



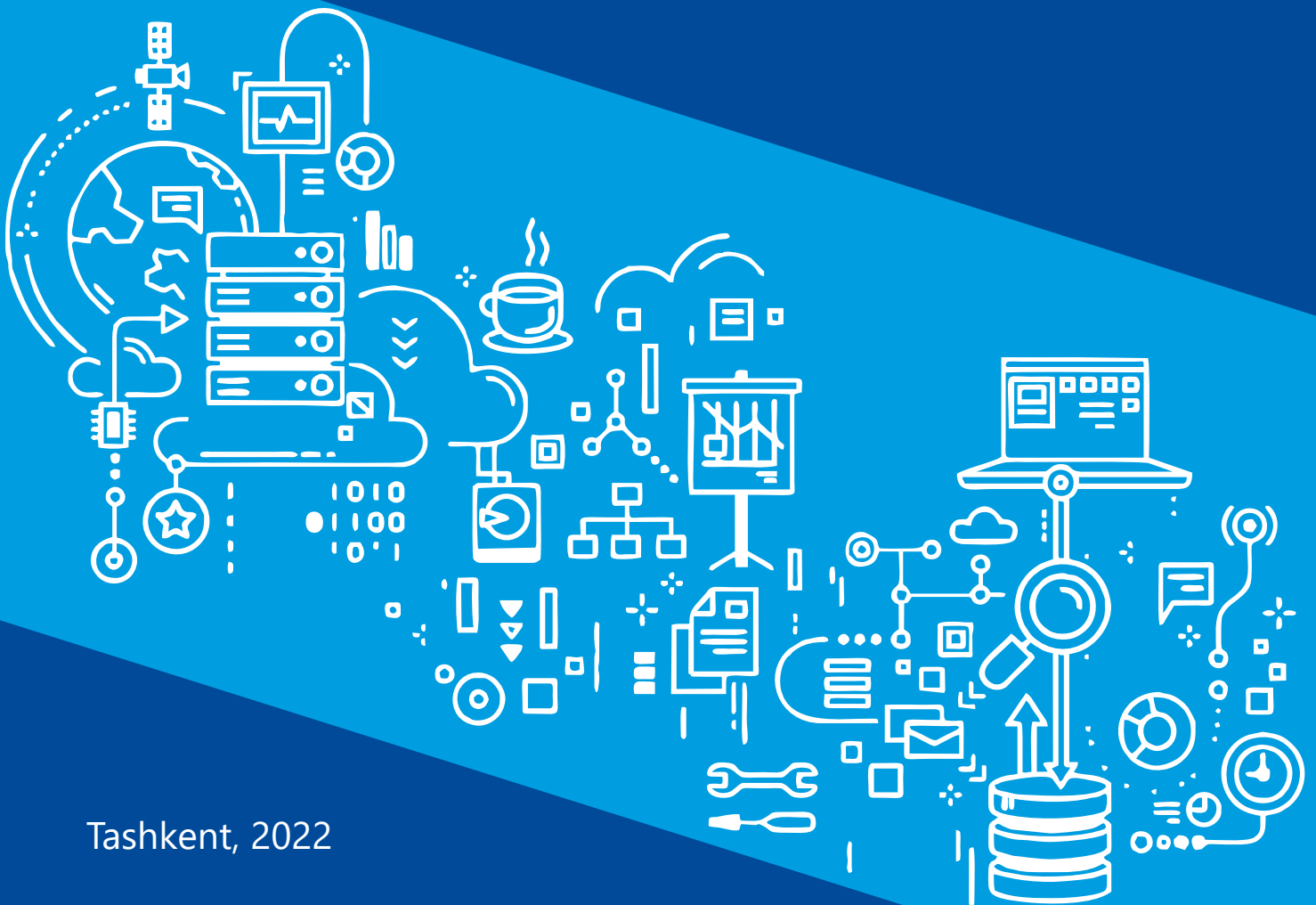
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THE MINISTRY FOR DEVELOPMENT
OF INFORMATION TECHNOLOGIES
AND COMMUNICATIONS OF THE
REPUBLIC OF UZBEKISTAN



HUMAN CAPACITY IN THE FIELD OF DIGITAL DEVELOPMENT OF UZBEKISTAN



Tashkent, 2022

Analytical review

"Human Capacity in the Field of Digital Development of Uzbekistan"

Team of Contributors:

Bunyod Avliyokulov (UNDP), Rumila Dautova (UNDP),
Jakhongir Shukurov (Minifokom), Abdulahad Kuchkarov (IT Park),
Bokhodir Ayupov (IT Park), Arletta Isaeva (Ergo Analytics),
Shakhnoza Tosheva (Ergo Analytics), Nargiza Kasimova (Ergo Analytics),
Raufkhon Salakhodjaev (Ergo Analytics).

Editor:

Ekaterina Madjidova

Design and makeup:

Alisa Yuldasheva

Contacts:

UNDP Uzbekistan

4, Taras Shevchenko Street,
Tashkent 100029, Uzbekistan

Email: policybrief@undp.org

Website: www.uz.undp.org

Tel.: (998 78) 120 34 50, (998 78) 120 61 67

Fax: (998 78) 120 34 85

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The views and conclusions presented in this report reflect only the viewpoint of the authors and do not constitute the official viewpoint of the UNDP.

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■ INTRODUCTION

Human capacity is a key in the digital development of Uzbekistan. The successful implementation of ambitious strategies and programs in the field of digitalization largely depends on the availability and quality of human resources possessing modern knowledge and skills in the field of IT and digital transformation. It is equally important to have a complete picture of the current state, features and dynamics of the system of training and employment of IT specialists in the country.

This study is aimed at exploring the availability and quality of data on human capacity in the field of digital development of Uzbekistan. For this purpose, quantitative and qualitative data obtained from responsible organizations and open sources was analyzed, as well as data from surveys and interviews with IT experts. As a result, information on the training and retraining of IT specialists, targeted programs in the field of IT education, employment and labor market of IT specialists was collected and systematized, as well as on the system for collecting and managing data on human capacity in the field of IT.

In the course of the study, interviews were conducted with representatives of institutions that collect data on IT specialists, and with representatives of foreign universities that train such specialists. To study the IT labor market, a survey was conducted among IT specialists, as well as among representatives of HR companies.

The results of the study showed that, to date, the country has established and automated a system for collecting data on the number of graduates in IT on a bottom-up basis, where educational institutions (national and foreign ones) provide data on the number of graduates to higher organization in accordance with the established formats and deadlines. That is how, in online mode, data on the training of IT specialists is collected from all higher educational institutions by the Ministry of Higher and Secondary Specialized Education, as well as by the State Committee of the Republic of Uzbekistan on Statistics. However, for a more exhaustive assessment, the collected data needs to be disaggregated by highly-demanded areas (developers, graphic designers, machine learning engineers, etc.) and by socio-demographic characteristics.

Employment data were collected on the basis of information on the number of employees of legal entities whose core business is IT, and were disaggregated by employment sector, gender, education and region. According to the data obtained, there is a digital gap between the capital and the regions of the country. For instance, over 60% of IT employees are located in Tashkent city, with specialists with university degree prevailing.

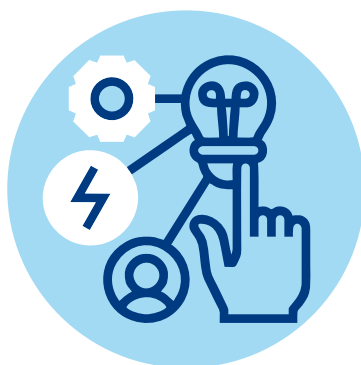
The classification of self-employed IT workers requires revision, since the current items of the register of self-employed workers, which match IT specialists, also cover occupations that are not IT-related, such as composer, sound engineer, arranger, presenter, photo editor, etc.

In addition to higher educational institutions, IT specialists are also trained by secondary specialized educational institutions (lyceums, colleges and vocational schools), but information about their graduates is not available due to the fact that colleges and vocational schools report on their activities to organizations and institutions of their own jurisdiction; that creates certain difficulties when attempting to assess the human digital capacity generated

by these educational institutions. The lack of such data does not allow to fully assess the digital gap in IT education between the capital and the regions.

In addition to public educational institutions, IT education is offered by private training centers that do not provide data on the number of graduates to any state bodies.

The study revealed that higher educational institutions do not provide the amount of IT knowledge and skills, that is necessary for competitiveness in the labor market. Almost a third of the surveyed IT specialists gained basic skills and knowledge through online or offline courses. According to HR managers, there is a shortage of IT specialists in the market, while job seekers primarily lack practical skills. Developers are in the greatest demand by employers in the local IT market.



METHODOLOGY OF THE STUDY

The purpose of this study is to explore the availability and quality of data on human capacity in the field of digital development of Uzbekistan. For this purpose, the study organized the collection of qualitative and quantitative data on the subject of the study.

The methodology of the study includes:

1. Desk review – collecting publicly available data, as well as data obtained through a request to responsible organizations.

On behalf of the national partner, official requests for statistical data on educational institutions were sent to the following responsible ministries and agencies:

- Ministry of Employment and Labor Relations;
- Ministry of Higher and Secondary Specialized Education;
- Ministry of Innovative Development;
- State Inspection for Supervision of Quality in Education under the Cabinet of Ministers of the Republic of Uzbekistan;
- State Tax Committee;
- State Committee of the Republic of Uzbekistan on Statistics.

As a result, replies were received from:

- Ministry of Employment and Labor Relations;
- Ministry of Higher and Secondary Specialized Education;
- State Committee of the Republic of Uzbekistan on Statistics.

In addition to requesting data from government ministries and agencies, collection of open source data on the remuneration of IT specialists was organized from online job search platforms, such as Headhunter, Uzjobs and others. Vacancies posted on such services were reviewed to learn about working conditions, the size of salary and the requirements for applicants to the following positions: web developers, machine learning engineers, data analysts, project managers, business and system analysts, information security analysts, system administrators, network operators, graphic designers, product designers, and web designers.

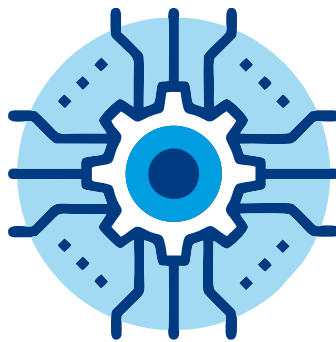
2. Collecting primary and secondary data through surveys.

To collect primary data, online surveys were conducted among IT specialists to identify their educational level, work experience, quality of skills, desired salary and other aspects. The number of respondents was 100. A survey was also conducted among HR companies and organizations that had experience in hiring IT specialists.

Heads of HR departments from 30 organizations took part in the survey. Questionnaires were distributed among representatives of both groups of respondents by posting on the LinkedIn and in the online communities of IT and HR specialists.

3. Conducting interviews with key experts - representatives of responsible organizations.

Within the framework of the project, meetings were held with representatives of the MHSSE and the SCS to study the current data collection system, the processes and mechanisms for data storage and processing. The roles of these organizations in the process of collecting statistical data on IT specialists as well as mechanisms of interagency interaction, methods of data collection digitalization, advantages and disadvantages of the current system were reviewed, and proposals regarding its improvement were collected. Interviews were also conducted with representatives of foreign universities – Amity University Tashkent (India), Turin Polytechnic University in Tashkent (Italy), Webster University Tashkent (USA), and Inha University in Tashkent (South Korea). The interviews were conducted via the Zoom platform



CHAPTER 1.

TRAINING OF IT SPECIALISTS

IT EDUCATION

NATIONAL EDUCATIONAL INSTITUTIONS

In Uzbekistan, the system of training of IT specialists includes higher educational institutions, secondary specialized educational institutions, training centers, advanced training and retraining programs, and specialized training and educational programs.

Data on the training of IT specialists is collected by the Ministry of Higher and Secondary Specialized Education, as well as the State Committee of the Republic of Uzbekistan on Statistics.

The MHSSE's data represents information on the number of graduates of national higher educational institutions over the past five years in the context of specialized programs of bachelor's and master's degrees.

The SCS's data includes information on the number of graduates and students of higher educational institutions, such as broken down by gender, and on the number of students of vocational colleges, in two specialties - "Computer Technologies and Informatics" and "Communications, Informatization and Telecommunication Technologies".

According to the MHSSE, Uzbekistan has 29 higher educational institutions that train IT specialists. According to statistics, the number of graduates over the past five years has been increasing every year (Fig. 1). For instance, from 2017 to 2021, the annual number of IT specialists graduated from national higher educational institutions ranged from 3,976 to 5,199. According to the forecast of the Ministry of Higher and Secondary Specialized Education, almost six thousand IT specialists will be trained in the 2021-2022 academic year.

Figure 1. Number of IT specialists with Master's and Bachelor's degrees

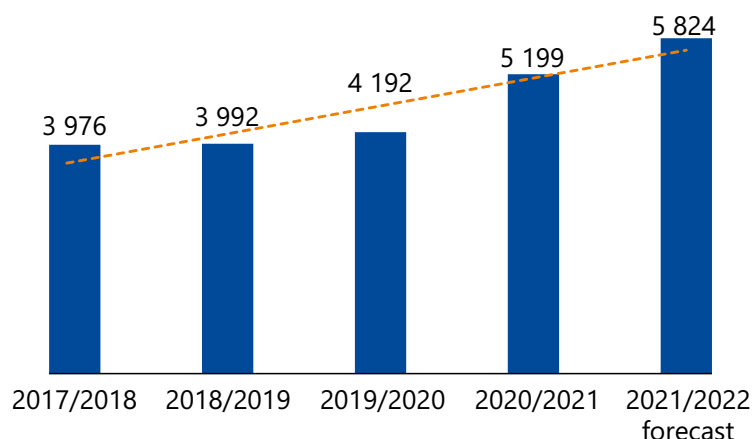
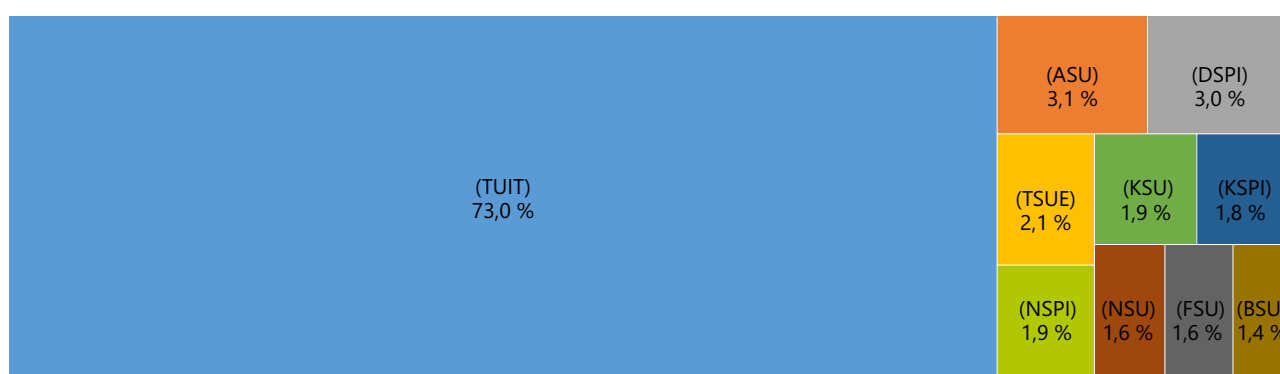
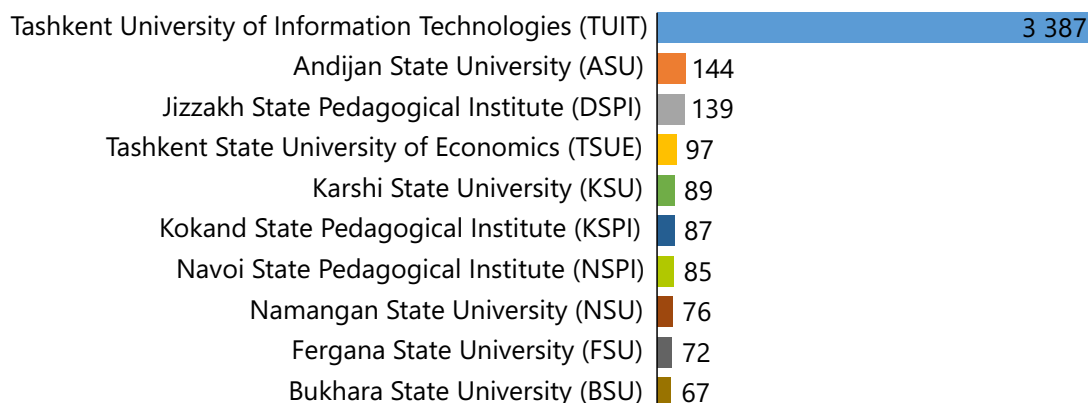


Figure 2. Top 10 higher educational institutions with the number of IT specialists graduated in the 2020-2021 academic year



According to the MHSSE (Fig. 2), in the context of universities, Tashkent University of Information Technologies (TUIT) has been the leading national higher educational institution in terms of the number of IT specialists graduated over the past five years. While specialized higher educational institutions trained almost 5.2 thousand specialists in the 2020-2021 academic year, 73% of this number were trained by TUIT and its branches in Samarkand, Fergana, Karshi, Urgench and Nukus.

After TUIT and its branches, Andijan State University takes a lead in the number of IT specialists (3.1%), followed by Jizzakh State Pedagogical Institute (3.0%), Tashkent State University of Economics (2.1%), Karshi State University (1.9%), Kokand State Pedagogical Institute (1.9%) and Navoi State Pedagogical Institute (1.8%).

Figure 3. Number of graduates of higher educational institutions by specialty as of the beginning of the academic year

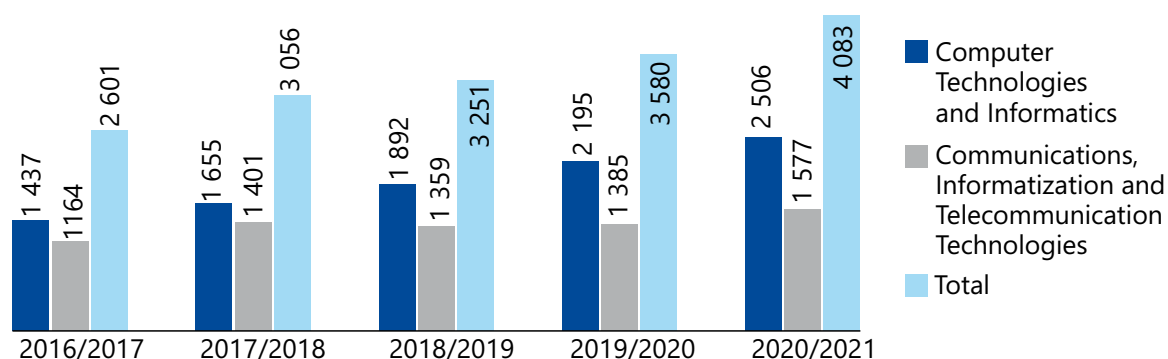
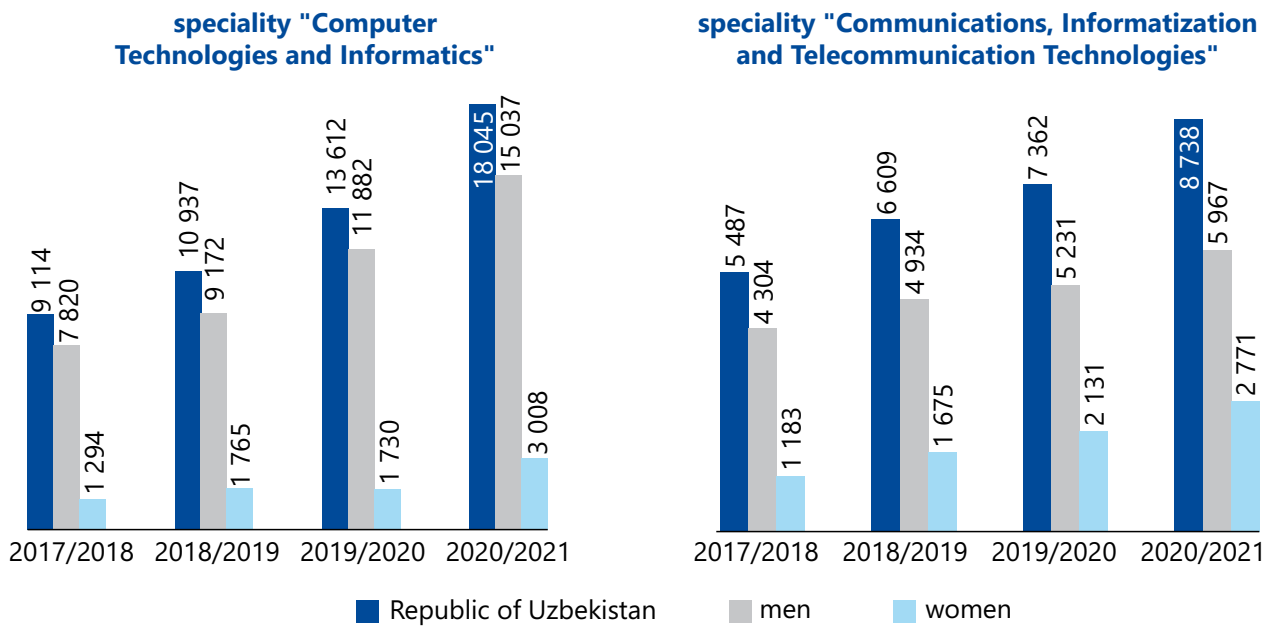


Figure 4. Number of students in higher educational institutions by speciality, men and women



According to the SCS, in the context of programs, existing higher educational institutions offer education in more than 30 bachelor's and master's degrees programs of in the field of IT. At the same time, in the 2020-2021 academic year, the number of graduates increased by 74% compared to the 2016-2017 academic year.

Over the past four years, the number of students in higher educational institutions in "Computer Technologies and Informatics" and "Communications, Informatization and Telecommunication Technologies" has increased, with more students coming from the "Computer Technologies and Informatics".

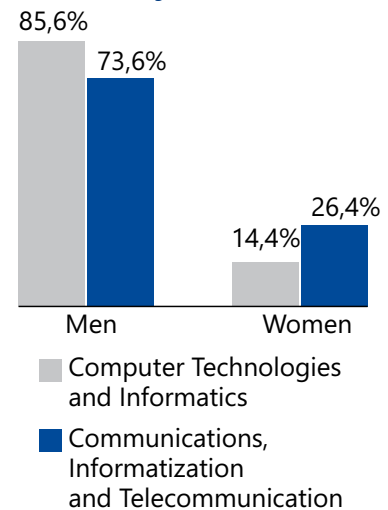
In the gender context, it is important to note that mostly men have been trained in these specialties over the past five years. For instance, in 2020-2021, the share of women who graduated in "Computer Technologies and Informatics" was only 14%, while the share of men was almost 86%. In "Communications, Informatization and Telecommunication Technologies", about 26% of women and about 74% of men graduated in the same academic year.

However, according to the SCS, the share of female graduates has increased over the past five years by almost 2 percentage points in "Computer Technologies and Informatics" and by 11 percentage points in "Communications, Informatization and Telecommunication Technologies".

TUIT, the leading higher educational institution in the field of IT, offers training in 10 bachelor's degree programs and in 21 master's degree programs, which can be summarized as follows:

- Computer and Telecommunication Engineering
- Television and Communication Technologies

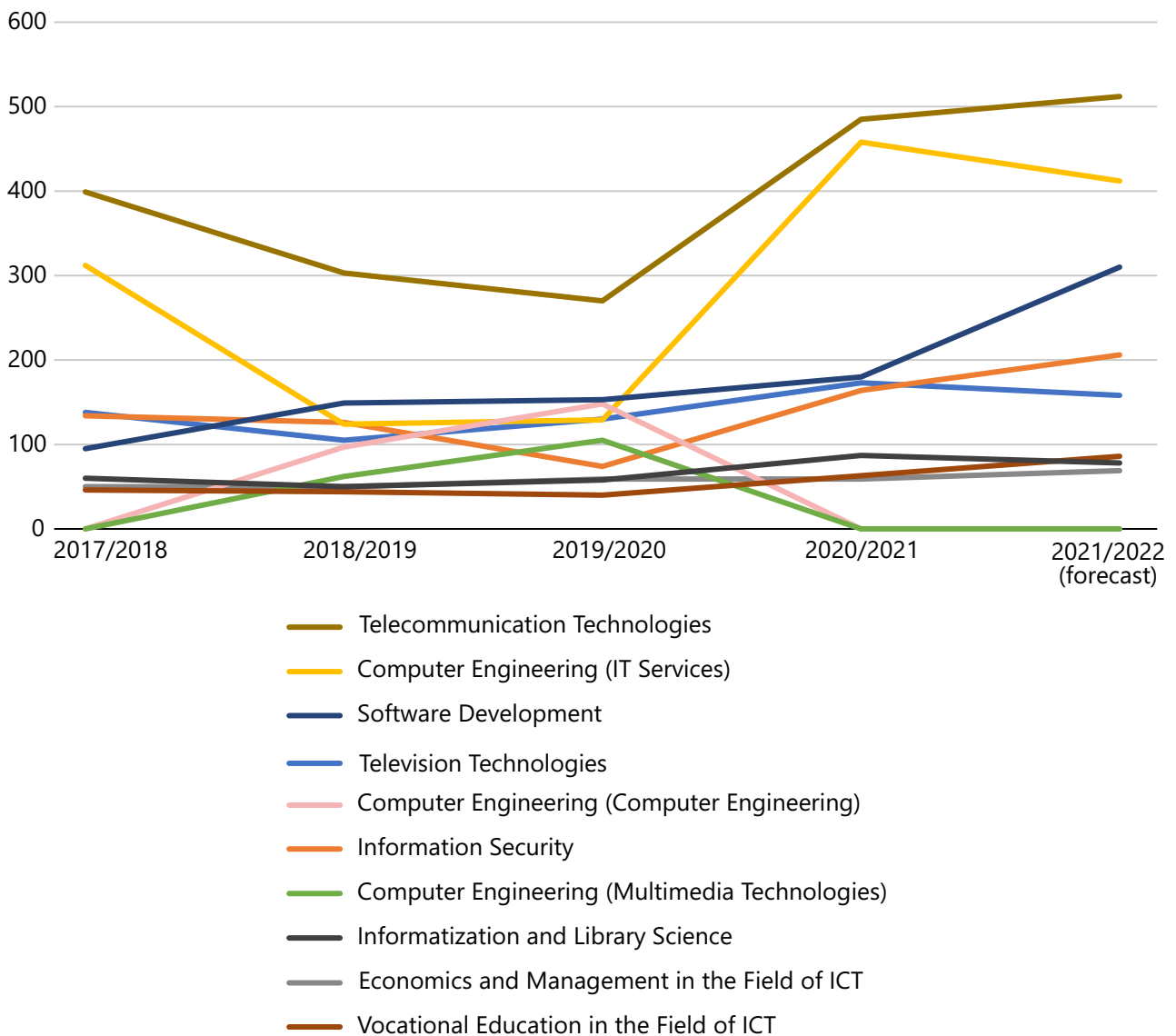
Figure 5. Share of graduates of higher educational institutions by specialty by gender for the 2020-2021 academic year, %



- Software Development
- Cryptography and Cryptanalysis
- Information Security
- Economics and Management in the Field of IT
- Implementation of E-Government System
- Electronic Library and Archives
- Audio Technologies
- Video Technologies
- Digital Economy
- E-Commerce
- Organization and Technology of Postal Communication
- Mobile Communication Systems

Table 1. Number of TUIT bachelor students for the 2017-2022 academic years

Bachelor's degree programs	academic year				2021/2022 (forecast)
	2017/2018	2018/2019	2019/2020	2020/2021	
Computer Engineering (Computer Engineering)	0	97	148	0	0
Computer Engineering (Multimedia Technologies)	0	62	105	0	0
Economics and Management in the Field of ICT	50	50	59	59	69
Informatization and Library Science	60	50	58	87	78
Vocational Education in the Field of ICT	46	44	40	63	86
Television Technologies	138	105	130	173	158
Information Security	134	126	74	164	206
Software Development	95	149	153	180	310
Computer Engineering (IT Services)	312	124	129	458	412
Telecommunication Technologies	399	303	270	485	512
Total	1234	1110	1166	1669	1831

Figure 6. Number of TUIT bachelor students for the 2018-2021 academic years

Over the past five years, the number of undergraduate (bachelor) students has grown from 1,329 to 1,906, while for the 2021-2022 academic year, the projected number of graduates was 2,251. At the same time, "Telecommunication Technologies" and "Computer Engineering, IT Services" are noticeably prevailing, followed by "Software Development".

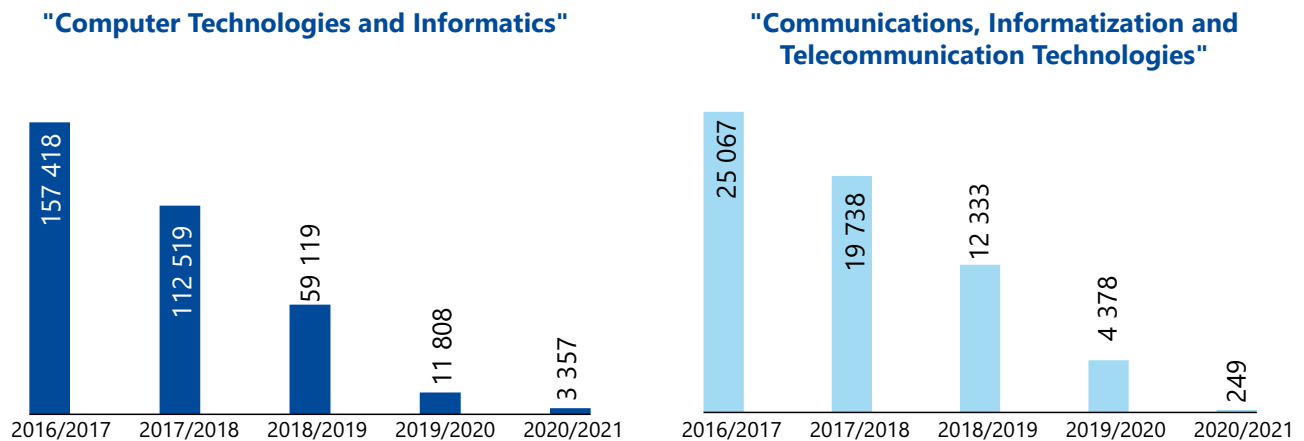
Table 2. Number of TUIT master 's students for the 2017-2022 academic years

Master's degree program	academic year				2021/2022 academic year (forecast)
	2017/2018	2018/2019	2019/2020	2020/2021	
Computer Engineering (Development of Practical Software Tools)	0	13	10	0	0
Computer Engineering (Information and Multimedia Technologies)	0	7	11	0	0
Implementation of E-Government System	3	3	13	0	0
Software Development	13	13	19	29	0
Telecommunication Engineering (Telecommunication Networks)	0	6	9	0	0
Economics and Management in the Field of ICT	4	0	4	0	0
Audio Technologies	0	2	6	0	0
Computer Systems in Medicine	0	0	0	4	0
Information Security in Telecommunication Systems and Networks	0	0	3	0	6
Cryptography and Cryptanalysis	0	0	5	0	8
Organization and Technology of Postal Communication	0	0	0	5	10
Electronic Library and Archives	2	3	8	7	13
Intelligent Information and Communication Systems	0	0	0	5	13
E-Commerce	0	0	0	10	14
Television, Broadcasting Devices and Systems	0	0	0	5	14
Digital Economy	0	0	0	9	17
Video Technologies	0	6	6	10	18
Mobile Communication Systems	0	0	0	12	28
Information Security	0	12	16	26	41
Telecommunication Engineering (Information Transmission Systems)	31	8	11	41	99
Computer Engineering (Computer Systems Design)	42	18	16	74	139
Total	95	91	137	237	420

Table 3. Higher educational institutions in the field of IT in Uzbekistan (MHSSE)

University name	Bachelor's degree	Master's degree
National University of Uzbekistan	4	7
Tashkent State Technical University	2	-
Tashkent State University of Economics	2	1
Tashkent State Pedagogical University	1	2
Andijan State University	2	1
Bukhara State University	2	1
Bukhara Engineering and Technology Institute	2	2
Gulistan State University	1	1
Jizzakh Polytechnic Institute	1	-
Karakalpak State University	1	1
Karshi State University	2	-
Namangan State University	1	2
Namangan Institute of Civil Engineering	1	2
Samarkand State University	2	1
Termez State University	3	1
Urgench State University	2	-
Fergana State University	1	-
Jizzakh State Pedagogical Institute	1	1
Kokand State Pedagogical Institute	1	1
Navoi State Pedagogical Institute	1	1
Nukus State Pedagogical Institute	1	1
Chirchik State Pedagogical Institute	1	-
Tashkent University of Information Technologies (TUIT)	10	21
TUIT, Karshi	5	2
TUIT, Nukus	5	2
TUIT, Samarkand	5	2
TUIT, Urgench	5	2
TUIT, Fergana	5	2
International Islamic Academy of Uzbekistan	1	-

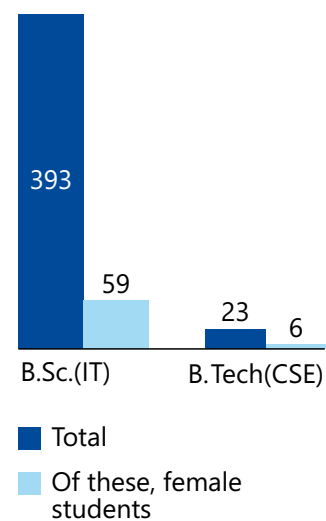
The number of master's degree graduates has also increased noticeably - from 95 in the 2017/2018 academic year to 237 in 2020/2021 academic year. This number is expected to reach 420 in 2021/2022 academic year. Over the past five years, the most popular master's degree programs were "Telecommunication Engineering", "Computer Engineering" (Computer Systems Design), "Information Security" and "Software Development".

Figure 7. Number of students in colleges and vocational schools by speciality

The TUIT branches train IT specialists in five bachelor's degree programs and in two master's degree programs, including "Computer Engineering", "Telecommunication Technologies", "Software Development", and "Information Security".

As for vocational education, according to the information provided by a representative of the MHSSE, data on graduates of vocational colleges and vocational schools is collected by the ministries, they belong to. Given that, it is reasonable to assume that data on graduates of colleges and vocational schools specializing in IT are collected by the Ministry for Development of Information Technologies and Communications, but in the process of the study, the Ministry did not confirm that it has this kind of data.

Representatives of the SCS provided data on the number of students in vocational colleges in two specialties: "Computer Technologies and Informatics" and "Communications, Informatization and Telecommunication Technologies". The number of students in colleges and vocational schools has decreased over the past five years, because the policy of compulsory vocational education was abolished and the 11-year secondary education system was brought back.

Figure 8. Number of Amity students in two bachelor's degree areas in the field of IT from 2019 to 2021

FOREIGN UNIVERSITIES

Amity University Tashkent (India)

Amity University Tashkent was founded with the aim of training highly qualified specialists in the field of information and communication technologies, including software developers and specialists in the management of information systems and computer networks. Currently, the university offers two bachelor's degree programs and one master's degree program in the field of IT. More than 850 students are currently enrolled in Amity University Tashkent. Graduates are awarded a standard diploma of Amity University (Republic of India), which is recognized as a document of higher education in the Republic of Uzbekistan.

393 undergraduate students are trained in "Information Technology" from the 1st to the 3rd year. The Bachelor of Science in Information Technology (B.Sc. (IT)) course offers students in-depth knowledge in building information databases, networks, software development and testing, and programming.

The second bachelor's degree program in IT is "Computer Science and Engineering" (B.Tech. (CSE)), where 23 students are trained. This course provides the industry with engineers with a high level of knowledge in mathematics, science, engineering fundamentals, and domain knowledge to solve complex engineering problems in the field of computer science and engineering.

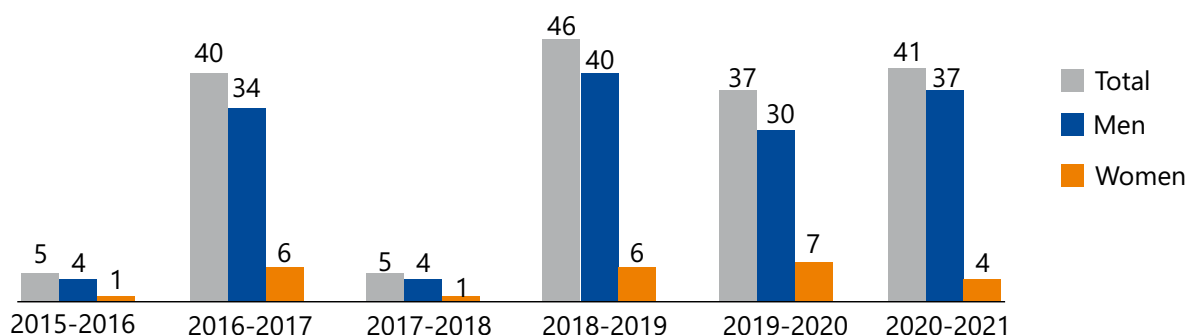
Moreover, the University offers a master's degree program in "Master of Science (Information Technology)" (M.Sc. (IT)), which allows students to enhance their knowledge and understanding of computer systems and prepare themselves for advanced positions in IT industries. To date, the university has trained 5 masters.

Turin Polytechnic University in Tashkent (Italy)

Turin Polytechnic University in Tashkent (TPUT) was established in 2009 with the aim of training highly-qualified specialists for the automotive, mechanical engineering and electrical industry, the energy industry, and companies and organizations of industrial and civil engineering and construction. TPUT graduates receive two diplomas of higher education – a TPUT diploma in accordance with the legislation of the Republic of Uzbekistan and a POLITO (Politecnico di Torino) diploma in accordance with the legislation of the Italian Republic.

In the period from 2015 to 2021, the number of graduates in "Information Technologies" increased from 5 to 41, of which 90.2% are men.

Figure 9. Number of TPUT graduates in "Information Technologies and Programming in Industry (Computer Engineering)" from 2015 to 2021



Webster University Tashkent (USA)

Webster University (USA) opened its branch in Tashkent on November 1, 2019, as an accredited private non-profit university. At the moment, the University offers five bachelor's degree areas:

- Management Information Systems
- Economics
- International Relations
- Business Administration
- Media Studies

The University opened the bachelor's degree program "Management Information Systems" (MIS) in August 2020. The MIS program is designed to train and develop managers who effectively manage the planning, design, selection, implementation, use and administration of new convergent information and communication technologies. The curriculum of the program provides students with the technical and managerial knowledge and skills that are necessary to effectively integrate human capacity, information and communication technologies and business processes in support of the strategic goals of an organization.

To date, the University has no graduates. The total number of students in the area of MIS is 176, of which 33 are women and 143 are men. The age of students is 18 to 21 years.

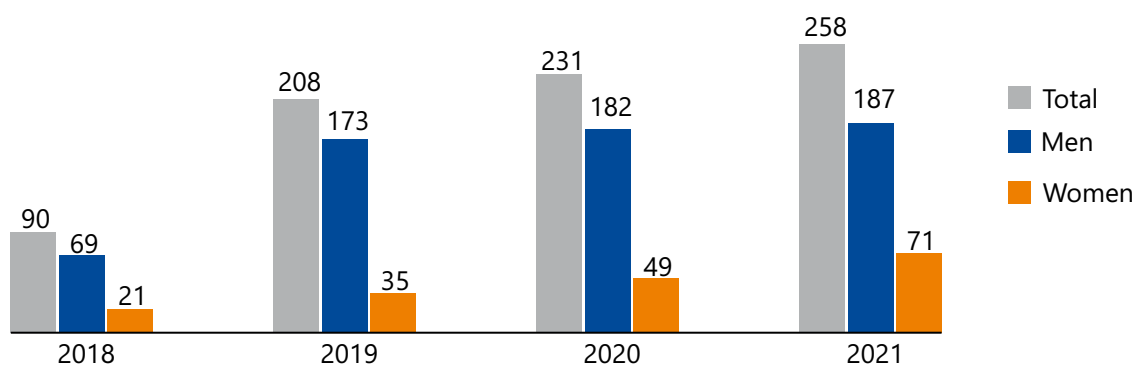
Among the students of the University, there are those who are either taking an internship or, working. Number of intern students / working students is 15. Places of internship / work include training centers, online schools, UzAutoMotors, Khokimiyat of Tashkent city. Positions include Teacher, Intern Assistant of the Finance Department, Specialist of the International Relations Department, Video Editor, and Manager.

There are no additional IT courses at the University yet. However, it is planned to open such courses for students in 2022-2023.

Inha University in Tashkent (South Korea)

Inha University in Tashkent was founded in 2014 in cooperation of the Republic of Uzbekistan with Inha University in the Republic of Korea. Currently, more than 1,500 students are studying in our university.

Figure 10. Number of students in "Computer and Software Engineering" from 2018 to 2021



The University trains students in two bachelor's degree programs and one master's degree program:

- *Computer and Software Engineering Department* - School of Computer and Information Engineering (SOCIE) offers training in two areas: "Computer Engineering" and "Software Engineering";
- *Logistics Department* - School of Logistics (SOL);
- *Business Administration in Digital Transformation*

Over 4 academic years, the University has trained 787 specialists in the field of IT, of which 83.9% are men and 16.1% are women. The University also tracks the employment rate of graduates through surveys on the University's platform <https://ums.inha.uz/>. For instance, in 2018, 74 out of 90 graduates were employed, and 15 continued their master's degree studies. In 2019, the number of graduates was 208, of which 178 were employed and 26 continued their master's degree studies.

In 2019 and 2020, employment rates also include graduates of the Logistics Department. In 2019, the number of students in two programs was 286 (where 231 in the field of IT), while their employment rate was 62%. In 2020 and 2021, 329 people graduated from Inha University, of which 231 are IT professionals. Total employment rate of 2021 graduates was almost 93%.

RETRAINING OF IT SPECIALISTS

In Uzbekistan, the system of retraining of IT specialists includes special IT courses created under the Ministry of Employment and Labor Relations, designed for unemployed citizens.

Data on retraining of IT specialists was provided by the Ministry of Employment and Labor Relations. According to this data, more than 7 thousand unemployed citizens throughout Uzbekistan have completed training, retraining or advanced training in the field of IT over 7 months of 10. Most of them studied Mobile Robotics (11%), Computer Engineering (8.6%), and Back-End Development (8.3%). In the context of regions, the largest shares of participants are in Fergana (11%), Namangan (10.5%) and Surkhandarya provinces (9.1%).

Figure 11. Training, retraining and advanced training courses in the field of IT, which completed by unemployed citizens in January - October 2021, % of the total number

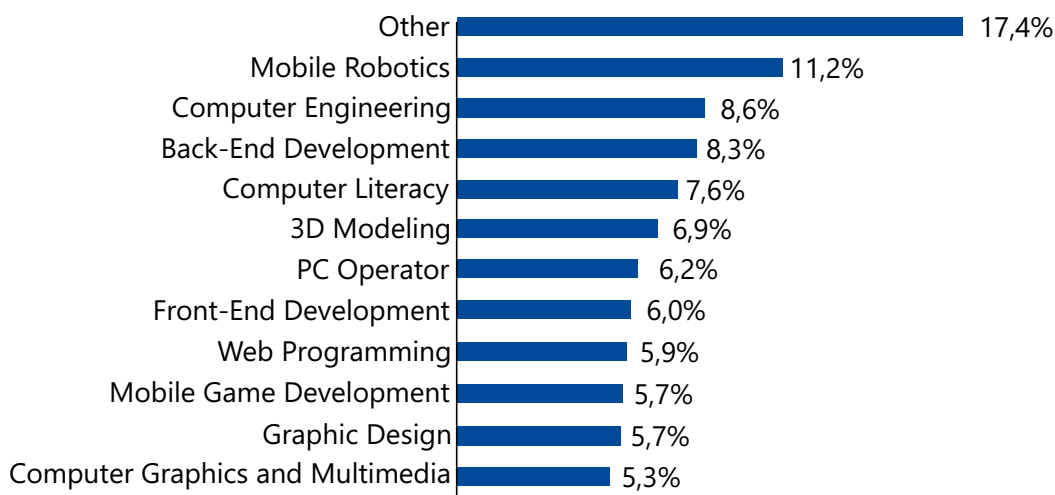
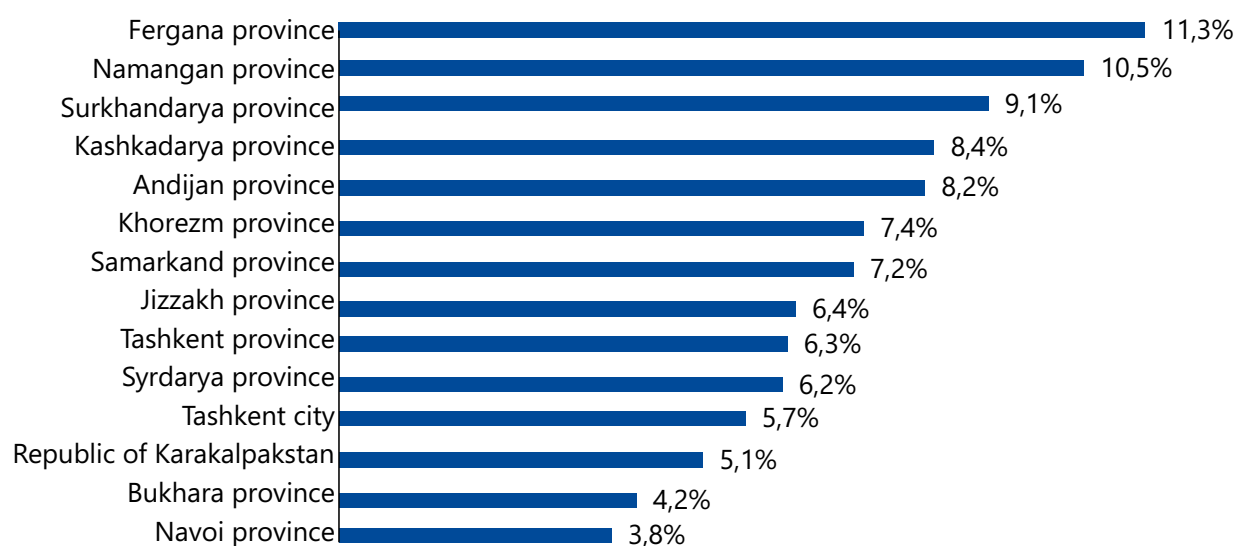


Figure 12. Unemployed citizens sent for IT training by region, % of the total number

EDUCATIONAL INITIATIVES AND CERTIFICATION PROGRAMS

In addition to national higher and secondary specialized educational institutions, various educational initiatives and certification programs initiated by governmental and non-governmental organizations also contribute to the digital capacity of Uzbekistan.

IT Park is one these organization that is engaged in training IT specialists. The existing educational programs of IT Park include free and paid courses:

- "Digitalization and the Basics of IT Entrepreneurship", a free program;
- "One Million Uzbek Coders", a free program;
- "Computer Literacy", a free program;
- "eSports", a free program;
- "Mobile Robotics", 100-220 thousand sums, 3-6 months;
- "Graphic and Web Design", 100-220 thousand sums, 3-6 months;
- "Front-End Development", 100-220 thousand sums, 3-9 months;
- "English for Programmers", 150 thousand sums, 3-6 months;
- "Back-End Development", 100-520 thousand sums, 3-9 months.

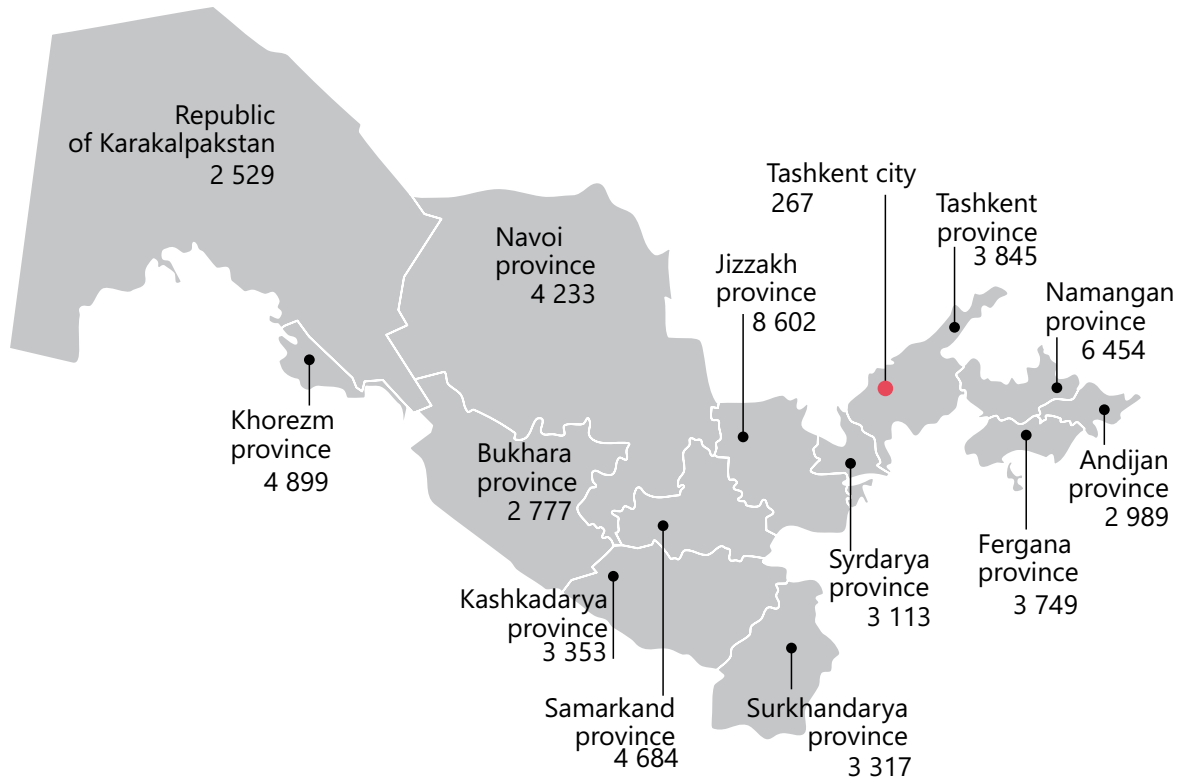
In order to ensure the implementation of the third of the Five Initiatives of the President of the Republic of Uzbekistan Shavkat Mirziyoyev, related to the organization of the effective use of computer technologies and the Internet among the population, including young people, 205 Digital Technology Training Centers (hereinafter – Centers) are established in the country as of 2022¹.

Currently, 189 trainers, 195 managers, 8 branch managers and 90 teachers work in the country's Centers under civil law employment contracts.

Moreover, more than 392 new jobs have been created in the Centers, and 54,811 students have already completed training courses in the basics of programming, computer literacy, robotics, web and mobile application development, as well as the basics of digital entrepreneurship.

¹ According to the Ministry of Innovative Development, November 2021.

Figure 13. Number of graduates of Digital Technology Training Centers

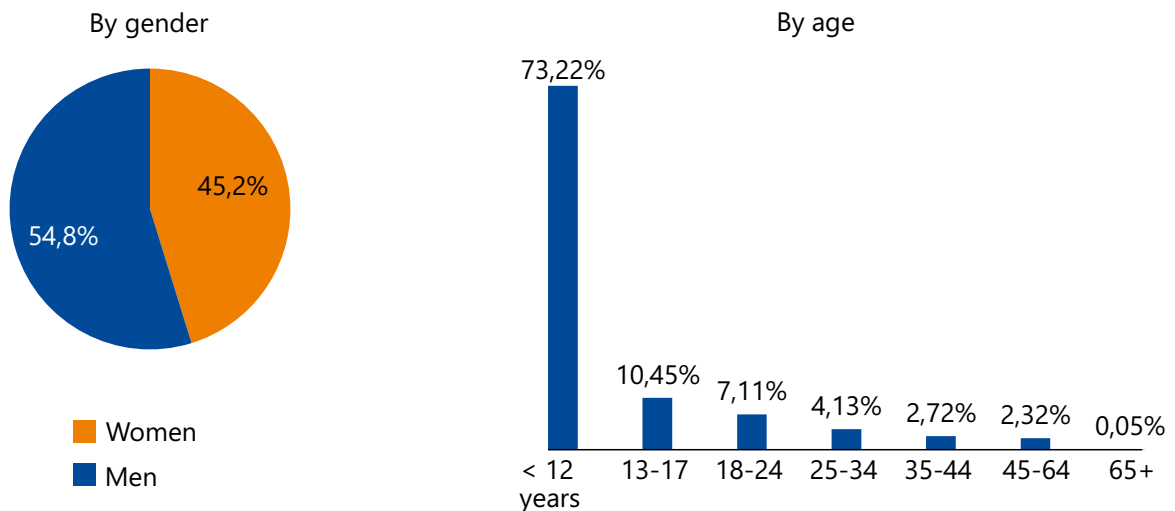


The Centers have nearly 55 thousand graduates throughout the country, of which 8.6 thousand in Jizzakh province, 6.4 thousand in Namangan province, and 4.8 thousand in Khorezm province.

ONE MILLION UZBEK CODERS

The One Million Uzbek Coders educational project was launched in 2019 at the initiative of IT Park with the support of the Ministry for Development of Information Technologies and Communications of the Republic of Uzbekistan. A project of a similar format for remote training of programmers started in the UAE and was called One Million Arab Coders. During Shavkat Mirziyoyev's official visit to the UAE in March 2019, agreements were reached in a

Figure 14. Share of the One Million Uzbek Coders program participants, %



number of areas, including the IT industry, and the UAE government developed a plan to adapt the concept to the context of Uzbekistan and launched a local level initiative called One Million Uzbek Coders.

The project in Uzbekistan is implemented by IT Park, the Ministry of Investments and Foreign Trade, the Ministry for Development of Information Technologies and Communications of the Republic of Uzbekistan in partnership with the Dubai Future Foundation and the IT Academy under IT Park.

The project is a distance learning-based, free of charge training of the general population in digital technologies through a specialized online portal. The purpose of the program is to train a generation of specialists in this area, and equip them with all the tools and programming skills. The project covers the four most demanded specialties in the global labor market: Data Analyst, Android Developer, Front-End Developer and Full-Stack Developer. The general course for each of them is designed for 120 hours of training. The outcome of each level will be the preparation of laboratory works and the receipt of appropriate certificates.

Figure 15. Share of the One Million Uzbek Coders program participants by regions, %

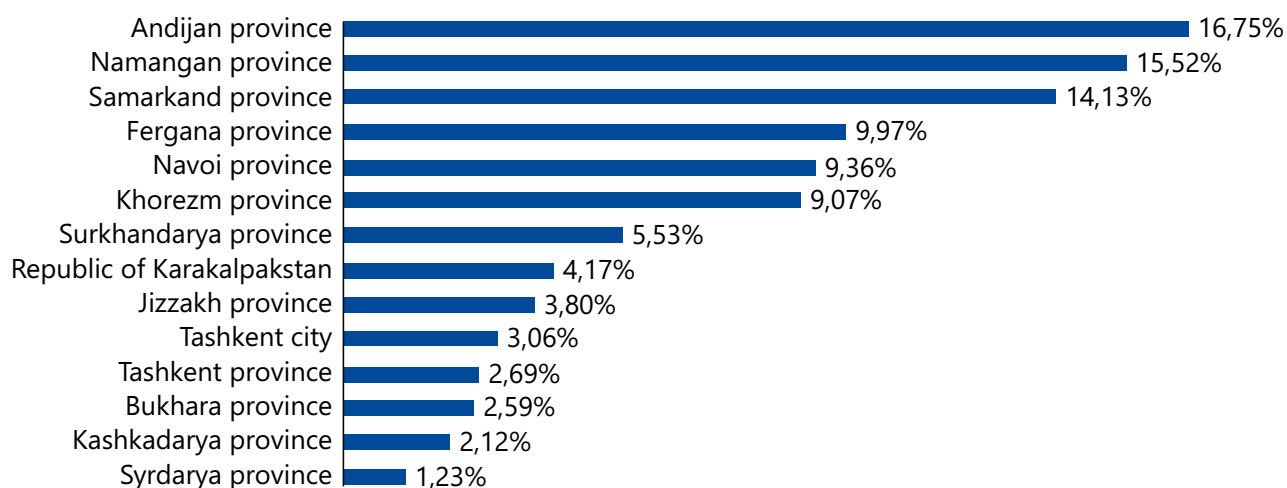
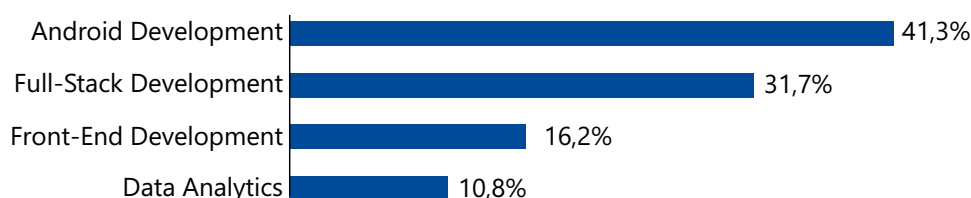


Figure 16. Share of the One Million Uzbek Coders program participants by areas of study, %



Students who have successfully completed the courses get the opportunity to compete for a grant and continue their studies in one of more than a hundred Udacity Nanodegree online programs, whose diplomas are recognized by such giants of the IT industry as Google, AT&T, Autodesk, Salesforce and many others. To do this, one must pass the final exam and enter the Top 150 students who received the highest scores.

More than one million people took part in the One Million Uzbek Coders program, of which almost 500 thousand received a graduate certificate, and almost 700 thousand received a participant certificate. Of these, 54.8% are men and 45.2% are women. In addition, the participants of the program are mainly young people under 30 years old (almost 84%), in particular, students of 13-17 years old (73.2%). In the context of regions, the largest share of the program participants falls on Andijan (16.75%), Namangan (15.52%) and Samarkand provinces (14.13%). The smallest share falls on Syrdarya, Kashkadarya and Bukhara provinces.

In the context of areas of study, the most popular ones were Android Development (41.3%) and Full-Stack Development (31.7%). Front-End Development and Data Analytics accounted for 16.2% and 10.8%, respectively.

FUTURE SKILLS UZBEKISTAN

In January 2021, IT Park signed a memorandum of cooperation with the Ministry of Employment and Labor Relations, which marked the beginning of the joint implementation of the Future Skills Uzbekistan project¹. The purpose of the Future Skills Uzbekistan project is to increase the number of highly qualified IT specialists through a comprehensive information technology training program. The project is aimed at improving the system of vocational training in this area. Within the framework of the project, about a hundred people from among school graduates, higher education applicants and unemployed persons registered in the Yoshlar Daftari database will be trained in each region of Uzbekistan in highly-demanded occupations in the information technology market².

The project includes three main stages:

- Vocational education and training of IT specialists.
- Assessment of competencies and issuance of a qualification passport of an IT specialist.
- Assistance to an IT specialist in employment and self-employment (freelance).

The first stage consists of a comprehensive training program, namely the Computer Literacy, English Language, and Soft Skills Development courses. Subsequently, upon completion of the Computer Literacy course, participants will be introduced to the specialty, after which each of them will be able to choose one of the following specializations for further training:

- Web Development;
- Mobile Application Development;
- Mobile Game Development;
- Mobile Robotics;
- Graphic Design;
- 3D Modeling;
- IT Management.

However, the available specializations vary by region.

¹ <https://ictnews.uz/12/01/2021/future-skills/>

² <https://mehnat.uz/ru/news/proekt-future-skills-uzbekistan-startoval-v-kashkadarinskoy-i-navoiyskoy-oblastyah>

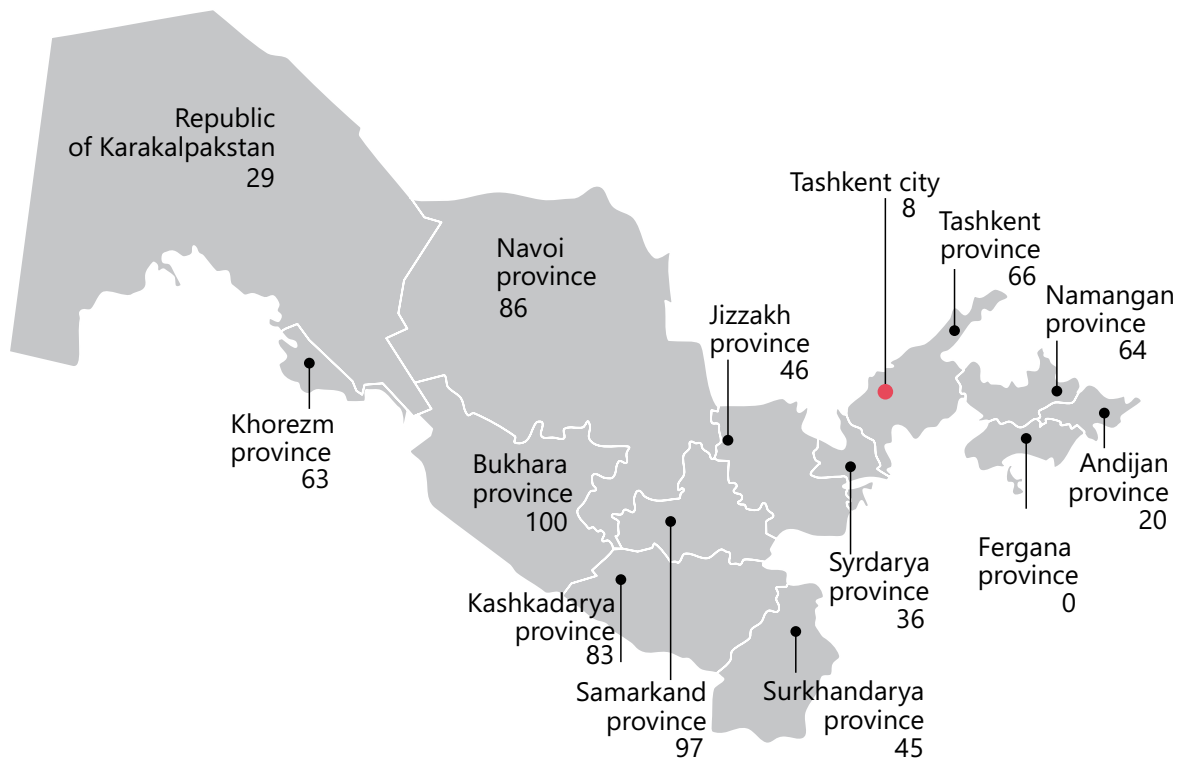
Table 4. Specializations of the Future Skills Uzbekistan program by regions

Region	Specialization
Andijan province	Front-End Programming Back-End Programming
Bukhara province	Front-End Programming Back-End Programming
Jizzakh province	Front-End Programming Back-End Programming Mobile Robotics
Kashkadarya province	Front-End Programming Back-End Programming
Navoi province	Front-End Programming Graphic Design 3D Modeling
Namangan province	Front-End Programming Graphic Design 3D Modeling Mobile Robotics
Republic of Karakalpakstan	Front-End Programming Back-End Programming
Samarkand province	Front-End Programming Graphic Design 3D Modeling
Syrdarya province	Front-End Programming
Surkhandarya province	Front-End Programming
Tashkent city	Front-End Programming Back-End Programming Mobile Application Development Mobile Game Development Graphic Design 3D Modeling
Tashkent province	Front-End Programming Back-End Programming
Fergana province	Front-End Programming Back-End Programming
Khorezm province	Front-End Programming Back-End Programming

Students are charged for the taking the training with financing provided from the State Fund for Promotion of Employment of the Republic of Uzbekistan, at the expense of future employers or the students themselves. Upon completion of the training, to determine the qualification level of graduates, an independent assessment of their competence will be carried out (at the request of a student), after which a qualification passport will be issued.

The project will not only train participants in IT specialties, but also provide comprehensive assistance and support to the best graduates in job search and employment.

Figure 17. Number of unemployed young people trained within the framework of the Future Skills Uzbekistan project



To determine the qualification level of graduates, an independent voluntary assessment of their competences is stipulated; based on the results of the assessment, a qualification passport of an IT specialist will be issued. The competence assessment will not be included in the cost of training and will be paid at the expense of the employer and/or the job seeker. The organization and conduct of the competence assessment and the issuance of a passport will be carried out in accordance with the procedure established by the legislation.

In addition, internships, hackathons, support for startups through accelerators and incubators, motivational events and competitions will be organized. The project will pay particular attention to the entry of IT specialists, who have been trained and have passed a competence assessment, into the international freelancing market through various platforms and aggregators.

It is a 9 months program – 3 days per week, 3 hours per day – and covers 12 regions, including the Republic of Karakalpakstan and Tashkent city. The requirements for participants are as follows:

- age over 16;
- unemployment status;
- passed tests for logic, minimal computer literacy, and English proficiency.

In total, 743 people are trained throughout the country under the program, most of which live in Bukhara (100), Samarkand (97) and Navoi (86) provinces.

TECHNOVATION GIRLS UZBEKISTAN

The program was initiated in 2016 by the Association for Support of Children and Families of Uzbekistan. The partners of the program: the United Nations Development Programme, the Ministry of Innovative Development of the Republic of Uzbekistan, and the Association for Support of Children and Families of Uzbekistan¹.

The purpose of the program: develop critical thinking, entrepreneurship and programming skills in girls (10-18 years old). The project is aimed at increasing the interest of participants and all involved parties in the technical fields, and increasing the percentage of girls in technical occupations.

Technovation Girls is the largest international technology contest for girls, which takes place in Uzbekistan. Girls, under the guidance of mentors, learn to solve socially important problems in their communities with the help of technology (they create a mobile application, write a business plan for a project, shoot a video about a project and present it in the final of the contest).

The contest program lasts 6 months and includes modules about the basics of marketing, programming, business planning and social entrepreneurship, on video creation, public speaking and presentation preparation skills. The training is conducted in English.

In 2021, 41 teams from seven regions of Uzbekistan (Tashkent, Samarkand, Andijan, Fergana, Namangan, Nukus and Urgench) completed their projects.

YOUTH TECHNOPARKS

To form a modern infrastructure for innovative and scientific activities of the regions, five technoparks, one business incubator, one business accelerator, one coworking center, three training centers and two innovation testing grounds were built in Uzbekistan by September 2021.

In particular, the activity of the innovative technopark "Yashnabad" began in 2017. Currently, 53 innovative projects are being implemented in the technopark, which have created 597 jobs. During the first nine months of 2021, residents of the technopark produced products worth 232.9 billion sums and exported products in the amount of 1.9 million US dollars, which is 121% more than in 2020.

Under the Resolution of the Cabinet of Ministers of the Republic of Uzbekistan dated May 22, 2020 No. 313 "On measures to create Youth Technoparks in the regions of the country"², measures to form Youth Technoparks are gradually being implemented in the territories of the regions. For instance, in Tashkent, Andijan and Samarkand provinces, the construction of Youth Technoparks has already been completed, with 10 jobs created in each of them.

In addition to supporting technical projects of schoolchildren and students, the Akhangaran Youth Technopark in the Tashkent province also implements educational programs for talented youth in the following areas: Computer Literacy, Robotics, 3D Prototyping, 3D Modeling, Programming, as well as courses on working with Autocad, 3Ds Max and on programming languages HTML5, CSS3, Sass, BootStrap, jQuery, JavaScript (ES6) and ReactJS.

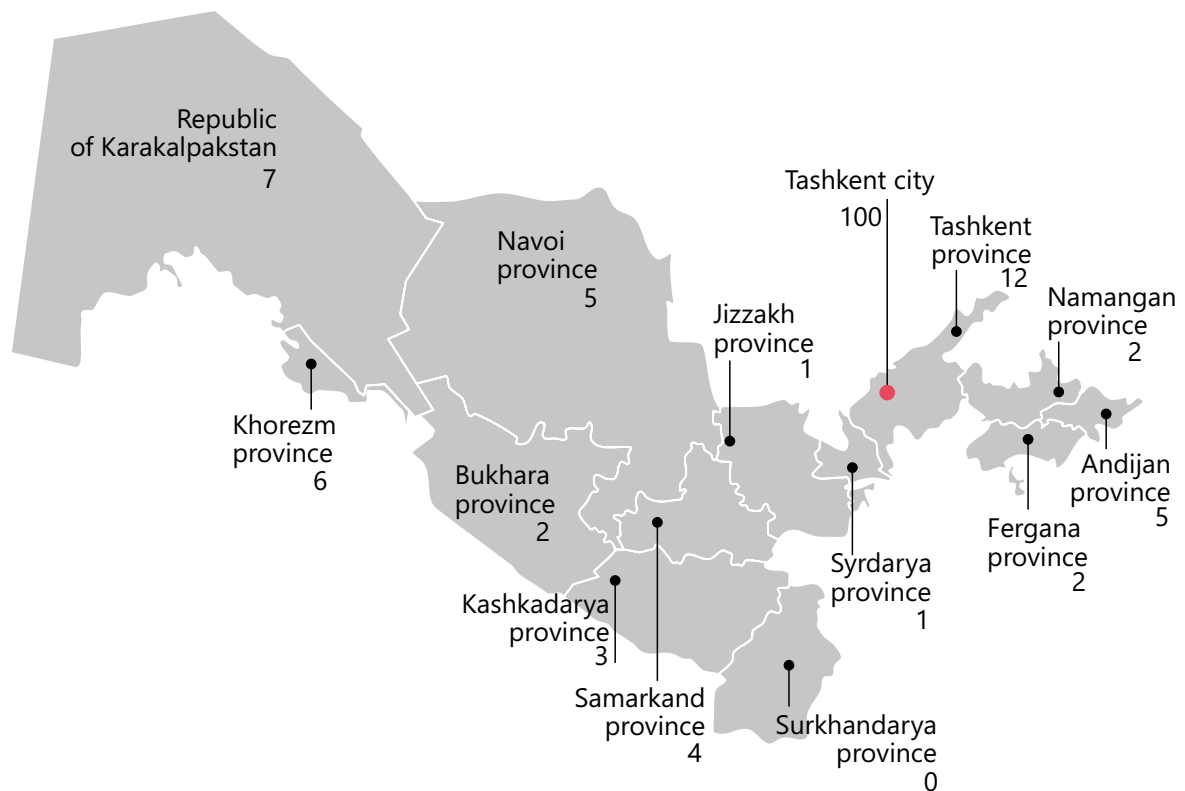
¹<http://technovation.uz/>

²<https://lex.uz/docs/4826985>

NON-PUBLIC EDUCATIONAL INSTITUTIONS IN THE REPUBLIC OF UZBEKISTAN

According to the State Inspection for Supervision of Quality in Education, there are 150 non-public educational institutions specializing in the field of IT in the territory of the country; almost 70% of them are located in the capital. There are 12 centers of this kind in Tashkent province, 7 in the Republic of Karakalpakstan, 6 in Khorezm province, 5 in Navoi province and 5 in Andijan province. However, the Inspection does not maintain a register of certificates issued by these non-public educational institutions.

Figure 18. Number of non-public educational institutions in the field of IT



CHAPTER 2. EMPLOYMENT OF IT SPECIALISTS

LABOR MARKET OF IT SPECIALISTS IN UZBEKISTAN

As of second quarter 2021, a total of 2,592,900 (19.2%) people are employed in the public sector of the Republic of Uzbekistan, while 10,919,400 (80.2%) people work in the non-public sector. This trend has been maintained over the past five years, with the share of public sector employees not exceeding 18.8%.

According to the data provided by the SCS, the nationwide number of employees of legal entities whose core business is IT is 50,609 as of January 1, 2021. It should be noted that slightly over 60% of IT employees are located in Tashkent city.

Of these, the number of IT employees working in the private sector was 48,881 (96.6%), and in the public sector – 1,728 (3.4%).

In the gender context, IT employees were divided as follows: 38,299 (75.7%) men and 12,310 (24.3%) women.

Figure 19. Share of all employees in the public and non-public sectors, %

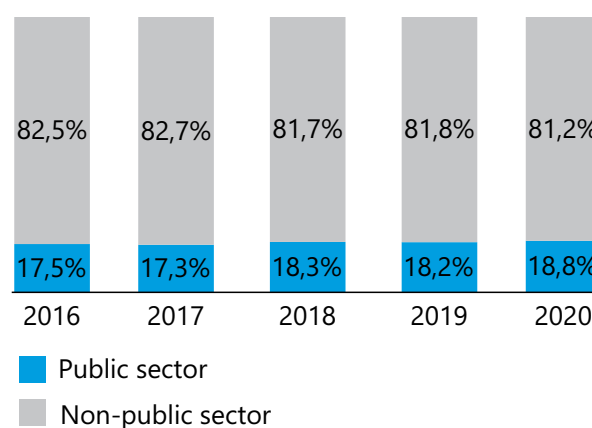


Figure 20. Number of employees of legal entities in the field of IT by region

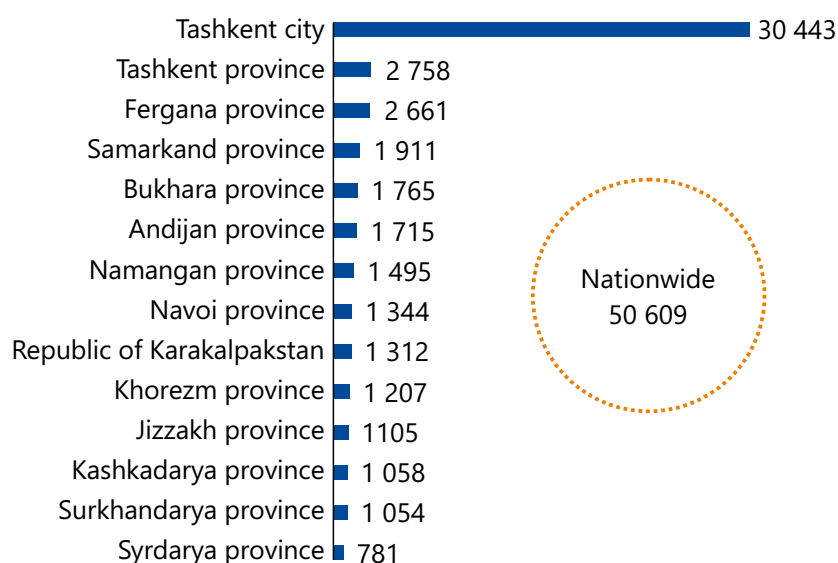


Figure 21. Share of employees of legal entities in the field of IT in the public and private sectors, %

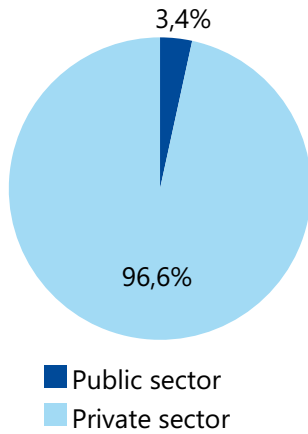


Figure 22. Gender ratio of IT employees, %

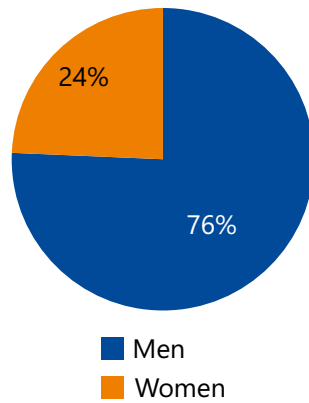
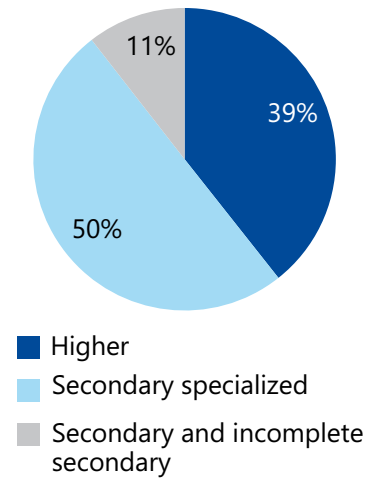


Figure 23. Share of IT employees by educational level, %



According to the survey results, IT employees are mainly young people – 18-30 years old and 31-39 years old (a total of 70.00%).

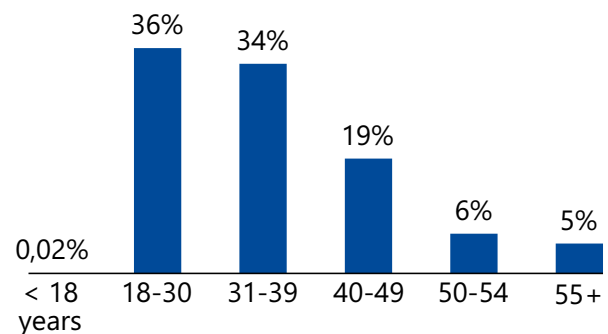
According to the MELR, by the end of July 2021, the number of self-employed workers amounted to 940,776, with 400,143 of them registered in 2021.

Compared to the nationwide number of registered self-employed IT workers, the highest rates were registered in Khorezm (61%), Navoi (57%) and Jizzakh (49%) provinces, and the lowest ones – in Namangan (36%), Surkhandarya (36%) and Andijan (32%) provinces.

According to the Register of Self-Employed Citizens by Type of Activity in Uzbekistan, as of 2021, **70 types of activities** of self-employed workers were identified, of which **paragraph 62 and 63** are partly or wholly related to IT activities. For instance, paragraph 62 covers the creation and processing of multimedia, design and art materials – *Web Designer, Graphic Designer, Computer Game Designer, Interior Designer, Landscape Designer, Costume Designer, Retoucher, Photo Collage, Vector Graphics Editor, Architect, Visual Designer, Data Designer, Interface Designer, Technical Designer, Mouse Designer, Banner Creator, Publishing Designer, 3D Designer, Video Editor, Videographer, Composer, Sound Engineer, Arranger, Presenter, Photo Editor, etc.*

A paragraph 63 covers software, information systems, mobile applications, website development and technical support – *Programmer, Software Tester, Webpage Designer, Web Analyst, Website Optimization Specialist.*

Figure 24. Distribution of IT employees by age, %



Thus, in 2021, the number of self-employed workers in the field of IT and related activities amounted to 2,225 or 0.6% of the total number. Most of the self-employed IT workers live in Tashkent city, followed by Navoi (0.8%) and Syrdarya (0.7%) provinces.

Figure 25. Share of registered self-employed IT workers in relation to the total share of self-employed workers in the context of regions in 2021, %

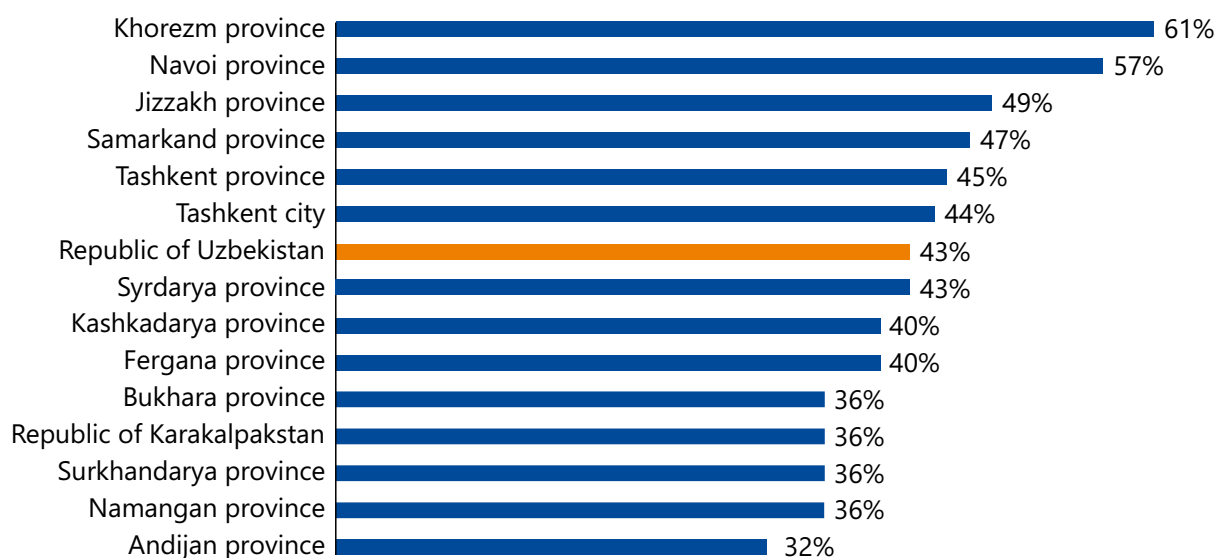
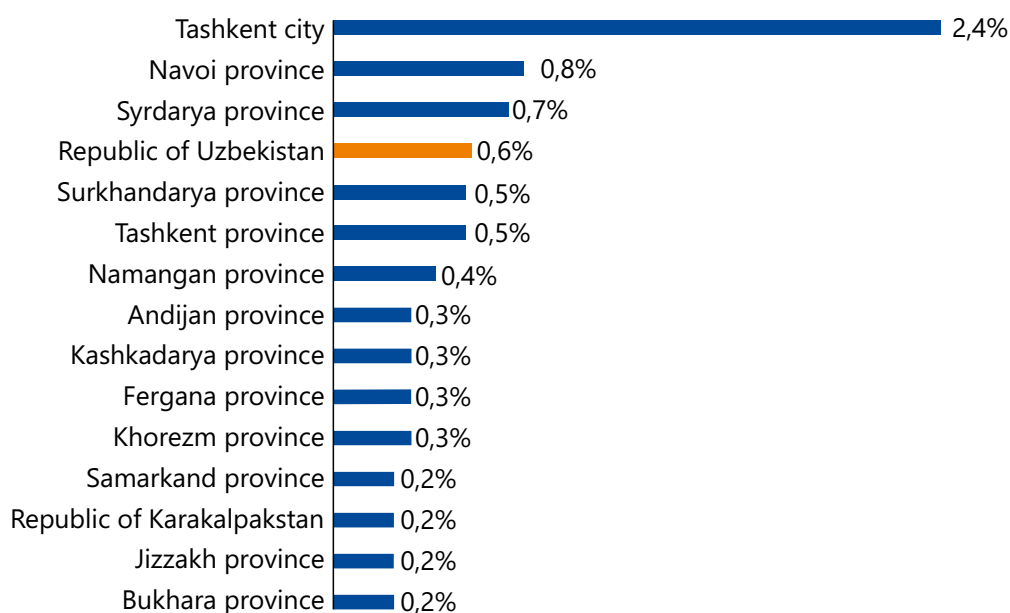


Figure 26. Share of self-employed IT workers registered in 2021 in the context of regions, %



EDUCATIONAL LEVEL OF IT SPECIALISTS

Educational level of IT employees in the county is as follows: the largest share – secondary specialized (50.0%), more than a third – higher (39.0%), and the smallest share – secondary or incomplete secondary (11.0%) education.

The educational level of IT employees in the regions differs from that in Tashkent city. For instance, the share of employees with a higher education degree is 77.00% in the capital and 39.00% in the regions. It is worth noting that in most provinces, such as Andijan, Bukhara, Jizzakh, Navoi, Namangan, Tashkent and Khorezm provinces, the share of employees with secondary and incomplete secondary education prevails.

Figure 27. Number of IT employees by educational level broken down by regions, %

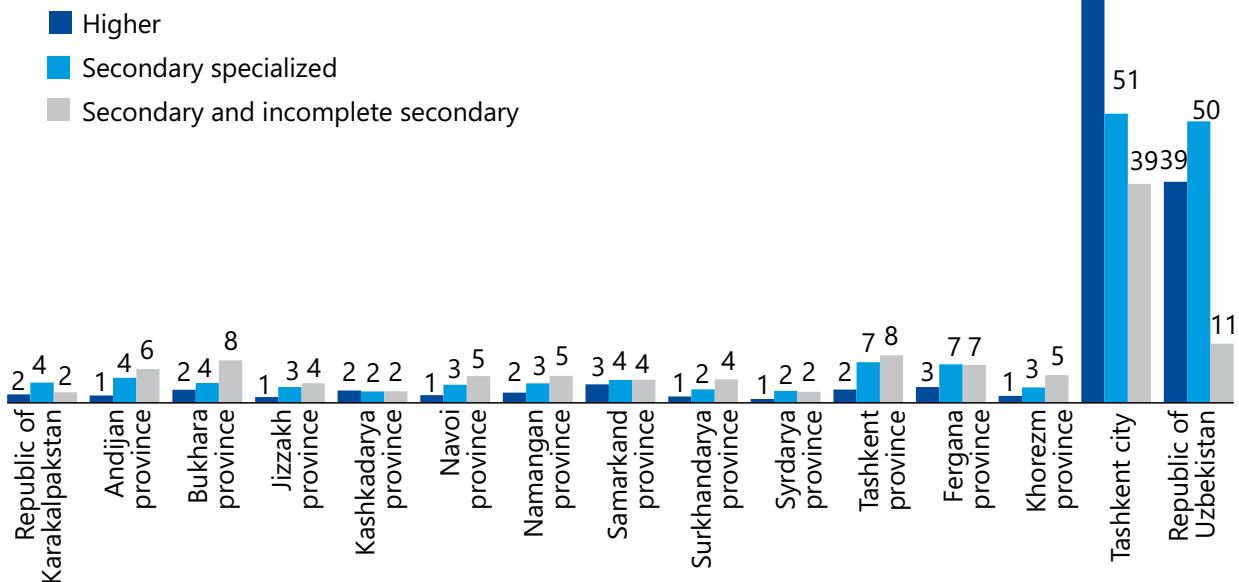


Figure 28. "Your educational background"

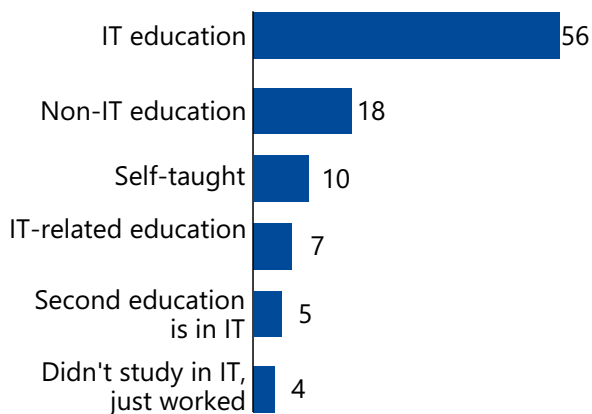
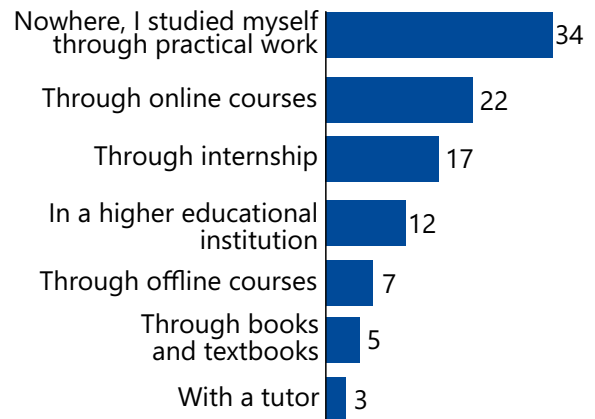


Figure 29. "Where did you gain your basic knowledge?"



To better understand the situation of IT specialists in the country, a survey of IT specialists was conducted as part of the study. The survey was aimed at identifying the typical image of an IT specialist, the source and quality of the knowledge they gain, employment type, salary, English proficiency, etc.

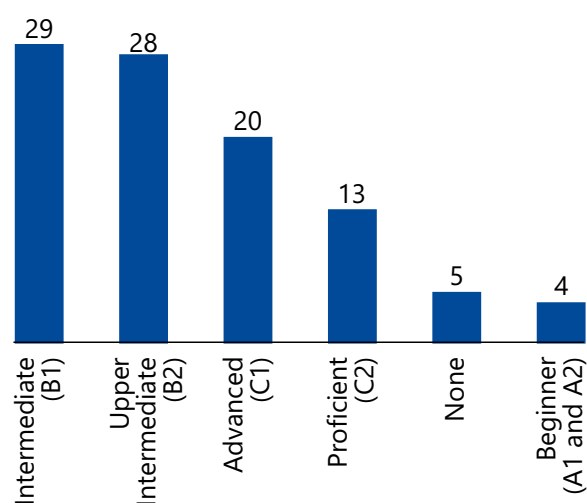
This survey was conducted in an online format among residents of IT Park, as well as through the LinkedIn social media platform. 100 respondents took part in the survey. The average age of respondents was 29 years, and 50% of their total number were under the age of 27. Women accounted for 15% and men for 85%. 78% of respondents live in Tashkent city and Tashkent province.

Respondents also gave answers about their educational level: 71% have a higher education degree, 17% have secondary specialized education, and 12% are university students. According to the survey, 56% of respondents have an IT educational background, 7% have an IT-related educational background, and 18% have non-IT educational background.

ENGLISH PROFICIENCY LEVEL OF IT SPECIALISTS

In general, English proficiency level of IT specialists is as follows: 29% – Intermediate, 28% – Upper Intermediate, 20% – Advanced, 13% – Proficient, and 5% of respondents do not speak English. Hence, knowledge of foreign languages is an important aspect of digital human capital. According to the survey, 34% of respondents gained their basic knowledge and skills only through practical work. Only 12% of respondents believe that they gained basic knowledge in higher educational institutions, while 7% gained knowledge through offline courses and 22% - through online courses. Thus, we can conclude that, despite the fact that 71% of respondents have a higher education degree, higher educational institutions today cannot provide the basic knowledge that is necessary in the labor market in the field of IT.

Figure 30. "English proficiency level"



EMPLOYMENT OF IT SPECIALISTS

Respondents were asked about their employment and the sector of the company in which they are employed.

56% of respondents work for local IT companies, while 21% – for foreign ones. At the same time, 8% work as freelancers (as contractor). According to the respondents' answers, 75% of the customers of their companies are private sector companies and 12% are public sector ones, while 13% of respondents were not sure.

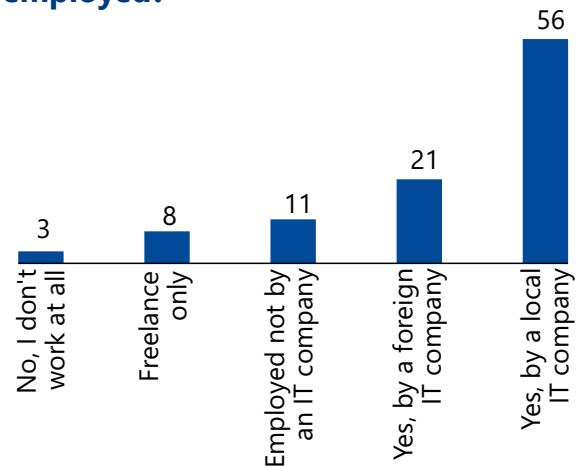
Respondents were also asked the question "What type of IT company is the company you work for?". For instance, 52% of respondents work for a product company, where they

develop their own products, and 22% work as contractors for other firms and enterprises.

At the same time, 51% of respondents work or do internship directly in the office, 14% – completely remotely, 10% – mainly from home, and 24% – mainly in the office.

Respondents have the following specializations: 50% – Developers, 10% – Analysts, 16% – Project Managers and 6% – Graphic Designers. 6% of respondents assess their professional level as Intern, 19% – as Junior, and 21% – as Lead. At the same time, 25% of respondents have less than one year of work experience, 30% – from two to five years, and 45% – more than five years.

Figure 31. "Are you currently employed?"

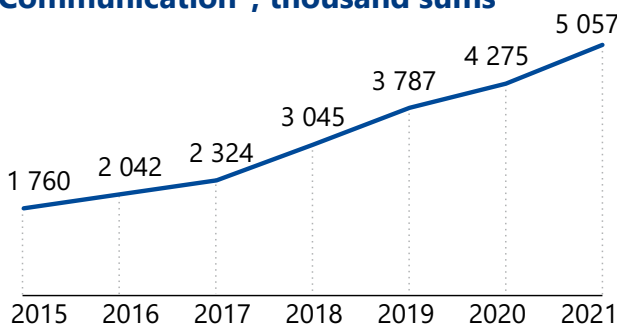


SALARIES OF IT SPECIALISTS

According to the SCS, the average monthly nominal accrued salary of workers in the field of "Information and Communication" in 2021 is slightly over 5 million sums.

The results of the analysis of salaries in the field of IT showed that the remuneration of an IT specialist depends on the skills and abilities of the specialist himself. For example, according to the Natal Uzbekistan 2021 report, the minimum salary of a Junior Developer is on average 4,560,000 sums (\$425), while the maximum salary is almost twice as much – 8,960,000 sums (\$825). The minimum and maximum salary of a Senior Developer is 20,520,000 sums (\$1,900) and 41,440,000 sums (\$3,900), respectively ¹.

Figure 32. Average monthly nominal accrued salary by type of economic activity "Information and Communication", thousand sums



Source: State Committee of the Republic of Uzbekistan on Statistics

Table 5. Average monthly salary of IT workers, 2021

IT, TELECOM	Average minimum	Average maximum
Sales Support Specialist	9 120 000	14 560 000
Junior Developer	4 560 000	8 960 000
Middle Developer	11 400 000	20 160 000
Senior Developer	20 520 000	41 440 000
Project Manager	17 100 000	30 240 000
System Analyst	13 680 000	33 600 000
Business Analyst	11 400 000	42 180 000

Source: natal Uzbekistan, 2021

¹ At the exchange rate of commercial banks of the Republic of Uzbekistan as of December 2021

Figure 33. "What type of IT company is the company you work for?"

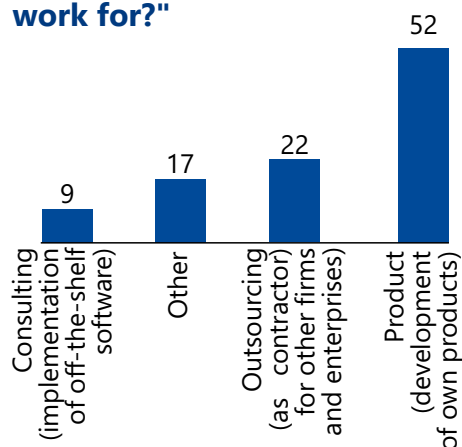
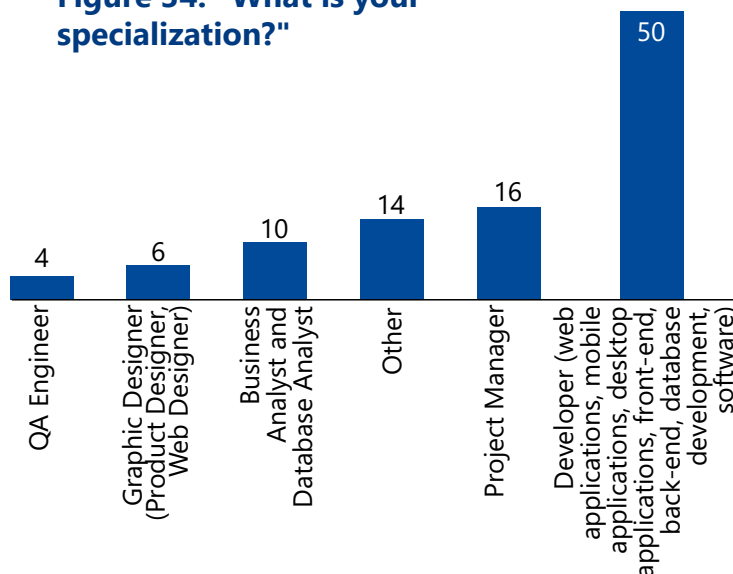


Figure 34. "What is your specialization?"



Within the framework of the project, the salaries of IT specialists were explored according to their basic skills and specializations ¹. Salaries are directly related to the position and individual performance of a specialist. In addition, the salary in the IT field depends on the knowledge of programming languages, the work experience of a specialist, the place of work, the amount of work, as well as on the company offering the vacancy. It should also be considered that the average salaries were taken in the context of Tashkent city; in the regions, they are relatively lower.

Table 6. Average monthly salary of IT workers, 2021

Area	Average minimum	Average maximum
Junior Developers	\$500	\$1 000
Middle Developers	\$950	\$2 300
Senior Developers	\$1 900	\$3 900
Machine Learning Engineer	\$1 000	\$1 800
Data Analysts and Researchers	\$1 450	\$2 500
Project Managers	\$800	\$1 300
Business Analysts	\$750	\$2 300
System Analysts	\$600	\$1 250
Information Security Analysts	\$730	\$1 100
System Administrators, Network Operators	\$700	\$1 400
Graphic Designers (Product Designer, Web Designer)	\$650	\$1 200

The survey also revealed preliminary differences in remuneration in the IT market. For instance, according to the data obtained, 18% of respondents receive less than \$500, 29% – \$500 to \$1,000, 16% – up to \$1,500 and 37% – more than \$1,500. The analysis showed that respondents who have gained basic knowledge through practical work and internship receive a higher salary. For instance, while a salary of more than \$2,000 is received by 25% of the total sample, the same salary is received by 35% of respondents who gained basic knowledge through internship and practical work.

¹ To explore salaries, open data from hh.uz, myjob.uz and rabota.uz websites and Zev Telegram channel were used

According to the survey, freelancing is not the main source of income for IT specialists. For instance, 39% of respondents answered that no share of their earnings comes from freelance orders, and 41% indicated that their income from freelancing is less than 25% of their monthly earnings.

According to the survey, the IT market has the following geography of customers: 38% of respondents answered that all their customers are local organizations and companies, 24% noted that their customers are mainly local customers, and another 8% believe that the shares of their local and foreign customers are 50% / 50%. Thus, we can conclude that local customers prevail in the national market of IT services, which means that there is a weak integration with the global market.

In addition, an econometric analysis of factors predicting salaries in the IT market of Uzbekistan was carried out. For instance, an econometric model was built, which includes experience, gender, English proficiency level (=1 if Upper Intermediate), age, and age squared.

Figure 35. "How do you assess your professional level?"

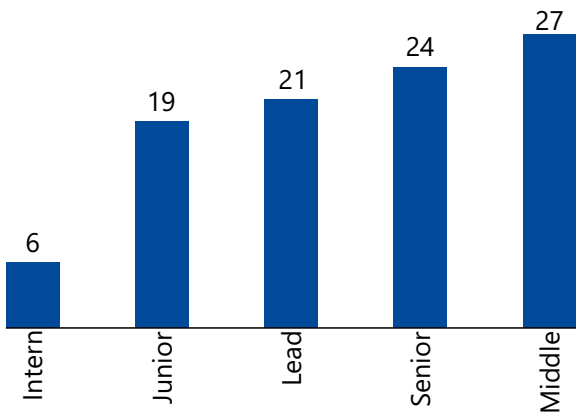


Figure 36. "Specify your monthly income"

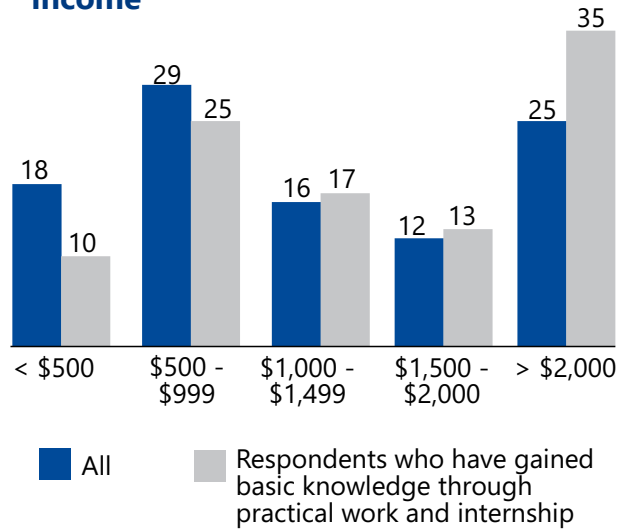


Figure 37. "What share of earnings comes from freelancing?"

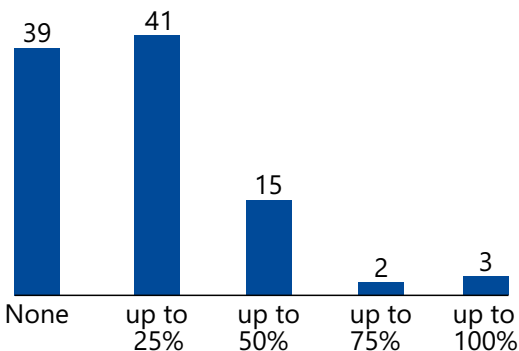
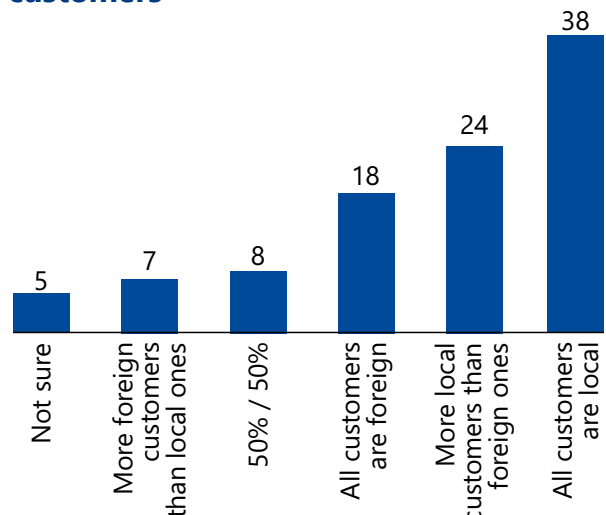


Figure 38. "Geography of your customers"



Studies of the labor market in developed and developing countries show that there is a non-linear relationship between the age and salary of a person. We have included Manager and Developer vacancies because they are prevalent in our sample. The econometric model was evaluated in the Stata 16 program by using robust regression. According to the results (Table 5), experience is the most significant factor that is related to salaries in the IT market. For instance, an increase in the "Experience" indicator by two years leads to an increase in salary by about \$200 per month. Similarly, a positive relationship was also revealed between English proficiency and salary. For instance, those respondents whose English proficiency level is Upper Intermediate receive a salary that is higher by \$390 compared to those whose English proficiency level is Intermediate or lower. Age is in a non-linear relationship with the level of income, which is growing most rapidly until the age of 33. The monthly income of developers is on average higher than that of other specialists in the IT market of Uzbekistan. These calculations are based on a survey of 100 respondents, and the model has an F-stat = 9.8, which is higher than the minimum threshold of 4 units.

Table 7. Econometric modeling of salaries of IT specialists

Variable	Coefficient (β)	P-value
Experience	0,41	0,00
Gender (female)	0,39	0,30
Knowledge of a foreign language	0,78	0,00
Age	0,47	0,00
Age squared	-0,007	0,00
Developer	0,56	0,07
Manager	0,51	0,19
Constant	-6,14	0,00

Key findings:

- The knowledge and skills gained by IT specialists in higher educational institutions do not allow for filling the gaps in the quality of knowledge and skills of graduates in the labor market of Uzbekistan.
- A good English proficiency level is an important factor that contributes to the growth of income of IT specialists.
- The national IT market is poorly integrated into the global market of IT services, there is therefore a significant potential for increasing the volume of services provided by local specialists at the global level.
- Most respondents use online/offline courses, as well as internships, as their main pass to the market of IT services. Respondents who have gained basic knowledge through practical work and internship receive a higher salary.
- Consequently, higher educational institutions need to significantly intensify interaction with the private sector for closer integration of practical work into educational processes, as well as for improving educational materials taking into account employers' preferences and IT market trends.

HR COMPANIES ABOUT HIRING IT EMPLOYEES

This survey was conducted in an online format among HR companies, as well as organizations that had experience in hiring IT specialists. The survey was attended by heads of HR departments from 30 organizations.

In most cases, heads of HR departments have dealt with hiring IT job seekers very rarely (53%), while slightly more than a quarter of them – quite often (27%) and one in five – constantly (20%).

According to the survey results, 30% of HR managers received applications from IT job seekers on a regular basis, 20% – once every 4-6 months, and 40% – rarely.

The survey also showed that the majority of IT job seekers are young people aged 20 to 25 years (50%), the rest are young people aged 26 to 35 years (47%). Among the job seekers, there are no applications from specialists over the age of 35.

According to 93% of HR managers, there is a staff shortage in the local IT market. And only 7% of respondents believe that there is no such shortage.

53% of potential employers offer IT specialists salaries of \$500 to \$1,000, 30% – \$1,000 to \$1,500. While job seekers are more likely to request a salary of \$1,000 to \$1,500.

Figure 39. "Have you had experience with hiring IT specialists?"

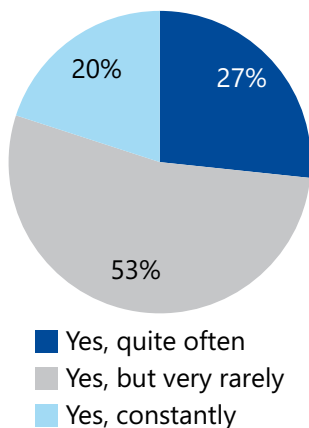


Figure 40. "How often do you receive applications from IT job seekers?"

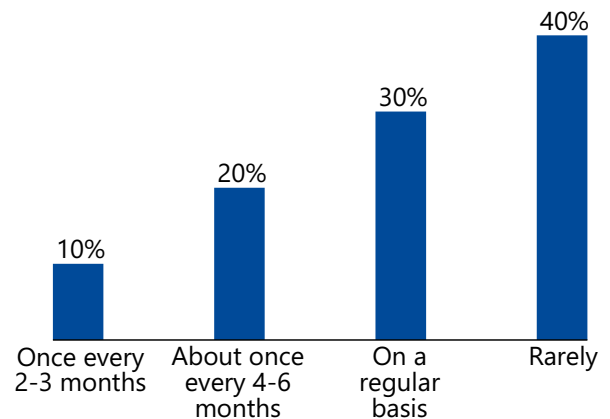


Figure 41. "What is the average age of IT job seekers?"

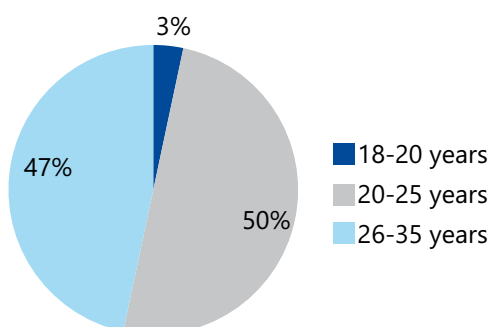


Figure 42. "Is there a staff shortage in the IT sector?"

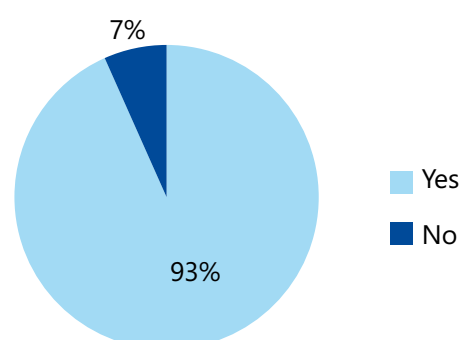
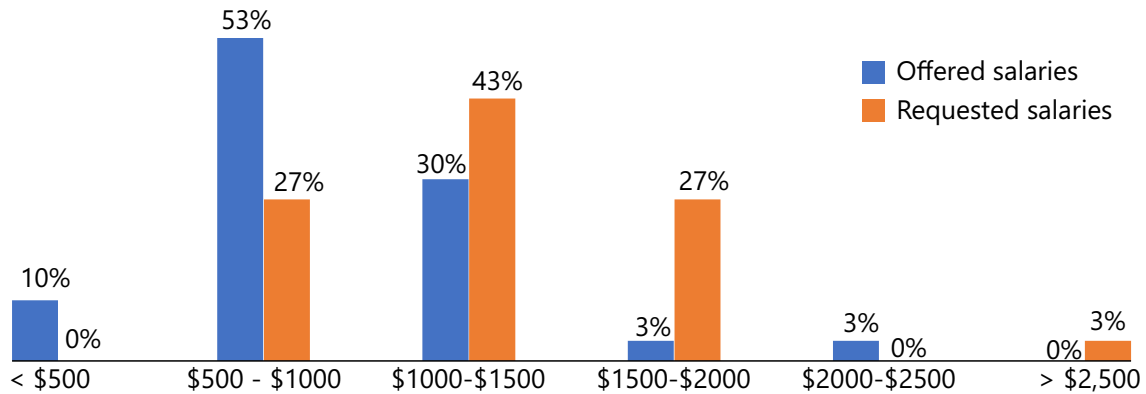


Figure 43. Shares of salaries offered by employers and those requested by job seekers, %



According to HR specialists, vacancies of Web Developer, Mobile App Developer, Desktop Developer, Front-End Developer, Back-End Developer, Database Developer and Software Developer are in the greatest demand (60%). The next come the vacancies of System Administrator, Network Operator, Database Analyst and Researcher, Graphic Designer, Product Designer and Web Designer (10% each).

According to heads of HR departments, job seekers primarily lack digital knowledge and skills, which means knowledge of IT systems and programming skills (33%), as well as diligence, integrity and discipline (27%), and last of all – self-education (3%).

Figure 44. "Which specialists are most in demand in the IT market?"

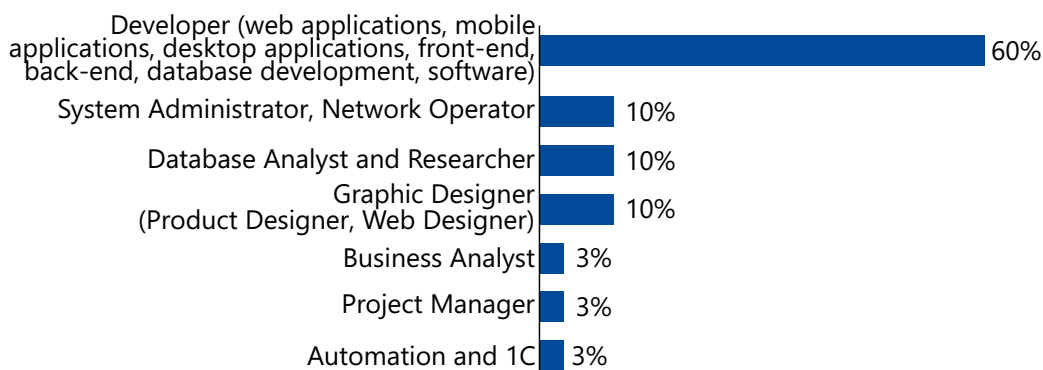
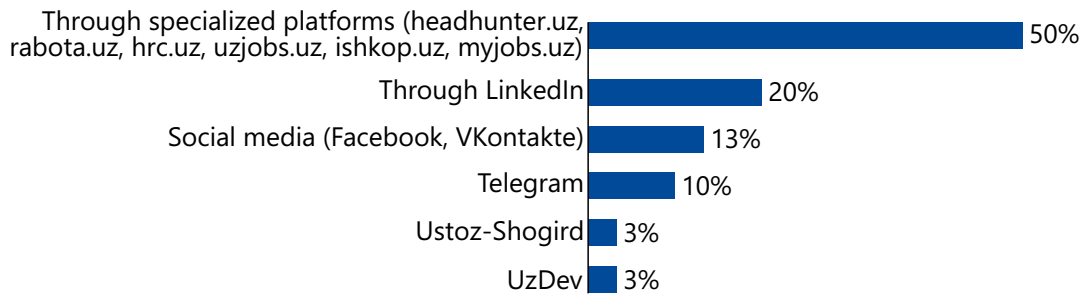
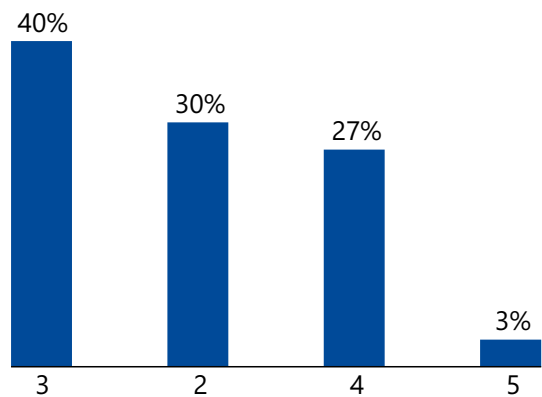


Figure 45. "What skills do IT job seekers lack?"



Figure 46. "What is the most typical way for you to search for IT candidates?"**Figure 47. "How do you assess the quality of training of IT specialists in specialized higher educational institutions of the country? (scale from 1 to 5, where 1 is very bad and 5 is very good)"**

The majority of HR managers (50%) use specialized platforms for searching candidates, followed by LinkedIn (20%) and social media (13%). Telegram and Telegram channels, such as UzDev and Ustoz-Shogird, are popular for 16% of managers. 50% of the surveyed organizations cooperate with Career Centers under higher educational institutions, 57% participate in job fairs.

In addition, the opinions of heads of HR departments on the quality of training of IT specialists was explored. 70% of them believe that the quality of training is at the level of 2 and 3 points on a 5-point scale.

To analyze the current system of collection, storage and processing of data on human capacity in the field of digital development, interviews were conducted with the SCS and MHSSE employees through in-person and online meetings.

CHAPTER 3.

MANAGING DATA ON HUMAN CAPACITY IN THE FIELD OF IT

Making effective policy decisions requires statistical justification. To reform and improve the system of collection of data on human capacity in the field of IT, and to subsequently implement appropriate mechanisms and programs for developing a favorable environment for IT specialists, a clear understanding of the functioning of the existing data collection system is necessary.

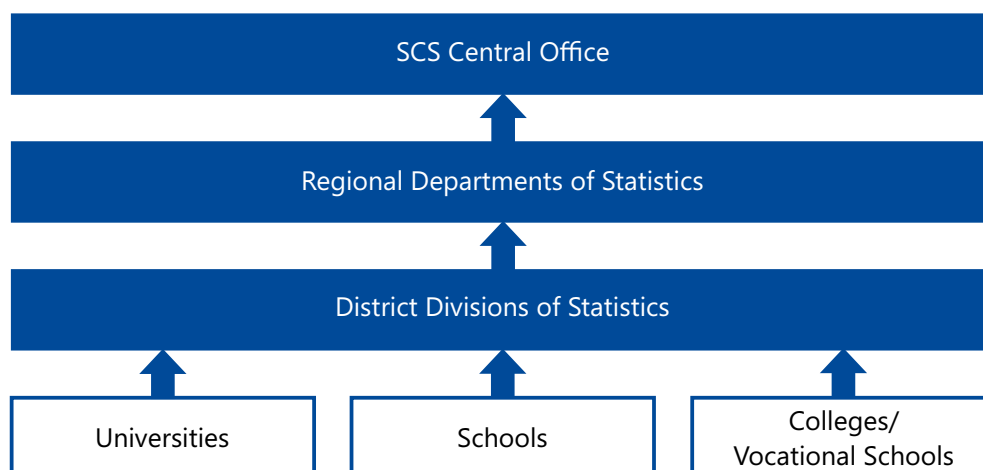
Until recently, it remained unclear how data on education, employment and retraining of IT specialists in Uzbekistan is collected, how detailed it is and who is responsible for collecting it. To explore the current system, the study conducted interviews with representatives of key stakeholders who are actively involved in both the formation and collection of data on digital human capacity.

CURRENT MECHANISM FOR COLLECTING DATA ON HUMAN CAPACITY IN THE FIELD OF IT

According to the study, the State Committee of the Republic of Uzbekistan on Statistics, the Ministry of Higher and Secondary Specialized Education and national higher educational institutions represented by it, as well as foreign universities are the key organizations in collecting data on the country's digital capacity. In-person or online meetings were held with representatives of these organizations. During the meetings, existing data collection mechanisms and their legal justification were discussed. In addition, attention was focused on the type of data collected, its detail degree, frequency and format.

All the above allowed to identify the current system of collection of data on the country's digital human capacity, its strengths and weaknesses.

Figure 48. The current data collection system



DATA COLLECTION SYSTEM OF THE STATE COMMITTEE ON STATISTICS

According to the information provided by the SCS employees, the data collection process is based on a bottom-up approach. That is, each school / college / university provides data to district divisions of statistics in an online format through the eStat system. The district divisions, having collected statistics for their respective districts, send data to their respective regional departments, where a statistical report for the region is prepared. The district divisions, if necessary, make adjustments to the data and, if there are misunderstandings, contact the educational institutions. Then, from the regional departments this data is transferred to the SCS Central Office.

Deadlines for submission and reporting forms are set up separately for each organization. For example, secondary educational institutions submit completed forms by October 4, vocational educational institutions - by November 5, and higher educational institutions - by December 6. Ministries also complete the reporting form within the established deadlines and send it through the E-xat system.

Having received data from the regional departments, the SCS forms indicators, disaggregates them, if necessary, by gender, age, region, and generates a report. Thus, all data is collected annually in electronic format. The SCS database is stored on the server and is available in Microsoft Access format. Open statistics on the stat.uz website are manually updated by IT specialists.

The SCS collects information on the number of graduates and students of higher educational institutions in the specialties "Computer Technologies and Informatics" and "Communications, Informatization and Telecommunication Technologies", the number of students in vocational colleges in IT specialties, and the number of employees of legal entities whose core business is IT.

DATA COLLECTION SYSTEM OF THE MINISTRY OF HIGHER AND SECONDARY SPECIALIZED EDUCATION

According to the Resolution of the Ministry of Economy of the Republic of Uzbekistan, the Ministry of Higher and Secondary Specialized Education of the Republic of Uzbekistan, the Ministry of Public Education of the Republic of Uzbekistan, and the Ministry of Employment and Labor Relations of the Republic of Uzbekistan dated August 6, 2005 No. 1506 "On approval of the Regulations on Targeted Training through Public Grants", new graduates, whose study was paid by the public grant, get their jobs in the spring of each year under tripartite agreements. Monitoring is carried out by the MHSSE in the autumn, and data is collected based on its results. Thus, data is collected every autumn (in October - November) in the context of all higher educational institutions and all curricula, forms and areas of study. Since 2021, the HEMIS (Higher Education Management Information System) system has been implemented. This system is connected to the my.mehnat.uz platform (MELR) and to the unified database of the State Tax Committee. The MIA, the MHSSE, the MELR, the STC and the SCS have access to the HEMIS system.

A student's employment data is visible online. Previously, the information was collected manually on behalf of the Ministry of Higher and Secondary Specialized Education every year. Starting from 2021, the MHSSE has an automated database of access to a graduate's data at the place of his/her employment: the name of the organization, the start date of work, and his/her position.

This platform currently covers undergraduate and graduate students only, because colleges and vocational schools have restarted their activities since 2020 and have no graduates yet to be included in the HEMIS platform. The MHSSE has no data on college graduates for previous years, due to the fact that previously this information was collected not by the MHSSE, but by relevant ministries and agencies.

The MHSSE can see the following information about a student: the name of the higher educational institution, his/her full name, province and district of permanent residence, address, form of study, employment status, position, TIN, and the name of the organization in which he/she is employed.

All HEMIS data is stored on a local server, with only the MHSSE and the MELR having access to it. The platform's data is automatically updated when the status of a graduate changes. But it should be noted that if a graduate gets a job, and his/her data is not entered into the my.mehnat.uz by an HR specialist, then the graduate may have the status of "unemployed". At the moment, the employment rate of graduates is 65%.

The STC platform indicates the following information: the name of the organization, the details of the employed graduate (TIN, IPSA), his/her position and salary. However, it does not specify the organization's sector and type of business. At the moment, this issue is solved by manually entering information about the type of business.

DATA COLLECTION SYSTEM OF FOREIGN UNIVERSITIES

Foreign universities provide information to the MHSSE, as well as to the SCS, on an ongoing basis once a quarter / once a year. The information is requested by the responsible person in the format of an Excel table. The MHSSE representatives themselves provide a template to be completed by foreign universities. According to representatives of the universities, this information includes the following: the number of graduates, the number of students in existing areas, faculty and academic staff, employment of graduates, etc. The completed Excel file is certified by a seal and sent by email as an official letter or delivered personally by representatives of the university. It was noted that sometimes the document is sent to the responsible person in the MHSSE directly through online messengers (e.g., Telegram) without sending an official letter or email.

Other stakeholders to whom the foreign universities provide information may differ depending on universities founders. For instance, in addition to the SCS and the MHSSE, Amity University provides information to the MITC (once every six months) and the MID (upon request). Inha University submits statistical information quarterly (upon request) to the MHSSE, the MITC, the SSS and the MIA. Turin University provides information once a quarter to the MHSSE, the SCS and, upon request, can provide it to JSC "Uzavtosaonat", "Uzmetkombinat", NMMC and other large companies (since they are among founders of Turin University). In addition, the universities enter data on the employment of graduates into the system of the MELR.

Representatives of the universities also noted that they have their own internal data accounting system, which includes personal data of students, contract arrears, academic performance, attendance and other information that is updated in real time. The universities also track the employment rate of graduates through questionnaires distributed through their own systems, as well as through social media and instant messengers. This data is stored in the system on internal servers. The data provided to stakeholders is stored in document formats (PDF, Excel) on a computer.

DISADVANTAGES OF THE CURRENT DATA COLLECTION SYSTEM

As a result of the study, the following conclusions were made:

- There is no unified system for collecting statistical data on human capacity in the field of digital development, as well as no single organization responsible for collecting and storing this information.
- Data collection is fragmented among ministries and agencies.
- Different ministries and agencies collect the same data. For example, data on the number of graduates and students is collected by both the MHSSE and the SCS.
- The data requested from higher educational institutions is not sufficiently disaggregated by gender, age, departments, forms of study, and other parameters.
- It is impossible to assess the current capacity of IT specialists trained by secondary specialized and vocational institutions (colleges / vocational schools), since information about graduates is collected by different organizations whose jurisdiction they belong to. That is, the data is collected in a decentralized manner and cannot be aggregated properly.
- It is not possible to determine the digital inequality between rural and urban areas, since the digital capacity in rural areas is built mainly by colleges / vocational schools..

PROPOSALS FOR IMPROVING THE SYSTEM OF COLLECTION, STORAGE AND EXCHANGE OF DATA ON HUMAN CAPACITY IN THE FIELD OF DIGITAL DEVELOPMENT

In today's world, IT specialists are drivers of progress in the country's digital capacity. Creation of appropriate favorable conditions, primarily the collection of high-quality statistical data on the country's existing digital capacity, is key to the sustainable development of the IT industry. Based on the results of the study and the identified disadvantages of the current system, the following proposals can be formulated to improve the situation in the field of IT:

- It is necessary to diversify higher educational institutions that train IT specialists with a focus on related industries, as well as on regions. For instance, according to the Ministry of Higher and Secondary Specialized Education of the Republic of Uzbekistan, 37% of graduates come from TUIT.
- It is necessary to focus educational programs on strengthening gender equality in the digital economy. For instance, the share of female graduates in the specialty "Computer Technologies and Informatics" was only 14%.
- It is necessary to reduce gender inequality in the IT market of Uzbekistan. In particular, one of the solutions could be to create financial and credit incentives for hiring female IT specialists and encourage women to start up IT businesses.
- While significant educational and retraining programs for unemployed citizens are being implemented, there is a significant imbalance in the labor market of Uzbekistan. For instance, 60% of IT workers are located in Tashkent city, which suggests that there are few incentives in the regions to preserve digital human capital.

- A survey of IT specialists showed that the curriculum of higher educational institutions needs upgrading to reduce the skills gap in the labor market of Uzbekistan. For example, only 12% believe that they gained basic knowledge in higher educational institutions, while 7% gained knowledge through offline courses and 22% - through online courses. We can therefore conclude that, despite the fact that 71% of respondents have a higher education degree, today higher educational institutions cannot provide the basic knowledge that is necessary in the labor market in the field of IT.
- 93% of HR managers note that there is a human resource shortage in the local IT market. Therefore, it is necessary to intensify work between the academy and the private sector to meet the growing demand for IT specialists.
- Developers (web applications, mobile applications, etc.) are the most in-demand specialists in the labor market. Therefore, it is necessary to actively enhance the capacity of local higher educational institutions to train such specialists.
- Establish a single database for collecting aggregated data in a standard format for graduates, disaggregated by higher educational institution, area and form of study, gender, and region. Since HEMIS-based data collection is automated in real time, it may be difficult to timely extract the necessary statistics when one needs to collect aggregated data. It is recommended to develop a single template for the main characteristics of graduates, which will be completed by higher, secondary and secondary specialized educational institutions. Once completed, these templates will be sent to the SCS, which, in turn, will provide statistics available to the public. This measure will contribute to the correct assessment of the capacity of IT specialists, as well as the development of relevant educational programs in the field of IT.
- Organize the collection of data on IT specialists separately from communication technology specialists. The current statistical data on IT specialists is collected in the aggregate. Existing statistics has no disaggregation of specialists exclusively by IT area. For comprehensive monitoring of the number of IT employees, it is recommended to collect the statistics that is separate from the communications sector.
- To strengthen the country's IT capacity, it is recommended to initiate the collection of statistics on IT employees, disaggregated by specialty, such as Front-End Developer, Back-End Developer, Machine Learning Engineer (MLE), Graphic Designer, etc. This initiative will contribute to the provision of this area with qualified personnel. Also, in order to provide the IT sector with qualified personnel, it is necessary to initiate the collection of data on individual IT specialties to monitor the IT capacity in the country. Moreover, this measure will contribute to a qualitative revision of curricula in the field of information technologies and the digital economy as a whole, as well as a better training of personnel in targeted areas.
- Revise the inclusion parameters of self-employed IT workers. The current classification includes specialists from other industries and areas of the labor market.

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■ LIST OF ABBREVIATIONS AND TERMS

SCS	—	State Committee of the Republic of Uzbekistan on Statistics
TIN	—	Taxpayer identification number
IPSA	—	Individual pension savings account
STC	—	State Tax Committee of the Republic of Uzbekistan
ICT	—	Information and communication technologies
IT	—	Information technology
Inspection	—	State Inspection for Supervision of Quality in Education under the Cabinet of Ministers of the Republic of Uzbekistan
NMMC	—	Navoi Mining and Metallurgical Company
MIA	—	Ministry of Internal Affairs of the Republic of Uzbekistan
MHSSE	—	Ministry of Higher and Secondary Specialized Education of the Republic of Uzbekistan
MITC	—	Ministry for Development of Information Technologies and Communications the Republic of Uzbekistan
MID	—	Ministry of Innovative Development of the Republic of Uzbekistan
MELR	—	Ministry of Employment and Labor Relations of the Republic of Uzbekistan
UNDP	—	United Nations Development Programme
SSS	—	State Security Service

