement
ERP	Enterprise Resource Planning
EU	European Union
FabLab	Fabrication Laboratory
FDI	Foreign Direct Investment
FEZ	Free Economic Zone
G4G	Governing for Growth in Georgia

GAU	Georgian American University
GCI	Global Competitiveness Index
GDP	Gross Domestic Product
GEL	Georgian Lari
GENIE	Georgian National Innovation Ecosystem
Geostat	National Statistics Office of Georgia
GERD	Gross Expenditure on R&D
GII	Global Innovation index
GIPA	Georgian Institute of Public Affairs
GITA	Georgian Innovation Technology Agency
GITR	Global Information Technology Report
GNAS	Georgian National Academy of Sciences
GNCC	Georgian National Communications Commission
GoG	Government of Georgia
GPS	Global to Pivot Success
GRDF	Georgian Research and Development Foundation
GTU	Georgian Technical University
HDM	Harmonization of Digital Markets
HEI	Higher education institutions
HTP	High Tech Park
IBRD	International Bank for Reconstruction and Development
IC	Innovation Council / Information and Communication equipment
ICT	Information and Communication Technology
ICTBC	Information and Communications Technology Business Council of Georgia
IFC	International Finance Corporation
Ilab	Innovation Laboratory
IMF	International Monetary Fund
Innocens	Enhancing Innovation Competencies and Entrepreneurial Skills in Engineering Education
IP	Intellectual Property
IPB	ICT Price Basket
ISP	Internet Service Provider
ISWD	Industry-led Skills and Workforce Development
IT	Information Technology
ITO	Information Technology Outsourcing
ITU	International Telecommunication Union
LTE	Long-Term Evolution
M&A	Merger and Acquisition
MA	Master of Arts
MCA	Millennium Challenge Account
mln	Million

MNC	Multinational Company
MoD	Ministry of Defense
MoES	Ministry of Education and Science of Georgia
MoESD	Ministry of Economy and Sustainable Development of Georgia
MoF	Ministry of Finance
MS	Master of Science
NACE	Statistical Classifications of Economic Activities in the European Community
NGO	Non-Governmental Organization
NIB	Nordic Investment Bank
OECD	Organization for Economic Co-Operation and development
PC	Personal Computer
PISA	Program for International Student Assessment
PMPR	Policy Mixed Peer Review
PPD	Public-Private Dialogue
PPP	Public Private Partnership
QS	Quacquarelli Symonds
R&D	Research and Development
RFP	Request for Proposals
RIH	Regional Innovation Hubs
ROI	Return on Investment
SDSU	San Diego State University
SME	Small and Medium size Enterprise
SRNSF	Shota Rustaveli National Science Foundation
STC	Science and Technology Centre
STEM	Science Technology Engineering and Mathematics
STEP	Science and Technology Entrepreneurship
STI	Science Technology and Innovation System
SWOT	Strength Weaknesses Opportunities and Threats
TAM	Tbilisi Aircraft Manufacturing
TCP	Technology Commercialization Project
TDZ	Technology Development Zone
TIEC	Texas International Education Consortium
TIMMS	Trends in International Mathematics and Science Study
TPP	Technology Product and Process
TSU	Tbilisi State University
TTCG	Technology Transfer Center of Georgia
TTO	Technology Transfer office
TUM	Technical University of Munich
TVET	Technical Vocational Education and Training
UAV	Unmanned Aerial Vehicle

UG	University of Georgia
UMTS	Universal Mobile Telecommunication System
UN	United Nations
UNESCO	the United Nations Educational, Scientific and Cultural Organization
USAID	United States Agency for International Development
USD	US dollar
VC	Venture Capitalist
VR	Virtual Reality
WB	World Bank
WDCMA	Wideband Code Division Multiple Access
WIPO	World Intellectual Property Organization

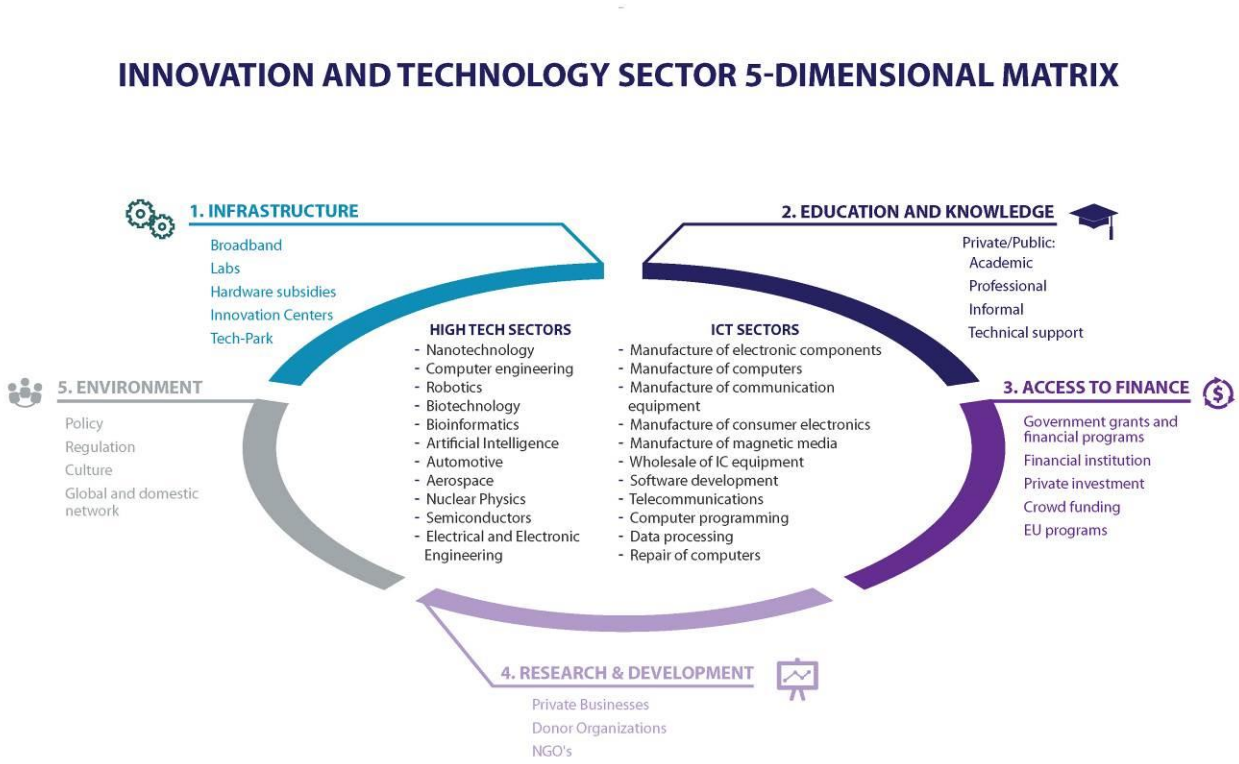
CONTENTS

1. EXECUTIVE SUMMARY

This report covers work performed by PMO LLC to create the first version of Georgia's *Innovation and Technology Sector Study*.

This document includes findings driven from extensive interviews with stakeholders, representatives from academia and business and desk research obtained during the study policy documents, data and reports.

The *Innovation and Technology Sector Study* was conducted for the first time in Georgia. The document provides baseline qualitative data for performance of the high-tech and information and communications technology (ICT) sectors in Georgia. The survey covers areas identified as eligible for funding by calls from government stakeholders and is based on the European Union (EU) statistical classification of economic activities in the European community (NACE) rev.2 classification of industries and services. The infographic below demonstrates dimensions the study document encompassed.



There are two distinct tracks for enabling innovation to occur in a country's ecosystem: one requires significant capital investments in hardware, human skills and know-how, the second could appear without sound interventions but rather is based on an original idea that gains traction. Non research and development (R&D) innovation could also be productive for companies and generate higher revenues.

The survey gives a current snapshot of the high-tech and ICT sectors' development in Georgia, identifies key players, describes weaknesses and opportunities and provides recommendations. In addition to the five-dimensional analysis of the sector, the survey also offers a comparative regional overview of the ICT sector in selected countries, analyzes global tendencies affecting sector performance and provides recommendations for improving Georgia's position in recognized global indexes through streamlining and better coordination of the reporting process.

Main findings:

Country Overview

- ICT sector development and its efficient integration into the global economy is regarded as one of the cornerstones of Georgia's social and economic development, and is outlined in various legal and policy documents, including *Georgia 2020* and EU-Georgia Association Agreement (AA).
- Georgia's economic development has been moderate (2.7% real growth in 2016), but on the other hand, Georgia is showing impressive progress in terms of improving its business climate.
- Main sectors of the economy are trade and repair services which accounts for 47% of total business turnover, followed by industry at 17% and transport and communications with 10%.

Market

- The volume of the technology sector in 2015 amounted to Georgian Lari (GEL) 1,869 million and accounted for 5.9% of GDP. ICT's share in the sector contributed to 90% of this amount.
- There are up to 1000 companies/organizations active in the technology field. Most companies operate in computer programming and consultancy (223 companies), followed by telecom (149 companies) and wholesale of information and communication equipment (IC) equipment (131 companies).
- The high-tech industry is underdeveloped with no current activity in many subsectors. However, there are some promising activities that are strengthening gradually. In high-tech, the main subsector is biotechnology with GEL 143 million from local production of pharmaceutical goods. The automotive and aviation sub-sectors are also worth mentioning with an approximate GEL 25 million export value for each in 2015.
- The ICT market accounted for GEL 1.68 billion in 2015 and showed 7% growth from the previous year. Telecom is a leading sub-sector with a 49% share, followed by wholesale of IC equipment at 34%.

Knowledge and Education

- Government, large companies and several universities have introduced short-track Information technology (IT) and web/mobile development training programs to leverage initial supply of qualified IT professionals to the field. The traditional, formal university-based bachelor of arts (BA) and master of arts (MA) programs are considered insufficient to match current market needs. Informal and self-education tracks are considered more efficient by the leading IT companies' managers.
- IT training centers are mostly available in Tbilisi. The short-term courses vary from basic to advanced. About 10-12 centers offer programming education with certification. Georgia's Innovation Technology Agency (GITA) managed entry level mobile and web development training programs in nine thematic areas and has produced more than one hundred trainers who are redelivering similar courses. Coordinated efforts in the field are recommended to fully employ existing interest in IT subjects.
- Science Technology Engineering and Mathematics (STEM) higher education institution (HEI) programs are being promoted by the government, and projects like the existing San Diego State University (SDSU) campus in Tbilisi and the Kutaisi Technology University project could play significant roles in introducing higher quality standards.

Environment

- Government continues to support the science, technology and innovations sector through new policy, financial and institutional instruments. The main policy document outlining the state priorities in the field is *Social-Economic Development Strategy of Georgia - Georgia 2020,* with a sub-chapter dedicated to innovation and technology.
- The World Bank (WB) National Innovation Ecosystem (GENIE) project plan is the main reference document for the implementation of the selected state strategies in the field. Detailed implementation plans and roadmaps have been drafted, but later changed creating a policy implementation gap.

Prioritization of areas for intervention and consensus based implementation strategies could have contributed to creating a firmer ground for genuine development of a knowledge based economy.

- GITA, under the Ministry of Economy and Sustainable Development (MoESD), serves as the main executive vehicle of innovation and technology policies and strategies since 2014. GITA's support to infrastructure development, legislative initiatives, startup ecosystem creation and capacity building is essential to the technology sector's advancement.
- Legislation supporting innovation development has been recently adopted. More initiatives concerning necessary policy instruments introduction (e.g. laws on crowdfunding, e-commerce) are in the pipeline.
- There is no commonly accepted definition of what constitutes a startup company. While the Government is concentrated on supporting innovative ideas and technology startups, other stakeholders, e.g. commercial banks in their startup support schemes, take a wider approach by also providing financing to new market business ideas of Georgian companies from a variety of sectors.
- The number of broadly defined startup companies created in 2015-2016 is more than 350. About 30% of them are related to the ICT sector. Startup support through Government programs is essential at the early stages. Startups are exposed to an increasing number of networking opportunities to showcase and possibly pitch their projects to the next rounds of financing, but no significant success stories are recorded yet. Evaluation of the first cohorts of startups will be the subject of subsequent studies.
- National Intellectual Property Center of Georgia – Sakpatenti, is increasing its efforts in incentivizing intellectual property (IP) protection and awareness among potential clients. At the same time, the culture and practice of patent search needs to be further developed, particularly in startup communities and programs, to avoid potential material damages and legal conflicts.

Infrastructure

- Technology infrastructure growth has been recorded throughout the country. Internet access rates and computer usage rates by individuals has reached 80%. Despite the rise in connectivity, the gap in digital skills, particularly in rural areas, is still evident.
- During the last 2 years the following infrastructure were built in Georgia: 2 Tech Parks opened in Tbilisi and Zugdidi, 14 Fabrication Laboratories (FabLabs) in vocational education institutions, 8 FabLabs in other places across Georgia, 3 Innovation Laboratories (ILabs), and 2 Innovation Centers (ICs) in the regions.
- Overall, state support to technology and innovation infrastructure is largely a work in progress. Technology parks, FabLabs, regional hubs, innovation centers and other facilities are being constructed across the country aiming at facilitation of innovation and technology ecosystem development.

Access to Finance

- Access to finance for newly established companies has been improved through government programs (Startup Georgia, Fab-Labs, business incubators, etc.) and several bank loan programs for startups (TBC Startuper; Bank of Georgia Female Start Upper; Procredit Bank Innovfin). In addition, international credit instruments in the field have become available for Georgian small and medium size enterprises (SMEs) just recently.
- Local venture capitalists (VCs) are currently inactive and does not show significant interest in local startups. However, a dozen fin-tech companies have been supported under the umbrella of a private bank managed accelerator with several successful exits. Access to foreign VCs is unavailable.

R&D

- Applied research at Georgian science institutions needs additional scaled seed-financing to support further development. Consolidation of efforts of qualified scientists' teams in similar fields, but from different institutions, would be fruitful for the development of successful commercialization projects.

- The most promising sectors for commercialization are biotechnology, with world-class scientific expertise, and applied physics research used for other sector needs. However, the number of research fields with high commercialization potential is limited.
- The number of patent applications has been decreasing until 2016. On the contrary, the number of trademark registrations has been growing steadily. These trends are rather indicative of weakness of genuine applied research product development but growth in trade activities, especially in the service sector.
- The GENIE project envisages creation of the National Technology Transfer Center, an umbrella institution that would help smaller branches in research institutions, universities, and labs to successfully develop their innovations and commercialize them.
- The value of gross expenditure on R&D for Georgia was underestimated in recent global indexes. The figure produced by the report is at least 0.4% of GDP and includes defense and agriculture applied research funding. The number is twice as large as previously, but even that improved number is far below the EU recommended spending of 3% of GDP.
- Measurement of business expenditure on R&D has to be improved in the next editions of the National Statistics Office of Georgia's (Geostat) annual studies of innovation activities in Georgian companies, mainly through sampling, terminology and methodology streamlining.
- The opportunities for utilization of the Deep and Comprehensive Free Trade Area (DCFTA), innovative research and business funding offered by the EU are new to Georgia. Their proper application would depend on successful partnerships, prioritization/matching of R&D fields and meaningful cluster development, along with awareness building in research and business communities.

Georgia in Global Rankings

- In the Global Competitiveness Index (GCI), Georgia has the greatest improvement in the region (29 positions), from 88th place to 59th during the 2011-2016 period (out of 138 countries). In this index, Azerbaijan ranks as the leading nation (37th) in the region followed by other selected countries in the region, such as Armenia, Azerbaijan, Turkey, Ukraine, Bulgaria, Kazakhstan, Belarus and Moldova.
- In the Global Information Technology Report (GITR), Georgia moved up by 40 positions, ranking 58th in 2016 compared to 98th place in 2011, the second highest in the region, after Armenia, but ahead of other selected countries in the region.
- In the Global Innovation Index (GII) ranking, Georgia is positioned amongst the ten best ranked countries in the group of lower-middle-income economies together with countries such as Moldova, Ukraine and Armenia. However, in the 2017 report, Georgia's ranking has dropped by four positions (from 64 to 68), primarily due to improved performance of other countries. The region is led by Bulgaria, a middle-income country, which ranks 36th among 128 countries, and thus remains closest to the top high-income country groups.
- Availability of verified data, which are used by global ranking agencies, plays a vital role in the formation of indexes and ultimately countries rankings. There are a number of cases where data is unavailable or imprecise, which has contributed to a negative influence on the global rankings of Georgia. Therefore, in order to improve data collection, the Government should consider assigning a responsible body that will coordinate proper gathering and validation of data used by global agencies and establish a methodology of collecting, sorting, verifying and keeping relevant economic, social, business, policy, regulatory and other data and information at national and sector levels.

Global Overview

According to recent study reports in information technology and innovation, there are a number of key global tendencies identified:

- Global innovation and technology trends have a greater influence on a high-tech and innovation sector than in lower-tech industries.

- In many smaller countries and developing economies, local firms most frequently do not have access to high–end knowledge and, therefore, innovation is often dependent on the availability of a multinational corporation (MNC) in the country.
- Successful innovation strategies cannot afford “stop-and-go” approaches. If R&D expenses or incentives to innovators are not sustained, the progress accumulated in previous years can vanish quickly.
- Although empirical economic work has gone a long way towards supporting international trade as a win-win strategy and in constructing appropriate indicators, the same is not true for global innovation. Countries are regularly perceived as “contenders rather than collaborators” and in some cases, “techno-nationalist policies” erecting barriers to different knowledge flows have become a popular endeavor.
- Innovation is becoming more global but significant gaps remain. The majority of activities are still concentrated in high-income economies and selected middle-income economies such as Brazil, China, India, and South Africa.
- There is no exact recipe to create sound innovation systems, entrepreneurial incentives and an environment for innovation. Absolute spending on R&D or absolute figures on the number of domestic researchers, or the number of science and engineering graduates, or scientific publications do not guarantee a successful innovation system. One solution to overcome a purely quantitative approach is to look at the quality of innovation, as high-quality innovation inputs and outputs are often the reflection of other factors that make an innovation ecosystem healthy, vibrant, and productive.

2. BACKGROUND

The general objective of the project was to develop the first *Innovation and Technology Sector Study* together with the study methodology, in order to provide the Government of Georgia (GoG), donor organizations, investors, the business sector and academia with a replicable study instrument for the innovation and technology sector in the country. The study report is accompanied by the directory of legal entities from the innovation and technology sector.

Development of the annual *Innovation and Technology Sector Study* began with the primary goal to build the framework and capture multidimensional, mutually reinforcing trends and constraints having a global as well as national focus in the innovation and technology sector. It also provides information on the level and resources of infrastructure, education and R&D, as well as, on the overall environment; scope and scale of past, present and future innovations demand and supply. Georgia's progress in global rankings and potential for future improvement is also analyzed.

3. METHODOLOGY

Collection of quantitative and qualitative data was conducted by using following approaches:

- Structured interviews with key informants and experts of the ICT and innovation sectors in Georgia;
- Data requests made to key sources of information;
- Desk review of existing data sources in Georgia.

The chapters below provide a summary of results identified during the research.

Overall, 46 face to face interviews were conducted with representatives of both the public and private sector.

Some legal and statistical documents were requested, which also will be analyzed and presented in the draft report. Private and public sector representatives were met with in order to gain more precise information about each sector.

The information acquired is summed up and presented through five dimensions – environment, infrastructure, research and development (R&D), knowledge and education and access to finance. Besides the five dimensions, some figures of ICT sector volume and values are provided.

The adapted questionnaire, designed to collect information from technology companies about their products, development phase, access to finance, marketing, R&D, etc. was developed by PMO (see Appendix A).

4. COUNTRY OVERVIEW

The economic, political and social environment of the country, as well as government strategies and expected development trends are an important basis for national development and its efficient integration into the global economy.

In 2014, the GoG developed and adopted *Social-Economic Development Strategy - Georgia 2020*, according to which the vision for national development entails three main principles:

- Ensuring fast and efficient economic growth driven by real (production) sector of the economy;
- Implementation of economic policies that facilitate inclusive economic growth through the universal involvement of various segments of the population;
- Rational use of natural resources, ensuring environmental safety and sustainability.

The *Strategy* identified weak competitiveness of the private sector, weak development of human capital and limited access to finance as outstanding challenges to the economic development of the country. The Strategy then elaborates on ways to respond to these challenges.

According to the *Strategy*, Georgia's economic growth model is based on the following main concepts:

- Private sector driven growth;
- Efficient government;
- Equal opportunities for businesses;
- State investment policy facilitating growth;
- Free competition;
- Openness to trade.

Georgia has signed the EU-Georgia AA, with the DCFTA as an integral aspect. Through this, Georgia aims at economic integration of the country into the EU's internal market. The process entails gradually bringing Georgian legislation and systems closer to the EU's relevant regulations and systems. Correspondingly, this creates new potential for Georgia's goods and services to enter the EU's internal market, and new export and investment opportunities in the country.

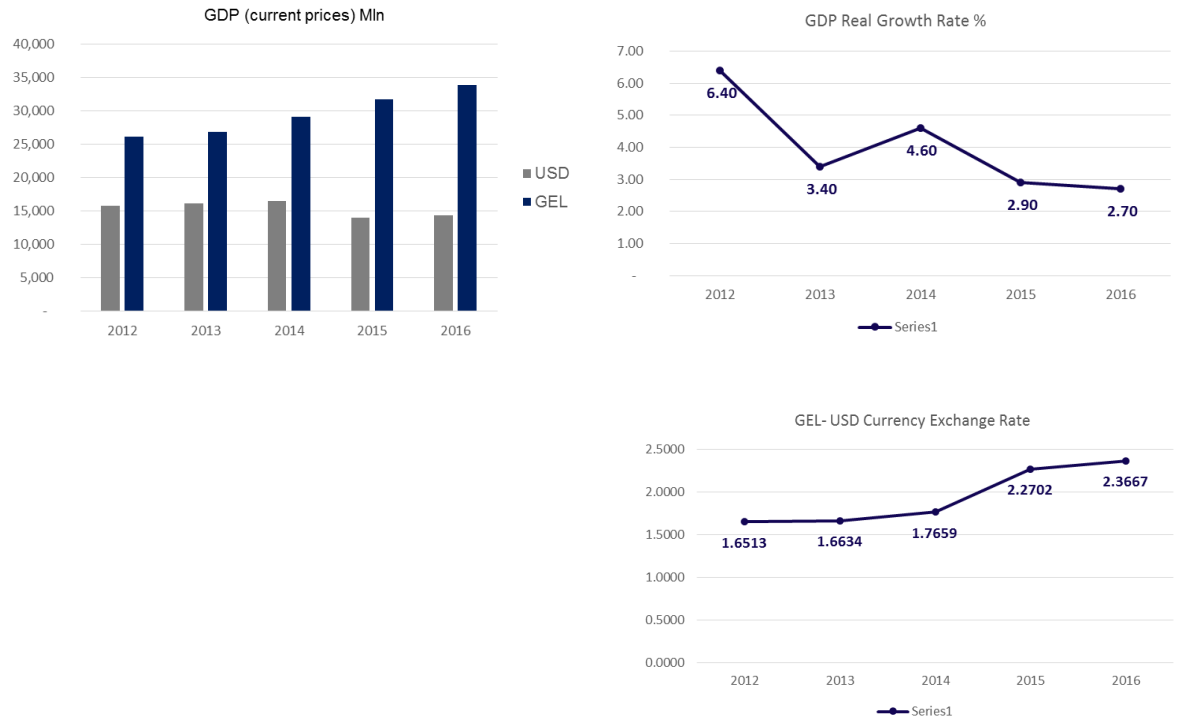
It is important to note that *Georgia 2020* also clearly believes that the level of innovation and technological sophistication shall increase in the country. ICT sector development is regarded as one of the cornerstones of Georgia's social and economic development. Its efficient integration into the global economy is of great importance.

MAIN FIGURES OF THE COUNTRY'S ECONOMIC AND SOCIAL STATE

The country's economic development has been moderate during the last five years. In 2016, GDP was US dollar (USD) 14.333 billion and showed 2.7% real growth.

The nominal value of gross domestic product (GDP) in GEL grew every year through 2012-2016, however the GDP depicted in USD decreased in 2015 and 2016. This was attributed to GEL-USD exchange rate fluctuations and 50% devaluation of GEL in 2015 over 2014 and 10% in 2016 over 2015.

Figure 1: General Economic Factors



Source: Geostat; NBG

According to Geostat, Georgia's population stands at 3.7 million in 2017. The GDP per capita in 2016 was USD 3,853 and the growth rate stood at 2% in 2016. Out of the whole population, by the end of 2016, the workforce was 1.998 million people (54% of population), whereas 1,763 million were engaged in economic activity (47% of population). The unemployment rate stood at 12%.

Georgia has made impressive progress in improving its business climate in the last decade and according to the *WB Ease of Doing Business* report, in 2016, Georgia was rated 6th among 189 countries in ease of starting a new business and 3rd in registering a property.

According to the *Rule of Law Index*, based on The World Justice Project 2015, Georgia was rated 29th among 102 countries, surpassing a number of Eastern European countries such as Croatia, Bulgaria, Moldova, Ukraine, in addition to Russia and Turkey.

In the Economic Freedom Index performed by the Heritage Foundation 2016, Georgia ranked 23th out of 178 countries.

Georgia is also regarded as a country having a very low level of corruption that creates a favorable climate for business development.

Figure 2: Snapshot 2016

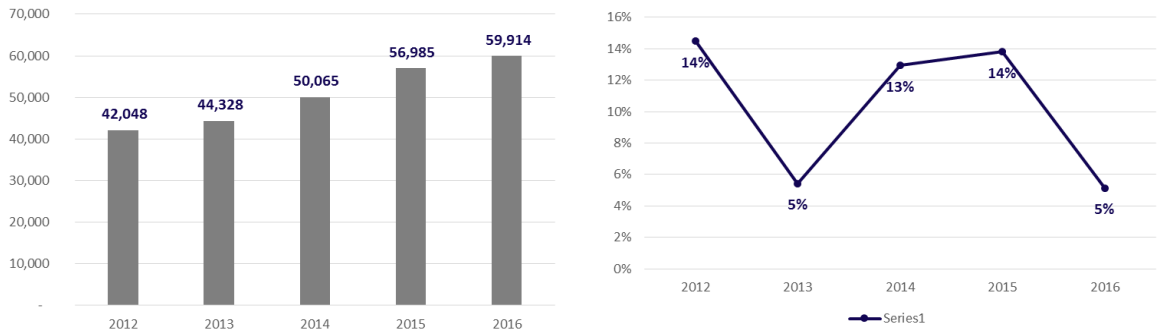
Population, million (mln) people	**3,7**
GDP, mln USD	14,333
GDP per capita, USD	3,853
GDP growth rate	2.7%
Average annual inflation	2.1%
Unemployment rate	12%

Source: Geostat; NBG

LEADING SECTORS OF THE ECONOMY OF GEORGIA

Business turnover volume has been growing stably from 2012 to 2016 and made a 9% compounded annual growth rate (CAGR).

Figure 3: Business Turnover GEL mln (Left) and Business Turnover Growth Rate (Right)

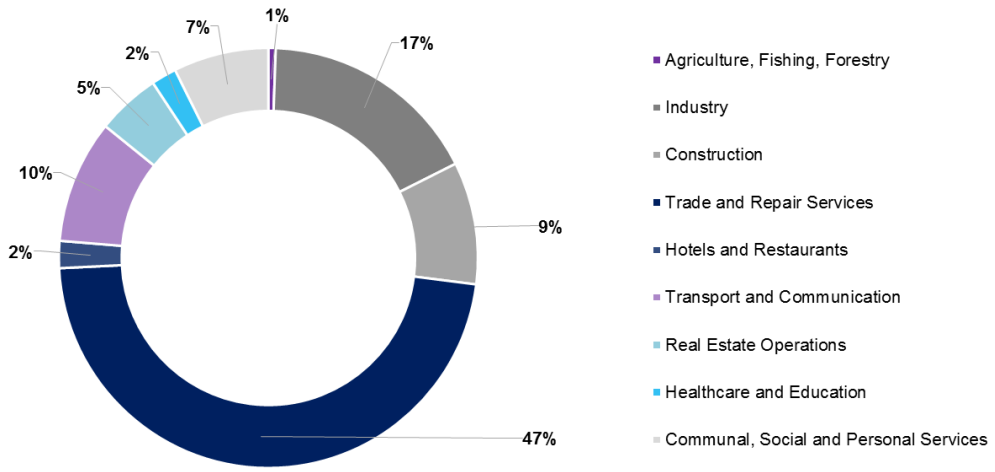


Source: Geostat; NBG

The official business registry of Georgia counts more than 650,000 registered businesses, out of which around 168,000 (25%) are active. Among active businesses, the area of activity of 27% of the companies is unknown to official statistics. However, within the available information, the highest share of registered active businesses is engaged in trade and repair services (36%), followed by real estate operations (8%), industry (7%) and transport and communications (5%). The other sectors stand below 5% out of the total number of active businesses.

In terms of volumes, as of 2016, 47% of business turnover was generated by businesses engaged in trade and repair services, followed by 17% of turnover generated by industry and 10% by transport and communications.

Figure 4: Business Turnover, 2016



Source:Geostat

During the last five years the highest turnover in terms of CAGR has been observed in the following business sectors – utilities, social and personal services 35%, education 17%, real estate operations 15%, hotels and restaurants 11%, agriculture, forestry and fishing - 13%.

It is also important to note that the largest sectors by turnover also showed 2012-2016 growth, making CAGR of 8% in trade and repair services, 8% industry and 6% transport and communication.

A. Country Economic Development – Innovation and Technologies

Georgia 2020

The *Socio Economic Development Strategy - Georgia 2020*, underlines the development of the innovation and technology sector as one of the cornerstones of sustainable economic development and global integration of the country.

The government developed Georgia's innovation strategy draft document – *Innovative Georgia 2020*, with plans to revise and adopt it in September 2017. Already in 2014, the GoG founded GITA under the MoESD, with the aim to develop and coordinate innovation in the country. In 2015, the Research and Innovation Council (RIC) was established and assigned a strategic coordinator function for the country's innovation policies.

In order to develop the innovation and technology sector, the *Georgia 2020* strategy focuses on implementation of the following five key directions:

1. Improving access to finance for R&D and support in commercialization;
2. Developing infrastructure necessary for innovation;
3. Strengthening protection of intellectual rights;
4. Supporting wide utilization of information and communication technologies in the economy;
5. Attracting foreign direct investments (FDI) in innovation and technology.

Four Point Plan

Another document that can promote the development of the technology and innovation sector is the government's 4-point reform plan that focuses on carrying out economic, educational, spatial and governance reforms.

The economic reform part of the document focuses on tax reforms and also the encouragement of start-ups through the introduction of financing mechanisms.

Education reform includes three main focuses: 1) the development of labor-market oriented professions by strengthening professional education; 2) directing financing opportunities of the most in-demand professions to higher education institutions; and 3) teacher qualification improvement in secondary education.

Spatial reform focuses on the development of the transportation network and related infrastructure throughout Georgia, while governance reform targets increasing effectiveness and transparency of government agencies.

Global Rankings

The country plans to improve its position in global indexes. The following positions in global indexes are planned to be attained by 2017:

- GCI at 58th position;
- GII at 65th position;
- GITR at 58th position.

Other Indicators

Other important indicators to represent the ICT sector in the country as of June 2016 are presented below:

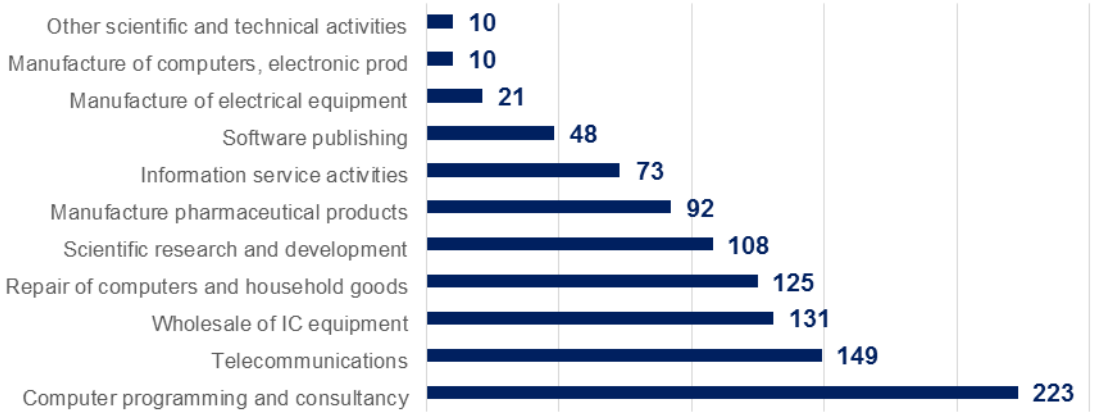
- Share of households with fixed internet access in Georgia stood at 71% for the whole country, with 80% in the urban areas and 57% in rural areas;
- 65% of households had computer access, 78% in urban and 47% in rural areas. The share of the population aged six and above that used a computer within last three months stood at 58%, while 2% had used a computer earlier than last three months and 40% have never used computer at all;
- 79% of Georgia's population aged six and above owns mobile phones, standing at 81% in urban and 77% in rural areas.

5. SECTOR ANALYSIS

MARKET

The technology market is diverse in terms of sub sectors with up to 1000 economically active organizations operating in the market. The total volume of the market based on Geostat is GEL 1.869 billion in 2015. The distribution of companies in terms of sub-sectors are presented below:

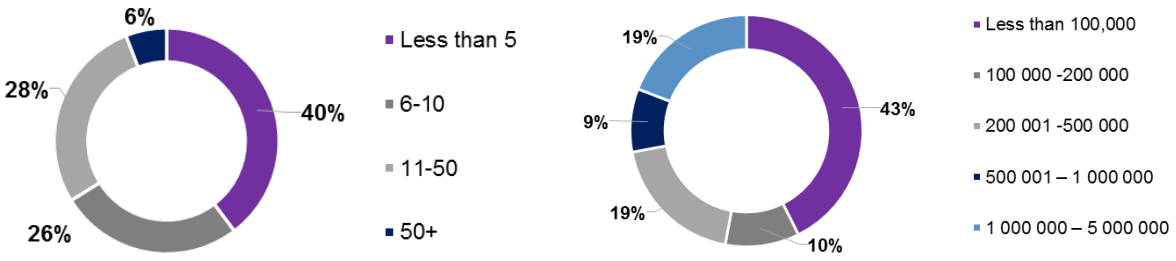
Figure 5: Sector Distribution by Activities, 2016



Source: Geostat

Based on the survey of technology firms conducted by PMO, the market is also diversified by the number of employees and turnover size. The figure below depicts the allocation of economically active companies in the sector:

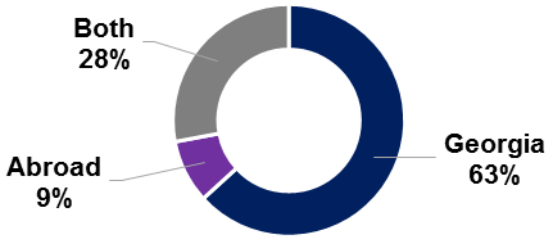
Figure 6: Size and Revenue Categorization



Source: Technology Firms Survey, 2017

The technology sector is also developed in terms of international business relations. Thirty-seven percent of respondents interviewed state that they are carrying out business activities outside of Georgia.

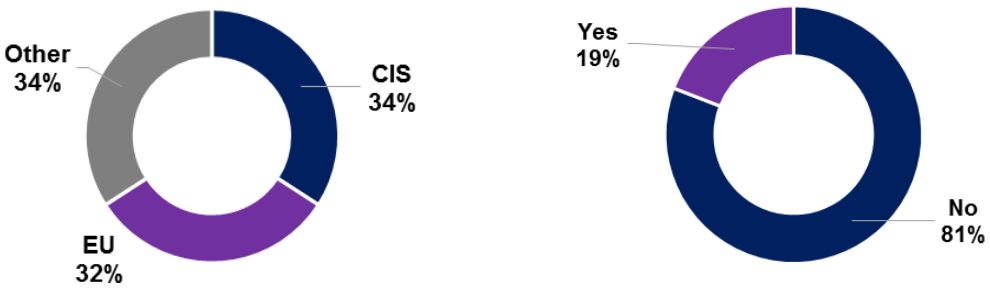
Figure 7: Geographic Area of Business Activity



Source: Technology Firms Survey, 2017

Exporting activity is not high and amounts to 19% of companies interviewed. In terms of geographic area, shares are almost evenly distributed between EU and CIS countries.

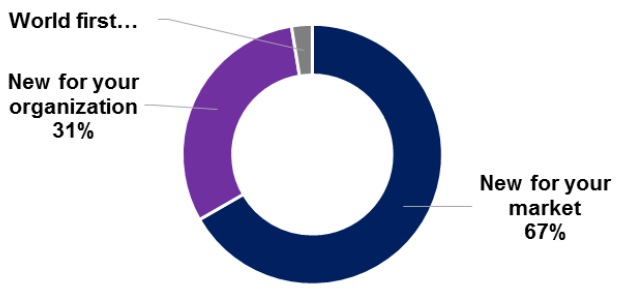
Figure 8: Exporting Activities



Source: Technology Firms Survey, 2017

Level of innovation in the sector is high compared to other sectors. Fifty-seven percent of companies interviewed have introduced new or significantly improved technology in the last three years. As expected, only 2% of innovations introduced are classified as world's first.

Figure 9: Innovation Types



Source: Technology Firms Survey, 2017

HIGH TECH MARKET

Generally, the high-tech industry is underdeveloped, with no current activity in many subsectors. However, there are some promising activities that are strengthening gradually. Overall, high-tech market value accounted to GEL 191.8 million in 2015, which is 10% more than 2014 in absolute value of Georgian Lari. Moreover, local currency deterioration towards foreign currency slightly diminished the difference, without which the effect would have been larger. In high-tech, the main subsector is biotechnology, with a local production of 143 million pharmaceutical products. The automotive and aviation sub-sectors are also worth mentioning with approximately GEL 25 million in export value for each in 2015. Unfortunately, the value of the automotive sector is not fully visible due to confidentiality reasons of the market players. Therefore, the high-tech sector volume is actually larger then results provided. It should be mentioned that the output of several sub-sectors (computer engineering and electrical and electronic engineering) overlap with the ICT sector figures. Therefore, data on the ICT market is included in this report.

Unfortunately, most sub-sectors, namely, nanotechnology, nuclear physics, bioinformatics, artificial intelligence (AI), robotics and semiconductors show zero results for 2014-2016.

The following table summarizes the main figures of the high tech sector. The detailed reviews of each sub-sector are represented below:

Figure 10: High-Tech Market Volume

Description	unit	2014	2015	2016
Biotechnology				
Local production of pharmaceuticals	mln GEL	136.7	142.8	-
Export of pharmaceuticals	mln GEL	80.8	63.1	67.2
Automotive and Aerospace				
Export of motor vehicles and parts	mln GEL	35.6	24.9	23.6
Export of aircrafts, space craft and parts	mln GEL	1.9	24.1	3.5
Total Sector Values	**mln GEL**	**174.1**	**191.8**	

Source: Geostat, United Nations (UN) Comtrade

Below is a description of each subsector based on primary and desk research.

NANOTECHNOLOGY

Development of nanoscience and technology can contribute to the economy as it is used in the development of novel materials, devices and products in almost every sector of the economy.

Despite being included in GITA's high-tech startup funding priorities, Georgia's nanotechnology sector is underdeveloped. There is no current activity on the market in terms of production, local sale, import or export. In terms of scientific research, there are several institutions that work in nanotechnology, but advancement to the commercialization stage is not visible.

The reasons behind it can be poor funding and a lack of encouragement of the sector, as well as the high costs of piloting the research, as the equipment for developing nano products are expensive. Furthermore, during research, no significant expertise has been found in Georgia in this sphere.

In terms of potential in the near future, the EU research program Horizon 2020, where Georgia is an associate member, encourages its members to embrace smart specialization in their national strategies. This program could be good ground and opportunity for researchers that might incentivize activity in this sector.

COMPUTER ENGINEERING

In terms of computer engineering, there are insignificant activities on the market. According to Geostat, in the broad category of manufacturing of computers, electronic and optical products, Georgia has issued GEL 5.1 million products in 2015, which is almost 100% growth from the previous year (GEL 2.6 million).

In terms of prototyping, only one individual entrepreneur has been found working on boards, with an average annual production of GEL 50,000. The enterprise is comprised of three employees only. According to interviews conducted with this entrepreneur, by his opinion and experience, Georgia does not have the potential to develop board production further from prototyping, because China has unbeatable pricing and technologic excellence. Moreover, according to his statement, they are making only prototypes and mass production of that prototype takes place in China due to lower cost and larger capacity.

Other technological companies located in the Mioni cluster (region of Tbilisi), such as Azry, are also working on this direction, but still the activity is minor.

ROBOTICS

In terms of robotics there is no current activity on the market, unless considering some elements of robotics which are incorporated in educational programs, but this could not be seen as solid ground for the development of this sub-sector.

In terms of international trade, activity is very low and unsystematic. According to data, it is assumed that goods imported and exported are for personal and/or scientific research use only.

Figure 11: Industrial Robots

Year	Trade Flow	Trade Value	Quantity
2013	Import	$1,851	2
2014	Import	$6,780	1
2014	Export	$1,000	1
2015	Import	$32,496	7
2016	Import	$39,632	1

Source: UN Comtrade

BIOTECHNOLOGY AND BIOINFORMATICS

In terms of biotechnology, there are certain genuine activities that have a potential of commercialization, but still the market is immature.

The main commercial application of Biotechnology in Georgia is Pharmaceuticals. According to Geostat, manufacturing of basic pharmaceutical products and pharmaceutical preparations accounted to GEL 142.8 million in 2015.

In terms of international trade, on average half of the local production is exported. The main importers of Georgian pharmaceutical products are Uzbekistan and Azerbaijan.

Figure 12: Pharmaceutical Market (GEL)

Biotechnology		2014	2015	2016
Local production of pharmaceuticals	GEL	136,665,907	142,779,425	-
Export of pharmaceuticals	GEL	80,828,373	63,084,372	67,239,489

Source: Geostat, UN Comtrade

The bulk of the pharmaceutical sector production accounts for licensed generic products. There are only a handful of companies that could be considered as spin-offs of research institutions that produce unique medications and have a growth record and potential.

One of the most successful case in terms of biotechnology is Eliava Institute, which is extending activities in several EU countries.

AUTOMOTIVE AND AEROSPACE

Georgia has two main producers, Science and Technology Centre (STC) Delta, under the Ministry of Defense of Georgia (MoD), which produces a variety of armored vehicles and aircrafts, including unmanned aerial vehicle (UAV) helicopters (drones), and Tbilisi Aircraft Manufacturing (TAM) which produces military and civil aircrafts and parts. The table below (Figure 13) reflects the availability of high-value international contracts for TAM in 2015 (Azerbaijan) that has been phased out in 2016.

There is a major project in development that shall influence the aerospace industry sector's performance. The state-owned Partnership Fund has invested USD 85 million in construction of a new composite material plant for civil aviation. It is a joint venture between the Israeli electronics firm Elbit Systems and the Partnership Fund. The plant is under construction and will be fully operational by 2018. Its core competencies will include: composites parts for aircrafts; composites aero structure sub-assemblies; and assemblies for various commercial aerospace applications. Most of the products produced are to be exported.

In terms of motor vehicles, Georgia has exported GEL 23.6 million vehicles in 2016. The main importers are Azerbaijan, Armenia and United Arab Emirates.

The aviation market is export driven with GEL 3.5 million in 2016. Azerbaijan is also a leading importer in the aviation market.

Figure 13: Aviation Market Exporting Activities

Export		2014	2015	2016
Motor vehicles and parts	GEL	35,567,115	24,941,651	23,616,061
Aircrafts, space craft and parts	GEL	1,891,625	24,116,897	3,507,413

Source: UN Comtrade

It should be mentioned that information requested from Delta was rejected due to confidentiality reasons, therefore the value of the sector is underestimated and is projected to be larger in reality.

ELECTRICAL AND ELECTRONIC ENGINEERING

Engineering, manufacturing of electrical components and equipment amounted to GEL 61 million in 2015. Regarding international trade, Georgia exported GEL 43 million products. The main importers are Azerbaijan and Armenia. Even though these figures are part of the medium high-tech category, it still can be seen as a precondition for the development of high tech production. At this time, this data is included in ICT market volume.

Figure 14 – Sector Volume 2014-2016

Electrical and Electronic Engineering		2014	2015	2016
Manufacture of Electrical Components and Machinery	GEL	100,207,096	61,295,596	-
Export of Electronic Equipment	GEL	13,039,483	42,956,660	29,465,421

Source: Geostat, UN Comtrade

OTHER HIGH TECH SUB-SECTORS

There is no current activity in the sub-sectors of nuclear physics, semiconductors and artificial intelligence. However, there is some activity at the institutional level that can lead to the commercialization of products in the future.

ICT MARKET

There are longstanding challenges in the systemic collection and analysis of the data related to the ICT market and ICT companies in Georgia. The quantitative aggregated sector data concerning turnover and development trends is not gathered by Geostat separately from transport and communications. The only subsector where comprehensive historical and up-to-date data is available is telecommunications, regulated by the Georgian National Communications Commission (GNCC).

The study employed data available on Comtrade - a United Nations International Trade Statistics Database, and Geostat data requests regarding volumes of pre-selected (according to NACE 2 classification) industry codes related to high-tech and ICT, desk research and assessments of industry subsector leading companies.

According to interviews in both the private and public sector, as well as analysis of official data and documents, the total volume of the ICT market accounted for GEL 1.68 billion in 2015 and showed 7% growth from the previous year. However, its share in GDP remained almost the same in 2015 at 5.3%. The chart below summarizes the major categories of the ICT sector. Each of the sub-sectors is described separately in this section of the document.

Figure 15: Summary Chart

Description	2014	2015
Wholesale of IC Equipment		
Wholesale of IC equipment	514,409,104	585,316,477
Software Licensing		
Licensed software	4856321	4,761,904
Computer Programming and Data Processing		
Computer programming, consultancy and related activities	89,478,873	144,553,840
Information service activities	13,606,015	25,897,134
Repair of Computers		
Repair of computers and personal and household goods	47,473,567	31,260,811
Manufacturing		
Manufacture of computer, electronic and optical products	2,572,941	5,085,646
Manufacture of electrical components and machinery	100,207,096	61,295,596
Telecommunication		
Mobile	455,019,843	479,387,701
Fixed-Line	70,436,800	57,051,268
Internet	160,001,990	185,161,408
Television	94,609,174	84,963,182
Radio	9,737,697	13,241,577
Total	**1,562,409,420**	**1,677,976,543**

Source: Geostat, GNCC

MANUFACTURING

Manufacturing of IC equipment accounts for GEL 66.3 million in 2015. In terms of manufacturing of computers, there are several assembly lines producing approximately 10,000 personal computers (PCs) annually. However, the number is steadily decreasing, reflecting the global trend of shrinking in desktop PC sales.

In terms of production, there are 52 economically active entities.

Figure 16: Manufacturing 2014-2015, GEL

Manufacturing	2014	2015
Manufacture of computer, electronic and optical products	2,572,941	5,085,646
Manufacture of electrical components and machinery	100,207,096	61,295,596

Source: Geostat

WHOLESALE OF IC EQUIPMENTS

The wholesale market of IC equipment increased by 14% from 2014 and reached GEL 585 million in 2015. This figure includes wholesale of computers, computer peripheral equipment, software, electronic and telecommunications equipment and parts.

Figure 17: Wholesale of IC Equipment, 2014-2015

Wholesale of IC Equipment	2014	2015
Wholesale of information equipment	514,409,104	585,316,477

Source: Geostat

According to Geostat, there are 148 active organizations that engage in wholesale of IC equipment. The leading companies in this sub-sector are UGT, Alta and Orient-Logic.

SOFTWARE DEVELOPMENT

Software licensing has decreased from a 95% rate of unlicensed software installations in 2009 to 84% in 2015. According to a BSA Software Alliance survey, the total value of licensed software accounted for GEL 4.7 million in 2015. The major share of licensing revenue comes from the public sector and large private organizations. Licensing in the retail sector is less than 10%.

The main players in local software development are Alta Software, Azry, Apex, Lemondo, Leavingstone and ITDC including mobile and web development. Georgian companies in this sub-sector report their activities under computer programming and data processing code, and there are only two entities that declare software publishing as their main activity in the Geostat database.

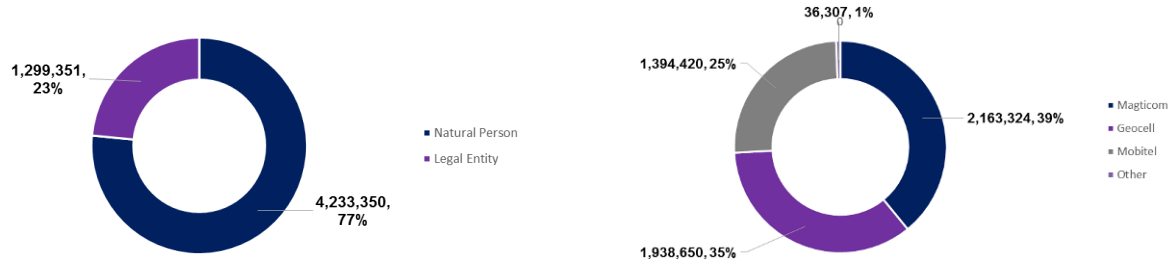
TELECOMMUNICATIONS

The telecommunications sector is the most developed sub-sector in ICT. Telecom covers several categories including mobile and fixed-line phone, internet, TV and radio broadcasting. Each category is discussed separately below.

Mobile service users, based on active SIM cards, are growing at an annual compounded growth rate of 2% during the period of 2012 -2016, reaching 5.5 million mobile service users in 2016. Almost 30% of users are legal entities.

In terms of companies, Magticom is the market leader with a 39% share, followed by Geocell and Mobitel with 35% and 25% respectively. The chart below depicts the distribution of users based on user types and companies.

Figure 18: Distribution of Users by Type (Left) and Distribution of Users by Companies (Right), 2016



Source: GNCC

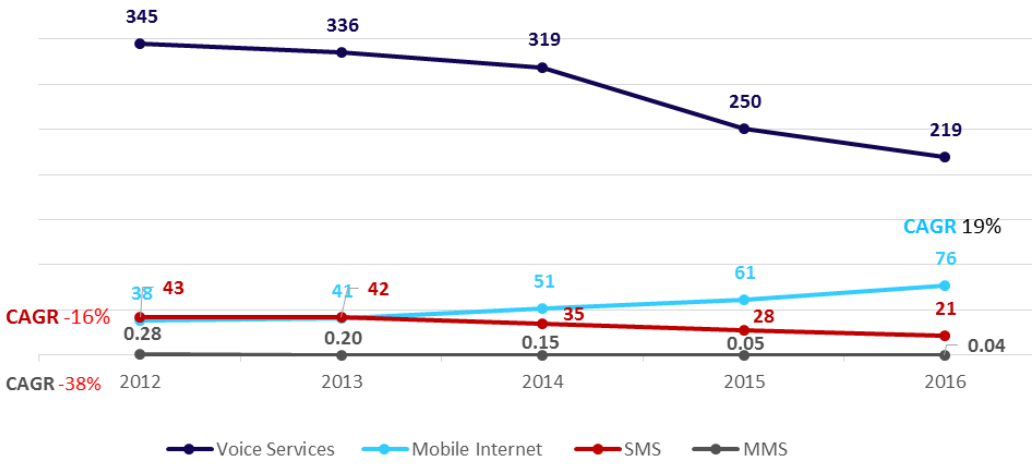
The main mobile services are divided into three categories: voice services, internet services and SMS/MMS services. In terms of revenue, voice and SMS/MMS services are on a decline while internet services are increasing.

Voice services declined at a compounded rate of -11%, going from GEL 345 million to GEL 219 million during the period 2012 to 2016.

SMS/MMS services are also showing a downturn with a negative CAGR of -16% for SMS and -38% for MMS services.

In contrast to falling trends for mobile services, internet revenue is growing at a 19% CAGR from GEL 38 million to GEL 76 million during the period of 2012 to 2016.

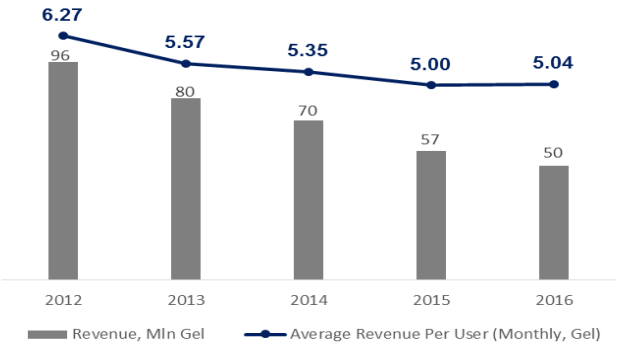
Figure 19: Revenue by Mobile Services, mln GEL



Source: GNCC

Fixed-line phone use is on the decline, going from 1.2 million users in 2012 to 831,000 users in 2016. Revenues are decreasing commensurately. In 2016, the average revenue per user amounted to GEL 5.04 monthly. The total revenue decreased to GEL 50 million. With the development of mobile phone services, fixed-line phone usage is expected to continue a declining trend. The chart below depicts the fixed-line phone revenue trend during the period 2012-2016.

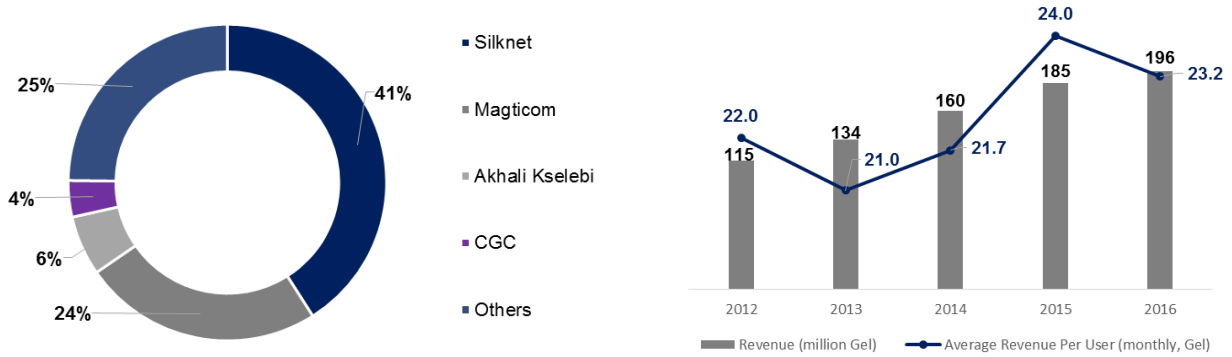
Figure 20: Fixed-Line Phone Revenue



Source: GNCC

Internet usage revenue shows an increasing trend growing by 14% CAGR during 2012-2016. The market leader is Silknet, with a 41% share, followed by Magticom, which has merged with Caucasus Online, at 24%. The chart below presents the allocation of market shares between companies and internet revenue trends during a five-year period.

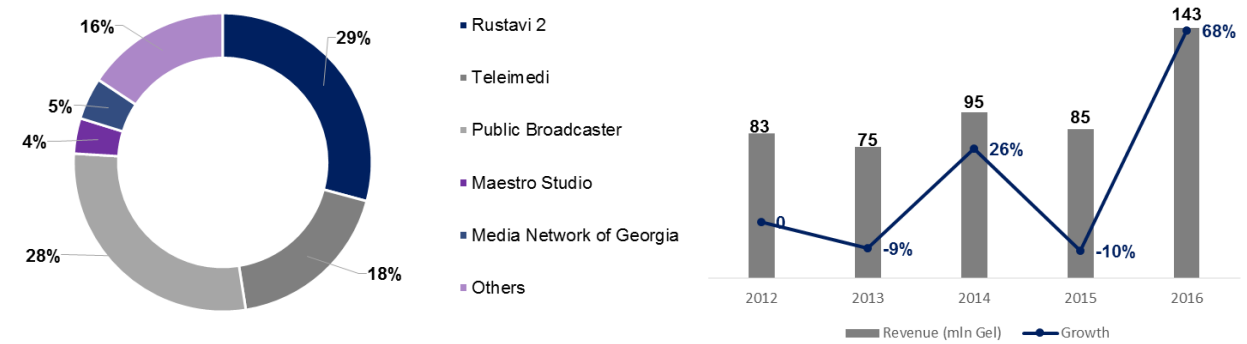
Figure 21: Internet Usage by Companies (Left) and Internet Revenue (Right)



Source: GNCC

Television broadcasting is one of the growing sub-sector in Telecom, with a 15% CAGR, reaching GEL 143 million in 2016. Twenty-nine percent of sub-sector revenue is allocated to Rustavi 2 followed by Public Broadcaster and Teleimedi with 28% and 18% respectively.

Figure 22: Television Revenue and Distribution by Companies

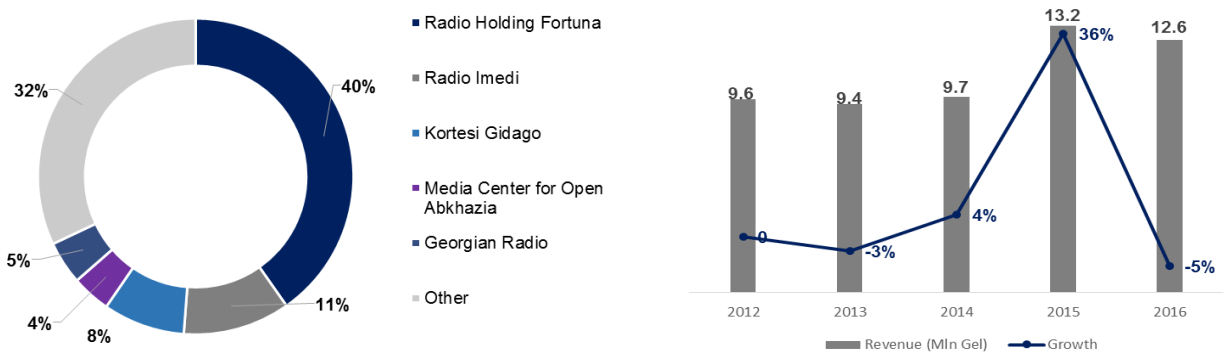


Source: GNCC

Despite a sharp drop of revenue by -5% in 2016, radio broadcasting sub-sector is showing an increasing trend in a five years' period, with a CAGR of 7%. The main market players are Radio Holding Fortuna, a group of four radio stations, with a market share of 40% and Radio Imedi with a 11% share. Five percent is allocated to Georgian Radio and 4% to Media Center for Open Abkhazia. The rest of the 32% are distributed between 33 smaller radio stations.

Revenue trends and company shares are shown in the chart below.

Figure 23: Radio Broadcasting Revenue by Companies, 2016 (Left) and Radio Broadcasting Revenue by years (Right)



Source: GNCC

COMPUTER PROGRAMMING AND DATA PROCESSING

According to Geostat, the computer programming sub-sector has increased significantly, by showing a 60% increase in 2015 reaching GEL 144 million. There are 272 legal entities working in this field out of which 29 entities are working solely on computer programming.

Figure 24: Computer Programming and Data Processing, 2014-2015

Computer Programming and Data Processing	2014	2015
Computer programming, consultancy and related activities	89,478,873	144,553,840

Source: Geostat

Data processing is a relatively small subsector and it is combined with other informational service activities[1]. Although the sub-sector is small it more than doubled in 2015, compared to previous year reaching GEL 25.9 million.

According to Geostat, there are 68 economically active entities working on data processing activities.

REPAIR OF COMPUTERS

The repair sector in Georgia is relatively small with a revenue of GEL 31 million in 2015.

The repair sector is very diverse in Georgia with many small players. According to Geostat, there are 238 economically active entities in Georgia working in this field. Existence of too many players without defined leaders makes it unstable and volatile. A drop of revenue by 66% in 2015 is also an indication of an immature sector.

[1] According to NACE Rev.2 classification figure includes revenue derived from data processing, hosting and related activities; web portals; News agency activities and other information service activities n.e.c.

Figure 25: Repair of Computers Revenue (GEL)

Repair of Computers	2014	2015
Repair of computers and personal and household goods	47,473,567	31,260,811

Source: Geostat

KNOWLEDGE AND EDUCATION

As the interconnected world moves towards an ubiquitous knowledge economy, STEM education has become a cornerstone of public policy makers' attention in regards to future workforce development. It is believed that the high-tech sector and knowledge-intensive services will require a growing number of professionals able to quickly adapt to dynamically changing environments. Acknowledging the advancement of education systems in certain Asian countries, like South Korea and Singapore, as demonstrated by international assessment tests (Program for International Student Assessment (PISA) and Trends in International Mathematics and Science Study (TIMMS)), there is a global effort to make STEM disciplines more attractive to younger generations.

Georgia joined this trend in 2010. In Georgia, the Ministry of Education and Science (MoES) is a major stakeholder, but several important international programs should also be considered.

One example is Millennium Challenge Account (MCA) Georgia which has focused solely on supporting education for its second compact. The constraints analysis performed in 2011 identified several key challenges to tackle. One of them is an inefficient innovation system. As the constraint analysis states:

"The main reason for low level of innovation is the lack of qualified labor force, which is a binding constraint for growth in Georgia." Currently MCA Georgia supports several initiatives in IT and STEM education on all levels: secondary, technical vocational education and training (TVET), and higher education.

HIGHER EDUCATION

The science and engineering disciplines have been given priority in the state programs of university grants, providing a higher share of government funding for successful applicants. That however does not mean that young people are naturally capable in hard or life sciences. The full evaluation of the quality of HEI programs in STEM is beyond the scope of the survey. But IT and engineering education, which are believed to catalyze the innovation development process, have been studied.

IT Education

The study performed by the Texas International Education Consortium (TIEC) reported that "Georgia's public colleges and universities have difficulties in producing graduates who are able to meet the needs and expectations of private and public sector employers." [2]

That statement could be particularly attributed to IT education. It is commonly stated that HEI or VET institutions in Georgia also do not provide sufficient cadres to satisfy business demand. The Economic Prosperity Initiative (EPI) 2011 study of IT education in Georgia revealed the mismatch of HEI graduates' knowledge level and the ICT market demand. That trend is confirmed by the present study. However, the IT companies' representatives also acknowledge that the level of IT professionals has been going up during last five years. That could be partially caused by increased availability of online resources and e-learning opportunities that enables IT professionals with necessary skills for career growth. Launching GITA training

[2] Texas International Education Consortium (TIEC) 2011

programs also contributed to increasing interest in IT specializations, having in mind its free offerings and initial involvement of highly qualified trainers.

The first step and the largest supply channel to the pool of IT specialists is a bachelor program. Currently, there are a number of BS level IT programs in 24 HEIs (universities, teaching universities and colleges).

There were 5,275 students enrolled in BS programs related to IT in 2016, almost 90% of them in Tbilisi. The number of MS students was 887, and PhD level students – 274.

Figure 26: Student Enrollment quantities by degree and program types, 2016

Program	Number of BS Students	Number of MS Students	Number of PhD Students
Informatics	3831	541	147
Information Technologies	153	61	-
Information Technology and Computer Modelling	-	27	-
Information Technology Management	-	36	-
Information Technology and Flight Management Information Systems	55	9	
Information Systems	-	41	-
Computer Science /Computer Technologies, Computing	915	112	71
Computer Science and Math	235	-	-
Business Informatics	-	22	-
Electronic Business, Information Technologies for Electronic Business	-	6	-
Computer Systems and Networks	31	5	-
Math Modelling and Computer Science	-	-	56
Program Engineering	-	18	-
Programming and Web-Development	10	-	-
Media Engineering	-	9	-
Computer Engineering	44	-	-
Data Processing and Management Automated Systems	1	-	-

Source: National Center for Education Quality Enhancement (EQE)

The annual average number of graduates is about 1,100.

Whilst the BS program in informatics at Georgian Technical University (GTU) has the largest share of students (more than 3,000), several smaller ones do not have active enrollments. There are observations that the GTU program loosely controls students' attendance and allows a majority of BS students to work in parallel to studies.

There is no qualification framework approved by EQE center for IT professions.

Career development and advice centers are moderately active in the system of higher education. Successful BA students are being selected for entry-level jobs in a number of companies, however most companies tend to walk the apprentices through an in-house or ad-hoc training process.

It should be noted that IT curriculum needs to be elastic to respond to frequently changing products and trends of the global IT industry, but that is a challenging task for the often conservative decision-making environments in HEIs.

Mobile internet and cloud technology industries along with big data processing and analytics are considered as top-drivers of the global job market by the *World Economic Forum 2016 The Future of Jobs and Skills* report. These trends are poorly reflected in the current offerings by Georgian HEI programs related to IT. The IT industry is more flexible in at least keeping-up with the mobile apps and services development framework.

Considering the nature of the fast-developing industry, the HEI programs need to better consider the recent industry trends, not only globally but domestically. For example, despite the huge growth of mobile penetration (up to 148%) and mobile internet (up to 50%), HEIs do not provide relevant and sufficient academic programs.

Among the positive recent developments, two newly established HEIsshould be mentioned.

The first is SDSU's program in three Georgian Universities supported by MCA Georgia, which was launched in 2015 to address the challenges and gaps in STEM education in Georgia. It does not have its facilities yet, and utilizes teaching spaces in three leading Georgian Universities: Tbilisi State University, Ilia State University and Georgian Technical University. It offers dual diplomas to students and through sponsorship and grants and manages to attract the best academic achievers or winners of science contests. It offers programs in computer science and computer engineering, electrical engineering and biochemistry. Programs in civil engineering and construction engineering shall be launched in 2017.

Another newcomer is the newly established Business and Technology University (BTU). It became operational in 2016. It focuses on advancing academic knowledge and practical skills of students in digital business. BTU offers an IT program at the BA level (both a major and a minor), a business administration and modern technologies program at the MA level, along with programs in business administration. BTU is positioning itself as a Silicon Valley equivalent in Tbilisi and provides opportunities to develop digital business ideas through specialized training programs. The offering includes a business incubator and accelerator, IT academy, research center, virtual reality (VR) lab and other facilities. BTU has established connections with more than 100 employers and emphasizes the prospects of the global employability of its graduates. The list includes Check Point, Symantec/Veritas, ESET, Hewlett Packard Enterprise, Prodware, IBM, ORACLE, Linux, VMware, EMC2, Fortinet, Extreme, HP and Google Development Group.

Another important recent initiative is the creation of a technology oriented university campus near Kutaisi. The partnership with Technical University of Munich (TUM) shall contribute to the development of programs and quality management framework. The project envisages the creation of an innovation center, clusters hub and applied research centre with potential for commercialization.

STEM and Innovation Education

There are currently 15,955 BS students and 1,918 MS students enrolled in science and engineering programs in Georgia (including the IT specializations mentioned above). The overall quota of STEM programs announced by HEIs for 2017 is just above 5,000, that is about 15% of all available slots.

Places available at the BS level for engineering specializations are as follows:

Figure 27: BS Level Engineering Specialization Capacity

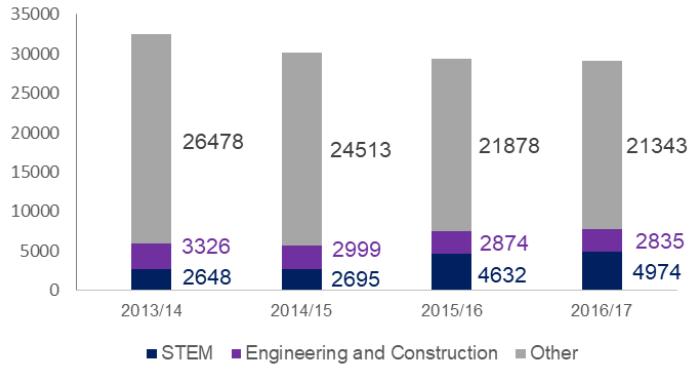
Computer Engineering	795
Electrical Engineering	1,090
Construction Engineering	700
Civil Engineering	359
Total:	**2,944**

Source: NAEC

The number of students in STEM disciplines have almost doubled in recent years following government incentives of providing state grants. However, these numbers are not indicative of the improvement of the quality of the programs. Another important point is that the enlarged cohort has not completed BA studies yet, and it is early to evaluate its impact.

The chart below provides the dynamics of enrollment in Georgian HEIs with breakdown in STEM subjects and engineering and construction.

Figure 28: Science and Engineering Students Annual Enrollment



Source: GEOSTAT

International cooperation, especially in EU programs, could provide the necessary growth in competence in the field. Among the new projects aimed at improving the presence of innovation and entrepreneurship in academia, the Erasmus+ project Enhancing Innovation Competencies and Entrepreneurial Skills in Engineering Education (Innocens) could be mentioned. The project is led by the Royal Institute of Technology, Sweden, two EU partners, and eight universities in Armenia, Georgia, Belarus and Kazakhstan. The goal of the project is "to enhance innovation competences and entrepreneurial skills in engineering education through university-business cooperation in order to support creation of new enterprises, new jobs and economic growth in the partner countries."

Despite the current buzz related to innovation and startup development, no systemic approaches are observed in introducing education programs targeting the innovation process. There are only occasional announcements of innovation management courses provided by the training centers.

Teaching innovation has been considered a priority for established champions of international assessments, such as South Korea. Developing skills in innovation management has been also recommended and envisaged by the WB GENIE project.

INFORMAL IT EDUCATION

The industry leaders concentrate on attracting the talent and considering them later for job-opportunities. The largest hardware reseller UGT runs an IT knowledge training center, ITDC – formerly the largest web-development company and currently cloud-services provider, which offers high-quality trainings. The leading mobile development company Lemondo has partnered with the University of Georgia (UG) in launching UG labs. However, the project has been phased out. Some IT companies have invested in providing high quality intensive training programs and offered them for appropriate fees. Since GITA has announced a lower-end free program, many trainees preferred to attend the latter. In addition to the obvious cost saving motivation, the majority of trainees could have been unaware about the different levels of the mentioned training courses. As the fees appeared to be a barrier for many potential customers, alternative offers emerge, e.g. web-based, low-cost e-learning skills development platforms, such as skills.ge supported by Lemondo.

There are other short-term GITA-funded professional development courses at UG and other universities, namely Geolab at Georgian American University (GAU), Gamelab at Ilia State University, and CG Multilab at the Georgian Institute of Public Affairs (GIPA).

The number of private centers (including university based short-course programs) providing IT related training regularly is about 30. Offers include entry level courses in graphics suites, operation systems, popular graphics/design suites and animation, web-development, computers and networks administration. About half of the centers could be considered advanced, providing among others Cisco certification, databases, Java and .Net programming, IT projects management, mobile programming, game development, etc. There are no training centers in the regions providing basic level coding training. Courses for network administration and PC management are scarcely available.

Despite the availability of certification courses, the major track in raising the qualification of young IT professionals is related to self-education. As the teaching materials are not available in Georgian, English proficiency becomes a by-qualification. That opens prospects for Georgian freelancers to participate in web-based projects to gain expertise and utilize networking opportunities.

The gaps in IT education are partially addressed by the new initiatives involving universities, GITA and private organizations.

GITA aims at expanding its training offer through networks of innovation centers, FabLabs and other facilities in the regions. At the moment, there are eight FabLabs operating in Tbilisi, Batumi and Kutaisi, some of them based in partner universities. Further expansion of the FabLab network currently involves 14 regional VET colleges.

There are nine thematic areas of training and certification requirements. GITA IT professional trainings create the entry or basic level IT education framework for applicants needed to seek employment in Georgian companies, through web-portals or networking possibilities. The training program has already certified 135 trainers (out of 180 trainees) that are being required to re-deliver trainings for two more groups. There were about 1,100 specialists trained by the end of 2016.

The community of IT professionals has a large representation in public sector organizations. Strong competency centers in institutions responsible for providing e-Government services accommodate capable IT teams. More recently, the trend of their migration to the business sector is observed, which could contribute to its competitiveness growth through knowledge sharing and peer learning.

GITA is considering the creation of a special platform dedicated to IT professionals' skills showcase. Due to limitations of centralized personal data collection, the platform could be advertised and promoted among IT specialists as a focal place for sharing industry news, finding vacancies in IT companies and presenting their portfolios. Examples of such platforms exist and could be considered (e.g. dou.ua in Ukraine).

ENTREPRENEURSHIP EDUCATION

Another finding of the survey is related to the lack of entrepreneurial education among Georgian startups or prospective businessmen. The business model is often not discussed or thought through during the development of innovative ideas.

GITA recognizes the existing gap and provides programs aiming at helping prospective startups to acknowledge the full cycle of innovative product or service development via mentorship, training and capacity building events. That also includes intensive training for successful finalists of high-tech startup

programs. In addition, tailored training is provided to GITA Business Incubator residents in finance, marketing, project management, business idea development, etc.

Another important initiative of GITA is Startup Accelerator. Through services and technical assistance of startup accelerator programs in universities, students can generate new innovative ideas, transfer the ideas to businesses and accelerate them rapidly. Startups are going through training programs in business modelling, relationship with investors, customer identification and attraction, as well as marketing and other relevant areas. GITA is providing guidelines and access to TechPark's virtual services.

Other consulting opportunities include:

- Partnership Fund also provides consulting for potential applicants of "Startup Georgia" (startup.gov.ge) in preparing proposals, business plans, and financial models. It also offers training after the first round of its Innovation Funding Program;
- TBC Bank Startup program nurtures credited/funded startup companies by offering training and support in marketing, finance and startup development;
- Bank of Georgia offers an 18-hour course "How to Develop a Business" for participants of a women owned startup program.

Nevertheless, according to survey respondents involved in funding or evaluation of the startup initiatives, the new entrants and idea merchants of seed forums and startup events often lack the basic entrepreneurial skills which negatively affects the quality of their proposals.

Furthermore, until recently there were no systemic programs in science and technology entrepreneurship (STEP). The previous programs focusing on this area (STEP) have delivered mixed results and did not gain sustainability.

Recently Georgian Research and Development Foundation (GRDF), in partnership with GITA, has launched another round of competition under a renewed STEP program targeting startup companies with growth potential with focus on ICT, clean-tech, biotech, artificial intelligence, robotics, biotech, VR and augmented reality (AR). The maximum amount of a grant is 30,000 USD. The goal of Global Pivot to Success (GPS) training and startup competition is designed to support technology entrepreneurship in Georgia through mentorship and funding. The overall goals of the program are:

- Support development of a knowledge-based free-market economy in Georgia by fostering innovation and technology entrepreneurship;
- Encourage the development of new technology-based products and services and their commercialization in local and global markets;
- Facilitate collaborations between local inventors and investors, global science and technology and business communities and the Georgian-based technology entrepreneurs and private companies.

Some survey respondents indicated that Georgian businessmen are often not interested in long-term investment or supporting R&D. A Rustaveli Foundation report also states that private funding is negligible. Furthermore, entrepreneurial skills of Georgian scientists are not fully utilized as they are concerned with protecting their inventions/ideas, rather than entering an IP disclosure and protection process.

GENERAL EDUCATION

One important bottleneck hampering initial supply of quality students to knowledge intensive sectors is the relatively poor performance of Georgian students in general education confirmed by the aforementioned international assessments (PISA and TIMMS). Georgian student scores have been progressing but still rank in the bottom tier. About 11,000 high school graduates (more than a third) failed their graduation tests. That obviously limits the availability of capable university entrants and later creates challenges to developing a qualified and knowledgeable workforce. One of the contributing factors to the low scores on exams is the poor qualifications of the vast majority of Georgian secondary school teachers, especially in STEM subjects.

There have been substantial efforts in increasing secondary education technological infrastructure. The government is gifting each first-grader in the public school a personal netbook for six consecutive years. However, the educational impact of these types of interventions has not been measured.

The IT subjects' curriculum familiarizes schoolchildren with the basics of computing and information processing. Coding and informatics principles are under consideration for inclusion into the school curriculum.

There are several science olympiads (competitions) supported by the MoES and Georgian students regularly achieve prizes. Despite success cases of several students in IT olympiads, that does not generally contribute to improving general academic ability and does not necessarily create examples to follow.

There have been indirect efforts to bring scientific inquiry to the forefront through science picnics, science festivals, robotic clubs and other science communication events.

Science communication and popularization has been supported by the MoES and several universities. The Rustaveli Foundation runs the Leonardo da Vinci young scientists contest and also provides grants enabling students to participate in research projects. One of the largest commercial banks, TBC Bank, provides support to the contest by offering their premises, media coverage and dissemination of information. Ilia State University regularly organizes science picnics attracting thousands of participants to watch simple science shows and experiments. Another notable contest is organized by MCA annually and attracts media and beneficiaries' attention.

The above-mentioned activities are important steps towards attracting young talent to science and innovation. At the same time, further steps are needed to attract and engage young prospective scientists and engineers into the field. The pool of science animators, advisors and promoters, interactive science museums, and robotics clubs and centers could have attracted more students to STEM disciplines. Currently, there are no substantive plans to take the requisite steps.

VOCATIONAL EDUCATION

TVET Analysis: Current Profile and Perspectives.

Vocational education and training programs have suffered a lack of public attention and funding in the years following the blackouts of the 1990s and even reforms in the early 2000s.

Currently, the GoG has prioritized the development of a modern and sound TVET system to meet demands of 21st century economic needs. New programs are being developed. Industry–VET collaboration is envisaged.

MCA Georgia has funded 13 programs through its Industry-led Skills and Workforce Development Program (ISWD). ISWD is a $16 million project that started in 2014 and will continue until 2019.

The recently funded projects include two programs related to IT and high-tech sectors. Namely, it supports developing of long-term teaching models and programs in IT and aviation.

- Development of a unified teaching model in TVET for the specializations of IT support specialist, a computer network administrator and a systems administrator, based on CISCO standards and launching them in partner regional colleges.
- Development of TVET programs of aircraft and engines maintenance technicians and aircraft avionics and electrics system maintenance technicians in Georgian Aviation Institute.

Graduates and Programs of VETs

There were 781 students of IT specializations in 21 TVET educational institutions in Georgia in 2016. The annual number of graduates is comparable to that figure. Grade 3 programs have an enrollment of 680 students, Grade 4 programs - 54 and Grade 5 programs – 97.

Figure 29: Enrollment Quantities, 2016

Program /Specialization	Number of Students	Grade
Web-Developers, Web-Specialists, Web-Interface Developers	82	3,4,5
Information Technologist, IT support	233	3
Internet Technologist, Web-specialist	85	3,4
Computer Graphics Specialist, 3D Graphics Specialist	73	3,4
Computer Engineering	3	3
Computer Networks and Systems Administrator	232	3,4,5
Software Developer	6	5
Technical Designer for Publishing	37	3

Source: EQE

The planned investments to standardize IT programs in regional VET colleges will contribute to better systemization of specializations and skills, and improve the value of a VET education.

ENVIRONMENT

One of the important pillars of innovation ecosystem is the environment, under which, for the sake of the report, we analyze policy and regulations, cultural background and traditions, global and domestic network.

POLICY AND REGULATIONS

The main policy document covering Innovation and Technology development strategy is *Social-Economic Development Strategy of Georgia - Georgia 2020* adopted by the GoG in 2014. Its overall review is provided above in the country profile section.

The main goal of the state policy in the innovation and technology domain is “to facilitate the transfer and introduction of innovative activities and modern technologies both at the national and regional levels.”

There are several directions in the innovation and technology field where the state aims to focus its interventions:

- **Improving access to funding for research and development.**
  The GoG has declared a commitment to increase funding for R&D, support applied research and improve access to funding to SMEs as main drivers for innovation.
  The state will also facilitate commercialization of R&D through deepening partnerships between private sector, educational system and science and technology systems.

- **Developing infrastructure needed for innovation.**
  Development of “relevant infrastructure such as industrial parks, incubators, regional development agencies and innovation centers,” is envisaged along with improving auxiliary infrastructure needed for R&D in academia. Training of the workforce to provide adequate qualifications is also considered.

- **Strengthening the protection of intellectual property.**
  The GoG commits to strengthen relevant legislative and institutional framework and to initiate best practices in compliance with the EU-Georgia AA.

- **Facilitating the broad use of information and communication technologies in the economy.**
ICTs are considered important for leveraging competitiveness and respective support is planned to telecommunications and internet accessibility.

- **Attracting FDIs oriented towards modern technologies.**
The Government will encourage FDIs oriented towards the introduction of new technologies, especially environmentally-friendly and resource-saving technologies which will encourage the development of a "green" economy.

Expected Results of Georgia 2020 in the Innovation Domain

Some of the most important targets of the strategy is "improvement of knowledge transfers and technological absorption by Georgian firms, establishment of science-business partnerships, raising level of innovations, that in overall increases competitiveness and technological sophistication of local production."

The important strategy document aiming at guiding innovation support process is GENIE Project - a loan based program by WB.

According to working documents, *Georgia 2020* goals in the domain of innovation and technology should be reached through the following:

1. Implementation of new legal framework for innovations and modernization of existing framework;
2. Improving access to finance;
3. Tax benefit and other state systems to support innovation.

POLICY AND REGULATIONS IMPLEMENTATION BENCHMARKS

Implementation of New Legal Framework for Innovations and Modernization of Existing Framework.

GITA was established in 2014 as the main executive vehicle of innovation and technology policies and strategies. At the time the Agency was created, legislation did not stimulate companies and R&D institutions to develop innovation and did not support innovation ecosystem development. The main objectives of legislative changes were:

- Creation of legislation that defines innovation, decreases barriers and motivates innovation, supports business and science interaction, encourages development of innovation on the basis of universities;
- Legislative support of infrastructure development;
- Creation of regulations and amendments to legislation for improved access to finance, including startup financing and financial engineering, angel investors, venture capital, private capital and donations;
- Regulatory and legislative support to education and skills development;
- Creation of additional infrastructures for startups, technological business incubators, technological transfer and other mechanisms.

GITA developed a package of legislative regulations that consists of the Law on Innovations that was adopted in 2016, and amendments to the Law on Grants in order to introduce GoG grant financing to private entities.

The table below shows progress in policy and regulations presented with key points:

Figure 30: Timeline of Main Activities in Policy and Regulations

Prior to 2014	▪ Several strategies or policy recommendations envisaged innovation ecosystem development e.g. Regional Development Diagnostics Report, 2010. ▪ Law on Information Technology Zones
2014	▪ No legal framework for innovations existed ▪ The term “innovation” was not defined in the legislation
2015	▪ Innovative Georgia 2020 strategy drafted ▪ Research and Innovation Council established
2016	▪ Law on Innovation adopted ▪ Amendments to Law on Grants ▪ Law on e-Commerce drafted ▪ Strategy for MSME development for 2016-2020 ▪ Legal provisions for crowdfunding drafted
2020	▪ Approval of legal framework for venture capital and innovation & ecosystem support

Source: PMO Analysis

The new Law on Innovation aims at creating a national innovation ecosystem, developing knowledge and innovation based economy, promoting export of intellectual property and technology. It was enacted in 2016. According to the Law, the Research and Innovation Council has been created to develop and coordinate policies affecting innovation and research. GITA along with the MoES are empowered to implement these policies.

Country Definition of Start-ups

It is essential that the definition of start-up is available in the country. There are several practices used in various countries as to how “start-up” is defined. The most prevailing practice is to define it based on the type of activity, which means that start-up is regarded only when activity is related to technological innovations. Another criterion is the maturity of operation, where only relatively young firms (e.g. operations less than five years) are regarded as start-ups. In some countries, size of turnover not exceeding EUR 5 million is also used. Countries therefore need to develop their own definition, based on strategy and exact goals they want to achieve in this regard. GITA, as the main coordinator of the innovation ecosystem in Georgia, shall provide this definition, which will be used in the public as well as the private sector. Making too narrow a definition could be an obstacle, therefore it is recommended to use leading international practices and define start-up as a new business having an innovation idea, with a fast, scalable opportunity and growth oriented business model.

Improved Access to Finance

Limited access to finance is one of the important barriers to innovation development. Existence of traditional, as well as non-traditional instruments to finance innovation is essential. From 133,802 MSMEs registered in the country, only 30% have loans and only 15% are eligible to receive loans.[3] Existing products on the financial markets did not satisfy the needs of SMEs since almost 76% of investments are from their own sources, and bank loans constitute a mere 11.5% of investments. Banks refrained from issuing loans to technological and innovative startups. Companies creating innovative products often lag behind due to R&D requirements, their greatest assets are IP and they are often unable to demonstrate proven income and availability of fixed assets to banks since IP is not tangible. Private and venture capital markets are also underdeveloped.

New regulations and also amendments to existing policies are developing, improving access to finance for players in the innovation ecosystem.

Tax Advantages and State Systems Supporting Innovations

Tax advantages can play an important role for innovation development. In classic models of taxation, innovations may face problems to deduct all expenditures on R&D. Before Georgia's new corporate income tax (CIT) model was established, companies could deduct R&D expenses. Under the new model, companies are liable to pay profit tax only upon distribution of profits or on transfers of a similar nature (non-economic costs), without calculating allowable costs.

A special tax benefit scheme exists since 2011. The Law on Information Technology Zone establishes the following exemptions for virtual zone persons (VZPs) for:

- Profits earned from supplying outside of Georgia;
- VAT on the supply outside of Georgia;
- Export duties.

The first point is assured by the 99th provision of the tax code, where it is stated that the distribution of profits out of the profits earned outside Georgia is exempted for VZPs. With regard to the 2nd and 3rd points, it is worth mentioning that VAT and other export duties, such as excise are generally not payable on export. This exemptions are just ensured by this specific law, if, at some point in time, the general approach of the tax code changes.

Alternative forms of support from the state to consider could be:

- Grants;
- Subsidies or facilitated loans;

Implementation of innovation oriented state purchases.

Other Policies and Projects

Harmonization of digital markets (HDM) is a new initiative aiming at harmonization and convergence of EU and Eastern Partnership countries' digital markets by means of multilateral projects to be implemented by partner countries. The focus areas of the project relevant to innovation and technology sector development are:

- E-commerce for SMEs;
- Infrastructure for ICT research and innovation;
- Digital skills.

Topics also include eTrade and eHealth that would create additional opportunities for ICT companies to access EU and Eastern Partnership – EU cooperation initiative (EaP) markets.

The project has a coordinator from the public sector and also contact points from non-governmental organizations (NGOs) of the participating countries.

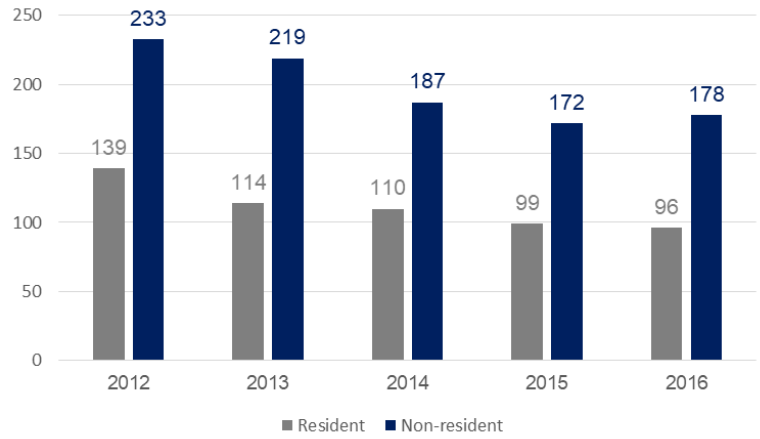
3 http://www.enterprisesurveys.org/~/media/GIAWB/EnterpriseSurveys/Documents/Profiles/English/Georgia-2013.pdf

INTELLECTUAL PROPERTY PROTECTION

Strong IP protection and clear regulations are key factors to streamlining the innovation process and gaining commercial benefits from R&D products/services. Patent based assessment of Innovation is sometimes used to evaluate countries' performance in technological development. Georgian IP protection regulations are considered fully compliant with international requirements and standards. At the same time, the demand side seems to be stagnating.

Patent applications, an indicator of innovation activity, received by Georgian National Intellectual Property Center Sakpatenti, have been decreasing for six consecutive years until flattening in 2016.

Figure 31: Number of Patent Applications



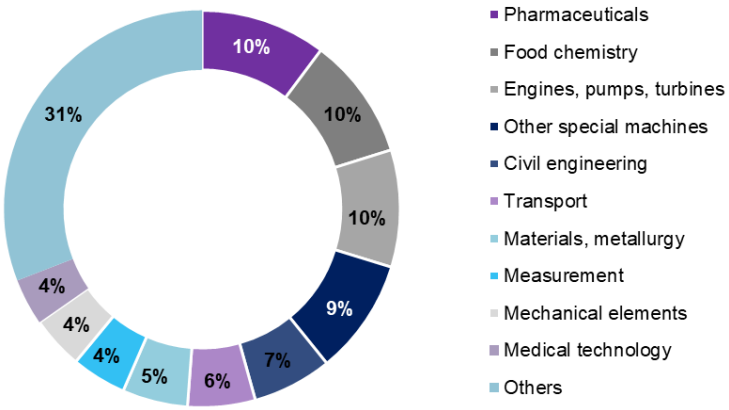
Source: WIPO

Recent reports and survey observations indicate that patent protection costs are still considered high for physical persons and legal entities. Recent incentives for universities allowed for an increase in the number of patent applications originated in research institutions. However, there is a more substantial problem with international protection costs. The higher costs (e.g. about USD 20,000 for Europe) are restrictive to extending national patents. "Considering that the commercial potential of a patent protection limited to the domestic market of a small country is negligible, this could also contribute to the decline in patent filings in Georgia."[4] Due to high costs, several reports suggest subsidizing patents by priority fields or development potential.

The chart below shows the distribution of patent applications according to different fields.

[4] Research Performance in Georgia: Analysis and Recommendations, 2014, Bregvadze, Medjad, Bregvadze

Figure 32: Sectoral Distribution of Patent Applications



Source WIPO

Several relatively unsuccessful attempts to create technology transfer centers in Georgia and the stakeholders' observations indicate that applied research in academia/research institutions does not produce the substantive number of outcomes with commercialization opportunity.

More nuanced recent policy guideline suggests that ***countries with strong manufacturers or a specialization in information and communication technology tend to turn to patents rather than trademarks. Countries with a large services sector tend to engage more in trademark protection.***[5]

That is confirmed by the growth in the number of trademark registrations in Georgia. That is also an indication of increased economic activity and potential for further growth.

Sakpatenti has been actively engaged in collaboration with GITA and its beneficiaries in the forms of IP pre-inquiries and providing consultations for funded or potential startups. Its representatives also keep conducting information campaigns among scientists and researchers. ***However, the culture of checking the proposed innovations for availability of similar protected products/services needs to be further developed, especially in startup communities, to avoid potential material damages and legal conflicts.***

CULTURAL BACKGROUND AND TRADITION

The recent technological revolution is a worldwide phenomenon and a capable manifestation of globalization powers. At the same time, implementing ideas that work elsewhere often stumble upon cultural factors that should be considered and resolved. The research into managerial and work practices of global companies' branches in different countries in 1980's by Geert Hofstede has created a framework for evaluation of these factors called the "Cultural Dimensions Theory." It includes dimensions of individualism-collectivism; uncertainty avoidance; power distance; masculinity-femininity; and long-term orientation. Lower or higher scores on each dimension/axis could be considered differentiating factors in influencing work and business cultures of different societies.

The more recent work states that "in countries with higher power distance, innovative manufacturing companies are somewhat more bound to resort to process innovations."[6] According to another work[7],

[5] Measuring Innovation**,** A New Perspective. OECD, 2010

[6] A study on the relation between manufacturing strategy, company size, country culture and product and process innovation in Europe Coelho, D, 2011.

[7] The Effects of Culture on the Leadership Style in Georgia, Tkeshelashvili, N (2009) international Black Sea University, Tbilisi, Georgia

Georgia has high power distance score; thus, it could be expected that companies tend to implement process innovations rather than product innovations.

Another cultural dimension that could affect the process of innovative ecosystem development is uncertainty avoidance. With low scores in that dimension, which implies higher tolerance for risk taking, Georgian entrepreneurs could presumably become good innovators.

However, a low score in long-term orientation cultural mode could create additional challenges for long-term business investments in R&D that are necessary for a successful and sustainable innovation ecosystem.

GLOBAL AND DOMESTIC NETWORK

Networking and peer-learning are considered important building blocks of a vibrant startup and innovation ecosystem. Often the necessary knowledge transfer happens through attendance of international events and exhibitions, communication and networking. However, local associations and networks could also play a significant role in advocating and promoting the sector.

According to a GiZ report in 2017[8] on assessing Georgian ICT cluster potential in terms of strengths, weaknesses and internationalization opportunities, it was found that market-driven and regulation-driven developments in the EU markets open significant opportunities for Georgian ICT companies to export both "more-of-the-same", as well as new products. Therefore, cluster formation is essential to promote linkages and cooperation among companies initially in Tbilisi and, in the mid-to-long term, other ICT centers in the country, at the same time creating market linkages and partnership opportunities with well-known regional and international IT clusters.

It is also recommended to facilitate access to markets via internationalization by scoping market opportunities to tap into:

- Eastern Europe – ready for business solutions for financial and government institutions;
- Western Europe – innovative solutions for businesses;
- Position as a hub in the South Caucasus region;
- "Endless" mobile application industry and website industry;
- Teaching companies to focus on smart, simple and cost-effective solutions to counter inflexibility of industry giants.

Another key recommendation is to support enterprises in export development and to promote private-public dialogue (PPD) by enhancing the ability of companies to advocate for necessary regulatory and/or policy changes through a formal cluster organization.

ICT Business Council

In the ICT domain, the ICT Business Council of Georgia (ICTBC, ictbc.ge) is an association of Georgian IT companies and other institutions/individuals. ICTBC organizes a major annual event called "Georgian Information Technology and Innovation." This event gathers participants from both the private and public sectors to present their latest projects and products. The conference attracts professionals and companies from more than 20 countries and provides prizes to the best recent IT solutions and projects in different categories. Traditionally, Georgian and Armenian IT sectors have the highest representation. The conference topics cover public sector information systems, cybersecurity, and ICT business to business (B2B) and business to consumer (B2C) solutions.

Pre-Accelerator Program Network

Involving Ilia State University, Tbilisi State University (TSU), University of Georgia (UG) and GAU's GeoLab, the program is administered by GITA.

Technological Startups Association

[8] Georgian ICT Cluster Potential Evaluation, GIZ, 2017

The association was established in 2016 to advocate and promote a technology startups ecosystem in Georgia. It does not have significant activities on record, but it is officially registered and plans to become more operational.

Business Angels Network

The newly created Georgian Business Angels Association (with support of Swedish International Development Cooperation Agency) seeks to promote funding of early stage start-ups by strengthening communication with investors.

iHub Georgia

iHUB is a local provider of startup mentoring and investor matchmaking opportunities through Seed Forum Global. It regularly organizes networking and mentoring events and facilitates pitching sessions to prospective Georgian startups.

Georgian National Cluster Platform

Established in March 2017, the platform aims to implement a cluster based development framework in Georgia. Active biotech stakeholders are becoming its members.

Creative Business Cup (CBC) Georgia

CBC Georgia is a national partner of the Denmark based Creative Business Cup. CBC is a not-for-profit organization that supports the development of a creative entrepreneurship environment and startup culture in Georgia.

CBC Georgia organizes an annual “Creative Business Cup Georgia” competition that identifies, enables, and rewards the best local creative/innovative talent, mostly by offering winners participation in international rounds of the competition.

Enterprise Europe Network (EEN)

Enterprise Europe Network is a central platform for EU and EaP SMEs for networking and innovation. GITA and Enterprise Georgia are serving as focal points. There are no active Georgian companies at the moment at EEN.

EU Horizon 2020 Programs.

- Innovation in SMEs;
- Information and communication technologies;
- Nanotechnologies, advanced materials, biotechnology and advanced manufacturing and processing.

Competitiveness of Enterprises and Small and Medium-Sized Enterprises (COSME)

The EU program COSME could also provide additional opportunities for Georgian companies to grow. It provides support in the following areas:

- Facilitating access to finance;
- Supporting internationalization and access to markets;
- Creating an environment favorable to competitiveness;
- Encouraging an entrepreneurial culture.

Currently, Georgia is not a member of the program, but is eligible to participate. Moldova and Armenia have participated in COSME from 2015, and Ukraine from 2017.

Specialized Social Media Groups and Internet Resources

The communities of developers and IT specialists actively communicate on social networks. For example, there is Georgian Web and Mobile Development Industry Group, Innovations and Entrepreneurship Group, Cyber Security Professionals Group, Google Developer Group and others.

The dedicated to startups website Startup.ge is maintained by a business consulting company Start, that also offers funding opportunities (current portfolio volume is mentioned in the Access to Finance section of Section 5).

TBC bank also offers a platform for startups to register and gain publicity called Startuperi.ge. The platform does not distinguish applicants/participants of the TBC bank loan program Startuperi (mentioned in Access to Finance section of Section 5), and any Startup company can upload their profile.

Georgian Startup Community

The Georgian startup community is growing. In addition to social media groups, new products and services are launched through Government programs or private initiatives. In 2015 there were about 50 startups created, in 2016 – the number has passed 300. Among total pool of active Startup companies:

- 175 are kick started by state programs -Startup Georgia, business accelerators, FabLabs;
- 65 are engaged in startup supporting loan programs by Georgian financial institutions (details are provided in Access to Finance section of Section 5);
- 180 are created through private local early-stage funding or VC.

With GITA focusing on technology and innovative startups, financial institutions are taking the first steps to support innovation of more traditional industries. The share of technology related startups is about 30%.

There is significant room for development in spin-offs of research organizations.

Creative Industries

Creative industry indicators are also considered in compiling global indexes. Namely, GII has a sub-component of creative outputs. Georgian digital marketing/advertise agencies have achieved success on the international stage by, for example, winning both a silver and bronze at the Cannes Creative Festival. These examples not only contribute to increasing the country's visibility, but also help in attracting more talent to the industry, and creating further expansion opportunities. It is notable that several Georgian web-development companies (ITDC, Leavingstone) position themselves more frequently as advertising agencies, by also adding the digital marketing field to their portfolio.

Freelancer Community

According to the IT community estimates, there are about a couple of hundred qualified Georgian IT professionals working on outsourcing projects without declaring their sources. Despite the fact that profits generated abroad are not generally subject to income tax deduction according to Georgian legislation, that employment scheme is not transparent and hardly measurable. At the same time, it is an indication of the relative competitiveness of Georgian IT professionals on the global market and their connection to their respective networks.

INFRASTRUCTURE

INTRODUCTION

Availability of respective infrastructure is one of the cornerstones for innovation sector development. This chapter will analyze the infrastructure available in the country to assist innovation development. Under this item, such important indicators as access to internet throughout the country, rate of personal computers available to households, number of tech parks, innovation and FabLabs, innovation centers (ICs) and other indicators will be examined.

The chapter will also present an overview of the GENIE project and one of its components – innovation infrastructure.

The chapter will also present information on hardware subsidies, as well as public and private services.

Besides the above mentioned quantitative information, this chapter also analyzes the quality of infrastructural support provided, draws its strengths and limitations, planned developments and elaborates on potential opportunities.

OVERVIEW

The best policies and practices worldwide indicate that creation of a modern innovation ecosystem is mandatory to transform research results into marketed products and services, where availability of infrastructure plays an important role.

Properly developed innovation infrastructure should help in decreasing the risks of startup companies, enabling them access to expensive innovative technologies. Infrastructure development will result in creating Georgian innovative products and increasing competitiveness of various businesses, through implementing innovation in day-to-day operations.

The table below shows important components of innovation infrastructure that are being developed by GITA according to the Georgia 2020 strategy and working documents.

Figure 33: Infrastructure

Name	Purpose	Description
Innovation Center	Infrastructure for stimulating innovation in the population.	To develop innovation centers on the basis of libraries in Georgia, offering both intellectual and technical resource to the population, educational programs, including distance learning.
FabLabs	Infrastructure for producing innovations, modeling, prototyping, testing, customer tailored product development. .	Offering universal equipment complexes that enables the full cycle of prototyping, in various industries. Serviced by qualified professionals who support in transforming idea into prototype.
Innovation Laboratories (ILab)	Infrastructure for applicable knowledge sharing, business and university interaction point.	A space, on the basis of university, where university cooperates with business – for applicable knowledge sharing, increasing competitiveness of young specialists, their engagement in business project. ILabs offer knowledge, as well as access to innovation technologies.
Business Accelerator and Incubator	Infrastructure for innovative startup development.	A mechanism for defining potential success/failure of a startup, through offering training, consulting, mentoring and helping startups define the right business model. The business acceleration project continues for 3-4 months to decide on terminating or developing business ideas. The business incubator provides free, as well as paid space and supporting services to startups, such as - accounting, marketing, finances, human resources, and others, through which the startup costs are being decreased.
Regional Hub	Infrastructure for regional coordination of innovation centers.	A hub for innovation centers, having training infrastructure, FabLab and ILab modules. Common working and conference spaces. This infrastructure also aims at supporting coordinated functioning of data centers, cloud and parallel computing/accounting systems and Georgia information and communication transit channels data exchange.
Common Working Space	Infrastructure for co-working.	A space for co-working of innovative people, with supported and shared facilities and services.
Thematic Innovation Labs	Infrastructure aimed at supporting innovation within one specific field/industry.	E.g. innovative kitchen lab, equipped with high tech appliances for food production, these labs can be used by any potential innovators who have innovative ideas in food production.
Scientific and Technological Parks	Infrastructure for high level applicable research and prototyping.	Large infrastructural hubs, where all the above mentioned infrastructural facilities have connection and beneficiaries receive access to qualified scientific and technological expertise and to expensive equipment for innovations development.

Source: GITA, PMO Analysis

The strategy aims at developing all the infrastructural units, presented in the table above.

WORLD BANK GENIE PROJECT - OVERVIEW (INFRASTRUCTURE COMPONENTS)

In 2016, WB approved a USD 40 million loan to Georgia under the GENIE project with the objective to increase innovative activities of firms and individuals and their participation in the digital economy in Georgia. This is one of the important projects running within the innovation ecosystem; therefore, it is reviewed in this document. The main beneficiaries of the project are Georgian businesses as well as individuals. Its key performance indicators are stated as:

1. Number of new/improved products or services introduced to new or existing markets by project beneficiaries;
2. Number of start-ups launched by project beneficiaries;
3. Access to broadband internet (number of subscribers per 100 people);
4. Number of beneficiary MSMEs selling via e-commerce platforms.

The project encompasses four components - innovation infrastructure, innovation services, innovation financing and project implementation support. The project is set under the management of GITA, oversight is under the MoESD and is subject to overall (high-level) oversight by the Research and Innovation Council of Georgia.

For the sake of this chapter, only GENIE project Component 1 will be covered - innovation infrastructure (USD 14.7 million.)

The innovation infrastructure component consists of three sub components listed below, and in this overview, the first component is the center of focus, as the other two are currently being reviewed and reconsidered:

1. Developing a network of community innovation centers (CICs) and regional innovation hubs (RIHs) in selected areas of Georgia;
2. Designing a broadband-for-development (BfD) program, to support usage by households and MSMEs, with a focus on rural areas;
3. Pilot, and, as applicable, implement the BfD program, and provide BfD payments and related training.

Sub-Component 1 – Developing a Network of RIHs and ICs

The ICs are intended to be the primary mechanisms for inclusion of beneficiaries in rural communities and smaller cities into the innovation ecosystem, consisting of rather basic infrastructure, mainly established in existing public libraries and other facilities maintained by local municipalities. RIHs are expected to provide more extended facilities, including prototyping equipment and other specialized lab equipment to support testing and commercialization of innovation. RIHs are intended to also serve as a regional hub to ICs. Key function of both the CICs and RIHs will be to draw users into the innovation acceleration framework.

The GENIE project component aims at financing a total of 50 CICs; 10 in a pilot phase, and 40 in a follow-up phase and total of 10 RIHs; three in a pilot phase and the rest in a follow up phase. Based on financial analysis conducted by the WB for the RIHs and CICs, it was concluded that RIHs can operate in a financially sustainable manner as long as they charge user fees and maintain a moderate level of user demand, while the CICs will most likely require public subsidies, along with charging user fees, considering the lower ability to pay by their poorer and more rural users.

The expected measurable benefits from the network of RIHs and CICs lays within new startups, new products and process innovations developed by users of the centers. The economic value of these impacts is expected from the profits to be generated over time by new startups and profits of existing companies from the commercialization of innovations.

INNOVATION INFRASTRUCTURE - CURRENT STATE AND ANALYSIS

General

By the end of 2016, Georgia's innovation infrastructure became accessible as in the opening phase, while

overall infrastructure, including research and testing facilities, has significant room for improvement. ICT acceptance is medium to high in big cities, increasing but still relatively low in regions and rural areas, representing a nationwide digital gap.

However, there have been positive developments, especially in terms of plans for the “Open Net” initiative and establishment of GITA.

Internet Access Market and Broadband in Georgia

The Georgian internet access market is represented by five large, private telecommunications companies providing a mix of wireless and line internet networks across the country. There are also a large number of smaller internet service providers (ISPs) that have regional networks. By May 2016, there were 132 small rural ISPs that collectively had 54,000 subscribers (about 406 per operator, on average). Together, these companies have rolled out multiple cable and/or fiber optic “backbone” and access networks and widespread wireless networks where the commercial case exists.

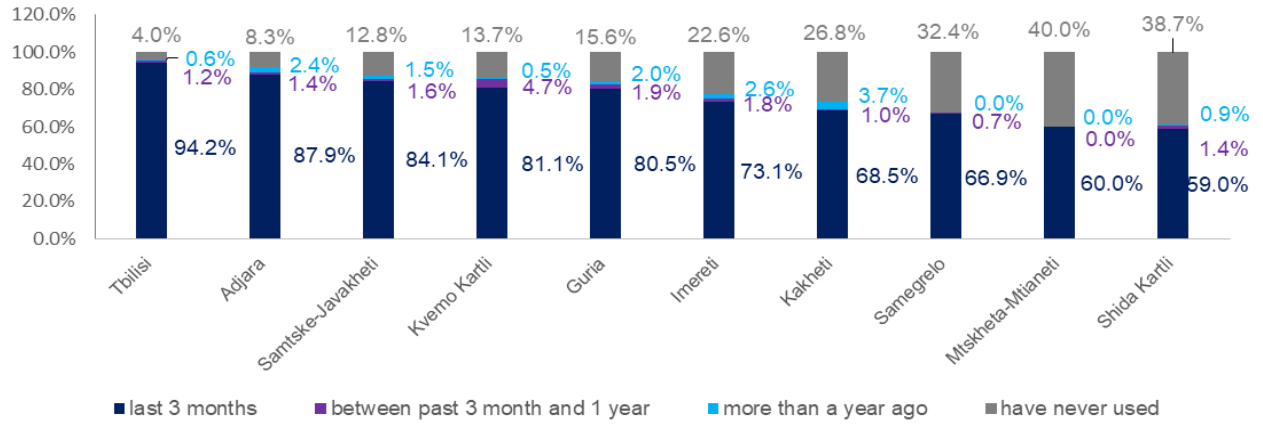
Until the recent fast growth, access to ICT and the internet was at medium levels in Tbilisi and other large cities and was low in regions and rural areas, as well as among the MSME segment.

According to GNCC data in June 2015, approximately 24% of the population had broadband subscriptions while subscription to fixed broadband (high-speed internet) was held by about 15% of the population, mostly in the main cities. The disparity of personal computer ownership and internet subscriptions among poor vs. the non-poor population, especially rural population, was significant but the gap is closing. According to the *2016 e-Readiness Survey*, more than 90% of households in both urban and rural areas have access to the internet through a desktop, portable or mobile device, and the gap is only 6%. About 60% of households have at least basic broadband (2-30mb/s).

To see the dynamics: in 2013, according to data from the *Integrated Annual Household Survey* by Geostat, only 10% in rural areas had internet connections and 21% computers, while in Tbilisi, the corresponding figures were 74% and 79%, respectively. In 2016, the number of households using desktop computers for accessing the internet was similar in Tbilisi and the regions at 64%, and for laptops the respective numbers are 63% and 46%.

For 2016 – 80% of the population is regular internet users.

Figure 34: Internet Usage Frequency Breakdown by Regions, 2016



Source: Geostat

Despite the rise in connectivity, the gap in digital skills, particularly in rural areas, is still evident. According to the *2016 e-Readiness Survey*, 35% of respondents in the regions have no basic word processing or PC

skills, with a high number of PC illiteracy in spreadsheets (Excel -44%) and presentations (PowerPoint – 57%)).[9]

ICT Access and Usage by Enterprises

According to WB Enterprise Surveys, only 50% of businesses surveyed in 2013 had their own website, and more than three in four used e-mail to interact with clients/suppliers. But numbers are lower for firms located outside of Tbilisi, indicating a digital gap.

There was a regress in terms of having a company website: according to a Geostat 2016 survey, only 44.3% of enterprises have had their own website. At the same time, 97.5% of enterprises reported having internet access. Seventy and one tenth percent of them have basic broadband connections (2-30mbs). But only 9.2% were receiving orders via the internet and 9.2% use enterprise resource planning (ERP) systems.

At the same time, the present survey findings regarding companies having websites provides a more modest number:[10] both in the survey's final sample, and in the created high-tech and ICT companies full directory, it is only 24-25%. The higher number provided by Geostat can only be attributed to sampling shortcomings, as the question regarding having a company website is straightforward and does not require special knowledge.

Research and Development Infrastructure

Acquisition of research infrastructure in high-tech related science disciplines is often related to high costs. The present study focused on purchasing of R&D related equipment by Georgian companies that is presented in companies' survey. However, several observations indicate that international cooperation programs often also contribute to capital investments in scientific R&D infrastructure.

INNOVATION INFRASTRUCTURE IMPLEMENTATION

Georgia's innovation infrastructure finds itself in the starting phase of development, with high motivation from the GoG and GITA. However, limited staff experience and in certain cases also capacity and funding is an impediment. This scarcity of innovation infrastructure, particularly outside of Tbilisi, and especially in rural areas is evident. During 2013-2016, the following infrastructural developments took place and are presented as key points in the table below.

Figure 35: Infrastructure Development Timeline

2013	▪ Little infrastructure available ▪ 10% of rural households had internet, 21% had computer
2014	▪ First innovation infrastructure created ▪ Internet access project for rural areas initiated (Opennet) ▪ GITA founded
2015	▪ First RIC opened
2016	▪ Broadband infrastructure state program "Open Net" approved ▪ WB GENIE financing approved, with important components for innovation infrastructure and broadband development ▪ 2 Tech Parks opened in Tbilisi and Zugdidi ▪ 8 FabLabs across Georgia ▪ 14 FabLabs in vocational education institutions ▪ 3 ILabs ▪ 2 ICs in the regions
2017	▪ Plans are to open 1 RIH in Telavi, and 5 CICs.
2020	▪ GITA plans to open at least 8 RIHs, 50 ICs and subsidize 33,000 household internet subscriptions.

[9] National e-Readiness Survey. USAID/Tetratech, accessible at http://www.dea.gov.ge/uploads/E-readiness_ENG2.pdf

[10] The sample is based on BIA agency (bia.ge) database of active companies

Source: PMO Analysis

From 2016, GITA began the creation of innovation infrastructure in Tbilisi and expanding to the regions as well. The plan is to open more than 50 innovation centers in the libraries thought Georgia. The WB GENIE project is an important component in this process, under which Georgia's regions will be equipped with up to 10 RIHs in the bigger cities and 50 ICs in the villages by 2020.

It is important to recognize not only the number of innovation infrastructural units opened but their demand and usage data. The demand and usage risk has to be mitigated by various communication campaigns and engagement actions. Low demand is a risk that would also reduce revenues generated from user fees and potentially undermine the financial sustainability of the centers. Other risks include a lack of interest in the BfD program by households and MSMEs, which, in the authors' opinion, is less realistic with the condition when they will be receiving GENIE project support for access to computer equipment, networks and capacity building.

Figure 36: GITA Strategy Indicators

GITA KPIs	2016
Number of different types of innovation infrastructure	30
Number of beneficiaries using regional ICs/Total beneficiaries	450/3,000
Number of tech park residents (stat-up teams)	100
Number of events in a year and number of participants	200/12,000

Source: GITA

OTHER ICT AND INNOVATION INFRASTRUCTURE

Technology Transfer Offices (TTOs)

Currently, only a few universities in Georgia have a fully functioning, traditional TTO or a well-developed innovation and IP policy. The most advanced facility is the Technology Transfer Center of Georgia (TTCG), established in 2012 with the support of the Patent Office Sakpatenti and GiZ. However, the technical and financial support provided to TTCG has not been sufficient to build its capacity to deliver an adequate set of services. Donor programs facilitated the recent creation of TTOs at the TSU and GTU, which currently face challenges in capacity building and delivering technology transfer services.

GRDF recently supported creation of TTOs in Ilia State University and Eliava Bacteriophage Institute, and provided initial funding for the first round of requests for proposals (RFPs) announced. The quality of received applications, according to the respondents, was not high.

A technology transfer center was created at the University of Georgia in March 2017. It aims at assisting startup development and providing consultation in IP rights and opportunities for researchers and innovators. The center plans to involve business and also to establish cooperation with international systems for commercialization facilitations, such as: Nine Sigma, Yet2.com, and Innocentive.

The GENIE project envisages creation of National Technology Transfer Center, an umbrella institution that would help smaller branches in research institutions, universities, and labs to successfully develop their innovations and commercialize them.

Business Incubators

There are five business and IT incubators in Georgia, three of which were created approximately five years ago and are located at Free University, Ilia State University and GTU. There is also the Batumi Business Incubator (in operation since 2009) that has developed into one of the main business service providers in the Adjara Region; as well as the IT Garage Incubator created in March 2014 under the management of the Patent Office Sakpatenti with a focus on ICT. The success rates of incubators until now could be measured as moderate, with some projects phasing out without major achievements.

Public Services

The GoG is actively promoting electronic usage of public services. Most of the government services are also available digitally. Digital services are well developed and user-friendly, contributing to digital literacy and increased usage in the population. With additional communication and promotional campaigns – e.g. lower service fees for digital usage, this resource can increase population engagement in digital activities. The primary task for e-governance development currently is to leverage uptake of existing e-services through the internet.

The GoG continues its commitment to provide netbooks to all first-grade school students for six consecutive years. Supported initially by Intel, and later partnered by Microsoft, the program has provided more than 250,000 entry level portable computers that are also used in households. The program boosted PC infrastructure especially in the regions. As it continues, more families will have the opportunity to develop their computer literacy skills and begin using technology.

Partnerships

GITA is in the process of partnering with the Georgian National Academy of Sciences (GNAS) to establish a bio-technology center that will help Georgia realize its market potential in innovative applications of indigenous bacteria, enzymes and phages.

ACCESS TO FINANCE

Financing opportunities are increasing in Georgia both for the public and private sector. Partnership Fund and GITA are two main sources of financing in the public sector, while TBC Bank began implementing a large project for startups. This section lists major financial opportunities in the Georgian market both from the public and the private sector.

GOVERNMENT AND DONOR FINANCING

Startup Georgia is founded by JSC Partnership Fund with the aim to incentivize the development of Georgian startup companies. The project is divided into two parts: Partnership Fund finances innovative startups for the local market while GITA finances high-tech globally scalable startups. The total amount of funds allocated for this project is GEL 11 million, which is intended to increase up to GEL 35 million.

In total, 79 companies were financed in both components in 2016-2017. Of the 79 companies, 20 projects received additional venture financing of up to GEL 100,000 with a 5% equity composition. Participating investment funds were: Venrock, Alloey Ventures, VTF Capital, IBM Capital, NEA, Enterprise Investors and Sparklabs Global.

Besides that, GITA issues micro and matching grants of up to GEL 5,000 for financing prototyping R&D and IP rights. In 2016, GITA financed up to 80 projects.

In 2015, GITA implemented a grant project whereby 17 organizations received a grant of up to GEL 50,000 each.

The success rate is mixed. Only a handful of grantees have established companies and even less consider themselves successful. The reasons for not proceeding as planned vary, but there is a common pattern of limited collaboration between scientists and entrepreneurs towards full commercialization of products/services.

Under the GENIE project, significant funds are allocated to financially support startup companies. The total funding of USD seven million will be distributed through a matching grants program. This component shall provide two types of grants:

1. Startup matching grants to Georgian companies less than two years' old that are in the early stage of innovative product development, with a monetary value of up to USD 30,000 and 10% of co-financing from other sources;
2. Innovation matching grants for SMEs and consortia that are aiming at developing or adopting innovations that have (independently proved) market potential; the maximum amount of USD 250,000 shall be complemented by 30-40% of co-funding.

It should be mentioned that one of the major EU projects supporting the GoG is Horizon 2020. Horizon 2020 is the largest multinational program dedicated to research and innovation, with a budget of EUR 77 billion for 2014-2020. Until now, Georgia participated in Horizon 2020 as a third country. From 2016, Georgia is an

associated country, which opens up new opportunities to the country's universities, research institutions and enterprises.

FINANCIAL SECTOR LENDING OPPORTUNITIES

TBC – Startuper

TBC Bank introduced the new Startuper program offering startups both financial and non-financial services, such as loans, leases, training, meetings and workshops. The main objective of the project is to stimulate young entrepreneurs to start businesses by creating a startup ecosystem.

Within the scope of the project, the bank intends to issue loans of up to GEL100,000 to innovative startup companies with a performance period of seven years. The project began in February 2017 and granted up to GEL two million in loans for approximately 40 companies.

Bank of Georgia (BoG) – "Female Start Upper"

BoG, in cooperation with EBRD, provides an innovative startup program for women entrepreneurs. The program was launched in December 2016 and is on-going. The total amount of funding is GEL 25 million and finances start-ups as well as current business expansion and development activities.

The submission form is electronic and the minimum loan amount is GEL 10,000. In order to be eligible for the project, a company should be registered as a legal entity and should be managed by a female director or partner.

Besides the access to finance program, it also involves training and monitoring components. Until now, BoG has disbursed up to GEL 500,000 for 20 companies.

ProCredit Bank - Innovfin (EU Finance for Innovators)

ProCredit Bank launched a new program of financing under the Innovfin initiative. Innovfin is a joint initiative launched by the European Investment Bank (EIB) Group in cooperation with the European Commission under the EU research and innovation program "Horizon 2020."

The first agreement was signed between the bank and European Investment Fund (EIF) in February 2017. Under this agreement, EIF offers a bank SME loan guarantees and provides financing opportunities for EURO 50 million. Loans are targeted for innovative SMEs. Until now, ProCredit Bank issued six loans with a total value of up to USD six million. The issuance of an additional USD 15 million is planned. This program targets relatively larger projects and the program portfolio does not currently contain hi-tech startups.

Liberty Bank - Smartex

Liberty Bank, together with the Smartex Group, was the first entity to create a start-up incubator for Georgian entrepreneurs in 2013. E-commerce, telecom and electronic payments were the three main areas of focus.

Overall investment exceeded GEL one million and included 12 projects along with eMoney, Money Movers, eLoan.ge, Swoop and others. Out of those, five comparably large projects were successful, with an overall return on investment (RoI) of up to 300%.

Unison – Startup Insurance

Insurance company Unison offers an innovative insurance package for startup companies and already existing SMEs. The offer includes an insurance policy for a symbolic price of GEL one and grace period of six months. The offer covers property, auto, building and cargo insurance products. After six months, Unison offers a personalized payment schedule to the company.

Crystal – Startup Product

Microfinance organization Crystal has developed a startup program for innovative entrepreneurs. The package offers a loan of up to GEL 5,000 without security, customized repayment schedule, adapted to customers' needs and a training course from Crystal.

The offer includes non-secured loans of up to GEL 5,000, with a 24-month maturity and secured loans of USD 200 – 10,000 with 36-month maturity period.

LOCAL PRIVATE CAPITAL

Holmes & Watson – Startup Call

Advertising agency Holmes & Watson are supporting startups with pro-bono marketing communication. The idea came from a desire to support startups with insufficient resources. The project began in April 2017 and already implemented one project with the Georgian startup Hangi.

Start Business Solutions - Startup Marani

Start is a business consulting firm offering various services to startup firms. Startup Marani is a project aimed at connecting entrepreneurs and investors. Interested entrepreneurs can fill out the application after which they go through a preparation phase and present it to the interested investors. Until now, there have been four supported projects with up to USD 100,000 in total funding.

FOREIGN PRIVATE CAPITAL

In terms of foreign private capital, there are no such opportunities for startup companies at the present time.

R&D

R&D perception as a catalyst for innovative competitiveness and economic growth in developed countries should be cautiously applied in the context of countries in transition. The high-tech first world innovation rarely appears in conditions of constant deficit of investment on genuine R&D. At the same time, advanced technology equipment purchases for the R&D process or for innovative goods/services production is also considered a part of R&D expenditures supporting innovation.

In comparison to international standards of gross expenditure on research and development (GERD) of 3% of GDP, the current rate of Georgia (estimated at 0.2% of GDP in recent international survey, but revised and doubled through the present survey) is acknowledged as insufficient. The recommendations provided in the recent studies focus on importance of identifying the "priority fields of major economic and social impact for the country." [11]

According to the *Policy Mix Peer Review* (PMPR), the definition of the priority fields could include two distinct types of fields:

- Research fields where currently strong research capacity exists, e.g. around best practice examples/infrastructures in the country (mainly biotechnology);
- Research fields that are centered around promising economic fields (niches) in the country, e.g. wine industry and other food products; tourism and other services; etc.

The PMPR recommends to increase the role and influence of Research and Innovation Council headed by the Prime Minister.

Other studies also found prospective projects in the fields of biotechnology, materials science, and electrical engineering.

According to the present study respondents, despite the high valuation in different studies of a biotechnology sector, further commercialization in this area needs capital investments that are currently unavailable. Neither government grants and programs, nor private funding allows to fund commercial piloting worth at least USD one million. This gap could have been addressed by a biotechnology center project, however its planned budget of GEL one million is still below the needed resources.

The high price of scientific equipment is the first barrier to overcome on the road to successful commercialization of innovations in the high-tech sectors. Choosing the right equipment to enable full life-cycle support for the innovation process is another important issue needed to be addressed.

ICT and its new emerging fields of the internet of things, big data and artificial intelligence have not been targeted in Georgia as fields with highpotential. However, they could be considered as cross-cutting features and innovative application of ICT in other (to be identified) priority fields could bring positive results.

[11] Policy Mix Peer Review (PMPR) of the Georgia STI system. 2015

R&D IN GEORGIAN SCIENCE, TECHNOLOGY AND INNOVATION SYSTEM

Georgian Science Technology and Innovation (STI) System

It is important to underline the roles of Governments in supporting national innovation ecosystems, particularly for countries in transition.

Departing from the Soviet system of STI ecosystem organization was quite painful for Georgia. The deterioration of the 1990's has brought the Georgian STI system if not to a full collapsed state, but definitely to dire straits.

Further economic recovery and state building efforts of reforming the government has not been particularly efficient in revitalizing the STI system. The problem was related to a lack of state priorities in supporting science, and sometimes the resistance of "old school" scientists to reforms.

More recently (in 2014), the surviving science and research institutions were moved under umbrellas of five major universities, MoD subsidiaries, MoES and the Ministry of Culture & Monuments Protection (the latter are considered independent research centers).

Before reforms, the Georgian science and technology system was mainly represented by National Academy of Sciences (with 66 research institutions), Academy of Agrarian Sciences (with 12 institutions) and seven State universities.

After reform the following represent the system:

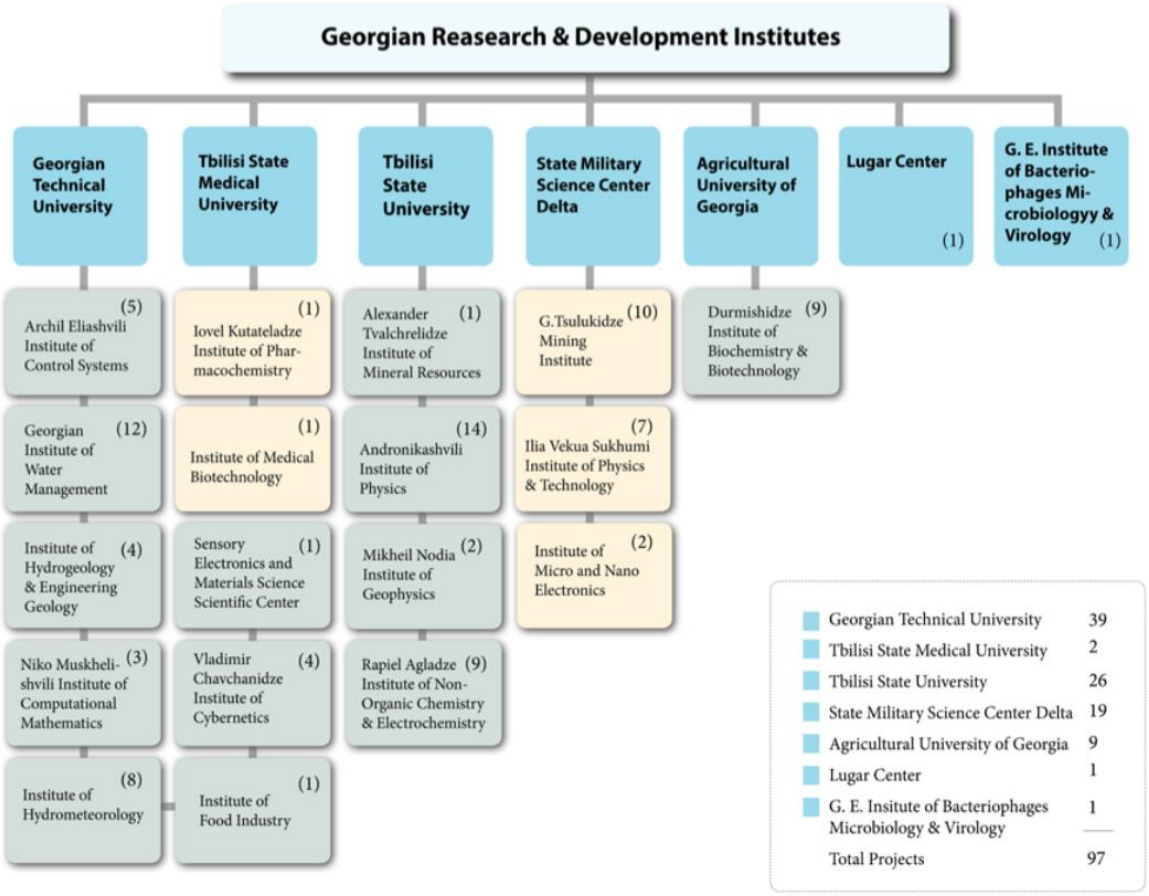
- National Academy of Science;
- Academy of Agrarian Science;
- Five independent research centers;
- 75 higher education institutions, including 32 research universities administering PhD, MA, BA programs (including 13 State universities/LEPLs), 28 teaching universities administering MA, BA programs (including seven state universities/LEPLs) and 15 colleges[12];
- 73 research institutions functioning under umbrellas of several universities or organizations.

Source: Shota Rustaveli National Science Foundation (SRNSF)

It is also worth mentioning that salaries of researchers were increased by 2.5 times commencing in January 2015.

The *Assessment Report of Research & Development Projects of Georgia of 2015* collected projects from Georgian STI organizations and identified several of them having the highest commercialization potential. The chart below shows the number of the initial projects breakdown by the institutions. Basically, it detects the research institutions and clusters that could have potential for further successful commercial applications and spin-offs.

[12] The full list of accredited HEIs http://eqe.gov.ge/eng/static/89/register/hei



According to the report: “All institutes need very early stage (seed level) financing to assist in creating business R&D partnerships and proof of feasibility/prototype development rather than venture capital at this stage.” [13]

Among the identified fields with highest potential of commercialization are:

- Biotechnology, including phages and the world-class expertise at George Eliava Institute of Bacteriophages, Microbiology and Virology; emerging fungal based technologies to generate a biomass from agricultural wastes;
- Physics applications and materials science, including plasma incineration reactor application for waste management; differential scanning calorimeter (DSC) applications for cancer diagnosis, thermoelectric generators and nanotechnology powders to be further researched;
- Pharmacochemistry, including remedy for herpes treatment.

The further optimization or cluster creation of STI institutions working in similar or adjacent domains would have been beneficial to focusing on quality applied research in priority areas.

[13] Assessment Report: Research & Development Projects of Georgia, 2015. Capital City Venture

GOVERNMENT EXPENDITURE ON R&D

According to the Organization for Economic Co-operation and Development (OECD), one of the important indicators in innovation surveys - GERD, is defined as the total expenditure (current and capital) on R&D carried out by all resident companies, research institutes, university and government laboratories, etc. in the country. It includes R&D funded from abroad, but excludes domestic funds for R&D performed outside the domestic economy[14].

The leading player of R&D funding from the public sector is Shota Rustaveli National Science Foundation. Currently the foundation is working on a new strategic document, which will identify the main directions of the foundation:

1) **Grant programs for the research projects** - this direction will include travel and mobility grants, short term internships, joint research programs, bilateral agreements, etc. Also, targeted grants which will be focused on biotechnology and archeology;
2) **Science communication** - popularization of science for society in a more systematic way;
3) **Funding and research internationalization** - this will include the encouragement of scientists in the engagement of Horizon 2020. Here, SRNSF envisions a centralized system of networking with Horizon 2020 instead of national contact points which is a decentralized approach;
4) **Technology transfer promotion** – seeks to actively participate in this process together with GITA and other stakeholders**.**

Source: SRNSF

The data from SNSRF shows the average expenditure on R&D channeled via this main STI funding agency and also provided through international cooperation programs during the period of 2006-2017:

- Total SRNSF Funding: GEL 162 million ~ USD 62 million;
- The main funding sources in international cooperation contributed to the estimated funding of EUR 67.5 million ~ USD 75-78 million.

Total cumulative GDP accounted for USD 144 billion in the same period of 2006-2017.[15] Thus, average foreign investment in R&D accounted for 0.05% of GDP and remains not included into gross expenditure on R&D. Methodologically it might be not considered precise as international science programs are often multi-year, and extracting annual spending data requires additional efforts but it gives a general indicative surplus to the overall indicator.

The total absolute value of science programs and support programs funding from the state budget has steadily increased and accounted for GEL 35,732 in 2013, GEL 49,707 in 2014, GEL 59,857.4 in 2015, and GEL 66,502.5 million in 2016.

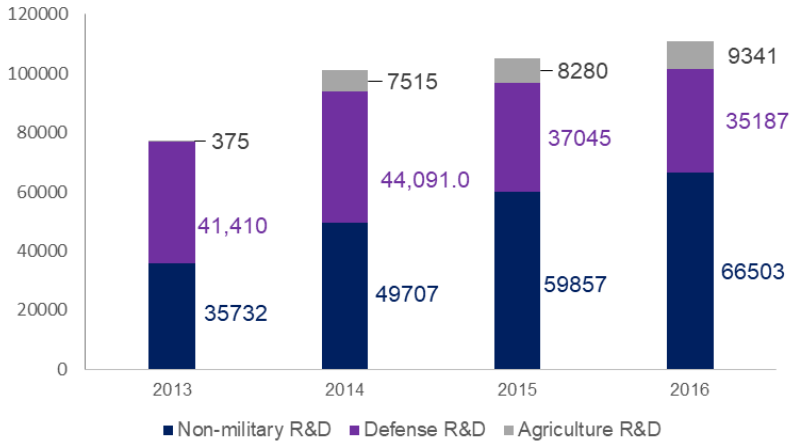
Another state expenditure line often not included in overall R&D expenditure is spending in the defense and agriculture fields. While in many European countries R&D on defense made up a negligible part of government expenditures, which accounted for less than a 0.1 average in the EU[16], for Georgia similar spending is comparable to other government funding on research. In the US defense sector, R&D accounts for 58% of total GERD.

[14] https://data.oecd.org/rd/gross-domestic-spending-on-r-d.htm

[15] https://tradingeconomics.com/georgia/gdp

[16] http://ec.europa.eu/eurostat/statistics-explained/index.php/Government_expenditure_on_defence

Figure 37: Government Expenditure on R&D, mln GEL (Bars), % of GDP (Line)



Source: GEOSTAT/MOF/PMO analysis

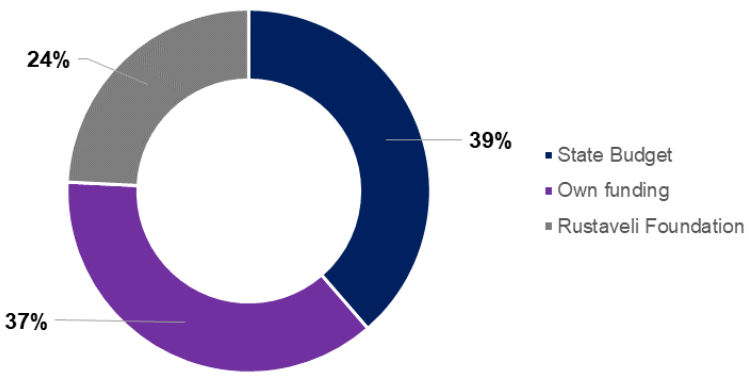
- The government expenditure on R&D (including defense and agriculture during the last three years grew), but incrementally from 0.29% to 0.33% of GDP.
- The total absolute value of science funding and support programs from the state budget amounted to GEL 111 million in 2016.

Since 2014, another state agency provides state funding for R&D. GITA's innovation high-tech grants programs could be considered as an attempt to narrow down the priority areas to 15 high-tech fields (that are subject of the current study).

Another expenditure line that is usually not included in the previous assessments is the resources of universities. In addition to the state budget and international funding, Georgian higher education and research institutions also invest their own funds to support fundamental and applied research.

The example of TSU shows that its own financing is comparable to the state budget financing for the same purpose.

Figure 38: TSU and its Institutes R&D Funding, 2016



Source: TSU, PMO analysis

A more accurate calculation of R&D expenditure indicator allows the authors to suggest that its value should be at least 0.4% of GDP.

BUSINESS EXPENDITURE ON RESEARCH AND DEVELOPMENT

The data from GII and other indexes places Georgia in the insufficient innovators section. Business expenditure on R&D (BERD) has been measured for the first time in 2016 by Geostat as a part of the *Innovations in Companies Survey*, according to the EU adopted methodology of the *Community Innovations Survey* (CIS). However, due to terminology, sampling and response rate/quality issues the data were not fully published and could be considered only as an approximation.

Geostat has also provided preliminary figures of R&D expenditures conducted by Georgian companies. Figures are provided in the table below (million GEL):

Figure 39: R&D Expenditure by Types (Preliminary data)

In-house R&D	External R&D	Acquisition of Machinery and Software	Acquisition of existing knowledge from other enterprises/organizations	Total
15.7	**13.1**	**346.1**	**21.1**	**396.0**

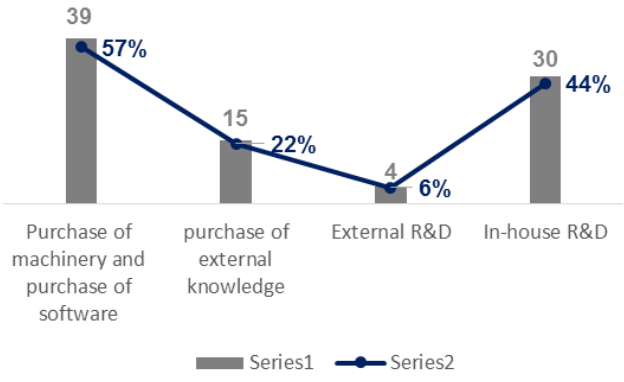
Source: Geostat

The data can be verified once the 2017 edition of the Geostat *Survey on Innovation in Georgian Companies* is published.

R&D indicators for the companies sampled from the high-tech and ICT sectors are relatively high. Namely, in-house R&D is performed by 44% of the companies and 57% have purchased machinery and software for R&D needs.

Distribution of R&D activities types in the surveyed High-Tech/ICT companies

Figure 40: Summary of R&D Categories



Source: PMO Analytics

Detailed data analysis of the sampled companies from high-tech and ICT sector is provided in the appendixes.

BUSINESS-RESEARCH COLLABORATION

The indicator of business-research collaboration places Georgia at a distant 117th place in global rankings. The study also showed that Georgian business is not active in developing partnerships with Georgian research institutions and considering their innovations for commercialization. Public events aiming at presenting university research and innovations did not result in establishing sustainable partnerships. Leading Georgian companies are represented in consultative boards of education institutions and informed about their needs. Sponsorship of events in the domain of innovation and technology is becoming more frequent, but the pattern of regular funding of applied research in STI institutions is not present. Such partnerships could have been productive in food industry where needs for lab testing of products are often essential.

Several international companies have participated in joint projects with Georgian institutions and even developed a handful of spin-offs.

However, the culture of long-term investment in R&D is generally absent among Georgian companies. There are some examples of direct cooperation of large foreign companies in funding Georgian R&D through special projects, but Georgian companies only make first steps in understanding the value of investments into applied research and product development.

The SME innovations direction of the EU Horizon 2020 program is open for Georgian companies and could provide certain incentives for high-tech research commercialization partnerships.

6. GEORGIA IN GLOBAL RANKINGS

The indicators are main contributors to countrywide standing measurement in global innovation and technology reports. They are essential items for maintaining efficient reporting of countrywide trends and statistics, which help international index providers to ease the process of data gathering and quality measurement for performance and impact of Georgia as a country.

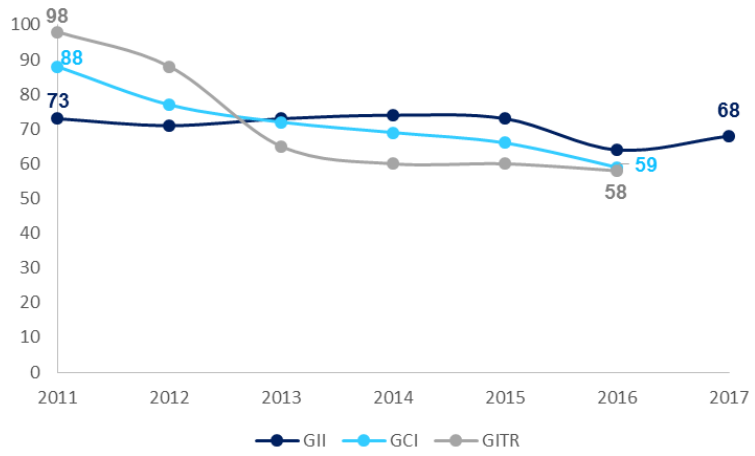
In this chapter, the three most relevant, strong and popular ranking schemes available globally are analyzed. They are:

- Global Innovation Index (GII);
- Global Information Technology Report (GITR);
- Global Competitiveness Index (GCI).

In the last years, Georgia made significant strides in improving its global rankings in technology and innovation related indexes worldwide such as GITR, GCI and GII.

Figure 41 below summarizes Georgia's advancement in global rankings through the period of 2011-2017.

Figure 41: Georgia in Global Indexes



Source: GII 2017, GCI 2016, GITR 2016

As seen above, according to the GITR, Georgia moved up by 40 positions, ranking 58th in 2016 compared to 98th place in 2011, the second largest in the region after Armenia. The improvement in this ranking is captured through various reforms reflected in the respective indicators.

In the GCI, Georgia has the highest improvement in the region (29 positions), from 88th place to 59th during the 2011-2016 period.

In the GII ranking, Georgia is positioned among the ten best ranked countries in the group of lower-middle-income economies together with countries such as Moldova, Ukraine and Armenia. In this index, Georgia has improved from 73rd to 68th place during 2011 - 2017. However, last years' position has worsened by four points due to the better performance of other countries in spite of the fact that the overall country score increased from 33.9 to 34.4.

Although all these rankings have their unique methodology to assess countries' various indicators, they all give a similar profile for Georgia. It is evident that in most of the indicators in environment, infrastructure, R&D, knowledge and education and access to finance related to ICT and technology innovation of the country, Georgia needs to do more in order to progress in rankings. Specific findings and recommendations in this regard are described below:

General Methodology of Forming Indexes

Formation of countries' rankings in global indexes such as GII, GITR and GCI are directly linked to a country's ability to adopt and benefit from leading technologies, increased human capacities, organizational and operational developments and enhanced institutional performance. Global indexes bring together a number of balancing concepts aimed at providing a holistic basis for measuring country profiles in various pillars related to political, regulatory and business environment, human capital and research capacity, infrastructure, market and business sophistication, knowledge, technology and creative outputs. Global rankings are intended to serve not only as a means for determining a particular country's relative response capacity, but also gives a clearer picture of a country's strengths and deficiencies with respect to innovation-related policies and practices.

GII utilizes the framework upon which the model relies on eight pillars made up of five inputs and three outputs that support the factors that enhance innovative capacity and demonstrate results from successful innovation. It uses a combination of objective data drawn from a variety of public and private sources such as the WB, International Telecommunications Union (ITU) and subjective data drawn from the World Economic Forum's annual *Executive Opinion Survey*. The latter helps to capture concepts for which objective data are typically unavailable. Despite its subjective nature, this data is crucial to an adequate understanding of numerous essential factors underlying a nation's innovative performance.

The GII for any given country is calculated by scaling of the values of each variable for the country on a range of 1 to 100. In total there are 82 indicators, out of which 17 is index based, five is survey based and the remaining 60 have different sources for information gathering.

Another prevailing index worldwide, GCI combines indicators that capture concepts that matter for productivity. These indicators are grouped into 12 pillars, out of which three are directly linked to technology and innovation - technological readiness (pillar 9), business sophistication (pillar 11) and innovation (pillar 12). The rest are indirectly influencing country's level of performance with respect to innovation-related policies and practices such as institutions, infrastructure, macroeconomic environment, health and primary education, higher education and training, goods market efficiency, labor market efficiency, financial market development and market size. These are in turn organized into three sub-indexes, in line with three main stages of development as factor driven, efficiency-driven and innovation-driven factors.

The GCI includes statistical data from internationally recognized sources, notably the International Monetary Fund (IMF), the United Nations Educational, Scientific and Cultural Organization and the World Health Organization. It also includes data from the World Economic Forum's annual *Executive Opinion Survey* to capture concepts that require a more qualitative assessment, or for which comprehensive and internationally comparable statistical data are not available.

The indicators are converted to a 1-to-7 scale in order to align them with the survey results, unless they represent value or percent in the report. There are 14 indicators related to technology readiness (pillar 9) and innovation (pillar 12), out of which survey based indicators are nine, and the other five have different sources for information gathering such as ITU (the UN specialized agency for ICTs, ITU is the official source for global ICT statistics) and OECD.

GITR has a similar methodology to GCI. The difference is the number of pillars (10) and individual indicators (53) distributed across the different pillars. All pillars directly reflect the level of a country's performance in ICT policy and practices, penetration, development, adoption and others. There are four sub-indexes: 1) environmental, comparison 2 pillars such has political and regulatory and business and innovation; 2) readiness, comprising infrastructure, affordability and skills pillars; 3) usage, consisting of individual, business and government usage; 4) and impact, including economic and social impacts.

About half of the individual indicators used in the GITR are sourced from international organizations. The main providers are the ITU; the United Nations Educational, Scientific and Cultural Organization (UNESCO); other UN agencies; and WB. Carefully chosen alternative data sources, including national sources, are used to fill data gaps in certain cases. The other half of the GITR indicators are derived from the World Economic Forum's *Executive Opinion Survey*.The *Survey* is used to measure concepts that are qualitative in nature or for which internationally comparable statistics are not available for countries. The *Survey* is completed annually by over 13,000 business executives in all the economies included in the GITR.

The computation of the overall score in GITR is based on successive aggregations of scores, where each indicator is normalized onto a common scale ranging from 1 to 7, unless they represent value or percent in

the report. There are 53 indicators, out of which half of them are derived from the survey and the rest has different sources of information.

Appendix C of this document provides list of global indicators of GII, GCI and GITR together with source of information that are being used by these ranking agencies for each given indicator. The group of indicators are divided based on five dimensions (environment, infrastructure, R&D, knowledge & education and access to finance) giving a reader additional help for subject awareness.

Country's Role in Assisting with Formation of Global Indexes

Availability of verified data, which are used by global ranking agencies, plays a vital role in formation of indexes and ultimately country rankings. Open and reliable data promotes transparency, accountability and value creation by making such data available to its user. Public bodies produce huge quantities of data and information. By making their datasets available, public institutions become more useful in use, reuse and free distribution of datasets. Countries therefore need to develop a framework and establish a methodology of collecting, sorting, verifying and keeping relevant economic, social, business, policy, regulatory and other data and information at the national and sector levels.

Georgia has committed itself to reforms of opening governance, which shall encompass commitments to open data as well. Indeed, a government which is recognized as one of the most transparent in the Europe and Central Asia (ECA) region also had to be on the forefront of the open data movement. But, open data and open government are really not the same thing. Georgia is at the forefront of open government by being very responsive to freedom of information requests and by proactively publishing some data about the work of government ministries and agencies. But, when it gets to open data, Georgia is far from a leading level. In the Global Open Data Index, Georgia is in 49th place among 148 countries. This index measures availability and the spectrum of data provided by Geostat, the Ministry of Finance (MoF) and other government bodies. In order to improve data collection, the government should assign a responsible body which will coordinate proper gathering and validation of data used by global agencies.

Challenges in Gathering Relevant Data Used in Global Indexes

As mentioned above, there are different sources of data provided from the government. But GeoStat is the main source regarding the country's performance data. General statistical data is free however more detailed statistics are fee based. The statistics are sufficiently detailed, but there are some sectors where information is missing or data is not reliable. For example, when measuring the ICT sector, GeoStat was unable to give monetary data on the software publishing, aerospace and automotive sub sectors. Some key ministries and government agencies are not sufficiently responsive to either provide requested data or proactively manage gathering and verifying data used in global indexes.

There are concrete problem cases identified during examination of data used by global indexes for Georgia. Particularly, there are cases were data is unavailable or imprecise, which has a negative influence on the rankings.

In the GII, there are indicators measured for countries such as:

- GERD performed by business, % of GDP;
- GERD financed by business, % of GDP;
- Global entertainment & media market/th pop. (age 15–69);
- Video uploads on YouTube/pop. (age 15–69).

Data for Georgia on these indicators are missing. The first two indicators are based on data collected by UNESCO's Institute for Statistics, which in turn extracts respective numbers from country's reliable sources, such as national statistics and other. In the case of Georgia, GeoStat conducted a private sector survey initiated by GITA. The survey aimed at collecting the information on gross expenditures on R&D performed and/or financed by businesses in 2015, but results were considered as unreliable due to questionable correctness of collected data. This survey is planned to be revised in order to incorporate feedbacks from previous results. However, some feedbacks were not considered due to budget limitations, which still can be a barrier to collect reliable data from survey. For example, such limitation is filtering of firms based on the number of employees, where companies employing less than 10 people are omitted, thus not fully representing a sector of interest.

The same applies to the next two indicators, which are missing in recent GII reports. These data are collected by United Nations Department of Economic and Social Affairs from international reports. For example, the global entertainment and media outlook is measured as a five-year forecast and five-year historic consumer and advertiser spending data and commentary for 13 entertainment and media segments across 61 countries by PWC and the report is fee based. As they have not found this figure for Georgia, they put a score of zero in the GII. The same applies to data on video uploads on the YouTube/pop indicator. This problem can be solved if the GoG subscribes to respective reports.

Lastly, there are indicators, which are based on distorted or outdated data. For example, gross expenditure on R&D, % GDP, where GII relies on information gathered by UNESCO Institute for Statistics, has the value of 0.1%, which is less than real 0.4% found out during the sector study. Also, there are some indicators in the GII 2017 report, where data is taken from old reports (i.e. 2013), which negatively works on ranking improvements as most of Georgia's achievements have an increasing trend and updated data would bring a higher rank in global indexes.

Recommendations for Better Ranking

For the achievement of better rankings in global indexes, Georgia should take a series of improvements based on practical actions:

- Establishment of a responsible government unit, which will communicate with international organizations (the United Nations Educational, Scientific and Cultural Organization and other UN agencies, WB, ITU, World Economic Forum, World Intellectual Property Organization (WIPO), IMF and others) and facilitate them in gathering proper data to be used in calculation of global indexes.
- Division of global indicators by subject and allocation to responsible ministries (i.e. indicators covering the knowledge & education section to be allocated to the MoES, access to finance indicators to the MoF, etc.) for working on improvement of these indicators and verification/validation of existing data.
- Filling the gap of missing global indicators by identifying sources and ways to extract missing data from respective reports.
- Geostat to conduct reliable annual survey of ICT and innovation sector by setting a realistic methodology and also segregate the sub-sector of high-tech and ICT, currently merged with other sectors.
- Ministries and other Government agencies to become more proactive in providing public data to researchers and other stakeholders of the sector.

7. REGIONAL OVERVIEW

Regional overview in an innovation and technology sector study provides analysis of selected countries' innovation and technology at the regional level giving comparability of main indicators and also identifying specificities typical of the various individual nations in terms of innovation ecosystems.

Regional factors can influence the innovative capacity of firms, which leads to increasing interest in analyzing innovation at the regional level. Regional differences in levels of innovation activity can be substantial and identifying the main characteristics and factors that promote innovation activity and the development of specific sectors at regional level that can help in understanding innovation processes, and can therefore be valuable information for an innovation sector study of Georgia.

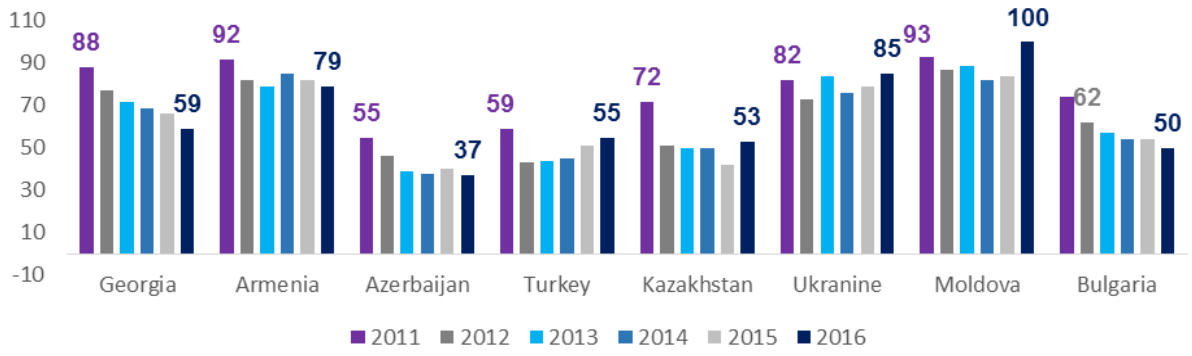
This chapter covers regional and sub-regional trends, analysis of neighboring/regional countries' positions in current and previous rankings, pathways and patterns of their historical improvement and identifying key policy/regulations and economic factors or methodological considerations that impacted the indicators.

Selection of specific countries to be analyzed in the region in this study was based on comparability of countries in terms of size, economic development, neighborhood, trade balance with Georgia and level of innovation and technology.

Considering the above-mentioned criteria, the following countries have been selected: **Armenia, Azerbaijan, Turkey, Ukraine, Bulgaria, Kazakhstan, Belarus and Moldova.**

Selected countries' positions in current and previous rankings are provided in the graphs below.

Figure 41: GCI by Selected Countries



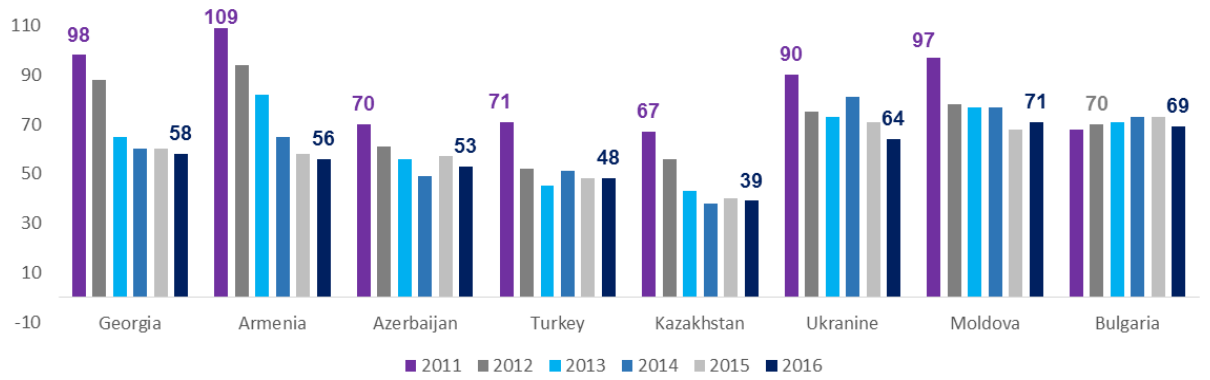
Source: GCI

As seen from this graph, Georgia has the highest advancement in terms of position in GCI, improving its ranking from 88 to 59 (out of 138 countries). Results were affected by good achievements in indicators including, macroeconomic environment, market efficiency, financial market development and technological readiness (internet bandwidth). However, there are indicators where Georgia has to work for improvement, such as financing through local equity market (130th), venture capital availability (94th), availability of latest technologies and firm level technology absorption (111th), technology transfer and domestic market size (99th), local supplier quantity and quality (132 and 116 respectively), state of cluster development (122nd), capacity for innovation (105th), quality of scientific research institutions (118th), company spending on R&D (123rd), university-industry research collaboration in R&D (119th) and availability of scientists and engineers (115th).

In this index, Azerbaijan holds the leading position (37th) among selected countries in the region, mainly benefiting from a strong macroeconomic environment, favorable public finances and labor market efficiency. However, this report does not reflect the recent crisis taking place in Azerbaijan and neighboring economies, which shall have a negative influence on current rankings and presumably the next few years.

In another global ranking report - GITR, the figure below shows a comparison of regional countries' rankings:

Figure 42: GITR by Selected Countries



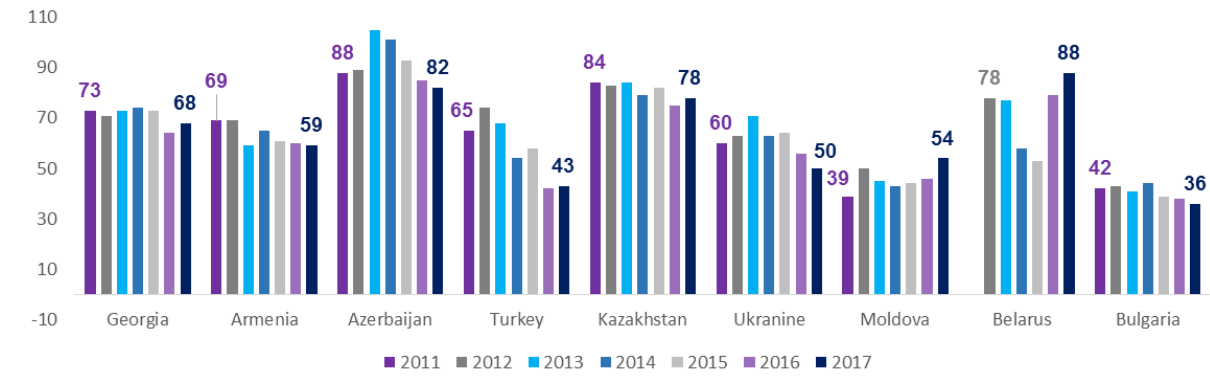
Source: GITR

As seen from the graph above, Georgia moved up by 40 positions, ranking 58th (out of 139 countries) in 2016 compared to 98th place in 2011, the second largest move in the region after Armenia. This advancement was reached due to better performance reflected in indicators such as ICT use and government efficiency (26th), adult literacy rate (10th), internet and telephone competition (1st), total tax rate % of profits (8th), pre-paid mobile cellular tariffs (18th), number of days to enforce the contract (8th) and government online service (49th). However, there are weak positions identified in indicators such as impact of ICT on business and organizational models (102nd and 116th), IP protection (101st), software piracy rate, % software installed (102nd), venture capital availability (119th) that Georgia needs to improve to see more advancement in the ranking.

The region is led by Kazakhstan, continuing its positive trajectory of recent years to land in 39th place. Improvements are observed across all four elements that make up the index - environment, readiness, usage, and impact.

In another very powerful and popular global index, GII, regional country performance looks as follows:

Figure 43: GII by Selected Countries



Source: GII 2017

In **GII**, Georgia is positioned among the ten best ranked countries in the group of lower-middle-income economies, together with the countries such as Moldova, Ukraine and Armenia. As seen, Georgia has improved from 73rd to 68th place. However, last years' position has worsened by four points due to the better performance of other countries in spite of the fact that the overall country score increased from 33.9 to 34.4. Indicators where Georgia has a relatively strong position are ease of starting business (8th), gross capital

formation % GDP (10th), ease of getting credit (7th), pupil-teacher ratio in secondary education (4th), applied tariff rate (5), foreign direct investment, net inflows (12th) and printing and publishing manufacturers % (7th). However, there are Indicators which are hindering advancement of Georgia in ranking, such as expenditure on education % GDP (114th), gross expenditure on R&D % GDP (104th), average expenditure on R&D of the top three global companies (43rd), logistic performance (118th), market capitalization (80th), firms offering formal trainings % firms (89th), university industry research collaboration (107th), state of cluster development (111th), IP payments (101st) and ICTs & organizational model creation (107th).

The region is led by Bulgaria, a middle-income country ranked 36 among 128 countries, remaining still closest to top high-income country groups. Main contributors of such advancements are indicators from business sophistication, knowledge and technology output pillars such as gross expenditure on R&D financed by abroad and ISO 9001 quality certificates (3rd), new business density (13th) and others.

A description of the ecosystems of each of the countries selected is given in five-dimensions comprised of - **environment, infrastructure, knowledge & education, R&D** and **access to finance.** Detailed analysis of each dimension is provided below.

ENVIRONMENT

This section describes the main factors that impact sector development of selected countries. Primarily they are general economic picture, as well as innovation and technology sector contribution in the whole economy of the country. This part also comprises policy and regulation issues, cultural background and others.

Armenia

Armenia has retained its potential for technology development. It was regarded as a hub for software development, industrial computing, electronics, and production of semiconductors, even under the Soviet Union.

Armenia's ITC industry's total revenue, which consists of the software and services sector and the internet service provider sector, reached USD 559.1 million in 2015, an increase of 17.7% over 2014's total of USD 474.9 million.

Key figures in the region related to environment of the country as of 2016 are given below:

Figure 44: Key Figures – Environment

Source: GII, GCI and GITR report 2016

Armenia's competitive technical workforce creates a favorable investment climate for large ICT companies and multinationals. ICT companies specialize in embedded software development, semiconductor design, customized software, outsourcing, financial software, multimedia, web design, information systems, and

system integration. Armenia has made significant gains in semiconductor design and the creation of related IP.

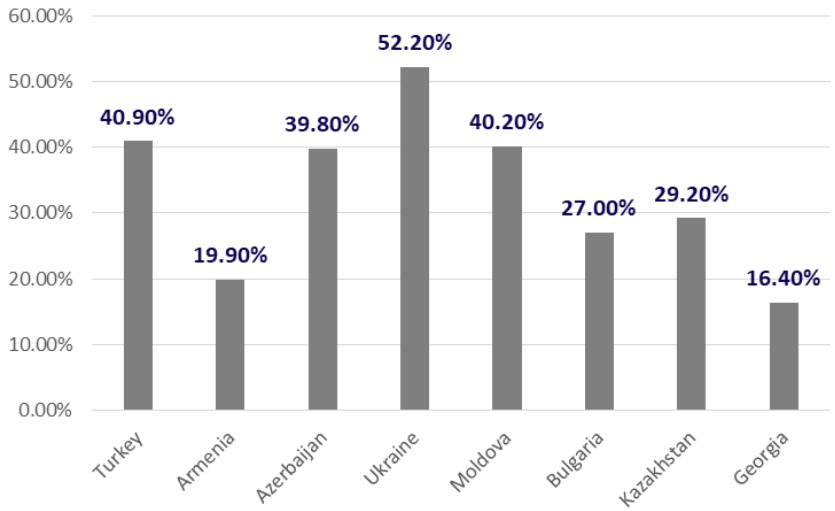
Today, about 450 ICT companies operate in Armenia, generating an average annual growth of 10%.

In late 2014, the country adopted a legislative package on state support to IT, which became successfully enforced the following year. Aiming to promote startup company formation and new job creation, Armenia also adopted and enacted the Law on State Support to Information Technology Sphere such as tax privileges for newly established and startup entities, including a 0% profit tax rate and a 10% income tax rate.

In addition to these legislative reforms, Armenia has furthered previous efforts in various areas, including the development of the business environment for IT companies, through undertakings with respect to tax privileges, foreign trade, investor protection, property registration and others.

Key figures in region related to tax rates as of 2016 are given below:

Figure 45: Tax Rates by Countries, 2016



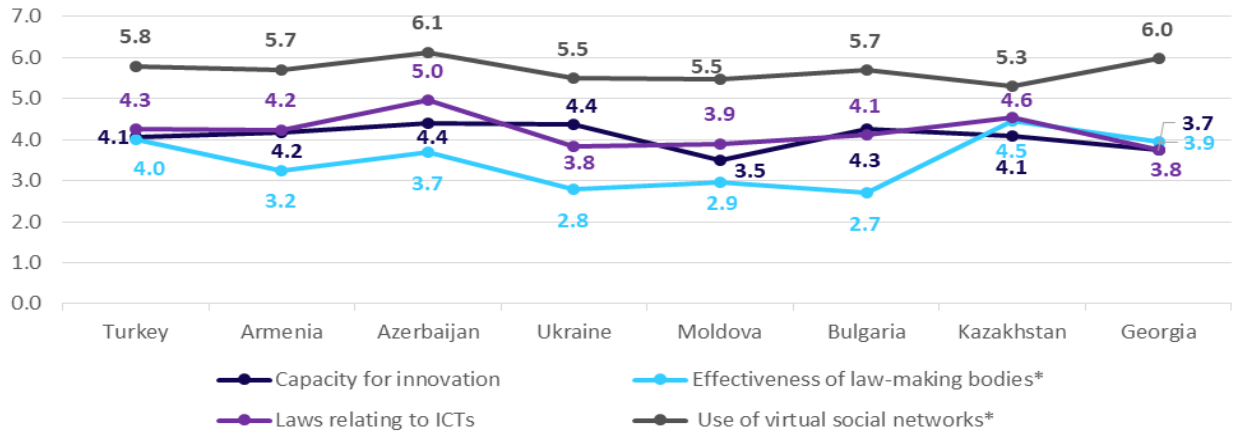
Source: GII, GCI and GITR report 2016

The Government of Armenia implements targeted projects for the development of IT sector infrastructure, such as reconstructing Gyumri to be a techno-city known for being a business environment with large educational institutions, research centers and strong facilities for development, testing, and realization of innovative information and high-tech projects, a capacity for starting large-scale production and small and medium high-tech companies.

In 2012, the first free economic zone (FEZ) was established in Armenia, pursuing the goal to contribute to the increase in export volumes and creation of new jobs, as well as to ensure sustainable economic development through attracting FDI and introducing advanced technologies. FEZ is oriented to the production and export of innovative and high technologies in the field of electronics, precision engineering, pharmaceuticals and biotechnologies, information technologies, alternative energy, industrial design and telecommunications.

The Armenian IT/High-Tech Representative Office was officially launched in December 2012, at Plug & Play Tech Center in Silicon Valley, California. The office operates as a hub to foster the development of sales and investment opportunities for Armenian IT and high-tech companies in the US.

Figure 46: Government Effectiveness in Creation of Technology and Innovation, 2016



Source: GII, GCI and GITR report 2016

Azerbaijan

Azerbaijan's national innovation system is still immature and underdeveloped. Many of the central pillars that are typical of innovation systems in mature economies are non-existent in Azerbaijan. In particular, so far, the authorities have not prepared a national innovation strategy or plan, nor has any coherent national innovation policy framework in place.

Share of the ICT sector in non-oil GDP was 3.3% in 2013. The proportion of jobs in the services sector of the domestic IT industry, as well as the industry's contribution to GDP is small.

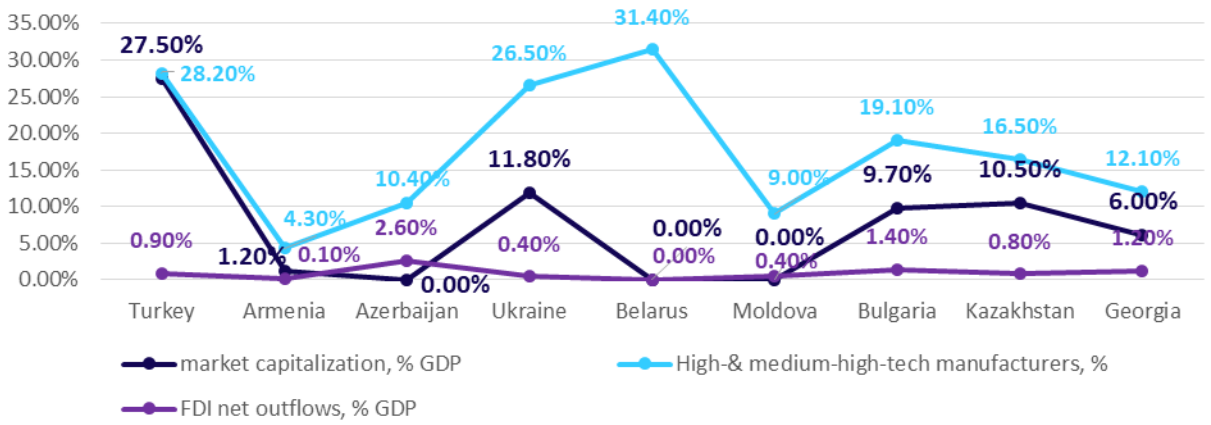
Azerbaijan's government recognizes, however, that the country faces some long-term challenges, including an over-dependence on oil exports, a concentration of employment in only a few sectors, and a rapidly growing population of young people entering the labor market in the coming years.

Consequently, the government has shifted its focus recently to a range of policies that include diversification of the economy and increased investment in ICT. Identified as an important future contributor to non-oil GDP, the ICT sector could help to facilitate the country's transition into a successful knowledge economy by 2020.

Azerbaijan's ICT sector has been expanding at an average rate of 25-30% per year since 2005, stimulated largely by modernization and extension of the national telecom infrastructure, and implementation of e-governance, among other sector-specific policies. Overall development of the country's ICT sector has been fueled mostly by the telecom industry, especially by its mobile segment.

Key figures in the region as of 2016 related to market sophistication and high and medium-high-tech firms' participation is given in the table below:

Figure 47: Key Indicators – Environment



Source: GII, GCI and GITR report 2016

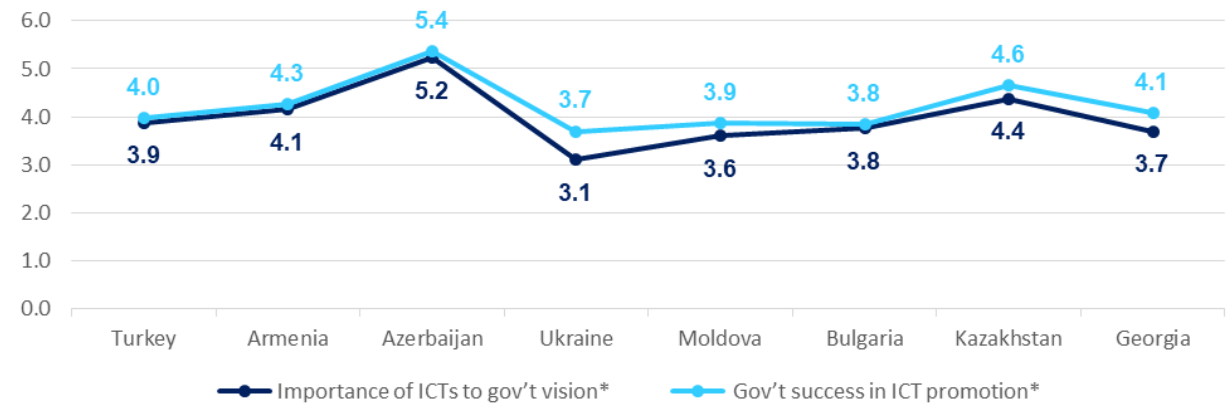
The framework conditions for R&D and innovation in Azerbaijan have not been particularly supportive. With very few recent exceptions, mostly related to ICT, the framework conditions offer no particular incentive for engaging in this type of activity or, for that matter, in entrepreneurship in general.

In terms of public bodies tasked to promote innovation, the responsibilities regarding the support of innovation and R&D activities are dispersed among different bodies but in a limited context as compared to mature economies.

Recently, government assigned high priority to ICT. Particularly development of the ICT sector has been defined as a long-term strategic goal for Azerbaijan. For this purpose, an ICT development fund has recently been established, but, innovation and innovation policy have often been on the Government's agenda. Authorities have not developed either a formal national innovation strategy or a coherent innovation policy framework so far.

Key figures in region as of 2016, related to Governments' effort in ICT sector development is given in the table below:

Figure 48: Key Indicators – Environment



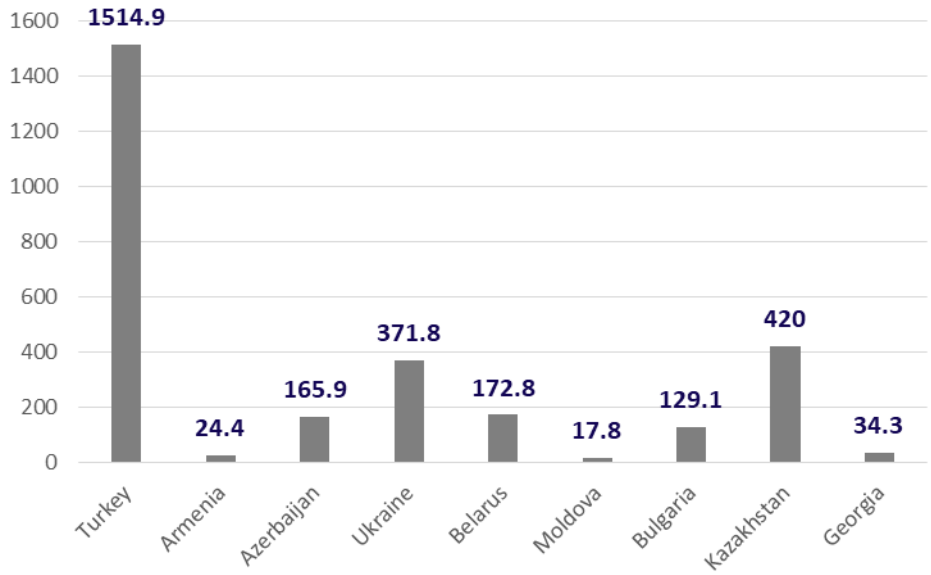
Source: GII, GCI and GITR report 2016

Turkey

Turkey has experienced profound economic transformation over the last decade and its economic fundamentals are quite solid. It is the 17th largest economy in the world and the 6th largest economy in Europe with a current GDP of approximately USD 733 billion in 2016.

Domestic market scale in absolute figures in region as of 2016 is given in the below chart:

Figure 49: Domestic Market Volume, Billion USD, 2016



Source: GII, GCI and GITR report 2016

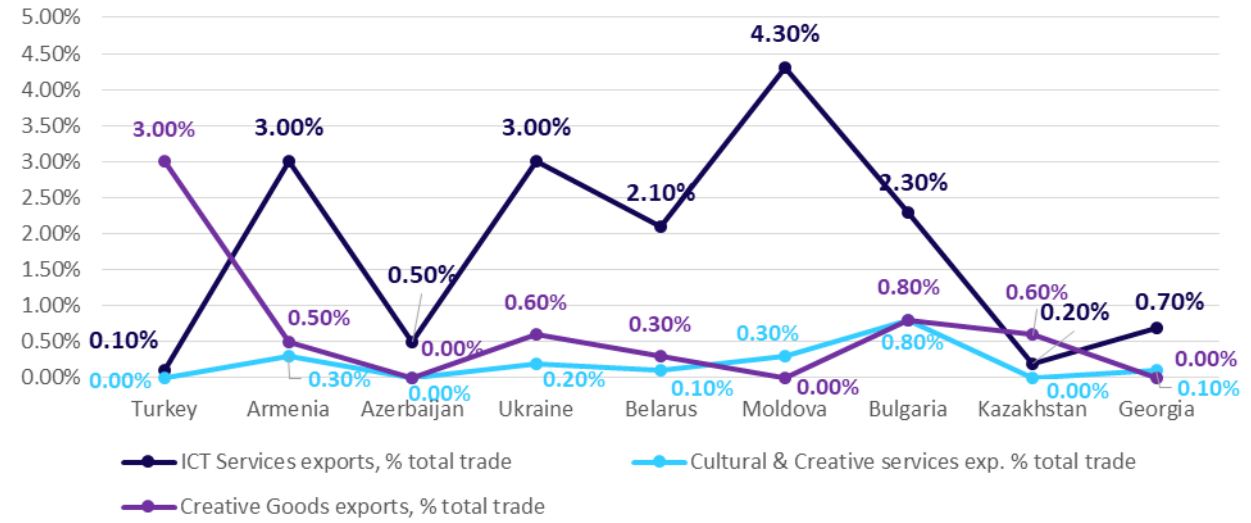
The government is focused on improving the ICT sector by 2023, with the goal of reaching an ICT sector size of USD 160 billion and sector share of 8% of the GDP. Since the 1990s, 36 technology development zones have been built and 14 more are under construction for a total of 2,209 companies.

Turkey has been chosen as a regional hub by many market leaders including Microsoft, Intel, Hewlett-Packard as well as others. These companies chose Turkey as a hub not only because of geographical reasons, but also because of its demographic advantages.

Stable economic growth and recent data on the correlation between increasing GDP and ICT spending in Turkey shows that the ICT sector has a promising future having ICT market size around USD 30 billion in 2015 and growth rate of 18% between 2014-2016. However, its export share in total trade is one of the weakest in the region. A relatively high share is in creative goods export.

Key export figures in ICT in the region as of 2016 are given in a chart below:

Figure 50: Regional Figures of ICT Indicators



Source: GII, GCI and GITR report 2016

With a broad classification including all technology spending in Turkey, the total spending is expected be around USD 53.5 billion in 2017, with a CAGR of 12.65% between the years 2009-2017.

Ukraine

Despite recent political turmoil and war in the east, the Ukrainian IT sector demonstrated record growth in 2015. The investment market reached an unprecedented USD 132 million in total volume, demonstrating a 240% growth from previous year, when the market shortened by over 55% due to instability in the country.

Recognizing the country's highly skilled workforce and its comparatively lower costs, there are over 4,000 IT companies and more than 300 internet providers employing approximately 100,000 programmers, administrators and consultants.

Foreign investors kept interest in the Ukrainian tech sector, making or leading more than 40% of the funding deals in 2015.

The ICT sector is very promising. Recognizing the country's highly skilled workforce and its comparatively lower costs, a significant number of Ukrainian specialists have international education or job experience abroad.

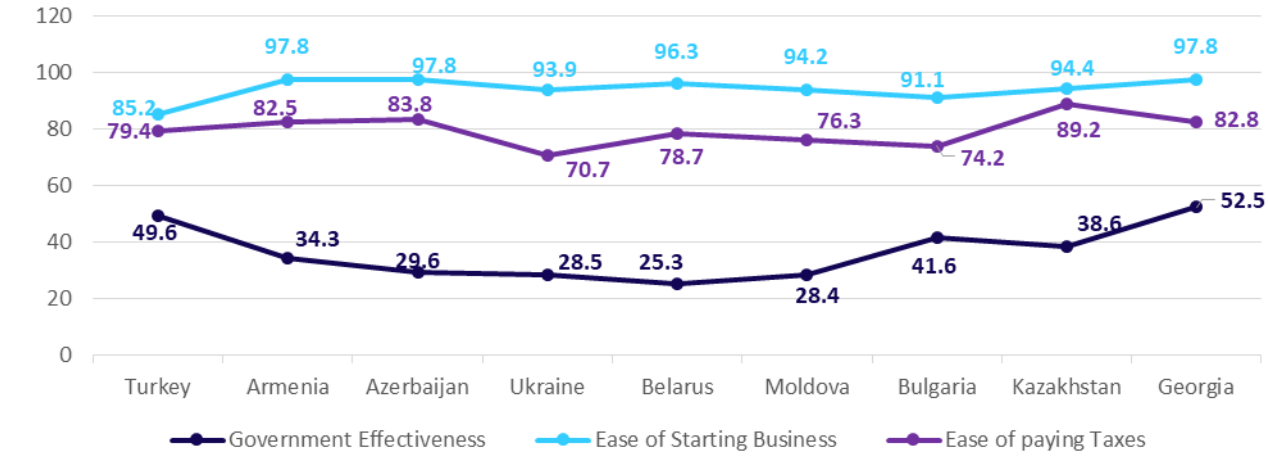
Ukraine's taxes for the IT sector are comparatively lower than in most developed countries. Employers do not pay taxes on salaries and the employee pays a fixed rate of only 4% of his or her earnings. VAT is also exempt.

The government launched several initiatives to increase access to communication services and reinforce the country's innovation capacity.

The 2014-2015 period was marked by a government push for reforms. The IT sector played a major role in the design and implementation of some of the most important reforms, including those addressing deregulation and e-government.

Key figures in economic environment in region as of 2016 are given below:

Figure 51: Key Indicators - Economic Environment, 2016



Source: GII, GCI and GITR report 2016

R&D and innovation are considered a priority in the "Program of Economic Reforms" for 2010-2014 comprising of increased budget for basic and applied research, development of public private partnership (PPP) in the R&D and innovation sector, improvement of the innovation infrastructure, support to innovative activities and negotiations for the accession to the European Research Area.

Ukraine has the largest number of IT professionals in Central and Eastern Europe (putting aside Russia); its IT engineering work force is expected to double and reach 200,000 by 2020.

Ukraine has the cheapest and largest engineering labor force in Europe with average developer salary of USD 1,600.

Ukrainian outsourcing companies offer a wide range of engineering capabilities. The export volume of Ukraine's software development and IT services reached at least USD 2.5 billion in 2015, showing double-digit growth year after year. The US market is the main destination with an estimated 80% volume of exported services.

EU-funded project "Inno-Policy Ukraine" promotes regulatory and legislative improvements for research, innovation and IP, and "Inno Enterprise," which aims at bridging the gap between research and production; other initiatives such as "Technology Commercialization for SME Competitiveness" also has to be mentioned with the aim of awareness raising, match-making and funding of new partnerships between Ukraine's research sector and SMEs (USD 2,000 vouchers to jointly commercialize near market-ready technologies).

Bulgaria

Bulgaria had a well-developed ICT industry back in the 1970s - based on massive investments in hardware production for the ex-Soviet economic block. After the collapse of the system, many well educated and experienced IT, communication and software engineers immigrated to Western Europe and the USA and the government regulated IT industry disappeared.

Nowadays, Bulgaria has all ICT subsectors grouped in 3 major areas - communication, hardware/electronics and software products & services. The total amount of the market is around EURO 4 billion and is more or less equally distributed between those three areas. Revenue from the ICT sector amounts to about 10 % of the total GDP.

New opportunities exist in the ICT sector as Bulgarian companies work to increase their competitiveness in the EU and as the Bulgarian Government complies with EU directives and legislation concerning its digital economy.

The Bulgarian software sector is very much expected to continue its internationalization, mainly focusing on product innovation development rather than on the pure service side.

Currently, the software industry is employing more than 20,000 software engineers and another 35,000 are employed by the newly developed outsourcing sector (business process outsourcing (BPO), information technology outsourcing (ITO), tech support, etc.). Software is one of the fastest growing sectors. It boasts continuous growth from 0.57% of GDP in 2005 to 1.74% in 2014 (forecasts) in absolute terms from USD 200 million in 2005 to USD one billion revenue in 2014.

In 2013, the year to year increase was 11%, and for 2014, a 15% increase is forecasted. Sixty-five percent of revenues are from export – mainly to the rest of the EU and the US.

Better online public services will enable Bulgarians to interact with public authorities and provide the government with more resources (filled-in forms, for example), where Bulgaria is the second lowest in the EU.

International ICT companies find Bulgaria attractive because of the zero percent export tax, low operating costs and a skilled local workforce. More and more foreign companies are opening global call and service centers in Bulgaria as they move their operation out of India to Bulgaria, for example.

Government tender opportunities exist for EU-mandated IT solutions to include computers, peripherals, data centers, software, servers and other hardware technologies and integration services

Government and private companies have undertaken various information and communication initiatives.

EU funding is available for innovations, for the implementation of the hybrid government private cloud, for the national e-identification project, for rural development by providing broadband access throughout Bulgaria, e-government services and other ICT projects.

Kazakhstan

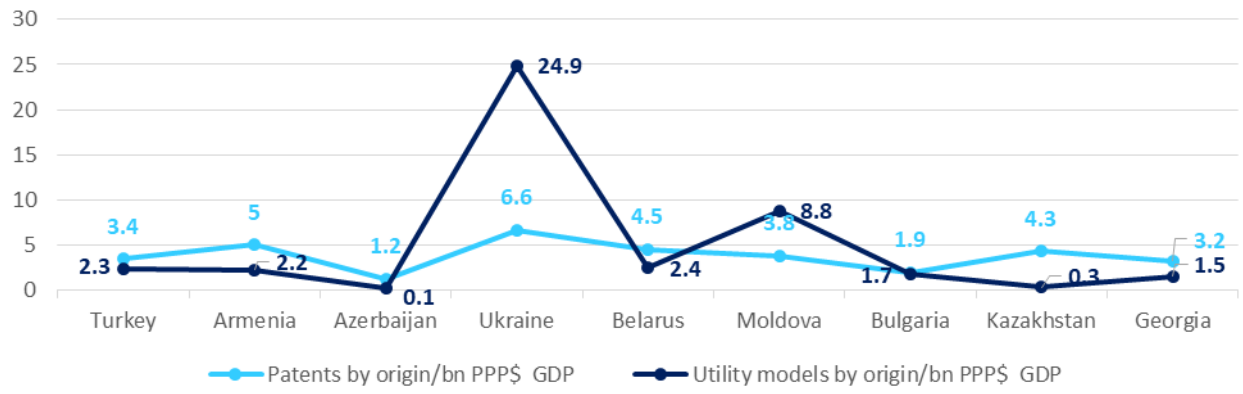
Kazakhstan plays an important role in the world economy and politics due to its geographical position on the border of Europe and Asia, and also between dominant participants of international relations, Russian Federation and China. Kazakhstan has the world's ninth largest geographic area with considerable mineral and other natural resources such as oil and gas. The country is in a state of transition, from traditional heavy industry and commodity sectors to a more sustainable economy based on science and technology.

The Government's plan for scientific and technological development of the country was approved in 2010, with the aim to maximize the national welfare of the Republic of Kazakhstan, as well as to build the platform for the development of new industries, based on emerging new scientific knowledge and technological areas.

According to *Global Innovation Technology Report 2016*, Kazakhstan leads the Eurasia region with notable improvement observed in elements such as environment, network readiness, technology usage and impact, holding the 39th position among 143 countries advancing from 43rd position in 2013. However, obstacles in the pathway of transition still exist, mainly these are low market potential for high technology products, the low level IP legislation, the lack of a system that provides private capital access to the domestic and world markets of high-tech development, challenges in an entrepreneur's transfer of rights to create new industries on the basis of foreign patents and licenses, and establishment of grounds for the commercialization of technological developments.

Some of the key figures as of 2016 in technology usage and impact are given in the chart below:

Figure 52: Key Indicators – IP



Source: GII, GCI and GITR report 2016

The Government of Kazakhstan has taken on a number of reforms to ensure effectiveness of the public administration system, availability of information, communication infrastructure, creation of an information environment for socio-economic and cultural development of society.

By the *GITR Report 2016*, Kazakhstan is in 33rd place among 139 countries by government success in ICT promotion. In overall environmental sub-index (comprising political and regulatory environment, as well as business and innovation environment), the country is in 47th position.

Kazakhstan set targets for 2020 in the following directions: Kazakhstan in the Doing Business rating of the WB should be in the list of the first 35 countries, in the index of "e-government" should be among the first 25 countries, availability of information and communication infrastructure in households of Kazakhstan to reach 100% and the number of internet users in 2020 - 75%, the share of the ICT sector in the country's GDP should be 4%, the share of scientific and educational institutions connected to the unified national scientific and educational network - 100%, the level of computer literacy of the population - 80%, the share of turnover of Kazakhstani online stores in the total turnover of goods and services, paid electronically - 40%, and the share of public services provided in electronic format - 50%.

As a result of actions taken in the period of implementation of the program for 2013-2015, so far the following indicators were achieved: “Doing Business" in 2015 - 41st place, "e-government" in 2014 - 28th place, the share of households with access to the Internet in 2014 - 86.9%, share of the ICT sector in GDP in 2015 - 3.9%, the level of computer literacy in 2015 - 74.2%, the share of turnover of Kazakhstani online stores in the total turnover of goods and services, paid electronically in 2014 - 7.8%, in wholesale trade via the internet in 2014 - 49.9%, and services via the internet in 2014 - 53.1%.

The volume of the ICT market for the period of 2011-2015 amounted to USD 29.25 billion. At the end of 2015, the volume of the ICT market amounted to USD 4.4 billion. The percentage of telecommunications and IT markets is 70% to 30% per year in favor of the telecommunications market. Both markets have progressed steadily from year to year, despite the fact that in 2015 the market showed only 1% growth compared to 2014.

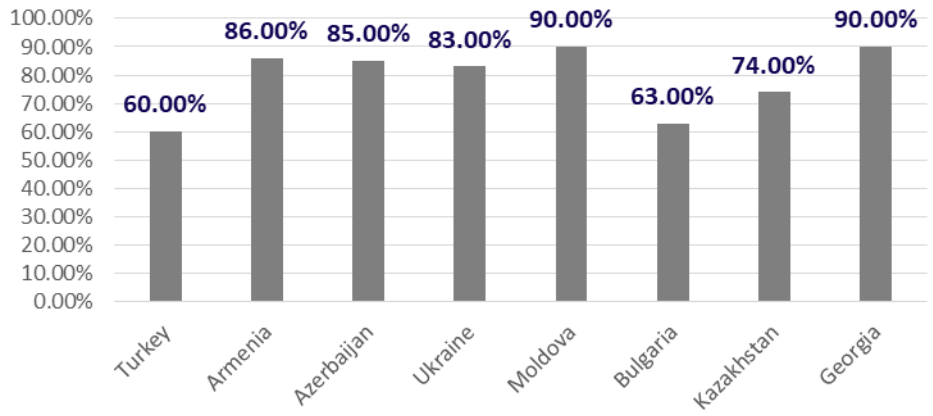
The share of the ICT sector in GDP of Kazakhstan is steadily rising, reaching 3.9% of the total volume by 2015. The percentage of the IT market for five years has changed as follows: IT equipment sector in 2011 58% and in 2015 54%; IT services sector in 2011 and in 2015 38%, sector of licensed software in 2011 4% and in 2015 8%. The volume of exports of goods and services of ICT in 2014 showed an increase of 290% compared to 2011, reaching a level of USD 547.1 million. However, in 2015, the level of exports decreased more than two times.

At the same period, IT services and licensed software sectors increased annually, but IT equipment sales volume decreased by 13%. This decrease was due primarily to the reduction in budgets for the purchase of IT equipment in the market, including the public sector. Therefore, as a response, suppliers of equipment are

encouraged to sell equipment in combination with services, including the construction of an integrated IT infrastructure for enterprises.

The chart below demonstrates figures about the software piracy rate, % software installed as of 2016 in the region:

Figure 53: Software Piracy Rates



Source: GII, GCI and GITR report 2016

Belarus

Belarus is known on the global scene as one of the recognized centers for offshore programming. The Republic of Belarus is among the leaders in exports of computer and information services per capita. This indicator increased from USD five per capita in 2005 to USD 79 per capita in 2015. The indicator of Belarus is more than three times higher than that of Russia and Ukraine.

Ten Belarusian companies were included in Software Magazine's Software 500 ranking of the world's largest software and service providers.

The growth rates of software exports increased by 322% in 2015 compared to 2010.

Personnel costs in the Belarusian IT-industry are lower than in many outsourcing centers of Central and Eastern Europe and comparable with many Asian countries. The salary of Belarusian IT specialist amounts to USD 9-22 per hour, which is considerably lower than in other leading countries in the region. In that context, the emigration problem arises, when highly qualified programmers move from Belarus to other countries with a higher salary.

The number of IT-specialist working in high-tech parks of Belarus amounted to 24,037 at the end of 2015. The share of IT-specialists per capita in Belarus is much higher than in other countries of Central and Eastern Europe.

Belarus adopted a state policy in the IT-industry as early as 1999. Since then, the government has enacted a number of laws to regulate and develop the IT Industry, protect social and national interests within the information sphere, and to create favorable conditions for further development and to improve quality and availability of the information related to operation of the state administration and other organizations

Favorable tax conditions are created for the IT-industry in Belarus. The Republic of Belarus has concluded double taxation agreements with 65 countries, including most Western European countries, the Baltic states, the CIS countries, China, South Korea and Japan.

According to the *Information and Communications Technology Development Index* (IDI), Belarus is ranked 36th internationally. Belarus has been a leader in the region for the second consecutive year. Since 2010, Belarus is among 10 the most dynamically developing countries in the field of ICT. The Belarusian

government has adopted an ICT development program for the period of 2016-2020, and is planning to implement major projects valued around USD one billion.

ITU's *ICT Price Basket* (IPB) index, which is used to monitor the affordability of ICT services, such as cost and affordability of fixed, mobile and fixed broadband services, Belarus is among the leading countries, being followed only by Russia in the CIS.

The Government launched a high-tech park (HTP) project in 2005. The first residents were registered in June 2006. Currently, 164 IT companies with over 27,000 software engineers are registered as residents of the HTP. More than 60% of them are foreign companies and joint ventures. About 3,000 new jobs are created in HTP companies annually. The HTP provides a special business environment for IT business with special taxation conditions until 2020. Residents are exempt from all corporate taxes, including value added tax (VAT) and profit tax. Individual income tax has a fixed rate of nine percent for HTP resident companies.

However, according to the internet freedom ranking compiled by international human rights watchdog organization Freedom House, Belarus does not belong to the list of free countries. Human rights advocates have found barriers to internet access in Belarus, as well as censorship (limited access to political information, in particular) and violations of user rights.

Moldova

With GDP per capita EUR 4,627, Moldova attained notable improvement observed in elements such as environment, network readiness and technology usage and impact, holding the 68th position among 143 countries advancing from the 77th position in 2013.

Moldova has the lowest labor cost in Europe as well as a small tax load on personal and corporate income taxes. The cost of living is also lowest in the region with the capital city Chisinau as the cheapest city in Europe. CIT is as low as 12%, while incentives for the IT sector include exemption from most taxes. Recent successes in EU cooperation pushed the country to start important reforms in an association and free trade agreement in harmonization of rules, FP7/H2020 association in strategy development, with the use of foresight and external expertise, in innovation ecosystem creation. Despite the country's efforts, the innovation ecosystem still faces important problems such as low funding, aging of R&D personnel, etc.

The ICT sector in Moldova is primarily in a build out phase. It is regarded as among the most dynamically developing sectors of the national economy with major investments focused on basic hardware infrastructure, such as server, storage, infrastructure software, and network equipment implementations. In the long term, the IT services sector is expected to be driven primarily by large government projects, such as new e-government initiatives and technology investments in highly competitive sectors (banking and telecommunications, e.g.) and initiatives that support the alignment of IT with business goals.

With double-digit growth rates, ICT is one of the fastest sectors in Moldova reaching USD 403.8 million which amounted to 6% of GDP in 2015. Export of ICT services reached USD 200.3 million in the same period. These figures are expected to double in the upcoming years. Proportionally, Moldova is also very competitive in terms of skilled ICT professionals with 21,000 employees.

The Government of Moldova initiated a strategic direction and specific schemes related to IT development in the country, such as "Digital Moldova 2020" and "ICT Competitiveness." According to these strategies, the country has a plan to increase the ICT sector position within the global value chain. This includes: increasing exports of ICT products and services; upgrading the national infrastructure through greater involvement of the private sector; strengthening IT skills through education to ensure adequate resources for ICT sector development; increasing technological parks and incubators in the ICT field and to attract international companies; sector stimulation through public procurement; creating specific advantages for ICT companies such as 0% corporate income tax and 0% income tax on all IT staff; a low flat rate for social welfare payments for employers; and the e-Government Centre initiative (2010) and aiming at improving access for citizens to public information.

INFRASTRUCTURE

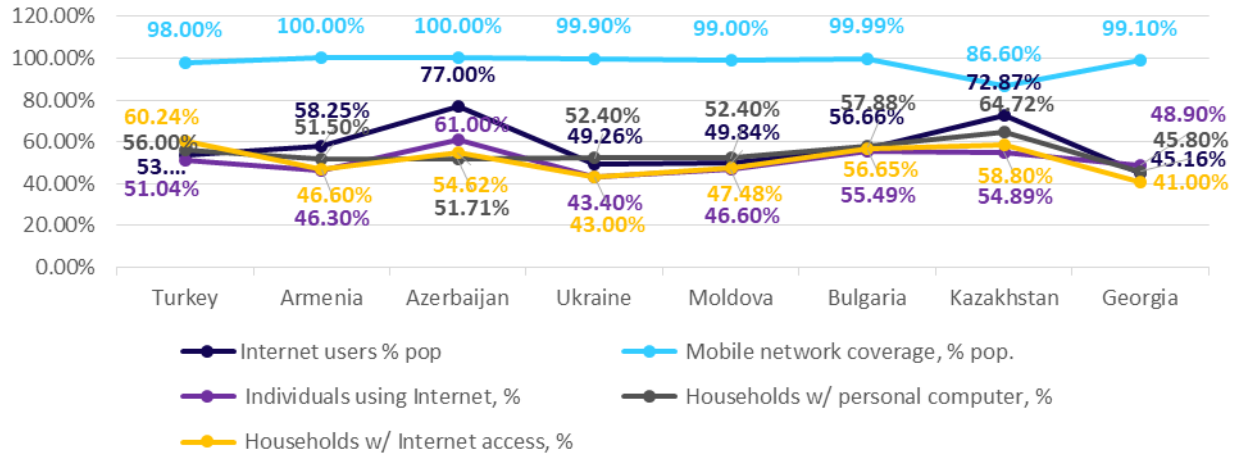
This chapter analyzes the level of infrastructure in selected countries related to high-tech and ICT development, such as internet and computer coverage, e-governance, number of tech parks, labs and other important means countries should create to support development of the innovation and technology ecosystem.

Armenia

A number of efforts have been undertaken by the Government of Armenia, including ensuring the possibility of an electronic business registry system. These improvements help to significantly reduce the time required to register shareholder companies, minimize citizen-state entity contacts and documentation requirements, reduce the time and cost for state registration of changes, and streamline the entire process.

The internet coverage has maintained its trend of positive change through 2015, with the number of internet users reaching 2.2 million i.e., about 69% coverage. This number includes mobile, broadband and internet. The chart below demonstrates main figures of technology infrastructure of Armenia and regional countries.

Figure 54: Key Indicators – Technology Infrastructure



Source: GII, GCI and GITR report 2016

In Armenia, 43% of internet service providers are foreign-owned companies. Internet providers offer the following services in the domestic market: asymmetric digital subscriber line (ADSL); fiber-optic and cable access; WiFi and WiMax wireless technologies; general packet radio services (GPRS); enhanced data GSM environment (EDGE); code division multiple access (CDMA) and 3G technologies (universal mobile telecommunications system (UMTS)/wideband code division multiple access (WCDMA)); and 4G/LTE. Internet services based on 4G/long-term evolution (LTE) are available in limited locations.

At present, the number of ADSL subscribers in Armenia is 148,000, which indicates a decrease of about 2,000 customers. Tariff plans offer various internet speeds, including 1Mbps to 32Mbps. All of these services are offered across the country, except in 150 villages where phone lines are not available. There are approximately 91,000 fiber-optic network (FTTB) subscribers.

In 2015, the number of broadband internet services users (including 3G) has reached about two million. The average price for 1MB/s internet is 500 Armenian Dinari (AMD) (USD 1.00). The operators also offer three-in-one packages that include internet protocol television and fixed telephone services, priced at 10,500 AMD (USD 22.00) on average for 20 Mbps.

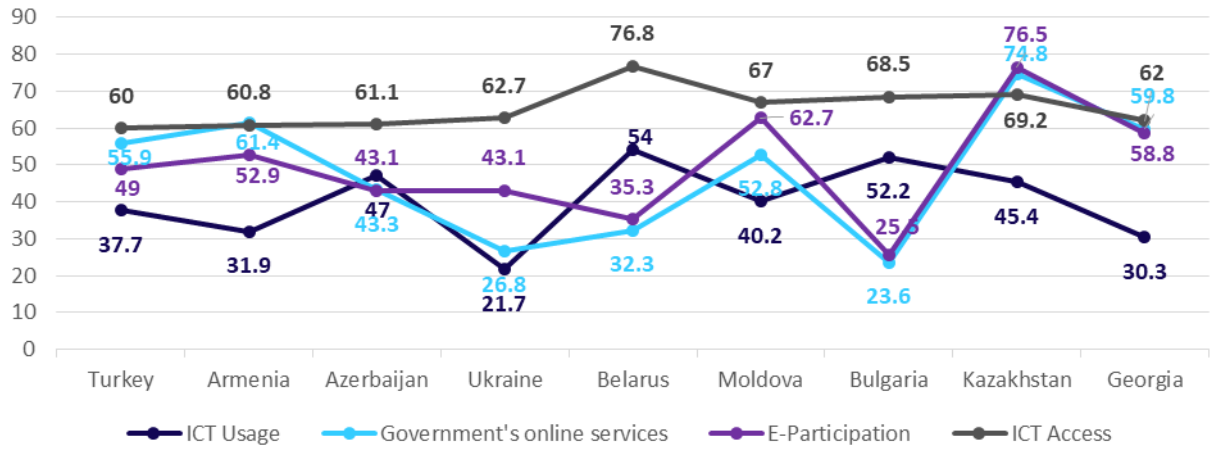
There are 247,000 wireless technologies subscribers (WiMax4, WiFi). In late 2015, 3G coverage has reached 98%. Data transfer and internet connection via wireless network is organized through GSM/EDGE (900MHz and 1800MHz), UMTS 2,100 and UMTS 900 technologies.

Azerbaijan

The number of Internet users in Azerbaijan soared from only 17% of the population in 2008 to 73% in 2013. By 2014, wireless penetration per capita had grown to over 100%, while around one third of the population had gained access to mobile broadband and 30% of households had subscribed to fixed (wired) broadband internet.

ICT access level, Government online services and E-participation of Azerbaijan is moderate in regional comparison. The chart below demonstrates the latest figures:

Figure 55: Key Figures - ICT



Source: GII, GCI and GITR report 2016

Increased internet penetration and improved affordability are the results of a gradual extension of mobile and fixed broadband networks, coupled with significant reduction in broadband access wholesale and retail prices for the country's ISPs and customers. Quality of broadband service in Azerbaijan is still low.

The absence of a level-playing field between state-owned incumbents and alternative operators in Azerbaijan means that ISPs are not sufficiently incentivized to develop their own access fixed networks through regulatory means and therefore increase the quality of their service provision.

The Sumgait Technologies Park is an important infrastructural project focusing on the development of renewable and alternative energy sources. The Park is based on German technology and is designed to produce collectors to harness solar energy for heating. The final products should meet international quality standards with a view to marketing them not only on the local market but also on European markets. Future production plans include photovoltaic panels.

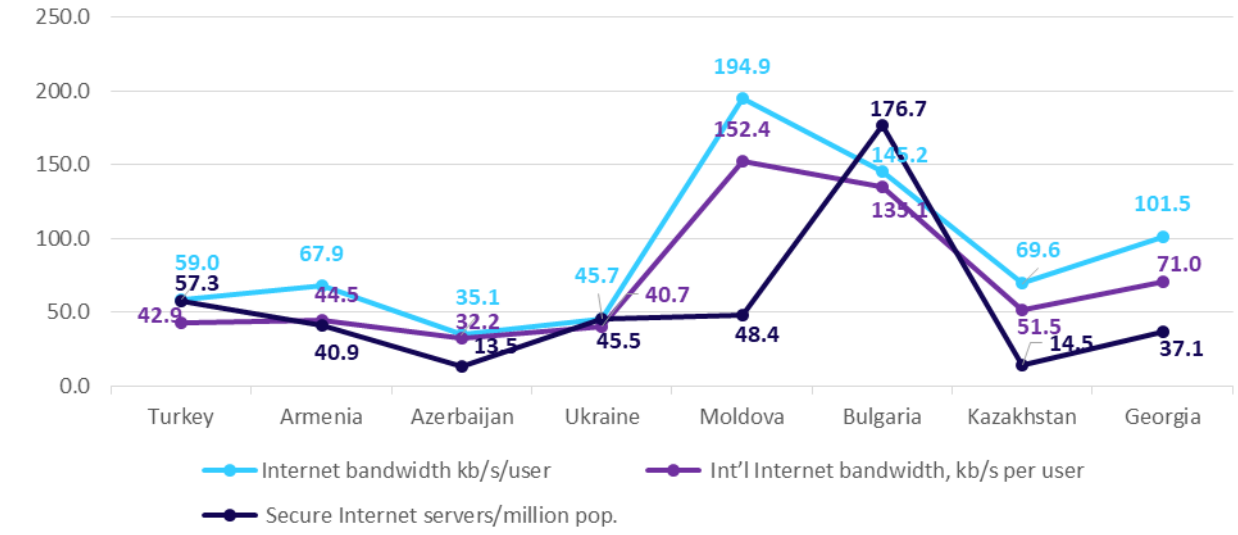
Turkey

Turkey has had modern infrastructure and the increasing investment therein (disregarding the current political situation). In Turkey, academia collaborates with business for innovation at technology development centers. There are 129 important ICT research centers in Turkey.

Increasing government spending in ICT runs parallel to Turkey's 2023 goals of having 80% of all citizens computer-literate. By 2016, fixed broadband internet subscription per 100 people is 12.4, similar to Georgia's rate. Fifty-one per 100 people subscribe to mobile broadband, still slightly below the EU average of 75.

The chart below shows that the internet connection level in Turkey is not higher than in other countries in the region. Moreover, Georgia is better in its internet bandwidth index.

Figure 56: Key Figures – Internet Infrastructure



Source: GII, GCI and GITR report 2016

In the Government Online Service Index (0–1), Turkey holds 0.56 points representing the 53rd position and average of other infrastructure sub-indexes (Electricity production, kWh/capita, mobile network coverage, % pop, international internet bandwidth, kb/s per user, secure internet servers/million pop) and 59th place in GITR 2016 among 139 countries.

Ukraine

Continuing the current reform effort, the Government of Ukraine increasingly uses IT to modernize its infrastructure. In the past year, IT and volunteers from the sector played a major role in deregulation, implementation of 3G, independent online tender systems where users can see the details of government budgets and multiple parts of the larger e-government implementation. As the government continues to pursue reforms, these projects are designed and implemented by the IT community.

BIONIC Hill is the first Ukrainian innovation park with a project investment of USD 1 billion, operating since 2012. It is a modern scientific and business city for high-tech business, where businesses get access to the talented specialists and financing, space, modern engineering solutions, tax incentives, comprehensive assistance service and up-to-date infrastructure.

Another national project is Technopolis, a high-tech park planned to be developed in Kiev on a PPP basis for a total investment of EUR 60 million.

There are number other national projects, such as development of a broadband network servicing 20,000 secondary schools and up to five million subscribers with high speed internet, development of a 4G broadband network (up to USD 350 million), implementation of an educational portal (up to USD 20 million) and equipment of secondary schools with computer devices (up to USD 80 million).

Bulgaria

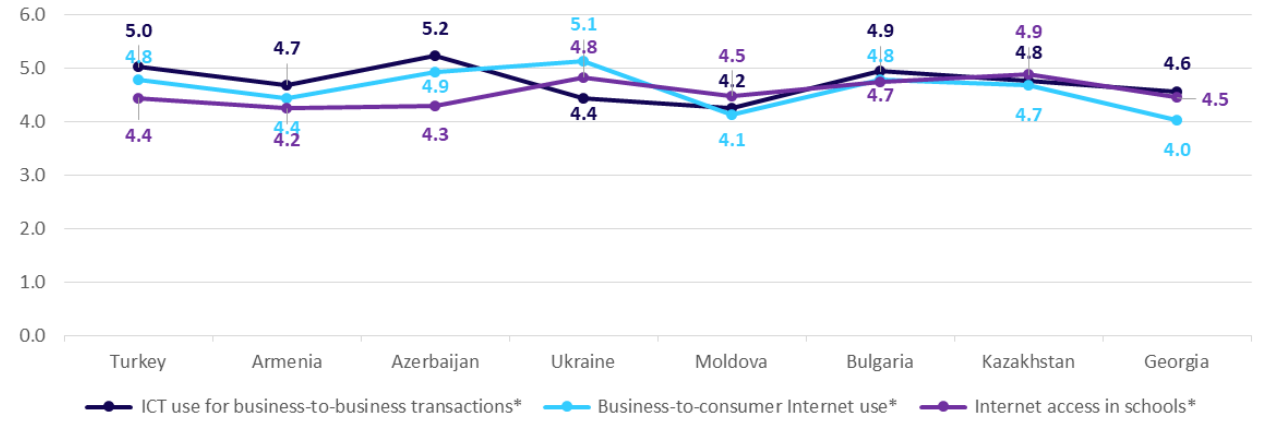
As of 2016, high speed broadband is available to 72 percent of homes in Bulgaria but rural areas lack high speed coverage. Only 55% of Bulgarian households subscribe to a fixed broadband connection (27th in the EU) but half of them benefit from a high speed connection (10th in the EU).

Bulgarian internet users are among the most intensive users of on-line video calls (1st place) and social networks (6th place). However, Bulgarian internet users appear to refrain the most from using the internet

when they need to do online banking and shop on-line. Despite some progress and its “Silicon Valley” image, Bulgaria ranks last in the EU for its ability to provide e-Government public services.

Bulgaria’s ICT utilized by different users are shown in a chart below:

Figure 57: Key Indicators – ICT Usage



Source: GII, GCI and GITR report 2016

Fixed broadband networks reach 95% of Bulgaria’s households, slightly below the EU average (97%). Only 55% of homes subscribe to fixed broadband (27th in the EU) limiting Bulgaria's ability to exploit the benefits of the digital economy. Seventy per 100 people subscribe to mobile broadband (up from 66 per 100), still slightly below the EU average of 75. Half (49 percent) of fixed internet subscriptions offer high-speed connections (10th in the EU), although the overall level of fixed take-up remains low (27th in the EU).

Kazakhstan

The Government of Kazakhstan spends considerable resources on technology infrastructure. In this context, modernization of e-government should be regarded as a successful program as evidenced by Kazakhstan's position in international rankings and ICT indicators.

By April 2016, there were 270 public service houses with a new format. The transition to new formats made it possible to improve the quality of public services for the population and also to create tools for monitoring and quality assessment. Today, e-government is in the fourth stage of transformation. The main goal from now on is maximum efficiency in the provision of services to citizens and legal entities.

In order to build an effective national science technology and innovation system in Kazakhstan, new state programs have been designed to provide high-quality support for the country's innovators. The country adopted state program of Industrial-Innovative Development, targets to create favorable conditions for scientific and technological breakthroughs in Kazakhstan through providing grants, developing innovative infrastructure, establishing science – technological centers and regional offices of commercialization.

The Government launched the Technology Commercializing Project (TCP), designed to change and improve regional and international competitiveness of the national economy. The TCP is well positioned to link the scientific research and business sectors, thereby contributing to improved innovation and commercialization outcomes.

The development of technology parks, to fill a gap between the academic and business environment, was another science, technology and innovation infrastructure initiative taken by the Government. Since 2004, more than 10 regional technology parks with different priority directions have been established.

In the *Government Online Service Index* (0–1), Kazakhstan holds 0.75 points representing the 23rd position and average of other infrastructure sub-indexes (electricity production, kWh/capita, mobile network coverage, % pop, international internet bandwidth, kb/s per user, secure internet servers/million pop) and 64th place in *GITR 2016* among 139 countries.

Belarus

A HTP was established in 2005 for the purpose of software development in the Republic of Belarus, information and communication technologies as well as other new high technologies development, aimed at increasing the competitiveness of the national economy. HTP provides a wide range of advantages for its resident companies. A special decree “On the Park of High Technologies” regulates operation of HTP resident-companies in Belarus.

The HTP business incubator, the largest in Eastern Europe, is intended to provide assistance to startup companies which develop their own products, and build a special innovative environment in its co-working space designed for communication, learning, exchange of ideas and joint creativity.

In the *Government Online Service Index* (0–100), Belarus holds 32.3 points representing the 91st position. By the e-participation indicator, Belarus is at the 85th position and in general technological infrastructure 63rd place in the infrastructure sub-index in the *GII 2016* report.

Moldova

In comparison with CIS countries, Moldova enjoys a higher rate of computer penetration (49.5%). The public administration and education sectors are probably the sectors with potentially the highest demand for computers. In terms of internet access, Moldova also has a good position at 64th with 46% coverage. Moldova has one of the highest internet connection speeds in the world, especially in Chisinau, where most offshore/nearshore companies are located.

In the *Government Online Service Index* (0–100), Moldova holds 52.8 points representing the 75th position. By the e-participation indicator, Moldova is at the 40th position and in general technological infrastructure at 75th place in the infrastructure sub-index in the *GII 2016* report.

ICT-related infrastructure, especially broadband speed and mobile networks, is where Moldova has a competitive advantage compared to other countries and could – if maintained – function as an engine for IT sector growth. However, other infrastructural aspects may undermine this advantage.

R&D

This part of the report describes R&D activities and figures of selected countries in the private and public sectors as well as in academia and provides comparison of these figures from the regional perspective.

Armenia

The number of Armenian ICT companies developing their own products and investing in R&D is growing from year to year. The average revenue generated from products and services of companies included in the survey sample have grown to 47% of average revenue in the industry. Innovation-related revenue generation in large companies is mainly correlated with the number of company employees, i.e., the larger the company, the higher the investment in R&D.

For 78% of companies in the ICT sector established from 2014 through 2015, development of products and services is a primary operation. This is an increase of one percent over the previous year.

Generally, governments use R&D tax incentives to support related activities. As to the companies, such tax incentives are an effective way of reducing innovation-related costs. Several of the tax incentives provided by the Government are unique in their type and nature.

In Armenia, R&D tax incentives are still under development. As already mentioned, in 2014, tax incentives were introduced at the Parliament, which has created unprecedented favorable conditions for IT industry growth: for newly established start-ups, the income tax is 10%, and profit tax is zero, and they can benefit from these incentives for up to three years.

Key indicators related to R&D in the country are represented below:

Figure 58: Gross Expenditure on R&D as % of GDP

Source: GII, GCI and GITR report 2016

Azerbaijan

The level of innovation activity and performance in Azerbaijan is low, even as compared to other CIS countries. National statistics of R&D and innovation in Azerbaijan are quite scarce, they do not follow internationally agreed standards of compilation and their quality is sometimes questionable. Therefore, the assessment presented below is also only partial and only covers some selected specific aspects of innovations activity.

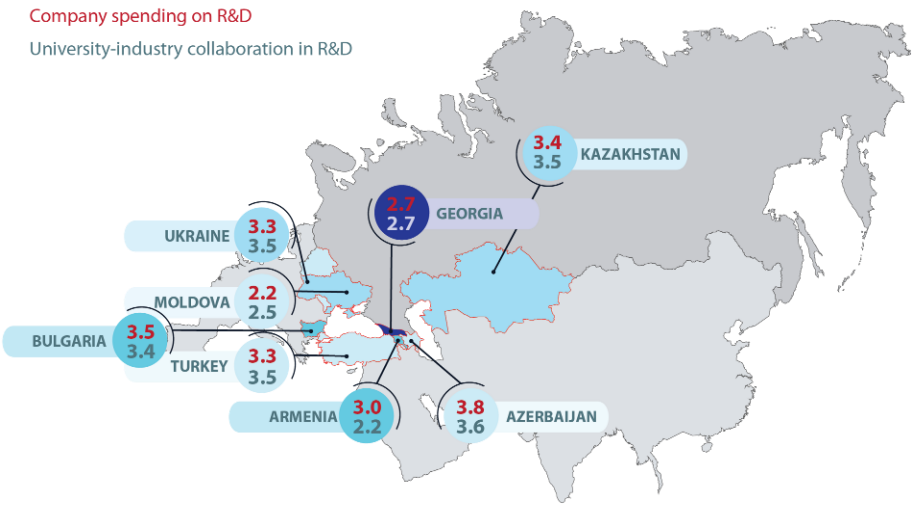
The level of gross expenditures on research and development at present is just around 0.2% of GDP. Most of the funding of R&D in Azerbaijan (around 80% in recent years) originates in the public sector, whereas the business sector (even in the presence of the strong FDI-dominated oil and gas sector) provides only about 20% of the funding.

Turkey

Turkey currently has 129 research and development centers and is building more. Out of them, there are 13 R&D centers in the information and communication technologies sector, carrying out around 10% of the total R&D activities. By 2012, there were 14,837 people employed in these centers with 1,784 working in the ICT sector.

Private sector spending on R&D and collaboration between industry and academic institutions are one of the key indicators. Below is the regional comparison of countries in this regard.

Figure 59: Key Figures – R&D



Source: GII, GCI and GITR report 2016

In Turkey, apart from R&D centers, there are 50 technology development zones (TDZs) with 2,200 companies as of 2013. The Government has a goal for TDZs to reach 5,500 companies, 65,000 employed and USD 10 billion in exports by 2023.

The number of R&D technicians per million people in Turkey increased 16.4% between 2009 and 2010 reaching 142. This solid increase in technicians in R&D signifies the increasing focus on R&D in Turkey.

Research and development centers in Turkey are involved in R&D of new generation web-based services and applications, future network technologies, novel internet architectures, future computing systems, cloud computing, future internet technologies addressing societal challenges, advanced software engineering, CT for health, ICT for governance and policy making, e-learning, intelligent tutoring systems, embedded systems and adaptation of business and manufacturing processes, cognitive systems, mobile learning tools, embodied evolution of artificial intelligence systems, interactions between humans & smart spaces and other creative ICTs, smart grids, ICT systems for energy efficiency and other areas.

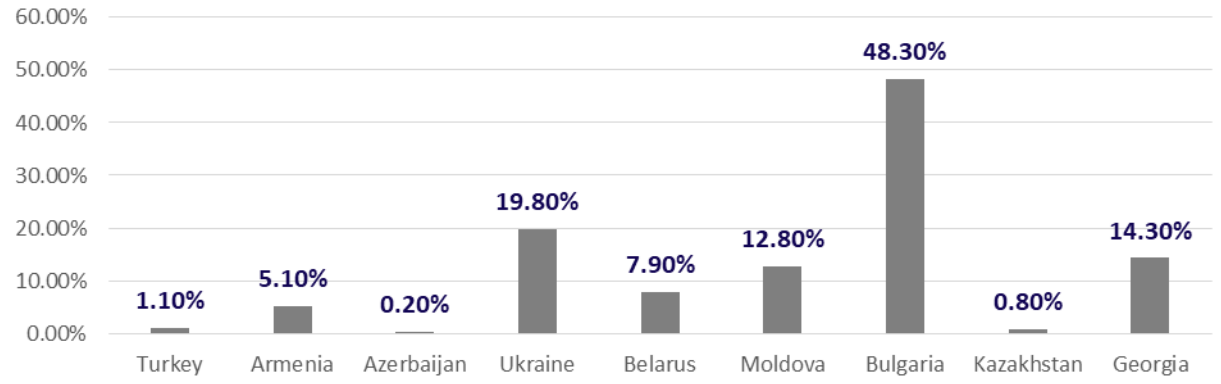
Ukraine

Ukraine is home to over 100 R&D subsidiaries of global companies from a variety of industries, including telecoms, software, gaming and e-commerce. A significant part of these global companies entered the Ukrainian market indirectly, through merger and acquisitions (M&As), joint R&D with an outsourcing component or out staffing service companies.

Ukraine hosts more than 90 R&D centers of global technology companies from four continents. Most of these companies have headquarters in the USA and Western Europe, followed by companies from neighboring Russian-speaking countries as well as Israel. Their primary industry ranges from telecommunication to electronics, to 3D graphing, to energy. Software, financial services and e-commerce are also involved. In these international R&D centers, there are 12,400 local engineers employed in the sphere of software, telecom, gaming, e-commerce, electronics, web-technologies and others.

Ukraine has quite a high gross expenditure on R&D financed from abroad, highest in the region after Bulgaria. The chart below demonstrates respective figures.

Figure 60: Gross Expenditure on R&D by Foreign Capital



Source: GII, GCI and GITR report 2016

The US remains Ukraine's largest partner for joint R&D activities (around 45% of the companies involved), followed by EU countries and Israel. Kyiv (Kiev) is the most popular location in Ukraine for opening an R&D center, concentrating over half of all such bases in the country.

Bulgaria

Expenditure on research and development (R&D) activity in Bulgaria increased by nearly 25% in 2015 compared to the previous year. The total amount allocated to R&D was EUR 425 million, which is 27.4% more than in 2014. R&D intensity - its value as % of GDP - also went up, rising to 0.96% last year. It was 0.79% in 2014. But, this is still below the EU 2020 standards, under which total expenditure on R&D is to reach at least three percent. Bulgaria plans on raising this figure to two percent by 2025. R&D value as a share of GDP has nearly doubled since 2011, when it was Bulgarian Lev (BGN) 429.6 million (0.53% of the economy). Almost all of the growth in 2015 was due to the business enterprise sector where expenditure on R&D increased by EUR 95 Million or 42%.

By 2015, the business enterprise sector was the largest of the four institutional sectors of R&D performance, accounting for 73.3% of the total expenditure. It was followed by the government sector, higher education sector and private non-profit sector with shares of 20.8%, 5.4% and 0.5% respectively.

R&D activity was financed from the state budget, businesses, other national sources and from abroad. Foreign sources of funds continued to have the largest share in the R&D funding in Bulgaria - in 2015 it amounted to 44.0% of total R&D expenditure.

At the same time, the highest growth rate was that of R&D funds which come from the business enterprise sector, they have doubled compared to the previous year (2014) and accounted for 35.3% of total R&D expenditure in the country.

Applied research was prevalent in the structure of current R&D expenditure by type of research in 2015, as in the previous year, its share being 66.8%, followed by experimental development and basic research – with a share of 23.9% (EUR 90 million) and 9.3% (USD 35 million) respectively.

The number of people employed with R&D activity as a full-time assignment increased last year to 22,421, up 16% compared to 2014.

For the first time in 2015, the main part of the scientific staff is concentrated in companies and research institutes in the business enterprise sector - 42.0% of the total staff (in full time equivalent) or 9,409 persons.

Kazakhstan

Kazakhstan R&D expenditure as % of GDP fluctuated substantially in recent years, 0.3% in 2005 and, by the most recent statistics, decreasing to 0.2% in 2016. The decrease in this figure is caused by the rapid increase in the country's GDP over the last decade.

High-technology exports of products with high R&D content, such as in aerospace, computers, pharmaceuticals, scientific instruments, and electrical machinery as % of manufactured exports of Kazakhstan increased from 11.3% in 2005 to 37.2% in 2014 totaling USD 3.3 billion, growing at an average annual rate of 17.54% in the given period.

Kazakhstan is paying special attention to the development of the science and research sector, R&D finance, and skilled researchers. The number of research organizations is increasing gradually. Along with this increase in research organization throughout the country, attempts to connect research and industry, investment for commercialization projects with the participation of foreign scientists and researchers. However, the country is still weak in this respect. According to *GII 2016*, university-industry research collaboration index is 38.2 (82 place among 138) and gross expenditure on R&D financed from abroad is 0.8% (91st place).

The structure of internal costs for scientific research and development by source of funding are as follows: own funds 19%, state budget fund 45%, funds of foreign investors including foreign loans 13%, and funds from other organizations 22%.

Belarus

Gross expenditure on R&D is 0.7% of GDP, which is one of the highest in the region. The number of organizations working on scientific R&D as of 2015 was 439. Of that number, 20% is in the public sector, 65% in the private sector and 15% in the education sector with a total number of personnel engaged at 26,000.

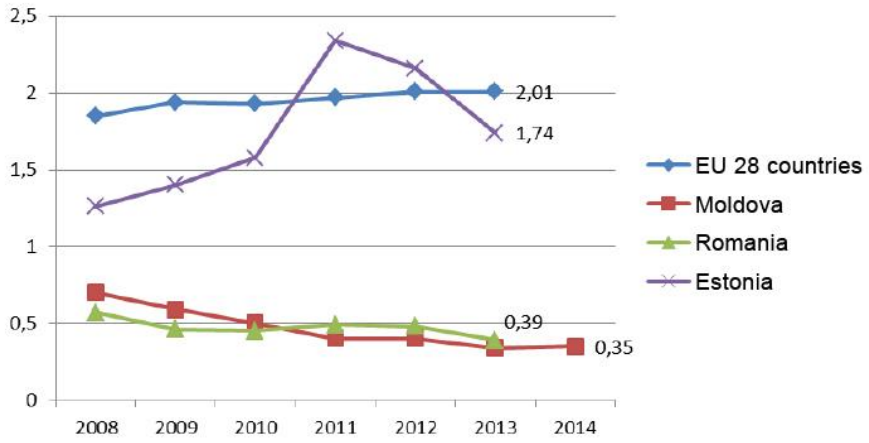
The structure of internal costs for scientific research and development by source of funding are as follows: own funds 19%, state budget fund 45%, funds from foreign investors including foreign loans 13%, and funds from other organizations 22%.

HTP residents are actively involved in new R&D activities (micro, opto, and nano-electronics, mechatronics, telecommunications, radar ranging, radio navigation and wireless communication), information protection, establishment of data processing centers, etc.

Moldova

Moldova's R&D expenditure as % of GDP has decreased in recent years, from 0.7% in 2008 and by latest statistics having 0.4% in 2016. The drop of this figure is caused by a rapid increase of the country's GDP over the last decade. The figure below shows a comparison of GERD expenditure as % GDP with other countries in Europe.

Figure 61: GERD expenditure as % GDP



Source: UNESCO / UIS, EUROSTAT 2015

The Government share of GERD is around 70%, while business and higher education participation is 19% and 11%, respectively. There are 19 governmental academic institutes which are the main research performers. There are also 15 branch research institutes under various ministries. In higher education, there are 31 institutions, including 19 state and 12 private.

According to *GII 2016*, R&D related indicators where Moldova has a weak position are: global R&D companies' average expenditure (45), Quacquarelli Symonds (QS) university ranking (73), and GERD performed by businesses (62).

According to *GCI 2016*, Moldova has poor standing in university - industry collaboration in R&D (133 among 138) and availability of scientists and engineers (131).

KNOWLEDGE AND EDUCATION

This chapter provides information about public and private formal as well as informal education programs and figures of selected countries such as number of graduates in IT and technology, academic programs, informal education opportunities, number of skillful workforce, innovation commercialization capacities of universities and other.

Armenia

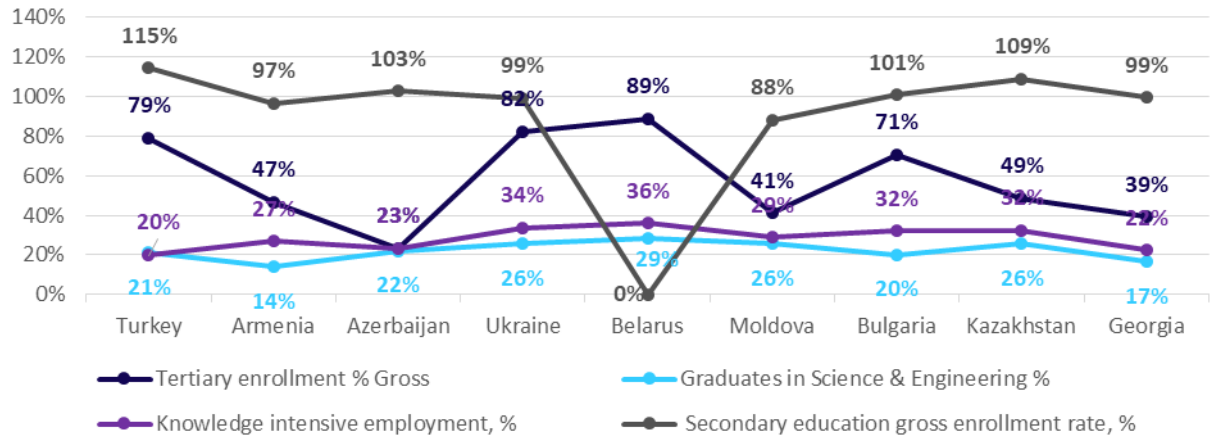
There are 26 public state universities and 40 private universities in Armenia, the majority of which are based in Yerevan and some of them have branches in the regions.

The universities emphasize teaching of fundamental knowledge, along with hands-on practical experience. Educational methodologies used by the universities are continuously supplemented with new ideas and enhanced by the traditions and approaches utilized by the internationally acclaimed institutions of higher education. Upholding free market principles in Armenia has made such developments possible.

During the academic year of 2014/2015, a total of 9,352 students were enrolled in specializations related to IT and high-tech, which constitutes 11.71% of total student population (79,623). On the other hand, the students engaged in studying economics and management represented nearly 19% of the total number of students enrolled in Armenian universities.

Key indicators as of 2016, related to knowledge and education of the country are given below:

Figure 62: Key Indicators – Education



Source: GII, GCI and GITR report 2016

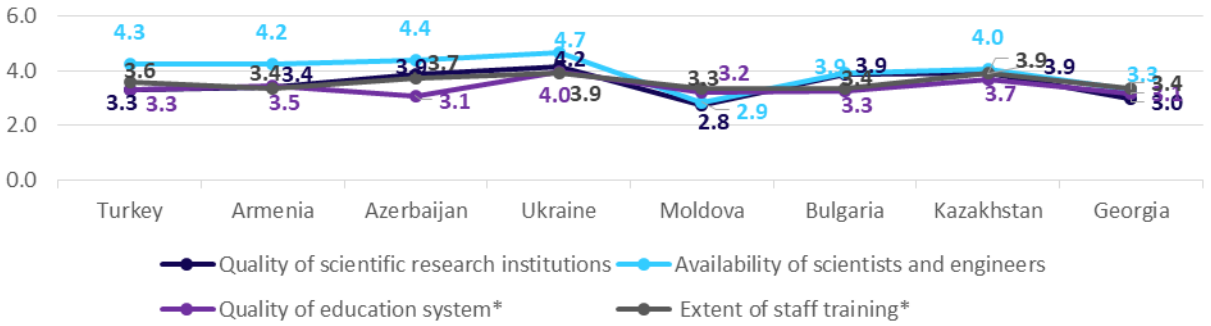
Azerbaijan

Azerbaijan has 47 higher education institutions, including 30 public universities and 17 accredited private universities. Universities in Azerbaijan focus on teaching and their research activities are relatively weak. While the number of knowledge-generating organizations in Azerbaijan is considerable, their output has not been impressive.

The number of scientific articles by Azeri authors in international publications is low, as is the level of patent applications and the citations of the scientific results published by Azeri authors. Thus in 2011, just 418 patent applications were filed in Azerbaijan, compared with 2,368 in Belarus, 1,821 in Kazakhstan and 3,312 in Ukraine.

Key indicators as of 2016, related to knowledge and education of the country are given in the chart below:

Figure 63: Key indicators - Quality of Education



Source: GII, GCI and GITR report 2016

Overall, the level of understanding of IP issues appears to be inadequate both among researchers and among technology entrepreneurs.

Turkey

Turkey has a high percentage of young people, which is a crucial indicator of a country's future work force. Education programs continue to expand and Turkey provides a well-educated and highly skilled workforce to its economy.

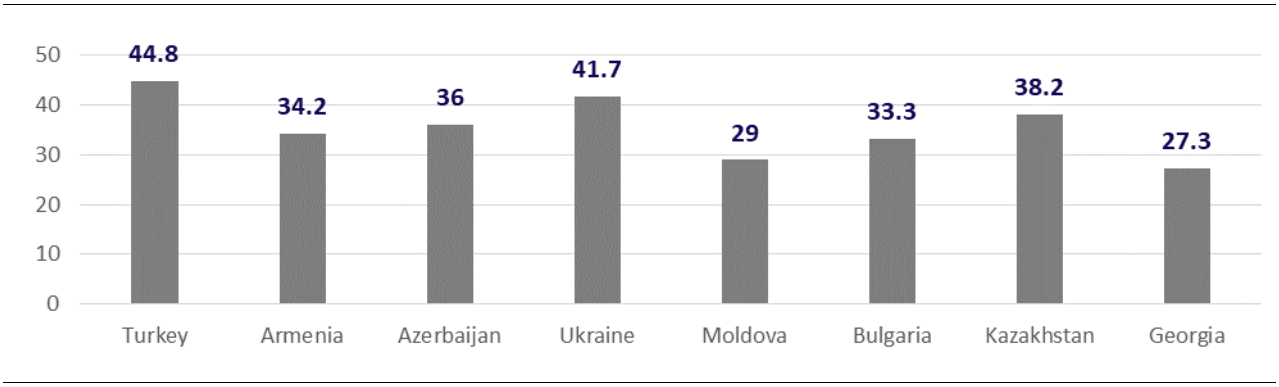
In Turkey, the engineering fields related to the ICT sector are among the most popular choices for undergraduate and graduate studies. Every year, a significant portion of the best students in Turkey join programs related to the ICT sector, and, hence, a high-quality workforce is provided.

In 2012, there were 115,528 students enrolled in undergraduate programs and 140,713 students enrolled in associate programs. The number of graduate students in ICT related departments increased by 29% in 2012 compared to 2011. Due to an increase in number of technology development zones and research centers, the quality of engineering departments is improving as well as the quantity of students in the field.

Besides universities, there are private education and training centers that grant certifications in coding, system and network management, database management, graphics and digital design and other.

The level of university/industry research collaboration in Turkey is highest in the region, followed by Ukraine. Figures are given below:

Figure 64: Level of University/Industry Research Collaboration (on a 100 point scale)



Source: GII, GCI and GITR report 2016

Ukraine

Ukraine's technical education is the foundation of Ukraine's IT ecosystem. Over 150,000 students graduate each year, among which 36,000 are with degrees in technical studies, including some 15,000 IT specialists.

Expenditure in education as a % of GDP in Ukraine is one of the highest in the region where Moldova is the leader.

A regional snapshot of spending on education is given below:

Figure 65: Expenditure of Education % GDP

Source: GII, GCI and GITR report 2016

Ukraine has more than 90,000 IT professionals, which makes it a leading country in Central and Eastern Europe by the number of engineers and the number of graduates joining the labor market. With its obsolete, theory-heavy curriculum and weak government funding, Ukraine hardly claims to have a modern educational system. However, they have a deeply-routed tradition in technical education. The country still needs more government investments to modernize university curriculums and equipment, fund research labs and introduce more international exchanges with world-leading universities. A number of steps have been taken in the right direction, including the introduction of standardized tests and a reduction in corruption levels, but the current situation still needs to be improved.

Bulgaria

Bulgaria holds 3rd place in Europe and the 10th position worldwide regarding the absolute number of certified ICT professionals.

There are 220 high-schools in Bulgaria with ICT-focused curricula backed up by a solid language preparation, and more than 15 universities offering majors in ICT. A range of ICT certificate programs are also available, ranking Bulgaria 3rd in Europe with regard to ICT certified professionals and substantial supply of specialists with competitive wages.

Three-thousand five-hundred students get a degree in IT from universities in Bulgaria each year. Out of enrolled students in IT specializations, 30% comes from computer science, information systems and technologies, 26% from business informatics and information technologies and 23% from communication and network technologies.

However, by total population, Bulgaria lacks digital skills, where there is a significant gap. Only 31% of the population has basic digital skills.

Kazakhstan

In Kazakhstan, over the past five years, the amount of funds allocated to primary and secondary education has increased in nominal terms by 2.7 times. However, despite a steady growth of oil and gas revenues of the state, public spending for education is still low. By *GII 2016*, expenditure on education as the % of GDP in Kazakhstan shows relatively poor performance (102th place) with 2.9%. However, in quality of its education system, it has the 67th position, according to *GITR 2016*. Moreover, the adult literacy rate is 99.8% and in this index, the country is positioned in 6th place.

One of the major directions of Kazakhstan is to integrate the higher education system into the world educational structure. In the 2015/2016 academic year, there were 127 higher education institutions and 780 colleges in the country that train ICT specialists.

The total number of graduates in ICT specializations for 2013-2015 is 93,335 people. Further, considering graduates of universities in ICT specialties, the most desired specialization is information systems with 9,623 graduates, while graduates in informatics amounted to 8,490 people. Computer science and technology software and radio engineering, electronics and telecommunications have equal number of graduates at around 7,000 each.

There is a noticeable shortage of specialists in the market. Given the projected growth in the market and the pace of training of young specialists by universities and secondary special educational institutions, this shortage is anticipated to be eliminated in 2017.

Belarus

Belarus is famous for its strong computer programming school. There are 51 universities in Belarus and 16,000 students graduate with ICT and related technical skills annually. The country adopted a unique system of cooperation between IT companies and IT education providers. By 2016, HTP residents support over 50 joint research labs, which serve as a channel for practical knowledge transfer to the higher education system.

A number of IT companies developed specialized educational courses that were integrated in the education process of specialized university departments. Free training courses for faculty members and practical seminars for students are held all year round.

The table below gives information about key numbers of higher education system:

Figure 66: Higher Education System in Belarus

	2010	2011	2012	2013	2014	2015	2016
Higher education institutions	55	55	54	54	54	52	51
including public higher education institutions	45	45	45	45	45	43	42
Number of students enrolled – total, thousand	442.9	445.6	428.4	395.3	362.9	336.4	313.2
Engineering and Technology	82.9	84.1	83.2	77.7	70.8	66.3	63.2
Natural Sciences	13.5	13.7	13.8	13.5	12.7	12.3	12.1
Number of graduates – total, thousand	73.3		84.6	82.7	81.1	78.0	74.6
Engineering and Technology	12.1	12.5	12.7	13.1	14.3	13.5	12.9
Natural Sciences	2.2	2.1	2.2	2.3	2.4	2.2	2.2
Total intake, thousand	100.5	96.0	88.1	68.7	63.4	63.1	62.7
Engineering and Technology	20.2	19.6	18.3	13.4	11.6	12.0	12.6
Natural Sciences	3.1	3.0	3.0	2.9	2.5	2.4	2.5

Source: Бюллетень Образование в Республике Беларусь-2016-2017

The number of IT engineers to graduate in 2017-2020 (computer science, software engineering):

Figure 67: The Number of Graduates in IT-Related Disciplines

	2017	2018	2019	2020
The number of graduates in IT-related disciplines	6698	3942	4263	4744

Source: Бюллетень Образование в Республике Беларусь-2016-2017

Also, over 20 branches of university departments of computer science are operating in IT companies. This form of cooperation is intended for bringing together the educational process and production and improving the training of Belarusian IT specialists. Companies' employees conduct special courses, supervise course

works and theses. Also, students are receiving practical training, giving them professional experience. In 2010, the educational center of the high-tech park was established to provide re-education for adults with a technical background.

Moldova

One-thousand five-hundred students graduate Moldovan universities yearly with degrees in computing and related fields. Another 5,000 have math or engineering degrees. However, education is not fully up to the needs of the labor market. This is due to outdated curricula, lack of access to modern equipment and software and teaching staff who often do not meet international standards. Those problems are aggravated by a serious lack of practical experience in higher and vocational education.

According to statistics, 26% of total graduates are from the science & engineering fields. This figure is higher than the countries in the Caucusus region, Turkey and Bulgaria and only fall behind Belarus.

Moldova has a good indicator in knowledge creation, (21th by GII 2016). However, it shows relatively poor outcome in total quality of education system (102nd by *GCI 2016*), extant of staff training (128th by *GCI 2016*) and availability of specialized training services (114th by *GCI 2016*).

ACCESS TO FINANCE

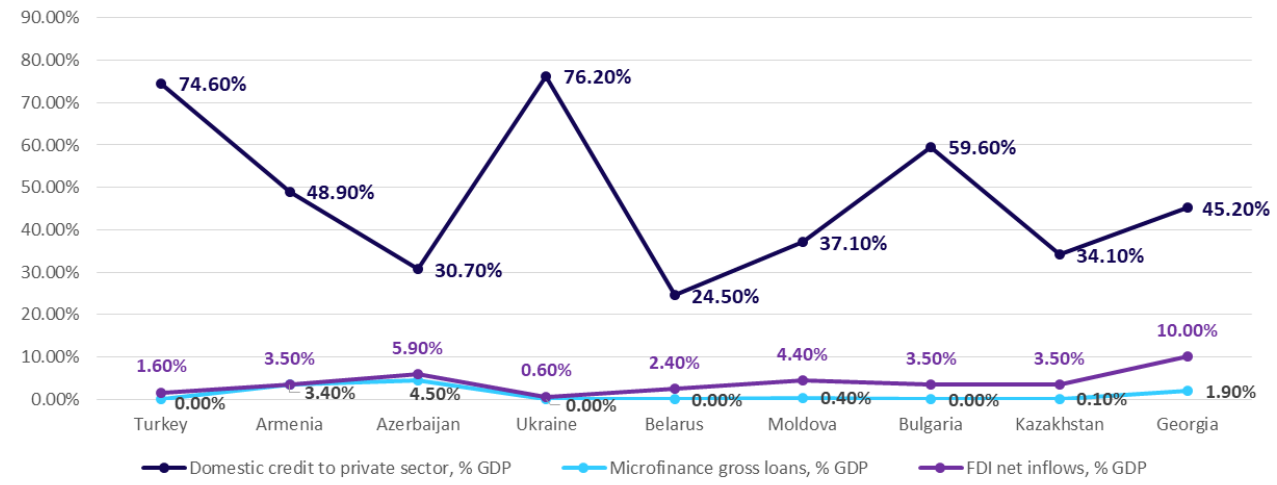
This part of the study describes financial sophistication and affordability to the high-tech and ICT sector in selected countries. Attention is addressed to local and foreign private capital, government grants and donor financing for startups as well as financial sector lending availabilities.

Armenia

In 2013, the first venture fund in Armenia was established, with the support of the Ministry of Economy of the Republic of Armenia. In 2014, another venture fund, Granatus Ventures, was established. The primary importance of such an initiative for Armenian IT companies is to support the innovativeness of Armenian companies, promoting networking with the western market of high technologies, FDI options and developing the Armenian IT infrastructure in the country. The funds seek to promote their innovative initiatives, facilitate establishment of contacts with western markets, increase capacities, and support the general development of the IT infrastructure in Armenia.

Key indicators as of 2016, related to access to finance in Armenia are given below:

Figure 68: Key Figures – Access to Finance



Source: GII, GCI and GITR report 2016

Azerbaijan

Azerbaijan has a special fund, which applies to both fundamental and applied projects and also allows for the purchase of necessary equipment. It offers grants to scientists to travel abroad and for organizing conferences. As of the end of 2012, six calls for project proposals had been completed or continued and one call was still under evaluation. Within these calls, funding amounting to some EUR 25 million and was allocated to 155 projects.

The newly established ICT Development Fund started operations in early 2013. Some EUR 15 million was expected to be allocated from the budget of the State Oil Fund of Azerbaijan during 2013 to back its activities. The Fund is expected to provide project support through concessional funding (loans and grants) to companies, including small innovative companies and promising start-ups in science and technology. It will also be offering special incentives in taxation and customs to firms in the ICT sector, in particular, stimulating the import of high-tech products.

However, early financing of entrepreneurial and innovative activity is practically missing. This early financing is a very specific area involving high risks and banks usually are cautious to engage in it. The financial institutions that typically undertake such risky activity (such as business angels and venture capital institutions) need time to develop targeted public support – both in the form of sharing some of the financial risks by the Government and in establishing enabling regulatory framework.

Black Sea Trade and Development Bank (BSTDB) concluded a new agreement opening a loan facility aimed at reducing greenhouse gas emissions in BSTDB's member countries. The new loan program has a 10-year maturity and totals EUR 30 million. Some 70% of the loan program is to be allocated towards reducing the emissions in countries around the Black Sea. Projects may be implemented in the areas of renewable energy, energy efficiency and energy saving as well as public transportation. From the point of view of the funding agencies, the main objective of the program is to contribute to mitigating climate change and the effective use of energy in the countries of the region. The funds will also be used for projects involving advanced technology from and cooperation with enterprises from Nordic Investment Bank (NIB) member countries.

Turkey

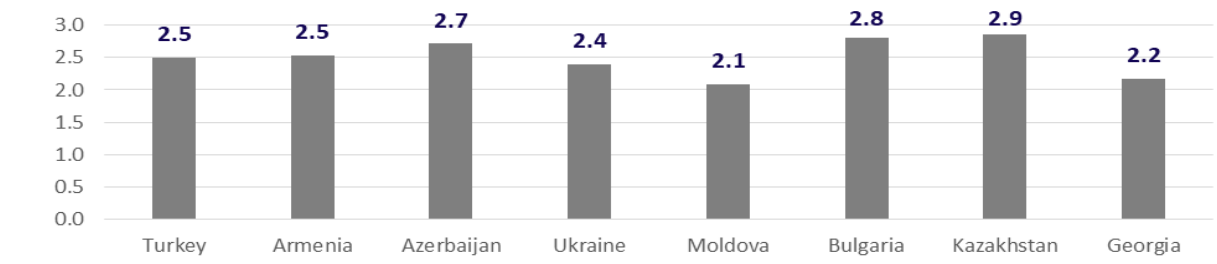
Loans provided to the ICT sector keep increasing each year. With a 41% increase in 2011, the total lending to 142 companies was more than USD 4 billion. Loans provided to manufacturing of IT equipment had an increase of 39% in 2011 compared to 2010.

Major financing institutions continue to finance profitable projects. A robust, well-regulated banking sector with strong capitalization helped Turkey avoid the recession other countries experienced.

Private equity and venture capital are emerging as popular capital raising and partnership strategies.

Venture capital investments are principally made in established companies in growth trend instead of start-up companies. The number of investees has been increasing since 2007. From 2012, the number of total investees in Turkey was approximately 150.

Figure 69: Venture Capital availability, (on 7-point scale)



Source: GII, GCI and GITR report 2016

Private equity fund sources obtain their funding from investors with high purchasing power, insurance companies and banks to a certain extent. On the other hand, mainly Turkish private equities obtain their funding from sources such as International Finance Corporation (IFC), EIB, and Dutch Development Cooperation. There has not been major activity from the small sized Turkish funds. However, some big investor companies are continuing to look for new investments in the Turkish market. Generally, private equity investments have focused on healthcare and life sciences, consumer, industrial and manufacturing, services and media and telecommunications.

Ukraine

In 2015, the Ukrainian venture markets show a record number of total investments exceeding USD 132 million. That number triples the USD 39 million of 2014 and significantly exceeds the USD 89 million of 2013.

Investment volume significantly increased across seed deals. In 2015, the majority of early capital came from professional angels and VC funds. The average seed investment in 2015 came to USD 380,000, almost twice that of 2013-2014.

Ukrainian investors and funds committed a record USD 68 million in 2015, three times more than in 2014 and 25% more than 2013. Accounting for 52% of total committed capital, Ukrainian funds were nearly even with foreign funds, exceeding the latter by only USD 10 million. The most active local funds in 2014-2015 by the number of deals included Digital Future, AVentures Capital, Detonate Ventures, and CIG.

Foreign funds and individuals invested a record USD 60 million in 2015, a double increase over 2013 and an increase by a factor of three from 2014. The biggest deals of the year by foreign funds included the Soros Fund investment in Ciklum, Horizon Capital in Rozetka, TMT Investments in Depositphotos, Almaz Capital, ABRT and AVentures Capital in Starwind Software, InVenture Partners and others. The most active foreign funds by number of investments included Almaz Capital and Imperious Group. While some previously active funds remained inactive in 2015, several newly formed funds emerged as active investors. As an example, Digital Future alone made seven disclosed seed investments in 2015.

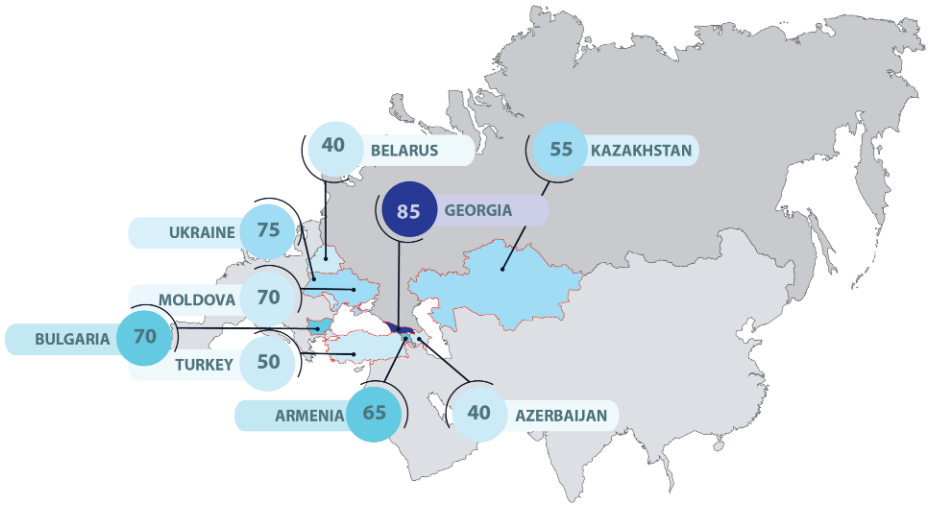
Bulgaria

According to 2014 statistics, access to finance in Bulgaria is on par with the EU average. The latest results did not substantially change from the previous year, although there was a noticeable deterioration in the availability of bank or public financial support. Access to bank loans became more difficult.

The rate of loan applications refused increased to 24%, which is substantially higher than the EU average of 16%. Banks' willingness to provide finance to SME’s declined slightly but remained safely above the EU average. The additional risk premiums banks charged for small loans to SMEs were the second-lowest in the EU. At the same time, public guarantees became more difficult to obtain and venture capital remained scarce. EU funding for SMEs was considered to be relatively difficult to get.

Figures below show that Bulgaria’s ease of getting credit indicator is far less than that of Georgia.

Figure 70: Ease of Getting Credit



Source: GII, GCI and GITR report 2016

The Government announced two policy measures in the area, both relying on EIF financing. The first one is a standalone, equity-type facility, intended to support knowledge-intensive young companies. Eligible companies will include start-ups established in universities, R&D institutes or science labs. Financing will be used to support transfer of patents or licenses as well as big R&D projects from researchers to commercial ventures. It will be provided until the companies can obtain financing from regular market players: venture capital, private equity, banks, strategic investors or corporations. The second fund program announced is an "acceleration and seed fund," which would provide early-stage financing to emerging entrepreneurs to help them develop their concepts and bring them to market.

Kazakhstan

Access to finance is regarded as one of the most problematic factors for doing business in Kazakhstan. According to the *GCI 2016*, the country is at the 104th position (among 138 countries) in the financial market development pillar with major sub-indexes such as ease of access to loans (89th), venture capital availability, financial services meeting business needs (80th), affordability of financial services (76th) and soundness of banks (105th).

Domestic credits addressed to the private sector comprises 34% of GDP and microfinance gross loans holds only 0.1% of GDP according to *GII 2016*. Regarding venture capital, the country also has a relatively poor performance, holding the 85th position in venture capital deals.

Belarus

According to many global study reports, access to finance is regarded as one of the main challenging factors of the business environment in Belarus. Several surveys conducted either by international or national organizations identify access to finance as the first or second most important obstacle to doing business. For example, in the *GII 2016* report, in financial market sophistication index, Belarus holds the 116th position among 128 countries.

According to a survey conducted by the National Bank of Belarus, financial inclusion of SMEs for credit services is 38%, while 59% of firms have not used external financing. This particular problem exists in start-up financing and micro-enterprises in rural areas. This, in turn, negatively impacts the financing of R&D and business development of local firms in the country.

According to *GII 2016*, the country stands at the 92nd position in the ease of getting credit indicator. Domestic credit to the private sector is 24% of GDP holding the 104th position. In venture capital deals, the country is at the 79th position and in ease of protecting minority it stands at the 55th position.

Moldova

According to many global study reports, access to finance is weak in Moldova, especially for startup businesses, because of the gap between business needs and fund providers. There are few initiatives from the Government to promote start up ideas in IT, but no significant improvements have been found in this regard. Global study reports, such as *GII, GITR* or *GCI* rank Moldova's financial sophistication as underdeveloped. For example, in the *GII 2016* report financial market sophistication index, Moldova holds the 93rd position among 128 countries.

According to the *GII 2016* in the ease of getting credit indicator, Moldova is in the 27th position, domestic credit to the private sector is 37.1% of GDP at the 81st position, and total value of stocks traded at 0.2% of GDP at the 71st position.

According to *GCI 2016*, the 8th pillar related to financial market development of Moldova, the country is at the 129th position (among 138), one of the weakest in the region. Main indicators of this pillar relate to access to finance, where Moldova has poor standing in soundness of banks (136), venture capital availability (133), financing through local equity market (128), affordability of financial services (125) and financial services meeting business needs (121).

8. GLOBAL OVERVIEW

The globalization process is a powerful driving force for innovation. It forces firms to become more competitive and increase their efficiency. Globalization also encourages development of new industries and adaptation of countries' institutional frameworks.

Global innovation and technology trends have a greater influence on a high-tech and innovation sector than in lower-tech industries. In many smaller countries and developing economies, local firms frequently do not have access to high–end knowledge and therefore innovation is often dependent on the availability of MNC representation in the country. That representation could take the form of local factories, research and development centers, business partnerships and regional offices.

This chapter describes the global perspective in the innovation and technology sector, identifying the key global challenges and tendencies, analyzing trends presented in global indexes, including country and regional data. It also identifies successful cases of policy interventions and/or business/startup developments based on an overview of available reports related to the innovation and technology sectors (e.g. Gartner, OECD and other).

KEY GLOBAL TENDENCIES AND CHALLENGES

According to recent study reports in IT and innovation, experts and researchers have identified a number of global tendencies and challenges that policy makers, governments and other key stakeholders should take into consideration. These tendencies and challenges are described below.

LEVERAGING GLOBAL INNOVATION TO AVOID A CONTINUED LOW-GROWTH SCENARIO

Investments in R&D and innovation are central for economic growth. One of the key factors to avoid a continued global low-growth scenario is leveraging global innovation. Typically, the countries that have been repeatedly part of the top 25 of the GII, have a common pattern by which innovation has remained a key priority, supported by a steady flow of R&D spending. Concerns about weak future output growth and low productivity are now serious. In this light, discovering new sources of productivity and future growth are a top priority. More efforts are needed to return to pre-crisis R&D growth levels and to counteract an apparent R&D expenditure slowdown in 2014, which was caused by both slower growths in China and other emerging economies and tighter R&D budgets in high-income economies.

The question faced by the innovation community is how to more systematically spread R&D to low and middle-income economies, thus avoiding an overreliance on a handful of countries to drive global R&D growth. Policy makers are urged to step up public investments in innovation to boost short-term demand and to raise long-term growth potential. Successful innovation strategies cannot afford "stop-and-go" approaches. If R&D expenses or incentives to innovators are not sustained, the progress accumulated in previous years can vanish quickly.

NEED FOR A GLOBAL INNOVATION MINDSET AND FRESH GOVERNANCE FRAMEWORKS

Science and innovation are more internationalized and collaborative than ever before. All stand to gain from global innovation. More innovation investments are conducted today than at any other time. Through international openness, the potential for global knowledge spillovers are on the rise. Innovation actors in emerging countries now make meaningful contributions to local and global innovation. However, innovation is sometimes not portrayed as a global win-win proposition. On the contrary, most metrics and innovation policies are designed for the national level. Countries are regularly perceived as 'contenders rather than collaborators'. In some cases, 'techno-nationalist policies' erecting barriers to different knowledge flows have become a popular endeavor. In order to better communicate and amplify the benefits of global innovation and related cooperation, measurable evidence regarding the organization and outcomes of the current global innovation model is missing. Although empirical economic work has gone a long way towards supporting international trade as a win-win strategy and in constructing appropriate indicators, the same is not true for global innovation.

Apart from that, although difficult to measure, there seems to be ample scope to expand global corporate and public R&D cooperation.

Business strategies and public policies need to better approach innovation as a global positive - rather than as a zero-sum - proposition and better complement the realm of national innovation systems. For firms, global innovation has been a long time in the making. Yet, despite this positive trend, untapped potential exists according to the analysis presented in this report. Most companies in high-income countries nearly all firms in emerging economies still run all of their innovation activities at their corporate centers.

INNOVATION IS BECOMING MORE GLOBAL BUT SIGNIFICANT GAPS REMAIN

The GII rankings have shown a remarkable level of global diversity among innovation leaders over the years. In 2016, the GII remains relatively stable at the top. Switzerland leads the rankings for the sixth consecutive year. Yet among the top ranked 25 innovation nations this year are not only economies from North America (such as Canada and the USA) and Europe (such as Germany, Switzerland, and the UK), but also from Southeast Asia, East Asia, and Oceania (such as Australia, Japan, Korea, and Singapore) and Western Asia (Israel). Economies that perform at least 10% higher than their peers for their level of GDP are labelled “innovation achievers.” They include many economies from Africa, one from Northern Africa, Southeast Asia, East Asia and Western Asia (Armenia), and several from Central and Southern Asia (such as India and Tajikistan). A wide variety of countries outperform their income group on many GII indicators. These include countries such as Brazil, Cambodia, Costa Rica, Georgia, Indonesia, Mexico, Morocco, the Philippines, South Africa, and others.

The majority of activities are still concentrated in high-income economies and selected middle-income economies, such as Brazil, China, India, and South Africa. Only China has seen its R&D expenditures or other innovation metrics move closer to rich countries such as the USA. Other middle-income economies remain distant. The gap between the group of upper-middle-income economies and the group of high income economies is large, especially in infrastructure, research, human capital, institutions and other.

THERE IS NO EXACT RECIPE TO CREATE SOUND INNOVATION SYSTEMS, ENTREPRENEURIAL INCENTIVES AND A GOOD ENVIRONMENT FOR INNOVATION

There is no exact recipe for creating sound innovation systems. Absolute spending on R&D or absolute figures on the number of domestic researchers, or the number of science and engineering graduates, or scientific publications do not guarantee a successful innovation system. Clearly policy makers have to start somewhere, and this factor is easily measurable. Yet the creation of sound innovation systems - with solid innovation inputs, sophisticated markets, a thriving business sector, and sturdy linkages among innovation actors - and assessing their performance, is more complex than aiming at increasing one innovation input variable, as evidenced in the GII model.

One solution to overcome a purely quantitative approach is to look at the quality of innovation, as the GII does, assessing the worth of universities, scientific outputs, and patents. Good quality remains a distinct characteristic of leaders such as Germany, Japan, the UK, and the USA. China is the only middle-income country showing a comparable innovation quality. India comes in second among middle-income economies. High-quality innovation inputs and outputs are often the reflection of other factors that make an innovation ecosystem healthy, vibrant, and productive. Ideally, these systems become self-perpetuating, bottom up, and without a recurrent need for policy or government to drive innovation. How best to create such an organic innovation system poses an interesting dilemma for governments and their role in future innovation policy models. On the one hand, it is now accepted that governments continue to play an important role in generating innovation.

On the other hand, if governments overreach, if they select technologies, they might quickly end up diluting the possibility of self-sustaining organic innovation ecosystems, and not provide enough space for entrepreneurship and innovation. The right incentives and encouragement to bottom-up forces such as individuals, students, small firms, and others, and a certain “freedom to operate” that often challenges the status quo is part of the equation. Surely developing countries are well advised to avoid overreliance on government forces as the sole driver to orchestrating a sound innovation system.

9. SWOT ANALYSIS

This chapter provides analysis of the strengths, weaknesses, opportunities and threats currently attributed to the innovation and technology sector in Georgia. This will help the user to summarize the information and strategically look at strong and weak sides, future potential and risk of the sector.

STRENGTHS

- Strong and developed telecom sector;
- Diverse ICT market players;
- Long-term government strategy;
- Solid regulatory framework in the innovation and technology sector;
- Tax advantages and development of free zones;
- IT qualified force in government sector;
- Ease of starting a business;
- Ease of paying taxes;
- High level of ICT access;
- Strong online government services;
- IP incentives for research institutions;
- High salary rates of ICT sector relatively to other sub-sectors;
- Availability of up-to-date sector specific vocational programs;
- Increased availability of STEM related informal educational activities (robotics clubs, contests, coding clubs, etc.).

WEAKNESS

- Poor diversification of the high-tech sector;
- Nascent phase of many subsectors in high-tech (semiconductors, nuclear physics, robotics, etc.);
- Small scale of local high-tech market;
- Scarcity of official data;
- Questionable reliability of sector related official data;
- Poorly structured data with lack of detailing in sub-sectors;
- Passive research and Innovation Council;
- Negligence and frequent modification of strategies and policies in public organizations;
- Short-term orientation regarding investments in R&D;
- Cultural inclination for process innovation rather than product innovation;
- Lack of government prioritization in subsidizing technology sector;
- Negligence of IP rights;
- High rates of software piracy;
- Relatively high costs of getting patents;
- Low presence of top global firms;

- Low levels of GDP expenditure on R&D;
- Lack of interaction between R&D institutions;
- Lack of interaction between GITA and research institutions;
- Lack of university and industry research collaboration;
- Knowledge gap in preparation of required documents for receiving international funding;
- Insufficient or nonexistent infrastructure for various High Tech sub-sectors (semiconductors, nuclear physics and other);
- Lack of entrepreneurial skills;
- Low expenditure on education from government;
- Outdated educational programs;
- Low level of professional science teachers in schools;
- Insufficient financing through local equity market;
- Lack of availability of venture capital;
- Overall low quality of scientific research institutions;
- Low level of formal trainings offered by firms.

OPPORTUNITIES

- Growth potential of biotechnology, automotive and aerospace sub-sectors;
- Risk tolerant culture in terms of innovation;
- Regional extension of innovation and technology infrastructure;
- Human capital potential in creative industry development;
- Increasing salaries in R&D field;
- International funding opportunities for Georgian innovative enterprises;
- Potential of crowd funding development;
- Growing quantity of STEM disciplines;
- Increased interest of startup lending opportunities from financial sector and government;
- Increased recognition of startups in international networking;
- Government decree on proactive publication of public information which may incentivize the aggregation of official data;
- Potential benefits for education and science field arising from EU-Georgia AA;
- EU market opportunities to fill IT skills gap;
- Increased income of local labor with advanced technology knowledge by working on global market.

THREATS

- Possible worsening of political stability;
- Capital intensive nature of R&D in the high-tech sector;
- Aging personnel in science and technology sphere;
- Brain drain of science and technology specialists;
- Immaturity of innovation sector in terms of technology transfer center development;

- Lack of entrepreneurial commitment in startups;
- Regional competition for technology sector specialists;
- Inflexibility of educational institutions in terms of adapting to a changing environment of technology sector;
- Possible demotivation of fund providers in case of massive startup failures;
- Difficulty in attracting of foreign private capital in technology and innovation sectors due to high competition in global market;
- Possible reduction of free IT zone benefits due to newly introduced Estonian CIT model.

10. RECOMMENDATIONS

The recommendations provided below are derived from the analysis of the sector on the local, regional and international levels. Opinions of key stakeholders, industry experts, and sector players are also analyzed and represented in the form of recommendations.

Prior to developing the recommendations, a SWOT and stakeholder analysis were conducted which are also interpreted as recommendations and provided in this section of the document.

ENVIRONMENT

Data availability is one of the major constraints for analyzing the innovation and technology sub-sector.

The main problems identified in this direction are:

- Unavailability of past data due to unmatched past and present methodologies. Geostat had switched to NACE Rev. 2 classification from NACE Rev. 1 in 2014, which created gaps in interpreting information from one classification to another. Therefore, comparison of past data with 2014 and 2015 figures are invalid.

Recommendation – Geostat should ensure the harmonization of data between past and present periods.

- Unavailability of sub-sector data due to internal regulations. Geostat rejected some data requests due to few sector players in the sub-sector, even though it was offered to merge the data.
- Another problem in terms of data is sorting. In many cases, Geostat does not provide proper sorting of data according to sub-sectors.

Recommendation – Geostat should provide sorted sector data

- Timeliness of data from Geostat – Geostat is not able to provide previous year data until the following year. That means that sector data of 2016 is not available until 2018, which raises the question of data relevance.

Recommendation – Geostat should change the internal timeline in order to provide up to date data

- Representativeness of innovation and technology surveys of Geostat – A survey conducted in 2015 only included firms with more than 10 employees. This was due to sector specific characteristics that might create an important misperception on sector size and activities.

Recommendation – Geostat should extend the scope of research by including companies with less than 10 employees in the selection.

- Problems in defining economic activities of organizations – The loose policy of the National Agency of Public Registry (NAPR) on providing specific economic activity during the registration process creates confusion in sector classification.

Recommendation – Add a mandatory field on the registration form, where organizations must provide their exact future economic activity.

- Poor interaction of public bodies in terms of collecting and sharing information – Public bodies produce huge quantities of data. However, sharing of information is still a problem. For instance, out of nine official datasets requested from mygov.ge, four of them were unanswered.

Recommendation – Take measures to ensure the unimpeded flow of information from and between the public sector

Recommendation – Develop a framework and establish a methodology of collecting, sorting, verifying and keeping relevant economic, social, business, policy, regulatory and other data and information at the national and sector levels collected from public sources

- Established but ineffective platform for the exchange of public data – www.mygov.ge is a platform for the exchange of public data electronically. However, there are problems arising from public institutions when requesting the information. Some of the public institutions had problems with registering the data. Some of them disregarded the deadline for providing the data. Most of them sent the information in a hard copy via mail and some of them did not provided the answer at all.

Recommendation – trainings should be established for the staff that is responsible for receiving and sending the data

Recommendation – internal policy should be established and effective actions should be taken to prevent breaches of law on information disclosure

R&D

- The major problems in R&D are related to the collaboration of research institutions and private companies as well as low rates of expenditure on R&D, both in the private and public sectors. Based on these issues, the following recommendations were made:

Recommendation – Encouraging an appropriate environment for early stage financing of R&D

Recommendation – Government to incentivize and allocate funds for applied science; after strengthening the preliminary stages, the commercialization and tech transfer facility should be developed

Recommendation – Facilitating the development of internationally comparable statistics and indicators to track research, development and commercialization

Recommendation –To place incentives for private companies to enhance cooperation with research institutions

Recommendation – Increase business expenditure on R&D

EDUCATION

- In terms of education, the major problems are scarcity of sector specific knowledge programs and low flexibility of the sector in terms of updating and modernizing educational programs. Recommendations developed on education sector are provided below:

Recommendation – Strengthen entrepreneurial education

Recommendation – Develop education programs in order to improve the quality and quantity of scientific research publications

Recommendation – Provide government subsidies for PhDs in STEM fields

Recommendation – Prioritize sectors and focus on targeted funding

Recommendation – Increase capacity of applicants through mediation of professional services for application development for the international scientific programs (horizon 2020)

Recommendation – Increase horizontal cooperation between research institutions of similar profile to assist in cluster formation

Recommendation – Promote usage of patent search for inventors

Recommendation – Standardize IT qualification and certification framework

Recommendation – Consider Industry requirements, especially in higher education institutions, while shaping the skills development programs to match the needs of private sector

INFRASTRUCTURE

Recommendation – Increasing effectiveness of the Technical Advisory Board and working groups under the Research and Innovation Council for prioritizing needs in infrastructure, knowledge and education, R&D, policy and regulatory framework

Recommendation – Formation and maintenance of databases of IT professionals and startup companies

ACCESS TO FINANCE

Recommendation – Utilization of tax incentives on crowd funding

Recommendation – Increasing capacity of lenders and fund providers in assessment of the commercial potential of startups

Recommendation – Strengthen collaboration between GITA and the Enterprise Development Agency in order to establish international networks for the promotion of exporting activities

Recommendation – Stick to the adopted and formalized strategy and objectives without abrupt and frequent changes of set out objectives and KPIs

APPENDIX A:

TECHNOLOGY FIRMS STUDY, 2017

OBJECTIVE

The purpose of this study was to identify the detailed information on technology and IT companies in order to clarify the sector size, characteristics and development trends. Specifically, the research examined the scale and pattern of R&D, innovation activities, access to finance possibilities, export trends and the level of IT professionals, from the point of view of the target audience in order to find gaps and provide recommendations for supporting the development of the sector.

The three purposes of this section are to: (1) describe the research methodology of this study; (2) show the results of the study; and (3) provide the study instrument.

METHODOLOGY

A descriptive research methodology was used for this study. A survey was administered to a selected list of 1,008 companies provided by Geostat based on the NACE rev.2 codes. Only economically active companies were selected. The list of the sectors selected based on the classification is provided below:

Figure 71: Sector Classification

NACE rev.2 code	Description
26	Manufacture of computer, electronic and optical products
27	Manufacture of electrical equipment
46.5	Wholesale of information and communication equipment
58.2	Software publishing
61	Telecommunications
62	Computer programming, consultancy and related activities
63	Information service activities
72	Scientific research and development
74	Other professional, scientific and technical activities
95	Repair of computers and personal and household goods

Source: NACE rev.2

The survey instrument used for this research is a questionnaire consisting of five sections. The questionnaire is designed to gather information from C level executives or technical personnel. An online survey was conducted. At the first phase of research, the respondents were contacted via telephone and sent links of the survey via emails. At the second phase, reminder calls and messages were given to the inactive respondents.

Sample

The methodology for this study was a random sample of companies in Georgia which were economically active. The final sample list comprised of 390 companies, from which 80 companies filled in the survey. In order to get proportionate and meaningful results, the sample list was disaggregated into 10 sub-groups based on the sub-sectors where the companies operated. In order to get a representative sample, companies were divided in three size groups. All the listed organizations were contacted (medium and large size companies) and for the small size companies frequency distribution was used. A 50% response rate was expected, accordingly the selection was doubled.

Area of focus

The main topics that the survey covers include:

- Products;
- R&D;
- Access to finance;
- Technology product and process (TPP) innovation;
- Target markets;
- IT professionals.

Method of Analysis

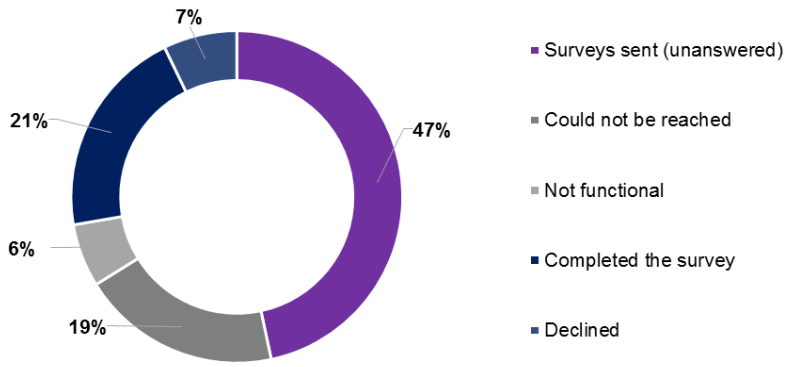
The data analysis consisted of examining the surveys for correctness and completeness, sorting and filtering data into a database in excel and performing an analysis of descriptive responses according to frequency distribution and descriptive statistics. Frequency tables, charts and descriptive statistics are constructed to display the results.

SUMMARY RESULTS

A total of 390 companies were reached by telephone. Due to low rates of response, phone calls were repeated and reminder e-mails were sent. From the total pool, only 80 responses were received, out of which 68 were valid for the analysis.

Distribution of Total Pool by Answers

Figure 72: Survey Responses

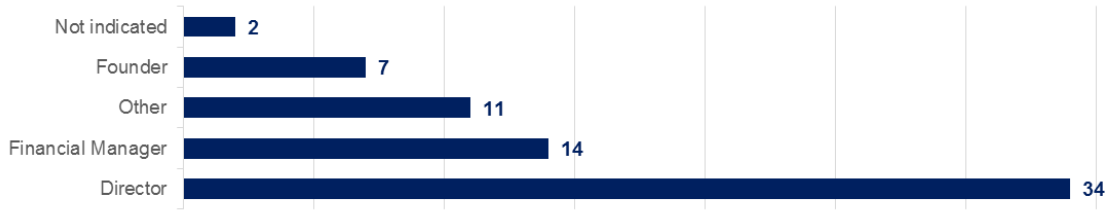


Source: PMO Analytics

Survey Results

As was desired, the survey was mostly filled in by top executives. The others included chiefs of IT departments, marketing and sales managers and other operational staff.

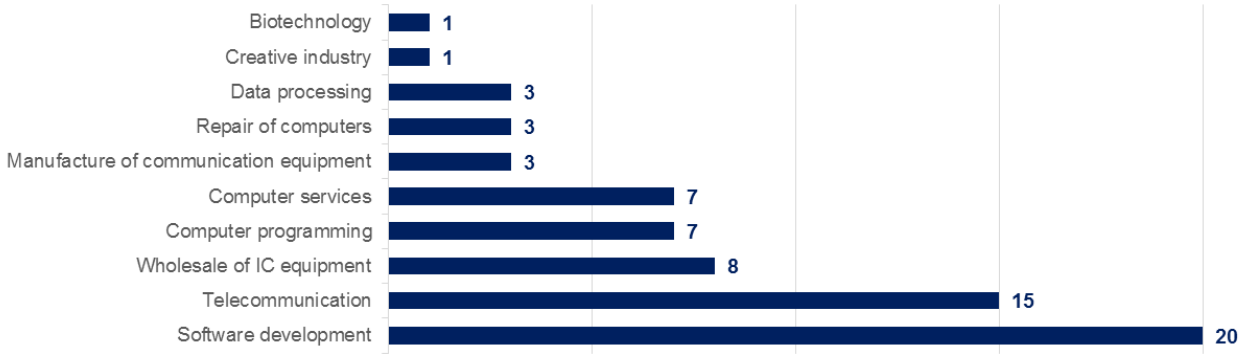
Figure 73: Positions Interviewed



Source: PMO Analysis

In terms of sub-sectors, distribution is very close to the actual market allocation.

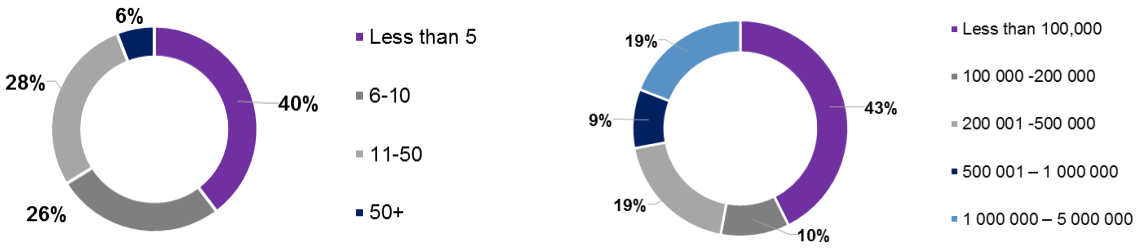
Figure 74: Industries Interviewed



Source PMO Analysis

Variety is also seen in the size and revenue of the organizations. There are four categories of size in terms of number of employees and five categories regarding the revenue:

Figure 75: Size and Revenue Categorization



Source: PMO Analysis

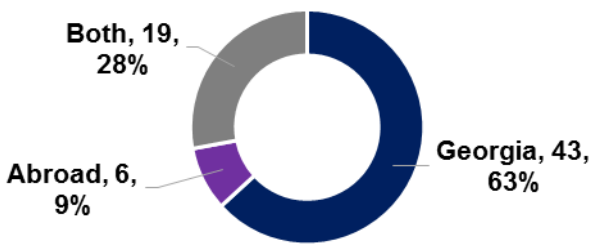
Figure 76: Size and Revenue Categorization by Sub-Sectors

Revenue by categories		Less than 100,000	100 000 - 200 000	200 001 - 500 000	500 001 - 1 000 000	1 000 000 – 5 000 000	Total
Software development		9	2	4	2	3	20
	%	**45%**	**10%**	**20%**	**10%**	**15%**	**100%**
Telecommunication		7	-	4	1	3	15
	%	**47%**	**-**	**27%**	**7%**	**20%**	**100%**
Manufacture of IC equipment		-	-	1	1	1	3
	%			**33%**	**33%**	**33%**	**100%**
Repair of computers		2	-	1			3
	%	**67%**		**33%**			**100%**
Wholesale of IC equipment		-	2	1	1	4	8
	%	-	**25%**	**13%**	**13%**	**50%**	**100%**
Computer programming		3	2	-	-	2	7
	%	**43%**	**29%**			**29%**	**100%**
IT services		6		-	1	-	7
	%	**86%**		**-**	**14%**	**-**	**100%**
Data processing		3					3
Creative industry				1			2
Biotechnology			1				1

Source: PMO Analytics

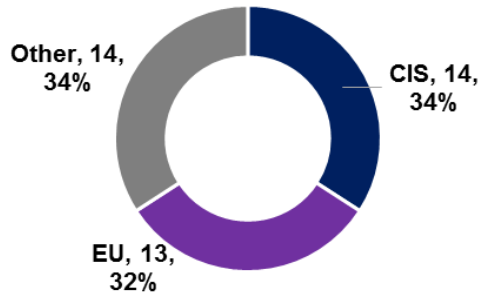
There is a fairly high share (37%) of companies who have international business relationships beyond Georgia. However, companies who export products are only 13 out of the 68 of the companies included in this study. The major services exported are software development, IT services, internet services and the sale of IC equipment.

Figure 77: Geographic Area of Activity

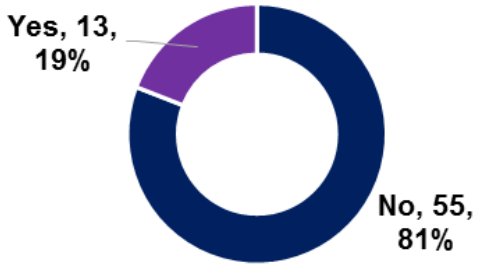


Source: PMO Analytics

Figure 78: Distribution of Companies Based on Regions



Export of Products/Services



Source:PMO Analytics

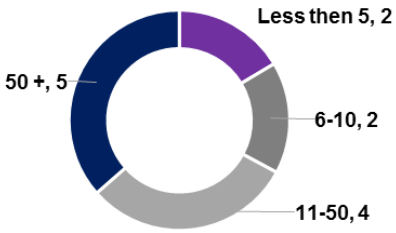
Percentage of export share in the revenue varies but mainly falls between 10% of total revenue.

R&D

In-house R&D is very high compared to other sub-sectors. The high rate of in-house R&D is mostly attributed to the specific nature of the sector, where R&D is an inseparable part of business activity.

Figure 79: Companies with In-house R&D

Average Number of R&D Employees Based on the Size of the Company

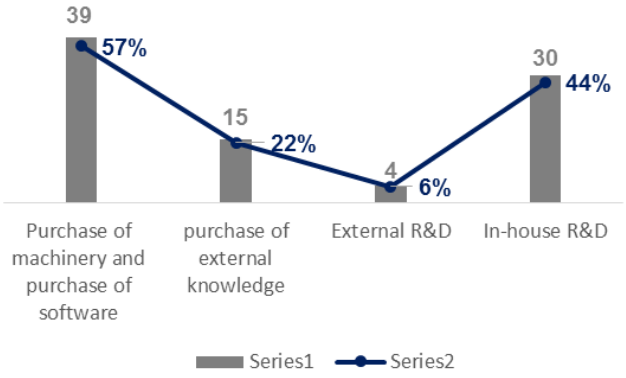


Source: PMO Analytics

Number of employees is directly correlated with the size of the organization. On average, there are two R&D employees in companies where total number of employees do not exceed 10, while companies who employ more than 50 people have on average five employees allocated for in-house R&D.

To summarize the R&D categories, the highest share of R&D expenditures goes to purchases of software and machinery. This trend is visible in the overall market also.

Figure 80: Summary of R&D Categories

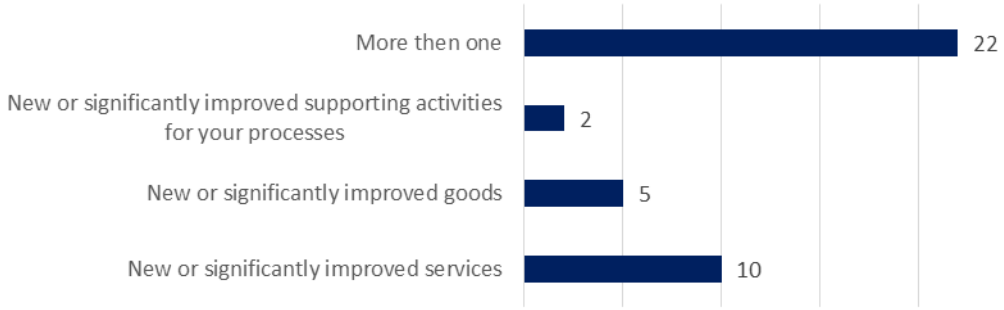


Source: PMO Analytics

Innovation

Out of a total of 68 companies, a fairly high number 39 (57%) of companies introduced a new or significantly improved product or service to the market.

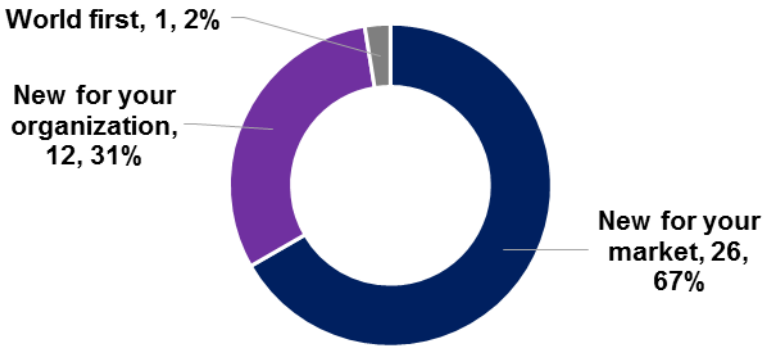
Figure 81: Innovation Types



Source: PMO Analytics

As expected, most of the innovations are only new for the local market or for the company in question. Organizations received up to GEL 100,000 on average from the introduction of innovation for the last three years.

Figure 82: Scale of Innovation



Source: PMO Analytics

The same amount of companies (39) were conducting innovative activities, out of which 10 were abandoned or suspended before completion and the remaining 29 are still on-going.

Access to Finance

In terms of financial support, only three companies (4.4%) received funding from government or other sources, out of which two received funding from the government and only one received funds from an international source United States Agency for International Development (USAID).

IT Professionals

IT professionals tend to have higher salaries then the market average. Based on the survey, the salary of IT professionals varies between GEL 900 to 3,400 monthly. In terms of quality, most of the firms consider staff qualification to be on high or medium levels.

Figure 83: Level of IT Professionals

Source:PMO Analytics

It is also noteworthy that companies spend on average GEL 2,600 yearly to improve the qualifications of the technical staff.

QUESTIONNAIRE

Form of the interview	☐Telephone	☐Online
Legal Name of the entity		
Organization's Main economic activity		
Organizations contact information	Address: Telephone: E-mail	
Respondent's Name Surname		
Respondent's Position		
Contact Information	Mobile: E-mail:	

Section I: Company operations		
1.1	Organization's Year of establishment	
1.2	Number of employees	☐below 5 ☐6 - 10 ☐11 - 50 ☐50 +
1.3	Geographic markets of operations (*you can select more than one option)*	☐Within Georgia ☐EU Countries[17] ☐CIS Countries[18] ☐Other Countries
1.4	Company revenue (*please select the range)*	☐below 100,000 ☐100 000 -200 000 ☐200 001 -500 000 ☐500 001 – 1 000 000 ☐1 000 000 – 5 000 000 ☐ 5 000 001 – 10 000 000 ☐10 000 000 +
1.5	Core products/services of the company	
1.6	Share of revenue for each product/service line (%)	

Section II: R&D			
2.1	In-house R&D	☐Yes	☐ No

[17] Countries included in European Union

[18] Commonwealth of Independent State Members

2.2	Number of employees in R&D	☐Yes	☐ No
2.3	External R&D	☐Yes	☐ No
2.4	Acquisition of machinery, equipment and software	☐Yes	☐ No
2.5	Acquisition of existing knowledge from other enterprises or Organizations	☐Yes	☐ No
2.6	How much did your organization spent on each of the following activities during 2016	In-House R&D (GEL) External R&D (GEL) Acquisition of machinery, equipment and software (GEL) Acquisition of existing knowledge from other enterprises or Organizations (GEL) Total expenditures on all types of activities (GEL)	

Section III: Access to Finance		
3.1	During the three years 2014 to 2016, did your enterprise receive any public financial support for innovation activities from the following levels of government?	☐Local or regional authorities ☐Central government ☐International Sources *(Please specify the country and source)*
3.2	Please list the amount of financing that your enterprise received for each of the sources	

Section IV: TPP Innovation

5.1 During the three years 2014 to 2016, did your enterprise introduce:

	Goods innovations: New or significantly improved goods (exclude the simple resale of new goods and changes of a solely aesthetic nature)	☐Yes	☐ No
	Service innovations: New or significantly improved services	☐Yes	☐ No
	New or significantly improved methods of manufacturing or producing goods or services	☐Yes	☐ No
	New or significantly improved logistics, delivery or distribution methods for your inputs, goods or services	☐Yes	☐ No
	New or significantly improved supporting activities for your processes, such as maintenance systems or operations for purchasing, accounting, or computing	☐Yes	☐ No

5.2 Who developed these product innovations?

	Your enterprise by itself	☐Yes	☐ No
	Your enterprise together with other enterprises or Institutions	☐Yes	☐ No
	Your enterprise by adapting or modifying goods or services originally developed by other enterprises or institutions	☐Yes	☐ No
	Other enterprises or institutions	☐Yes	☐ No
5.3	Were any of your product innovations (goods or services) during the three years 2014 to 2016		
	New to your market?	☐Yes	☐ No

	Only new to your firm?	☐Yes	☐ No
	World first	☐Yes	☐ No
5.4	The amount that enterprise earned from innovation that was introduced during three years period (GEL)		
5.5	During the three years 2014 to 2016, did your enterprise have any innovation activities that did not result in a product or process innovation because the activities were:		
	Abandoned or suspended before completion	☐Yes	☐ No
	Still on-going at the end of the 2016	☐Yes	☐ No
Section V: IT professionals			
6.1	Number of IT professionals		
6.2	Range of Salary (*Please provide if the income tax is included/excluded)*	From: _____ To: _____	
6.3	Money spent on training and education of IT professionals yearly (GEL)		
6.4	Percentage of IT professionals with different levels of qualifications.	☐Low skilled _____ ☐Skilled _____ ☐High skilled _____	

APPENDIX B

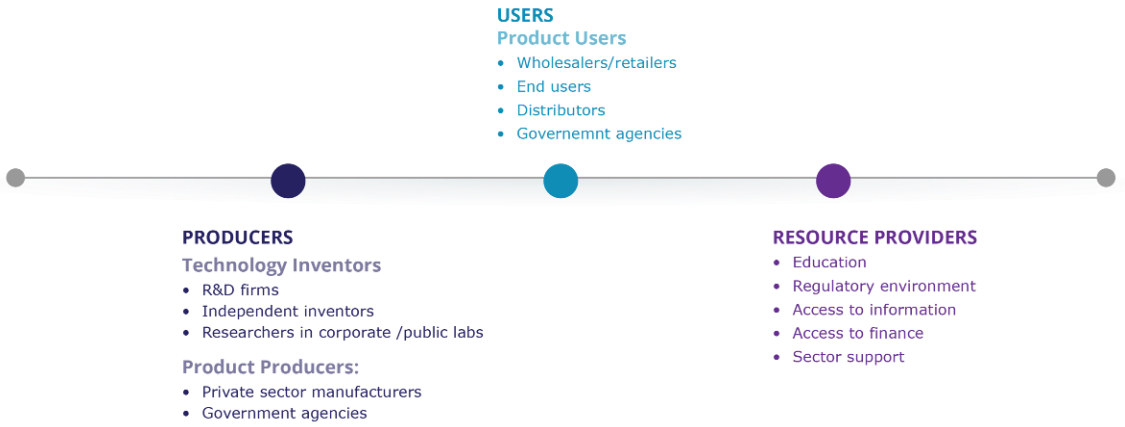
STAKEHOLDER ANALYSIS

For the purposes of this report, stakeholders are defined as any group that affects or is affected by GITA. This section describes the key stakeholder groups and their interrelationships, as well as their role in the innovation and technology ecosystem.

As GITA focuses on multi-sector innovations and the development of technology sector, it can have a great influence on the political, economic, social and technological environment of the country. Therefore, the quantity of stakeholders might be several hundred with different characteristics and levels of influence.

STAKEHOLDER GROUPS

As identified there are three major stakeholder groups, which are then subdivided into smaller categories. The first category is producers, who produce innovative technology products in various sectors of the economy as well as technology firms who manufacture or supply technological products. The second category, product users, include end users as well as product resellers and distributors. The third category, resource providers, are players that provide various resources which create an ecosystem for producing products and technologies.[19] Each of the categories are analyzed more precisely below:



Producers – in this category, two types are identified: one is technology producers, which includes the researchers and inventors who develop and prototype the idea; the other is product producers who apply the technological product or process in the development of the product.

Users – this category includes the end users, or the ones who deliver the finished product to the end users (intermediaries).

Resource providers – this category includes all the elements and players for incentivizing and supporting the production of technology and products and bring it to the users.

Stakeholder group characteristics – in this area greater details of stakeholder groups and their participants and discuss them by their characteristics.

Four criteria were chosen for the analysis of each group and its sub-groups: scope, level of interest, power and areas of interest. By the scope, the scale of activity of each stakeholder group were measured as being local, national or international. By interest and power, stakeholder's attention to GITA's activities and ability to influence them were measured. Three categories were used for measuring the interest and power – low, medium and high.

Areas of interest lists the actions that GITA can offer in order to support its stakeholders. These actions include policy and regulatory framework, entrepreneurial learning and technical assistance, R&D

[19] The model was developed on the basis of this source: http://t2rerc.buffalo.edu/evaluation/stakeholders.htm

commercialization, infrastructure for innovation, availability of information and access to finance and are based on the agency's objectives.

The first group is the technology producers group. The table below lists the major sub-categories and their characteristics:

Figure 84: Technology Producers Group

Sub-group	*Scope*	*Interest*	*Power*	*Areas of interest*
Science academies	National	Medium	Low	policy framework
Public research institutions	National	Medium	Low	infrastructure for innovation, R&D commercialization
Private research institutions	National	Medium	Low	R&D commercialization, access to finance
Independent inventors	Local	High	Low	R&D commercialization, access to finance
Research in corporate/public labs	Local	Medium	low	entrepreneurial learning and technical assistance

Source: PMO Analysis

After the technology is developed, it is moved into the hands of product producers. This category includes manufacturers and government agencies that use technological achievements in governmental services.

Figure 85: Product Producers Group

Sub-group	*Scope*	*Interest*	*Power*	*Areas of interest*
Private sector manufacturers	National/ International	Medium	Medium	regulatory framework
Government agencies	National	Medium	Medium	regulatory framework

Source: PMO Analytics

The final and the broadest category is resource providers, which include a wide range of stakeholders:

Figure 86: Resource Providers Group

Sub-group	*Scope*	*Interest*	*Power*	*Areas of interest*
Education				

HEI (formal)	National	High	Medium	entrepreneurial learning and technical assistance
Schools (formal)	National	High	Medium	entrepreneurial learning and technical assistance
Training Centers (informal)	Local	Medium	Low	regulatory framework
Vocational education (formal)	Local	Medium	Low	regulatory framework
Regulatory environment				
Parliament	National	Medium	High	regulatory framework
Key Ministries	National	Medium/High	High	regulatory framework
Sakpatenti	National	High	High	regulatory framework
International agreements/obligations	National	High	High	regulatory framework
Access to finance				
Donors	International	Medium	High	access to finance
Government agencies related to the development of entrepreneurship	National	High	High	access to finance/entrepreneurial learning and technical assistance
Venture capitalists	National/International	Low	High	access to finance
Investors	National/International	Medium	High	access to finance
Access to information				
Consultancy firms	Local	High	Medium	entrepreneurship, learning & technology, assist innovation, infrastructure, access to finance
Associations	Local	Medium	Medium	availability of information
NGOs	Local	Medium	Low	availability of information
Government bodies[20]	National	Medium	High	availability of information
Sector support				
Business incubators	Local	High	Medium	entrepreneurship, learning &

[20] Including GNCC, Geostat, Sakpatenti and etc.

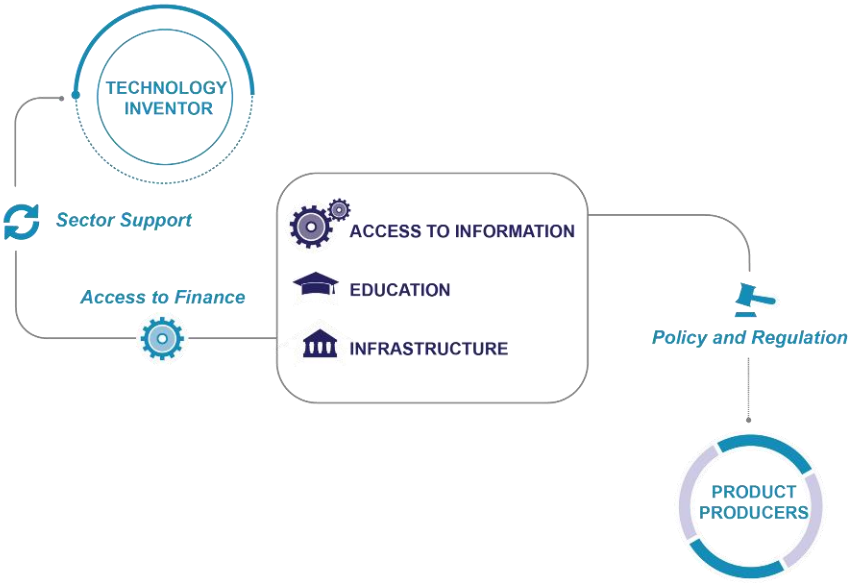
				technology, assist innovation, infrastructure, access to finance
Tech parks	Local	High	Medium	entrepreneurship, learning & technology, assist innovation, infrastructure, access to finance
Associations	Local	Medium	Medium	entrepreneurship, learning & technology, assist innovation, infrastructure, access to finance
Innovation centers	Local	Medium	Medium	entrepreneurship, learning & technology, assist innovation, infrastructure, access to finance
National government bodies	National	Medium	High	innovation infrastructure
Local governmental bodies	Local	Medium	High	innovation infrastructure
SRNSF	National	High	High	access to finance
Researchers in universities and labs	Local	High	Medium	entrepreneurship, learning & technology, assist innovation, infrastructure, access to finance

Source: PMO Analytics

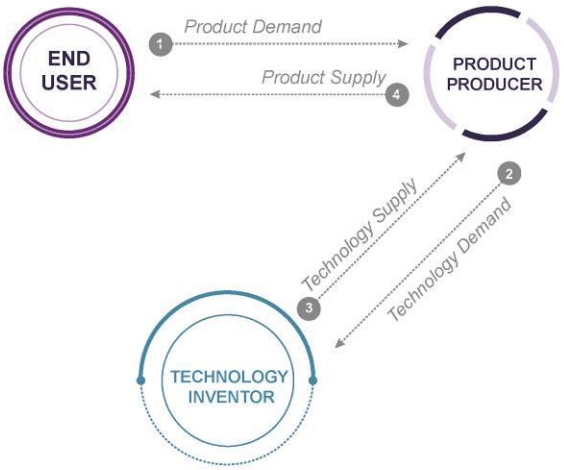
RELATIONSHIP MAP

In this section, the dynamic relationships are described between the stakeholder groups and how they affect each other's development.

The basis of an innovative ecosystem stands on two major pillars - education and the regulatory environment. The regulatory environment directly affects the business environment which strengthens the product producers. Education and access to finance strengthens technology producers, while sector support gives additional incentive to it. Access to information affects technology and product producers. The infographic below depicts the relationships between sector stakeholders:



Besides the relationships between the key players, the relationship between producers and end users should also be discussed. There are two methods for triggering the technology innovation. One is driven by the inventor when an idea is transformed into a new technology. It is commercialized and used by the product producer to introduce an innovative new product to market. This process starts without addressing the needs of customers and develops a demand after the introduction of the product to market. Technology transfer centers and other sector support players play a significant role in this process. The second approach is customer driven, when end users affect the supply of an innovative technology. The scheme below depicts the end user driven process of innovative product introduction to market:



As our country's innovation and technology sector is at an early stage of development, the main focus of GITA should be on the third category (Resource Providers Group) which will build the basis for strengthening the rest of the two categories.

APPENDIX C

DIMENTION	GLOBAL INDICATORS	RANKING AGENCY	CURRENT SOURCE
INFRASTRUCTURE	ICT Access	GII	http://www.itu.int/en/ITU-D/Statistics/Documents/publications/misr2015/MISR2015-w5.pdf
	ICT Use	GII	http://www.itu.int/en/ITU-D/Statistics/Documents/publications/misr2015/MISR2015-w5.pdf
	Government's online services	GII	https://publicadministration.un.org/egovkb/Reports/ UN-E-Government-Survey-2014
	E-Participation	GII	https://publicadministration.un.org/egovkb/Reports/ UN-E-Government-Survey-2014
	Electricity Output, kWh/cap	GII	http://www.iea.org/statistics/
	Logistics Performance	GII	http://lpi.worldbank.org/
	Gross Capital Formation. % GDP	GII	http://www.imf.org/external/pubs/ft/weo/2015/02/weodata/weoselgr.aspx
	GDP/unit of energy use, 2005 ppp$/kg oil eq.	GII	http://www.iea.org/statistics/
	Computer Software Spending, % GDP	GII	https://www.ihs.com/industry/economics-country-risk.html
	ICTs & Business model creation	GII	http://reports.weforum.org/global-competitiveness-report-2015-2016/
	ICTs & Organizational model creation	GII	http://reports.weforum.org/global-competitiveness-report-2015-2016/
	Generic TLDs/th pop. 15-69	GII	http://www.zooknic.com/
	Country-code TLDs/th pop. 15-69	GII	http://www.zooknic.com/
	Availability of latest technologies	GCI	World Economic Forum, Executive Opinion Survey.
	Firm-level technology absorption	GCI	World Economic Forum, Executive Opinion Survey.
	FDI and technology transfer	GCI	World Economic Forum, Executive Opinion Survey.
	Internet users % pop	GCI	International Telecommunication Union, ITU World Telecommunication/ICT Indicators June 2016
	Fixed-broadband Internet subscriptions /100 pop	GCI	International Telecommunication Union, ITU World Telecommunication/ICT Indicators June 2016
	Internet bandwidth kb/s/user	GCI	International Telecommunication Union, ITU World Telecommunication/ICT Indicators June 2016
	Mobile-broadband subscriptions /100 pop.	GCI	International Telecommunication Union, ITU World Telecommunication/ICT Indicators June 2016
	Gov't procurement of advanced tech. products	GCI	World Economic Forum, Executive Opinion Survey. For more details, refer to Chapter 1.3 of this Report
	Availability of latest technologies*	GITR	World Economic Forum, Executive Opinion Survey, 2014 and 2015 editions
	Gov't procurement of advanced tech*	GITR	World Economic Forum, Executive Opinion Survey, 2014 and 2015 editions
	Electricity production, kWh/capita	GITR	http://data.worldbank.org
	Mobile network coverage, % pop.	GITR	http://www.itu.int/en/ITU-D/Statistics/Pages/publications/wtid.aspx
	Int'l Internet bandwidth, kb/s per user	GITR	http://www.itu.int/en/ITU-D/Statistics/Pages/publications/wtid.aspx
	Secure Internet servers/million pop.	GITR	http://data.worldbank.org
	Individuals using Internet, %	GITR	http://www.itu.int/en/ITU-D/Statistics/Pages/publications/wtid.aspx
	Households w/ personal computer, %	GITR	http://www.itu.int/en/ITU-D/Statistics/Pages/publications/wtid.aspx
	Households w/ Internet access, %	GITR	http://www.itu.int/en/ITU-D/Statistics/Pages/publications/wtid.aspx
	Fixed broadband Internet subs/100 pop.	GITR	http://www.itu.int/en/ITU-D/Statistics/Pages/publications/wtid.aspx
	Mobile broadband subs/100 pop.	GITR	http://www.itu.int/en/ITU-D/Statistics/Pages/publications/wtid.aspx
	Firm-level technology absorption*	GITR	World Economic Forum, Executive Opinion Survey, 2014 and 2015 editions
	ICT use for business-to-business transactions*	GITR	World Economic Forum, Executive Opinion Survey, 2014 and 2015 editions
	Business-to-consumer Internet use*	GITR	World Economic Forum, Executive Opinion Survey, 2014 and 2015 editions
	Government Online Service Index, 0–1 (best)	GITR	http://unpan3.un.org/egovkb/en-us/
	Impact of ICTs on business models*	GITR	World Economic Forum, Executive Opinion Survey, 2014 and 2015 editions
	Impact of ICTs on organizational models*	GITR	World Economic Forum, Executive Opinion Survey, 2014 and 2015 editions
	Impact of ICTs on access to basic services*	GITR	World Economic Forum, Executive Opinion Survey, 2014 and 2015 editions
	Internet access in schools*	GITR	World Economic Forum, Executive Opinion Survey, 2014 and 2015 editions
	ICT use & gov't efficiency*	GITR	World Economic Forum, Executive Opinion Survey, 2014 and 2015 editions
	E-Participation Index, 0–1 (best)	GITR	http://unpan3.un.org/egovkb/en-us/

DIMENTION	GLOBAL INDICATORS	RANKING AGENCY	CURRENT SOURCE
ACCESS TO FINANCE	Ease of getting credit	GII	http://www.doingbusiness.org/reports/global-reports/doing-business-2016
	Domestic Credit to private sector, % GDP	GII	http://data.worldbank.org/
	Microfinance Gross Loans, % GDP	GII	http://www.imf.org/external/error.htm?URL=http://www.imf.org/external/pubs/ft
	Total Value of stocks traded, % GDP	GII	http://data.worldbank.org/
	Venture Capital Deals/bn PPP$ GDP	GII	http://www.imf.org/external/index.htm
	FDI net inflows, % GDP	GII	http://data.worldbank.org/
	Venture capital availability*	GITR	World Economic Forum, Executive Opinion Survey, 2014 and 2015 editions
EDUCATION	Expenditure on education % GDP	GII	http://data.uis.unesco.org/
	Gov't Expenditure on Edu secondary (Scaled by % of GDP per Capita)	GII	http://data.uis.unesco.org/
	School life expectancy, years	GII	http://data.uis.unesco.org/
	PISA Scales in Reading, Math & Science	GII	http://www.oecd.org/pisa/
	Pupil to Teacher Ratio, Secondary	GII	http://data.uis.unesco.org/
	Tertiary enrollment % Gross	GII	http://data.uis.unesco.org/
	Graduates in Science & Engineering %	GII	http://data.uis.unesco.org/
	Tertiary Inbound Mobility %	GII	http://data.uis.unesco.org/
	Researchers. FTE/mn pop	GII	http://data.uis.unesco.org/
	QS university Ranking average score top 3	GII	https://www.topuniversities.com/university-rankings/world-university-rankings/2015
	Knowledge Intensive Employment, %	GII	http://www.ilo.org/ilostat/faces/wcnav_defaultSelection;ILOSTAT-COOKIE=mO7SDF_T8mSXD8RI-ooT_jxa2bbXp7RFHmBYTDcjP-GwLSabAdQ!-181507458?_afrLoop=338148047371235&_afrWindow-Mode=0&_afrWindowId=null#!%40%40%3F_afrWindowId%3Dnull%26_afrLoop%3D338148047371235%26_afrWindowMode%3D0%26_adf.ctrl-state%3D8hok34ejh_4
	Firms offering formal trainings, % firms	GII	http://www.enterprisesurveys.org/
	Females emp. w/adv. Degrees, % tot. emp.	GII	http://www5.statcan.gc.ca/
	University/Industry research collaboration	GII	http://reports.weforum.org/global-competitiveness-report-2015-2016/
	Scientific & Technical articles/bn PPP$ GDP	GII	http://thomsonreuters.com/en/products-services/scholarly-scientific-research.html
	Citable Documents H Index	GII	http://www.scimagojr.com/
	Wikipedia monthly edits/mn pop. 15-69	GII	https://stats.wikimedia.org/wikimedia/squids/SquidReportsCountriesLanguagesVisitsEdits.htm
	Quality of scientific research institutions	GCI	World Economic Forum, Executive Opinion Survey. For more details, refer to Chapter 1.3 of this Report
	Availability of scientists and engineers	GCI	World Economic Forum, Executive Opinion Survey. For more details, refer to Chapter 1.3 of this Report
	Tertiary education gross enrollment rate, %	GITR	http://stats.oecd.org/
	Quality of management schools*	GITR	World Economic Forum, Executive Opinion Survey, 2014 and 2015 editions
	Quality of education system*	GITR	World Economic Forum, Executive Opinion Survey, 2014 and 2015 editions
	Quality of math & science education*	GITR	World Economic Forum, Executive Opinion Survey, 2014 and 2015 editions
	Secondary education gross enrollment rate, %	GITR	http://data.uis.unesco. org/
	Adult literacy rate, %	GITR	http://data.uis.unesco. org/
	Extent of staff training*	GITR	World Economic Forum, Executive Opinion Survey, 2014 and 2015 editions
	Knowledge-intensive jobs, % workforce	GITR	http://www.ilo.org/ilostat

DIMENTION	GLOBAL INDICATORS	RANKING AGENCY	CURRENT SOURCE
ENVIRONMENT	Political Stability and Safety	GII	http://info.worldbank.org/governance/wgi/index.aspx#home
	Government Effectiveness	GII	http://info.worldbank.org/governance/wgi/index.aspx#home
	Regulatory Quality	GII	http://info.worldbank.org/governance/wgi/index.aspx#home
	Rule of Law	GII	http://info.worldbank.org/governance/wgi/index.aspx#home
	Cost of Redundancy dismissal, salary weeks	GII	http://www.doingbusiness.org/reports/global-reports/doing-business-2016
	Ease of Starting Business	GII	http://www.doingbusiness.org/reports/global-reports/doing-business-2016
	Ease of Resolving Insolvenvy	GII	http://www.doingbusiness.org/reports/global-reports/doing-business-2016
	Ease of paying Taxes	GII	http://www.doingbusiness.org/reports/global-reports/doing-business-2016
	Environmental Performance	GII	http://epi.yale.edu/
	ISO 14001 environment, certificates/bn PPP$ GDP	GII	http://www.imf.org/external/error.htm?URL=http://www.imf.org/external/pubs/ft
	Ease of protecting minority investors	GII	http://www.doingbusiness.org/reports/global-reports/doing-business-2016
	market Capitalization, % GDP	GII	http://data.worldbank.org/
	Applied Tariff rate, weighted mean %	GII	http://data.worldbank.org/
	Intensivity of local competition	GII	http://reports.weforum.org/global-competitiveness-report-2015-2016/
	Domestic Market Scale, bn PPP$	GII	http://www.imf.org/external/pubs/ft/weo/2015/02/weodata/weoselgr.aspx
	State of Cluster Development	GII	http://reports.weforum.org/global-competitiveness-report-2015-2016/
	JV-Strategic alliance details/bn PPP$ GDP	GII	http://www.imf.org/external/pubs/ft/weo/2015/02/
	Patent families filed in 2 + Offices/bn PPP$ GDB	GII	http://www.wipo.int/ipstats/en/
	Intellectual Propery Payments, % total Trade	GII	http://stat.wto.org/StatisticalProgram/WSDBStatProgramHome.aspx?Language=E
	High-tech imports less re-imports, % tot. Trade	GII	https://comtrade.un.org/
	ICT services imports, % total trade	GII	http://stat.wto.org/StatisticalProgram/WSDBStatProgramSeries.aspx
	Patents by origin/bn PPP$ GDP	GII	http://www.wipo.int/ipstats/en/
	PCT patent application/bn PPP$ GDP	GII	http://www.wipo.int/ipstats/en/
	Utility models by origin/bn PPP$ GDP	GII	http://www.wipo.int/ipstats/en/
	Growth rate of PPP$ GDP/Worker, %	GII	https://www.conference-board.org/data/economydatabase/
	New Businesses/th pop. 15-64	GII	http://www.doingbusiness.org/data/exploretopics/entrepreneurship
	ISO 9001 quality certificates/bn PPP$ GDP	GII	https://www.iso.org/home.html
	High-& medium-high-tech manufacturers, %	GII	http://www.unido.org/statistics.html
	Intellectual Property receipts, % total trade	GII	http://stat.wto.org/StatisticalProgram/WSDBStatProgramSeries.aspx
	High-tech exports less re-exports, % total trade	GII	https://comtrade.un.org/
	ICT Services exports, % total trade	GII	http://stat.wto.org/StatisticalProgram/WSDBStatProgramSeries.aspx
	FDI net outflows, % GDP	GII	http://stat.wto.org/StatisticalProgram/WSDBStatProgramSeries.aspx
	Trademarks by origin/bn PPP$ GDP	GII	http://www.wipo.int/ipstats/en/
	Industrial designs by origin/bn PPP$ GDP	GII	http://www.wipo.int/ipstats/en/
	Cultural & Creative services exp. % total trade	GII	http://stat.wto.org/StatisticalProgram/WSDBStatProgramSeries.aspx
	National feature films/mn pop. 15-69	GII	http://data.uis.unesco.org/
	Global ent. & media market/th pop. 15-69	GII	http://www.pwc.com/outlook
	Printing & publishing manufacturers, %	GII	http://www.unido.org/statistics.html
	Creative Goods exports, % total trade	GII	http://unctadstat.unctad.org/EN/
	Video uploads on youtube/pop. 15-69	GII	https://www.youtube.com/

DIMENTION	GLOBAL INDICATORS	RANKING AGENCY	CURRENT SOURCE
ENVIRONMENT	PCT patent applications applications/million pop.	GCI	http://www.oecd.org/sti/inno/oecdpatentdatabases.htm
	Capacity for innovation	GCI	World Economic Forum, Executive Opinion Survey. For more details, refer to Chapter 1.3 of this Report
	Effectiveness of law-making bodies*	GITR	World Economic Forum, Executive Opinion Survey, 2014 and 2015 editions
	Laws relating to ICTs	GITR	World Economic Forum, Executive Opinion Survey, 2014 and 2015 editions
	Judicial independence*	GITR	World Economic Forum, Executive Opinion Survey, 2014 and 2015 editions
	Efficiency of legal system in settling disputes*	GITR	World Economic Forum, Executive Opinion Survey, 2014 and 2015 editions
	Efficiency of legal system in challenging regs*	GITR	World Economic Forum, Executive Opinion Survey, 2014 and 2015 editions
	Intellectual property protection*	GITR	World Economic Forum, Executive Opinion Survey, 2014 and 2015 editions
	Software piracy rate, % software installed	GITR	http://globalstudy.bsa.org/2013/index.html
	No. procedures to enforce a contract	GITR	http://globalstudy.bsa.org/2013/downloads/studies/2013GlobalSurvey_Study_en.pdf
	No. days to enforce a contract	GITR	http://www.doingbusiness.org/methodology/enforcing-contracts.
	Total tax rate, % profits	GITR	http://www.doingbusiness.org/methodology/paying-taxes
	No. days to start a business	GITR	http://www.doingbusiness.org/methodology/starting-a-business
	No. procedures to start a business	GITR	http://www.doingbusiness.org/methodology/starting-a-business
	Intensity of local competition*	GITR	World Economic Forum, Executive Opinion Survey, 2014 and 2015 editions
	Prepaid mobile cellular tariffs, PPP $/min.	GITR	http://data.worldbank.org
	Fixed broadband Internet tariffs, PPP $/month	GITR	http://www.itu.int/en/ITU-D/Statistics/Pages/publications/wtid.aspx
	Internet & telephony competition, 0–2 (best)	GITR	http://www.itu.int/ITU-D/ICTEYE/Reports.aspx
	Mobile phone subscriptions/100 pop.	GITR	http://www.itu.int/en/ITU-D/Statistics/Pages/publications/wtid.aspx
	Use of virtual social networks*	GITR	World Economic Forum, Executive Opinion Survey, 2014 and 2015 editions
	Capacity for innovation*	GITR	World Economic Forum, Executive Opinion Survey, 2014 and 2015 editions
	PCT patents, applications/million pop.	GITR	http://www.oecd.org/sti/innovationinsciencetechnologyandindustry/oecdpatentdatabases.
	Importance of ICTs to gov't vision*	GITR	World Economic Forum, Executive Opinion Survey, 2014 and 2015 editions
	Gov't success in ICT promotion*	GITR	World Economic Forum, Executive Opinion Survey, 2014 and 2015 editions
	ICT PCT patents, applications/million pop.	GITR	http://www.oecd.org/sti/innovationinsciencetechnologyandindustry/oecdpatentdatabases
R&D	Gross Expenditure on R&D as % of GDP	GII	http://data.uis.unesco.org/
	Global R&D firms avg. exp. Top 3, mn USD	GII	http://iri.jrc.ec.europa.eu/scoreboard14.html
	GERD performance by business, % GDP	GII	http://data.uis.unesco.org/
	GERD finance by business, %	GII	http://data.uis.unesco.org/
	GERD financed by abroad, %	GII	http://data.uis.unesco.org/
	Research talent, % in business Enterprise	GII	http://data.uis.unesco.org/
	Company spending on R&D	GCI	World Economic Forum, Executive Opinion Survey. For more details, refer to Chapter 1.3 of this Report
	University-industry collaboration in R&D	GCI	World Economic Forum, Executive Opinion Survey. For more details, refer to Chapter 1.3 of this Report

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