ATLAS
OF NEW
PROFESSIONS
IN KAZAKHSTAN

№
04

2020

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INFORMATION TECHNOLOGY

MINISTRY OF LABOUR AND SOCIAL PROTECTION OF THE REPUBLIC OF KAZAKHSTAN

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DEVELOPING WORK SKILLS AND STIMULATING JOBS

ATLAS OF NEW PROFESSIONS AND COMPETENCIES OF KAZAKHSTAN

CONTENT

LIST OF ABBREVIATIONS

- AI - artificial intelligence.
- CP - computing power.
- CS MNE RK - Committee on Statistics of the Ministry of National Economy of the Republic of Kazakhstan.
- COVID-19 - coronavirus infection that caused a pandemic in 2020
- GCEA – General classifier of economic activity.
- GDP – gross domestic product.
- ICS – information and computing systems.
- ICT – information and communication technologies.
- IoT – Internet of things.
- IT - information technology.
- IQF - Industry qualifications framework.
- MDDAI RK – Ministry of Digital Development and Aerospace Industry of the Republic of Kazakhstan.
- MIID RK – Ministry of Industry and Infrastructure Development of the Republic of Kazakhstan.
- MLSPP RK – Ministry of Labor and Social Protection of the Population of the Republic of Kazakhstan.
- NCE RK «Atameken» – National Chamber of Entrepreneurs of the Republic of Kazakhstan «Atameken».
- NCO - national classifier of occupations.
- NQF - national qualifications framework.
- OS – operating system.

- PC – personal computer.
- PD – personal data.
- PS – professional standard.
- R & D– research and development.
- RK – Republic of Kazakhstan.
- STP - scientific and technological progress
- UN – United Nations.
- USA – United States of America.
- VR, AR, MR – virtual, augmented, mixed reality.
- WC under MLSPP RK – Working Commission under Ministry of Labor and Social Protection of the Population of the Republic of Kazakhstan.
- WEF – World Economic Forum.

Transforming professions in the IT industry

Disappearing professions in the IT industry

New professions in the IT industry

FOREWORD

2.

FOREWORD

Dear reader!

We live in an amazing time of changes, we are going through the stage of another deep transformation of the socio-cultural paradigm of our civilization, in the era of daily micro-breakthroughs in scientific and technological development.

The fourth industrial revolution dictates a new agenda to society and the labor market. In the next 10-15 years, the speed of scientific and technological progress will only increase.

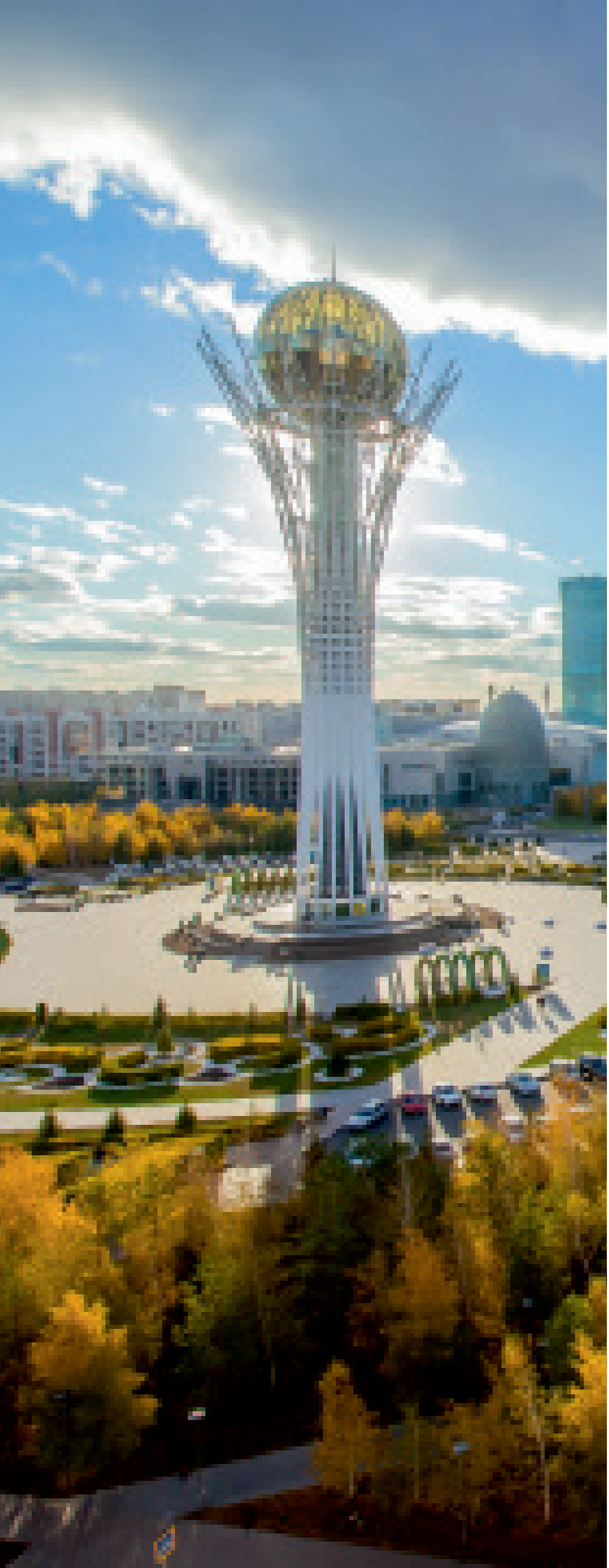
This will be especially vividly manifested in the IT sector, the development horizons of which are so wide, the changes in which are taking place so quickly, new directions of technological progress appear so often that it is difficult even to catch the pace of evolution of the IT sector, let alone adapt to it.

The configuration of the labor market is shaped by many factors

The population and the average life expectancy of people are increasing and, as a result, the period of their working capacity and economic activity, mobility is increasing, and the availability of education is expanding.

According to UN forecasts, by 2030 the world's population will grow from the current 7.7 bln. people to 8.5 bln. And in Kazakhstan, the number of citizens will reach 24 mn. against 18.6 mn. in 2019.

Projecting the current level of economic activity onto the prospective mass of the population of our country, taking into account the growth rates of life expectancy and the increase in the retirement age, the share of our economically active compatriots at the turn of the 2030s will approach 70% of the population - 14.4 mn. able-bodied citizens against current 9.2 mn. Add to this the intensification of urbanization, which also has



a significant impact on the IT sector, since its centers of gravity are located mainly in urban areas, and we get very tough competition for jobs. And if we take into account that IT has no borders, and add here the growth of people's mobility, then the whole world becomes a potential market for the IT specialist of the future, the competition in which is incomparable with Kazakhstani realities.

In addition, people's interest in IT is growing. This is a powerful subjective factor associated with the growth of the prestige, importance, and profitability of this industry.

On the other hand, in addition to demographic and socio-economic factors, technological trends affect the dynamics of the labor market.

In particular - automation, robotization and digitalization. These processes lead to the release of a huge mass of labor.

According to the most optimistic estimates, by 2030 the functionality of 60% of professions will be automated. And this applies to all sectors of the economy.

New technologies are transforming the labor market on an unprecedented scale.

Professions disappear and change, new specializations appear.

Corporations, governments and economic industries compete for the intellectual capital of the future - people with the skills and competencies of the 21st century.

There is no guarantee that you will get your dream job by going to college or university. Already today, in Kazakhstan, 60% of university graduates do not work in their specialty.

- What will happen tomorrow?
- How to choose a profession that will be loved by us and in demand on the market?

After all, this is the most important choice in life.

We need a universal tool that will allow us to look into the future and understand which path to follow. Do your kids play video games a lot and you think it's bad? This is no longer the case.

The gamification of production is becoming one of the key trends in the technological re-equipment of industrial enterprises and makes it possible to use the skills developed through computer games.

Is the child fond of constructors?

- How to develop this interest so that in the future it becomes a demanded professional skill?
- Which area to choose, which direction to move on?
- Maybe towards the development of artificial intelligence or virtual, hybrid realities.
- Or dive into the world of quantum computing and the quantum internet.
- Or become a professional cryptographer.

The choice is great, but the competition is great.

For our children, those who are now 3-5-10 years old, in the future the Atlas will be especially useful as a guide in the difficult process of choosing a profession. And if schoolchildren are determined with an approximate area of occupation by the time they finish school, then with the choice of a specific specialization within this area, everything is not so simple.

The situation is even more difficult for those who are already working, but are at risk of facing a reduction due to the transformation of the labor market.

IN THE IT SECTOR WHAT THE IT SPECIALIST DID LITERALLY YESTERDAY MAY BE AUTOMATED ALREADY TOMORROW.

The functionality is constantly changing, it can both shrink and expand.

- How soon and where will all these changes take place?
- What professions will be relevant in 10-15 years?
- What skills and competencies will be needed?
- Where can they learn in Kazakhstan?
- How to stay permanently competitive?

FOR THESE AND MANY OTHER QUESTIONS WE WILL TRY TO ANSWER IN THIS ATLAS.

3. ABOUT THE ATLAS OF NEW PROFESSIONS

ATLAS OF NEW PROFESSIONS AND COMPETENCIES IN KAZAKHSTAN

MMC

Complex of interrelated industries and stages of the production process from raw material extraction to production of finished products - ferrous and nonferrous metals and their alloys.

Energetics

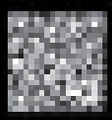
The sector of economy engaged in generation, transformation, distribution and use of resources of all types.

Oil and gas

Economic sector. Engaged in extraction, processing, storage and sale of natural minerals - oil and related petroleum products.

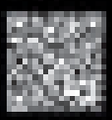
Mechanical engineering

The sector of economy that designs, manufactures, maintains, disposes of all kinds of machines, technological equipment and their parts.



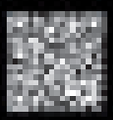
Agriculture

Economic sector aimed at production, storage and processing of food (food products) and raw materials for a number of industries



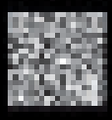
IT

Sector of economy aimed at finding, collecting, storing, processing, transmitting and providing useful information through technical means



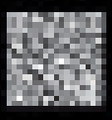
Transport and logistics

The economy sector carrying passengers, as well as the management system for the purpose of optimization



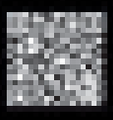
Tourism

An industry that organizes trips (travels) to another country or area other than its place of residence to learn about the lifestyle, gastronomy, nature, etc.



Construction

The sector of economy that designs, creates (erects) buildings, structures, as well as performs their capital and current repair.



ABOUT THE ATLAS OF NEW PROFESSIONS

The world is experiencing another, so-called, fourth industrial revolution. The pace of change driven by this process is extremely high, and the rate of innovation diffusion is increasing exponentially.

It took more than 100 years to spread spinning machines during the First Industrial Revolution, which led to the industrialization of society.

Electrification during the Second Revolution took over 40 years. The Internet, within the framework of the Third Revolution, has swept the planet in less than 10 years. Today, advanced technology solutions and IT developments, such as mobile apps, are distributed digitally in a matter of months.

States that will not be able to embark on the trajectory of advanced development will be left out of the process of intensifying economies and innovative growth, which means they will not be able to successfully compete in the world market. As a result, they will face a socio-economic crisis, a decline in living standards and a permanently increasing lag behind the advanced, technologically developed countries.

Founder and President of the World Economic Forum, Klaus Schwab, in his book “Technologies of the fourth Industrial Revolution”, notes that some developing countries are virtually excluded from the process of shaping the impact of new technologies and knowledge on their societies and are not affected by the new industrial revolution.

Since states with developed economies are pioneers of scientific and technological progress, the balance between technology, society, and economies can easily shift in their direction. If nothing is done, the future for developing countries will be chaotic rather than purposeful, and technology

will limit, not expand opportunities.

We still have a reserve of 10-15 years to stand on a par with the leaders of this race. If this time is not used wisely, we risk missing the only chance to make a breakthrough from the 20th century to the 21st. The starting impetus should be the training of personnel of the future, without which it is impossible to quickly and large-scale implement the advanced achievements of scientific and technological progress. By training specialists after the fact, we will not keep up with the pace of change, which means that we need to train them with a distant aim, looking not around ourselves, but looking far ahead. Think not tactically, but strategically.

It is critically important not only to increase the pace of educational and innovative development, but to give them such an impetus that will allow us to make a leap forward in a decade, bypassing intermediate phases. If this is not done, we will, of course, continue our technological evolution, but we will remain outside the technological revolution. As a result, we will be trailing in the wake of world scientific and technical leaders, gradually increasing the lag behind them.

There are many problems in the IT sector of Kazakhstan now. Small market capacity, high dependence on the state, infrastructural backwardness, low efficiency of the training system and the outflow of qualified specialists, weak competition and tightness within the country without scaling up in foreign markets, etc. Of course, these problems need to be addressed. However, if we focus solely on them, we are missing valuable time. In popular parlance, we will not have time to jump into the last car of an ever-accelerating train.

This Atlas is a navigator for the specializations and competencies of the labor market of the future, a guide to the non-existent occupations generated by the Fourth Industrial Revolution. These professions will inevitably appear in the horizon of the next 15 years as a result of the acceleration of scientific and technological progress.

Of course, the generator of these professions will primarily be technology leaders - states and companies that directly conduct R&D in promising areas of IT development: quantum computing, AI, mixed realities, distributed ledgers, etc. By the way, the first three vectors, Microsoft CEO Satya Nadella calls technological whales, on which the further development strategy of this techno giant is based.

However, Kazakhstan should not and cannot accept the role of a recipient or a trivial replicator of innovative specializations. We need to start training specialists of the future in the next 5-10 years in order to catch up with technically developed states in the horizon of 15 years. This is where the Atlas of New Professions will help us.

It consists of logically related sections, on the basis of which lists of new, changing and disappearing professions in the IT sector are formed. Each of them will open a part of the veil of the future over the IT labor market.

The section «IT sector of Kazakhstan» observes the current state of our IT industry. It is based on the analysis of statistical

data and is necessary in order to understand what is happening in this area now.

The section «Innovations in IT: human, technologies, the future» reveals the form and essence of the technological, economic and socio-cultural trends observed today and expected in the future that arise within the framework of the Fourth Industrial Revolution, change or will change the paradigm of life in modern society and society of the future.

The section presents the results of the joint work of IT industry experts who predicted the main development trends in their area and identified the most important technologies that will affect the future of the labor market and the entire IT sector as a whole.

This is a key section for the formation of a clear and substantive understanding of the future of the IT industry in Kazakhstan. On its basis, as well as on the basis of the analysis of expert assessments of various industry trends, expectations, prospective risks, opportunities and other elements, the image of the future is determined - a collective concept portrait of the IT sector of Kazakhstan after 2035. Based on it, specific directions of technological development are determined, and, consequently, the necessary professional specializations. They are presented in the section «Professions of the future in the IT sector of Kazakhstan», in which they are subdivided into three categories: new, transforming and disappearing professions. The section gives a clear understanding of which specializations will lose their relevance, which will change under the influence of scientific and technological progress, and which will appear in the future in the next 10-15 years.

It is important to understand that, no matter how futuristic these professions may seem, no matter how skepticism or a smile they may cause, this is a reality that we will face in the future. It is needed to prepare for it in advance.

One of the steps along this path is to define the competencies and skills of an IT specialist at the turn of the 2030s. These are outlined in the Competencies for Future Professions section and are structured by category.

The section «Localization of new professions» is intended to practically contribute to the training system of Kazakhstan and the IT sector in the search and selection of the most suitable educational organizations, based on which it will soon be possible to start training IT specialists of the future. The most likely employers are also indicated there - large business structures that will be innovative leaders, which means they will need qualified personnel.

ATLAS IS AN APPLIED TOOL OF PREPARATION FOR THE FUTURE. IT CANNOT BE IGNORED BECAUSE THE FUTURE HAS ALREADY HAPPENED.

IT SECTOR OF KAZAKHSTAN

4.

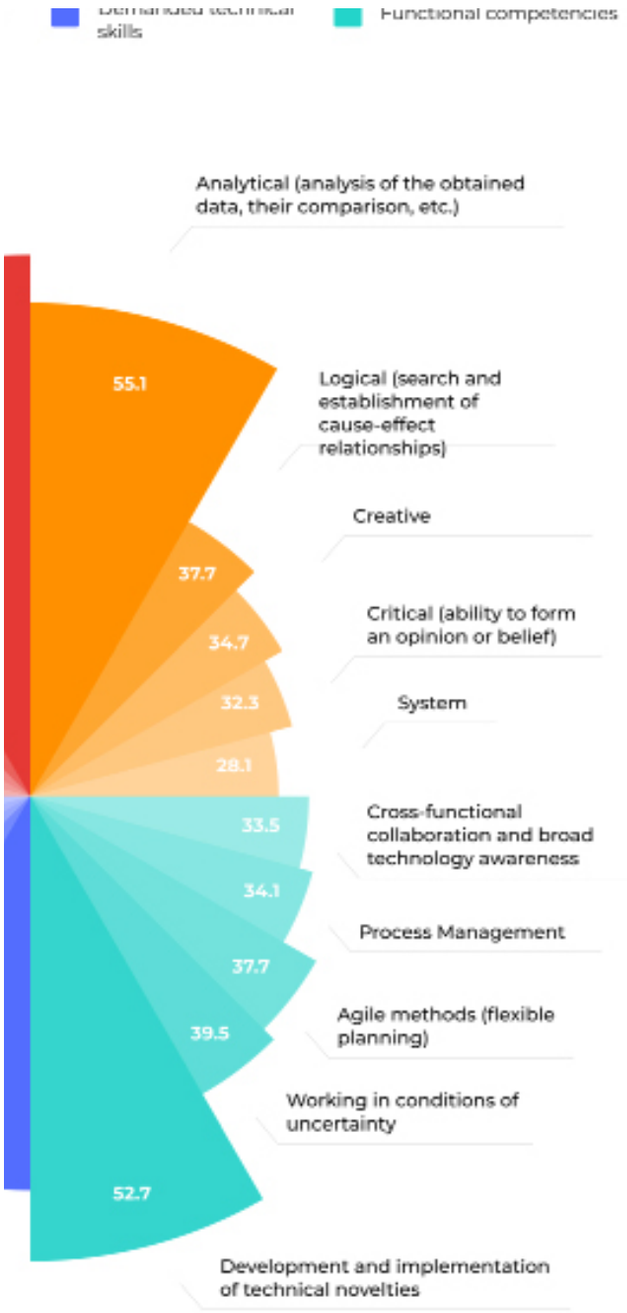
IT SECTOR OF KAZAKHSTAN

IT is one of the key sectors of Kazakhstan's economy. However, its development has slowed somewhat in recent years.

Official statistics track developments in the field of information and communication. As of 2018, according to the data of the Statistics Committee of the Ministry of National Economy of the Republic of Kazakhstan, in the structure of the GDP of our country, this sector accounted for 1.9%. According to operational data for 2019, this value has not changed.

At the same time, in the dynamics of this indicator, a tendency of a consistent decline from 3.1% in 2010 to the current 1.9% is recorded.

[1] *It should be noted that these values are obtained as a result of GDP calculation by the production method.*



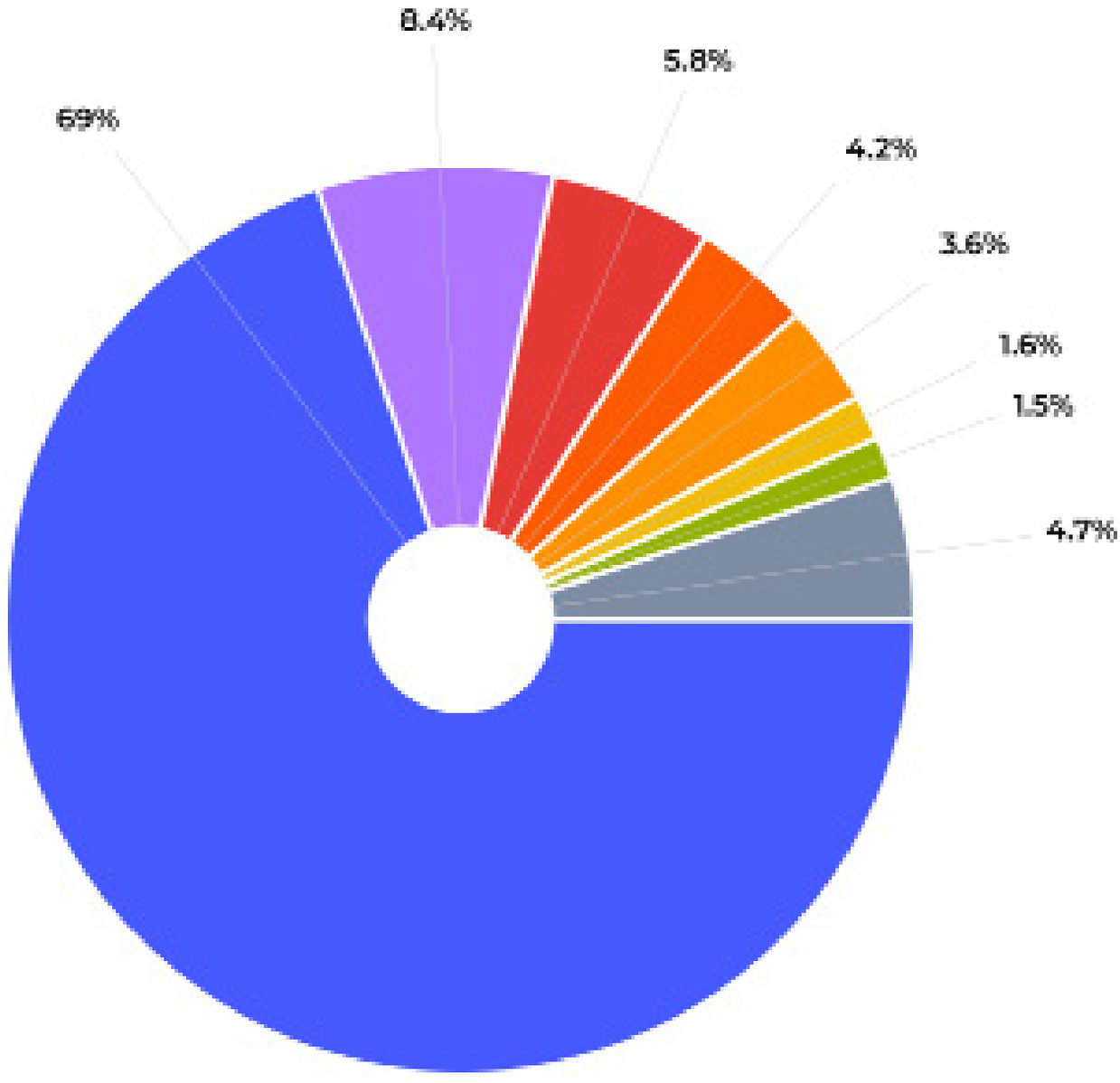
GDP STRUCTURE

OF KAZAKHSTAN BY PRODUCTION METHOD

INDUSTRY AND THEIR SHARE OF KAZAKHSTAN'S GDP (%)

Figures 4.2.

Share of types of services in the gross volume of services produced by the «Information and communication» sector (%)



Sources: CS INE RK

At the same time, in terms of services production , the Information and communication sector accounts for 3.3% – 1.3 trillion tenge in 2019.

For this indicator, ***the industry ICT is comparable to the health and social services sector***, which accounts for 3.4%.

In the structure of services ***produced by the «Information and communication» sector***, communication services are expected to prevail.

Communications account for about 70% of the total volume of services provided in the sector.

In turn, various other services, including those related to IT, remain on the periphery. So, the most highly productive areas of IT services are design and development of application programs - 8.4%, other services in the field of IT and computer systems, not included in other groups - 5.8%, data processing services - 4.2%.

Number of organizations engaged in the ICT sector, 2014-2018 increased by more than 43% – from 7120 to 10192. At the same time, the share of unprofitable institutions decreased from 30.9% to 23%. However, in the context of applying advanced achievements in the field of it, the Kazakh economy shows low indicators.

Analysis of the main indicators of the use of ICT by organizations in the context of types of economic activity shows that, on average, only 3.8% of companies in their work exploit such innovative technologies as cloud IT services (on average 8.5%), digital technologies in production (3, 7%), big data analysis tools (1.5%) and robotics (1.6%). At the same time, in the context of industries, the most technologically advanced sectors are financial and insurance activities (13.2%), activities in the field of compulsory social insurance and the field of information and communication (8.7%).

Table 4.1.

Differentiation of the use of individual innovative ICTs by type of economic activity

(% of companies)

	USING CLOUD IT SERVICES	USING DIGITAL TECHNOLOGIES IN PRODUCTION	USING BIG DATA ANALYSIS	USING ROBOTICS	THE INDUSTRY AVERAGE
Agriculture, forestry and fishery	3,0	0,9	0,1	0,5	1,1
Mining industry and quarrying	9,4	5,9	1,3	2,7	4,8
Manufacturing industry	11,8	6,0	1,2	3,7	5,7
Electricity, gas, steam and air conditioning	10,4	5,3	3,5	0,6	4,9
Collection, treatment and distribution of water	6,2	0,8	1,4	1,4	2,5
Sewage system					
Waste collection, treatment and disposal; waste utilization	5,4	1,2	1,2	4,7	3,1
Recultivation and other waste management services					
Construction	8,5	2,9	0,9	3,3	3,9
Wholesale and retail trade; repair of cars and motorcycles	10,4	1,5	1,9	1,8	3,9
Transportation and warehousing	7,9	1,0	0,6	1,8	2,8
Accommodation services	11,2	2,6	3,1	1,0	4,5
Information and communication	18,8	12,4	3,1	0,5	8,7
Financial and insurance activities	10,5	15,8			13,2
Real estate operations	3,5	0,1	0,2	1,8	1,4
Professional, scientific and technical activities	11,1	1,4	1,4	0,1	3,5
Administrative and support services activities	7,5	0,7	2,2	1,4	2,9

As we can see from table 4.1, theuse ***of modern technologies in the Kazakh economy remains at a low level***. The same robots that are supposed to replace many working professions are still being used point-by-point. This is mostly service work.

Of the 2,196 organizations that use robotics, 1,812 or 82.5% use service robots. First of all, these are

	USING CLOUD IT SERVICES	USING DIGITAL TECHNOLOGIES IN PRODUCTION	USING BIG DATA ANALYSIS	USING ROBOTICS	THE INDUSTRY AVERAGE
General public administration	3,5		0,6	0,0	1,4
Regulation of the activities of institutions providing medical care, education, cultural services and other social services, except social security	6,5		0,2	0,1	2,3
Regulating and promoting the efficient conduct of economic activities	3,7		0,3		2,0
International activity					
Activities in the field of compulsory social insurance	17,1		5,7		11,4
Activities in the field of health	9,6	2,2	1,5	1,5	3,7
Activities in the field of sports	6,2		1,5	2,8	3,5
Activities on recreation and entertainment	5,3	2,4	0,8	0,4	2,2
Repair of computers and communication equipment	8,9	2,8	0,9		4,2
Technology average	8,5	3,7	1,5	1,6	

Table 4.2.

Differentiation of robotics usage by type of economic activity (% of companies)

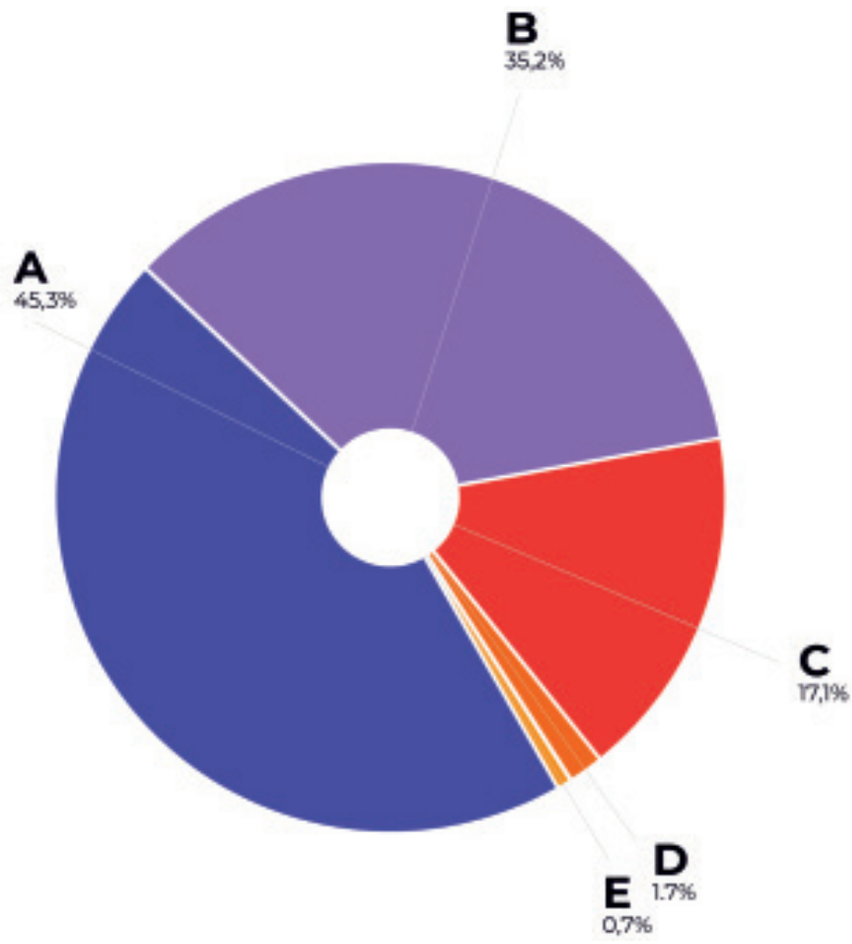
	Use cobots[2]	Use industrial robots	Use service robots
Agriculture, forestry and fishery	2,3	0,5	1,5
Mining industry and quarrying	0,9	1,8	1,8
Manufacturing industry	5,0	34,5	7,2
Electricity supply, gas supply, steam and air conditioning		0,2	0,2
Water collection, treatment and distribution		0,2	0,2
Waste collection, treatment and disposal; waste utilization	0,9		1,6
Construction	32,4	8,2	22,9
Wholesale and retail trade; repair of cars and motorcycles	0,5	38,0	37,5
Transportation and warehousing	9,0	0,6	5,2
Accommodation services	1,8		0,2
Information and communication	1,8	0,5	1,2
Real estate operations			8,9
Professional, scientific and technical activities	0,5	1,1	0,7
Administrative and support services activities	41,9	14,2	7,0
General public administration			0,1
Regulation of the activity of institutions providing medical care, education, cultural services and other social services, except for social security			0,1
Activities in the field of health	3,2	0,5	2,8
Activities in the field of sports			0,8
Activities on recreation and entertainment			0,3

[2]*Cobot – The robot is a collaborative robot capable of working together with humans to solve tasks that cannot be fully automated..*

construction companies (22.9%) and enterprises of wholesale and retail trade, repair of cars and motorcycles (37.5%). The latter area is also leading in terms of the use of industrial robots (38% organizations), but this fact is not surprising because this industry is the most numerous in the context of the number of organizations.

As of 2018, communications also prevails in the structure of organizations ' gross expenditures on ICT. 54.7% of companies ' expenses are related to other types of related expenses. Of these, ***staff training costs related to the development and use of ICT*** account for only 0.7%.

Figures 4.3.
Company ICT costs (%)



- *Costs of purchasing software tools used under licensed agreements.*
- *Expenses for independent software development within organizations*
- *Costs of employee training related to ICT development.*

Sources: CS INE RK

The bulk of expenses is generated by the costs of paying for the services of third-party organizations and specialists related to ICT.

Kazakhstan, despite the decrease in the volume of imported products in nominal terms, remains an import-dependent state in the ICT industry. Imports are 25 times higher than exports. In 2018 alone, the volume of imported products in this area amounted to USD 2.3 bn., while exports - only USD 92.9 mn.. In the structure of imports, as well as in exports, expenses for telecommunications equipment prevail - 45.3% and 32.8%, respectively.

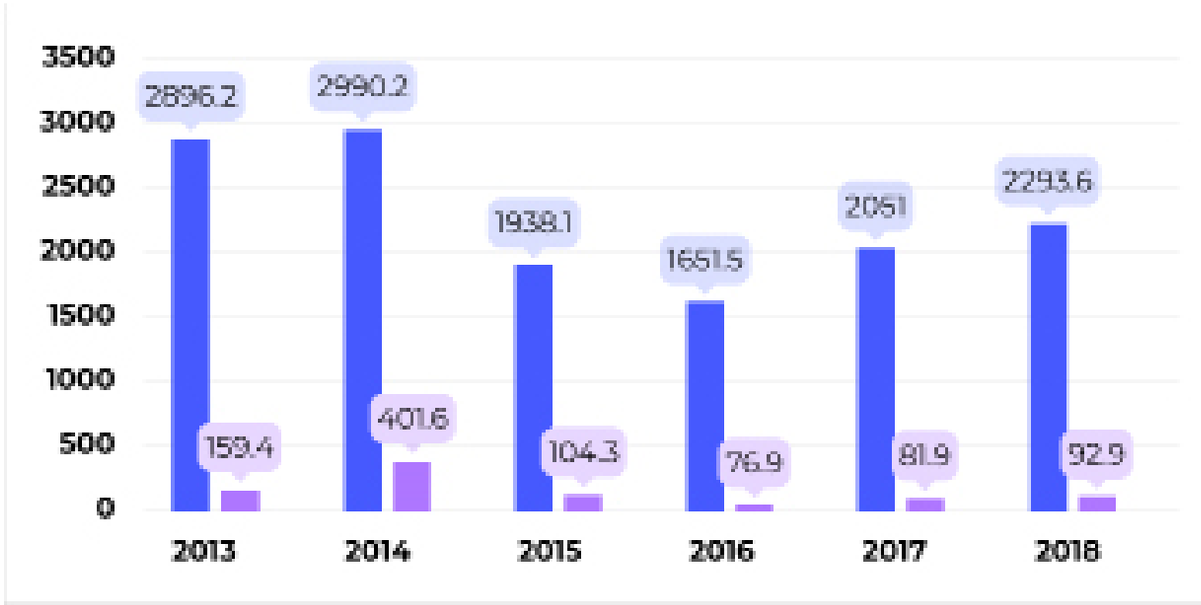
In fact, **Kazakhstan is still largely a recipient**, that is, a consumer of the products of the global IT industry. And now we are taking large-scale steps, both in the public and corporate sectors, to overcome this problem.

In 2018, the state program «Digital Kazakhstan» was launched, the implementation of which will last until 2022.

One of the key objectives of this strategy is to increase Kazakhstan's ranking in the global ICT Development Index to 30th place in 2022. **At the moment we are in 52nd position out of 176, adjacent to Brunei and Argentina.**

Figures 4.4.

Dynamics of import and export of ICT products (million USD)

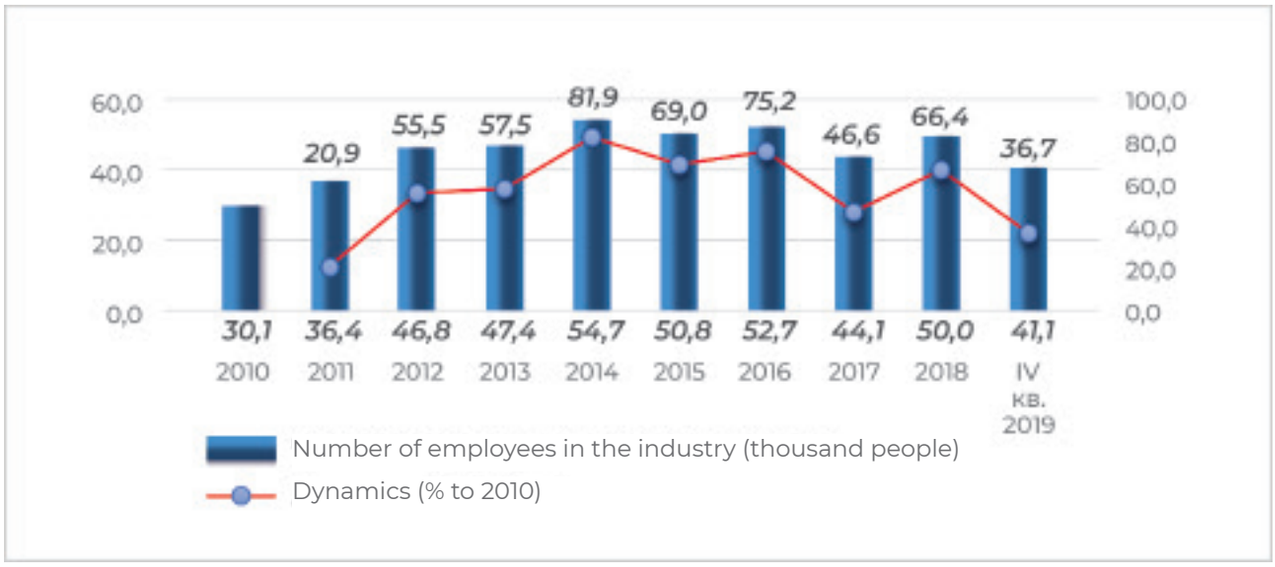


Sources: CS INE RK

[3] *State program «Digital Kazakhstan»: http:,,adilet.zan.kz,rus,docs,P1700000827.*
[4] *ICT Development Index: https:,,gtmarket.ru,ratings,ict-development-index,ict-development-index-info.*

Figures 4.5.

Changes in the number of hired workers in the ICT industry



Sources: CS INE RK

An important result of the implementation of the program will be the creation of 300 thsd. jobs due to digitalization in various sectors of the economy of Kazakhstan.

In 2018, the actual number of employees in the ICT sector, including the self-employed, according to official statistics, amounted to 83.3 thousand people. 49.9% of them are engaged in the provision of communication services, and 23.7% provide computer programming, consulting and other types of IT services. 15.7% provide services for hosting and processing data, web portals, etc.

Over 9 years, the number of employees in the industry has grown by 36,7%. The share of the total number of employees in the country is about 1.9%. At the same time, significant changes in the number of employees are recorded by year.

According to the data of the Committee on Statistics of the Ministry of National Economy of the Republic of Kazakhstan, in terms of income, the most highly paid group of workers are representatives of the consumer electronics sector. Their average monthly salary was 777 thsd. tenge in 2018.

However, this category occupies only 0.2% of the total mass of workers in the ICT field, the average salary in which is now about 250.3 thsd. tenge per month. The smallest average monthly income is recorded for workers who provide services for the repair of computers and communication equipment.

Overall, the average wages in the industry are significantly higher than the average wages in the country.

However, the rate of increase has been declining in recent years and there is a significant lag in comparison with the increase in average wages in the country.

Our survey of industry experts identified the most problematic areas in the IT sector, including training, government support and regulation of the industry, and the development and assembly of IT equipment.

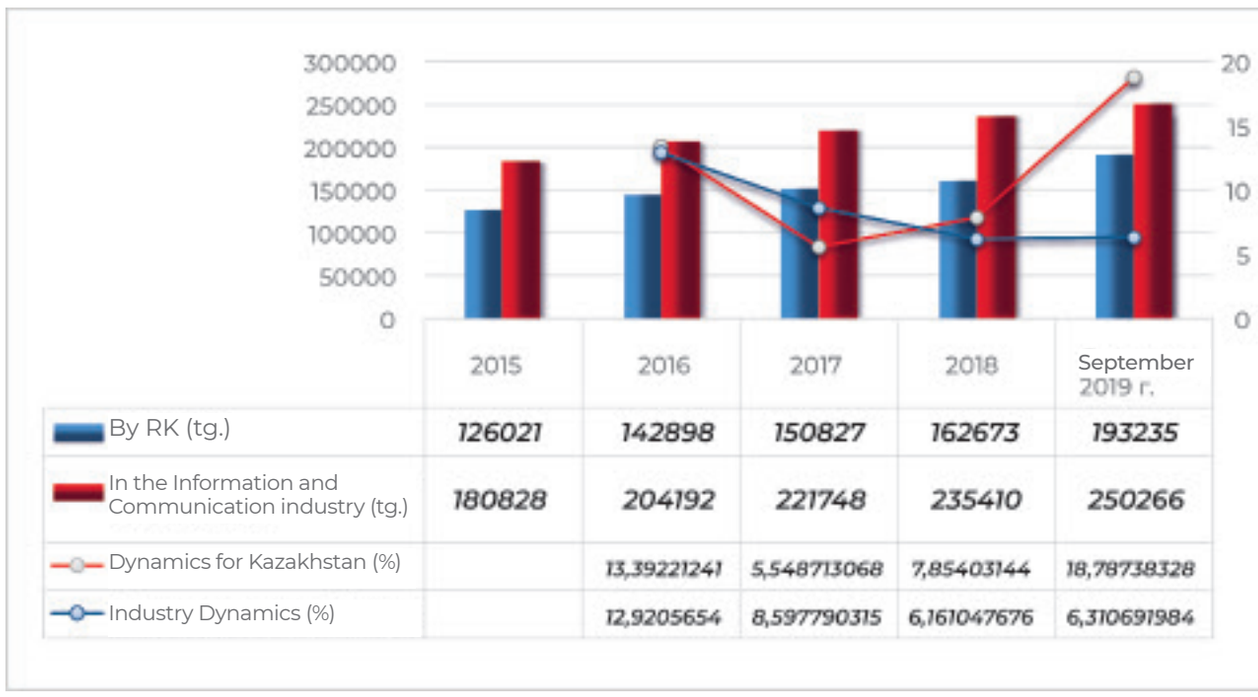
The expert community notes that the IT training system is not relevant to the needs of the labor market in this industry. Kazakhstan's education is not yet able to provide the industry highly qualified personnel that meet the realities market's.

Today in Kazakhstan, training specialists for the industry ICT is implemented by 83 higher Education institutions in 7 specialties licensed by the Ministry of education and science of the Republic of Kazakhstan:

1. Automation and control;
2. Computer technology and software;
3. Informatics;
4. Information systems;
5. Mathematical and computer modeling;
6. Engineering, electronics and telecommunications;
7. System information security

Figures 4.6.

Dynamics of average WPs in the «Information and Communication» sector in Kazakhstan



	2015	2016	2017	2018	September 2019 г.
By RK (tg.)	126021	142898	150827	162673	193235
In the Information and Communication industry (tg.)	180828	204192	221748	235410	250266
Dynamics for Kazakhstan (%)		13,39221241	5,548713068	7,85403144	18,78738328
Industry Dynamics (%)		12,9205654	8,597790315	6,161047676	6,310691984

Sources: CS INE RK

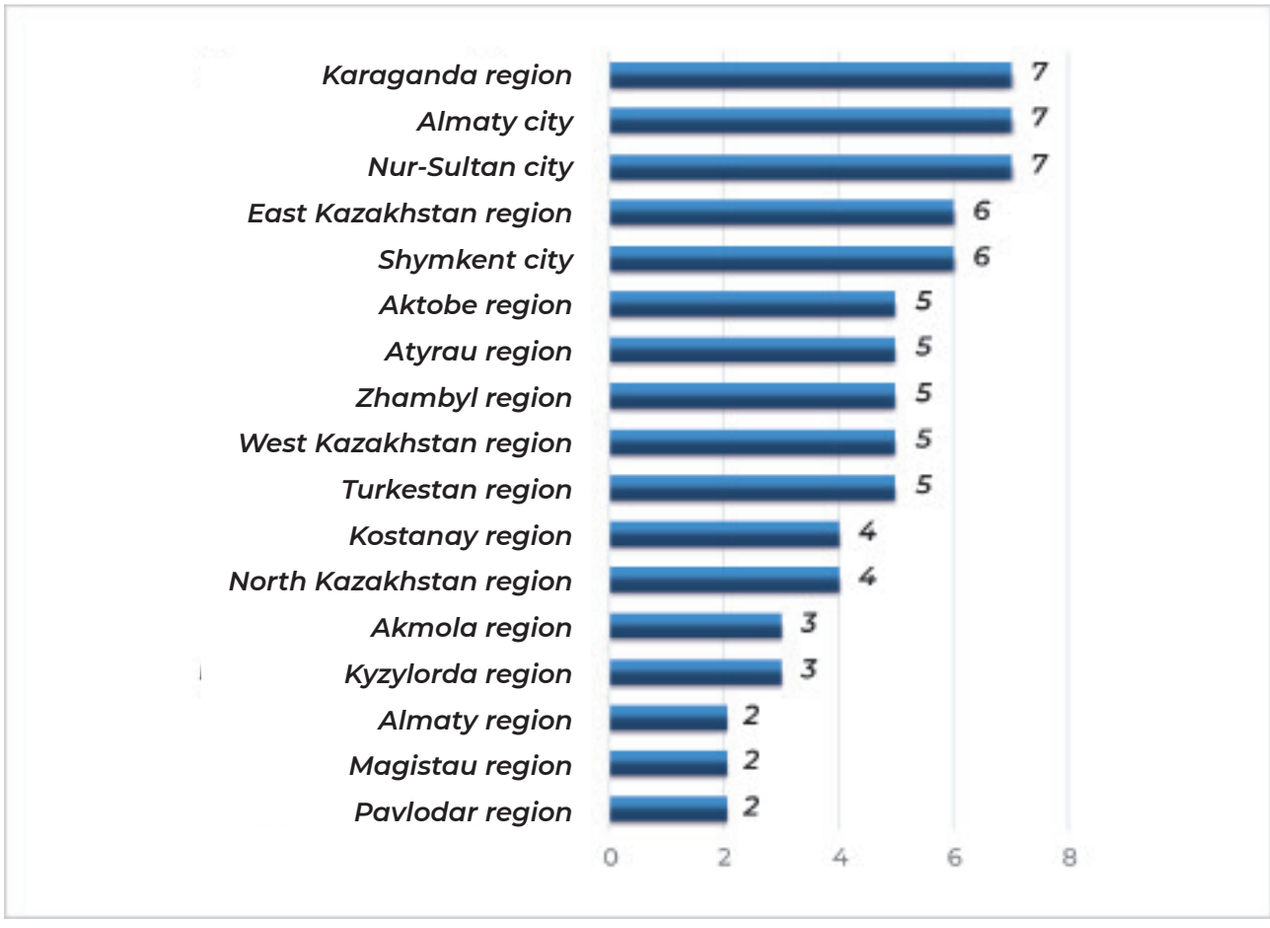
However, if we look at the coverage of the population with the provision of educational services in these specialties, there are serious disparities both in the context of educational programs and regions.

The leaders in terms of coverage are the cities of Nur-Sultan, Almaty and the Karaganda region, in whose universities all 7 specialties are taught. Among the outsiders are Almaty, Mangistau and Pavlodar regions, where you can study only in 2 specialties out of 7.

In the context of the coverage of regions with specialties of information and communication orientation, there is also a significant differentiation. For example, the specialties «Information systems» and «Informatics» are represented in 17 regions, while «Information security systems» only in 4.

Figures 4.7.

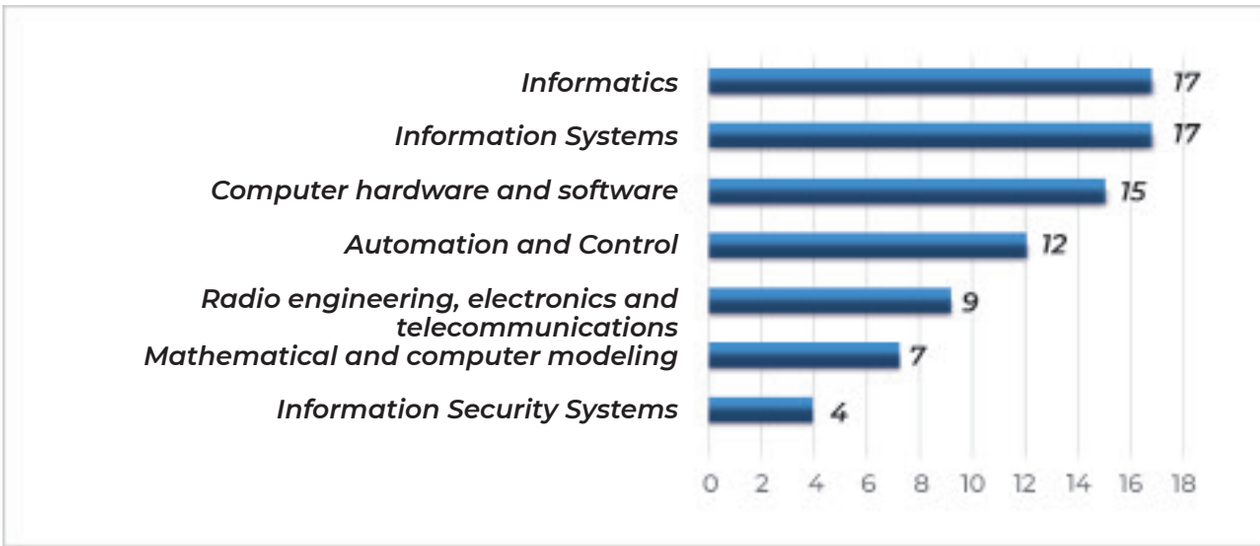
Number of ICT specialties taught in the region
(higher education)



[5] *Independent research based on the study ofwebsites of higher education institutions (2018).*

Figures 4.8.

Coverage of the regions of the Republic of Kazakhstan in the field of higher education in ICT *(units)*



The infrastructure of informal IT education is also gradually developing. Various private programming schools are increasing the range of educational services provided, their approach to organizing training and the methods used, focused on obtaining practical experience, as well as interaction with many large it companies, have a positive effect.

The startup support ecosystem is also expanding, which is based on business incubators, technology parks, accelerators, and other platforms for supporting business initiatives.

However, the IT sector faces a number of systemic challenges.

The «Digital Kazakhstan» program emphasizes that digitalization is significantly ahead of the existing system of production requirements for the composition of professions employed in the labour market.

In other words, the lack of an operational link between the labor market and the education system can simultaneously lead to the training of no longer demanded personnel and the release of personnel in disappearing professions. In this regard, a comprehensive revision of the content of all levels of education through the prism of the development of digital skills of all specialists is of critical importance.

In this regard, a comprehensive review of the content of all levels of education through the prism of the development of digital skills of all specialists is of critical importance.

In addition, the global labor market

is experiencing a steady trend of transformation of IT professionals from narrow-sector employees. profile in multi-functional employees.

Renowned IT company Gartner expects 40% of its IT workforce to be performing multiple professional roles by 2021. These workers should have a broad range of skills, rather than focus on one or two vectors of technical challenges. The bulk of their work will not be technology-related, but business-related.

Most likely, this will primarily concern small IT companies, which will seek to optimize staffing by attracting multidisciplinary specialists who can contribute to the development of the business as a whole, and not perform a narrow set of functions.

It should be noted that in Kazakhstan, 98.7% of all organizations in the IT sector are small businesses.

However, large companies will try to use such employees, but, along with them, continue to attract highly specialized employees with a high level of professionalism.

The IT specialist of the future will no longer be an employee «sharpened» for strictly defined functionality and specific specific tasks of a technical nature, such as programming or maintaining local networks. It will be a broad-spectrum professional, technically advanced, with knowledge in various fields (marketing, sociology, psychology, etc.), with the skills of cross-industry communication and business process management.

5. THESES ABOUT IT AND THE FUTURE

BAGDAT MUSIN

Minister of Digital Development, Innovations and Aerospace Industry of the Republic of Kazakhstan

ABOUT THE DEVELOPMENT OF THE IT SECTOR

One of the main trends in the IT industry is changing approaches to doing business with modern technologies. Unfortunately, on a national scale, we are only beginning to understand the importance and value of automation and digitalization, innovation and the introduction of modern solutions in large-scale industries in all sectors of the economy. Meanwhile, they help to save resources, increase profitability, eliminate corruption and increase profitability.

In Kazakhstan, every second industry needs to implement advanced it solutions in business processes. It is advisable for IT companies to focus on a specific market segment and develop their products in this direction, promoting them to the domestic market. The demand is very high – from agriculture to knowledge-intensive industries such as the aerospace industry or the oil and gas sector.

In terms of estimates of the future, it is now quite difficult to predict anything. The pace and directions of IT development are so large and diverse that their hard to track. Especially for such a long-term perspective as 10-15 years. We can only speculate. However, observing what is happening in the world and being a participant in these changes, we can already assume that in the future IT specialists will become universal employees with multi-skills.

The claim that human participation in certain industries will be minimized as a result of it penetration is highly controversial. Of course, the development of IT will adjust the markets, but not everywhere. I am convinced that areas such as education and medicine will suffer the least in the future.

However, I am sure that IT specialists will become universal employees with multi-skills in the future.

RAMIL MUKHORYAPOV

Founder and co-owner of Chocofamily Holding

Currently, there are three trends that will also be relevant over the next 10 years. ***The first trend.*** The transition to «full online», that is, what we are doing now «offline» will be done «online». Any interaction with the government, with companies, with everything that we buy will take place online.. ***The second trend.*** Rapid growth of the delivery sector. People will understand that time is a key and most expensive resource. As a result, they will stop spending it on trips anywhere, and prefer to have everything delivered to them. ***The third trend.*** Competition at the ecosystem level. The development of an ecosystem economy in which new audiences and frequencies, so-called «super apps» will dominate. They will offer the best services and platforms, and will be audience distributors for these services.

Three key technologies of the future are, first of all, artificial intelligence. Everything will become smart. Where people are not needed, they will be replaced by AI. Many professions will die out, from drivers to lawyers. The second technology is IoT, things will become intelligent. And the third technology that is needed for IoT is 5G. Here are three technologies that I think will revolutionize the next 10 years . In 10-15 years, there will be up to 10 large founders from Kazakhstan who will be able to grow so-called unicorns. Kazakh business will no longer think about the Kazakh market. There will be a breakthrough in business technologization, young entrepreneurs will give preference to the development of international Internet business. There are already examples of people who left Kazakhstan and built great companies, and the capital of these companies will return to their homeland. This will be a good investment base for new companies. Of course, we need to overcome a common lack of specialists. Of course, we need to overcome the General lack of specialists. For strong technology companies, we need people who can work in them: developers, product scientists, designers, data specialists, Internet marketers, etc. But it takes time. It is not so easy to train specialists. All the more serious skills. The key competencies of the future are, first of all, technology. This is a basic skill in 10-15 years. People need to understand how the technology works from the inside in order to apply it. And secondly, advanced English.

BAURZHAN MUKANOV

Head of the direction «Strategy and development of IT-architecture» JSC «Transtelecom»

ABOUT PERSONNEL DRAIN AND IT EDUCATION QUALITY:

Our university education is outdated. Therefore, when selecting young personnel who have just graduated from the university, we use an individual approach, because sometimes guys come not only from the same university, from the same group, and here some guys, for example, have risen to development in 1.5 years, master something new, develop, and others are interested in support, they still sit on it, or did not pull the development at all.

Yes, they go through certain algorithms and training programs in universities, but the people are not ready to come and immediately sit down to develop. To do this, they need from three to six months of work with experienced developers on large projects.

Market realities are such that many strong specialists, not finding themselves in our market, leave for the same Belarus, for example. Most IT professionals with good abilities stay here only at the initial stage to understand how the work works, get some hands-on experience, and then leave.
The solution to this problem lies within creating suitable conditions for them, state support in the form of stimulating start-ups and supporting young specialists.

UVALEEV ZHOLAMAN

Executive Director of the Kazakhstan Association of IT Companies

ABOUT THE ATLAS OF NEW PROFESSIONS AND IT EDUCATION PERSONALIZATION:

The Atlas will be a kind of reference book for the educational system, a guideline for the further development of IT in Kazakhstan in the context of training qualified personnel.

The deficit in them is constantly being felt. You need to work in this direction from school.
The quality of textbooks and the quality of education already at school remain extremely low. The same computer science, which is the base. It is taught according to outdated programs 1-2 hours a week.

There are many young talented people in Kazakhstan, but they are forced to educate themselves. They «shoot», but at the expense of their abilities and zeal, and not what they were taught at school, college, university.
80 universities of the country train IT specialists. However, this is raw material. Few of them get a job in their profession.
We need a personal approach to each student from school; you need to track the children, identify them, and help them decide on which path they want to develop.

DAGAR DAVLETOV

CEO of the Alem Programming School, Co-founder of Method Coding School

ABOUT THE SPECIALIZATIONS OF THE FUTURE AND THE ROLE OF THE IT SECTOR:

In Kazakhstan, it is necessary to develop a startup culture and expand the collaboration of IT with other areas, for example, medicine and IT, the agricultural sector and IT, construction and IT, etc. The IT industry absorbs many different areas and, within their specificity, makes it possible to simplify tasks.

As a result, there will be more demand on the labor market for specialists who will combine two professions, one of which is related to IT.

For example, an IT medic. IT is so intertwined with different spheres of human life that today they cannot be projected separately.

The IT sphere is changing rapidly, and within the framework of professions it is a big problem precisely because students enter the university and focus on certain things, and upon graduation these accents shift.

Education after 4-6 years changes, and the people who enter the first year receive a specialty, and by the time they graduate it will have already been transformed, either removed, or merged. This is often the case in the IT industry.

BELOSHITSKY ANDREY

Vice-Rector for Science and Innovation «Astana IT University»

ABOUT IT EDUCATION AND PROFESSIONAL TRANSFORMATION OF IT SPECIALISTS:

They say that 70% of university graduates do not work in their specialty. According to my feelings, that is really the case. Then why did they go to college? In fact, we have been paying for the training of obviously unemployed people from our taxes for 4 years. At the same time, the quality of the initial human capital in our country is no worse than anywhere else. We have strong school performance, we are in the top at international Olympiads in mathematics, computer science, physics, chemistry, etc. It is difficult to describe what competencies IT specialists will need. Of course, hard skills, constant development, mastering new areas are important. Because the area in which they work is constantly changing. You need to think through the prism of the theses: «I am not the smartest, there is something that I do not know.» Soft skills are also important. A person who can combine all this will be as close as possible to success. Programming, communication, and creativity are all about the programmer in general.

Simple things in IT are automated. To be relevant in this market, you have to transform into something complex. For example, if you were a layout designer, you have to become a front-end developer, learn a Java script or a popular framework to do more complex things, because what you did 3 years ago is already automated. Everyone who works in IT, in my opinion, should undergo a transformation procedure every 3-4 years.


override fun onPageScrolled(position: Int,
override fun onPageSelected(position: Int) {
selectedTab = position
tabLayout.getTabAt(selectedTab)
tabLayout.tabMode = TabLayout.MODE_FIXED
tabLayout.tabGravity = TabLayout.GRAVITY_FILL
tabLayout.setupWithViewPager(myViewPager)
fun displayViewPager(packageResult: ArrayList
= PackagePagerAdapter(
supportFragmentManager,
packageResult,
bundleResult)

AMIRKHAN OMAROV

CEO of BI Innovations

ABOUT INDUSTRY TRENDS AND FUTURE SKILLS:

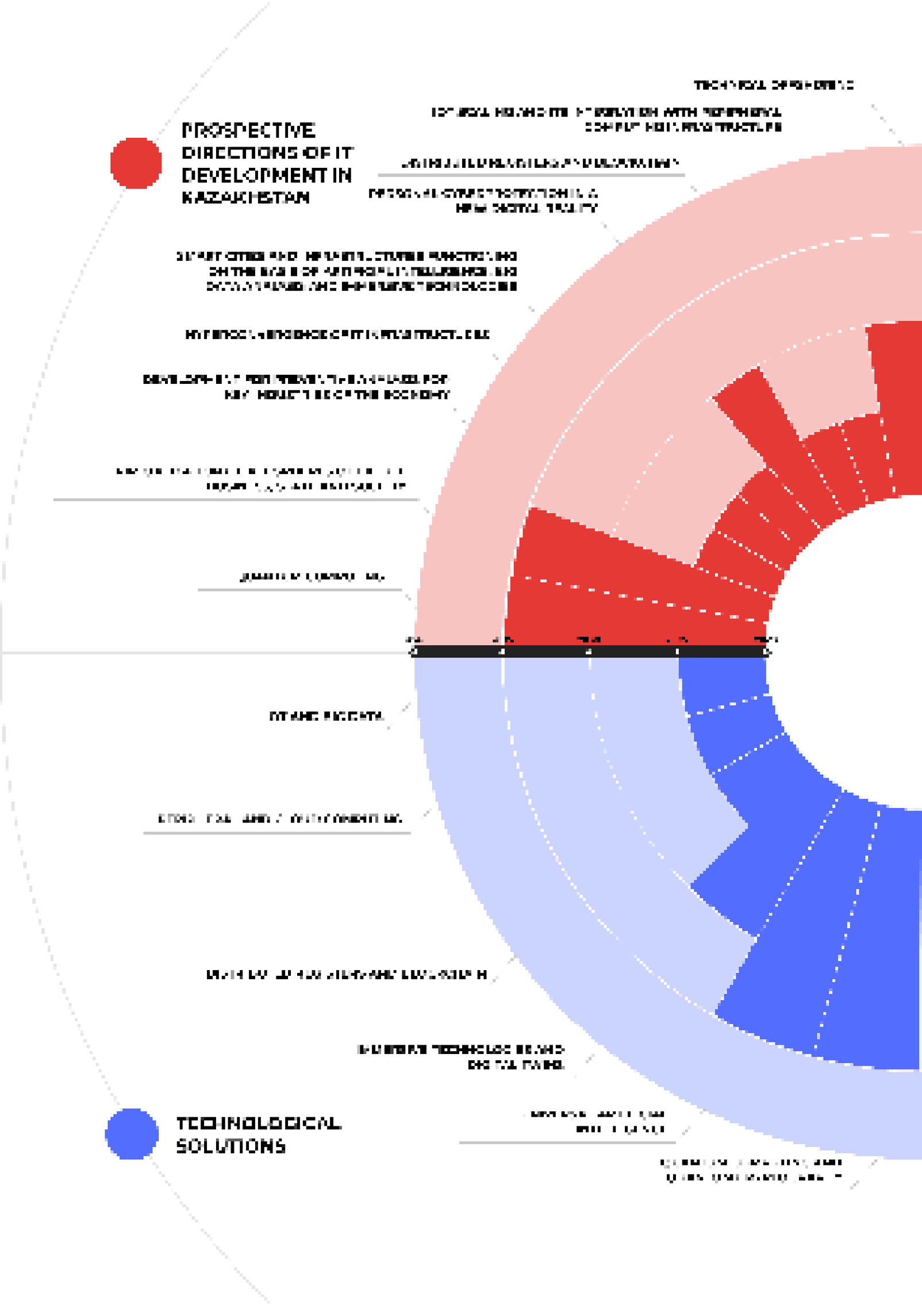
At the moment, I see a trend of aggressive digitalization in all industries. More and more routine blue-collar jobs are being digitalized. The growth of the technologies themselves is accelerating every year, and the cost of automation becomes cheaper.

This trend is, among other things, leading to the emergence of new types of IT professionals. For example, DevOps.

The IT specialists of the future need to be creative and passionate, soft skills are becoming critical skills for them.

6. INNOVATIONS IN IT: HUMAN, TECHNOLOGIES, FUTURE

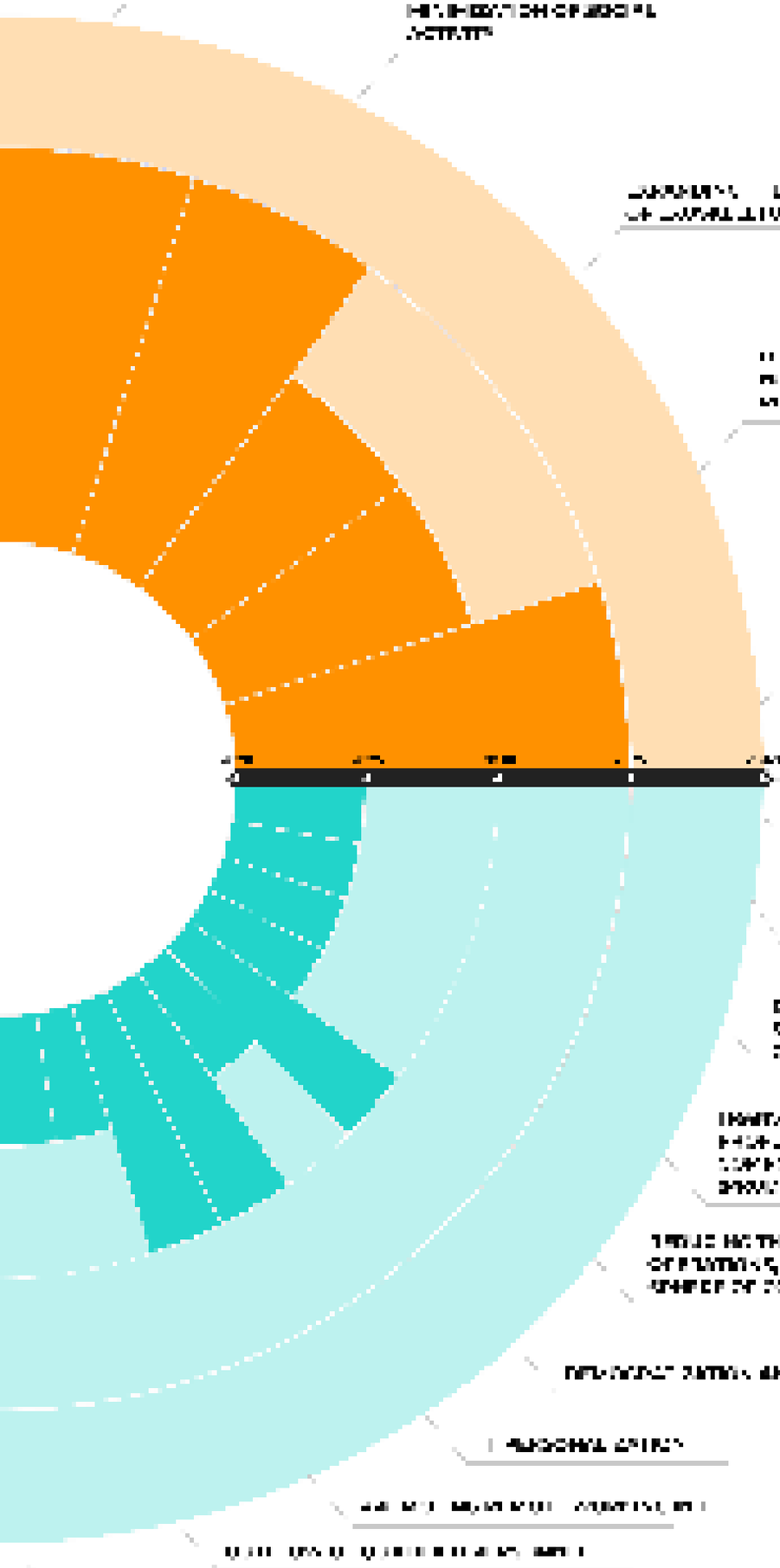
PROSPECTIVE DIRECTIONS OF IT DEVELOPMENT IN KAZAKHSTAN



TECHNOLOGICAL SOLUTIONS

TRANSHUMANISM AND HUMAN EVERGRIZATION

IT SOCIAL BACKGROUND



INNOVATIONS IN IT: HUMAN, TECHNOLOGIES, FUTURE

The development of information technologies is a global, ubiquitous process, one of the key factors for the success of any economy, any business. Growth in the number of IT users, digitalization, intensive innovation, R & D, and growth in venture capital investments are both driving factors and the result of IT development.

The analysis revealed a number of major industry trends that will be relevant over the next 10-15 years. Together, they will determine the vectors for the development of the IT sector in general and specific technologies in particular. Structurally, they are grouped under a series of megatrends that are common throughout the world.

Each of these megatrends has a huge impact on the global economy and society. At the same time, they are a reflection of reality, a product and result of human life.

Digitalization, automation and robotization are innovative processes caused by the acceleration of scientific and technological progress. In practice, these trends are very closely interconnected, since machines and robots without software are just a composite of various materials - iron, plastic, photocells, etc.

Just a few decades ago, the computer was a highly specific device aimed at solving a narrow set of tasks. It was a technical curiosity. And now a computer or a smartphone is an integral part of everyday life, almost irreplaceable basic necessities.

Technology is becoming more and more available.

An increasing number of people can manage and create them.

01 ***Innovation, digitalization and automation***

02 ***Transformation of consumer preferences***

03 ***Changing the needs of a new generation of professionals and workers (generation Y and Z), their qualifications and expectations***

04 ***Stricterand broader environmental requirements***

05 ***Depletion, increase of energy sources, resources***

According to IDC forecasts, by 2022, 60% of global GDP will be generated by digital technologies.

The threshold of «entry» into the IT industry for a person is becoming more and more elusive. In fact, there is a democratization of IT. Almost everyone with a minimum set of IT competencies can build an application based on existing templates. IDC experts believe that ***by 2024, a new type of developers who create code without using their own scripts will increase the community of programmers as a whole by 30%.***

Futurologists believe that by 2040, humanity will fully move into virtual reality.

This will further catalyze digital transformation.

Research and development in the field of artificial intelligence, the development of channels for its interaction with people and technology, the expansion of the physical and cognitive capabilities of a person, is accelerating and virtualization is accelerating.

In the digital world, the volume of data is growing, new technologies for their transmission, storage, processing and analysis, for example, edge computing and blockchain, are emerging.

For $ 160 on the darknet, you can buy any user's online banking login credentials.

The newest quantum computer only takes three minutes to complete the computational operations that advanced supercomputers will take 10,000 years to complete. Cybersecurity is becoming increasingly important.

Almost 2 mn. users in 2019 were attacked by cybercriminals through password interception and theft programs. And with the increase in the number of users and the number of gadgets per person, the issue of ensuring privacy and security is becoming more and more important.

The banking sector pays special attention to this. In 2019, 67% of the world's banks invested in biometric technology. Smart technologies have learned to communicate with each other without human intervention. Innovations such as the Internet of Things and "smart systems" allow us to manage spaces and industries while minimizing human participation. At the same time, they significantly increase efficiency. For example, according to some estimates, by 2050, precision farming based on AI technologies, the Internet of Things, GPS, GIS, satellite data, etc., will increase crop yields by 70%.

Automation optimizes work processes, saves time, effort and money, and at the same time frees up a lot of labor resources.

By 2030, 60% of all professions will be automated. 77% of employees will be forced to acquire new skills or completely retrain in the near future. Moreover, even in those areas

that were considered the fiefdom of man. For example, robots will progressively replace surgeons, and the market for robotic surgeons by 2023 could amount to about US$ 6.5 bn. AI is increasingly active in the processes of digitalization and automation.

According to expert forecasts, by 2030 the world economy will attract $13 tn.. US dollars only due to the development of AI, and 14% of the growth of global GDP will be provided precisely through the use of AI.

Technologies of machine vision, interaction of AI with technologies of virtual and augmented reality are being actively tested. According to Gartner forecasts, by 2024 more than 50% of user operations will use machine vision, speech, natural language processing and VR, AR functions.

Socio-economic development and scientific and technological progress have led to an increase in the standard of living of the majority of the world's population. Human needs are no longer limited to a standard set that satisfies basic instincts. We have become selective and picky. We make more and more decisions based on their influence on the dynamics of comfort and convenience of our life. Our preferences are becoming more complex, mutating, becoming more sophisticated. During the coronavirus pandemic, these changes began to be traced especially clearly. For example, now we no longer want to waste time and energy on going to the supermarket. After all, they can deliver everything to us. Moreover, we will receive online comprehensive information about the goods, we will be able to pay for them, share our opinions about them, etc. Augmented reality technologies allow you to try on clothes, design a room and much more. In 2019, IKEA presented a system that makes it possible to embed virtual furniture into the interior of a home, Nike created a service for remote selection of sneakers, and online retailer Lamoda placed 16 virtual fitting rooms in Moscow.

The market is forced to satisfy the growing human needs. And one of its key tools is IT. Moreover, these technologies already know everything about you. All the necessary information is accumulated in databases, analyzed and used to compose personalized advertisements. test the car.

Omnichannel models will become the main engine of retail, and ***shopping will be simple, you don't even have to leave your house to buy the right size clothes or test a car.***

The priority is the convenience of the client. Your smartphone, your laptop, every site you visited, every search query, every click on an advertising link are sources of information that does not disappear anywhere, but is meticulously accumulated and carefully structured and analyzed, after which it is used for business purposes.

We are becoming more and more demanding of personal gadgets, our vehicles, even our homes. Thanks to this, the development of SMART technologies, the demand for which is constantly growing, does not stand still. Smart things save our time and energy. The air conditioner will set the optimal temperature by itself, the kettle will boil the water, etc.

Your smartphone, your laptop,every website you visited,every search query, every click on an advertising link– these are sources of information that does not disappear anywhere, but is carefully accumulated and carefully structured and analyzed, andthen used for business purposes, which is permanently growing. Smart things save us time and money.forces. The air conditioner will set the optimal temperature, the kettle will boil water, and so on.

There is no fundamental solution to the two key social problems of the twenty–first century - overpopulation and growing inequality.

To these are added derivative problems – the environmental crisis and the depletion of natural resources

On the other hand, the human population is constantly growing. Outstanding scientist and popularizer of science Carl Sagan in his book “Billions and billions” notes the exponential nature of this process and predicts that by 2040 the Earth population will reach 12 bn., by 2080 - 24 bn. Every 40 years our number doubles. At the same time, the problem of providing the population with food will come to the fore. In addition, it will be exacerbated by growing social stratification, and, as a result, access to food resources will be increasingly limited.

The solution of these four tasks becomes the most important priority of scientific, technical, economic, political and socio-cultural development of human civilization. And the vector of IT development is largely determined in correlation with them.

It turns out that on the one hand, humanity continues to be a consumer society, the needs and interests of the majority vary within the limits of meeting personal or microsocial needs, and with the maximization of personal comfort. On the other hand, there is still some transformation of values. First of all, this applies to young people who now he has open access to education, technology, has a broad outlook and almost unlimited travel opportunities.

All this encourages a shift in mass psychology. Young people see problems and are actively involved in solving them. As a result, a new type of society is being formed.

The trend of changing the needs of a new generation of specialists and workers, their expectations and qualifications largely stems from the first three trends. However, as a social phenomenon, it is almost Autonomous. In the coming years, businesses will have to change their PR policies due to the influx of generation Z clients. For those born after 1995, the world looks different, they perceive it differently.

What matters to them is not the brand, title,or big story, but the culture and experience built around IT.

Generations Y and Z will be the engines of progress, socio-economic, cultural, scientific and technological development in the next 15 years. And they will determine the reality of the market.

This is a mobile, flexible, socially active layer of society that is inextricably linked to IT. And its impact on the development of the IT sector it's hard to over estimate.

Modern youth is a completely new formation, a special category of people who were «born and live» with a button on their finger. They are constantly online.

There are no stable, solid, long-term trends in their life. Fashion changes every day. Young people need a rationale forany theory, proposal, orinitiative. Age ceases to be an authority for them. They have their own opinions and ideas about the world. And even if they may not enter into a polemic , they will leave their opinion unchanged.

Young people do not want to work hard and for a long time to build their lives. They need success here and now. Main value-satisfaction of current needs. Modern young people do not like to make plans for the long term.

This is the portrait of the mass consumer of the next 10-15 years. Their age in the 2030s will vary in the 34-48 corridor years, and this will be the most active part of the world's population. These are technical people who are completely immersed in the online world. This means that their technology needs will only grow.

Their competencies will be diverse, but entirely based on technological development. In their work, they rely entirely on technical tools. Traditional formal education takes a back seat for them. The priority is self-development, and remote, which does not require special organizational efforts, and is as digitized and accessible as possible.

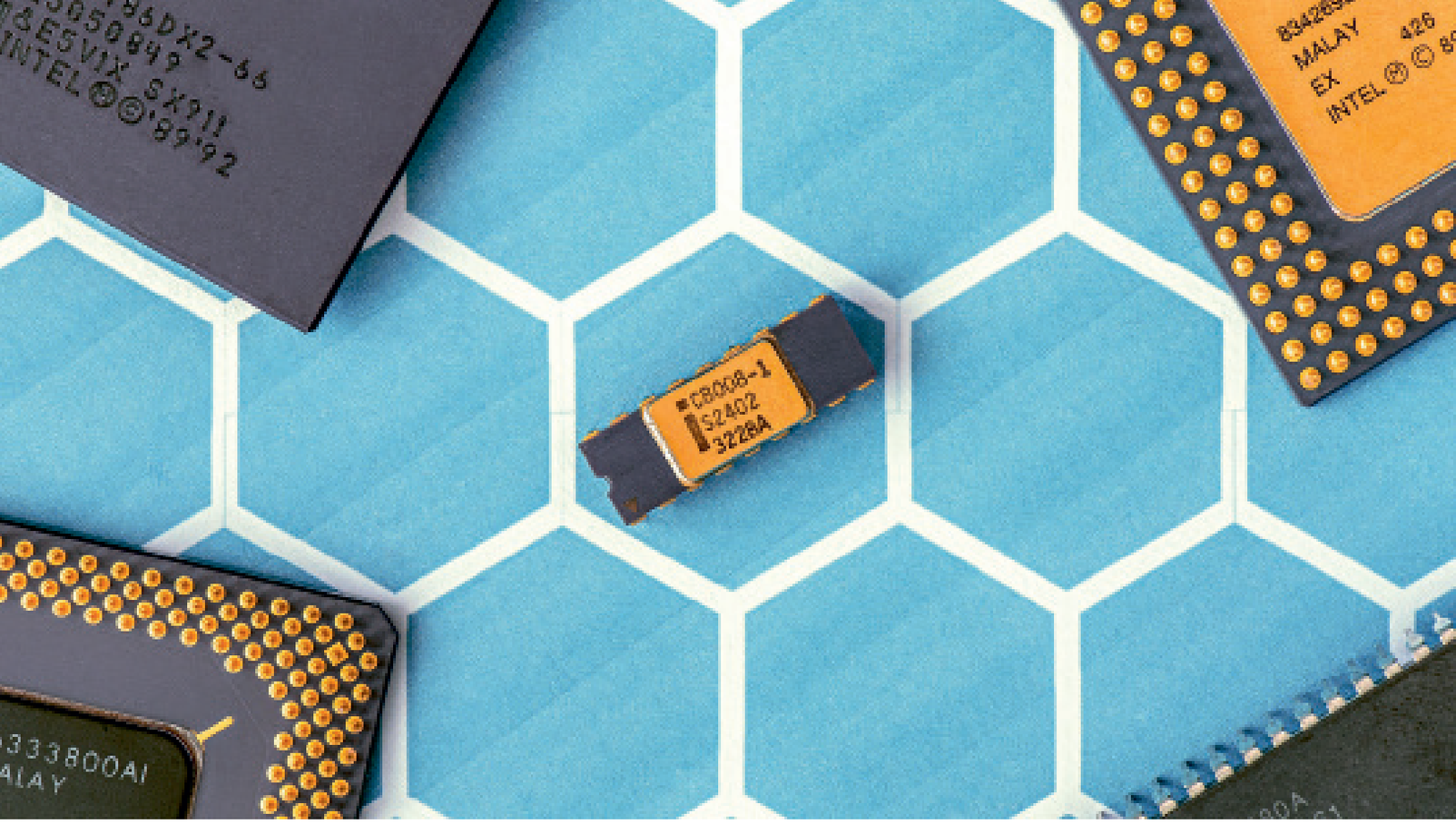
Comfortable working conditions, the ability to be distracted, and rebuilt are important for them. At the same time, the non-triviality of tasks plays an increasingly important role. An interesting project with a lower pay level will often be more attractive to them than a boring but high-paying job.

As a result, the IT industry is adapting to the needs of new generations of employees, creating the necessary incentives for your employees. It is widely known, for example, that in the office

Google doesn't have a strict daily routine. They start and finish work there as they please.

It is only important that the projects are implemented according to the plan. And every Friday, the offices hold informal gatherings that have become a tradition, during which you can enjoy a glass of beer with like – minded people - members of a

THIS MAKES THE IT SECTOR OF THE FUTURE MULTI-SOCIAL STRUCTURE, IN WHICH THE ENGINE, CATALYST AND RECIPIENT OF DEVELOPMENT THERE WILL BE PEOPLE OF GENERATIONS Y AND Z



special society.

The startup spirit is widely cultivated at Google. Each employee can spend 20% of their time working on projects that are interesting to them personally, regardless of whether they are relevant to its main profile, whether they are at least theoretically feasible, and what investments they require.

The IT worker of the future is a person who is deeply integrated into certain environments. He sees himself as an individual, but professional contact, multi-channel communication, and interconnection are important to him.

Recent Megatrends-tightening and expanding environmental requirements and depletion, increasing energy sources and resources-have a rather indirect impact on the IT sector. However, since NTP is closely related to IT, certain correlations can be traced in this industry. For example, technologies are becoming less energy-intensive and more energy-efficient.

When developing them, more and more emphasis is placed on the environmental friendliness of components, the possibility of creating them from the most energy-efficient or synthetic materials, and so on.

The IT sector itself contributes to improving the energy efficiency of the economy. In the same housing and utilities sector, for example, sensors track energy consumption, IoT provides rapid data exchange, and «smart» systems regulate light intensity or temperature, while maintaining the necessary level of comfort.

With the help of AI, robots, the Internet of Things, blockchain and other innovations, the state of aggregates in production, mines, factories and factories is monitored. IT manages megacities, transport

highways, power plants, etc., allowing you to record differences, the volume, composition and frequency of emissions, the level of pollution, the probability, time and degree of its impact on humans, and so on.

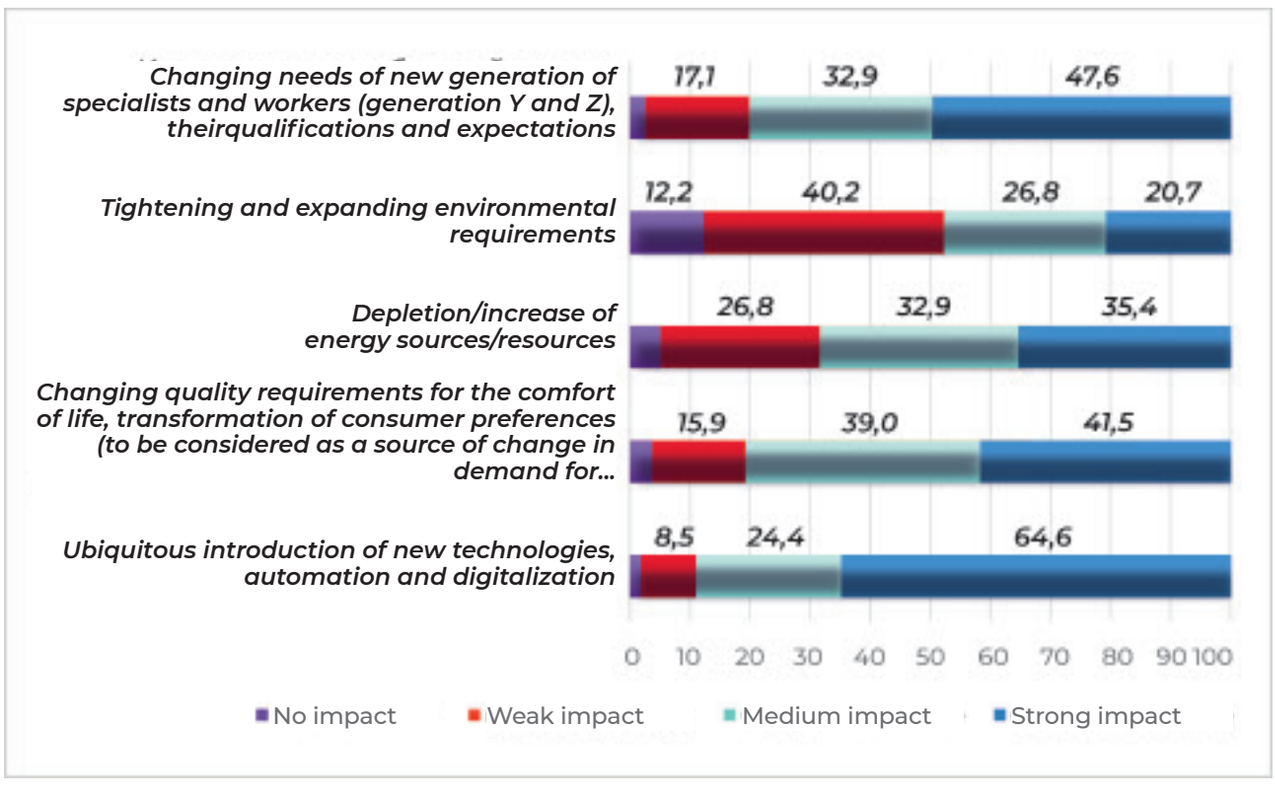
In this context, the fifth megatrend is more a recipient of IT development, ratherthan a subject of this process. As part of the development of this the impact of these Megatrends on the development of the it industry was determined by expert assessments of the Atlas.

Thus, the most powerful impact, according to the expert community, is caused by widespread technological innovationsand the intensification of digitalization, automation and robotization processes. 89% of the surveyed IT experts in Kazakhstan noted a significant impact of this trend on the IT sector, while 64.6% of them stated a strong degree of influence.

According to expert estimates, the least impact is expected to be the tightening and expansion of environmental requirements. 40.2% of experts consider the impact of this trend in significant, and 12.2% do not trace any impact at all.

Figures 6.1.

Evaluation of the impact of megatrends on the IT sector *(%)*



Sources: Industry experts survey

6.1.
DIGITAL DICTATORSHIP: SUPERDATA AND A TECHNOLOGICAL SINGULARITY

Human interaction with the IT world is becoming more systematic. In practice, most of us are increasingly dependent on digital technologies that manage factories, power plants, transportation infrastructure and megacities.

Human interaction with the IT world is becoming more systematic. In practice, most of us are increasingly dependent on digital technologies that manage factories, power plants, transportation infrastructure,and megacities. AI and robots, smart sensors and systems, the Internet of Things and cloud technologies are increasingly used in these processes.

Digital solutions have become so deeply embedded in everyday life that many of us can no longer imagine a full life without them. Smartphone, Internet, social networks, and computers. Almost half of a modern person's life is spent in the digital space. A highly active individual shows rapid social activity with the help of modern it.

Facebook, instagram posts, photos and videos, we work in Google Docs alongside our colleagues, and some even hold virtual meetings where the conference room is located on an orbiting station or on the surface of the moon.

Digitalization and automation as system expanding processes lead to serious technological, social and economic shifts. Many industry trends are recorded. Increasing the flow of data and metadata in IT.

First of all, this is an increase in the flow of data and metadata, which is associated with an increase in the number and activity of information generators. This is one of the key industry trends in the IT sector, which is closely related to another trend-an increase in the number, activity and expansion of user requests ICT, that is, ordinary people, businesses, government and public institutions. The logical consequence of these two processes is the deepening

01 ***Increasing the number,activityand demand of ICT users***

02 ***Increased number ofcybercrimes, increased security and privacy requirements, and development ofcyber defense tools***

03 ***Deepening researchand development in data generation, processing, transmission, and analysis***

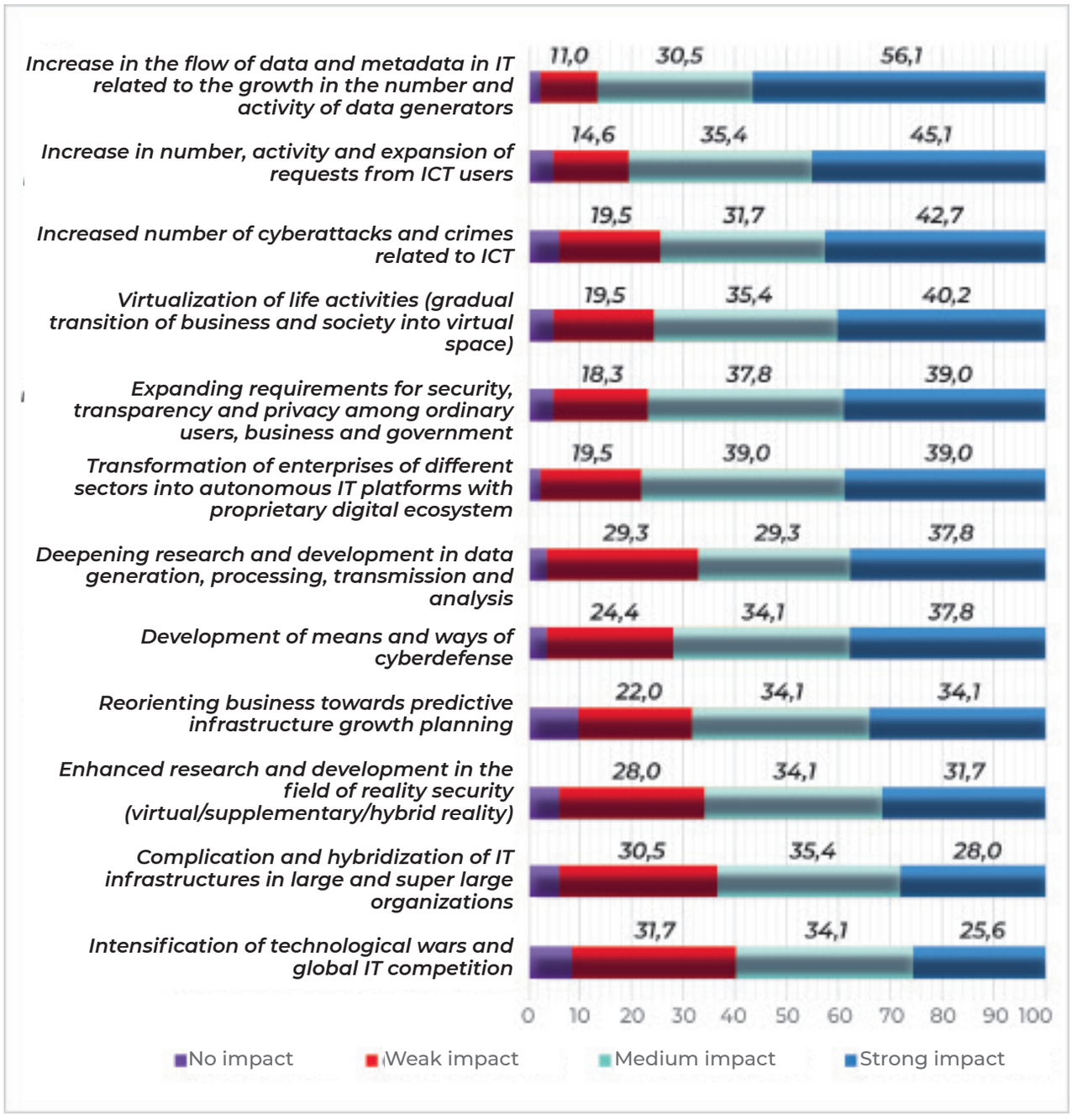
04 ***Growing number of cybercrimes, expanding requirements for security and privacy, development of cyber security means***

05 ***Deepening researchand development in datageneration, processing, transmission and analysis***

06 ***Complication and hybridization IT infrastructurein large and ultra-largeorganizations***

Figures 6.2.

Assessment of the impact of industry trends on IT sector development *(%)*



Sources: Industry experts survey

of research and development in the field of data generation, transmission, processing and analysis.

All the more important it is necessary to ensure the security of this data. The world is experiencing an increase in cybercrime, which creates aneed for the development of cyber defense tools and methods, including virtual and hybrid realities.

According to some estimates, by 2021, the total losses from cybercrime will reach 6 trillion us dollars, the number of hackers will reach 6 million people by 2022,and about 3.5 million will work in the field of cybersecurity.

In turn, organizations' spending on protecting IT-infrastructure will grow to $1 tn. Technological progress encourages the expansion of security and privacy requirements among ordinary users, businesses, and the state. At the global level, digitalization and automation provoke an intensification of IT competition, which, in turn, leads to the transformation of enterprises into Autonomous ones.

IT platform with a proprietary digital ecosystems the increasing complexity and hybridization IT infrastructure in large and super-large organizations, thegrowth of innovation activity and hyper automatization of business, its reorientation to predictive planning of infrastructure growth.

From a technical point of view, the megatrend of digitalization and automation leads to the development of technologies such as virtual, augmented and hybrid reality, quantum computing and the quantum Internet, artificial and advanced intelligence, cloud and peripheral computing, the Internet of things and «smart systems», etc.

There are many hypotheses as to how this particular turning point in history will affect humanity. These theories, put forward by futurists and visionaries, scientists and philosophers, are diverse and even suggest diametrically opposite scenarios: from the transition of man to a new stage of evolution – bionic man, to the total destruction of our species. But it is almost impossible to accurately predict the consequences of the technological singularity. We can only track current industry trends and analyze them to lift the veil of the future. Kazakh IT experts assessed the degree of influence of industry trends in the IT sector differentially.

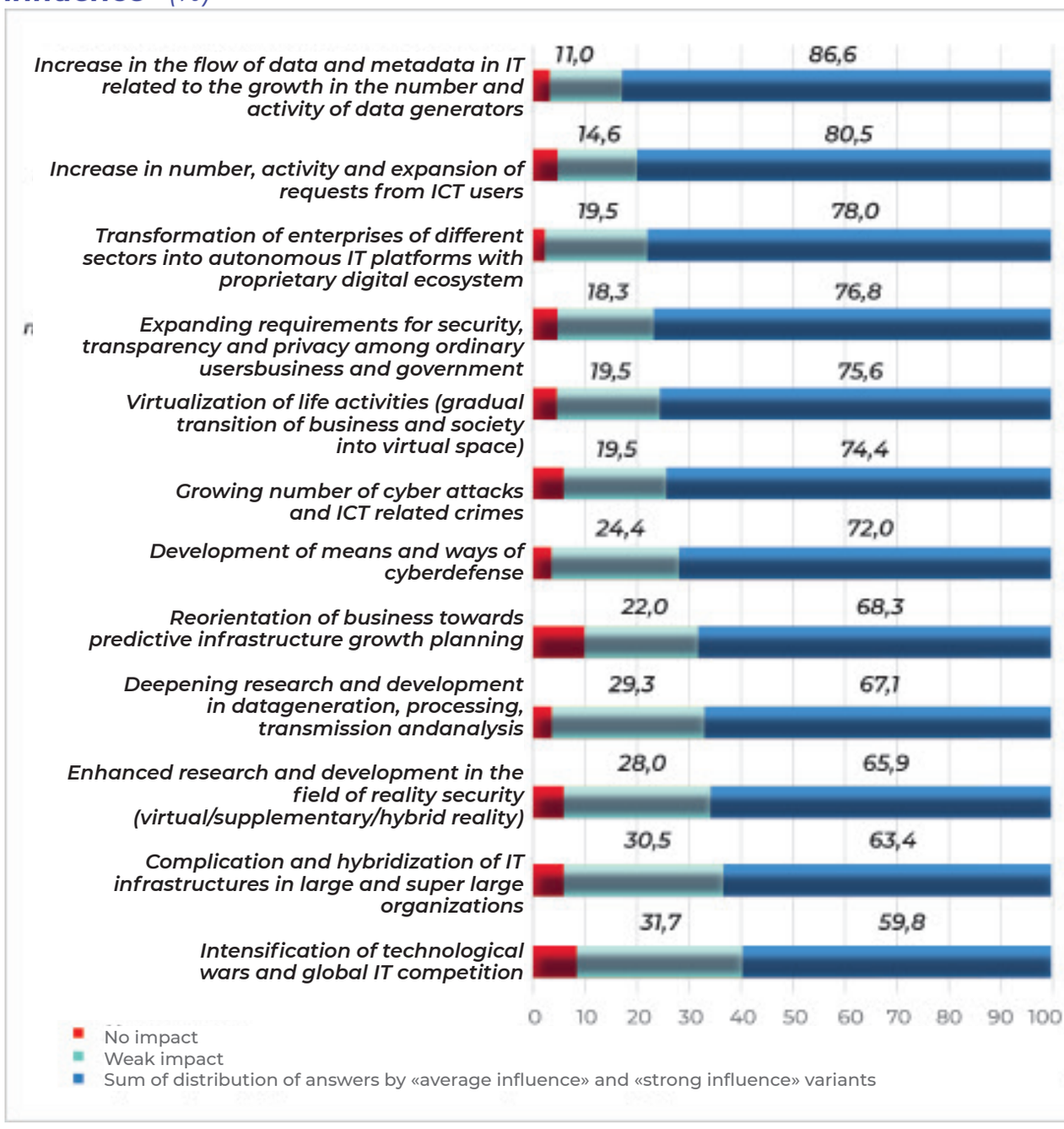
Technology improvement in the future will reach the so – called technological singularity-the stage when technological progress will become unstoppable, irreversible and unmanageable, which will provoke drastic changes in the evolution of man, civilization and the planet.

[6] *Internet portal Cybercrime Magazine Cybercrime Magazine: https:,,cybersecurityventures.com,jobs,*

The most important trends were recognized as an increase in the flow of data and metadata associated with an increase in the number and activity of data generators.
More than half of respondents believe that this trend has a strong impact on the IT sector. Accordingly, 45.1%

Figures 6.3.

Sum of answers distribution by "medium influence" and "strong influence" *(%)*



Sources: Industry experts survey

of respondents indicate a significant role played by the increase in the number, activity and expansion of requests from ICT users.

The growth in the number of cyber attacks and crimes related to ICT completes the top-3 most significant trends in the industry.
For example, such trends as an increase in the flow of data and metadata, an increase in the number, activity and expansion of user requests, as well as the expansion of requirements for data security and privacy in the next 10-15 years will unfold in all sectors of the economy. At the same time, the deepening of research and development in the field of generation, transmission, processing and analysis of data will be characteristic of such areas as the IT sector itself, defense and security, aerospace, scientific and technical activities.

Digitalization, automation, growth of activity and expansion of the scope of implementation and application of technical innovations, R&D, growth in the volume of venture capital investments are both driving factors and a result of IT development. This is due to the multifunctionality and simultaneous autonomy of this industry, its end-to-end, penetrating property that affects all spheres of human life in general, and each one in particular.

Industry trends are long-term. Some are even permanent, such as the growth of data, metadata and an increase in the number of users. But each of them has an active impact on the socio-economic development and evolution of society.

The growth of activity in the field of innovation is observed in almost all sectors of the economy.

Gartner predicts that by 2023, more than 50% of gross ICT spending will be spent on digital transformation, while, for example, in 2018, the share of this area of investment was only 27%.

7 INDUSTRY TREND

THE INCREASE IN THE FLOW OF DATA AND METADATA, ASSOCIATED WITH THE INCREASE IN THE NUMBER AND ACTIVITY DATA GENERATORS.

Each of us is a consumer of data and diverse content. But at the same time, we create this flow through various technical devices. And now technology has taken a step further. They generate content almost without our participation, relay it to the digital world, and exchange IT independently

The network of «smart» things has become a new reality, which accumulates the bulk of the gross volume of data produced in the world. Laptop, smartphone, tablet, SMART-watch, smart glasses, all kinds of sensors in factories, street lighting systems, sewers and other devices are data generators.

There are now more than 32 billion IOT devices connected to the world's network.

They account for most of the traffic. And their number is constantly growing. Moreover, they are increasing their activity. The range of data they collect is increasing, the speed of data exchange between them is accelerating, thanks to edge computing, smart devices conduct primary analysis, etc. With the development of AI, virtual and hybrid realities, quantum computing and other promising technologies, the amount of data will increase even more.

The famous Israeli scientist Yuval Noah Harari in his book «Homo Deus» hypothesizes that the 21st century will be the era of the formation of a new religion - dataism, which will replace humanism.

The data, as stated by Harari,

[7] *International research and consulting company, which specializes in IT.*
[8] *International Data Corporation is an international research and consulting company specializing in IT.*

will be the center of the entire universe, traditional market institutions will disappear, and liberalism, as the dominant type of socio-political structure, will collapse, like other species, by the way.

According to the IDC forecasts, in 2025 the total amount of data will reach 175 zettabytes - 175*10^21.

For comparison, in 2018 this number was 33 zettabytes. At the same time, Big Data coming from the Internet of Things will progressively increase its share in the gross data array.

To get a clearer idea of the scale of these values, imagine that you are counting to a billion, adding one every second, or simply pressing a button once a second.

It will take you 32 years to get to a billion (10^9), 32 thsd. years (human civilization exists less) to get to a trillion (10^12). And to a quadrillion (10^15) - 32 mn. years (humanity as a species exists less), to a quintillion (10^18) - 32 bn. years. The universe is more than 2 times younger. Its age is about 13.8 bn. years. And we didn't even get to the sextillion - that is, the required 10^21.

As a result, technologies for data transmission, storage and processing will develop. The role of data centers and cloud services is growing. In the near future, at least 30% of all data will pass through the so-called clouds.

Data storage resources have naturally less traffic. According to expert estimates, by 2023 the gross volume of all world data warehouses will reach 11.7 zettabytes. However, IDC believes that only 1-2% of the data produced is stored for a long time.

It turns out that the vast majority of data disappears. But with the development of IT, new data storage tools are emerging that may allow you to use them in the future save absolutely all generated data arrays.

In addition to increasing the number and activity of devices that generate data, the number of people and organizations using these devices is also growing, and the range of their needs is expanding. People and devices are the engines of the data flow building process.

We Are Social, in its report on the state of the digital sphere Digital 2020, stated that at the beginning of this year, the number of Internet users exceeded 4.5 bn. people.
- 59% of the world's population.
5.2 bn. people use mobile phones
- 67% of the Earth's population.
There are now about 3.8 bn. active users of social networks - 49% of the global population. The average user spends 6 hours 43 minutes a day online. This is more than 100 days a year.

The digital world has actually consumed half of our lives. We communicate on social networks, watch movies and post videos, study, work, read books, buy clothes and groceries. If IT could meet the primary needs: food and water, recreation, procreation, we would be completely immersed in digital reality.

Some futurists believe that IT in the future will inevitably acquire such capabilities thanks to scientific and technological progress in bio- and genetic engineering, nanotechnology, etc. Most of the user traffic (53.3%) is on mobile phones, 44% on computers, 2.7 % for tablets. Moreover, there are several devices per person. According to IDC estimates, by 2025 the number of gigabytes per capita will increase by an average of 21% annually. And in the future, the growth rates will only accelerate. IDC experts believe that in 2025, the average Internet user will, on average, interact with data every 18 seconds, and the number of devices connected to the network per capita will grow to 15. Given the population growth rate (approximately + 1.1% per year), increased availability of funds communications, as well as the inclusion of new generations in the global information network, which by definition are technical users of a much higher level, the increase in the number of modern IT operators and the intensification of their activity will be constant trends until 2035, and most likely even after.

[9] *International agency We Are Social, specializing in social media research*

3 INDUSTRY TREND

Deepening research and development in the field of generation, processing, transmission and analysis of data logically associated with the increased volume of data and number of users IT.

Moore's law, which States that the density of transistors on an integrated circuit doubles every 1.5-2 years is coming to a close no, due to the fact that almos treached the physical limits limiting further reducing the size of transistors. 3 nm is the smallest step of microprocessors. But at Berkeley, a 1 nm transistor was created.

Soon, doubling the number of transistors on circuits it will become physically impossible.

At the same time, the growing volume of data and the need for their rapid processing make it necessary to further increase computing power. Handling data is one of the key elements of it. BigData produced by a huge number of devices and users is itself just a set of bits that need to be transmitted and processed to become complete information. Along with their generation, tools for transmitting, storing, and processing them are also being developed. First of all, these are quantum computers.
Data traffic is growing steadily and it needs more and more powerful tools to work with them.

Most recently, in may 2020, Australian scientists successfully tested a new technology that could bring the speed of data transmission over the Internet to 44.2 TB/s through a standard fiber with a single integrated chip.

The technology, called microcomb, will allow you to download almost instantly about 5 TB of files or 50 movies per second Ultra HD quality. In the long term, this technology will become publicly available.

4 INDUSTRY TREND

GROWING NUMBER OF CYBER ATTACKS AND CRIMES, IT-RELATED, AT THE INITIAL LEVEL, IS DRIVEN BY THE FIRST TWO INDUSTRY TRENDS.

Over the past 10 years, the frequency of cyber attacks has increased 2.8 times. In 2009, according to a University study Maryland (USA) cyber attacks occurred every 39 seconds. And in 2019, according to the calculations of international experts, Cybersecurity Ventures is already every 14 seconds.

In 2021, according to their forecasts, the frequency will increase to 11 seconds. Continuing this trend, by the 2030s, cyber attacks can be detected every second. Humanity as a whole and everyone individuals are increasingly dependent on new technologies.

Losses of the global economy from cybercrime for various reasons estimates range in the corridor from 3 to 6 trillion us dollars, and by 2022, according to the WEF forecasts, they can reach 8 trillion per year.

Cashless payments and online banking in everyday life, multibillion-dollar financial transactions on the global stock market, data in individual user PCs,

In the IT infrastructures of organizations, corporations, and States, including those of a defense nature, everything that is somehow directly or indirectly related to the storage and transmission of information becomes an object for cyber attacks, a means of extortion, blackmail or manipulation.

One of the most striking examples of hacker attacks on the financial system was the hacking of the NASDAQ in 2013, when the data of almost 160 mn. credit cards fell into the hands of hackers, and money was withdrawn from 800 thsd. accounts.

Modern hacker, gaining access to your devices and PD can radically change your life, turn you from a financially secure person to a bankrupt, from a respected member of society to a social outcast, from a law-abiding citizen to a criminal.

In 2015, The Impact Team hacked the popular social networking site Ashley Madison, which has an

audience of mostly married men and married women looking for an outside relationship.

Cybercriminals made the entire database of users of this resource publicly available, as a result of which marriages collapsed, families broke up, and some took their own lives. It should be noted that the hackers published this information only after the network administration refused to close the site.

Neither the man in the street, nor large companies, nor the state is immune from cybercrime. Any users and organizations, any devices, networks and servers, from home PCs to missile defense systems, can be subjected to DDos attacks, phishing, the introduction of malware and other types of cyber attacks. There is no doubt that with the progress of IT, cyber threats will only grow. The development of AI, VR, AR and hybrid realities, digitalization are creating new spaces and expanding the horizons of hacker activity, increasing the danger of cyber warfare and making the world community more and more vulnerable, and the problem of ensuring cyber security more and more important.

However, the socio-psychological aspect must also be taken into account.

The hacker movement in the world is gaining popularity, even a special term has appeared - hacktivism, which means the use of IT to promote the ideas of political freedom, freedom of

speech, information, protection of human rights, etc.

In this light, it is difficult to determine exactly what will be considered cybercrime in the future and what will not. At the same time, there may be a clear line between legal interpretation and public opinion.

The part of the hackers who declared the struggle for any ideals is becoming a kind of idol for today's youth. Many believe that hacking for good purposes is permissible, and the activities of organizations such as Anonymous (an international decentralized network of activists and hacktivists) are necessary.

One way or another, cybersecurity issues will be one of the most important elements of the future agenda. The specialties related to IT security in general are among the most demanded in the labor market of the IT sector.

[10] *Portal HackZone.ru: https:„hackzone.ru,news,view,id,5204*

The expansion of security, transparency and privacy requirements among ordinary users, businesses and the state is a logical consequence of increased cyber threats.

Their forms and scales change systematically, and their focus may shift from PC to mobile apps, from websites to messengers, and back again.

Information is becoming an increasingly valuable resource containing increasingly important personalor corporate data. As aresult, people, companies and governments are willing to invest more and more money in its protection and expect that this protection will be maximum and exhaustive, able to prevent any threat.

According to experts surveyed by EY[11], in the TOP 3 the most dangerous cyber threats for the private sector include phishing, malware, and cyber attacks aimed at disrupting activities.

The key risks associated with this are leakage of financial and client information, strategic plans, or, directly, loss of funds. For the state, the risks associated with cyber threats are also very high and diverse.

States will not stop at any means to ensure their cybersecurity

From the transportation authority and social security to financial infrastructure and national security.

So, in may 2019, real military force was used for the first time to prevent a cyber attack. The IDF air force carried out a targeted attack on a building in the city of Gaza, where the hacker attack was conducted.

Ordinary users can at any time face hacking of their social network account, bank account or email. It would seem that the threats are obvious, and ensuring the security and privacy of personal and corporate data is necessary by definition.

But it is rather difficult to form

[11] *EY is one of the largest audit and consulting companies in the world. https:,,www.ey.com, Publication, vwLUAssets,ey-global-information-security-survey-rus,they-global-information-security-survey-rus.pdf*
[12] *Tzahal - Israel Defense Forces*

a clear idea of how information will circulate in the distant future and whether data protection will be necessary at all, since polar currents have recently appeared in the issue of privacy and corporate information.

Most ordinary users, of course, are in favor of privacy, security of PD and devices. This position is strongly shared by the private sector and the state.

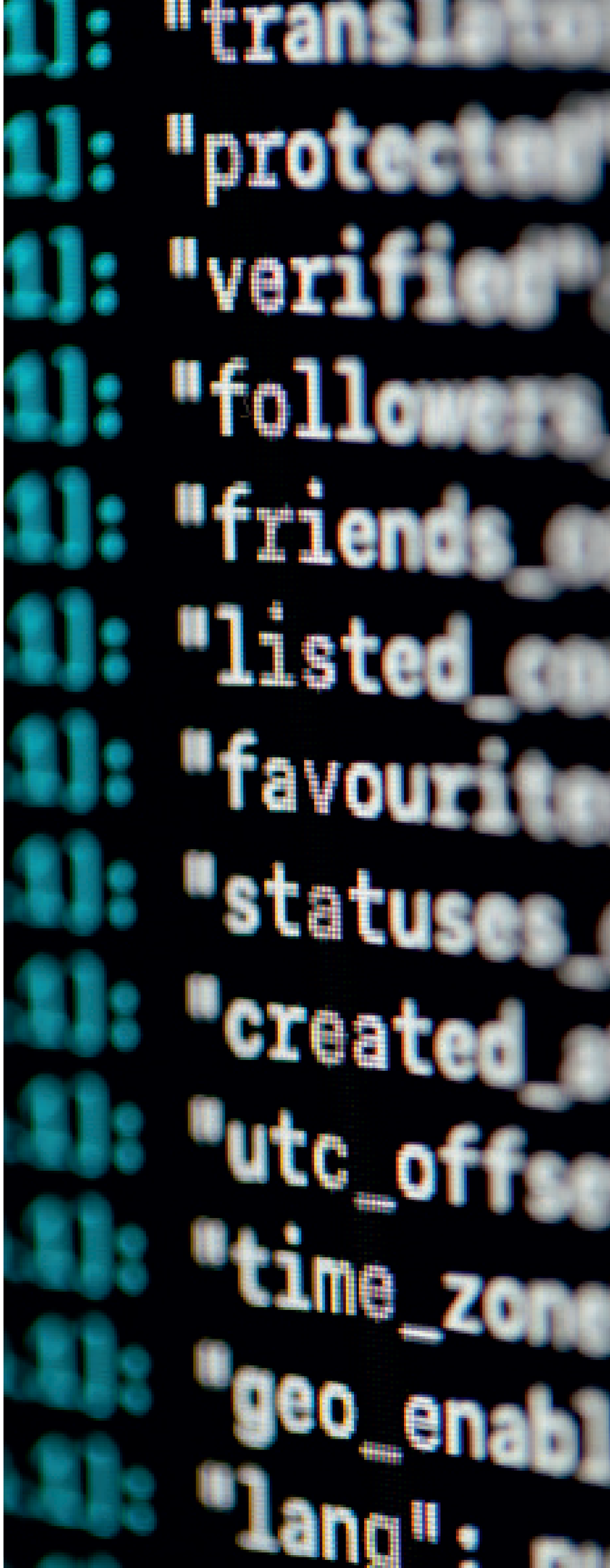
However, technological progress has led to the emergence of a category of people who advocate full the disclosure of the PD, the abolition of the secrecy of correspondence and the free circulation of information.

It is possible that in the future this will happen, and the concept of personal data and privacy will simply lose relevance, and all information generated in the world will be publicly available.

The most striking and tragic example of the struggle for freedom of information is the story of the American Internet activist, it visionary and talented programmer Aaron Schwartz, who was an ardent advocate of unlimited and free distribution of information.

On January 6, 2013, he was charged with illegal downloading academic publications from the database of the paid digital library JSTOR (an online aggregator of full-text scientific journals), which he was going to place in the public domain.

On a combination of charges,



including fraud, Schwartz faced up to 35 years in prison. By pleading guilty, he could have reduced the sentence to 6 months. But on January 11, 2013, the 26-year-old programmer was found hanged in his apartment.

Internet activists made a large number of statements, and on January 26 of the same year, the Anonymous movement even hacked the website of the US Commission on the execution of sentences, saying that this was done in retaliation for the death of Aaron Swartz.

The so-called dataists (followers of the concept of dataism, which stands for freedom of information, which in their understanding they promote the idea that everyone should share all information about themselves with everyone and not keep anything secret.

It would seem that this idea is absurd and impossible due to human nature. But it is worth remembering how communism in the 19th century from a little-known doctrine developed into a full-fledged global socio-political movement that became an alternative to capitalism and denied the right to private property, the possibility of developing dataism from an ordinary concept into a large-scale socio-information paradigm does not seem so unrealistic.

Although the ideological trend of dataism has emerged quite recently, and few people know about it, in practice it turns out that we are more and more we publish information about ourselves, whether it is arbitrary or not, in the public space. The current generation puts almost every actionin the network, shares their thoughts, emotions, experiences and plans. They gradually reject the very idea of personal information, progressively projecting more and more of their lives into the public field.

And the older generations also do not really think about protecting their PD. By downloading any application or registering on any site, we do not read the agreement on the provision of PD, but simply click «agree». We even stopped delving into what kind of information we open access to unauthorized people and programs.

AI and neural networks are increasingly being used to make decisions instead of humans, developing a crisis of confidence and creating a demand for ideas such as explainable AI and AI control.

According to the company's experts Gartner, this trend requires focusing on six key elements of trust:

- ethics,
- honesty,
- openness,
- responsibility,

- competence
- sequence.

ABOs such as the European Union General Data Protection Regulation (GDPR) are being adopted around the world, stimulating evolution and setting ground rules and restrictions for organizations engaged in research and development in the field of advanced intelligent technologies.

The person trusts and allows programs more and more. This is due to the opportunities they give us.

Having opened IT completely, we will be able to shift the enormous load that our socio-economic system used to bear on digital algorithms, and increase the comfort and safety of life.

For example, in his book «Homo Deus» Yu.V. Harari describes a hypothetical situation where Google, with access to our correspondence and queries in search engines, can identify the nascent influenza epidemic in London in a matter of minutes.

How?

It is enough for the program to track the words that city residents write in their messages, emails or type in the browser, and then compare them with a database of symptoms of certain diseases.

If Londoners on a typical day mention on average in their correspondence such keywords as «headache», «runny nose», «nausea», «chills» 100 thsd. times, and today there was a surge of up to 300 thsd. times, it means the outbreak of an epidemic. The only condition is that you need access to the users' personal data, including messengers, social networks, email, SMS messages, etc.

It would take weeks for a traditional healthcare system. Record the trend of an increase in morbidity, track contact persons, identify foci, etc.

The program, having access to our personal data, can do this all the time, continuously and with a high degree of efficiency.

> ***In the long run, humanity may well choose the rejection of privacy in favor of security and, moreover, survival.***

Against the backdrop of the COVID-19 crisis, such an opportunity does not seem absurd and unacceptable.

On the other hand, voices in favor of privacy and confidentiality of correspondence are also strong.

Consequently, it is difficult to accurately predict whether personal data protection and privacy will be top priorities after 2035.

Nevertheless, in the future, the next 10-15 years, the need to ensure the privacy and security of personal data and personal life, most likely, will be one of the most powerful incentives for the development of IT.

6 INDUSTRY TREND

The development of cyber defense tools and methods will be one of the most relevant scientific and technical trends in the it sphere now and in the coming years.

In response to the growing threats in the digital environment and the tightening of requirements for the security of personal data, new cyber protection tools are being developed.

Modern and future-proof cyber security methods such as hardware, biometric and passwordless authentication are replacing the traditional password system.

Logins and passwords are an easy target for modern hackers, which is why IT companies have entered the trajectory of introducing new means of ensuring the safety and privacy of data.

At the same time, new cyber defense tools also have weaknesses. For example, at the end of 2019 years of information security specialists from Tencent Security showed, how to unlock a smartphone protected by the owner's fingerprint in 20 minutes.

At the same time, new cyber defense tools also have weaknesses. For example, at the end of 2019, information security specialists from Tencent Security showed how in 20 minutes you can unlock a smartphone protected by the owner's fingerprint. After photographing this unique biometric parameter left on a glass of water and processing it in a special mobile application, they printed physical copies of the fingerprints on a device worth only $ 140 and opened the volunteer's smartphone.

It turns out that it is impossible to completely exclude the possibility of external penetration, you can only minimize its risk, and the responsibility largely lies with the users themselves.

The human factor also plays a role in this seemingly highly specific area.

Therefore, increasing the digital literacy of users is fundamental to maintaining cybersecurity.

IIT developers are constantly looking for vulnerabilities in modern technologies in order to fix

them proactively.

Defects are found in operating systems, hardware, hardware and software, etc. Every year, new HSSs are released on the market to identify and respond to threats. In the IT sector itself, changes can be traced in the field of information security associated with the modernization of the infrastructure and software and hardware base.

IT companies are consistently moving to cloud computing, which is gradually deactivating traditional cybersecurity tools.

Gartner notes that IT organizations now need to invest in employees, processes, and tools to manage this rapidly changing environment, for example, secure cloud access brokers.

Quantum computing can completely destroy the established paradigm of working with data, and ultra-modern.

For example, t***o hack using the RSA-1024 key cipher, which is currently used in many applications, aquantum computer will take less than a day***, whereas today's high-power supercomputers will take hundreds of years to complete.

In the future, after overcoming physical and engineering difficulties, they can easily overcome the most reliable means of protection. cryptographic

Optimization of quantum algorithms can further reduce this time. The invention of full-fledged high-power quantum computers will radically change approaches to cryptography.

7 INDUSTRY TREND

VIRTUALIZATION OF LIFE ACTIVITY. THE WORLD IS GRADUALLY MOVING INTO A NEW DIGITAL REALITY.

It is taking over more and more of our lives. We interact with the digital world almost constantly, with small interruptions.

The logical consequence of virtualization will be a complete immersion in the digital environment. Virtual counterparts of factories already allow you to manage large production facilities using digital models. In the future, this will scale to cities and territories, transport highways, and entire regions of the world.

Natural extension it can be the creation of digital clones of each person, which will first take over all types of manipulations of people in the digital space, and then become our full-fledged virtual profile.

In early 2020, a subsidiary of Samsung introduced Project Neon – so-called artificial people who are actually digital avatars. Of course, the technology is still raw, but its potential is combined with universal AI or hybrid intelligence is virtually unlimited and can lead to a revolution in the field of human digitalization.

Virtualization of life activity creates the risk of minimizing real contacts between people witheach other.

Remote work, remoteshopping, virtual travel, even the virtualization of tactile contacts and sensations, which, in practice, are just algorithms in the brain, can be synthesized.

A digital avatar, thanks to neurocomputer interfaces and advanced technologies in bioengineering, can become a second «Me» for every person.

The trend generates a lot of contradictions in society. The younger generation is happy to meet it, while people older people perceive it skeptically, and sometimes as a threat. Virtual-synthetic relationships can replace the traditional social and everyday contours of human life and radically change the picture of the world, making its streets deserted.

8 INDUSTRY TREND

COMPLEXITY OF IT INFRASTRUCTURES IN LARGE CITIES

This trend is the logical conclusion of digitalization at the current stage.

Taking into account the pace and scale of IT penetration into all spheres of the economy, medium and large businesses a priori increase their digital potential. This is due to two powerful factors: unconditional economic benefits, and the need to ensure information security.

Gartner analysts predict that by ***2023, 60% of large companies will be based on their own digital ecosystem***, supported by in-house programmers and application developers who will support their activities both in the format of interaction with customers and internal and external business processes. Half of these businesses will generate at least 20% of their revenue through a proprietary digital ecosystem platform.

In order to keep up with the rest of the world, companies in all sectors of the economy need to develop long-term plans for digital transformation, involving qualified digitalization specialists in their creation and implementation. According to IDC forecasts, 75% of all IT costs will be associated with the development of platforms for product promotion.

The success of enterprises will depend on having an extensive IT infrastructure that converges a complex ecosystem. These enterprises and organizations use cloud technologies, AI and IoT, Agile and DevOps practices, digital innovation platforms and communities, and integrated data management and monetization.

90% of all enterprises in all sectors of the economy will switch to their own digital technologies IT environment for further development тin the digital economy.

Given the trend of intensive virtualization of life, the evolution of any industry company into a complex IT organization is a requirement of time. In other words, in the future any company will be primarily an IT company, and only after that it will be a manufacturer of products or services.

Along with these industry trends, the expert community also proposed a number of trends related to human change during the foresight sessions. It is becoming

one of the means to accelerate its further historical evolution.

Civilization throughout its history has sought to overcome 3 main problems: famine, pestilence and war. These problems are now largely resolved, but they are being replaced by new ones: over population, social inequality, environmental crisis and the depletion of natural resources. At the same time, the degree of impact of these problems in the territorial the aspect is significantly differentiated. In underdeveloped countries, it is more acute, and in developed countries it is less relevant. Nevertheless, minds from all over the world are struggling to solve them.

Now all countries of the world see improving the quality of people's lives as their main task, which at its ideological and theoretical level implies the elimination of the above problems. At the same time, developing and developed countries are characterized by a profound transformation of the consumer consciousness of the population. This also leads to the correction of the course to improve the quality of life, taking into account modern requirements.

It is one of the key requests and, at the same time, a means of meeting them, depending on the point of view.

9 *INDUSTRY TREND*

DEMOCRATIZATION AND THE PERSONALIZATION OF IT

An intuitive, visual approach to application development, simplifying this process as a work task based on the use of templates and ready-made modules, will allow developers of all skill levels to create web and mobile applications with minimal programming experience.

This will lead to the fact that in the future, almost everyone who knows the basics of programming will be able to create their own IT products. In the long term, this will provoke an explosive increase in competition.

As a result, the threshold for entry into the industry in its low-skilled segment is reduced.

Of course, in order to create complex products, appropriate education and experience are required.

However, for the development of non-labor-intensive products with the development of visual programming based on the design of programs, rather than writing code, serious in-depth skills will not be required in the future.

Democratizing technology means making it easier to access technical or business knowledge without extensive and in most cases expensive training.

The process focuses on four key areas:

- application development;
- data and analytics;
- design;
- knowledge.

The democratization of technology, often referred to as "citizen access," is driving an increase in the number of citizen programmers, citizen developers, designers, and more.

For example, democratization would allow developers to create data models without the skills of a data scientist. Instead, they will rely on AI-driven development to generate source code and automate the testing process.

IT personalization is also an important trend. Any product is now not just thrown out to the market, to the masses, but is carefully thought out for relevance to current needs.

Further interaction with consumers takes place on the basis of constant active personal communication, receiving feedback, monitoring user experience, which in the future will develop into the so-called multi-experience.

Gartner points out that multi-experience replaces people who know technology with people who are literate and tech-savvy. In this trend, the traditional idea of a computer develops from a single point of interaction and includes multi-touch and multi-channel interfaces, such as wearable and advanced computer sensors.

Going forward, this trend will become what is called the ambient experience, but currently multi-experience focuses on immersive experiences using augmented reality (AR), virtual (VR), mixed reality, multichannel human-machine interfaces and perception technologies.

The combination of these technologies can be used for simple AR overlay or for full immersion in virtual reality.

10 INDUSTRY TREND

HUMAN CYBORGIZATION

This trend involves focusing the attention of technological progress on improving the cognitive and physical sensations of a person.

Physical improvement allows you to modify the innate physical capabilities of a person by introducing or placing technology inside or on the body (endo- and exogenous technologies). For example, the automotive or mining industry uses wearable products to improve worker safety. In other industries, such as retail and travel, wearable products are used to increase productivity.

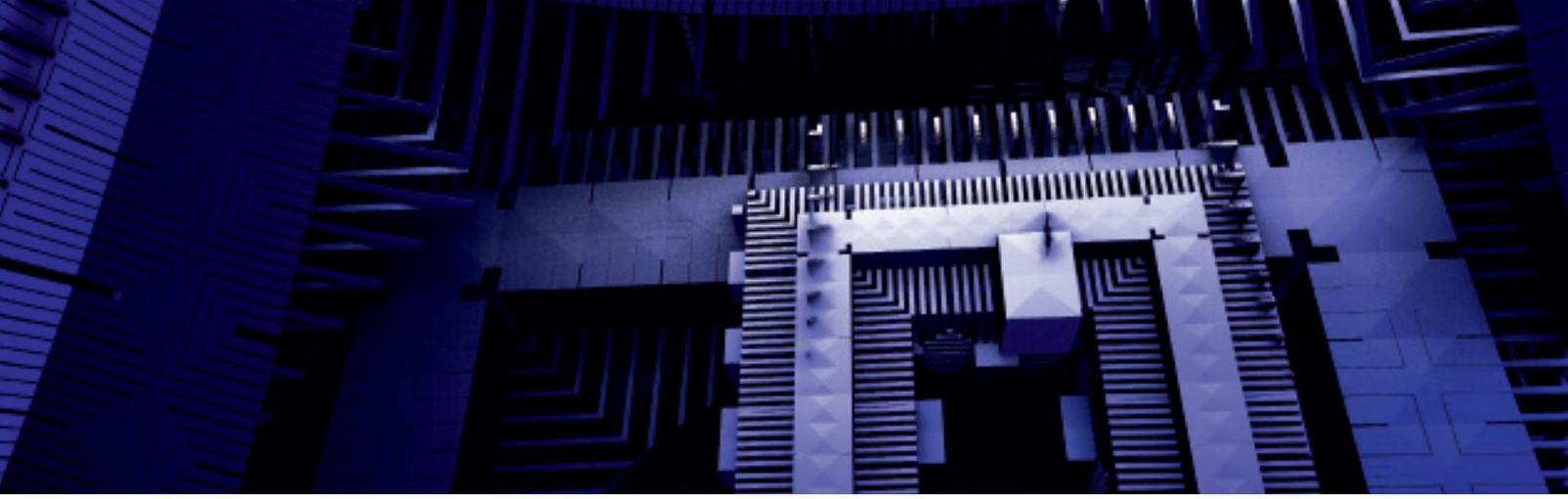
Modifications of this kind fall into four main categories: sensory augmentation (hearing, vision, perception), enlargement of the epididymis and biological function (exoskeletons, prosthetics), brain enhancement (implants for treating seizures), and genetic enhancement (somatic gene and cell therapy). Cognitive enhancement enhances a person's ability to think and make optimal decisions quickly, for example, by using information and applications to improve learning or new experiences.

Cognitive augmentation also includes some technologies in the brain augmentation category as they are physical implants that deal with cognitive thinking.

In addition, human cyborgization implies its hybridization with AI through neurocomputer interfaces, genetic and bioengineering aimed at eliminating deficiencies or increasing capabilities. By some estimates, by 2100, about 90% of the human body will be robotic.

In the long term, the development of the above trends can lead to the so-called digital immortality, when human consciousness can be immersed in a digital environment (the so-called consciousness upload), and bionic robotic twins or synthetic bodies will perform physical functions.

It should be noted that human improvement has a number of cultural and ethical implications. For example, using CRISPR (human genome editing) technologies to augment genes has important ethical nuances. Therefore, the development of IT, bio- and neurotechnologies in this direction should be carried out under strict supervision.



6.1.1.
TECHNOLOGIES OF THE FUTURE: ARTIFICIAL INTELLIGENCE, INTERNET OF THINGS, DISTRIBUTED LEDGERS AND QUANTUM COMPUTER

Technological progress is permanent and ubiquitous. Of course, its main centers are developed countries. But developing countries are also actively trying to increase their technological power, because they understand that the risk of remaining on the periphery of information technology development means that this country occupies an outsider position in the world economy

Technology is advancing at an incredible rate today. The pace will become even faster in the future.

IT advances such as virtual reality or AI seemed to be fantastical relatively recently.

In the future, STP in the next 10-15 years will be concentrated around a number of key technologies that will have the greatest impact on the development of IT.

ARTIFICIAL INTELLIGENCE

The progress in machine learning is so great that leading tech giants such as IBM, Google, Amazon and others are increasingly reporting on new breakthroughs in the field of creating not just AI, but artificial intelligence, which, in the near future, will be able to perform most of the functions. human intelligence that were previously considered inaccessible to machines. Many experts predict with a stick, but now this is modern reality. In the future, NTP in the next 10-15 years will be concentrated around a number of key technologies that will have the greatest impact on the development of IT. that by 2040 the so-called universal AI, capable of self-learning, will de-actualize the profession of programmers.

For example, research scientists at Oak Ridge National Laboratory, affiliated to the US Department of Energy, came to the conclusion back in 2017 that people would not write code for the foreseeable future, but would delegate it to AI algorithms.

EXAMPLES

- A prime example is the current derivatives of IBM's Watson AI supercomputer, one of which won the Jeopardy back in 2011. They are increasingly used in medicine, marketing, agriculture, education, etc.
- Watson's technical successors, such as Watson for Cyber Security, Watson IoT, Watson Analytics, Watson Data Catalog or Data Refinery, are now helping to automate many of the processes associated with managing information security centers, integrating devices and building IoT applications, predictive analytics, simplifying implementation AI, etc.
- Watson-based AI systems are used to train IT professionals. For example, in 2016 at the Georgia Institute of Technology (USA), teacher Jill Watson helped students develop programs for almost six months, answered questions, and consulted. But Jill is a Watson-based robot that no student has ever figured out.
- R&D in machine learning, deep learning, artificial neural networks, machine vision and universal AI is gaining momentum every year. In November 2019, Intel Corporation presented the Intel Nervana Neural Network Processors (NNP) accelerators for training neural networks (NNP-T1000) and for building inference (NNP-I1000). The main consumer of these products is cloud technology developers and data centers.

Such technologies are the operational thinking engine of digitalization and automation processes.

In the near future, a universal AI will be able to perform creative tasks, for example, compose music or paint pictures.

What will remain for a person in this case remains a question facing sociologists, economists and futurologists.

What will remain for a person in this case remains a question facing sociologists, economists and futurologists. In addition, the ethical problem is being updated. After all, understand the principles of decision-making. AI is often impossible, since its models can work as «black boxes».

The key focus of it development in the field of machine learning is cybersecurity and AI protection.

The development of modern technologies provokes significant risks and vulnerabilities in new potential attack targets.

In this regard, it is critical to ensure the security of technologies and processes based on AI. However, it is important for security agencies not only to ensure security for the technology itself, but also to ensure its security when assessing its impact on the outside world.

AI can become a threat if the protocols governing its expansion space arenot properly supported.

AI security includes three key aspects:

- Protecting AI-based systemsconsists of protecting the data used for training AI, training pipelines and machine learning models.
- Using theAI for enhanced security: using machine learning to understand patterns, detect attacks, and automate cybersecurity processes (response, mitigation, and remediation).
- Anticipate malicious use of AI by attackers by detecting attacks and protecting against them. In the development of AI, quantum computers will be actively used, ensuring the security of which will be themain priority.

Thus, specialists involved in the development and management of AI, neural networks and their security, and also, AI consultants on complex logical algorithms that are closely related to moral and ethical aspects will be one of the most popular IT specialists of the future.

QUANTUM COMPUTING AND QUANTUM CRYPTOGRAPHY

The gradual exhaustion of the potential of Moore's law necessitates the search for new ways of storing and operating data. The most promising in this regard looks like quantum computing - a fundamentally new technology, R&D in which almost all tech giants are engaged, including Google, Dell, Microsoft, etc., defense structures, research laboratories of technological institutes, etc.

Quantum computers are transforming the very approach to computing.

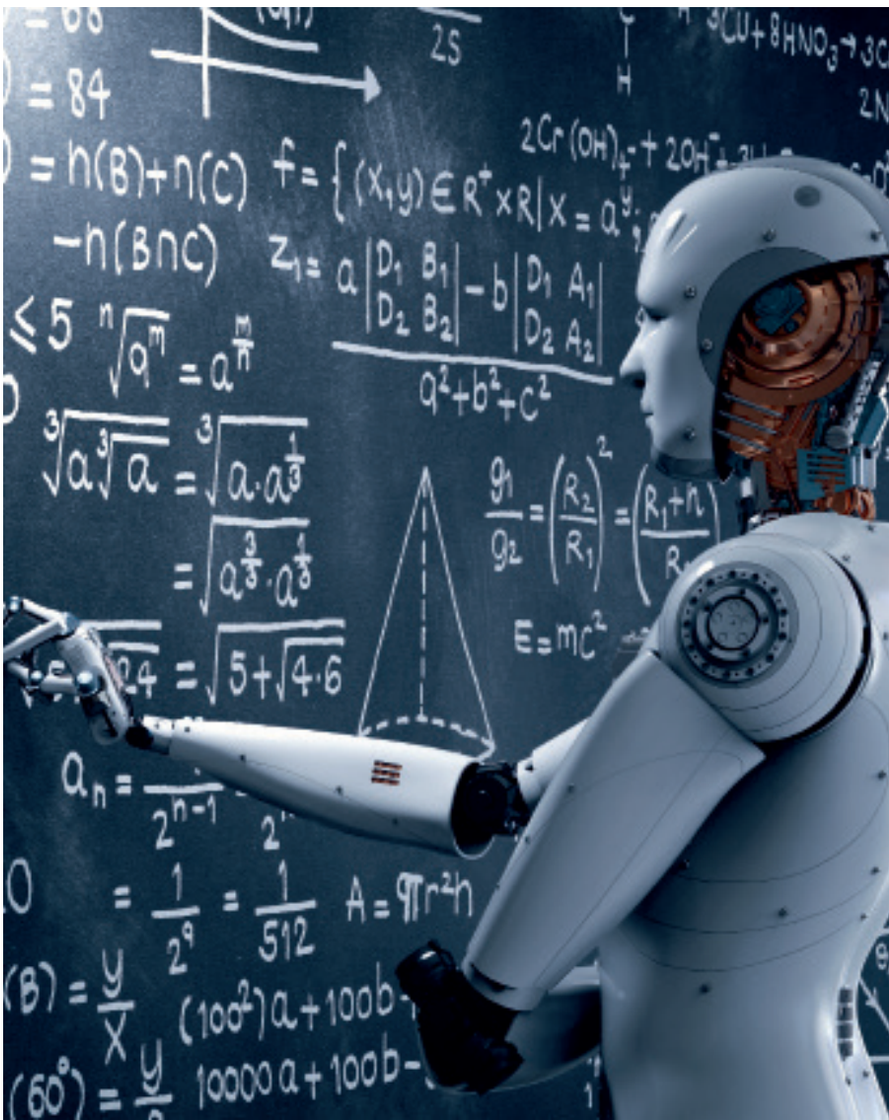
Instead of exhaustive transistors operating on binary values - zeros and ones, called bits, quantum mechanics comes, which uses quantum bits (qubits).

Their key advantage is that their values can constitute a so-called quantum superposition of possible states. As a consequence, only the probability with which one or another value can be obtained can be known in advance. In turn, quantum entanglement (or quantum entanglement) implies the ability to obtain data on the state of all qubits associated with one primary source.

The capabilities of quantum computers are incomparable with traditional computing devices and transmission networks, for example, fiber optic. Quantum networks or the quantum Internet can become the safest means of transferring data, since their encryption algorithms will be built on the laws of quantum mechanics and are not available for ordinary supercomputers.

Consequently, tech giants will begin to implement these technologies in their IT infrastructure to ensure, on the one hand, the speed of data transfer, and on the other hand, the reliability of their storage.

In the future, this trend will be typical for all large IT companies.



EXAMPLES

- Certain advances have already been made in the field of quantum computing. At the end of 2019, Google announced the creation of the most powerful quantum computer at the moment, capable of performing calculations in 3 minutes 20 seconds, which would have taken the IBM Summit supercomputer over 10 thsd. years. However, later, various authors published a number of theoretical refutations of this information, based on the assertion that Google was not using pure quantum mechanics.
- In March 2020, aerospace industrial equipment manufacturer Honeywell International announced that it was preparing to build the world's most powerful quantum computing system. According to them, it will have a performance of 64 qubits. By comparison, the fastest quantum computer from IBM to date has a capacity of 32 qubits.
- The European Quantum Internet Alliance for the R&D of the quantum Internet, together with the Delft University of Technology (Netherlands), plans to launch the network in four cities in the country in 2020. If they succeed, this network will be the first in history to allow data qubits to be transferred between two network nodes.
- Research in the field of quantum computing is actively supported by the US government, which, under the National Quantum Initiative Act, generously funds a number of highly specialized laboratories working on quantum computing technologies.

Of course, while these prototypes are limited in their potential due to a number of practical problems. However, there are currently physical and engineering obstacles to the development of quantum computing, for example, the problem of creating and maintaining the necessary environments that meet the qubit safety requirements will inevitably be overcome in the medium term.

After that, the IT world will change radically.

This will particularly affect the field of quantum cryptography. With the development of quantum computing, traditional encryption will become completelyineffective, since the newtechnology performs calculations thousands of times faster and can decrypt keys in minutes or even seconds. As a result, quantum cryptography will be actively developed, which solves one of the fundamental the problem of cryptography is the distribution of keys over open communication channels based on the laws of quantum mechanics.

Quantum cryptography will provide permanent and automated key change when transferring data in a one-time «cipher-pad» mode.

Today, it is the only reliable encryption tool that, unlike the traditional one based onmathematics, relies on physics, in particular, the Heisenberg uncertainty principle. In practice, it professionals will have to create cryptographic systems that even quantum computers cannot crack. Research and development in this area is already actively underway.

EXAMPLES

- In 2017, the Chinese military launched an «unbreakable» communications network in Jinan City, based on quantum cryptography.
- Their networks with quantum encryption are being created in Russia, the USA and Europe. For example, Rostelecom presented a prototype of a quantum network in St. Petersburg in 2019.
- Cryptologists are actively working to improve the efficiency of quantum cryptography. In April 2020, developers from the NTI Competence Center «Quantum Communications» presented a way to increase the level of security of quantum cryptography. By means of a special verification algorithm, extraneous «noises» that can affect the process of functioning of the random number generator are filtered. As a result, it is almost impossible to influence encryption from the outside.

As we can see, in the future, specialists who know quantum computing and quantum cryptology – two key components of working with data and protecting it in the 2030s-will become extremely popular personnel in the IT market.

INTERNET OF THINGS AND PERIPHERAL COMPUTING

IoT is called the basic infrastructure element of the fourth industrial revolution. IDC defines it as a network of networks with uniquely identifiable endpoints that communicate bi-directionally with one another over IP protocols and usually without human intervention.

Gartner as a network of physical objects that have built-in technologies that allow them to interact with the external environment, transmit information about their state and receive data from the outside.

The Internet of Things is expanding from year to year.

The number of connected smart sensors and «smart» devices in 2015 was 15.4 bn., in 2017 - 27 bn., in 2019 about 35 bn. devices.'.

According to the most conservative estimates , the network will increase to 75.5 billion by 2025. devices, and by 2030 to-125 billion.

WEF founder Klaus Schwab believes that this will increase five fold the use of technology in all aspects of life, connect the elements of the global economy in new ways and, possibly, start an economy in which only machines are involved.

The potential for IoT applications is almost unlimited.

Now it is used rather narrowly in industry and remote control of large objects, but in the future it will become the foundation for the spread of universal AI, neuronet and new digital reality.

The key task of the Internet of Things is the organization of constant communication and interaction of sensors and data processing devices to optimize decision-making and management of intelligent technical infrastructure, for example, «smart» houses, mines, transport, factories, etc.

The integration of IoT and technologies such as cloud computing, as well as AI and quantum networks, further expands the horizons of opportunity.

The so-called universal IoT, which is expected to appear by 2030, will become the basis of the global digital device environment - a new field of activity for IT companies.

The combination of IoT and edge computing will further enhance the role of intelligent cyber-physical systems.

Peripheral computing assumes the transfer of computing load from data centers to the periphery, closer to the devices that generate data.

As a result, the collection, processing and analysis of primary data do not take place in centralized nodes (data centers), but directly where they are created.

In fact, it is an intermediary link between data centers and sensors, in which the main computing resources are located. As a result, the work of cloud services is optimized, the response time when making decisions is reduced, security is increased, etc.

According to the forecasts of the Linux Foundation, by 2025 peripheral computing will become more important than cloud ones and will become the basis for the formation of a global cyber-physical digital infrastructure of the universal IoT.

In practice, it will be a fully automated matrix of constant, continuous processes of data and metadata acquisition, analysis, optimization and management. For the IT sector, this means the possibility of the emergence of universal models for installing containerized applications supported in a wide variety of

industries, universal applications, consoles, remote control interfaces, a total transition of the entire economy to a digital engine that requires constant IT support.

Development and maintenance of software for the Internet of Things will become one of the main activities of IT companies. However, already now this process is fraught with a number of technical difficulties due to its significant difference from the development of conventional mobile or web applications.

First of all, the programming of sensors and IoT networks implies the simultaneous programming of many devices, which, moreover, are constantly functioning, which means that interfering with the software is fraught with failures.

In addition, devices on the network are heterogeneous and diverse, many have different interfaces and supported input modes, which complicates the programming process, they are often physically difficult to access, dynamic, which requires the use of special techniques for the so-called swarms of devices. Moreover, of course, the main problem is ensuring cybersecurity.

Considering that more and more will depend on the IoT, from the management of small enterprises to state energy, transport, logistics and utility infrastructures, etc., the risk of external influence becomes key and its prevention or prompt mitigation will become the most important component of the IoT specialists of the future.

IT companies will have to create interoperable IoT and peripheral computing software development environments and change the development and deployment paradigm so that it simultaneously addresses many different dynamic problems and automates, for example, adopting DevOps.

EXAMPLES

- Currently, developments in the field of creating such environments are underway. For example, in May 2019, Nvidia presented its own AI platform for peripheral computing in the IoT structure - Nvidia EGX, which can process data in real time without the participation of data centers.

Integration of peripheral computing architectures will also require fine design, installation, and customization. In general, deploying large-scale cyber-physical infrastructures will require the concerted efforts of a range of IT professionals in the fields of IoT, peripheral computing, AI, distributed ledgers, cryptography, etc.

DISTRIBUTED REGISTRIES, THE BLOCKCHAIN AND CRYPTOCURRENCY

Distributed ledger technologies, in particular blockchain, can radically change many aspects of the life of modern society and the global economy. The trust architecture built within them opens up new possibilities for creating and exchanging unique digital records without centralized trusted parties.

Distributed ledgers and blockchain in particular help control the ability to accurately replicate digital objects and broadcast them without significant overhead to many users at the same time.

Blockchain makes it possible to produce and transmit reliably unique digital objects without the risk of creating copies or duplicating shipments.

These technologies help ensure data transparency, verification and immutability.

The ability to conduct transactions without human intervention is one of the key characteristics of distributed ledgers. Their inclusiveness, that is, the ability to participate in the chains of any user with the necessary minimum software, storage space and access to the network, opens up a wide range of users to enter the market as producers, consumers, shareholders and beneficiaries of any resources that can be monitored and sold in digital form.

Blockchain minimizes the risks of reward interception, hidden costs associated with centralized intermediaries.

Today, the area most widely used by blockchain is cryptocurrency transactions. However, the potential of the distributed ledger ecosystem is much more extensive.

Together with AI and IoT, it is capable of completely reorganizing the financial world, reconstructing the field of trade and logistics, and thanks to identity management, it can be used in the public sector, energy, law, etc.

The role of regulatory institutions is important, primarily the state, which must provide the necessary flexible regulatory framework for the use of blockchain on a large scale and in socially significant sectors.

For IT itself, distributed ledgers will become one of the most cost-effective vectors of activity, as the architecture of trust they create will be methodically popularized, which will lead to a sharp increase in interest from the corporate sector. Decentralization of the digital ecosystem is an important stage in its evolution.

Now all tech giants are methodically increasing R & D in this direction. This type of service will become very relevant in the future and IT companies that can provide them willbe at the top of the market.
The deployment of the blockchain infrastructure will require

EXAMPLES

- In 2018, IBM announced the implementation of more than 400 blockchain projects in the logistics and public sector, healthcare, retail and financial services, etc.
- full-fledged environments are being actively developed that allow users to build their own distributed ressters, in particular, blockchain networks. For example, the IBM Blockchain platform– this is a public cloud service that you can use to create such structures. A similar service is provided by Microsoft
- Azure Blockchain as a Service, which has already been developed by hundreds of developers blockchain solutions for various industries.

the IT sector to train multi-profile specialists, since its implementation in any industry is associated with many risks and unforeseen consequences, as well as the complexity of installation, taking into account the specifics of a particular industry, limited scalability and compatibility.

However, when technical difficulties are overcome, the construction of integrated blockchain networks in various industries will allow the IT sector to enter a new development trajectory associated with the decentralization of cyber-physical ecosystems.

NEW VR, AR, AND MR TECHNOLOGIES

Virtual reality is firmly established in our lives. There are already virtual fitting rooms, virtual tours, virtual rides and so on.

However, the potential of reality-changing technologies is still being used rather narrowly. The progress of immersive technologies is closely linked to the development of PAC, because the bigger it is the more detailed the simulation is, the more computing power is required.

Quantum computing, distributed registries, and serial computing can give a significant boost to the development of this area, which can become the computing base for creating a full-fledged global

virtual world.

In the future, all our life activities will be digitized and transferred to virtual environments, and neurocomputer interface technologies that can simulate external tactile sensations and even internal feelings, such as taste, smell, etc., by affecting the necessary areas of the brain, will allow a person to fully live in a new environment virtual reality.

Traditional VR (virtual reality) – this immerses users in a virtual environment using certain interfaces, like in video games.

More sophisticated AR (augmented reality) – projectsvirtual objects or even environments onto our reality. For example, you can wear a virtual costume for fitting without leaving your home. MR (mixed reality) – creates hybrids of real and virtual reality, in which a person can literally immerse their body in a new environment using special multi-profile wearable devices (sensors, tactile contacts, virtual headsets, controllers, controllers, etc.). noise Reduction and the presence of empty spaces create an almost complete effect of presence insuch spaces, so they are often used for training soldiers, firefighters, doctors, and other specializations.

EXAMPLES

- The Ford design center, located in Cologne, has a specially equipped Studio where design engineers can fully evaluate the car without having a physical prototype.
- Augmented Intelligence company has developed a technology called «Digital Twin». The results of various studies are combined into a single virtual model of the human body – its digital twin. Further, this model can be used to simulate various impacts, in order to conduct this impact in an optimal way.
- National Geografic has opened an open-air AR planetarium in Quebec sky. Augmented reality is super imposed directly on the night sky using the Aryzon AR viewer device with a smartphone inserted.
- Airbus uses mixed reality in the production of the A350 XWB and A380 to help with fuselage Assembly; they claim that after the introduction of this technology, the time required to check how 80,000 connecting brackets are installed has been reduced from three weeks to three days.
- Microsoft's HoloTour app for Hololens glasses lets you travel without leaving your home. It has a built-in personal guide by name Melissa, who will talk about what the app user sees
- The US Department of defense actively uses reality-altering technologies to train and train its soldiers by simulating combat in various environments. At the same time, the risks of information security, unauthorized intrusion, and external scenario correction are carefully monitored by the Pentagon. The reality is that there are certain risks in how the virtual environment unfolds. Some security issues are related to features that allow virtual machine owners to move users between different virtual worlds, upload your own content, and perform complex interactions - Douglas Maxwell, Manager of science and technology at the USAF training and simulation Center.
- In this regard, the Pentagon is working on creating its own proprietary virtual environment with a high level of protection.

[13] *Popular science site HI-news: https:„hi-news.ru,technology,realnye-riski-virtualnoj-realnosti.html*

NEURALIMPLANTS, BRAIN-COMPUTER INTERFACES AND EXOCORTEX`

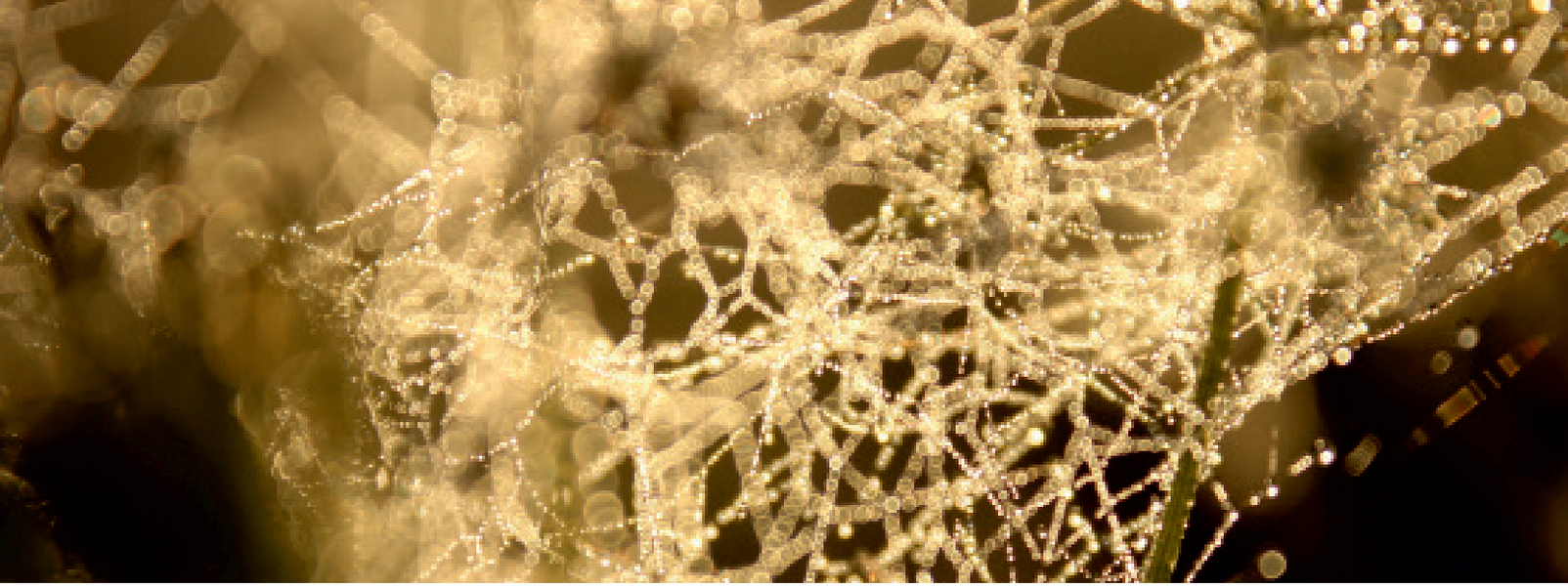
IT is closely related to the development of genetic and bioengineering, which rely on big data and huge computing power. Intervention in the human genome or restructuring of the body using bionic prostheses, exoskeletons, wearable sensors, etc. requires the permanent interaction of many technologies from various fields, the convergence of which is based on it

Cyborgization of a person at the level of cognitive improvements is based on technologies to increase the efficiency of intelligence. Earlier and now research in this area is mainly focused on the treatment of severe neurodegenerative diseases, such as Parkinson's disease. However, in the future, humanity will take a step forward and use the opportunities provided by such technologies to improve the standard capabilities of healthy people. For example, in order to increase the efficiency of the brain by 10 times or to enhance any sensations. Neural modulations can replace drugs and painkillers. They are harmless and non-addictive.

Neural implants and brain-computer interfaces they are heterogeneous devices implanted in the human brain and perform a certain set of functions.

The first ones are mainly used for monitoring the human condition, permanent assessment of the work of certain areas of the brain, and so on. The latter connect humans and computers and allow us to hybridize our intelligence, combining its capabilities with the potential of AI.

The next step will be the development of the so-called exocortex - a theoretical development that allows to combine and synchronize human and artificial intelligence in some biological or robotic physical medium. Of course, this idea can only be realized in the distant future.



EXAMPLES

- Founded by Elon Musk in 2016, Neuralink is engaged in research and development in the field of invasive neurocomputer interfaces. At the end of August 2020, Musk presented the N2 chip. More precisely, two pigs, in whose brains it was implanted[14].

As we can see, the technological basis for innovation, digitalization and automation in the IT sector is very extensive.

Of course, this does not include some minor technological advances, for example, new developments in the field of data storage, which are mainly related to hardware, because the expert community does not believe that physical development will be a priority in our IT sector *(see the section «A look into the future of IT in Kazakhstan: expert assessments).*

If Kazakhstan's IT companies learn to quickly adopt new technical trends, they will be able to deepen their immersion in the field of universalization AI, scaling and integration of IoT, PV, distributed registries, and in the future actively implement quantum networks, will train the necessary range of specialists with competencies in time in the future, Kazakhstan's IT sector may well become at least a regional leader in its industry.

[14] *Portal about technologies ITC.ua: https:„itc.ua,news,neuralink-ilona-maska-prodemonstrirovala-novuyu-versiyu-nejrointerfejsa-mozg-kompyuter-v-dejstvii-na-svinyah,*

7. LOOKING INTO THE FUTURE OF THE IT SECTOR OF KAZAKHSTAN: EXPERT ASSESSMENTS

LOOKING INTO THE FUTURE OF THE IT SECTOR OF KAZAKHSTAN: EXPERT ASSESSMENTS

What is the future of Kazakhstan's IT sector in the next 10-15 years? From the previous sections, it becomes clear that the pace of development of the IT industry is so high that not every company and not every state can keep up with them.

Taking into account the cross-cutting nature of this sphere, which technologies are used in all economic sectors, public administration and in everyday life, it is very difficult to develop a detailed idea of what it will be like in Kazakhstan at the turn of the 2030s.

Nevertheless, we tried to look at this future through the prism of the opinions of industry experts: professional IT specialists, managers and owners of IT enterprises, private IT schools, teachers of IT disciplines at Universities and colleges, representatives of industry associations, science and interested government bodies.

As a result, we have identified 12 key generalized expert forecasts about various characteristics and the future Kazakhstan's IT sector, grouped around deterministic assessments of current and future industry trends. trends, challenges, risks and opportunities.

1 FORECAST

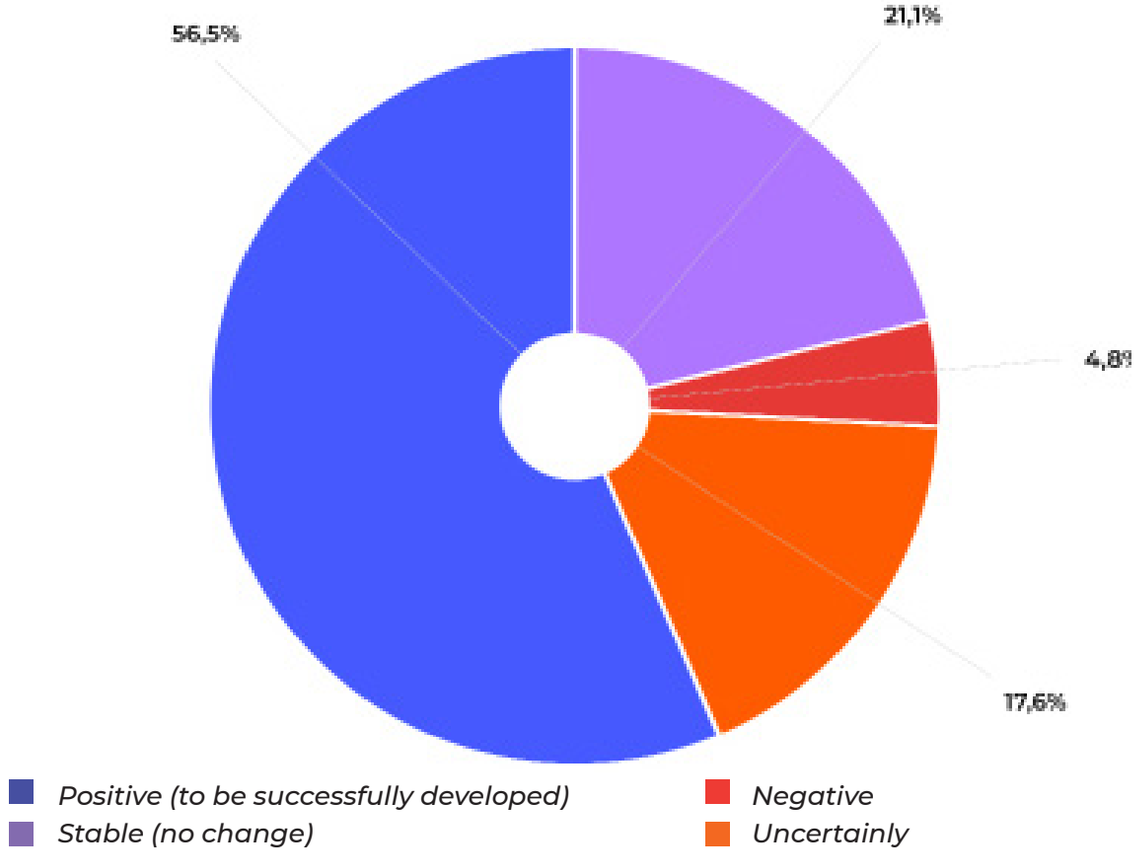
KAZAKHSTAN'S IT SECTOR WILL DEVELOP AT A MODERATE PACE, AND ITS READINESS THE ABILITY TO CHANGE IS QUESTIONABLE.

Most of the experts we interviewed positively assess the prospects of the it sector in Kazakhstan.

Only 4.8% of industry experts give them negative ratings. At the same time, the share of those who found it difficult to give an unambiguous answer is quite high – 17.6% of respondents noted the uncertainty of the future of their field, 21.1% stated

Figures 7.1.

Evaluation of the future of the IT sector of Kazakhstan (%)



Sources: Industry experts survey

the static nature of the industry. Summing up expert forecasts, we can assume that in general, the IT sector will gradually develop.

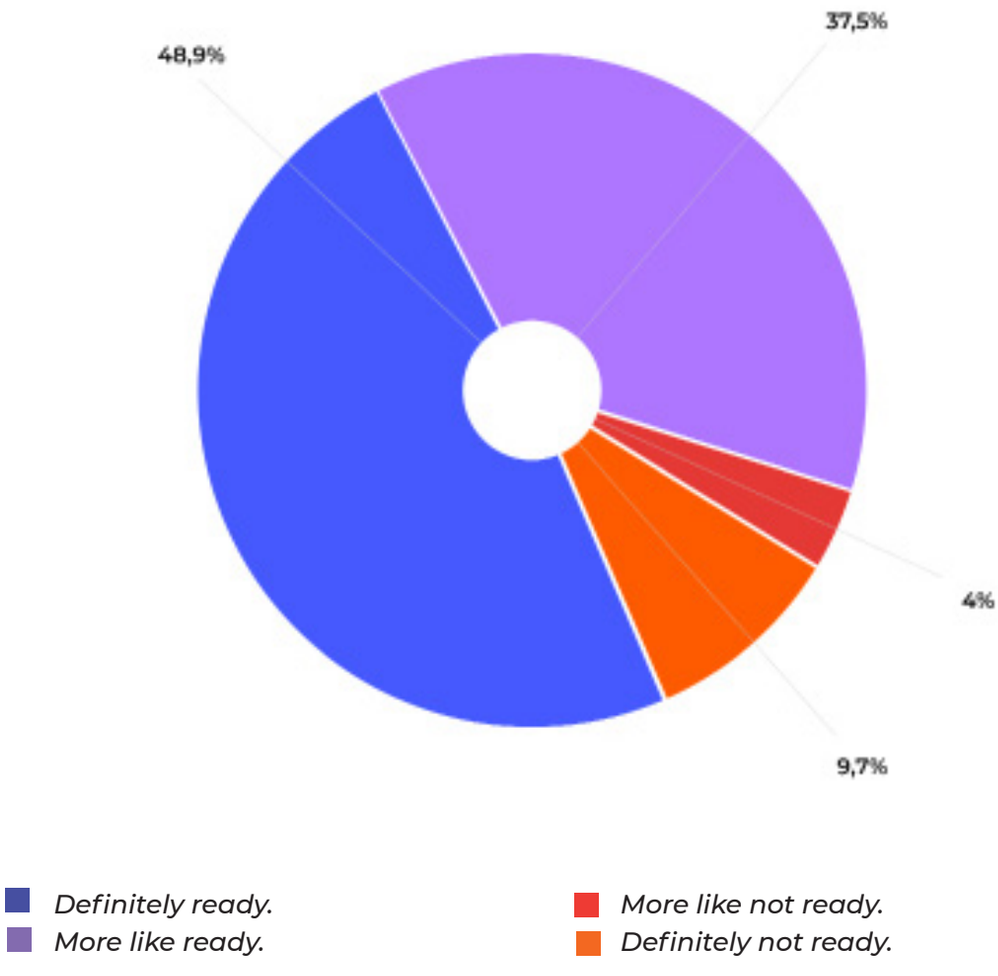
At the same time, despite the prevailing positive assessments of the future of the IT sector in Kazakhstan, experts are less optimistic about the industry's readiness for the upcoming changes.

41.5% of respondents believe that Kazakhstan's IT sector is not ready for the expected future transformations.

First of all, business indicates poor preparation. Of the pessimistic experts, 64% are owners and TOP management and middle-level management of existing IT companies and 36% are representatives of the education sector.

Figures 7.2.

Assessments of IT sector readiness for future changes (%)



Sources: Industry experts survey

2 FORECAST

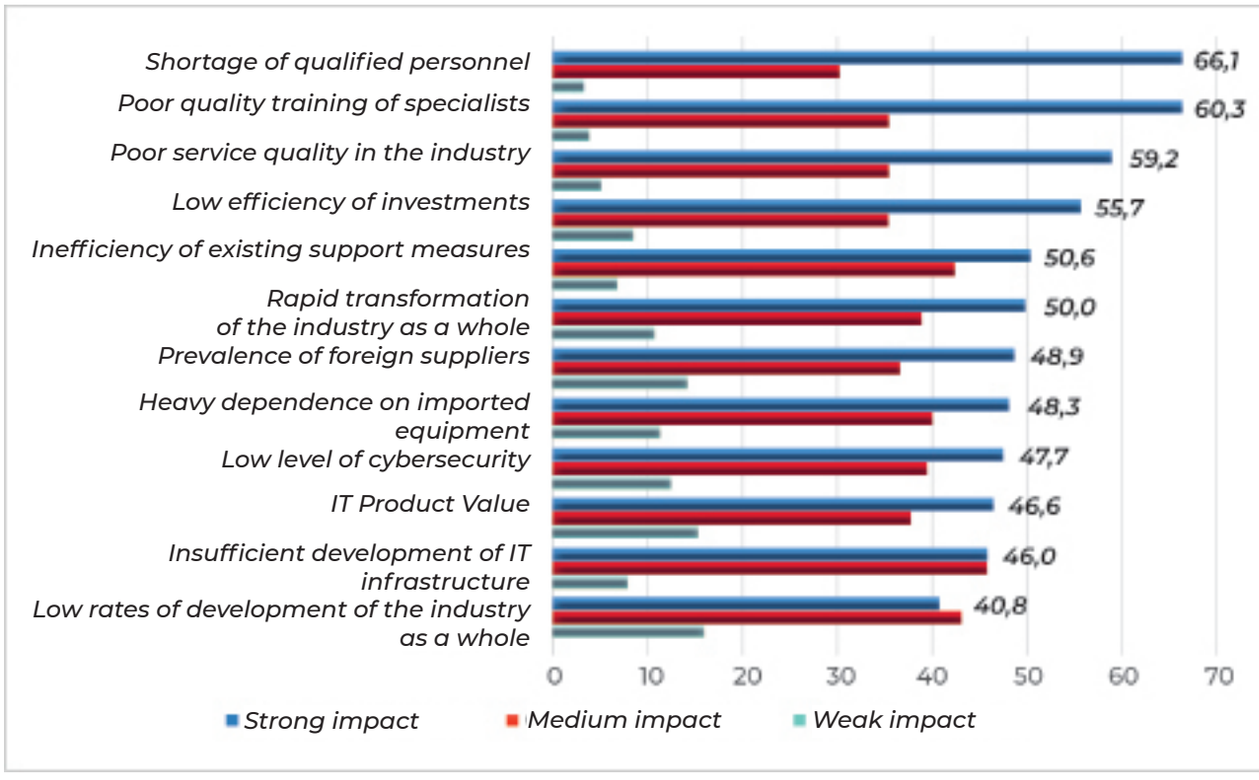
THE MAIN PROBLEMS OF THE INDUSTRY IN THE FUTURE ARE THE WEAK EFFICIENCY OF THE EDUCATION SYSTEM AND TRAINING OF IT SPECIALISTS AND THE DEFICIT QUALIFIED PERSONNEL

The main problems of the industry, which have the strongest constraining influence on its development, were noted by the expert community:

- lack of qualified personnel,
- low quality of training of specialists in the education system,
- poor quality of service in the industry,
- insufficient volume and low efficiency of investments in the industry,
- strong dependence on imports and the prevalence of foreign suppliers,
- as well as the ineffectiveness of existing measures of state support for the industry.

Figures 7.3.

***Estimation of probability of future risks realization** (%)*

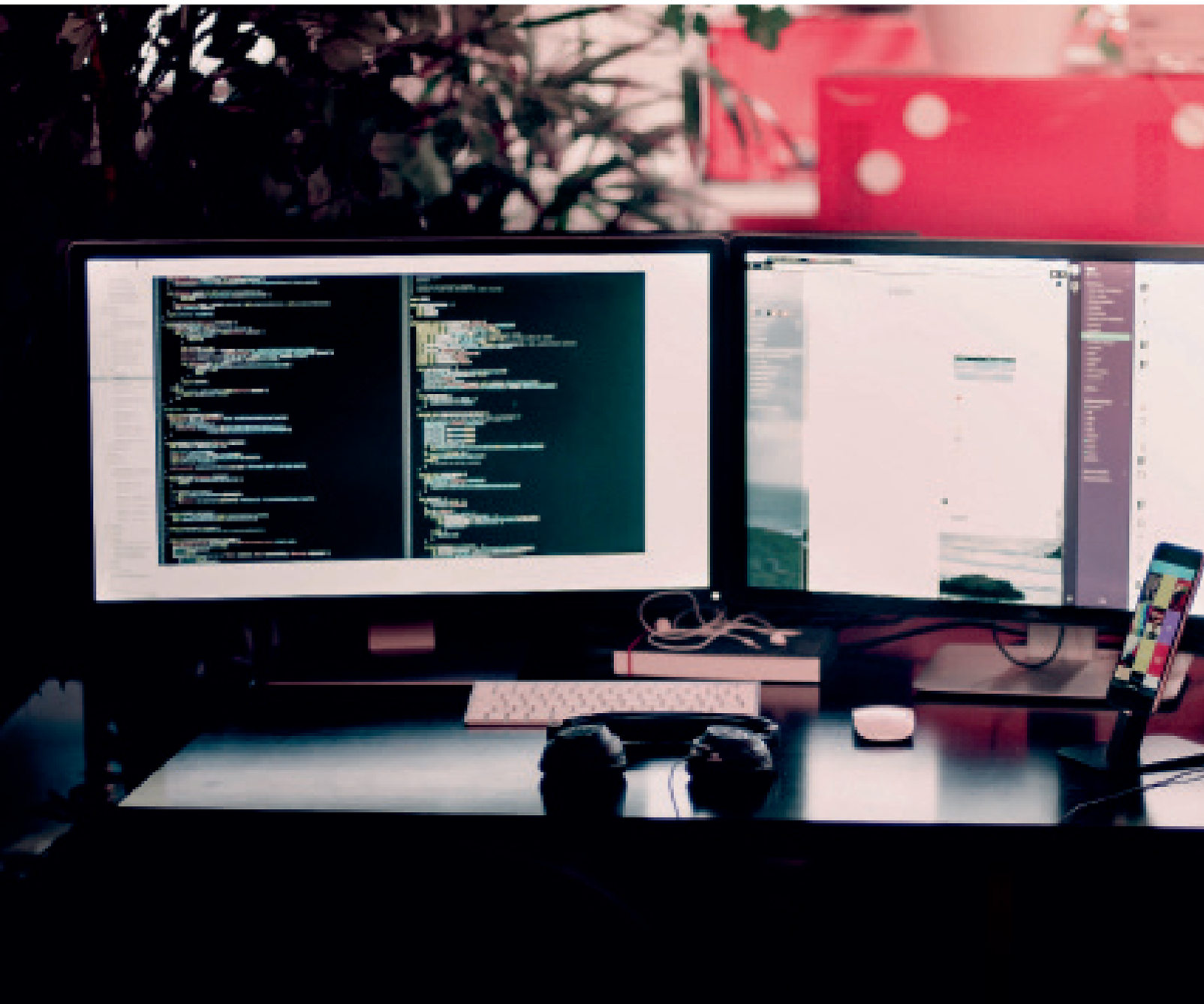


Sources: Industry experts survey

3 FORECAST

THE PROBLEM WITH THE SHORTAGE OF QUALIFIED PERSONNEL WILL HARDLY BE SOLVED IN THE NEXT 10-15 YEARS

The lack of quality labor resources is also a key risk for the future. 55.3% of experts agreed that the probability of this risk being realized in the future is high



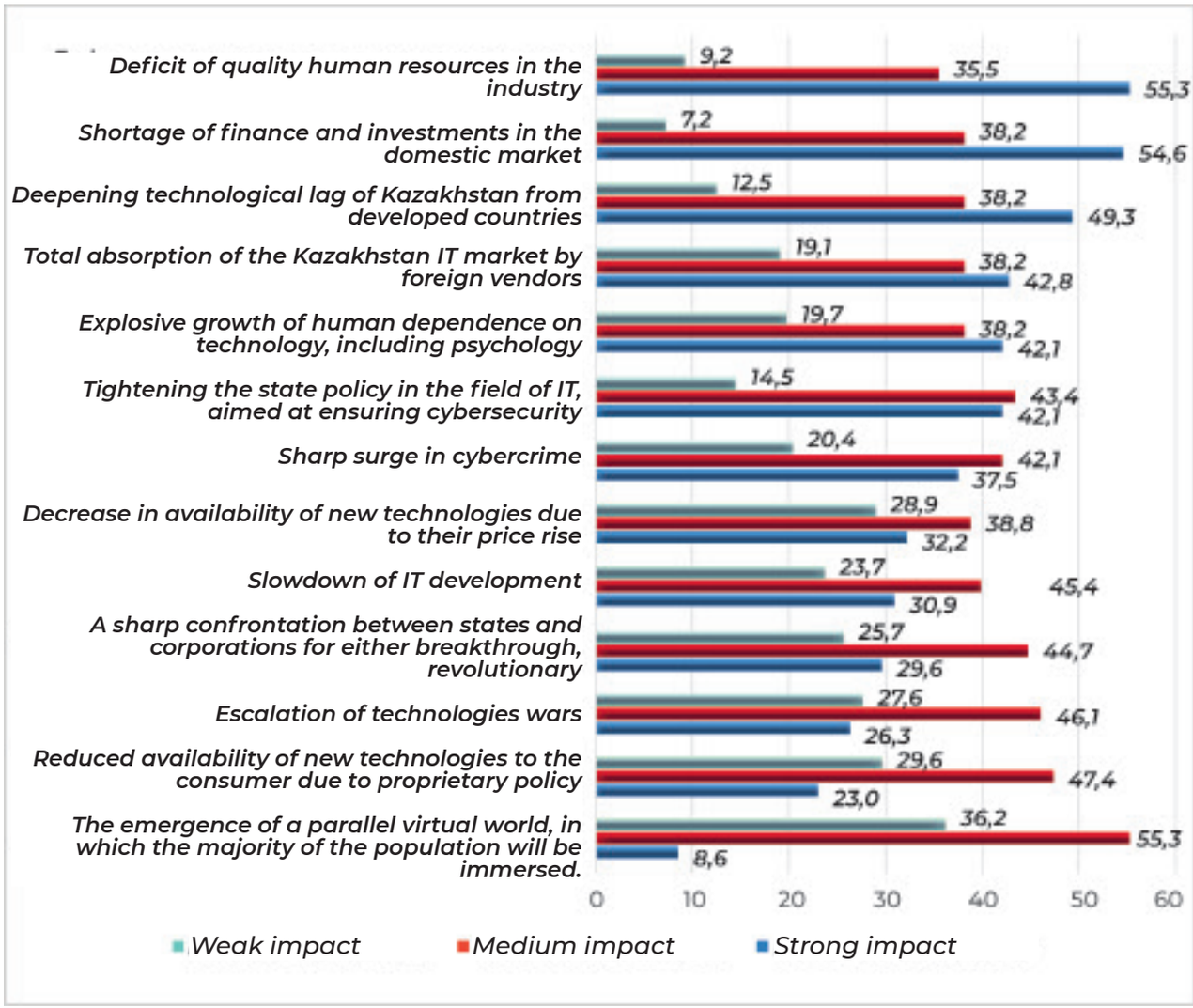
4 FORECAST

KAZAKHSTAN WILL NOT BE ABLE TO OVERCOME THE TECHNOLOGICAL LACK OF DEVELOPED COUNTRIES OVER THE NEXT 10-15 YEARS, AND INSUFFICIENCY IN FUNDING THE IT INDUSTRY IN THE DOMESTIC MARKET WILL BE ONE OF THE MAIN THREATS

Along with it, the top three risks of the future included the lack of finance and investment (54.6%), as well as the deepening technological gap between Kazakhstan and developed countries (49.3%). This is confirmed by estimates of the likelihood of certain events. including leveling the level of technological development of Kazakhstan and leading countries in the IT sectorsector.

Figures 7.4.

Estimates of the risks likelihood being realized in the future (%)



Sources: Industry experts survey

5 FORECAST

SCIENCE AND HUMAN RESOURCES SHOULD BECOME A PRIORITY VECTOR CAPITAL INVESTMENT

Considering that the expert community has identified the staffing of the industry as the most problematic area now and in the future, it is logical that investments should first of all be directed to the preparation of high-quality labor resources for the IT sector.

65.5% of experts consider science and personnel to be a priority object of investment. Also, the top-3 priority areas for investment included software and cybersecurity.

Despite the fact that science and staffing are the most important investment from the viewpoint of the expert community, the survey results show that educational institutions, in particular universities, colleges and private educational institutions have relatively little impact on the future of the IT sector.

Only a third of those surveyed believe that universities, colleges and educational centers are seriously affecting the industry. Even less influence, according to experts, is exerted by scientific institutions (research and development centers), *(see Fig. 7.5).*

Figures 7.5

***Investment direction assessments** (%)*

Sources: Industry experts survey

6 FORECAST

KAZAKHSTAN'S IT SECTOR WILL REMAIN MOSTLY BY THE RECIPIENT FOREIGN TECHNOLOGICAL INNOVATIONS, WILL DEVELOP IN THE WAKE OF GLOBAL TECHNOLOGY GIANT

In the TOP 3 by the degree of impact on the Kazakh market The IT sector includes global IT companies, for example, Apple, Google, Microsoft, etc., the government of the Republic of Kazakhstan, as well as market realities.

Moreover, the absolute leadership of the world's IT giants indicates that the expert community considers our IT sector to be more a recipient of technological innovations than their generator. In the context of a smaller but significant impact on the development of IT in Kazakhstan, the top-3 entities are banks and credit institutions, quasi-public sector entities, as well as owners and top management of IT companies.

The population (49.1% of experts), local executive bodies (44.6%) and industry associations with NCE Atameken (41.8%) are considered to have little or no influence on the development of IT in Kazakhstan.

The IT market closes the top-3 of the leading actors, influencing it the most from the viewpoint of industry experts. However, the survey showed that the business structures of the Kazakhstani market do not assess their influence on the sphere highly. The representatives of the private IT sector we interviewed rate their personal influence on the development of the industry at an average of 5 points out of 10, and the influence of their companies at 6 points. On the contrary, employees of state bodies highly assess their role - on average by 8 and 9 points, respectively (see Fig. 7.6. And 7.7.).

Educational staff consider their value to be high. The average personal influence score is 6, and the influence of their educational organizations is 7 points.

The differentiation of impact assessments by position is noteworthy.

Differentiation of assessments of influence in terms of positions held is noteworthy. Business owners rate their role in the development of the IT sector very low - 4 points out of 10 on average assessed personal influence, and 5 - the influence of their companies. At the same time, the top management of organizations, the main production personnel (ordinary IT specialists) and the management of the middle level of the IT sphere assess the importance of their companies at 7 points, and their personal influence

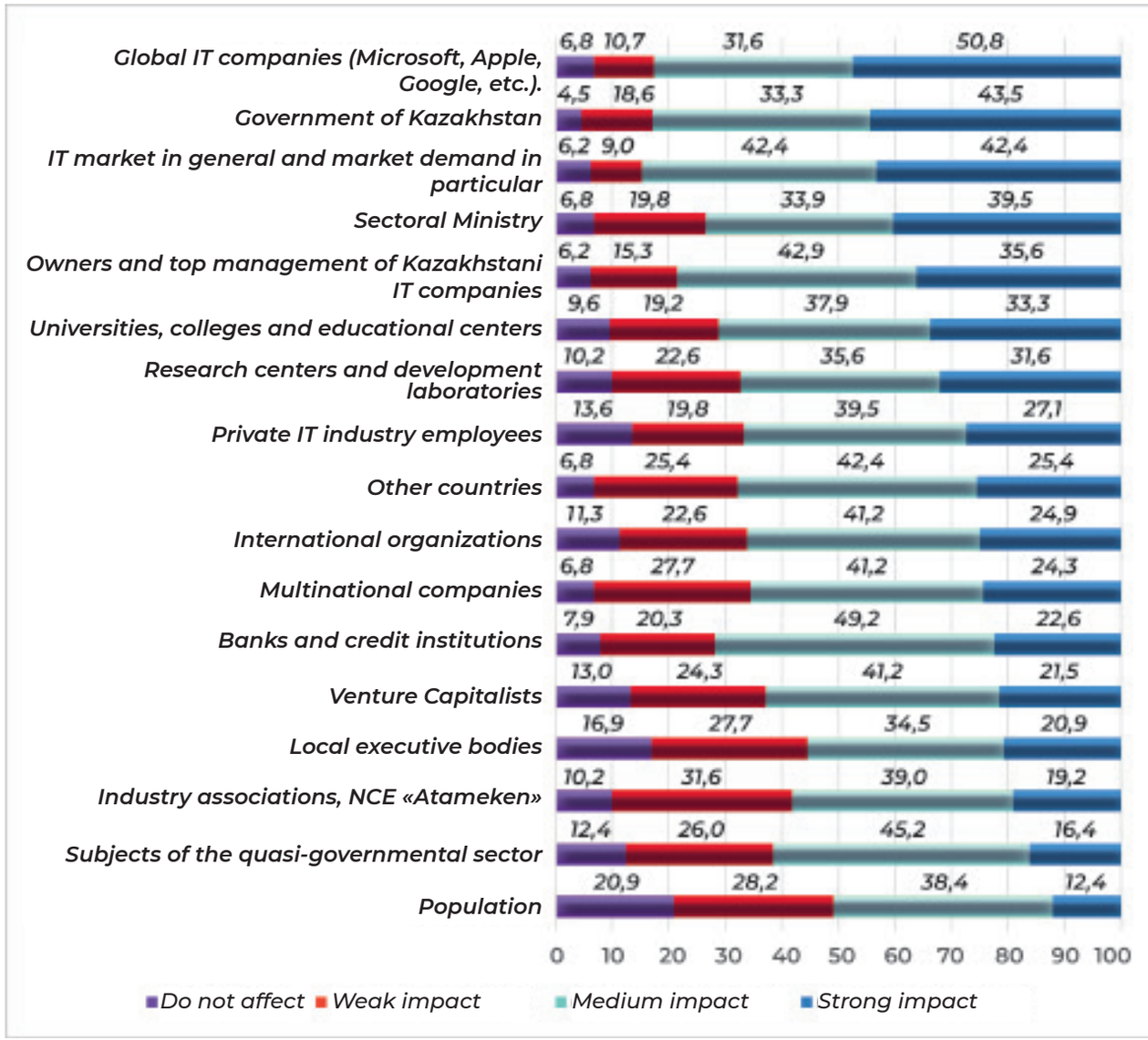
at 6 points.

It turns out that those representatives of the IT sector, whom the expert community identified as the most problematic in the survey, in their own opinion, are very important for the industry. After all, civil servants provide state support, regulation and control of the IT sector, teachers of IT disciplines - saturation of the industry with high-quality personnel, and production personnel are these very personnel. At the same time, the shortage of qualified specialists and the low quality of their training in the education system lead the ranking of the problems of the IT sector, and the ineffectiveness of support measures from the state ranks 5th out of 12.

Thus, it is reasonable to conclude that the most important elements of the IT sector in Kazakhstan are at the same time the most problematic, and, therefore, should be the main priority of state policy.

Figures 7.6.

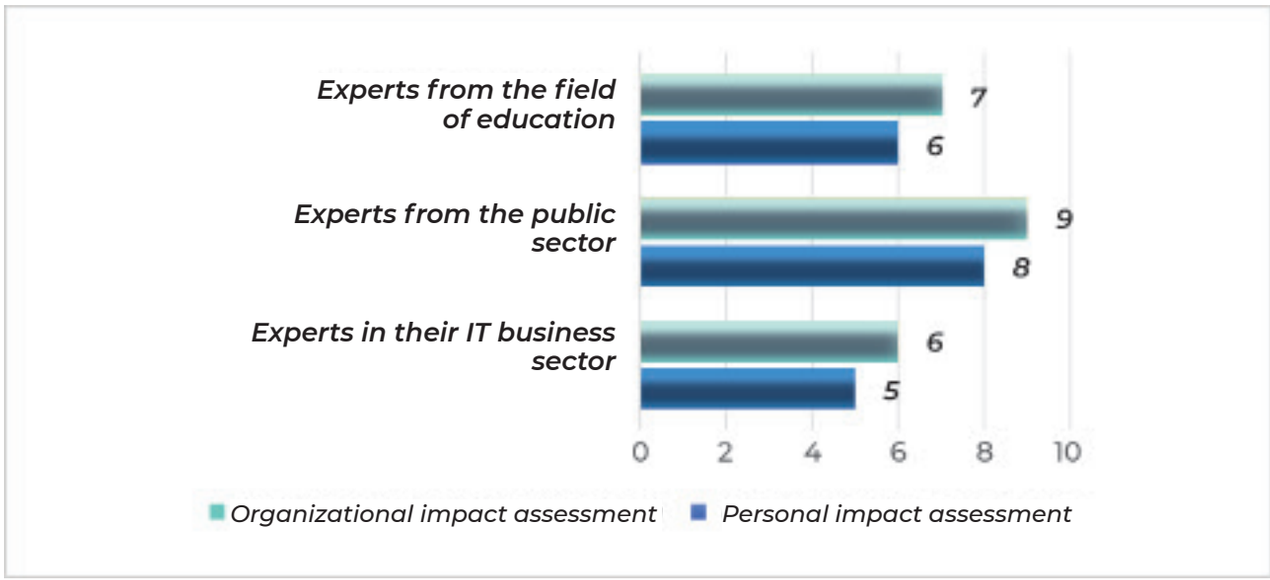
Assessment of the level of influence of various entities on the development of the IT sector in Kazakhstan



Sources: Industry experts survey

Figures 7.7.

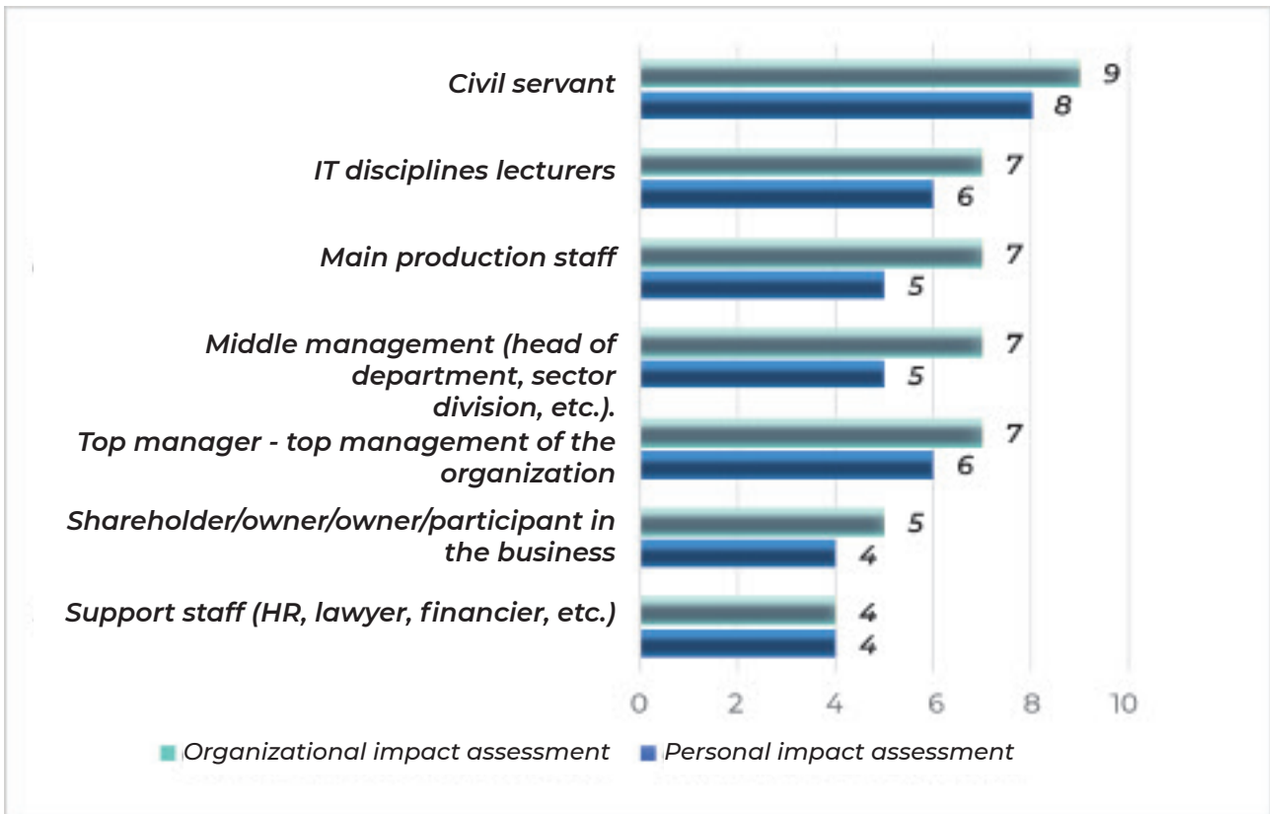
Subjective assessment of the impact on the development of the industry on a 10-point scale by field of activity



Sources: Industry experts survey

Figures 7.7.

Subjective assessment of the impact on the development of the industry on a 10-point scale of positions occupied



Sources: Industry experts survey

7 FORECAST

THE MOST PROMISING AREAS OF THE IT SECTOR ARE THE DEVELOPMENT, IMPLEMENTATION AND MAINTENANCE OF SOFTWARE AND WEB SERVICES

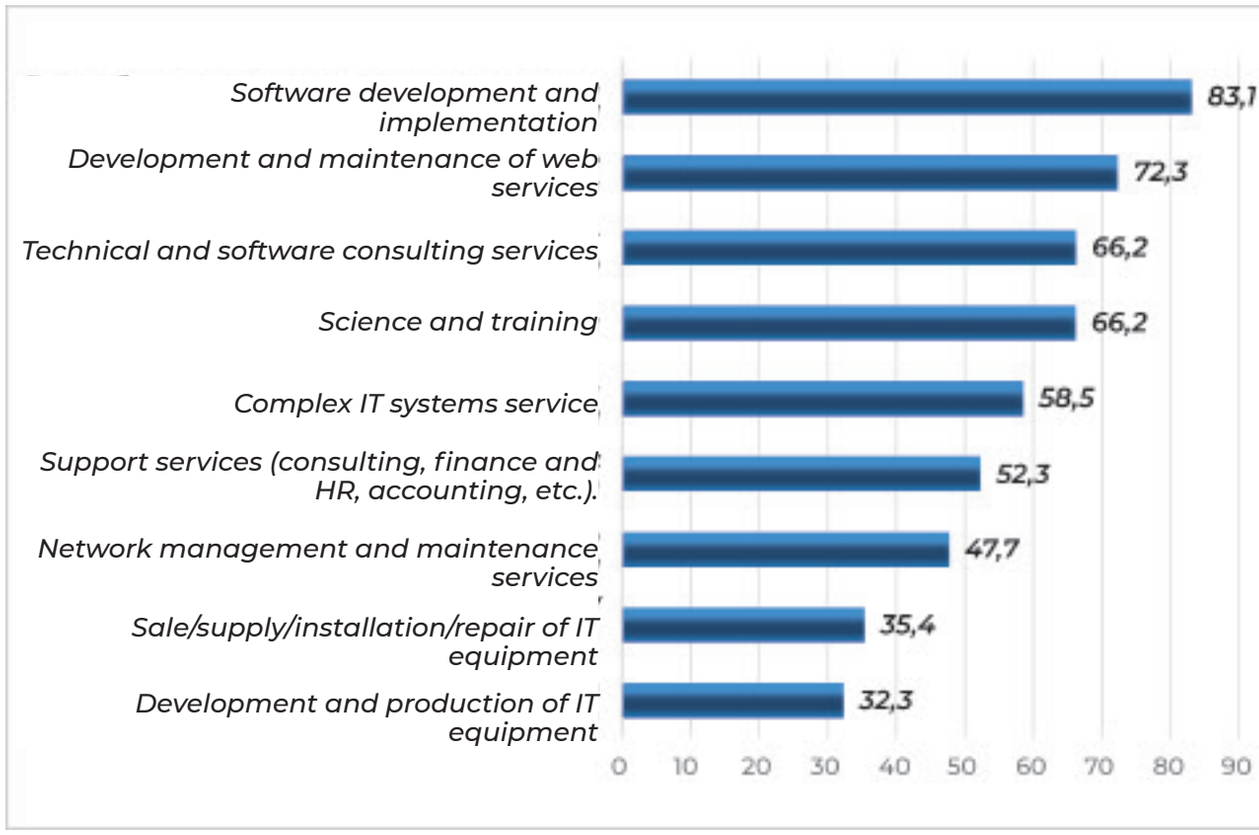
Kazakhstani experts from the business environment consider the development and implementation of software (83.1% of experts from IT companies), development and maintenance of web services (72.3%) and consulting services on hardware and software to be promising areas of development. Business does not see any prospects in the development and production of physical equipment and IT infrastructure, their maintenance and implementation.

Only about a third of surveyed experts consider these niches to be potentially profitable for their companies.

This is not surprising, since the likelihood that in the future Kazakhstani manufacturers will be able to produce affordable and high-quality analogs of foreign physical IT solutions is not high.

Figures 7.8.

Rating of the most promising technological changes in the IT sector in the opinion of the business community*(%).*



Sources: Industry experts survey

8 FORECAST

A MAJOR OPPORTUNITY FOR THE IT SECTOR OF KAZAKHSTAN WILL BE AN INCREASE IN THE USE OF IT IN THE ECONOMY AND EVERYDAY LIFE, ASSOCIATED WITH INCREASED AVAILABILITY OF NEW TECHNOLOGY AND THE ACCELERATING PACE OF DIGITIZATION

In addition to mastering new technological redistributions in the industry, the Kazakhstani community of IT experts identifies other opportunities that may appear in the future. First of all, this is the expansion of the applicability of IT in various sectors of the economy, the increased availability of new technologies and the acceleration of the pace of digitalization.

9 FORECAST

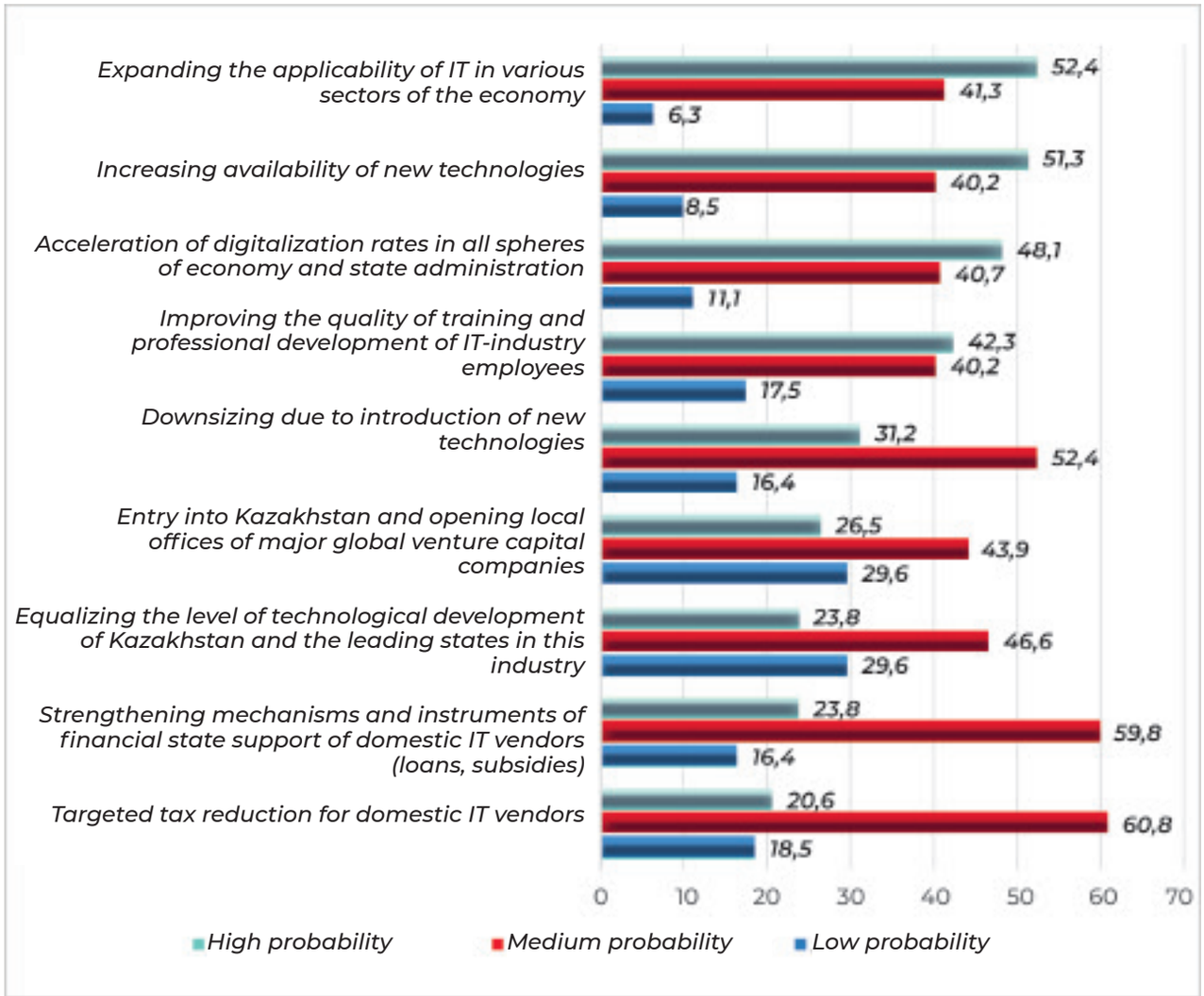
THE STATE CAN DEVELOP NEW EFFECTIVE MEASURES TO SUPPORT THE IT INDUSTRY. HOWEVER, THE PROBABILITY OF SUCH SCENARIO IS TWO-FOLD

It should be noted that, in general, the expert community admits the possibility of expanding state support for the industry and facilitating the tax regime, but considers it not so high. About 60% of experts assess the likelihood of such steps as medium.

Possibilities of equalizing the level of technological development of Kazakhstan and developed countries, as well as the arrival of large venture capital investors on our IT market, were assessed least optimistically. Almost 30% of respondents point to a low probability of such scenarios.

Figures 7.9.

Estimates of probability of new opportunities on the IT market of Kazakhstan *(%).*



Sources: Industry experts survey

10 FORECAST

FUTURE DATA, SOFTWARE, AND TOOLS HUMAN-TECHNOLOGY INTERACTIONS MAKE A TECHNICAL LEAP

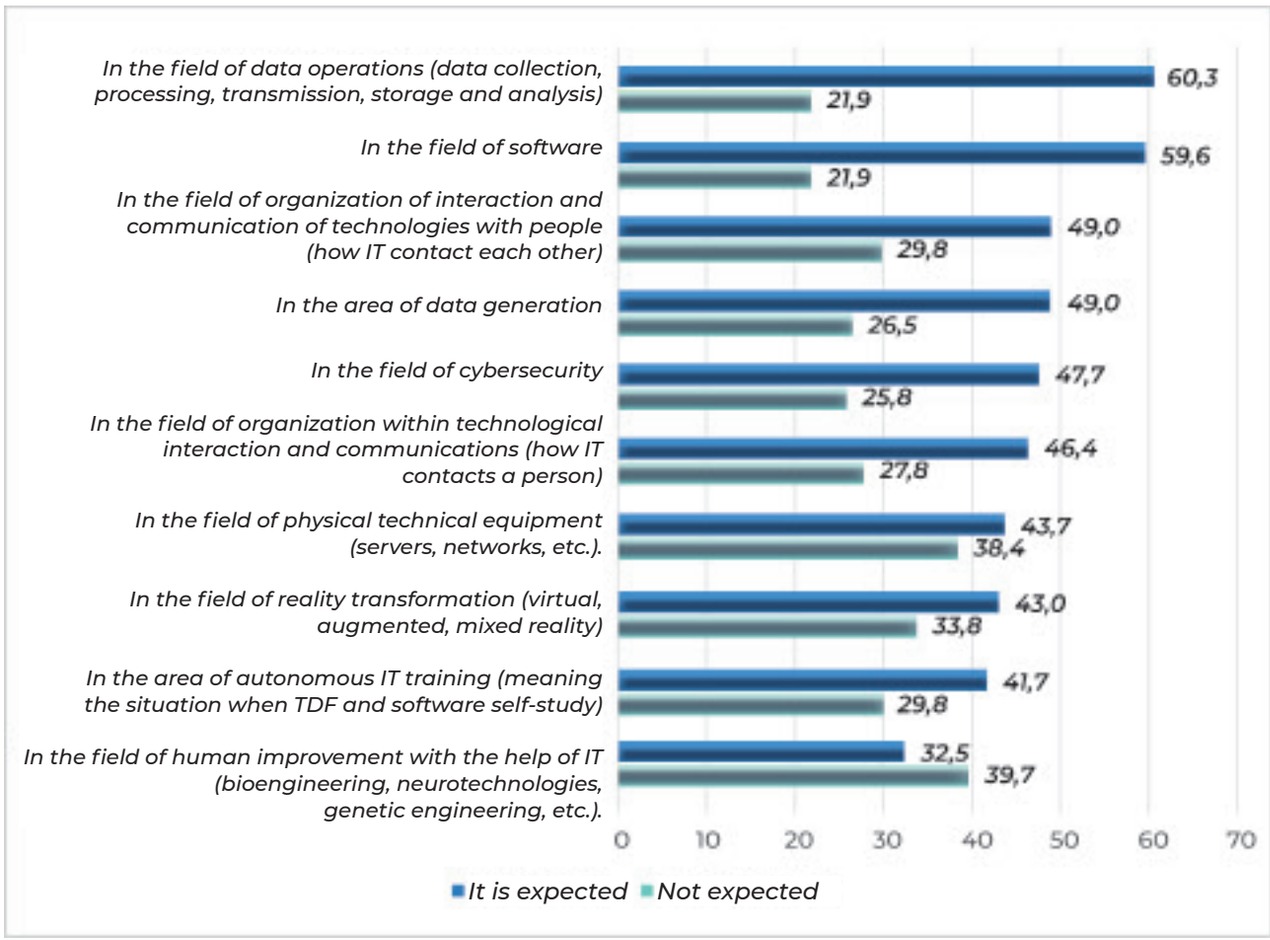
Against the backdrop of a high probability of increasing the availability of new technologies and accelerating digitalization, innovative breakthroughs are expected in such areas as:

- generation and manipulation of data,
- software,
- organization of interaction and communication of technologies with people.

Least of all, a leap in technological development is expected in the field of improving human capabilities with the help of IT, technical infrastructure and transformation of reality (VR, AR, hybrid reality).

Figures 7.10.

Experts answers to the question: «Is a technological breakthrough expected in the following directions of Kazakhstan's IT industry?



Sources: Industry experts survey

11 FORECAST

THE GLOBAL ECONOMIC CRISIS AND THE CREATION OF THE QUANTUM INTERNET ARE TWO LIKELY EVENTS THAT WILL HAVE THE GREATEST IMPACT ON IT CONFIGURATION AND DEVELOPMENT

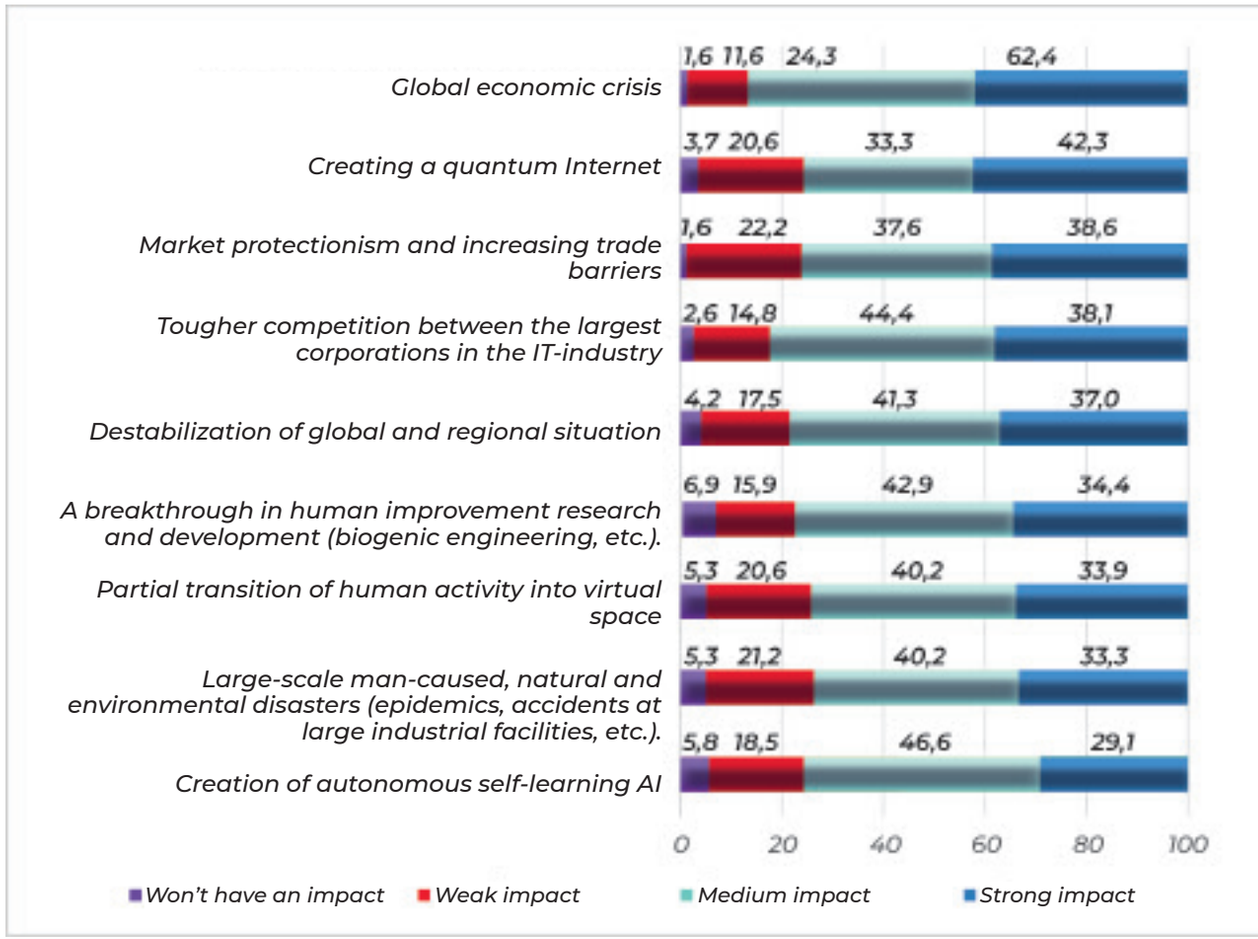
In turn, the development of the industry as a whole, in the opinion of the expert community, will be most influenced by such possible events as

- global economic crisis,
- the creation of a quantum Internet,
- protectionism and increased trade barriers in the global market.

Any natural environmental or man-made emergencies, a partial transition of human activity into a virtual environment and the creation of a self-learning AI will have an insignificant impact.

Figures 7.11.

***Impact assessments of possible events on IT sector development** (%)*



Sources: Industry experts survey

12 FORECAST

THE IT SECTOR OF THE FUTURE WILL HAVE EXTENSIVE FEATURES, AND THE FOCUS OF ITS PROGRESSIVE DEVELOPMENT WILL BE A PERSON

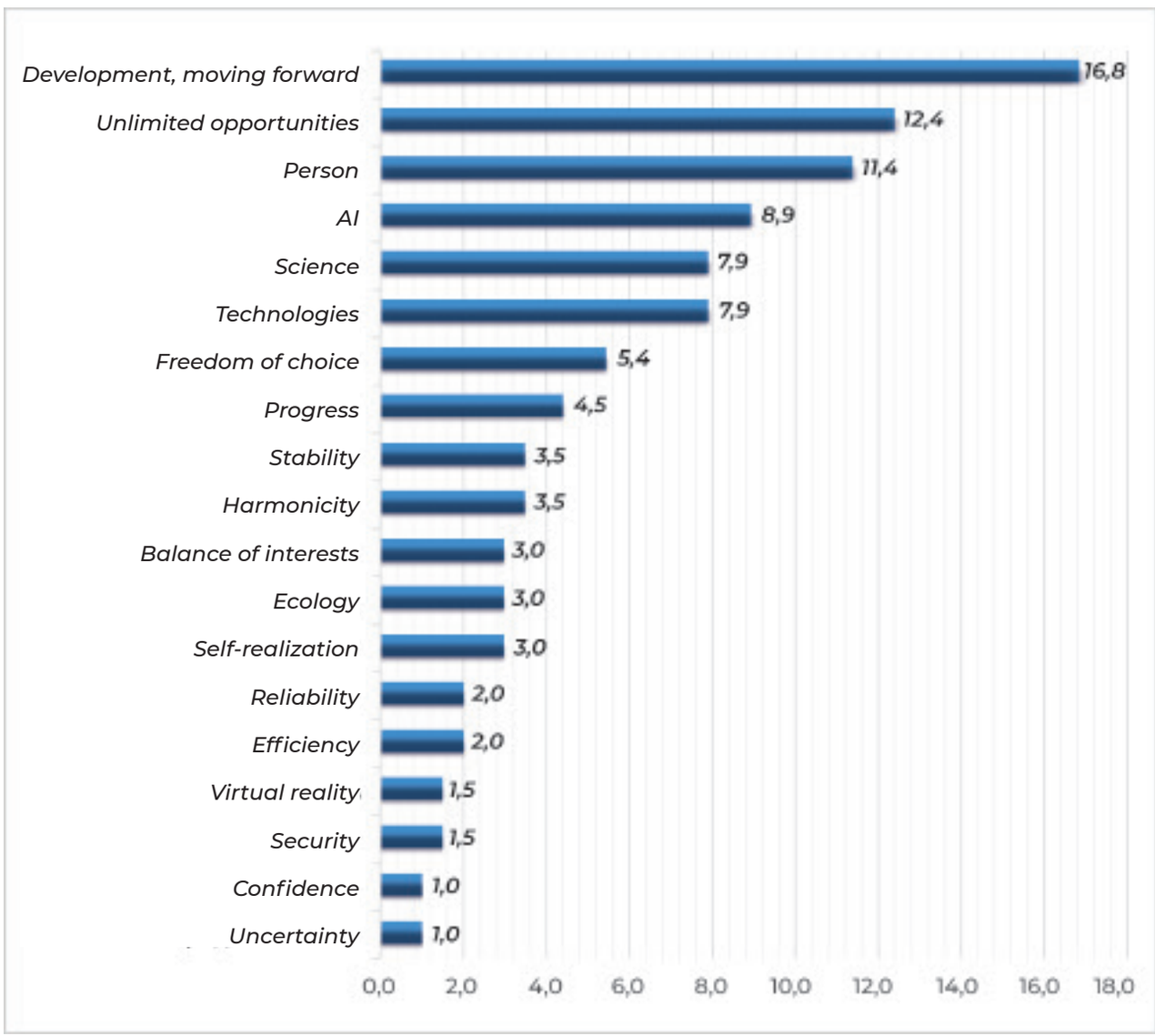
According to Kazakhstan's IT experts, the following priorities will be typical for the domestic IT industry of the future:

- Development, moving forward-16.8%.
- Unlimited possibilities – 12.4%.
- People – 11.4%.

The prospects of the IT sector are more associated with scientific and technological development. ***The TOP 5 top priorities include NTP in General and AI as its special area.***

Figures 7.12.

Expert determination of the future image *(%)*



Sources: Industry experts survey

At the same time, during the foresight sessions, experts developed additional forecasts regarding the opportunities and formats for the development of the IT sector in Kazakhstan.

13 FORECAST
KAZAKHSTAN CAN BECOME A CENTER

Using our wide natural, climatic, territorial and energy potential, we will be able to deploy a separate vector for the development of the IT sector, based on attracting large tech giants to our country who are interested in placing their production and computing facilities with us. Technological offshoring may become a key sector in Kazakhstan's GDP.

Cheap electricity, the availability of the necessary mass of relatively cheap and skilled labor, protection from natural and man-made disasters due to geographical and territorial characteristics, and the availability of the necessary infrastructure are a convenient starting platform for initiating a technological offshoring program.

14 FORECAST
RATIONALIZATION OF INFRASTRUCTURE SUPPORT FOR THE IT SECTOR WILL ALLOW TO INTENSIFY ITS DEVELOPMENT

The system of stimulating the development of the IT sector built in Kazakhstan at the moment does not realize its maximum potential. When reviewing approaches and introducing new institutional support tools, it is quite possible to force the evolution of the IT industry.

Accelerators, technoparks, Astana Hub, PIT can become real catalysts for the innovation process in Kazakhstan. Astana Hub as a key

[15] *15In 2015, as a result of a man-made disaster in the city of Tianjin, when powerful explosions occurred in petrochemical warehouses, the building of the national supercomputer center was damaged. Despite the fact that the Tianhe-12 supercomputer did not receive any damage, it was decided to shut it down.*

technology park should grow into a basic methodological center, endowed with the functions of training trackers for regions, mentors for young IT professionals and startups, developing training programs, organizing educational, methodological and consulting mechanisms for interaction between universities.

In addition, all startups will be tested through the Astana Hub for their relevance to modern and advanced market needs.

It should be understood that the IT sector generates ideas that have never been voiced before. A person cannot want what he has no idea about. He cannot desire a car if one has not yet been invented.

The key task of Astana Hub is to try to objectively assess the potential of a startup through the prism of a futuristic approach. In turn, mini-Astana Hubs will be created at all universities, collecting interesting ideas, supporting talents, providing financial, methodological, consulting and mentoring support.

15 FORECAST

KAZAKHSTAN WILL BE ABLE TO SIGNIFICANTLY IMPROVE QUALITY OF PERSONNEL TRAINING FOR THE INDUSTRY IF THE EDUCATION SYSTEM IS REORIENTED TO TRAINING SPECIALISTS IN WIDE-PROFILE PRODUCTS. DIGITAL EDUCATION WILL BE ACCESSIBLE AND UBIQUITOUS, PROVIDED IN NATIVE FORMAT THROUGH IMMERSIVE TECHNOLOGIES

By refocusing the training system on such specialists as MVP managers, Product managers, DevOps engineers, etc., Kazakhstan will be able to enter the world labor market as a generator of IT specialists of a wide profile and high class.

8. IMAGE OF THE FUTURE AND FORECASTS FOR THE DEVELOPMENT OF THE IT SECTOR IN KAZAKHSTAN

IMAGE OF THE FUTURE AND FORECASTS FOR THE DEVELOPMENT OF THE IT SECTOR IN KAZAKHSTAN

So what will Kazakhstan's IT industry look like in 15 years? Which innovations will find their niche, and which will remain unclaimed due to our socio-economic, cultural and political features? Is an accurate forecast possible, and who is responsible for its implementation?

There are no definite answers and cannot be. Only scenario-predictive approximation is possible.

Which path will we take - restrained growth, forced breakthrough, or actual stagnation as an observer and recipient? In all likelihood, it will be something between the first and the second, since the latter scenario will lead us to the status of a technological, and therefore an economic, outsider. Consequently, business, society and the state will oppose this scenario in the first place.

AT THE SAME TIME, THERE IS NO SENSE TO CALCULATE FOR AN INTEGRATED WIDE-SCALE TECHNOLOGICAL JUMP, BECAUSE, AS IT WAS ALREADY MADE ABOVE, KAZAKHSTAN SHOULD OVERCOME MANY VARIETIES AND PREVIOUSLY THE PROBABILITY THAT CAN BE DONE WITHOUT DAMAGE TO THE IT SECTOR'S EDUCATIONAL AND STAFF IS EXTREMELY SMALL.

Consequently, it is necessary to concentrate on the introduction of new professions selectively and in a measured manner, carefully analyzing the urgent and future needs of the labor market, the temporal and spatial horizons of the emergence and transformation of professional specializations, and not to conduct a continuous general training of personnel, who will then be left without work. Thus, we need to increase the pace of development, but carefully coordinate its vector. To do this, it is necessary to form a clear image of the future - a clear picture, starting from which, to determine the dynamics of the transformation of the IT industry labor market.
Foresight allowed us to do this as close as possible to the predicted realities of the future.

As a result, the key characteristics of the future IT sector in Kazakhstan were highlighted.

AT THE BORDER OF THE 2030S:

The domestic IT industry will mainly absorb foreign developments, primarily technical innovations from global tech giants. We will be able to deploy our own full-scale research and development base on condition of reducing state control, intensifying internal competition and increasing the efficiency of the personnel training system. However, the Government will remain one of the most influential actors in the IT field.

As a result, the pace of development of the industry will be moderate, as the IT sector is now showing weak readiness for the profound changes dictated by the Fourth Industrial Revolution. He will continue to face a shortage of qualified personnel. In view of this, the main investments in the IT sector will be directed to science and training. However, the lack of funding will significantly hinder the improvement of the education system and exacerbate the technological gap with developed countries.

The main field of activity in the IT sphere will be software development, in which a technological breakthrough is expected.

The introduction of new technologies will be targeted, depending on the dynamics of changes in consumer preferences. At the same time, the growth of their accessibility to the general public and the acceleration of digitalization will be a good opportunity for the IT sector of Kazakhstan to make an evolutionary breakthrough in the long term.

This will be facilitated by the gradual spread of new IT, which will lead not only to large-scale shifts in the entire economy and socio-economic relations in general, but also in the IT sector of Kazakhstan in particular.

New technologies and approaches will replace traditional computing resources. Quantum computing will gradually replace obsolete computational paradigms. Their proliferation will lead to the transformation of data centers, the emergence of the quantum Internet, a breakthrough in the generation, transmission and processing of big data, and a rethinking of cyber defense tools. Quantum computing and quantum cryptography will be of particular importance to the IT sector.

Kazakhstan, using its wide energy potential, will be able to become a powerful regional communication and computing center. We will become a technical offshoring country.

Large science-intensive corporations of various spectrum, attracted by the relatively cheap cost of electricity, labor and the availability of the necessary territorial, infrastructural and administrative conditions, will be able to deploy their computing power in our country, namely, data centers, quantum Internet bases, receiving stations, etc.

The IoT will cover all spheres of the economy and human life, from medicine and housing and communal services to the mining and oil and gas industries. Together with edge computing, it will become a major source of data and metadata that will grow exponentially. Specialists in the field of Internet of Things and PoE will be among the most in-demand in the labor market. And IT companies providing services for the development, installation, configuration, testing and maintenance of intelligent cyber-physical infrastructures will be the most cost-effective.

The operational management of industries, transport highways, cities, digital systems in various industries will be carried out by AI, which will be able to self-learn and make informed and quick decisions for a person, and the probability of errors will be minimized. Universal AI will be able to develop software according to the settings set by the designers, simulate and manage super-complex systems and networks, administer super-large databases, which will significantly reduce the time and intellectual costs of IT companies

and lead to the disappearance and transformation of many IT professions.

The development of AI will entail inevitable moral and ethical conflicts, for which developers and the IT sector as a whole will be responsible. Therefore, IT companies will have to carefully consider the process of improving and applying AI. Professionals in the field of AI development, machine and deep learning, design and development of artificial neural networks and neurocomputer interfaces will become key specialists in any IT company.

People will gradually cyborgize, hybrid intelligence will be consistently spread, first in large enterprises, and in the distant future among the general population. A modern programmer who develops this or that software using a keyboard and a monitor will give way to hybrid intelligence - a symbiosis of artificial and human intelligence, the neurocomputer interaction of which will simplify the process of designing, programming, testing, debugging and maintaining IT products.

Ordinary people will also become more interacting with IT through cyborgization. A specialized service will appear for the integration of neurocomputer interfaces into the human body, thanks to which we will be able to move between reality and the digital world without the use of special immersive devices.

These services will initially be provided by IT companies in conjunction with bioengineering structures to wealthy categories of citizens, and with their improvement and reduction in price, and to everyone else.

The digital space, along with real life, will become a full-fledged second habitat for individuals and organizations. Digital twins of enterprises and cities will appear, and each user will acquire a digital avatar - an «online clone» of a person, which will be his autonomous profile in a new social information network - a neuronet.

Digital twins will allow IT companies develop and maintain their products remotely, using large-format virtual, augmented and mixed reality technologies.

The new digital reality will lead to a change in social relations. People will leave their homes less and less, and virtual communication will completely replace real contacts. Administering this reality, creating new virtual and mixed spaces, ensuring the security of users connected to them, will become an important segment of the activities of IT companies.

The architecture of trust in new digital socio-economic relations will be based on distributed ledgers, which will completely reformat the accounting and data management systems in all large enterprises.

Blockchain will become a fundamental technological basis of knowledge-intensive industries.

Business information security will be based on these technologies. IT companies specializing in these types of databases will be the engines of progress in the sector.

The total penetration of IT threatens a surge in cybercrime. This will make it necessary to strengthen the means and methods of cyber protection, the introduction of new laws and regulations governing relations in the digital environment. Comprehensive user protection will become one of the most important areas of activity for IT companies.

The evolution of IT will inevitably face rejection among a large number of users.

The problem of «digital depression» will arise, caused by the explosive growth of human dependence on new technologies. An increase in the psycho-emotional load on people in connection with this process will lead to the need to create a system of psychological support for people who will have difficulty adapting to the new digital reality.

Large and ultra-large companies in all sectors of the economy will progressively transform into autonomous IT platforms with proprietary digital ecosystems, the infrastructure of which will become extremely complex and combined. As a consequence, the IT workforce in such organizations will grow relevantly.

The transformation of consumer preferences will lead to a radical change in the approach to work in the IT sector itself. IT companies will completely transfer their employees to a telecommuting format.

Advanced interfaces, cloud technologies and new digital reality will allow them to organize their work eliminating the need to rent premises, equipment, transportation costs, etc. The most valuable employees will be those who possess several key specializations at once.

In general, IT professionals will be the most in-demand workers in the labor market, but their skills and competencies will undergo dramatic changes.

The above-described image of the future IT sector in Kazakhstan looks very attractive. However, the question inevitably arises about the likelihood of its implementation. Taking into account the socio-economic and cultural-political characteristics of Kazakhstan, the development of the domestic IT industry is likely to proceed unevenly and inconsistently. Therefore, for clarification, potential scenarios for its development were developed.

SCENARIO FORECASTS OF DEVELOPMENT OF THE IT SECTOR OF KAZAKHSTAN IN THE TIME SPAN OF 10-15 YEARS

BASE SCENARIO

The IT industry is developing moderately. At the turn of the 2030s, the sector's share in the country's GDP will reach a corridor of 7-8%. A number of large IT hubs function in the country, but in general the industry remains import-dependent, the share of its own IT developments does not exceed 25%.

The technological development of the industry is progressing gradually, advanced IT achievements are being implemented with a significant delay. The most common technologies: AI, IoT, cloud services, distributed ledgers, including blockchain, VR, AR, MR.

The main emphasis in the development is placed on software and cybersecurity systems. The state remains a key driver and recipient of the development of the IT sector, which receives substantial government support.

Technological offshoring is gradually becoming more active, in which some large corporations, attracted by relatively cheap electricity, labor, suitable territorial infrastructure and administrative conditions, place their production communication and computing capacities in Kazakhstan.

The professional background of the IT industry is changing at a moderate pace. The dynamics depend on the degree of state support for IT education, political will, and understanding of the need to transform the professional environment of the IT sector.

The state remains the main investor in terms of personnel training for the industry. Due to the slow introduction of advanced technologies, new competencies and specializations are mastered on a narrow scale, while in most cases the basis for this is foreign education.

POSITIVE SCENARIO

The IT industry is actively developing. The sector's share in GDP will reach a corridor of 10-12%.

The country has established an ubiquitous efficient IT infrastructure based on cutting-edge innovations, including universal AI and hybrid intelligence, quantum computing, its own cryptocurrency and human cyborgization devices.

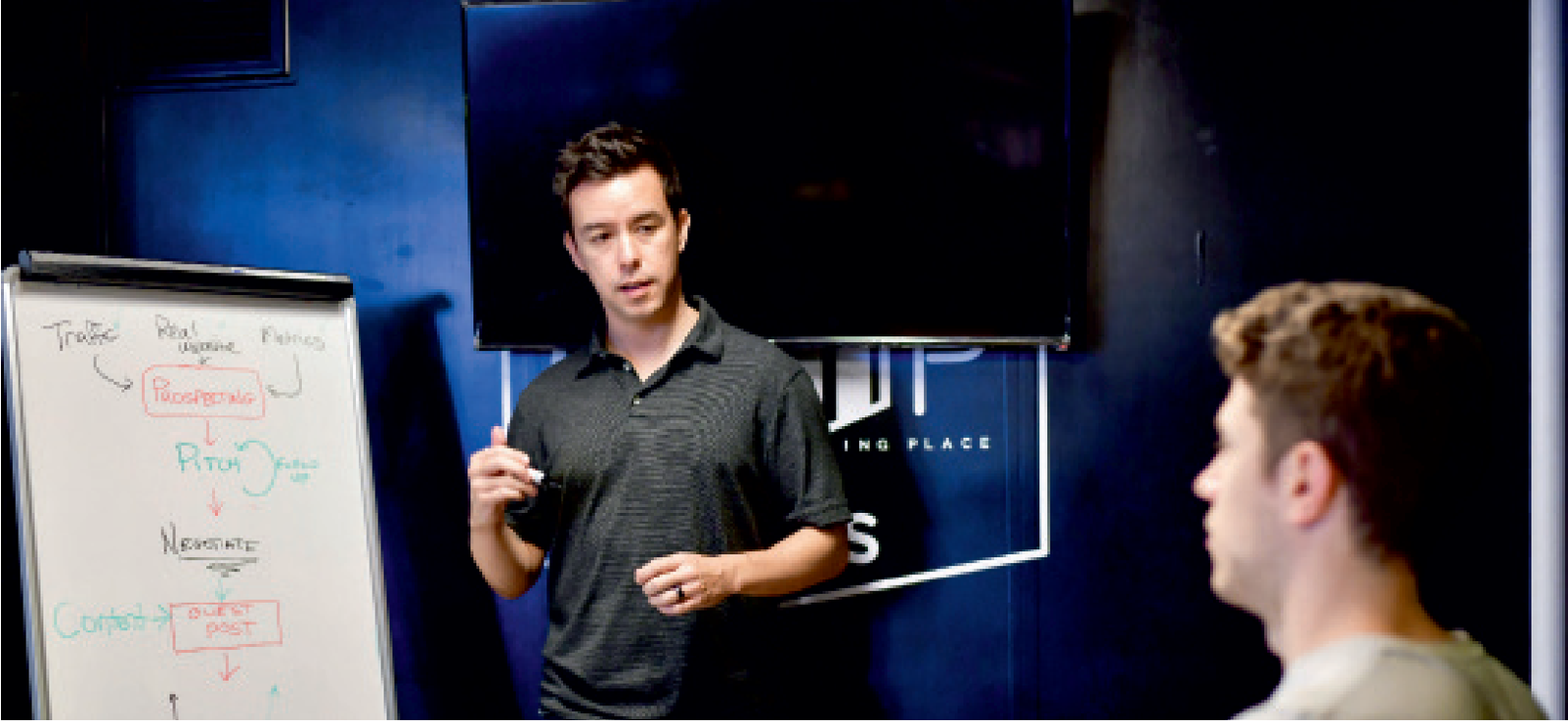
The IT sphere is becoming one of the main catalysts for economic development. Local companies compete with the world's leading IT vendors. We have built our own IT ecosystem, created a number of IT products that are used both domestically and exported abroad.

The IT market is autonomous, services and products of the Kazakhstani IT sector are priority for all sectors of the country's economy. The ecosystem of technological offshoring is widely deployed. The largest science-intensive companies in the world are actively deploying their communication and computing centers in Kazakhstan, which are becoming one of the key elements of the world information and communication system.

The professional background of the IT industry will change significantly. With the introduction of new technologies, new specializations appear, and the transformation of old professions is accelerated.

A broad base of professional retraining has been created, which allows personnel with disappearing specialties and unnecessary competencies to learn new skills and remain a competitive element of the market.

Business is investing heavily in the human capital of the industry, realizing the importance of employees with relevant IT profile.



NEGATIVE SCENARIO

Kazakhstan remains the periphery of the global IT ecosystem. The share of the IT sector in GDP is less than 5%. The state exercises total control over the IT sphere.

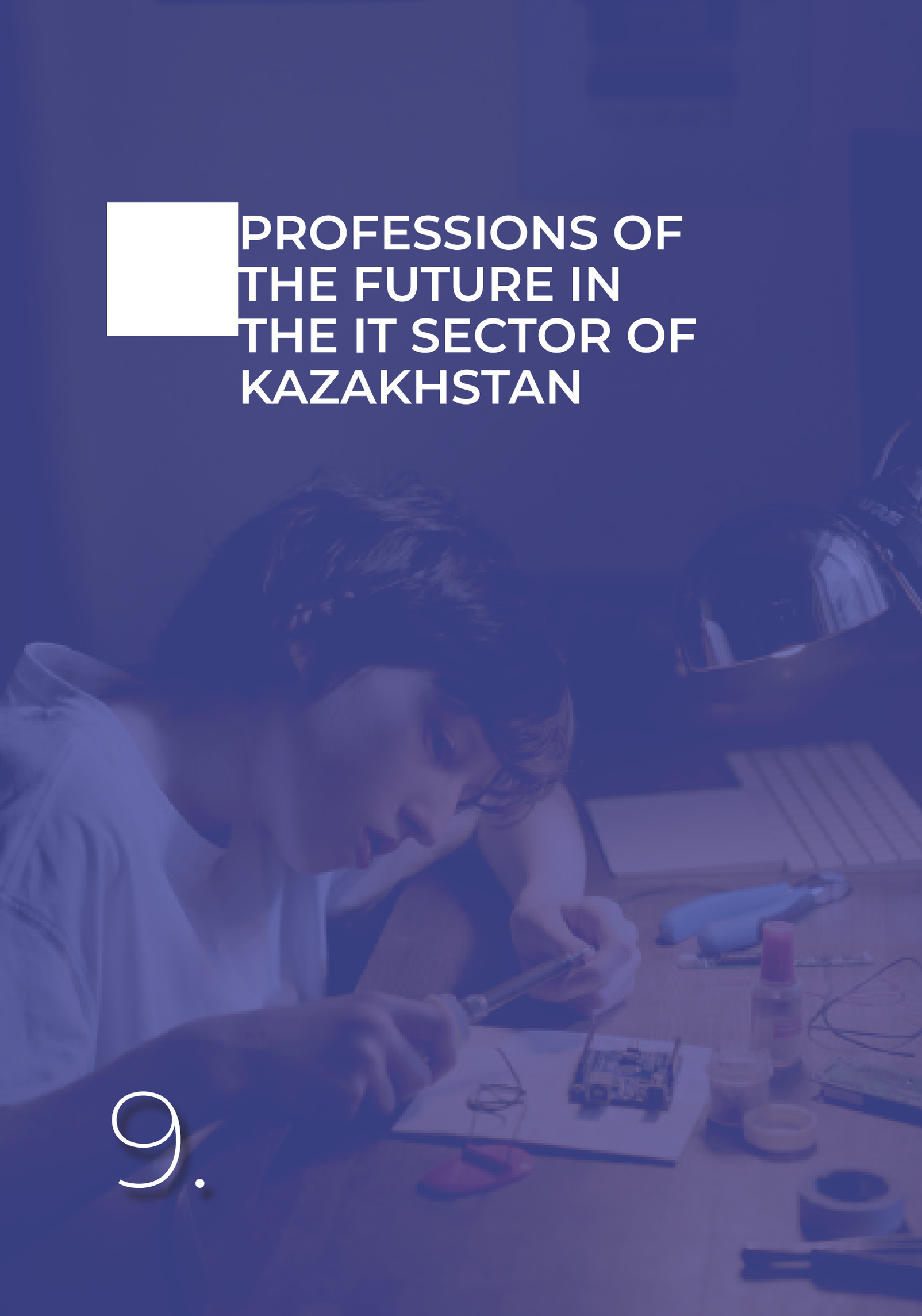
The IT infrastructure lags behind the pace of development of the global IT industry and is completely dependent on the import of software and hardware. The technological lag behind developed countries is increasing. Innovation is haphazard, point and fragmentary. The IT market is static, there are no incentives for development. The main activity of IT companies remains service maintenance and simple developments with weak application prospects.

The professional background of the IT industry is almost static. Educational programs are irrelevant. in general, the professional level of industry employees is significantly lower than the level of the average IT specialist in developed countries. A narrow circle of employees of large organizations of the quasi-public sector and large business have new specializations and competencies.

There is a permanent mass brain drain abroad.

As noted at the beginning of the section, it is most likely that Kazakhstan will follow the path between the baseline and the positive scenario. In any case, we need to make every effort to do so.

PROFESSIONS OF THE FUTURE IN THE IT SECTOR OF KAZAKHSTAN



9.

PROFESSIONS OF THE FUTURE IN THE IT SECTOR OF KAZAKHSTAN

The transformation of the labor market in the IT sector, determined by technological trends, causes a cascade of professional metamorphoses

This is the emergence of new professions associated with scientific and technical innovations, the change in existing professions due to the need to adapt to new technological realities, as well as the disappearance of those specializations that are losing their relevance due to their automation. Within the framework of the technological foresight of competencies, the framework of this transformation was outlined by determining the characteristics of these ***3 categories of professions.***

The following sections of the Atlas reveal the essence of changes in the context of each category.

The new professions developed by the expert community are structured in relation to technological trends and the necessary skills, the horizons of their emergence or widespread distribution are highlighted, if they already exist, but in the form of a narrow functional, and not a separate profession.

NEW PROFESSIONS ECHO THE TRANSFORMING PROFESSIONS, which, having structurally changed, are being transformed into new specializations. That is, those specialists who belong to changing professions can count on updating their functions with a corresponding modernization of their skills and educational competencies.

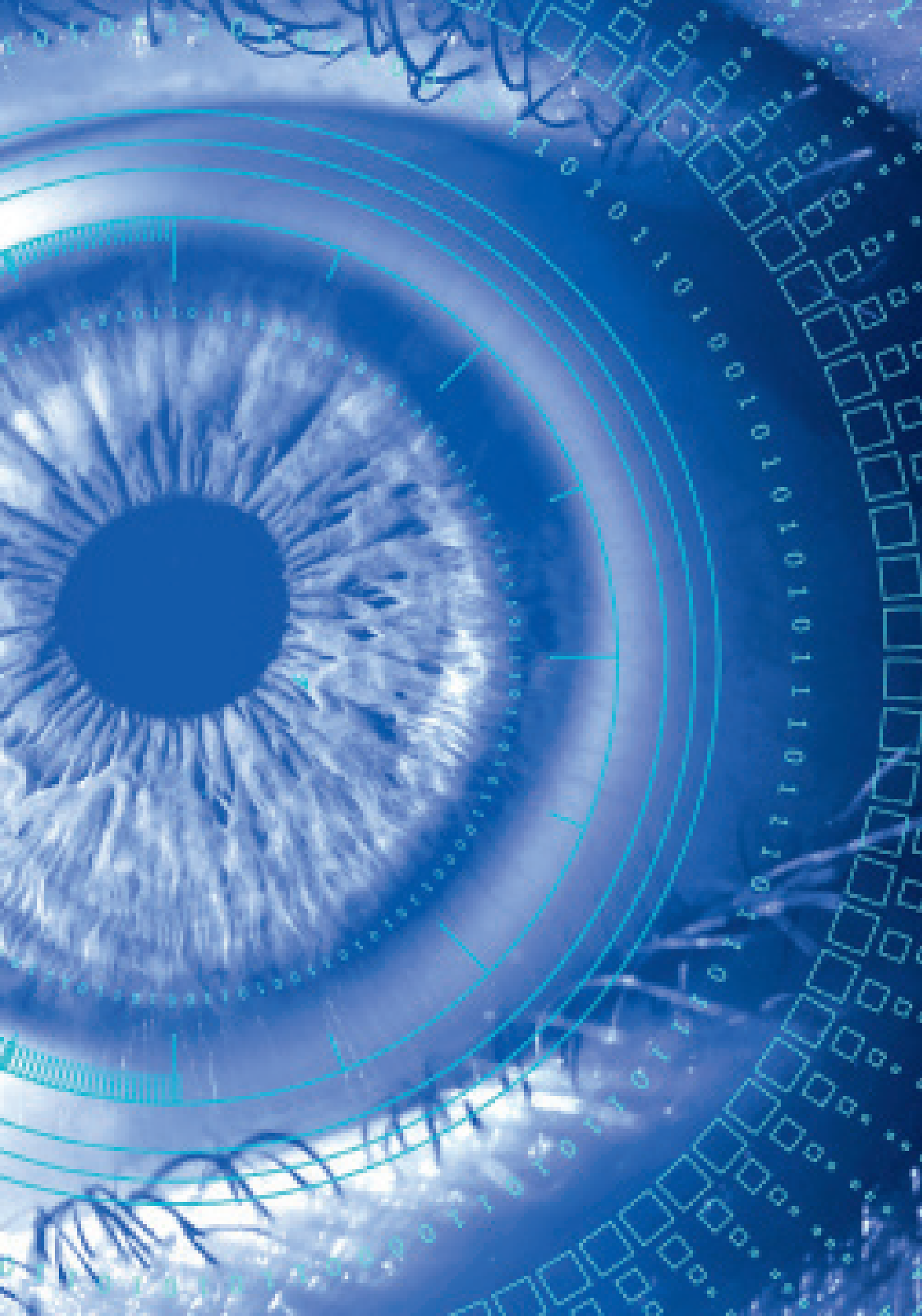
DISAPPEARING PROFESSIONS are those specializations that are most vulnerable to technological evolution due, first of all, to the possibility of replacing their functionality with innovations. Of course, we tried to take into account the specifics of the socio-economic, cultural and political realities of Kazakhstan and to approximate the forecast as much as possible to the most likely scenarios of the future.

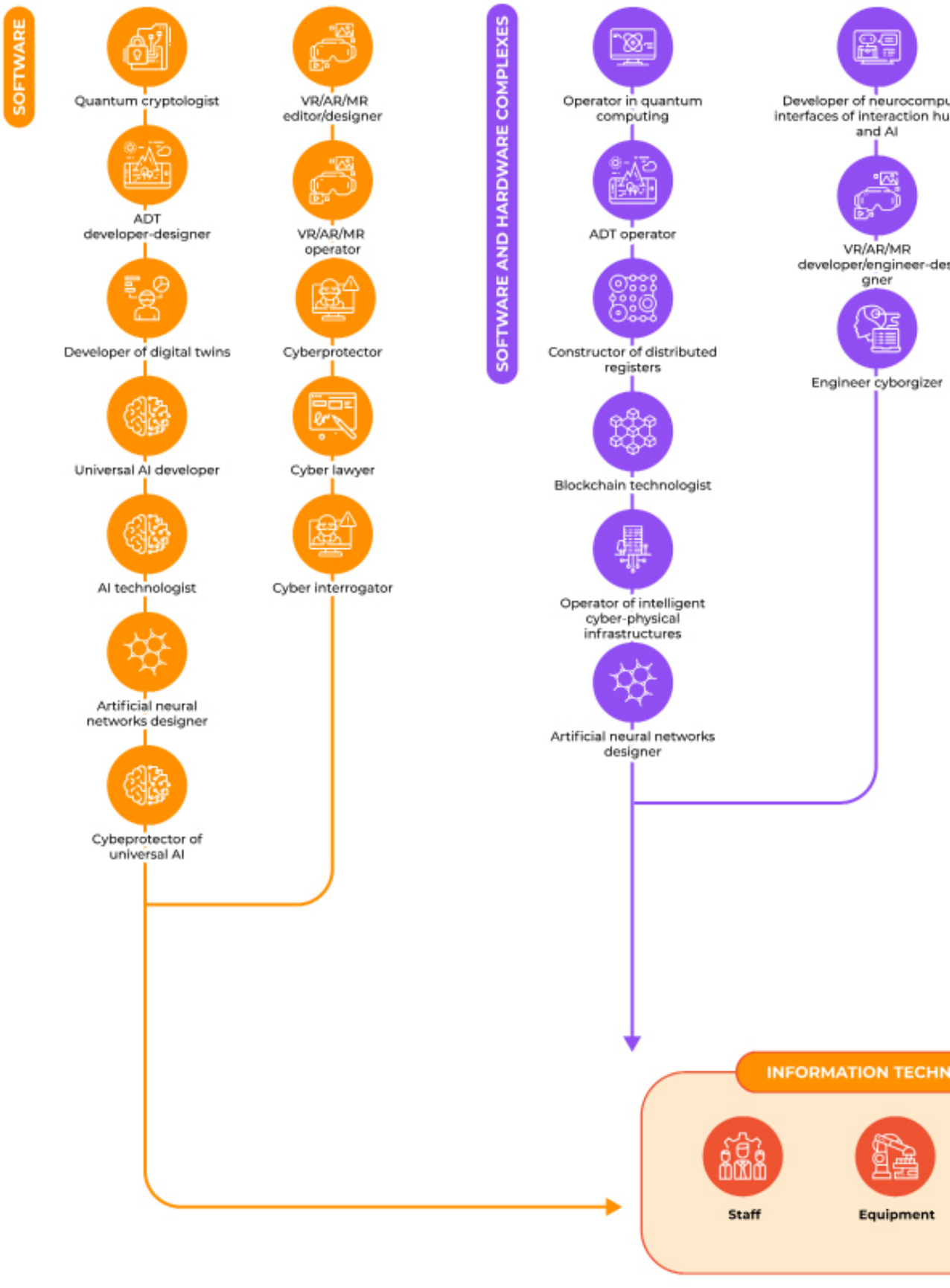
THE FORESIGHT HORIZON IS LIMITED TO THE YEAR 2040, ON THE THRESHOLD OF WHICH MANY EXPERTS FROM THE WORLD BY THE NAME OF A HISTORICAL PERSON BREAKTHROUGH IN THE NTP.

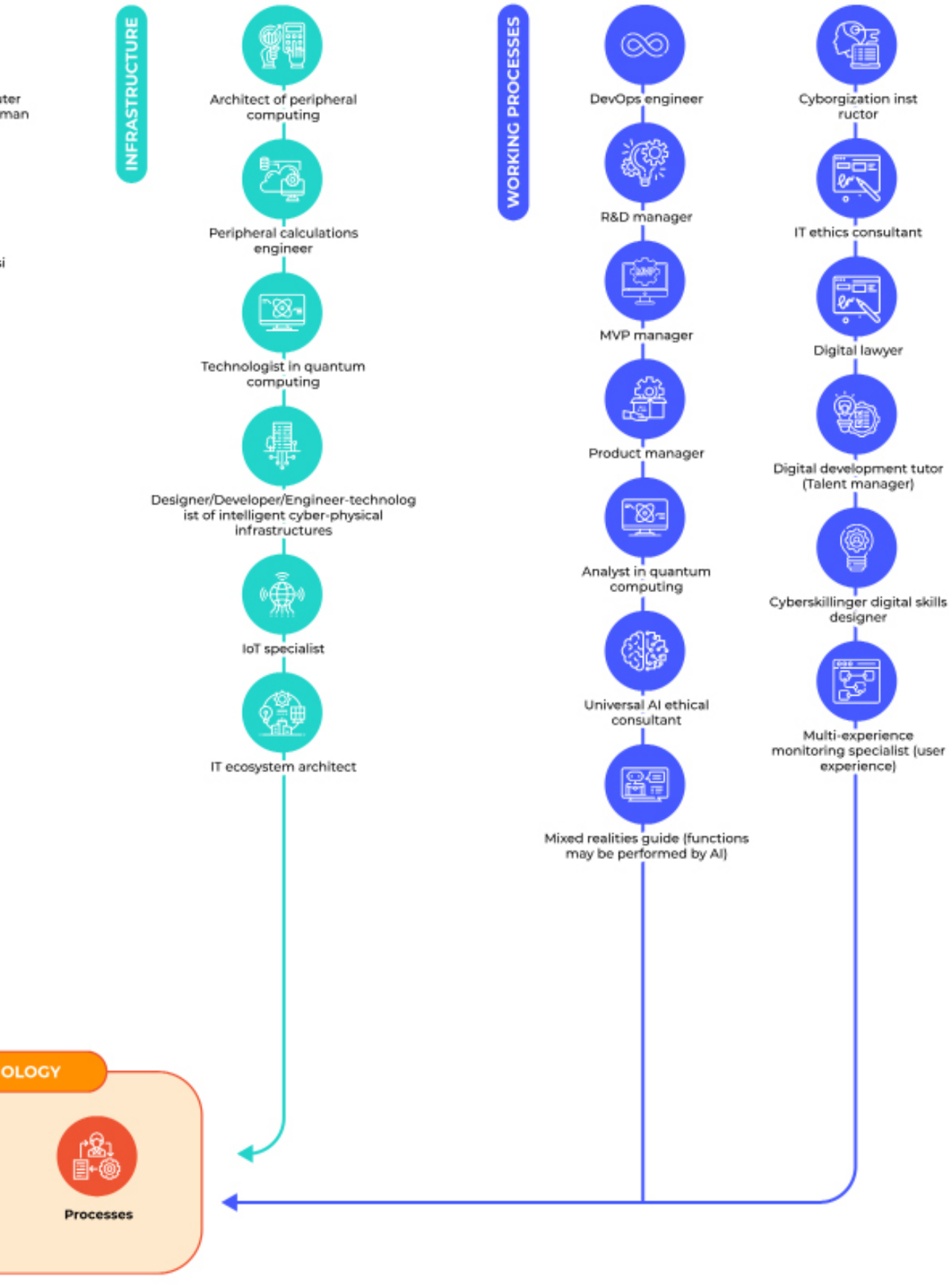
However, taking into account the pace of innovation in Kazakhstan, many specializations may emerge later than these dates. Despite this, it is necessary to start developing programs of basic educational training for them in 5-8 years.

NEW PROFESSIONS OF THE IT-SECTOR

9.1.




SOFTWARE
Quantum cryptologist
ADT developer-designer
Developer of digital twins
Universal AI developer
AI technologist
Artificial neural networks designer
Cybeprotector of universal AI
VR/AR/MR editor/designer
VR/AR/MR operator
Cyberprotector
Cyber lawyer
Cyber interrogator
SOFTWARE AND HARDWARE COMPLEXES
Operator in quantum computing
ADT operator
Constructor of distributed registers
Blockchain technologist
Operator of intelligent cyber-physical infrastructures
Artificial neural networks designer
Developer of neurocompu interfaces of interaction hu and AI
VR/AR/MR developer/engineer-des gner
Engineer cyborgizer
INFORMATION TECHN
Staff
Equipment


INFRASTRUCTURE
Architect of peripheral computing
Peripheral calculations engineer
Technologist in quantum computing
Designer/Developer/Engineer-technologist of intelligent cyber-physical infrastructures
IoT specialist
IT ecosystem architect
WORKING PROCESSES
DevOps engineer
R&D manager
MVP manager
Product manager
Analyst in quantum computing
Universal AI ethical consultant
Mixed realities guide (functions may be performed by AI)
Cyborgization instructor
IT ethics consultant
Digital lawyer
Digital development tutor (Talent manager)
Cyberskillinger digital skills designer
Multi-experience monitoring specialist (user experience)
OLOGY
Processes

9.1.
NEW PROFESSIONS IN THE IT SECTOR

New professions mean specializations that will appear on the IT labor market over the next 10-15 years. Their appearance will be due to the introduction of new technologies and the expansion of consumer preferences.

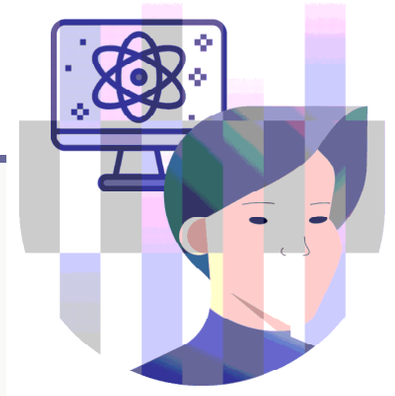
The functions of individual professions in a compressed form are already performed by IT specialists in our country.

But due to their increasing importance, complexity, and scale, these functions will inevitably evolve into separate professions. Some of these professions are already they exist in the world, but are not common in Kazakhstan, and some have yet to emerge in the Wake of the Fourth industrial revolution.

However, one thing is definitely clear – it is necessary to start preparing for their appearance in advance.

01

TECHNOLOGIST *IN QUANTUM COMPUTING*



- Develops and implements computer systems and networks based on the laws of quantum mechanics and quantum computing.

TRENDS

- innovation, digitalization and automation.

HORIZON *of appearance*

2030

NOVELTY *of the profession*

- the spread of quantum computing and the gradual replacement of traditional computer systems will require training of specialists with the skills to install, configure and service new equipment.

KEY COMPETENCE

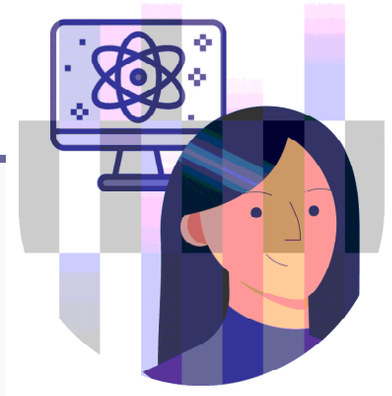
- design, development and installation of quantum computing systems;
- customization and tuning of quantum computing algorithms;
- software development for quantum computers and networks;
- technical and service maintenance of quantum computers and networks.

SUPER PROFESSIONAL *skills*

- programming, robotics and AI;
- systemic thinking;
- customer focus;
- project and process management

▶ 02

OPERATOR
IN QUANTUM COMPUTING



TRENDS

- innovation, digitalization and automation.

HORIZON *of appearance* ▶ 2030

NOVELTY *of the profession*

- The management of quantum computing systems will not initially be a generally available skill, but will fall on the shoulders of specially trained specialists.

- Performs current operational management of quantum computing systems – computing devices and networks at enterprises, deals with their maintenance, eliminates minor problems on a local scale, in the event of serious failures, organizes interaction with the supplier of quantum equipment and, together with quantum computing technologists, eliminates system errors.

KEY COMPETENCE

- management of quantum computing systems;
- monitoring of the current activity and state of quantum computing systems.

SUPERPROFESSIONAL *skills and abilities*

- programming, robotics and AI;
- systemic thinking;
- customer focus;
- project and process management.

▶ 03

ANALYST
IN QUANTUM COMPUTING

TRENDS

- innovation, digitalization and automation.

HORIZON of appearance ▶ 2030

NOVELTY of the profession

- continuous improvement and expansion of the capabilities of quantum computing will require permanent adaptation of its potential for certain tasks, which will require specialized workers.

- Analyzes the possibilities of optimizing and improving the efficiency of business processes usingquantum computing, forms a program for transformation and reorganization of quantum computing systems in enterprises.

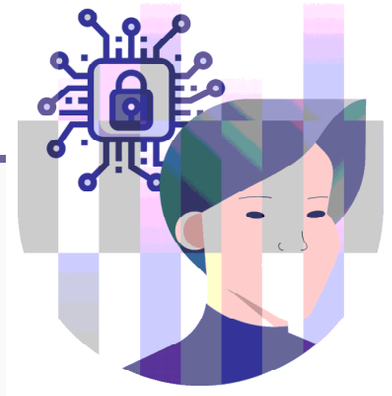
KEY COMPETENCE

- determination of directions and means of improving quantum computing systems and production processes of organizations, science-intensive research, supermassive computing, etc.
- development of projects for optimization and innovations in the field of quantum computing

SUPERPROFESSIONAL skills and abilities

- programming, robotics and AI;
- systemic thinking;
- customer focus;
- project and process management;
- cross-industry communication.

► 04



QUANTUM
CRYPTOLOGIST

- Studies the possibilities of data interception and protection in quantum networks, algorithmization and automation of quantum encryption.

TRENDS

- innovation, digitalization and automation.

HORIZON *of appearance*

► *2030*

NOVELTY *of the profession*

- the emergence and development of new data protection tools using quantum computing will require the training of a new layer of cybersecurity specialists proficient in various quantum cryptography tools.

KEY COMPETENCE

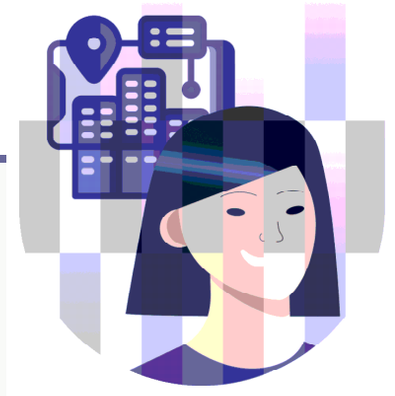
- encryption and decryption of data transmitted over quantum networks;
- development of quantum cryptography and security of quantum computing.

SUPERPROFESSIONAL *skills and abilities*

- programming, robotics and AI;
- systemic thinking;
- customer focus;
- project and process management.

► 05

ADT DEVELOPER DESIGNER
(AGGREGATED DIGITAL TWINS)



TRENDS

- innovation, digitalization and automation.

HORIZON *of appearance* ► *2030*

NOVELTY *of the profession*

- the structuring and convergence of the functionality of sets of multi-profile and multi-level digital twins will require training of specialists with a wide range of skills and competencies in the field of integration of highly complex digital systems.

SUPERPROFESSIONAL *skills and abilities*

- programming, robotics and AI;
- systemic thinking;
- customer focus;
- project and process management;
- cross-industry communication.

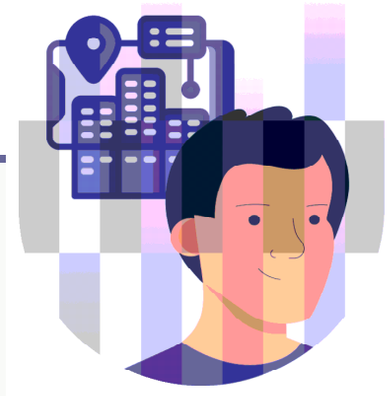
- Develops virtual models of products, businesses, and even cities to make it easier and more efficient to manage them. The designer creates a full-fledged large-scale compiled and dynamic digital copy of an object, with which you can carry out any manipulations, which will allow you to make accurate decisions in planning, design and development. For example, in urban planning, digital twins of cities will facilitate the development planning process, and a virtual copy of a plant allows you to simulate and optimize the location of workshops, equipment, and simulate emergency situations. In the IT sector itself, digital twins of complex systems, such as universal AI, quantum networks or intelligent cyber-physical infrastructures, will allow to visualize, optimize and simplify the processes of design, development, testing and debugging, etc.

KEY COMPETENCE

- configurative diagnostics, design and development of digital twins;
- customization and configuration of digital twins;
- expansion and integration of various digital twins, regardless of their profile and type.

► 06

ADT OPERATOR



TRENDS

- innovation, digitalization and automation.

HORIZON *of appearance* ► 2025

NOVELTY *of the profession*

- management of highly complex multi-profile digital systems requires a pool of specialist moderators who have skills in operational programming and customization of digital twins.

- Engages in current ADT management, monitoring and operational modeling.

KEY COMPETENCE

- management and coordination of ADT, modeling situations, projects, tasks, etc.
- monitoring the status and operability of the ADT;
- Operational level routine troubleshooting.

SUPERPROFESSIONAL *skills and abilities*

- programming, robotics and AI;
- systemic thinking;
- customer focus;
- project and process management;
- cross-industry communication.

► 07

DEVELOPER OF DIGITAL AVATARS

TRENDS

- innovation, digitalization and automation.
- transformation of consumer preferences and changing needs of the new generation.

HORIZON *of appearance* ► *2035*

NOVELTY *of the profession*

- the intensification of people's immersion in the digital space and the expansion of its functionality in relation to everyday life will lead to the need to create digital twins of people capable of solving many tasks, usually performed by people manually.

- Creates software and visual models of a person's personal digital twins, which take on some of the professional and household functions. For example, the avatar will be able to perform all computer manipulations for a person, while he himself will be engaged in creative tasks. Or, if a person needs to get some public service, he will not spend time on it, but will use the capabilities of a digital avatar. A digital avatar is a full-fledged representative of each person in digital reality. Initially, the technology of avatars will be based on immersive and neurotechnologies, and in the future it will become a full-fledged second «I» of each person in the digital space.

KEY COMPETENCE

- configurative diagnostics, design and development of digital avatars;
- monitoring the status and performance of avatars;
- software troubleshooting, as well as its improvement or change at the request of users.

SUPERPROFESSIONAL *skills and abilities*

- programming, robotics and AI;
- systemic thinking;
- customer focus;
- project and process management;
- multilingualism and multiculturalism.

► 08

CONSTRUCTOR
OF DISTRIBUTED LEDGERS

► Engages in the construction of distributed computing matrices and performs their operational coordination.

TRENDS

- innovation, digitalization and automation.

HORIZON of appearance ► 2025

NOVELTY of the profession

- the increasing complexity of trust architectures and the tendency to decentralize various highly complex computing processes lead to the proliferation of fundamentally new computing mechanisms, the development and implementation of which will require the training of specialized professionals.

KEY COMPETENCE

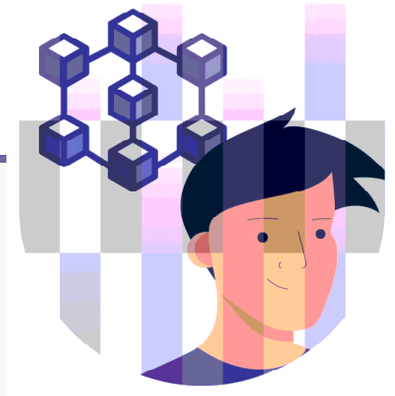
- development and implementation of distributed computing systems;
- organization of interaction between data processing centers;
- improving the PAK of distributed computing.

SUPERPROFESSIONAL skills and abilities

- programming, robotics and AI;
- systemic thinking;
- customer focus;
- project and process management;
- lean manufacturing.

09

BLOCKCHAIN-TECHNOLOGIST



A highly specialized blockchain specialist who integrates blockchain technology into business processes. Organizes internal and external interaction within the blockchain network, predicts the hashrate and complexity of calculations, tracks energy needs, and coordinates tasks for the network.

TRENDS

- innovation, digitalization and automation.

HORIZON *of appearance*

- exists in the world, will widely spread in Kazakhstan after *2025*

NOVELTY *of the profession*

- popularization of blockchain platforms and expanding the possibilities of their application in various fields necessitate the training of highly specialized specialists.

KEY COMPETENCE

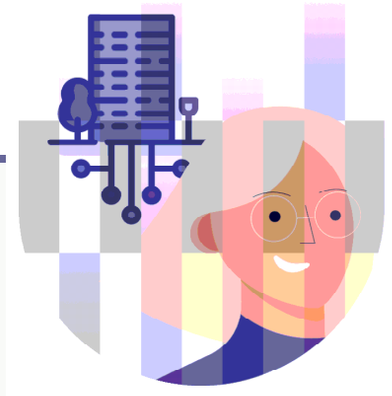
- development and integration of blockchain networks;
- building architecture and organizing interaction of numerous blocks;
- improving and extending the PAK of blockchain networks.

SUPERPROFESSIONAL *skills and abilities*

- programming, robotics and AI;
- systemic thinking;
- customer focus;
- project and process management;
- lean manufacturing.

► 10

DESIGNER, DEVELOPER, ENGINEER-TECHNOLOGIST
OF INTELLIGENT CYBER-PHYSICAL INFRASTRUCTURES



TRENDS

- innovation, digitalization and automation.
- transforming consumer preferences and changing the needs of a new generation.

HORIZON *of appearance* ► 2030

NOVELTY *of the profession*

- the complication and integration of various software and hardware complexes and computer systems into highly complex multi-profile IT ecosystems will require the involvement of highly specialized workers.

- Designs models, develops SOFTWARE, and Designs models, develops software, constructs highly complex cyber-physical environments (smart cities, smart highways, smart districts, smart industrial zones, etc.), in which all advanced technologies are involved. Combines and integrates disparate smart environments into a single matrix. For example, for large cities, these specialists create a complex cyber-physical infrastructure, which includes sensors for the Internet of Things and edge computing, AI, distributed registers, etc. for organizing transport management, security, housing and communal services, etc. based on the integration of individual «smart» houses, roads, enterprises, etc.

KEY COMPETENCE

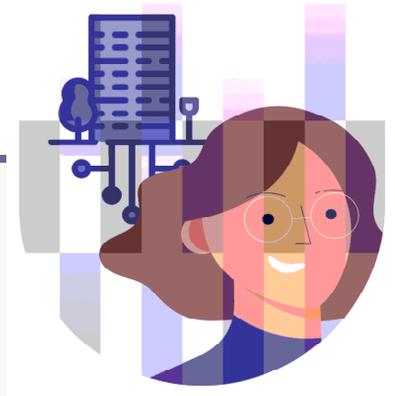
- design, construction of architectures, development and implementation of complex intelligent cyber-physical infrastructures;
- customization, configuration and integration of cyber-physical infrastructures of various levels, scales, profiles and types;
- improvement and expansion of software and hardware complexes of intelligent cyber-physical infrastructures.

SUPERPROFESSIONAL *skills and abilities*

- programming, robotics and AI;
- systemic thinking;
- customer focus;
- project and process management;
- cross-industry communication;
- lean manufacturing.

► 11

OPERATOR
OF INTELLIGENT CYBER-PHYSICAL INFRASTRUCTURES



- Deals with the current management of the intelligent system, monitoring its operation, setting and correcting tasks.

TRENDS

- innovation, digitalization and automation;
- transforming consumer preferences and changing needs of a new generation.

HORIZON *of appearance* ► 2030

KEY COMPETENCE

- management and coordination of intelligent cyber-physical infrastructures;
- monitoring the state and operability of infrastructures;
- operational level routine troubleshooting.

NOVELTY *of the profession*

- operational management of highly complex systems will require training of broad-profile specialists who are versed in various types of cyber-physical infrastructures.

SUPERPROFESSIONAL *skills and abilities*

- programming, robotics and AI;
- systemic thinking;
- customer focus;
- project and process management;
- cross-industry communication;
- lean manufacturing.

► 12

IOT SPECIALIST

► Multifunctional specialist engaged in designing the architecture of the Internet of Things, developing software for it, designing and setting up networks for the interaction of sensors and devices.

TRENDS

- innovation, digitalization and automation;
- transforming consumer preferences and changing needs of a new generation.

HORIZON *of appearance*

- will be widely distributed until ***2025***

NOVELTY *of the profession*

- proliferation of SMART technologies of various profiles and complexity, as well as their integration and interaction, will require the training of specialists with the skills to develop, configure and manage complex networks of autonomous data exchange and analysis.

KEY COMPETENCE

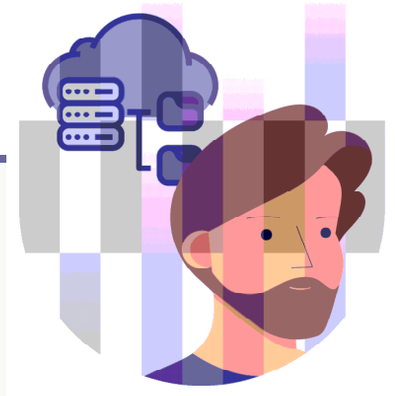
- design, construction of architectures, development and implementation of IoT networks;
- customization, configuration and integration of IoT networks of various levels, scales, profiles and types;
- improvement and expansion of the hardware and software complex of IoT networks;
- condition monitoring and routine maintenance of the hardware and software complex of IoT networks.

SUPERPROFESSIONAL *skills and abilities*

- programming, robotics and AI;
- systemic thinking;
- customer focus;
- project and process management;
- cross-industry communication.

► 13

ARCHITECT OF PERIPHERAL CALCULATIONS



TRENDS

- innovation, digitalization and automation.

HORIZON of appearance ► 2025

NOVELTY of the profession

- decentralization of data processing and the spread of new approaches to the interaction of data centers will require the construction of complex systems for the transmission and analysis of large amounts of data, which will require highly specialized specialists.

- Engages in the design, programming, deployment, and maintenance of Edge ecosystems. In IoT systems and highly complex intelligent cyber-physical infrastructures, they provide peripheral computing capabilities to optimize data analysis and filtering, minimize delays in workflows by reducing the response time between sensors, ensure data confidentiality, and reduce cloud storage capacity requirements by transferring part of the computing load to the periphery.

KEY COMPETENCE

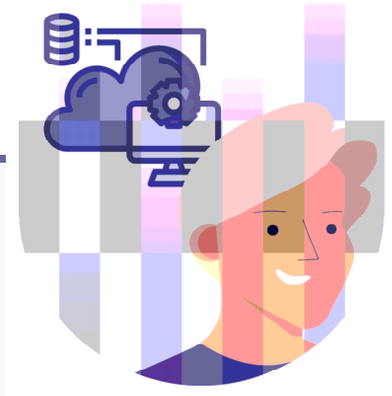
- design and development of peripheral computing systems;
- organizing the interaction of data centers and optimizing the computational load between the center and the periphery.

SUPERPROFESSIONAL skills and abilities

- programming, robotics and AI;
- systemic thinking;
- customer focus;
- project and process management;
- lean manufacturing.

▶ 14

PERIPHERAL CALCULATIONS ENGINEER



- Performs current operational management of the peripheral computing system, setting tasks, configuring and Troubleshooting peripheral devices..

TRENDS

- innovation, digitalization and automation.

HORIZON of appearance ▶ 2025

KEY COMPETENCE

- management of peripheral computing systems;
- monitoring the state and performance of peripheral computing systems;
- routine maintenance of peripheral computing systems.

NOVELTY of the profession

- traditional data centers will give way to new data processing mechanisms, installation, customization, management and maintenance of which will require special workers

SUPERPROFESSIONAL skills and abilities

- programming, robotics and AI;
- systemic thinking;
- customer focus;
- project and process management;
- lean manufacturing.

► 15

UNIVERSAL
AI DEVELOPER

- Develops algorithms and rules for analysis, decision-making, work, learning and self-learning, communication, interaction and development of universal AI.

TRENDS

- innovation, digitalization and automation .

HORIZON of appearance ► 2025

NOVELTY of the profession

- advances in AI and its evolution into an autonomous self-learning subject will require the involvement of highly specialized professionals

KEY COMPETENCE

- design and development of universal self-learning AI;
- creation of basic principles and standards for the work of universal AI;
- customization and adjustment of universal AI for specific primary tasks.

SUPERPROFESSIONAL skills and abilities

- programming, robotics and AI;
- systemic thinking;
- customer focus;
- project and process management;
- multilingualism and multiculturalism;
- cross-industry communication;
- artistic creation.

▶ 16

AI TECHNOLOGIST

TRENDS

- innovation, digitalization and automation.

HORIZON of appearance ▶ 2025

NOVELTY of the profession

- increasing capabilities and expanding the functionality of AI will lead to the emergence of a stratum of new employees who specialize in interacting with it in order to converge the potentials of human and artificial intelligence.

- Deals with operational moderation and management of AI in enterprises, monitoring, coordinating and configuring its work for specific tasks, and eliminating local errors and failures.

KEY COMPETENCE

- management and coordination of AI;
- monitoring the state and performance of AI;
- routine maintenance of the AI hardware and software complex.

SUPERPROFESSIONAL skills and abilities

- programming, robotics and AI;
- systemic thinking;
- customer focus;
- project and process management;
- multilingualism and multiculturalism;
- cross-industry communication;
- artistic creation.

► 17

ARTIFICIAL NEURAL NETWORK DESIGNER

- Designs models and develops the architecture of artificial neural networks for specific subject areas.

TRENDS

- innovation, digitalization and automation.

HORIZON *of appearance*

- will be widely distributed until *2025*

KEY COMPETENCE

- interaction with the primary recipient for the determination of configuration requirements, a range of potential problems and algorithms for their solution;
- designing neural networks, their basic customization and tuning;

NOVELTY *of the profession*

- it will be necessary to solve the problems of expanding neural networks as the basis for the operation of universal AI, which determines the need for specialists capable of constructing highly complex systems in the field of developing and improving AI.

SUPERPROFESSIONAL *skills and abilities*

- programming, robotics and AI;
- systemic thinking;
- customer focus;
- project and process management;
- cross-industry communication;
- artistic creation.

► 18

ENGINEER-DEVELOPER
OF ARTIFICIAL NEURAL NETWORKS

- Develops a PACKAGE for artificial neural networks, provides their installation and configuration.

TRENDS

- innovation, digitalization and automation.

KEY COMPETENCE

- development and installation of artificial neural networks;
- monitoring the state and performance of neural networks;
- routine maintenance of neural networks.

HORIZON *of appearance* ► 2035

SUPERPROFESSIONAL *skills and abilities*

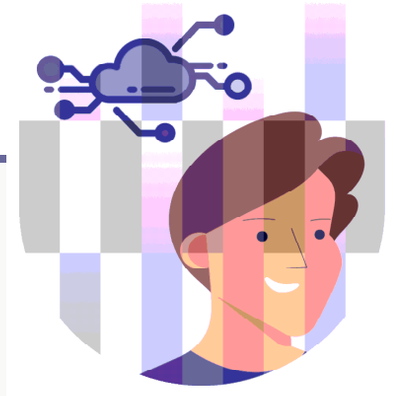
- programming, robotics and AI;
- systemic thinking;
- customer focus;
- project and process management;
- cross-industry communication;

NOVELTY *of the profession*

- it will be necessary to solve the problems of creating and customizing highly complex neural networks, for which specialized professionals will be needed.

▶ 19

DEVOPS ENGINEER



TRENDS

- innovation, digitalization and automation.

HORIZON *of appearance*

- currently required

NOVELTY *of the profession*

- revision of functional and process paradigms in the development of various IT products, convergence and cross-work of many different specialists will require the involvement of professionals in the field of aggregation and rationalization of processes.

- Implements and scales the DevOps methodology, synchronizing all stages and elements of the software development process from the code writing phase to the testing and release stage.

KEY COMPETENCE

- interaction with all components of the development process of a particular product;
- organization of effective collaboration and synchronization of product development stages.

SUPERPROFESSIONAL *skills and abilities*

- programming, robotics and AI;
- systemic thinking;
- customer focus;
- project and process management;
- cross-industry communication.

► 20

DEVELOPER
OF NEUROCOMPUTER INTERFACES OF HUMAN AND AI INTERACTION

- A narrow-profile specialist who designs and develops neurocomputer interfaces for organizing effective interaction between humans and AI.

TRENDS

- innovation, digitalization and automation;
- transforming consumer preferences and changing needs of a new generation.

HORIZON *of appearance* ► 2035

NOVELTY *of the profession*

- the trend of accelerating and facilitating the interaction of a person and various devices determines the evolution of two-way communication tools for biological subjects and computer objects, the development of which will lead to the emergence of new types of specializations in the field of IT and bioengineering.

KEY COMPETENCE

- development and installation of neurocomputer interfaces;
- customization of neurocomputer interfaces for the psychophysiological and cognitive profile of individual users;
- routine maintenance of neurocomputer interfaces..

SUPERPROFESSIONAL *skills and abilities*

- programming, robotics and AI;
- systemic thinking;
- customer focus;
- project and process management;
- multilingualism and multiculturalism.

▶ 21

UNIVERSAL
AI CYBER PROTECTOR

TRENDS

- innovation, digitalization and automation.

HORIZON of appearance ▶ 2030

NOVELTY of the profession

- the increasing complexity and expansion of the potential of AI, as well as the growing importance of its decisions against the backdrop of increasing cyber threats, will require the training of individual specialists involved in protecting AI.

- A narrow-profile specialist engaged in the development and maintenance of algorithms, systems for protecting AI from external influences - cyber threats aimed at hacking, deceiving or misleading AI in order to influence its decision-making process. A specialist helps AI to determine the direction, method and content of cyberattacks, correctly interpret and abstract them.

KEY COMPETENCE

- development of systems for protecting AI from external influences in order to reconfigure it;
- collaboration with AI for objectification and adequate assessment of external interactions;
- consulting AI in the field of self-defense.

SUPERPROFESSIONAL skills and abilities

- programming, robotics and AI;
- systemic thinking;
- project and process management;
- cross-industry communication.

UNIVERSAL
AI ETHICAL CONSULTANT

TRENDS

- innovation, digitalization and automation.

HORIZON *of appearance* ► 2030

NOVELTY *of the profession*

- the depth of AI penetration into everyday life and management of many processes, along with making strategically important decisions in various areas that directly affect the interests and values of people, will require the training of specialists who can interact with AI in the area of adequate assessment of its plans and actions.

- Together with the AI developer, they are engaged in machine learning, coordinating AI for compliance with certain ethical norms, building connections between the logical foundations of AI decisions and universal moral, ethical and value benchmarks to take into account all factors in solving tasks, including ethical dilemmas.

KEY COMPETENCE

- consulting AI on the conformity of certain decisions made to generally accepted moral norms and human values;
- improvement of the “ethical code” of universal AI;
- assisting AI in solving problems related to moral hazard.

SUPERPROFESSIONAL *skills and abilities*

- programming, robotics and AI;
- systemic thinking;
- project and process management;
- cross-industry communication;
- multilingualism and multiculturalism.

▶ 23

DEVELOPER, ENGINEERING DESIGNER
OF VR, AR, MR

- Deals with the development and improvement of technologies for transforming reality, constructs basic space templates, which are then used by editors and designers for specific tasks.

TRENDS

- innovation, digitalization and automation;
- transforming consumer preferences and changing needs of a new generation.

KEY COMPETENCE

- design of architectures and development of standard mutable digital realities;
- design and customization of virtual realities for the primary needs of customers.

HORIZON *of appearance*

- will be widely distributed until **2030**

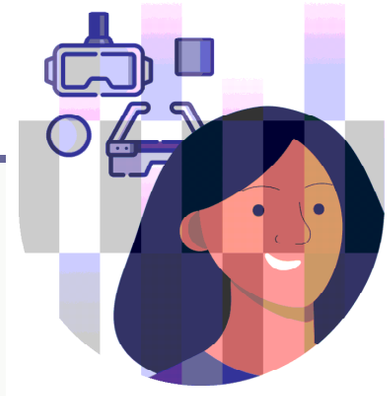
SUPERPROFESSIONAL *skills and abilities*

- programming, robotics and AI;
- systemic thinking;
- project and process management;
- artistic creativity;
- customer focus;
- cross-industry communication.

NOVELTY *of the profession*

- the gradual transition of the life of society and various groups of work processes to virtual reality will expand the functionality of specialists in this field and will lead to an increase in the need for highly specialized workers who create new digital realities.

▶ 24



VR, AR, MR
EDITOR, DESIGNER

- Provides operational editing, develops the design of virtual locations for organizations based on basic space templates.

TRENDS

- innovation, digitalization and automation;
- transforming consumer preferences and changing needs of a new generation.

KEY COMPETENCE

- development of design, elements and new locations in digital realities;
- ongoing editing of realities.

HORIZON *of appearance*

- will be widely distributed until **2030**

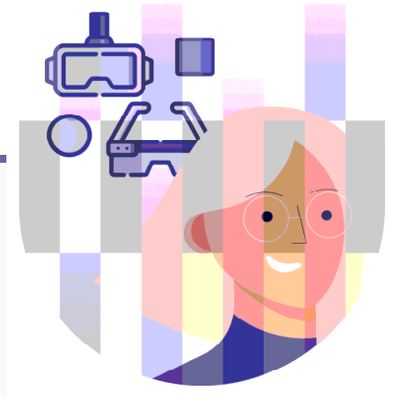
SUPERPROFESSIONAL *skills and abilities*

- programming, robotics and AI;
- systemic thinking;
- project and process management;
- artistic creativity;
- customer focus;
- cross-industry communication.

NOVELTY *of the profession*

- The digitization of ever larger types of activities and their immersion in virtual reality will necessitate operational moderation of locations and elements, which will require special workers with advanced technologies in the field of changing realities.

▶ 25



VR, AR, MR
OPERATOR

TRENDS

- innovation, digitalization and automation;
- transforming consumer preferences and changing needs of a new generation.

HORIZON
of appearance

- will be widely distributed until **2030**

NOVELTY
of the profession

- regulation and coordination of the activities of many subjects and objects in virtual realities, interaction with users and their consultation will require the training of specialized workers operating with advanced means of constructing realities.

- Provides operational coordination of locations, customization for current tasks and user requests. Eliminates errors, creates technical tasks for editors and designers based on data from the reality guide, and provides installation of innovations.

KEY COMPETENCE

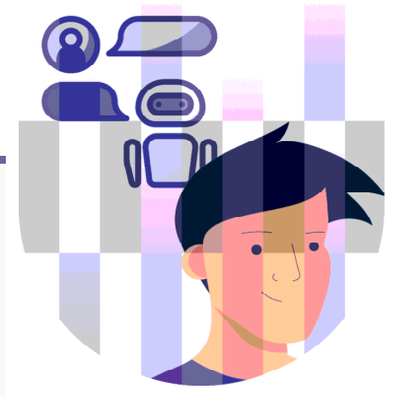
- operational management of realities;
- monitoring of the state of realities, user activities and the operation of elements.

SUPERPROFESSIONAL
skills and abilities

- programming, robotics and AI;
- systemic thinking;
- project and process management;
- artistic creativity;
- customer focus;
- cross-industry communication.

▶ 26

MIXED REALITIES GUIDE
(FUNCTIONS MAY BE PERFORMED BY AI)



TRENDS

- innovation, digitalization and automation;
- transforming consumer preferences and changing needs of a new generation.

HORIZON
of appearance

- will be widely distributed until **2030**

NOVELTY
of the profession

- constant expansion of locations and an increase in the number of users of various virtual realities determine the functionality of familiarization with them for newcomers, which may require separate specialists.

- Advises users on the technique of using spaces, moving around locations, acquaints with the rules and requirements. Summarizes and systematizes the requests and needs of users and organizations for transmission to the operator.

KEY COMPETENCE

- interaction and consultation of users;
- instruction in mastering new locations and manipulations.

SUPERPROFESSIONAL
skills and abilities

- programming, robotics and AI;
- systemic thinking;
- customer focus;
- cross-industry communication.

► 27

ENGINEER CYBORGIZER

TRENDS

- innovation, digitalization and automation;
- transforming consumer preferences and changing needs of a new generation.

HORIZON *of appearance* ► 2040

NOVELTY *of the profession*

- The trend of bionic convergence of humans and various invasive and non-invasive implantation devices through advanced IT will lead to the emergence of highly specialized IT and bioengineering professionals.

- Performs cyborgization of a person based on the data of cyborgization instructors. For example, the implantation of bionic limbs or exoskeletons, as well as their integration with neurocomputer interfaces. Cyborgization will determine the parameters specifications, tasks, and produces the process of cyborgization – implantation of electro-mechanical components.

KEY COMPETENCE

- installation of various types and profiles of electronic-mechanical bionic components;
- integration of components with a neurocomputer interface;
- customization of components for the psychophysiological and cognitive profile of individual users;
- routine servicing of components.

SUPERPROFESSIONAL *skills and abilities*

- programming, robotics and AI;
- systemic thinking;
- customer focus;
- multilingualism and multiculturalism.

▶ 28

CYBORGANIZATION
INSTRUCTOR

TRENDS

- innovation, digitalization and automation;
- transforming consumer preferences and changing needs of a new generation.

HORIZON *of appearance* ▶ 2040

NOVELTY *of the profession*

- solving problems in the field of organizing preparatory and adaptation procedures within the framework of human cyborgization.

- An individual consultant who creates a personal intellectual, physical, and psychoemotional portrait of the client, based on which he selects cyborg configurations for him and helps him prepare for the cyborgization procedure.

KEY COMPETENCE

- interaction with potential recipients to determine their needs and expectations from cyborgization procedures;
- drawing up an individual portrait and cyborgization plan of the recipient;
- basic preparation of recipients for the procedure;
- interaction with engineers and developers of neurocomputer interfaces in preparation for cyborgization.

SUPERPROFESSIONAL *skills and abilities*

- programming, robotics and AI;
- systemic thinking;
- customer focus;
- multilingualism and multiculturalism.

▶ 29

IT ETHICS CONSULTANT

TRENDS

- innovation, digitalization and automation;
- transforming consumer preferences and changing needs of a new generation.

HORIZON of appearance ▶ 2030

NOVELTY of the profession

- the deepening and expanding penetration of IT, as well as the accelerated pace of their evolution, lead to the need for a permanent and meticulous comparison of the vectors and opportunities for their development with different moral guidelines.

- Deals with ethical issues of IT development. Compares new IT with generally accepted norms in the field of ethics, morality, morality, ideological characteristics of various categories of people, informs users about certain software and hardware features they use IT that can infringe or offend their feelings and values.

KEY COMPETENCE

- ensuring that certain IT products comply with the moral and ethical standards of the majority of users through close interaction with developers;
- advising users on the observance of their rights, interests and moral principles by a certain product.
- maintaining ethical standards in the evolution of IT.

SUPERPROFESSIONAL skills and abilities

- programming, robotics and AI;
- systemic thinking;
- cross-industry communication;
- multilingualism and multiculturalism;
- customer focus.

DIGITAL LAWYER

TRENDS

- innovation, digitalization and automation;
- transforming consumer preferences and changing needs of a new generation.

HORIZON
of appearance

- will be widely distributed until
  2030

NOVELTY
of the profession

- the growing influence of the digital environment on the life of society leads to the need to regulate it, as well as to protect the interests of users both from technology and from the actions of other people.

- Engaged in legal support in the new digital reality. Develops legal acts regulating relations in the digital environment. Checks new IT for compliance with national legal acts of individual countries. Advises developers and users on compliance with the principles of security, transparency and data traceability. Performs investigative or advocacy functions in relation to IT offenses.

KEY COMPETENCE

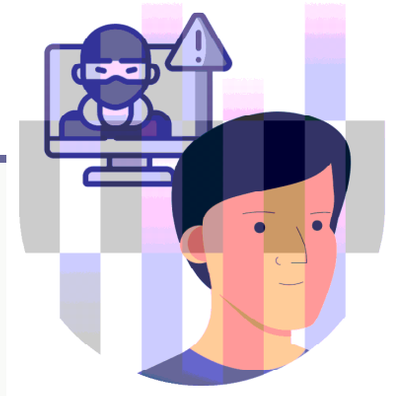
- improvement of regulatory support for scientific and technological progress in the field of IT;
- development and determination of the legal framework for IT development, taking into account the interests of end users;
- protection of the interests of legal entities and individuals in case of violation of their rights in the digital environment;
- comprehensive legal support for organizations closely related to IT.

SUPERPROFESSIONAL
skills and abilities

- programming, robotics and AI;
- systemic thinking;
- cross-industry communication;
- multilingualism and multiculturalism;
- customer focus.

▶ 31

CYBER INTERROGATOR



TRENDS

- innovation, digitalization and automation;
- transforming consumer preferences and changing needs of a new generation.

HORIZON *of appearance*

- will be widely distributed until *2030*

NOVELTY *of the profession*

- An increase in the threat of cybercrime, as well as an increase in the potential risks associated with it, necessitates the training of highly specialized professionals capable of working to counter illegal activities in the digital environment.

- Investigates digital crimes. An IT forensic scientist who monitors and analyzes new means, goals and channels for committing cybercrime and counteracts them through modern IT.

KEY COMPETENCE

- countering cybercrime;
- ▸ detection of cyberattacks, tracking and search for their sources, initiators and perpetrators;
- ▸ organization of constant monitoring of networks and computer systems for external interference.

SUPERPROFESSIONAL *skills and abilities*

- programming, robotics and AI;
- systemic thinking;
- cross-industry communication.

CYBERPROTECTOR

▶ A personal digital security guard who provides comprehensive security services to an individual user or organization in all types of interaction with IT, taking into account new vectors of IT development: human change, neural networks, mixed reality, AI, quantum computing and quantum cryptography, etc. Given that the means and depth of immersion of people and organizations in the digital environment will be increasingly complex and heterogeneous, the demand for this profession will constantly increase, and its representatives will have to constantly improve and master new specializations, and work closely with AI. The cyberprotector uses specialized SOFTWARE to provide permanent monitoring of its client's profile in the digital space, track external influences, contacts with other users, and AI.

TRENDS

- innovation, digitalization and automation;
- transforming consumer preferences and changing needs of a new generation.

HORIZON *of appearance*

- will be widely distributed unti ***2030***.

NOVELTY *of the profession*

- An increase in the threat of cybercrime, as well as an increase in the potential risks associated with it, necessitates the training of highly specialized professionals capable of providing comprehensive protection of the interests of various users in the digital space.

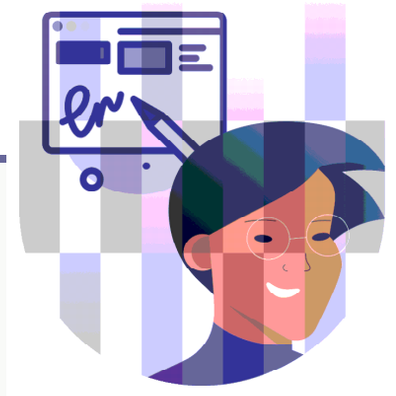
KEY COMPETENCE

- countering cybercrime in a personalized form for individual users;
- ensuring the client's security in all types and forms of interactions in the digital world (PC, networks, neuronet, etc.), including privacy requests.

SUPERPROFESSIONAL *skills and abilities*

- programming, robotics and AI;
- systemic thinking;
- cross-industry communication;
- customer focus;
- multilingualism and multiculturalism.

▶ 33



CYBER LAWYER

Provides comprehensive legal protection of the client in the digital space, virtual and mixed reality. In case of violation of the client's rights, defends his interests. Having a biometric portrait of the client, it can record his contacts with any devices in order to ensure that there is a permanent alibi in case of suspicion from law enforcement agencies in relation to the client.

TRENDS

- innovation, digitalization and automation;
- transforming consumer preferences and changing needs of a new generation.

HORIZON *of appearance*

- will be widely distributed unti ***2030***.

NOVELTY *of the profession*

- an increase in the number of various offenses committed with the help of IT, as well as the expansion of opportunities to discredit people for various purposes, along with the improvement of regulation of activities in the digital environment, create conditions for the emergence of new functionality of human rights activities in terms of protecting the rights and interests of users in various instances.

KEY COMPETENCE

- advising clients on the safety and legality of certain manipulations and actions in the digital environment;
- legal support for clients in case of violation of their interests in the digital environment;
- protection of clients' interests in authorized bodies.

SUPERPROFESSIONAL *skills and abilities*

- programming, robotics and AI;
- systemic thinking;
- cross-industry communication;
- customer focus;
- multilingualism and multiculturalism.

R&D-MANAGER

R&D manager develops technology development strategies for IT companies and innovation programs. Forms project teams for the implementation of effective technological solutions. The specialist constantly monitors the progress in the field of IT and other knowledge-intensive industries, the advanced achievements of which he integrates into the business processes of the company. The key task is to ensure business efficiency through systemic technological re-equipment and modernization, for which such a manager is constantly looking for new ways, methods and tools.

TRENDS

- innovation, digitalization and automation.

HORIZON *of appearance*

- currently required

NOVELTY *of the profession*

- intensification and deepening of scientific and technological progress in the field of IT leads to the need for continuous improvement and expansion of the tools used in IT companies, the permanent study of the potential of which is progressively becoming a separate line of activity.

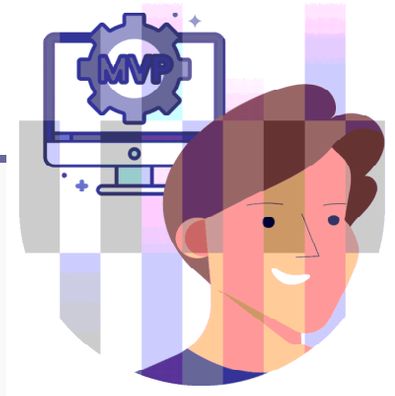
KEY COMPETENCE

- monitoring of scientific and technological progress in the field of IT, innovation, improvement, advanced and promising developments at domestic and foreign markets;
- development of programs for innovation and technical re-equipment of companies, assessment of certain advanced achievements for the feasibility of their implementation in the current business processes of IT companies;
- organizing effective interaction of various services in the process of introducing innovations;
- ensuring the smoothness and rationality of innovation.

SUPERPROFESSIONAL *skills and abilities*

- programming, robotics and AI;
- systemic thinking;
- cross-industry communication;
- customer focus;
- multilingualism and multiculturalism;
- project and process management.

▶ 35



MVP-MANAGER

TRENDS

- innovation, digitalization and automation.

HORIZON *of appearance*

- need now

NOVELTY *of the profession*

- the complexity and hybridization of the development of various IT products necessitate the rationalization and optimization of this process using modern approaches and operational practices.

- The MVP manager is responsible for the development process from a position of ensuring its market prospects. His task is to organize a smooth but rapid evolution of the product, building all processes and interactions so that at each, even a small segment, the product acquires more and more value and demand. At the same time, the traditional technical task as a rigid tool for regulating and setting goals fades into the background, giving way to flexible planning, which creates room for maneuver and product development, taking into account new ideas and opportunities. In the context of rapid scientific and technological progress and market growth, such specialists will be important from the point of view of product management at all stages of its development and further improvement.

KEY COMPETENCE

- ensuring the efficiency and rationality of the development process of a particular product;
- organization of effective cooperation of various components of the development process at all stages;
- ongoing operational modifications of the product in order to ensure that it meets the expectations of the end user.

SUPERPROFESSIONAL *skills and abilities*

- programming, robotics and AI;
- systemic thinking;
- cross-industry communication;
- customer focus;
- multilingualism and multiculturalism;
- project and process management.

▶ 36

PRODUCT-MANAGER

TRENDS

- innovation, digitalization and automation, changing consumer preferences.

HORIZON *of appearance*

- currently required

NOVELTY *of the profession*

- high competition and the intensity of development of various IT products determine the need for specialists who actively study the expectations of the market, users, industries and adapt the development process to current and future demands.

- Product managers will be one of the most popular specializations in the future. However, given the cross-cutting nature of IT development and distribution, they will have to be well-versed in a wide range of professional areas, know the specifics of many sectors of the economy and potential market needs. Such specialists will be responsible not only for the product creation process, but also for its demand. One of the main tasks is to predict before launching a project whether its final result will be in demand. For this managers should permanently and deeply study the market, consumer interests, competitors, form pricing policy, product requirements, build a marketing campaign and so on.

KEY COMPETENCE

- organizing market research to assess the potential demand for a particular product, as well as searching and identifying current market requests;
- generating ideas and ways to improve IT products;
- ensuring the market viability of the product by maintaining an interest in it.

SUPERPROFESSIONAL *skills and abilities*

- programming, robotics and AI;
- systemic thinking;
- cross-industry communication;
- customer focus;
- multilingualism and multiculturalism;
- project and process management.

▶ 37

DIGITAL
DEVELOPMENT TUTOR (TALENT MANAGER)

TRENDS

- innovation, digitalization and automation, changing consumer preferences, changing needs of generations Y and Z.

HORIZON *of appearance*

- after *2025*

NOVELTY *of the profession*

- the intensification of IT development and the expansion of their range lead to the need to rationalize educational processes in this area through the use of best practices.

- The specialist is a professional IT mentor. He possesses the skills of an IT specialist and a teacher, builds a training program for beginners who have not previously encountered IT professionally. In addition, these professionals will be looking for promising talent who could become outstanding industry professionals in the future.

KEY COMPETENCE

- search and selection of potentially valuable personnel in school, academic and business environments;
- organization of collective training on advanced techniques «from scratch».

SUPERPROFESSIONAL *skills and abilities*

- programming, robotics and AI;
- systemic thinking;
- cross-industry communication;
- customer focus;
- multilingualism and multiculturalism;
- artistic creation.

▶ 38

CYBER SKILLINGER - DIGITAL SKILLS DESIGNER

- Personal trainer for IT. Unlike a tutor who trains many beginners, this specialist works with personal clients. He forms a personal list of competencies that will need to be mastered by his ward based on his knowledge, skills and goals, and then consistently teaches him the necessary skills.

TRENDS

- innovation, digitalization and automation, changing consumer preferences, changing needs of generations Y and Z.

HORIZON *of appearance*

- after *2025*

NOVELTY *of the profession*

- solving problems in the field of meeting the need for personal training of IT specialists of a deterministic profile.

KEY COMPETENCE

- development of special training courses in priority areas in the field of IT, the most suitable for a particular patron.
- organization of IT training both «from scratch» and in the presence of a certain background, as well as building personal training programs for those benefiting from the existing knowledge and skills.

SUPERPROFESSIONAL *skills and abilities*

- programming, robotics and AI;
- systemic thinking;
- cross-industry communication;
- customer focus;
- multilingualism and multiculturalism;
- artistic creation.

▶ 39

IT ECOSYSTEMS ARCHITECT

TRENDS

- innovation, digitalization and automation.

HORIZON *of appearance*

- currently required

NOVELTY *of the profession*

- solving problems in the field of hyperintegration and hybridization of digital systems of various directions into a single multi-profile platform.

- The increasing complexity of digital platforms and cyber -physical infrastructures necessitates the training of specialists who are responsible not for one specific area or function, but for creating, configuring and regulating large ecosystems consisting of many different packages. Designing and developing highly complex multi-profile ecosystems that include many functions, maintaining their performance and consistent development will be the main activities of these specialists.

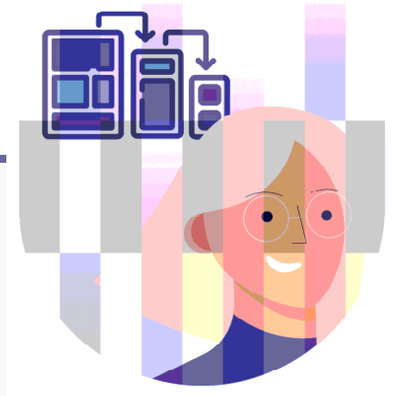
KEY COMPETENCE

- Computer Science,
- Informatics and computer technology,
- Programming and software engineering,
- Pedagogy and psychology.

SUPERPROFESSIONAL *skills and abilities*

- programming, robotics and AI;
- systemic thinking;
- cross-industry communication;
- customer focus;
- lean manufacturing.

▶ 40



MULTI-EXPERIENCE
MONITORING SPECIALIST (USER EXPERIENCE)

- Improving and expanding the means of human-IT interaction, changing the perception of the IT development process lead to a deepening of the user experience, which is increasingly evolving into the so-called multi-experience. In the future, the experience of human interaction with digital reality will be multimodal and multisensory. Immersive technologies, neurocomputer interfaces and hybridization of intelligence will become key areas and tools for human and IT collaboration. This means that specialists will be required who will permanently observe, track and evaluate mass reactions to certain products and developments in order to determine the vector of their further development.

TRENDS

- innovation, digitalization and automation, changing consumer preferences.

KEY COMPETENCE

- Computer Science,
- Informatics and computer technology,
- Programming and software engineering,
- Information and cyber-physical systems,
- Applied Sociology,
- Psychology.

HORIZON *of appearance*

- after *2035*

NOVELTY *of the profession*

- the forced immersion of society in the digital environment and the acceleration of the pace of mastering new technologies lead to the need to train specialists who deeply study the reactions and attitudes of people to advanced IT, the forms and channels of user interaction with them.

SUPERPROFESSIONAL *skills and abilities*

- programming, robotics and AI;
- systemic thinking;
- cross-industry communication;
- multilingualism and multiculturalism;
- customer focus.

TRANSFORMING PROFESSIONS IN THE IT SECTOR

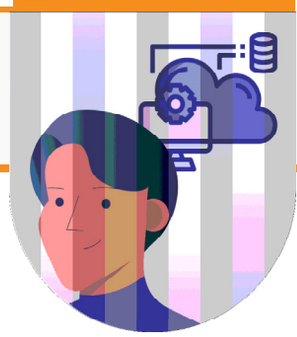
9.2.

9.2.
TRANSFORMING PROFESSIONS IN THE IT SECTOR

Technological re-equipment is a consistent long-term process. Many of the tasks currently performed by IT professionals can be automated, but will also require human involvement as a supervising operator.

In such cases, the functionality of these specialists will not disappear immediately, but is transformed into a higher-level set of tasks associated with the management of certain processes. Routine operations will be transferred to AI and various innovations, while the IT professionals themselves will be able to concentrate on intellectual and creative tasks and overall coordination.

2030



01

DATABASE ANALYST

INTELLIGENT DATABASE OPERATOR

- Analysis of databases against the background of their permanent increase and complication is becoming more and more difficult for the human mind. AI progressively displaces a person from this functionality, limiting his presence only to setting tasks.

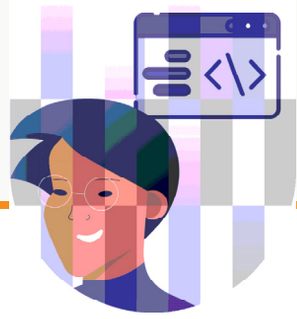
TRIGGER

- increase in data flow and metadata.

DIFFERENCE

- If a database analyst was required to have a deep knowledge of data management, then the operator will only need to be able to interact with the AI, in particular, clearly formulate tasks and have a clear idea of the final result.

2035



02

SPECIALIST IN DRAFTING, GRAPHIC INTERFACE ARCHITECTURE DEVELOPMENT

DEVELOPER OF NEURO INTERFACES

- The transition from traditional control interfaces to neural interfaces will force graphic developers to retrain and master neuroengineering.

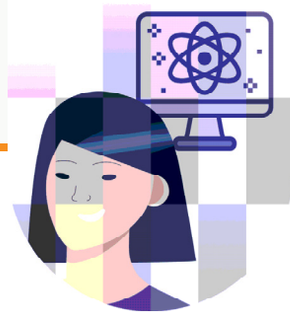
TRIGGER

- human cyborgization.

DIFFERENCE

- Neurointerfaces– a fundamentally new control mechanism based on bio-and neuroengineering, the management of systems directly by a person through brain impulses. Conventional graphical interfaces are evolving into virtual ones, and their developers will have to learn how to work with AI and hybrid intelligence, neural connections and virtual reality.

2030



03

DATA ENCRYPTOR

QUANTUM CRYPTOGRAPH

- Given that quantum technologies will eventually replace traditional data protection tools, cryptographers will have to master a new field of quantum cryptography.

TRIGGER

- Expanding the requirements for IT security and improving the means to ensure it.

DIFFERENCE

- The difference from modern cryptographers is that quantum cryptographers have an in- depth knowledge of quantum physics and quantum computing.

2030

04

NETWORK, SYSTEM ANALYST

INTELLIGENT CYBER-PHYSICAL SYSTEMS ANALYST

- The increasing complexity of network infrastructures and the integration within their framework of many innovations, such as IoT, PC, distributed ledgers, etc., as well as the increasing penetration of this AI functionality will require network, system analysts to radically transform into broad specialists with a flexible set of skills on interaction with AI, as well as the organization of intra-network communications between many infrastructure components - sensors, peripheral computing devices, etc.

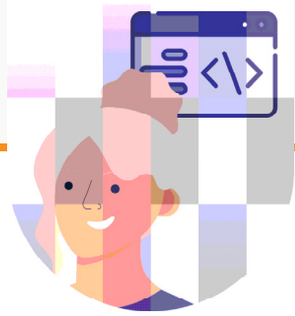
TRIGGER

- Increase in data flow and metadata q.
- IT infrastructure complication and hybridization.

DIFFERENCE

- If the earlier network, systems analysts engaged in the organization of network communications and preparation of technical specifications for their optimization in terms of networks at the horizontal level, then in the future, they will have to deal with complex networks that have many levels from primary sensors to data centers, which will require them to have in- depth skills in cross-functional interaction and AI management.

2035



05

WEB DEVELOPER

DEVELOPER OF REALITIES

- Websites will be completely replaced by VR, AR, and MR technologies in the future, and their developers will have to learn how to design and change realities.

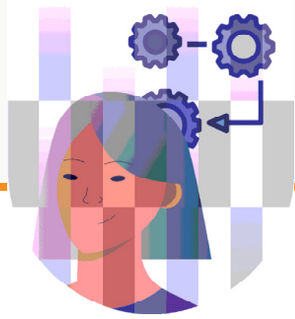
TRIGGER

- Virtualisation of life.

DIFFERENCE

- A reality developer must have a much broader toolbox than an average web developer who already relies heavily on web programming patterns. In virtual realities, you will have to use the potential of AI, quantum computing and quantum cryptography, as well as organize the interaction of thousands of users.

2030



06

SYSTEM, NETWORK ADMINISTRATOR

OPERATOR OF INTELLIGENT CYBER-PHYSICAL SYSTEMS

- The operator is a narrow-profile specialist who will not need a thorough knowledge of all the systems he controls. All operations for it will be performed by AI, monitoring the work of which will become the main task of these IT specialists, and data on the state of systems will be supplied by the IoT. At the same time, this specialist must be proficient in DevOps practice, be able to deploy and configure equipment, integrate different systems, make software adjustments, detect and fix AI errors.

TRIGGER

- Increase in data flow and metadata;
- IT infrastructure complication and hybridization.

DIFFERENCE

- If earlier system administrators themselves monitored, diagnosed and analyzed the state of networks and devices, now these tasks will be performed by AI, and the operator will coordinate and monitor its work, for which he will need management skills and interaction with AI.

DISAPPEARING PROFESSIONS IN THE IT SECTOR

9.3.

9.3.
DISAPPEARING PROFESSIONS IN THE IT SECTOR

Automation of many IT work processes, primarily through the participation of AI and the introduction of numerous operational templates, leads to the deactualization of many of the skills of modern IT professionals. Of course, this does not mean that their functionality will be fully assigned to automated systems. But the number of specialists performing these functions will be consistently reduced.

In the IT sector, given its special intellectual and technical properties, the disappearance of professions will not be a general process. However, some specializations will gradually lose their relevance in the labor market of this industry. Based on the NCO, the experts identified occupations that, in the horizon of the next 10-15 years, will be most exposed to the risk of replacement and, as a result, further disappearance.

01

WEBSITE ADMINISTRATOR

- Site management will also fall on the shoulders of AI. Given that communication with users will also be its competence, the AI will be able to provide fast and efficient site administration, analyze traffic, generate and upload relevant content, etc.

▸ 2030

02

WEB-SITE TECHNICIAN,
WEB-MASTER, WEB-TECHNICIAN

- Specialists who maintain the functioning of sites will also be supplanted by AI, which will be able not only to monitor the working dynamics of sites, but also to eliminate system failures. Moreover, the ever deeper immersion in virtual reality will cause the disappearance of websites, and hence the specialists in their maintenance.

▸ 2030

03

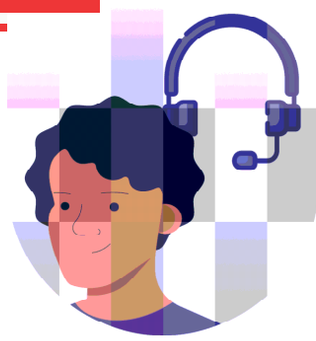
WEB PAGES
DEVELOPER

- The proliferation of web templates, as well as the increased use of AI in programming, will contribute to the de-actualization of this specialization. And if web design can remain a zone of creative activity to a certain extent, then website development will eventually become the prerogative of AI. In addition, in the distant future, due to total virtualization, the websites we are used to will become unnecessary.

▸ 2030

▶ 04

CALL CENTER OPERATOR
FOR SUPPORTING ICT USERS



- Technical support operators will be replaced by AI. Their profile implies a limited set of practical situations that can be fully studied and, therefore, solved by them.

▶ 2030

▶ 05

ICT USER
SUPPORT CONSULTANT

- Likewise with operators, technical support consultants will be replaced by AI. Despite the possibility of non-standard situations, their spectrum is not so large that a self-learning AI over time would not be able to cope with them.

▶ 2030

▶ 06

SUPPORT
SERVICE ANALYST

- Working with user requests requires an initial analysis to identify the causes of certain failures. This functionality can be fully performed by a self-learning AI much more quickly and efficiently than by a human, which will lead to the disappearance of this type of activity.

▶ 2030

07

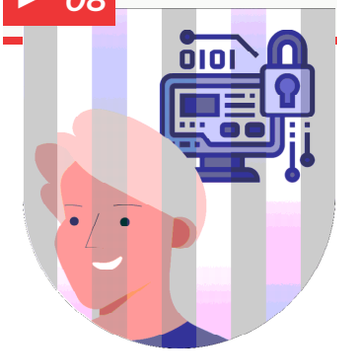
SPECIALIST
IN TECHNICAL SUPPORT OF INFORMATION AND COMMUNICATION SYSTEMS

- Network health diagnostics will be based on IoT technology, which will generate a permanent stream of metadata. The AI will analyze this data, as well as provide further consulting and technical support.

2030

08

MASTER
IN DIGITAL INFORMATION PROCESSING



- In the future, data processing will become the exclusive field of AI activity, which will be able to generate, process, and analyze supermassive data streams, which, in principle, a person is not capable of.

2030

09

SYSTEMS
CONSULTANT

- Specialists who provide consulting services will give way to AI, which, based on deep data analysis, will be able to provide comprehensive information and instructions for users on any request. Chatbots already advise users of web services, systems, and applications on a wide range of emerging issues. The assistance of a human consultant in such cases is only rarely required, and with the advent of a universal AI capable of rapid self-learning, their participation will be minimized.

2030

COMPETENCES OF NEW PROFESSIONS IN THE IT SECTOR

10.

COMPETENCES OF NEW PROFESSIONS IN THE IT SECTOR

The professional background of the IT sector in Kazakhstan is heterogeneous. Many specialists of different levels and profiles are involved in all sectors of the economy. And, as our expert community notes, despite the existence of problems in the field of education, in recent years there has been an improvement in the training of IT specialists. This was stated by 42.5% of respondents, including business representatives.

At the same time, almost 20% stated the absence of any changes, and 4.8% pointed to the deterioration of professional qualifications of employees in the industry. About 33% of experts noted multidirectional dynamics depending on their specialties. Respondents who noted the decline in professional qualifications of employees, as the main reasons, highlight the low level of quality of higher education, the outflow of qualified personnel and unclear prospects for personal growth IT professional.

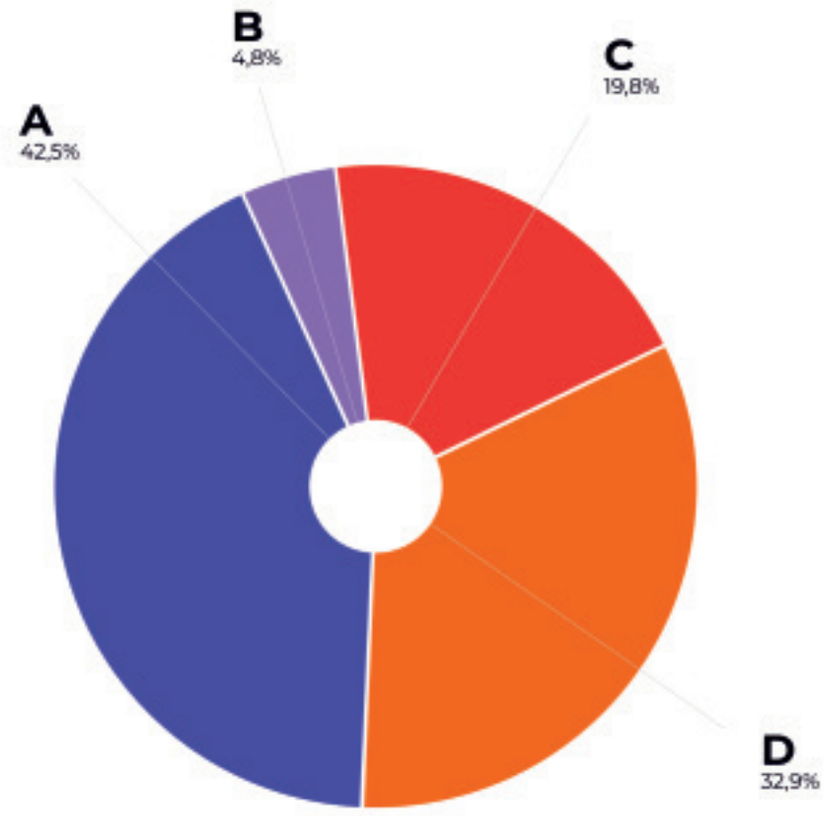
Improvement of professional qualifications, as shown by the study, is mostly associated with independent training of IT specialists, who are trying to actively master new specializations and systematically strengthen their potential as employees, expanding the set of competencies.

In the future, harmonious convergence of the so-called "hard and soft skills" will be of fundamental importance for the demand for specialists in the labor market.

The degree of balance and depth of their development will depend on employment, career promotion, social and business relationships.

Diagram 10.1.

Share of answers by respondents to the question «How has the level of professional qualification of industry specialists changed in recent years (%)?



- *Better.*
- *Got worse.*
- *Remains unchanged.*
- *In some specialties the qualification has improved, in others it has deteriorated.*

Sources: Industry experts survey

Given the rapid transformation of the industry, one of the key characteristics of the IT specialist of the future will be the ability to quickly learn regardless of the level of professional qualification and permanent readiness for it.

If the IT specialist of the future considers himself an all-knowing professional and therefore rejects the need for growth, no matter how high-class he may be, his competitiveness will inevitably fall.

Similar processes occur in all industries and lead to a change in the model of education and vocational training. If earlier the main scheme was the so-called industrial model, which is characterized by the algorithm «school - college - university - higher school», now the paradigm is changing towards the model of lifelong education.

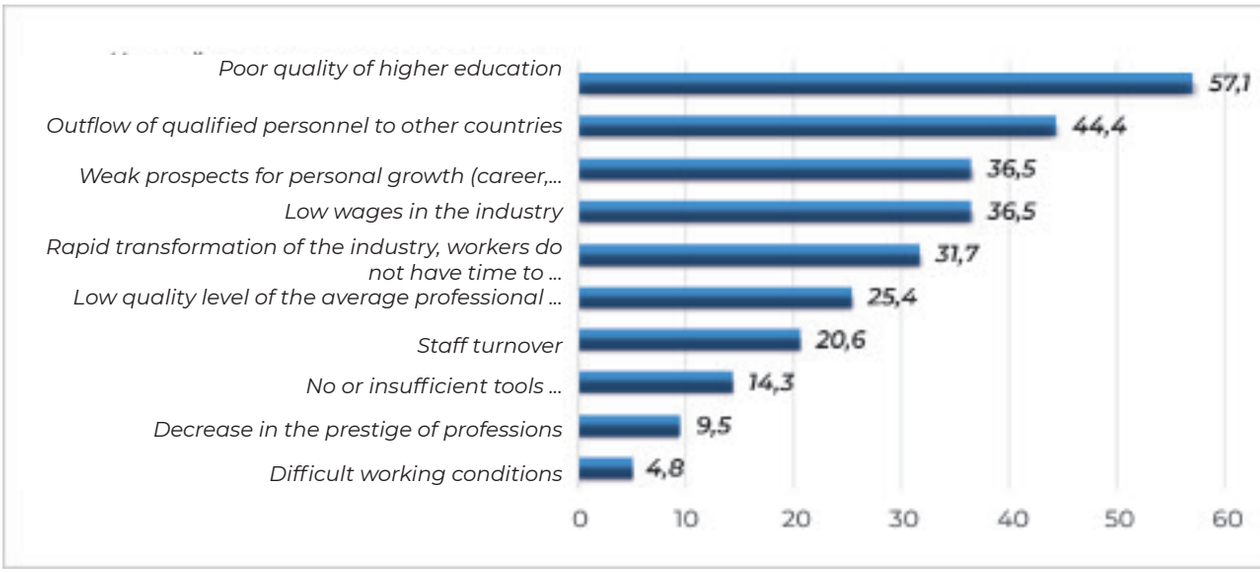
The result of the paradigm shift will be a complete transition to a new qualification model, which implies continuous training, innovation and re-profiling of IT specialists.

If previously they could be narrow-profile employees, then in the future they will be required to have a wide range of competencies.

The following section discusses in detail the required competencies in the market labor of the IT sector of the future.

Diagram 10.2.

Distribution of answers to the question «What has caused deterioration of professional qualification of personnel in the IT industry?



Sources: Industry experts survey

Distinctive features of the old model:	Distinctive features of the new model will become:
1. Obtaining education in youth. 2. One lifetime education. 3. Long-term training in the received specialty from three to five years depending on the level of education. 4. Fundamental theoretical training. 5. After receiving education, advanced training is optional, it is not necessary, exceptions are established by law. 6. The training system is localized in an educational institution. 7. The new model of education has not yet been formed, and various authors describe it differently.	1. Continuous education of mixed age groups: it will become the norm to acquire a new profession in adulthood. New teaching methods will be created, taking into account the age characteristics of students: weakening of memory, a higher level of responsibility and perseverance. 2. Appearance of different duration programs from ultra-short (10-15 hours) to ultra-long programs. 3. Globalization of the educational space: (on the one hand, residents of the regions will have more opportunities for access to quality education. Moving to the capital or highly developed countries will no longer be the only opportunity to get a specific education, for example, in biology, astrophysics, etc. There will be more equal opportunities). 4. Emergence of educational ecosystems and unified thematic educational platforms in the country (unified medical, engineering and other platforms uniting classical universities).

As we all know, all professions are based on a certain range of competencies that form the basis of professional skills.

In the 21st century, various skills of a general nature related to interaction with data, technology, and people are on a par with basic competencies, such as specialized and additional education. This Atlas has identified the key supra-professional skills that will be required by the IT professionals of the future, which have been categorized as follows:

- social and personal skills;
- thinking styles (thinking skills);
- technical skills;
- functional skills.

SKILLS OF A FUTURE SPECIALIST:

1 THINKING SKILLS (STYLE OF THINKING)

In the face of increasing mental workload associated with the need to process a huge amount of data, the complexity of the IT infrastructure, the expansion of the list of sources and aggregators of information, the cognitive skills of workers of all levels, from a simple programmer to project managers, are coming to the fore.

In addition, more and more functionality falls on the «shoulders» of AI, which actively expands the depth and scale of its penetration into all areas of activity.
AI becomes a direct competitor to human mental abilities. Now IT mainly performs template iterative operations, but as IT becomes more complex and develops the ability to self-study, AI will be able to compete with humans in the field of cognitive properties.

Despite the fact that while his potential is significantly limited, in the future he will be able to practically completely perform mental operations that are specific only to humans, including creative ones. And therefore, for the specialists of the future, it becomes extremely important to

develop their thinking abilities. And if analytical, systemic and logical thinking are the first links in the chain of absorption by artificial intelligence, then such paths of thought movement as creativity, generation of meanings, critical and visionary thinking will be the prerogative of a person for a long time to come.

Nevertheless, in the horizon of the next 10-15 years, according to the expert community, analytical and systems thinking will retain their leading positions among the mental characteristics of an IT specialist.

However, creative and critical thinking will become increasingly important.

2 SOCIAL AND PERSONAL SKILLS

The second important component of the professional portrait of an IT sector worker in the future will be his personal abilities, as well as the ability to interact with the outside world. Competition, selectivity and customer personalities, constant change of scenery, diffusion of technologies and work formats - all this makes a person's personal skills of critical importance.

If earlier he could become isolated around the implementation of a narrow-profile functional, being confident in his relevance, now it is vitally important for him to constantly develop. And in this context, personal properties are of particular importance. These characteristics include such important features of employees as the ability to quickly learn and retrain, situational adaptability, the ability to work in a team, etc.

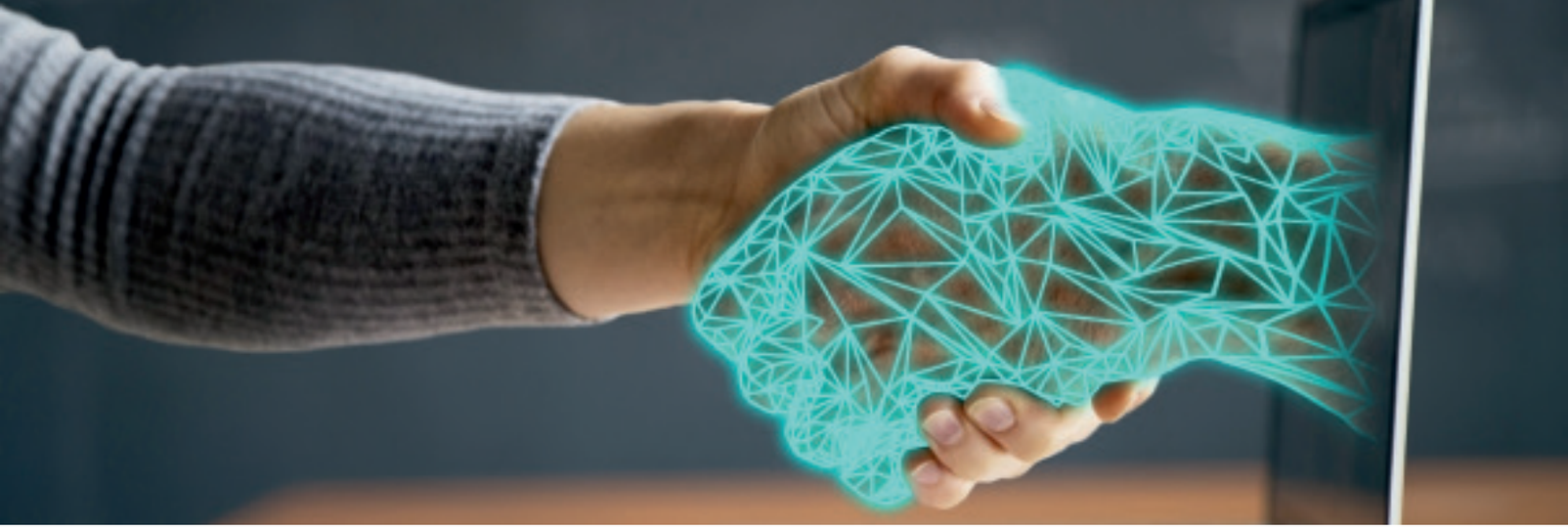
These are key skills that will ensure continued relevance and stability.

The new format of work of business structures presupposes the presence of multiple and highly active communications running on completely different contexts. Employees will need to be able to navigate these realities, and easily find common ground with the multitude of stakeholders and stakeholders.

3 TECHNICAL SKILLS

Interaction with modern technologies is one of the key competencies of the future. Scientific and technical progress and innovations have raised the ability to handle technical innovations to the rank of an absolute basic requirement, without which it will be simply impossible to find a job in the future.
New digital reality, AI, Big Data, IoT, robots and other scientific achievements have penetrated all sectors of the economy and spheres of human life. This is especially evident in the IT sector. If an employee does not know how to operate with them, it is impossible to call him qualified. If he cannot use them effectively, he will never be considered highly skilled. For the IT professional, skillfully handling innovation is in fact a fundamental competence.

For an IT professional, skilful handling of innovation is actually a fundamental competence. It needs to work closely with a huge amount of data, programs, and hardware, and use their capabilities to perform a wide variety of tasks.



Among the most important technical skills, experts attributed such skills as processing and analyzing BigData, designing, programming and servicing robots, programming in several languages, creating, customizing, maintaining, interacting with AI, as well as deep knowledge in the field of cyber defense.

4 FUNCTIONAL SKILLS

In the 20th century, large corporations entered the international market. The activities of any company are focused on consistent scaling. It is impossible to survive in modern realities without it.

The consolidation of organizations has led to a complete transformation and the creation of intra-corporate cultures and procedural ecosystems based on complex models of vertical and horizontal interaction. As a result, the work of any individual employee becomes not a separate important component in the production chain, as it was in the industrial era, but a dynamic link in a complex communication system that presupposes close contact with other links.

In the 21st century, this format is evolving into digital platforms and hyperstructured business models that imply the multi-profile of any company. Now any company from any sector of the economy, striving to develop successfully, will increasingly evolve into an IT company with certain vectors of activity.

Of course, the new format implies the need for certain corporate functional competencies, such as the development and implementation of technical innovations, working in conditions of uncertainty, mastering the methods of flexible planning and process management, as well as building cross-functional communication channels and broad technological awareness.

Employees who are fluent in a set of key functional competencies will become the locomotive for the development of the IT sector, its main management link.

10.1.
OVERVIEW OF FUTURE COMPETENCIES

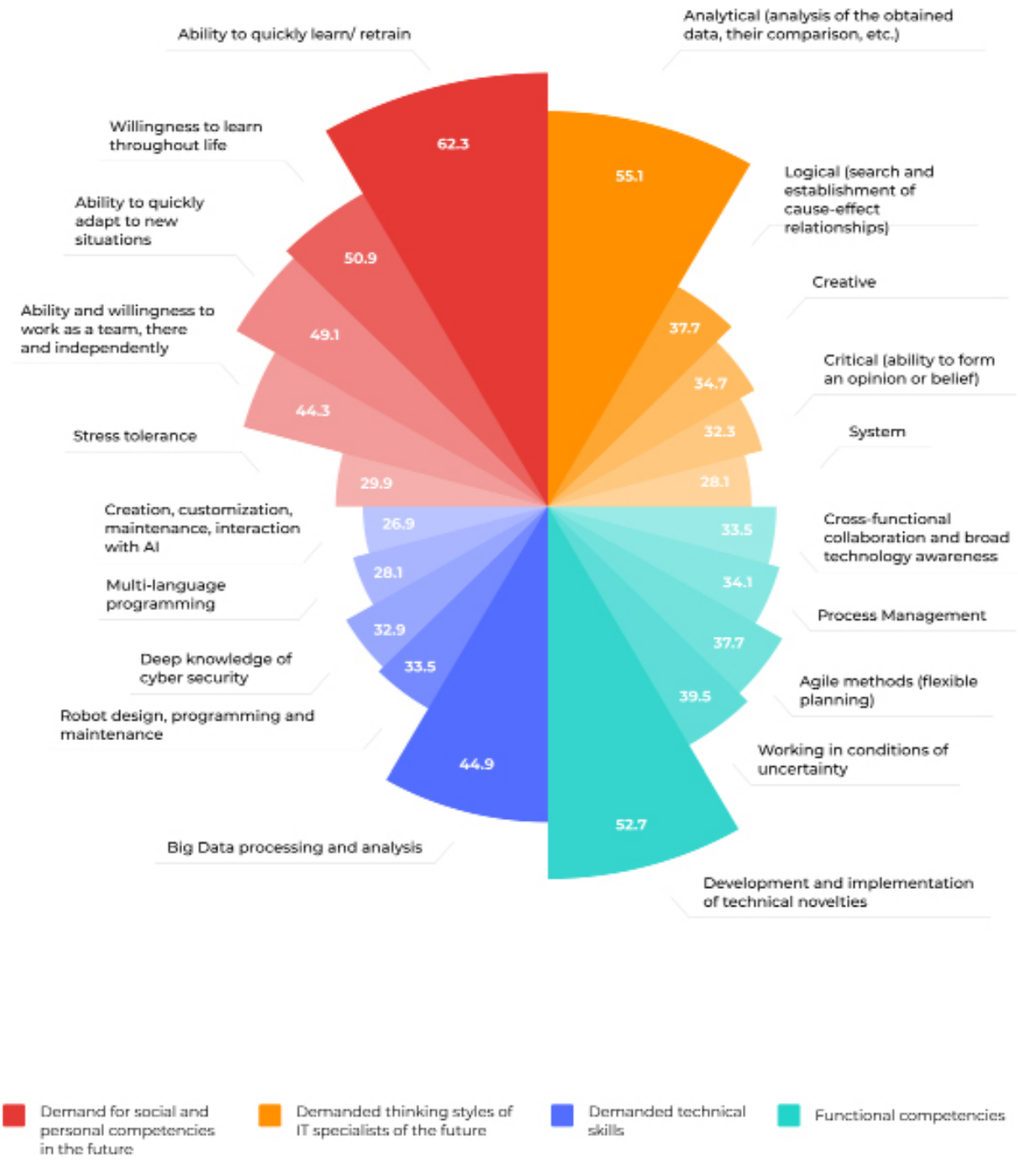
As we all know, all professions are based on a certain range of competencies that form the basis of professional skills.

This Atlas has identified the key competencies that will be required by the IT professionals of the future, which have been subdivided into categories:

- social and personal skills
- styles of thinking;
- technical skills;
- functional skills in corporate governance.

Figure 10.1.

Competencies of future IT specialist



7 SOCIAL AND PERSONAL SKILLS

What personal traits will determine the success and effectiveness of the IT industry worker in the future? According to industry experts, the most important will be the ability to quickly learn and retrain, situational adaptability, the ability and willingness to work in a team and alone, as well as stress resistance.

1.
ABILITY FOR FAST LEARNING AND RE-TRAINING, AS WELL AS WILLING TO LEARN DURING THE WHOLE LIFE.

62.3% of experts consider this ability to quickly master new things as one of the main personal characteristics of the employee of the future. In addition, according to the respondents, the willingness to learn constantly, throughout life is also important. 50.9% consider it an important indicator.

The knowledge and skills that everyone possesses tend to rapidly de-actualize. They become obsolete against the background of scientific and technological progress and the diffusion of technologies into the economy and everyday life.

Therefore, the key to the demand for a specialist in the market will be the ability to quickly learn a systematic nature. The transition to a lifelong learning model emphasizes the importance of this ability. People who expect that their profession will be unchanging and permanently needed do not have the full picture of what is happening and may be left behind in the future. Continuous improvement of their qualifications in the same direction is no longer a guarantee of demand, due to the fact that as a result of digitalization, automation and robotization, its functionality may simply become unnecessary.

At the same time, the tools used by specialists are constantly expanding, which is also a catalyst for the learning process. After all, if you ignore new trends, do not follow technological innovations and innovations introduced in the industry, there is a great risk of being unemployed, since all companies will strive for constant technological innovation, which is the key to survival.

2.
SITUATIONAL ADAPTABILITY

49.1% of respondents believe that the skill of quickly navigating and adapting to constantly changing conditions and situations will be one of the most demanded characteristics of IT workers.

Constant opportunistic changes, one after the other problems that need to be solved, unforeseen circumstances caused by both their own actions and external influences, require future specialists to develop the skill of quick orientation in any situation. The ability to not only adapt, but also derive some benefit in the form of either direct benefit or valuable experience will become an important personal skill. The ability to discern opportunity in threat, to see potential in risk and to realize it will be an important criterion in future recruitment.

3.
ABILITY AND WILLING TO WORK BOTH IN A TEAM AND OFFLINE.

44.3% of experts believe that an IT industry worker will need close functional interaction skills. Indeed, IT projects are becoming more complex and multidisciplinary. One person in most cases will not be able to cope with the workload and a wide range of tasks, especially if he is a highly specialized employee.

At the same time, he must be able to work alone, without looking back at how the work is progressing in other areas. Even if his functions depend on the work of other colleagues, he will be required to find opportunities to optimize stuck processes and continue to work autonomously.

An IT worker must quickly join new teams, but at the same time be able to take responsibility for his specific scope of work, without trying to «tie» it to the functionality of other employees.

4.
STRESS RESISTANCE.

Almost 30% of respondents indicate the importance of this personal characteristic in the future.

High workload, a wide range of functions, the need for constant training, interaction with many people, the frequent occurrence of unforeseen situations and other factors put significant emotional pressure on employees.

Employers will pay special attention to the psycho-emotional characteristics of workers. Resistance to mental overload will become one of the defining conditions for employment and career advancement.

The employee should be well aware of where the line of his positive and stable perception lies, and what stress factors can cause a negative reaction. His future will depend on how he copes with the psycho-emotional stress.

2 IN-DEMAND FUNCTIONAL SKILLS (STYLE OF THINKING)

Logical and systems thinking, the ability to analyze large amounts of data, think creatively and critically, according to the industry expert community, will be the most demanded cognitive skills of an IT worker in the future.

1. ANALYTICAL AND LOGICAL THINKING

The overwhelming majority of respondents believe that an analytical mindset, coupled with the ability to think logically, will become the main requirement for a specialist wishing to work in the IT field.

This is due to the increase in functionality, the need to work with a large amount of information, as well as to solve complex problems.

Logical thinking allows you to identify hidden cause-and-effect relationships, which means that you can find the root of problems and predict possible scenarios for the development of a particular situation.

In turn, analytical thinking contributes to the competent structuring, systematization and identification of the most important aspects in the process of solving certain problems.
In the field of managing complex information systems and programs, as well as handling large amounts of data, these skills are essential.

Big data analytics will become one of the most widely demanded technical skills in the future. Although the main burden will fall on AI, making the final decision will remain the prerogative of a person, which means that the ability to study, think logically, compare and highlight the main things will be extremely important personal skills of the IT specialist of the future.

2. CREATIVE, CREATIVE THINKING.

As discussed above, in the IT sector, many operations are automated.

Templates and design options are emerging to optimize work that used to require hard work. In the future, AI will increasingly intrude into this field of activity, leaving a person with a zone of creativity and creation of ideas.

34.7% of the respondents to this study indicate that an IT worker must be able to think creatively, go beyond established patterns, create something new, non-standard. This is quite natural for an industry that is at the forefront of scientific and technological progress. After all, if IT specialists do not create, but only use what they have, the world will stop developing.

3.
CRITICAL THINKING.

32.3% of experts believe that the ability to critically look at any information, situation, opinion, opportunity and threat will be one of the key thinking skills in the future.

Critical thinking involves checking any information coming from outside. Modern IT has entangled us with a dense web of information of all kinds. We know a little about everything. But at the same time, the ability to perceive information adequately, to pass it through the prism of sober assessments and analysis is not typical for everyone.

In the IT arena, the critical thinking skill will be especially important against the backdrop of the rapidly growing volume of data, as well as the increasing influence of machines as sources of decision-making.

4.
SYSTEM THINKING.

28.1% of respondents consider this type of thinking to be one of the most demanded for the IT sector of the future.

In this area, it is important to take into account many factors and constantly changing conditions, to add details to the big picture, based on which to make decisions. The skill of thinking systematically, one might say “from top to bottom”, will be one of the defining skills of a professional portrait of the worker of the future.

Considering the many links and components in the creation and operation of one or another IT solution, the skill of seeing the situation on a scale, the ability to assess the threat or possibility of a particular situation for the entire range of tasks, will become important skills of an IT worker.

3 IN-DEMAND TECHNICAL SKILL

The main selection criterion and a condition for the professional growth of an IT sector employee will be technical knowledge. Moreover, if earlier he could remain a narrow-profile specialist, then in the future he will need to constantly master new technical innovations, which he had not previously encountered and did not consider his field of activity.

1.
PROCESSING AND ANALYSIS OF BIG DATA.

The expert community considers the skill of working with large amounts of data to be the most important. Almost 45% of the respondents classified it as such. Digitization will lead to a dictate of data that will constantly generate a huge and ever-growing stream of raw and unstructured information. With the help of various tools and systems, specialists of the future will be able to efficiently process, analyze and use these data sets for decision-making.

The main direction of work in this area will be the management of over-aggregated digital infrastructures, which is impossible without the skill of working with big data.

2.
DESIGN, PROGRAMMING AND MAINTENANCE OF ROBOTS.

RPA is becoming a ubiquitous trend. Moreover, robots mean not only automation systems, but also physical mobile devices. According to 33.5% of experts, the skills of designing, programming and maintaining robots in the future, as they penetrate into all areas, will become more and more in demand. Robots will replace humans in manufacturing, in the transportation sector, and even in the process of writing complex codes. Already, robots are key instruments in the financial sector, performing more than 97% of all transactions in the stock market. They will also be able to automate programming processes.

Specialists who know how to create robots will be highly demanded workers in the labor market of the IT sector.

3.
DEEP KNOWLEDGE IN THE SPHERE OF CYBER DEFENSE

32.9% of respondents believe that this competence will be one of the main technical skills of a specialist of the future. The cross-cutting nature of IT, the degree of

dependence on them of all sectors of the economy and the life of the state and society require increased attention to ensuring security. In the future, any IT professional must understand cyber threat countermeasures, the variations and scope of which are steadily expanding.

Cyber defense will become one of the main areas of activity for IT companies in the market. Constant competition and the need to improve the tools for its provision will be the determining reasons in the selection of IT personnel not only in the IT sector, but also in all spheres of the economy.

4.
PROGRAMMING IN MULTIPLE LANGUAGES.

28.1% of experts believe that for a highly skilled worker in the industry, the ability to program in multiple languages will be critical. Their complication and expansion of the spectrum will lead to a significant transformation of traditional programmers, who, as a rule, specialize in one or two specific profiles.

With the penetration of AI, templates and software design, new languages will appear less frequently. However, the expansion of the areas of their application and the tightening of the specifics will require IT professionals to be proficient in a whole set of different languages to perform tasks of various kinds.

5.
CREATION, CUSTOMIZATION AND INTERACTION WITH AI.

This is not surprising, since AI is the main driving force and direction of technological development. Its capabilities in the future can expand to unthinkable limits, surpassing the potential of the human mind.

As it improves, the role of specialists who can interact with it, develop neural networks and machine and deep learning algorithms, and customize AI for specific tasks will increase. With the advent of universal self-learning AI, the functionality of workers associated with it will become the most important in the industry. The ability to maintain control and direct the work of the AI along the required trajectory will be an extremely important technical competence in the future.

4 IN-DEMAND FUNCTIONAL COMPETENCIES (CORPORATE SKILLS)

With the complexity of administrative and bureaucratic systems and continuous innovations, it will be important for the employee of the future to be able to organize the development and implementation of technical innovations, to work in conditions of uncertainty, to be flexible in planning their activities, and also to build close cross-functional interaction.

1. DEVELOPMENT AND IMPLEMENTATION OF INNOVATIONS.

35.7% of respondents indicate that the initiation and implementation of technological and business innovations will be important for the specialist of the future. He should be open to innovations, be able to harmoniously and smoothly implement them into business processes, administer the process, even without having narrow-profile skills in one area or another. The demand for this competence is due to the need for permanent technical renewal, because the IT sector is the most susceptible area to NTP.

Continuous attention to technological innovations will be an important characteristic of any IT worker of the future, but above all of the management level.

2. WORK UNDER CONDITIONS OF UNCERTAINTY.

34.7% of experts believe that in the future it will be critically important to be able to work in a constantly changing environment. Uncertainty in relationships with many counterparties and customers, business processes subject to force majeure have been and will be the hallmarks of the IT sector. Often, customers may not understand their own desires, the possibilities provided by one or another software or hardware, the essence of the proposed innovations. In this regard, the configuration of the work of IT companies presupposes constant changes to which it will be necessary to adapt.

Management and specialists who are accustomed to working in such conditions, who do not lose their composure, who are able to think soberly in difficult situations and make balanced decisions dictated by rational motives, will always be in demand on the market.

3. AGILE METHODS (FLEXIBLE PLANNING).

The traditional rigid approach to organizing workflows is giving way to flexible scheduling. This

leaves room for maneuver, creates an opportunity to rationalize algorithms and mechanisms of work, to adjust inter-functional and external interaction to the most effective rhythm. This is especially true for the IT sector.

Therefore, 37.7% of experts believe that mastering Agile methods in building development cycles for a particular product or targeted solution will be an important skill in the future.

4.
PROCESS CONTROL.

This competence is considered important by 34.1% of the respondents. «Manual control» and operational regulation of any process will become one of the core competencies of a highly qualified IT worker.

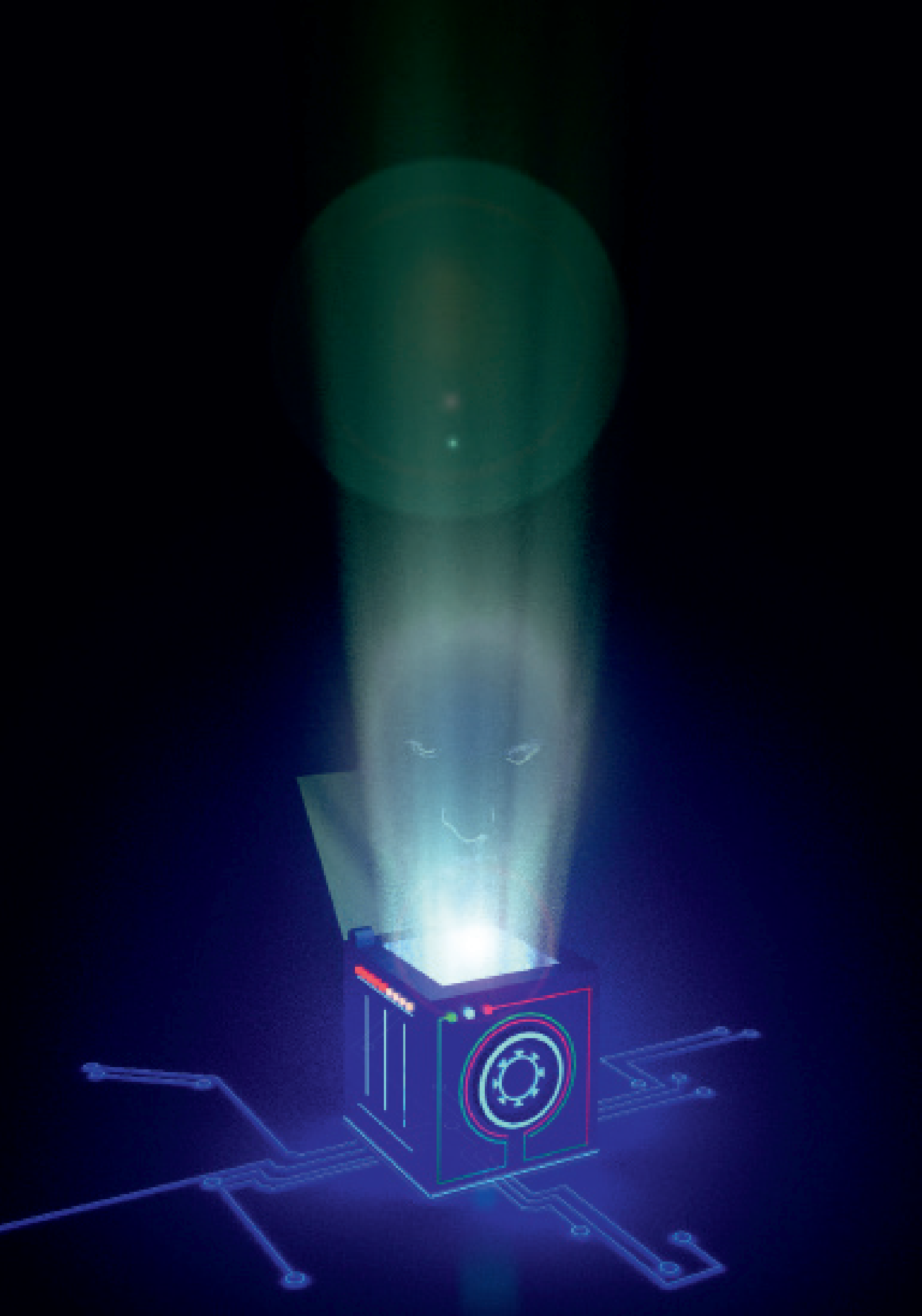
Orientation in unforeseen situations, setting up and coordinating work processes, organizing the interaction of employees vertically and horizontally, external communications, overall management of the development cycle, etc. will become a hallmark of an IT manager.
And although modern design approaches allow you to build a flexible system of work, often in the face of constant changes, IT specialists have to intervene in processes and change algorithms and tasks, and rebuild prioritization.

5.
INTERFUNCTIONAL INTERACTION AND WIDE TECHNOLOGICAL AWARENESS.

As has been said many times, IT is penetrating all areas. More and more complex and knowledge-intensive sectors of the economy are becoming dependent on the advanced achievements of the IT sector. At the same time, the functionality of IT specialists is constantly growing, and it becomes more and more difficult to remain a narrow-profile, but in-demand employee.

Understanding the specifics of the work of each IT specialist comes to the fore. An example would be so-called DevOps engineers who tie together many different functions. 33.7% of experts believe that the ability to build an effective system of cross-functional interaction and broad technological awareness will be important personal characteristics of the employee of the future.

Taking into account the complexity of the IT sphere itself, product creation cycles, an IT specialist needs to be able to closely interact with many employees both within his own functionality and within the framework of horizontal relations with representatives of other areas of activity.



As best practice shows, employers IT sectors are ready to give preference to specialists:

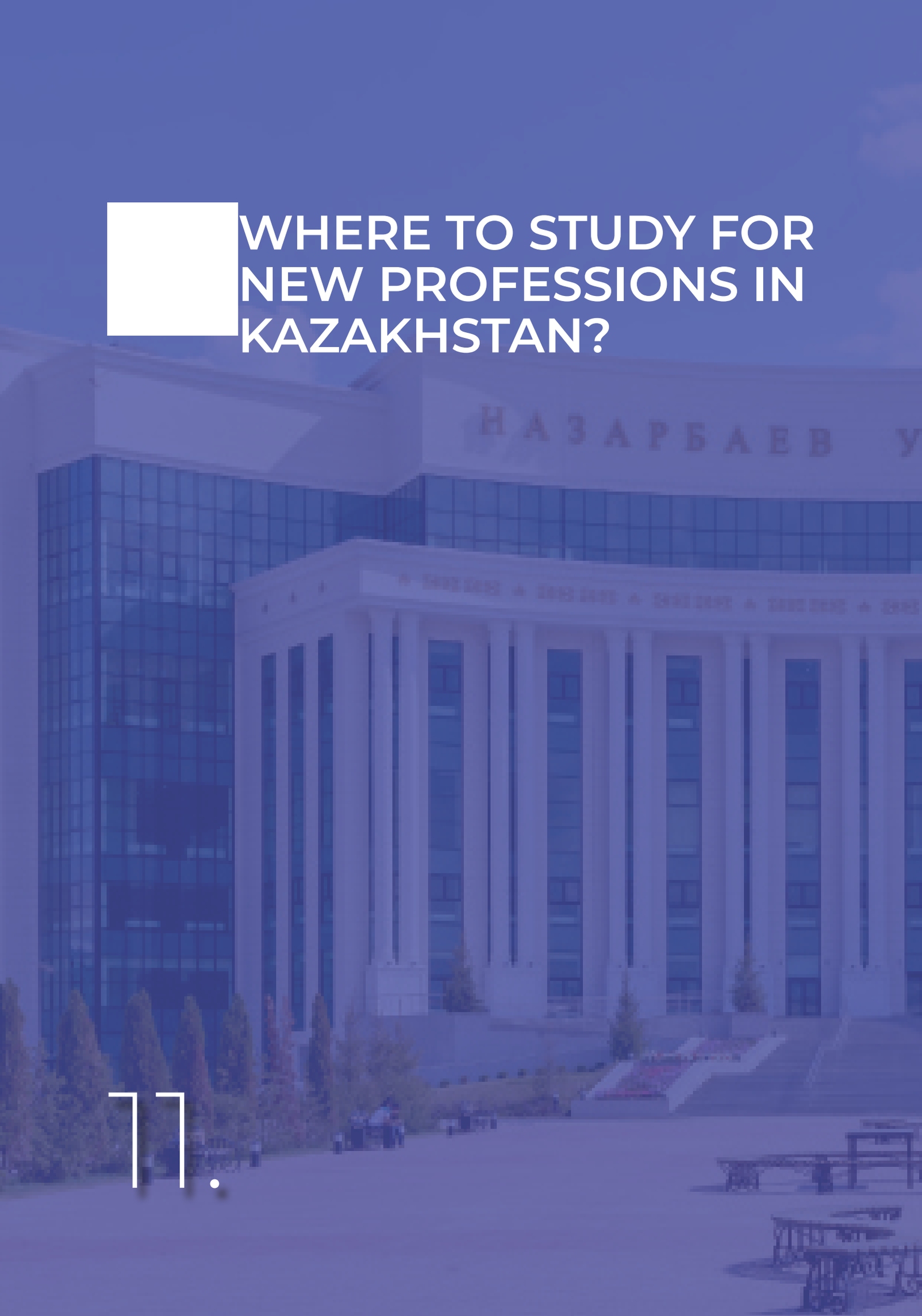
- striving for continuous qualification growth,
- self-development,
- have analytical logical thinking,
- own tools for working with Big Data,
- technically savvy,
- able to workin conditions of uncertainty and ready to work as a team,
- innovators, be able to model events, organize processes, and provide planning flexibility.

Of course, in addition to the key skills selected by the expert community, development of other soft skills, such as empathy and emotional intelligence, initiative and proactivity, communication skills and understanding of client interests, multiculturalism and multiculturalism, visionary thinking, etc.

Proficiency in all of the above competencies and tools for working with big data,be technically savvy, this is the key to success employment in the IT sector in the next 10-15 years. Aswe can see, in many ways hard skills are inferior to soft ones.

In other words, now we need to focus more on developing soft skills, because solid core competencies can change or even deactualize.

WHERE TO STUDY FOR NEW PROFESSIONS IN KAZAKHSTAN?



11.


НИВЕРСИТЕТІ

WHERE TO STUDY FOR NEW PROFESSIONS IN KAZAKHSTAN?

So, we have identified a list of new professions that will appear in the next 10-15 years. We have formed a set of competencies and skills necessary for mastering these professions. And if soft skills need to be developed throughout life, starting from school or even kindergarten, then basic competencies require professional training and mastering certain specializations in various fields.

So, for example, a quantum technologist must deeply understand physics, especially in quantum mechanics, programming and software engineering, computer science and cyber-physical systems, be able to operate with big data, etc. All this needs to be persistently and for a long time to study in specialized educational institutions, before all universities. The specialist of the future cannot be narrowly focused. They must possess a much wider range of skills and abilities than modern workers. At the same time, their competencies must constantly develop and expand.

A static specialist, indifferent to progress, who does not master new specializations and technologies, will inevitably face the threat of losing their job.

Where can we learn the necessary competencies now or in the near future? What educational institutions can provide the necessary basis and help in creating a professional portrait that meets the promising needs of the labor market already in our time?

The answer to these questions is the map of localization of new professions presented below, which represents the distribution of universities by specialties, allowing to train certain specialists.

Within the framework of localization, it is proposed to consider the potential of the 25 most suitable universities from the ranking of educational programs of universities, compiled by NCE Atameken (Table 11.1).

These universities were selected because they have a basic specialization «Computer technology and software», as well as additional courses that allow you to train specialists of the future. Universities with a ranking below 2.97 were not considered.

Table 11.1.

*Ranking of HEIs for the localization of new professions in the IT sector of Kazakhstan **

	HEI name	Ranking	Number of new professions
1	International IT University	3.90	23
2	Kazakhstani-British Technical University	3.89	19
3	Suleyman Demirel University	3.60	11
4	L.N.Gumilyov Eurasian National University	3.33	39
5	Kazakh National Agrarian University	3.30	16
6	Kh. Dosmukhamedov Atyrau State University	3.29	12
7	Sh. Ualikhanov Kokshetau State University	3.28	12
8	Turan University	3.26	6

	HEI name	Ranking	Number of new professions
9	S.Seifullin Kazakh Agro Technical University	3.23	5
10	Almaty University of Power Engineering and Telecommunications	3.220	10
11	D. Serikbayev East Kazakhstan Technical University	3.215	21
12	M. Dulatov Kostanay University of Engineering and Economics	3.18	10
13	West-Kazakhstan Innovative-Technological University	3.15	6
14	Zhubanov University	3.12	21
15	Almaty Technological University	3.10	10
16	M. Utemisov West Kazakhstan State University	3.073	12
17	Satbayev University	3.067	33
18	Kazakh University of Economics, Finance and International Trade	3.0353	5
19	TAU University	3.0352	6
20	Miras University	3.03	6
21	Kazakh Humanitarian Juridical Innovative University	3.02	8
22	Toraighyrov University	3.01	18
23	Astana University	3.00	8
24	Kazakhstan University of Innovation and Telecommunication Systems	2.98	12
25	Al-Farabi Kazakh National University	2.97	40

**SOURCE: rating of universities*[1]

[1] *https:,,atameken.kz,uploads,content,files.pdf*

Table 11.2 presents 40 new professions in the IT industry, as well as educational specializations, on the basis of which it is possible to deploy the localization of new professions.

Localization is activities aimed at developing educational and methodological materials and special educational practices for teaching knowledge, skills and competencies for new tasks of the industry on the basis of specific universities. Taking into account the cross-cutting nature of the professions of the future, 2-3 basic specializations were identified, on the basis of which a list of the most suitable universities was compiled. With an increase in the number of specializations, this list was compressed to the minimum values.

Table 11.2.

List of specialties required for localization of new IT professions in RK.

	Profession	The list of faculties and departments required for localization of new professions in the industry
1	Technologist in quantum computing	▶ 5B070400 CComputer equipment and software, ▶ 5B060500-Nuclear Physics or 5B011000-Physics
2	Operator in quantum computing	▶ 5B070400-Computer equipment and software, ▶ 5B060500-Nuclear Physics or 5B011000-Physics
3	Analyst in quantum computing	▶ 5B070400-Computer equipment and software, ▶ 5B060500-Nuclear Physics or 5B011000-Physics
4	Quantum cryptologist	▶ 5B070400-Computer equipment and software, ▶ 5B060500-Nuclear Physics or 5B011000-Physics
5	ADT developer-designer (aggregated digital twins)	▶ 5B070400-Computer equipment and software, ▶ 5B070200-Automation and management or 6M051800- Project management
6	ADT operator	▶ 5B070400-Computer equipment and software, ▶ 5B070200-Automation and Control or 6M051800- Project management

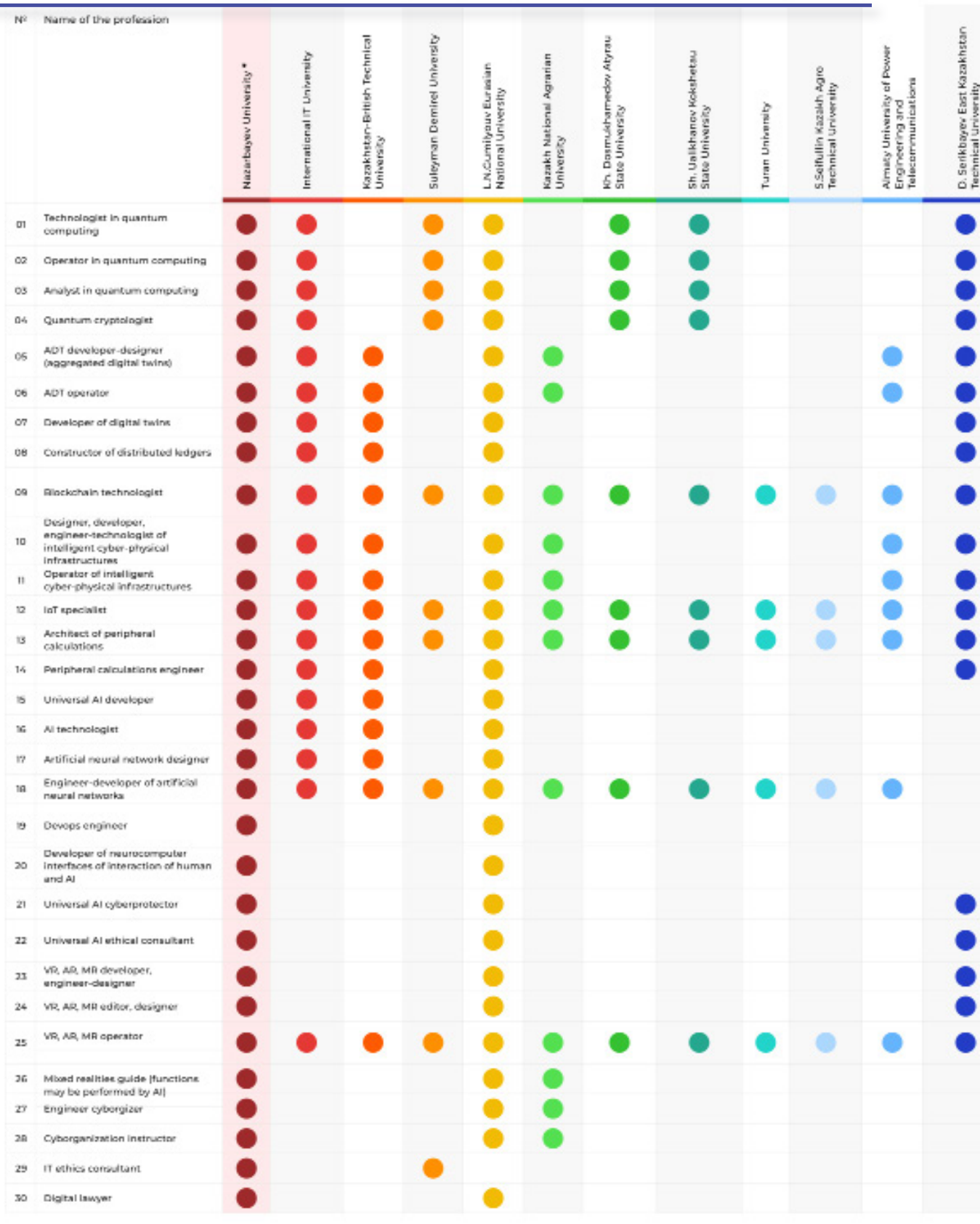
	Profession	The list of faculties and departments required for localization of new professions in the industry
7	Developer of digital twins	▶ 5B070500-Mathematical and computer modeling ▶ 5B070300-Information Systems ▶ 5B070400-Computer equipment and software
8	Constructor of distributed ledgers	▶ 5B070500-Mathematical and computer modeling ▶ 5B070300-Information Systems ▶ 5B070400-Computer equipment and software
9	Blockchain technologist	▶ 5B070500-Mathematical and computer modeling ▶ 5B070300-Information Systems ▶ 5B070400-Computer equipment and software
10	Designer, developer, engineer-technologist of intelligent cyber-physical infrastructures	▶ 5B070300-Information Systems ▶ 5B070400-Computer equipment and software
11	Operator of intelligent cyber-physical infrastructures	▶ 5B070400-Computer equipment and software ▶ 5B070200-Automation and Control
12	IoT specialist	▶ 5B070400-Computer equipment and software ▶ 5B070200-Automation and Control
13	Architect of peripheral calculations	▶ 5B070300-Information Systems ▶ 5B070400-Computer equipment and software
14	Peripheral calculations engineer	▶ 5B070300-Information Systems ▶ 5B070400-Computer equipment and software
15	Universal AI developer	▶ 5B070500-Mathematical and computer modeling ▶ 5B070300-Information Systems ▶ 5B070400-Computer equipment and software

	Profession	The list of faculties and departments required for localization of new professions in the industry
16	AI technologist	▶ 5B070500-Mathematical and computer modeling ▶ 5B070300-Information Systems ▶ 5B070400-Computer equipment and software
16	Neural Network Designer	▶ 5B070500-Mathematical and computer modeling ▶ 5B070300-Information Systems
17	Artificial neural network designer	▶ 5B070500-Mathematical and computer modeling ▶ 5B070300-Information Systems
18	Engineer-developer of artificial neural networks	▶ 5B070300-Information Systems ▶ 5B070400-Computer equipment and software
19	Devops engineer	▶ 5B070500-Mathematical and computer modeling ▶ 5B070100- Biotechnology ▶ 5B070400-Computer equipment and software
20	Developer of neurocomputer interfaces of interaction of human and ai	▶ 5B070500-Mathematical and computer modeling ▶ 5B070400-Computer equipment and software
21	Universal AI cyberprotector	▶ 5B070500- Mathematical and computer modeling ▶ 5B020100-Philosophy
22	Universal AI ethical consultant	▶ 5B070400-Computer equipment and software ▶ 5B070500- Mathematical and computer modeling ▶ 5B042100-Design
23	VR, AR, MR developer, engineer-designer	▶ 5B070400-Computer equipment and software ▶ 5B070500-Mathematical and computer modeling ▶ 5B042100-Design

	Profession	The list of faculties and departments required for localization of new professions in the industry
24	VR, AR, MR editor, designer	▶ 5B070400-Computer equipment and software ▶ 5B070500- Mathematical and computer modeling ▶ 5B042100-Design
25	VR, AR, MR operator	▶ 5B070400-Computer Science and Software ▶ 5B070300-Information Systems
26	Mixed realities guide (functions may be performed by AI)	▶ 5B070400-Computer equipment and software ▶ 5B070500-Mathematical and computer modeling ▶ 5B070100-Biotechnology
27	Engineer cyborgizer	▶ 5B070400-Computer equipment and software ▶ 5B070500-Mathematical and computer modeling ▶ 5B070100-Biotechnology
28	Cyborganization instructor	▶ 5B070400-Computer equipment and software ▶ 5B070500-Mathematical and computer modeling ▶ 5B070100-Biotechnology
29	IT ethics consultant	▶ 5B020100-Philosophy ▶ 5B070400-Computer equipment and software
30	Digital lawyer	▶ 5B030100-Jurisprudence ▶ 5B100200-Information security systems
31	Cyber interrogator	▶ 5B030100-Jurisprudence ▶ 5B100200-Information security systems
32	Cyberprotector	▶ 5B030100-Jurisprudence ▶ 5B100200-Information security systems
33	Cyber lawyer	▶ 5B030100-Jurisprudence ▶ 5B070300-Information Systems
34	R&D-manager	▶ 5B070400-Computer hardware and software, ▶ 5B070200-Automation and Control ▶ or 6M051800- Project management

	Profession	The list of faculties and departments required for localization of new professions in the industry
35	MVP-manager	▶ 6M051700-Innovation management or ▶ 6M051800-Project management ▶ 5B070400-Computer equipment and software
36	Product-manager	▶ 6M051700-Innovation management or 6M051800-Project management ▶ 5B070400-Computer equipment and software
37	Digital development tutor (talent manager)	▶ 5B010300-Pedagogy and psychology ▶ 5B070400-Вычислительная техника и программное обеспечение
38	Cyberskillinger - digital skills designer	▶ 5B010300-Pedagogy and psychology ▶ 5B070400-Computer equipment and software
39	IT ecosystems architect	▶ 5B070300-Information systems ▶ 5B070200-Automation and Control or 6M051800-Project Management
40	Multi-experience monitoring specialist (user experience)	▶ 5B070400-Computer equipment and software ▶ 5B070500-Mathematical and computer modeling ▶ 5B070100-Biotechnology

TABLE 3
LOCALIZATION OF PROFESSIONS OF THE FUTURE ITINDUSTRY IN THE UNIVERSITIES OF RK




M. Dulatov Kostanay University of Engineering and Economics
West Kazakhstan Innovative-Technological University
Zhubanov University
Almaty Technological University
M. Utemisov West Kazakhstan State University
Satbayev University
Kazakh University of Economics, Finance and International Trade
TAU University
Miras University
Kazakh Humanitarian Juridical Innovative University
Toraighyrov University
Astana University
Kazakhstan University of Innovation and Telecommunication Systems
Al-Farabi Kazakh National University

№	Name of the profession	Nazarbayev University *	International IT University	Kazakhstan-British Technical University	Suleyman Demirel University	L.N.Gumilyov Eurasian National University	Kazakh National Agrarian University	Kh. Dosmukhamedov Atyrau State University	Sh. Ualikhanov Kokshetau State University	Turan University	S.Seifullin Kazakh Agro Technical University	Almaty University of Power Engineering and Telecommunications	D. Serikbayev East Kazakhstan Technical University
31	Cyber interrogator	●				●							
32	Cyberprotector	●				●							
33	Cyber lawyer	●			●	●	●	●	●	●			
34	R&D-manager	●	●	●		●	●						●
35	MVP-manager	●	●	●		●							
36	Product-manager	●	●	●		●							
37	Digital development tutor (talent manager)	●				●		●	●				
38	Cyberskillinger - digital skills designer	●				●		●	●				
39	IT ecosystems architect	●	●	●		●	●					●	●
40	Multi-experience monitoring specialist (user experience)	●				●	●						
	Total:	40	23	19	11	39	16	12	12	6	5	10	21

* Nazarbayev University is not included in the rating of NPP "Atameken". However, the Atlas developers considered it necessary to take it into account in the localization program, since this university

has the necessary material, technical and educational and methodological potential to localize all new professions.

CONCLUSION

12.

CONCLUSION

The IT sector is one of the most complex branches of the economy in the intellectual and technical aspect. Innovation activity is the most intense, and the pace of technological renewal is unprecedented from a historical point of view.

The new digital reality puts the IT sector in need of revising traditional approaches to training, moving from the paradigm of basic education with occasional professional development to a model of continuous learning, which involves periodic and sometimes permanent development of new specializations and technical innovations.

Trying to lift the veil that hides the future, you can always make a mistake. How likely is an error? How accurate are the assumptions and forecasts? Should we believe them if it is impossible to evaluate them now,and then it will be too late? Finding an unambiguous answer seems impractical, since IT simply does not exist. This means that you need to decide for yourself which way to go, not knowing exactly where IT can lead.

When thinking about these questions, we should proceed from a simple logic of least risk. You can not pay attention to promising the transformation of the labour market, to study traditional professions and to learn new skills.

In this case, we will face strong competition in the market, because there will be a lot of the same specialists, both from among the already working ones and from those who have just finished their studies and are looking for employment opportunities. At the same time, the market itself will shrink, because automation and robotics are not ephemeral abstract processes, but objective reality. With such a personal policy, the risks are very high.

The same applies to working highly qualified specialists who believe that they are not

threatened by automation and digitalization. It is worth remembering, however, that three previous industrial revolutions led to the disappearance of many professions and occupations.

Moreover, the fourth industrial revolution, according to experts' forecasts, will deactivate about 60% of modern ones. That is, it is very risky to expect that extremely narrow-profile occupations, which seem to be the fiefdom of a person, will not be at risk of transformation or disappearance.

A different path involves moving along the trajectory of continuing education. Taking into account the actual situation and focusing on the future, you significantly mitigate the risks of being out of work for a number of reasons.

FIRST.

One way or another, you will receive a specialized education, the basic competencies of which include several modern specializations. That is, instead of one specific one, you are aggregating a set of competencies. In the future, you will not be a narrow-profile specialist, for example, an expert in the field of web design or a VR developer. You will be able to combine these professions, and even if the situation on the labor market does not change, and new professions do not appear or will be in limited demand, you can always find a job either in one area or in another.

SECOND.

By developing soft skills, you can be sure that you will be in demand in a variety of industries and will always be able to compete in any segment of the labor market. Experts directly say that in the future, soft skills may well prevail over hard ones. After all, the latter can be quickly learned using new formats for obtaining the necessary skills, such as online training or gamification, and practical skills you can hone it on the go. But skills such as critical thinking, empathy, cross-industry communication, or broad interaction with people require long-term work on yourself.

THE THIRD.

Orientation towards new professions is not a step forward or backward, but a step to the side. Getting out of the way of the educational process and looking at it from the outside, it's easy to see how much it is missing out on. How strongly it depends on changes, but it is difficult to give in to them. XXI century is the era of permanent transformations. Mobility and agility will be the keys to success. Now many professionals who pay great attention to improving their qualifications are beginning to understand that they need to work not only on developing their narrow-profile skills, but also to master areas that previously did not arouse interest or were not practical.

In the future, there will be no pure techies or humanitarians. Natural-scientific knowledge is closely intertwined with the Humanities. Creative thinking will combine with analytical thinking. Only such specialists will be competitive and in demand. This is especially true for the IT sector, whose development rate and depth of its penetration into all spheres of life from everyday life and communication to work and leisure, people are increasingly relying on advanced technologies.

Scientific and technological progress, the transition from the paradigm of personal consumption to the sharing economy, an increase in the quality of life, increased attention to environmental problems, the entry into the labor market of specialists of a new formation and many other socio-economic and natural factors lead to a profound transformation of all sectors of the economy. This is a fact that cannot be ignored.

You can adapt to new realities only by taking preventive measures, preparing well in advance. After all, it is always better to get on the train while it is still at the station than to jump in it on the move.

PROJECT TEAM

13.

PROJECT RESEARCH TEAM

**** Members of the research team who performed work within the framework of the project «Atlas of new professions and competencies of the IT industry of the Republic of Kazakhstan»***

1. **Aisautov Timur**	Project Team Leader
2. **Yale Willart**	International expert
3. **Kalkenova Botagoz**	National expert
4. **Tileubergenov Ilyas**	National expert
5. **Semibratova Galina**	National expert
6. **Kurganbaev Erdos**	National expert
7. **Kabylbekov Zhantas**	National expert
8. **Kassabekov Madi**	National expert
9. **Mukatov Arman**	National expert
10. **Nurmakhanov Berik**	National expert
11. **Vokarchuk Evgeniy**	National expert
12. **Taigulova Zhanar**	National expert
13. **Argynbaeva Gulzhan**	National expert
14. **Madenov Batyr**	National expert
15. **Ermagambet Dastan**	Junior expert
16. **Doszhan Nurkanat**	Junior expert

TEAM INDUSTRY EXPERTS UNPICK THE IT INDUSTRY

1. Abdeshov Olzhas
2. Abdoldin Farid
3. Abdrahman Zhandos
4. Abdrakhmanova Ainur
5. Ospanov Ablaykhan
6. Azamat Kairulin
7. Azbergenov Nuzhigit
8. Aydarkhanova Saule
9. Aydosuly Askar
10. Aizhan Zhukebaeva
11. Aimurzaeva Raushan
12. Aimyshev Batyrulan
13. Ainur Kanapyanovna
14. Aytuar Azat Narimanuly
15. Akzhalov Kassymbek
16. Tolemanova Akmaral
17. Almerekov Arman
18. Amangaliev Arman
19. Amantayev Alisher
20. Amirov Ualikhan
21. Esilov Asylkhan
22. Akhan Bakitov
23. Akhmetov Rustam
24. Ayapov Elmurat
25. Bazarov Berik
26. Bayrkhin Erbol
27. Bakirov Ilyas
28. Bakytzhanov Elaman
29. Barankova Anastasia
30. Basov Ruslan
31. Batyrkhan Kozhaakhmet
32. Bakhtiyar Akhan
33. Basheev Bolat
34. Begalieva Zakhira
35. Bekenova Anargul
36. Belyakov Maxim
37. Bibosinov Asylkhan
38. Bolatkanuly Rasul
39. Bralimova Almagul
40. Kubekov Bulat
41. Bulat Nikolay
42. Valiullin Rashit
43. Tsai Victor
44. Sultanova Victoria
45. Gabbasova Zhanna
46. Holtsman Klim
47. Darkhan Ahmed-Zaki
48. Dauletbaev Timur
49. Dzhailbekov Suyundyk
50. Iralyn Diaz
51. Drobysheva Love
52. Drozd Vladimir
53. Duzbaev Nurzhan
54. Duisenbaeva Asem
55. Dushabaev Daulet
56. Dushaev Jean
57. Dyusengazina Nazym
58. Yeleusin Omirzhan
59. Zhaksylykov Yerzhan
60. Duisekov Erkanat
61. Yessenov Alimzhan
62. Ibraeva Zhanar
63. Zhanbekova Altynai
64. Esenbayev Zhandos
65. Urazmakhanov Zhandos
66. Zhantasova Zheniskul
67. Zhanybek Nurlan
68. Zhienbaev Erdaulet
69. Zhienbaeva Lyazat
70. Zholzhan Azamat
71. Zhumagaliev Birzhan
72. Zhumanbaeva Kuralay
73. Zhumataev Daniyar
74. Zhumakhan Nurzhan
75. Alexey Zakevich
76. Izmukhanov Abzal
77. Iksanov Kimrat
78. Ilyin Sergey
79. Ilyasov Maksat
80. Imankulov Timur
81. Isabaev Timur
82. Isabekova Lyazzat
83. Isagalieva Zulfiya
84. Isimbaeva Assel

85. Isin Nurlan
86. Iskakov Nurlan
87. Ismanov Amantai
88. Kadyrov Darkhan
89. Kazantsev Vitaly
90. Kazi Bek Galymzhanovich
91. Kaminsky Dmitry
92. Karashin Zhasulan
93. Karashov Nauryzaly
94. Karibaeva Akmaral
95. Karmanova Makpal
96. Kasym Aizhan
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98. Kim Zhanna
99. Sergey Klimenko
100. Coccoat Mahabbat
101. Konyrbaev Askhat
102. Koptleuova Saule
103. Kosaev Kamil
104. Kramsheev Ardabek
105. Kuanysheva Raushan
106. Kubrin Yuri
107. Kuzbaev Akhmet
108. Kairbekova Nazgul
109. Leonid Smirnov
110. Nikolay Litvinenko
111. Lyutz Alexander
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113. Madykova Shirin
114. Mailybaev Ersayin
115. Maya Sadykova
116. Maksatbek Turan
117. Mansurova Madina
118. Masalimov Ali
119. Nurmagambetova Mausimzhan
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154. Elena Sverdlova
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156. Seilova Nurgul
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159. Suleimenova Laura
160. Suleimenova Saule
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163. Surkov Andrey
164. Tazhbenova Gulzhan
165. Taikumanova Mahabbat
166. Talipov Sergey
167. Temirbek Elaman
168. Ten Tatiana
169. Tenizbaeva Altynai
170. Timur Bektur
171. Toybaeva Shara
172. Tolstikhina Tatiana
173. Toremurat Hansultan
174. Tubekbaev Rustem
175. Turdalyuly Musa
176. Tursumbaeva Akmaral
177. Uvaleev Zholaman
178. Julia Ulikhina
179. Umarov Timur
180. Umirbaev Beybarys
181. Utegenova Anar
182. Khairzhanov Azamat
183. Khusainova Aigerim
184. Sharipov Bakhytzhan
185. Shayakhmetov Abulkhair
186. Shvedov Artem
187. Shorin Daniyar
188. Shorina Sezim
189. Elmira Obry

INDUSTRY EXPERTS REPRESENTED THE FOLLOWING COMPANIES

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- Astana hub
- Astana Polytechnic College
- ASTEL JSC
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- Asyl Trans Group LLP
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- BCPD ltd. Private Company
- Beineu Polytechnic College
- Bolashak College
- BTS Digital Ventures Ltd
- BTS Education LLP
- Center for Medical Technologies and Information Systems JSC
- Choco Holding
- College of Radio Engineering and Communication
- D. Serikbayev East Kazakhstan Technical University
- Eurasian Group LLP
- Eurasian Humanities Institute
- Eurasian Machinery LLP
- Fund for the Development of Socially Significant Initiatives Private Foundation
- GRT Company
- High college named after M.Zhumabaev
- Human Resource Development Center
- ICS Tech LLP
- ICS Tech LLP
- IDC
- IITU JSC
- Institute of Cybernetics and Information Technology
- Institution «College «Semey «
- IntelliSense-LAB Center for Technological Development
- International Kazakh-Turkish University named after Akhmet Yassawi
- IT Solutions Center LLP
- KAFU LLP
- Karaganda Economics University of Kazpotrebsoyuz
- Karaganda State Technical University
- Kazakhstan Association of IT Companies ALE
- Kazdream Technologies LLP
- KazMunayGas JSC NC
- Kazpost JSC
- KBTU Startup Incubator
- Korkem Telecom LLP
- Kvadra.kz
- Kyoto University
- L. N. Gumilyov Eurasian National University
- Laboratory BIM + LAB Center for Technological Development
- Luxystech LLP
- M. Dulatov Kostanay University of Engineering and Economics
- Mangistau industrial and technical College named after O. Turmaganbetuly
- Microsoft Kazakhstan
- Ministry of digital development, innovation and aerospace industry of the Republic of

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- Mobiluz LLP
- NAC Analytica CF
- National Center for Space Research and Technology JSC
- National company «Kazakhstan Gharysh Sapary JSC
- National Information Technologies JSC
- National Laboratory Astana Private Institution
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- NCOC
- Oqu study
- Public Fund «ITeachMe» competence development center»
- QWANT Programming School
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- Republican Center for Space Communication JSC
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- Sh. Ualikhanov Kokshetau State University
- Specialized Medical Supply LLC
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- Terralink, JShS
- Toraigyrov University
- Touristic Kamkor CF
- Turan University
- V.G. Fesenkov Astrophysical Institute Subsidiary LLP
- World trade Kazakhstan GC
- Wunder digital agency
- X-Holding LLP
- X-Tech LLP
- Zerde National Infocommunication Holding JSC
- Zhangir Khan West-Kazakhstan Agrarian-Technical University

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CYBER SECURITY
SYSTEM INTEGRATION


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INDUSTRY
4.0
LOUD
IO
BIG DATA
OMATION
MACH