ATLAS OF NEW PROFESSIONS AND COMPETENCIES OF KAZAKHSTAN

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CONSTRUCTION

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

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LIST OF ABBREVIATIONS

WEF – World Economic Forum.

GDP – Gross Domestic Product.

OECD-Organization for Economic Cooperation and Development.

EBITDA-Earnings before interest, taxes, depreciation and amortization

MNE RK – Ministry of National Economy of the Republic of Kazakhstan.

PPP – Public-Private Partnership.

HR - human resources management.

IT - Information Technologies.

R & D – Research and Development.

BIM - Building Information Modeling

AR - Augmented Reality

VR - Virtual Reality.

AI – Artificial Intelligence.

IoT - Internet of Things.

UAE – United Arab Emirates.

USA – United States of America.

GHG – Greenhouse Gases.

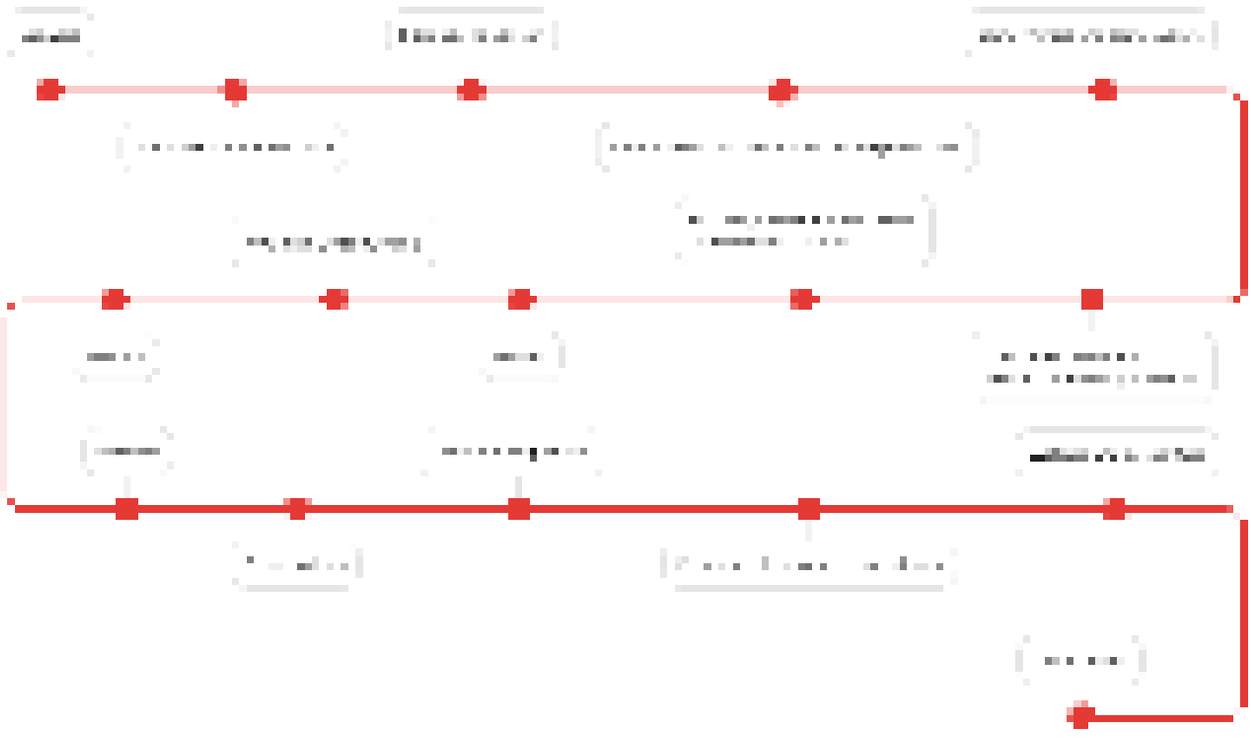
RES – Renewable Energy Sources.

CO2 – carbon dioxide.

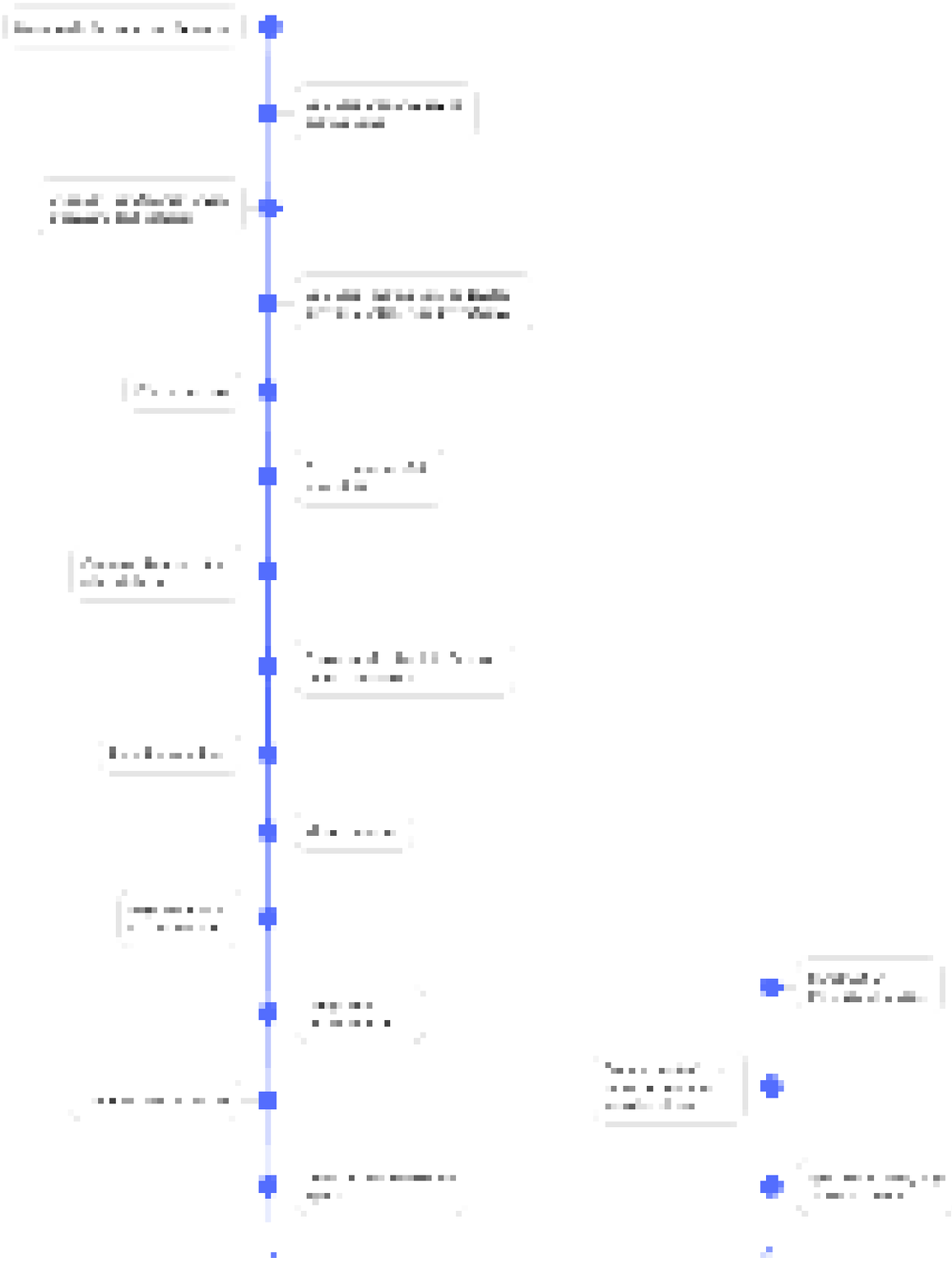
MDF – Medium Density Fiberboard.

Transforming professions in the construction industry

Disappearing professions Construction industry



New professions in the construction industry



630 WORDS TO THE READER

630
WORDS TO THE READER

Dear reader!

We are all witnessing and participating in the Fourth industrial revolution, which has virtually engulfed the entire world and all countries.

Over the past twenty - thirty years, we first entered the digital era, step by step, adapted to it and got used to living in a new reality. But scientific progress never stands still, and now all of humanity has already crossed the threshold of the Fourth Industrial Revolution.

WHAT SHOULD WE EXPECT FROM THE RAPIDLY CHANGING REALITY?

Let's remember the Hollywood movie of the eighties - «The Terminator». More than thirty years have passed since the release of the first «Terminator». The modern world as we know it sometimes surpasses in some ways the fantastic ideas, events, things described in this picture. But the most important thing that was warned about, anticipated by the creators of «Terminator» is that technologies will develop to such a level where the need for human labor, or at least some of its participation in the work process, can disappear or be reduced to a minimum. Moreover, this minimal human participation will require from him the highest qualifications and ability to work in a completely new reality, in order to manage the process, and not be a puppet in the flow of new technologies.

The fourth industrial revolution, like any technological revolution, is primarily aimed at increasing the efficiency of production, at facilitating the work of people - in a word, for good, not harm.

However, in the human world, this mechanistic approach does not work. As new technologies conquer the world, there appear those who «need to run as fast just to stay in place» and those who, «in order to get somewhere, you need to run at least twice as fast», in the words of Alice from Lewis Carroll Wonderland.

What does all this mean in relation to changing labor markets and sectors of the economy? Back in 2016, the World Economic Forum (WEF) conducted a study and published the report «The Future of Professions».

In the course of the study, WEF experts interviewed more than a hundred top managers who are responsible for strategic management of companies in several major multinational companies with a total number of employees exceeding 15 million people.

Global market leaders – multinational companies-agreed that the world's labor market is changing dramatically. Under the pressure of the Fourth industrial revolution, some knowledge and skills, and with them specific professions, will inevitably pass away in the near future. Some professions will remain, but working in these specialties will require completely different knowledge and skills.

And most importantly,

fascinating and unclear - new professions will appear!

For people who are already working or are just studying and preparing to become professionals, all these large-scale, global changes mean only one thing - to learn and retrain new things throughout their life ... But, you, dear reader, latently feel that there is no everything is so simple and schematic ... and it is true.

The development of a negative scenario is, of course, theoretically possible.

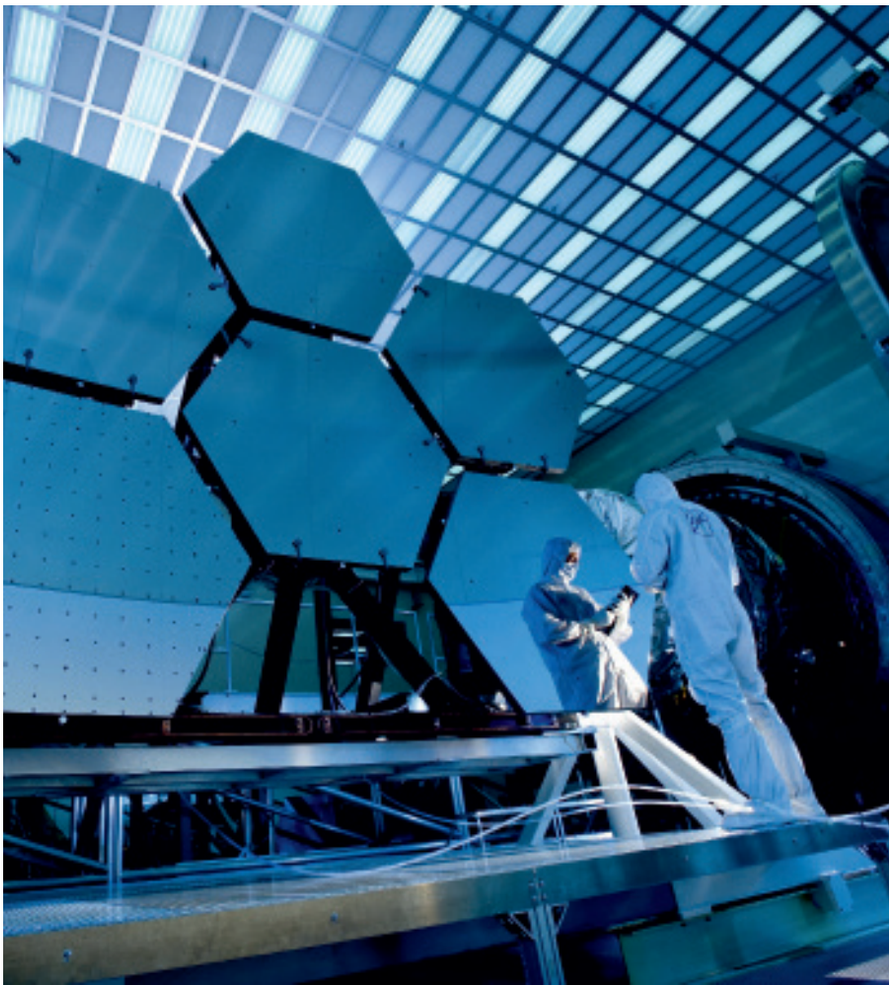
What do we mean? All these technological changes of the Fourth Industrial Revolution may be accompanied by an acute shortage of professionals in changing and new professions, unemployment among specialists in leaving professions will only grow and all this will significantly increase social inequality ...

The chances of this negative scenario developing will be negligible if governments, businesses and people proactively and jointly prepare for the wave of new technologies that are increasingly changing the way people, companies and entire industries work.

A respected reader can object and say that people have built, are building and will continue to build houses, structures and entire cities - that's right! Indeed, the construction industry until recently was considered one of the most conservative and slowly changing, however, new technologies of the XXI century will «shake» this industry to its very foundations, there is no doubt about it. Already, we can say that the construction industry is no longer a safe haven for traditional methods and accumulated knowledge. Therefore, all the risks and opportunities of the new era must be taken into account by professionals in this industry and those who are still planning to work in the construction sector.

THE APPEARANCE OF THE ATLAS OF NEW JOBS IS ONE OF THE STEPS THAT KAZAKHSTAN IS TAKING NOW TO ADAPT THE PEOPLE, BUSINESS AND ECONOMY OF THE REPUBLIC TO NEW REALITIES.

The Atlas, we hope, will help you, dear reader, to look more confidently into the future, consciously choose the direction of action for yourself, for the younger generation, for students and for employees!



ABOUT THE ATLAS NEW PROFESSION

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

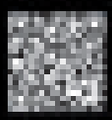
The sector of economy engaged in generation, transformation, distribution and use of resources of all types.

Oil and gas

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

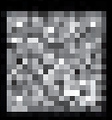
Mechanical engineering

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



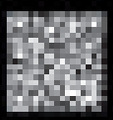
Agriculture

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



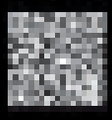
IT

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



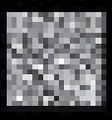
Transport and logistics

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



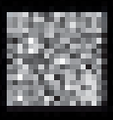
Tourism

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 NEW PROFESSION

The content of the Atlas of New Trades for the Construction Industry is structured as follows.

First, dear reader, you will familiarize yourself with the current situation in the construction sector in Kazakhstan, just in order to better understand the subject of our conversation - construction and work in the construction industry.

Next, you will take the first step into the future, you will find out the most likely scenario for the development of the construction sector in Kazakhstan. This forecast will be assembled, like a Lego constructor, from several parts. Industry opinion leaders will first express their assessments (section "Expert Opinion").

Then you will hear the voice of the entire industry, hundreds of professionals who are already working in the construction business, in specialized education, in trade unions (section «Looking into the future»).

The opinion of professionals is good, it is weighty, however, each person still makes a decision about the future of his career independently, without regard to authorities. It is precisely in order to help you, dear reader, understand what is happening, we will tell you about the «Global and industry trends affecting the construction industry.»

You will see the driving forces of change from the inside in order to try to determine your place in a changing world.

And now we have come to the most important thing - to the moment when the "Image of the Future" grows out of hundreds of personal opinions of professionals and objective facts of reality.

How does it work? Remember the Cheshire Cat from Alice in Wonderland?

His brilliant answer to Alice: «... if you don't know where you want to go, then you don't care which way to go.»

So, the desired future comes only if WE clearly know where we want to go and are actively moving in this direction ...

In our case, during the discussions at foresight sessions, industry professionals crystallize a theoretical image of the future, which has every chance to come true, since they are among those who are already bringing this future closer ...

The final sections of the Atlas will tell you, dear reader, what will happen to the professions in the construction sector

- (which professions will disappear,
- which ones to change,
- which ones will appear),

promising knowledge and skills that will be in demand in the future and where to go to study (sections

«List of future professions»,

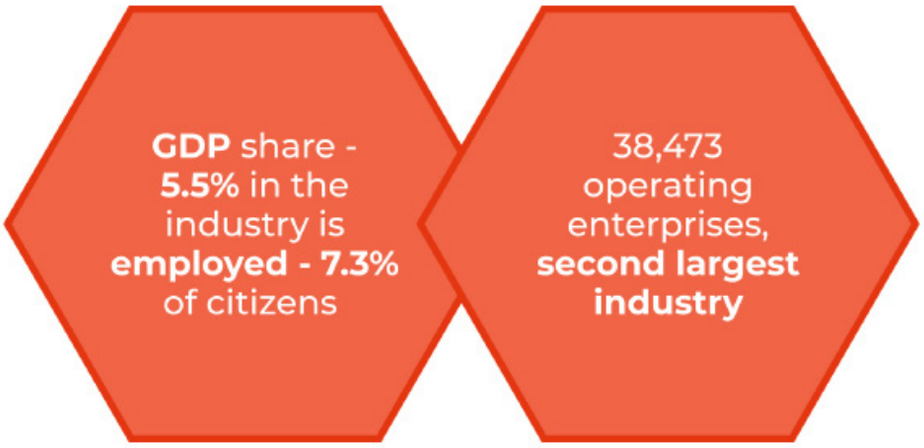
«Competence of future professions»,

«Localization of new professions»).

1. CONSTRUCTION INDUSTRY IN KAZAKHSTAN

CONSTRUCTION INDUSTRY IN KAZAKHSTAN

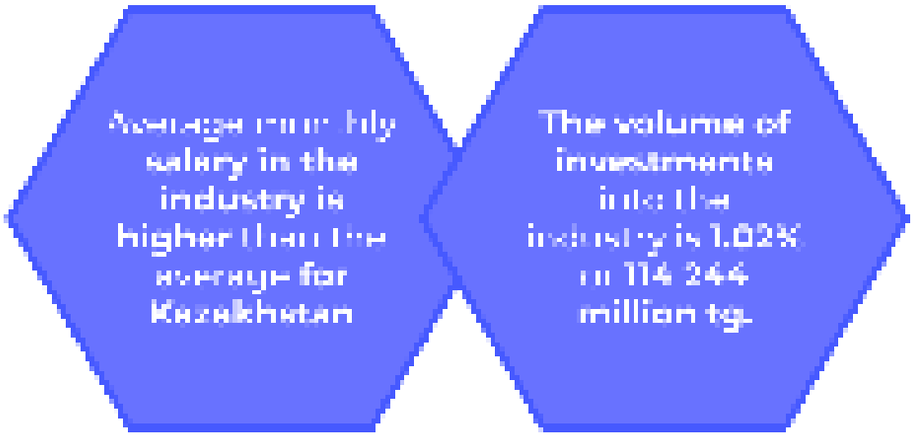
The construction industry in Kazakhstan is one of the basic industries, which is designed to create the necessary conditions for the development of the country's economy as a whole. The share of the construction industry in the total GDP of the republic is 5.5% according to the data of 2019[1], which makes the industry the fifth in terms of its contribution to the country's total gross product.



More than six hundred thousand people are employed in the industry, or 7.3% of the working-age population of the republic, according to the fourth quarter of 2019.

The average monthly salary in the industry was 256,602 tenge[2] in the IV quarter of 2019, and this is slightly higher than the average salary in the entire republic of 203,883 tenge. There are over 38,000 operating legal entities in the industry (or 12.5%[3]), this is the second largest industry in the republic in terms of the number of operating organizations[4]. The largest companies in the industry

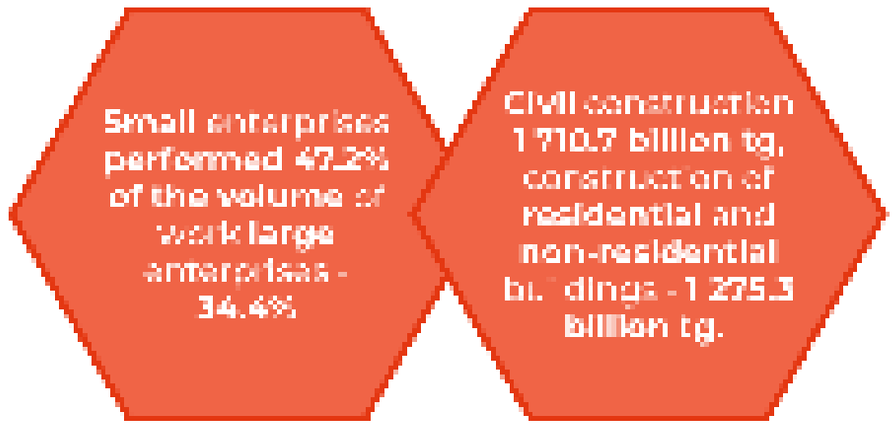
In 2018, the volume of investments in construction amounted to 114,244 million tenge, or 1.02% of the total investment in fixed assets.



are shown in Figure 15.

Private companies completed the largest volume (88.3%) of construction work (in value terms)[6]; at the same time, almost half (47.2%) of all work was performed by small enterprises, and the share of large companies was just over a third (34.4%).

The largest volume of work in 2019 (in value terms) was carried out in four regions of the country: in two capitals - Almaty (8.2%)[7] and Nur-Sultan (11.9%), in the west in



the Atyrau region (19.6%) and in the north in the Karaganda region (9.8%).

In the republic, according to 2018 data,[8] mainly civil construction projects, as well as residential and non-residential buildings are being built.

A strong incentive for the development of the construction industry in Kazakhstan in the last decade was the holding of the EXPO-2017 exhibition, which was held in Astana (now Nur-Sultan) in the fall of 2017.

The decision to hold the exhibition was made in 2011, and over the next few years, massive construction of EXPO-2017 facilities was launched in the capital.

In 2012, at the beginning of active work at the exhibition facilities, the volume of construction in Kazakhstan was estimated at 2,266.[8] billion tenge, but already in 2018 this figure increased to 3,863 billion tenge, thereby increasing by 70.4% [9] ...

Despite the fact that the industry as a whole grew under the influence of EXPO-2017, however, the dynamics of the employment level in the industry is ambiguous. During the period of active construction of exhibition facilities (from 2012 to 2016), the increase in the number of employed in the industry was 5.4%, and from 2017 to 2018 the increase in employed was only 2.5%.

It is safe to say that the construction industry will continue

to be an attractive opportunity for future employees to earn more than the economy average.

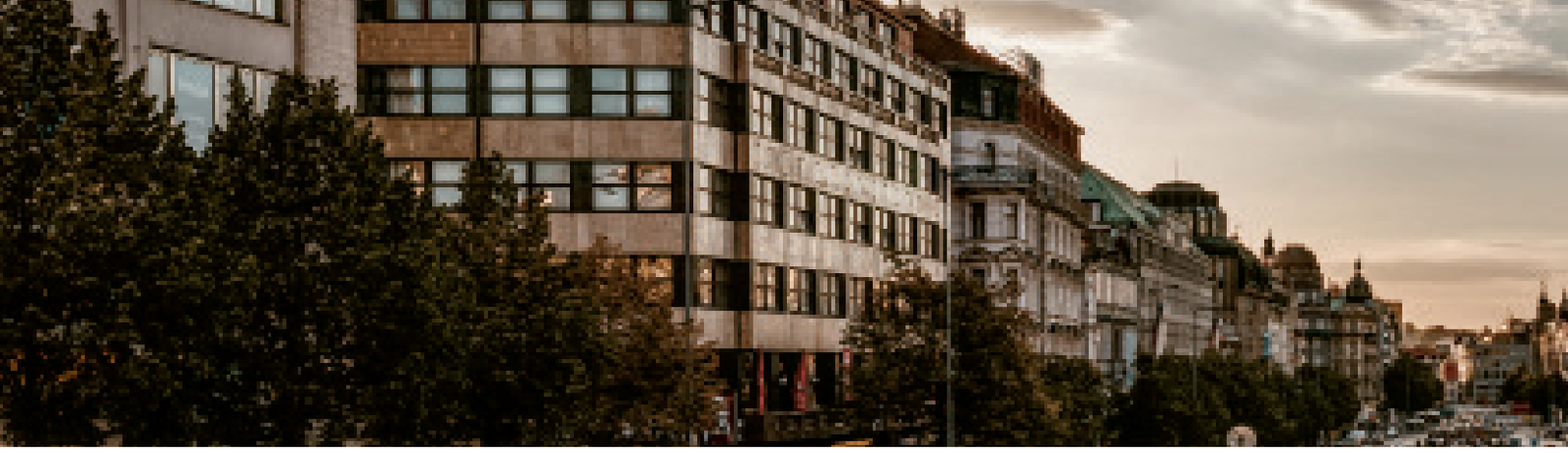
For example, in 2012, the gap between the average monthly wage in the industry and in the economy as a whole was just over 10 thousand tenge (10 626 tenge), and in 2018, this gap was already 51 111 tenge.

In the near future, the construction industry in Kazakhstan is likely to maintain positive growth rates.

There are several prerequisites for this. At the end of 2019, the government of Kazakhstan adopted the Nurly Zhol infrastructure development program for 2020-2025.

The implementation of this program will significantly affect the development of the construction industry in the next few years. In particular, one of the target indicators for the implementation of the program is to increase the share of republican roads in good and satisfactory condition to 100%, and the share of regional and district roads in good and satisfactory condition should be increased to 95% by 2025. Moreover, the republican budget will provide

[1] Sources: Express - information. No. 36-2 / 75 of February 14, 2020 Gross domestic product by production method for January-December 2019. https://stat.gov.kz/official/industry/11/statistic/6
[2] Sources: Average monthly wages by main types of economic activity for 2010-2019. https://stat.gov.kz/official/industry/25/statistic/7
[3] The total number of operating legal entities in the Republic of Kazakhstan according to data for 2019 was 308 011. Source: https://stat.gov.kz/official/industry/13/statistic/6
[4] According to 2019, the market leader is the wholesale and retail trade (83,158 active legal entities, or 27% of the total number of active legal entities in the republic). Source: https://stat.gov. kz / official / industry / 13 / statistic / 6
[5] Sources: http://nb.kz/ranking/?sector=building
[6] Sources: Committee on Statistics of the Ministry of National Economy of the Republic of Kazakhstan, 2019. Investment and construction statistics. On the implementation of construction work and commissioning of facilities in the Republic of Kazakhstan
[7] Sources: Committee on Statistics of the Ministry of National Economy of the Republic of Kazakhstan, 2019. Investment and construction statistics. On the implementation of construction work and commissioning of facilities in the Republic of Kazakhstan.
[8] Committee on Statistics of the Ministry of National Economy of the Republic of Kazakhstan
[9] According to the growth formula (3 863 billion tenge * 100% / 2 266.8 billion tenge) - 100% = 70.4%ßß.
[10] Sources: https://www.zakon.kz/5002901-programma-infrastrukturnogo-razvitiya-n.html



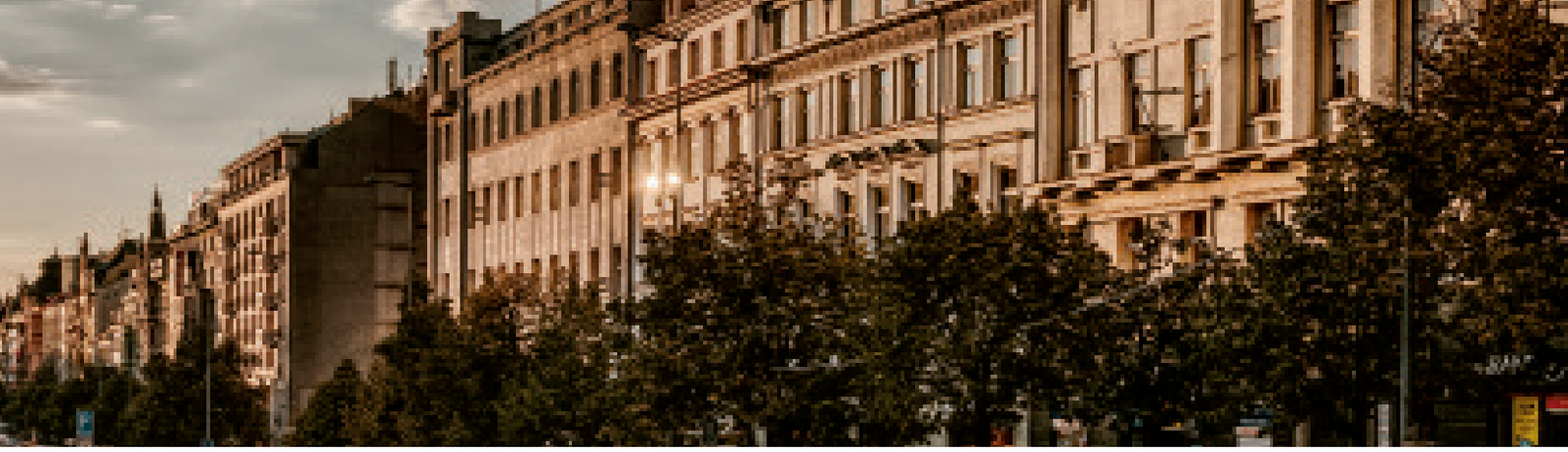
Growth driver: construction of 16 large hospitals by 2025

68.3% of all necessary funds for the implementation of the entire program[10].

Another driver of growth in the construction industry for the next few years may be the implementation of the plans of the Ministry of Health of the Republic of Kazakhstan for the construction of 16 large hospitals by 2025 in the amount of 838.5 billion tenge with provision of 19 thousand jobs. Moreover, the construction will be implemented using a public-private partnership (PPP) mechanism. In the fall of 2019, it was reported that the

Growth driver: housing program "Baikytty Bass"

[11] Sources: https://24.kz/ru/news/social/item/349282-16-bolnits-postroyat-v-kazakhstane-do-2025-goda



implementation of seven PPP projects with a total investment of 439.2 billion tenge had already begun.[11]

New growth drivers have also emerged in the housing construction market. In particular, in July 2019, a new housing program «Bakytty otbasy» (Happy Family) was launched in Kazakhstan. Within the framework of the program, large, single-parent and low-income families can receive soft loans at 2% per annum for a period of 20 years, with an initial payment of 10% [12].

In addition, as part of the implementation of the first social initiative, which was announced in the address of the President of the Republic of Kazakhstan to the people[13], by the resolution of the Board of the National Bank of the Republic of Kazakhstan in the spring of 2018, the Program of Mortgage Lending "7-20-25. New Opportunities for Buying

[12] Sources: https://strategy2050.kz/ru/news/bolee-3-tysyach-semey-kupili-zhile-po-lgotnoy-programme-ba-ytty-otbasy/
[13] Sources: https://www.zakon.kz/4924077-natsbank-utverdil-programmu-7-20-25.html

Growth driver: increasing share of renewable energy sources in the total energy balance of the country

Housing for Every Family ".

Under the program, the state will provide mortgage loans with an interest rate of 7% with an initial payment of 20% to families with middle and low income.

TheAlso, the development of the construction industry (energy and municipal construction) will be facilitated by the government's desire to increase the share of renewable energy sources in the country's total energy balance from 1.3% in 2019 to 50% by 2050. For example, in July 2019, the Asian Development Bank signed an agreement with the government of Kazakhstan to provide a loan of $ 30.5 million for the construction of a 100 megawatt (MW) solar power plant in the Zhambyl region[14].

[14] Sources: https://www.giiresearch.com/report/gd780690-construction-kazakhstan-key-trends-opportunities.html

Figure 1.1.

The largest companies in the construction industry in the Republic of Kazakhstan, according to the National Business Ranking 500[15]

10 LARGEST COMPANIES IN THE CONSTRUCTION INDUSTRY OF KAZAKHSTAN
#16 BI Group
#30 Sembol Investments & Development
#34 Branch Arabtec Consolidated Contractors Limited in Astana
#38 LLP «A subsidiary of the Chinese Petroleum Engineering and Construction Group»
#42 Group of companies «Bazis-A»
#47 JSC «NGSK «KazStroyServis»
#49 JSC «PSN «Kazstroy»
57 LLP «Senimdi kurilys»
63 LLP «Integra Construction KZ»
#69 LLP «Consortium «ISKER»

[15] The largest companies in the construction industry in the Republic of Kazakhstan, according to the National Business-500 ranking

2. PRIVATE EXPERTS' OPINION ON CONSTRUCTION INDUSTRY IN KAZAKHSTAN

SAURANBAYEV ERALY BOLATOVICH

Head and founder of SHEBERBUILD LLP, member of the Union of Urban Planners of the Republic of Kazakhstan. Founder and General Director of the SHEBER Group of Companies, member of the Union of Urban Planners of the Republic of Kazakhstan, Chairman of the Board of the Public Association "Union of the Construction Industry of the Republic of Kazakhstan", member of the Council of the Bolashak Association, member of the Board of Trustees of the Scientific and Educational Foundation named after academician Shakhmardan Yessenov.

At the moment, the construction industry is experiencing a certain recession. Of course, stress is still temporary in nature, however, whether this stress becomes chronic, systemic or only temporary depends on the actions of the government. Now the most important problem in the construction industry is the disruption of supply chains: imports, supplies, labor. I especially want to note the problem of human resources, there are not enough specialists. The market is also narrowing.

However, if we look at the industry in retrospect 5-10 years, we have seen a big leap for the better.

The construction industry in Kazakhstan is an integral and significant part of the economy, which at the moment has not yet realized its full potential.

As for the level of professionalism in the domestic construction industry, a high level of competence is observed in the construction of housing and industrial buildings.
Good specialists are employed in the construction of load-bearing structures, in engineering, electrical and plumbing works. At the same time, new technologies are used.

OUR COMPANY, FOR EXAMPLE, BUILT THE FIRST WARM WAREHOUSE IN THE CIS, IT IS FULLY AUTOMATED, ONLY ROBOTS ARE EMPLOYED IN OPERATION, HUMAN LABOR IS NOT ACTUALLY USED.

However, there is still a problem of a lack of qualified personnel.

We have trained personnel at the level of working hands, but the quality of training managers is lame, the composition of this echelon of specialists is limited. Our economy is changing rapidly, this is associated with staff turnover, there are large flows from one region to another, from one industry to another, and every 2-3 years in the construction industry there is either an inflow or an outflow of human resources. For example, now we are seeing a large outflow due to the pandemic, people are stuck in their regions.

In recent years, there has been a shortage of all specialists, or there are not enough people, or there is not enough professional training. Moreover, quantitatively, there is a lack of low-skilled personnel, and qualitatively, there is a lack of professional managers.

Young specialists enter the market. The impression from them is generally good. If there is not enough knowledge, then this deficiency is compensated by the openness of the worldview, thanks to digitalization, the mentality of young people is already different. Now the industry is supported by a mature generation of specialists. The engineering staff is basically a post-Soviet mentality, they are gorgeous craftsmen, but they cannot think in the format of a resource for saving, ecology, and so on. Many professionals lack the entrepreneurial mindset, especially among experienced engineers, and this leads to higher labor costs. In general, in Kazakhstan there is some kind of inferiority complex in relation to new technologies. Everyone interprets the concept of «new technologies» in their own way, many believe that it is necessarily something foreign, robots and so on. For some, this is part of their daily routine. This is probably more of a philosophical question, whether we accept them or not new technologies, it is as a way of our thinking. The people who are responsible for the control, for the implementation of standards, mostly think in the old rules and regulations and negatively perceive new technologies. There are also features of the industry itself. Construction is a fairly conservative sector and innovations come to us last. The attitude towards experiments is still negative, because the quality of our work determines how safe the buildings, the objects that we have built for people, for their lives, for their work will be. So innovation is still more in the field of consumer goods.

IF THERE IS THE GOLDEN STANDARD OF THE INDUSTRY, THEN THE WORLD NOW ALREADY USES 3D PRINTING, AND «GREEN» TECHNOLOGIES, AND ROBOTS AT BUILDING SITES, I AM SURE THIS ALSO COMES SOON TO US.

SOTNIKOV SERGEY VLADIMIROVICH

Director of Engineering Design Consulting Group LLP.

At the moment, the construction industry is experiencing a certain decline. Of course, the stress is temporary, but whether it becomes chronic, systemic, or only temporary depends on the government's actions.

Now the most important problem in the construction industry is the disruption of logistics chains: imports, supplies, and labor. I would especially like to note that there are not enough human resources and specialists. The market is also narrowing.

In the construction industry of Kazakhstan, projects commissioned by the state are carried out on 6 points out of 10, and this applies to the entire cycle of work, from financing to personnel.

If we talk about design, the situation is slightly better, because the base of specialists is preserved, and probably 70% of all design work is performed on 9 out of 10 points. Another particularly acute problem is the lack of use of new technologies in the production of building materials.

We can confidently say that at the moment there is a turnover and a shortage of qualified personnel in the industry. There is a great lack of specialists in bridge construction-road builders, specialists in the construction of Railways, highways, geologists, hydraulic engineers, qualified builders of a wide profile.

Our professional training in construction specialization has been split up. if earlier they first gave General knowledge of

construction, and then divided it into specific specializations, now graduates are more narrowly focused and the graduate who comes to work does not understand and does not see the General picture. The reality is different from the knowledge that students receive at the University, so it is necessary to send teachers on internships to exchange experience, improve their skills.

With new technologies, manufacturers come to us and talk about their technologies, hold seminars, provide educational materials, brochures, and we are exploring the possibility of their application in our projects.

I WANT TO NOTE ANOTHER INNOVATION IN THE CONSTRUCTION OF ROADS AND HYDRAULIC WORKS THAT HAVE COME TO US FROM ABROAD - USE BIOMATERIALS AT THE DEVICE OF THE WATERWAY AND ROADBED, THIS TECHNOLOGY CAN REDUCE THE COST OF WORK TO REDUCE THE TERM, INCREASES PERFORMANCE AND INCREASES THE SERVICE LIFE OBJECTS.

The use of this technology gives very good results, and with unlimited funds, we would invest in new biomaterials.

Builders, one might say, are little gods who improve the quality of life on Earth, so that construction specialties will not disappear anywhere. A person always wants more comfort and convenience for his life, which is realized through original engineering solutions. Of course, the development of technology will affect specialties,

but without the human factor - nowhere. For example, the same bricklayers will be retrained to use new machines, the work will be automated to improve the quality and shorten the construction time, but the specialty itself will not go anywhere, perhaps the bricklayer will combine some managerial abilities, take into account environmental factors, work with a bias in IT technologies. This requires a new generation of specialists and new teachers.

I BELIEVE IT IS NECESSARY TO STRIVE TO WORLD QUALITY PRODUCTION. BUT IT IS NECESSARY TO DO EVERYTHING LITERALLY AND GRADUALLY, IT IS NOT NECESSARY TO REFLECT ONLY FOR SOMETHING, BUT HIGHLY PROFESSIONAL MANAGEMENT IS NECESSARY FOR THIS.

SERZHAN ABUGALI

Technical Director
of SKTL LLP

It is not easy to unequivocally assess the state of the construction industry in Kazakhstan, there are opposite poles. On the one hand, companies in the private sector invest massively in technologies and equipment and they get the corresponding results - accelerating the pace of construction and improving the quality of work.

This is not the case in the state-building sector. Everything rests on the issue of financing - this is the cost of building materials, construction and installation work, in general, the entire process from the beginning to the end of the project.

The main problem of the public sector is that the project itself is approved and signed, coordinated 2-3 years before the actual start of the project, but almost always there are questions of revision, re-approval, re-registration, and as a result, the project is delayed. During this time, economic conditions have changed: the dollar / tenge exchange rate has changed, inflation is growing, and as a result, all the materials that are needed for construction become more expensive, we buy almost everything we need abroad, we do not produce much in Kazakhstan. Low efficiency, timeliness, bureaucracy - all this ultimately slows down the work on the project.

Another problem is the policy of the construction companies themselves. It often happens that a new company is opened in the private sector and the management recruits employees of low or even low qualifications for low wages. Of course, this approach yields as a result, and problems in the quality of work and the timing of the project itself are stretched.

The last five we have tried to introduce new technologies, but problems with red tape on the project and problems with the level of qualifications of personnel still slow down this process. It cannot be said that we do not have enough personnel, it is not a matter of quantity, but of quality and, first of all, the quality of personnel training. If you look at the examples of Canada or the United States, or remember how specialists were trained in the Soviet Union, then upon graduation, a graduate, for example, a future foreman, he already had a real working internship under his belt just as a foreman, and not as a handyman at a construction site. During the internship, the master teaches the trainee and shows how everything works in production; at the end of such an internship, the future graduate already has qualifications and real work experience. Nowadays, such a situation often happens, the employees who are hired have neither practical experience nor good knowledge, and out of ten hired only one may turn out to be sensible. Problems with the qualifications

of employees inevitably lead to an increase in the construction time and disruption of the entire cycle of work, because you have to spend time correcting mistakes made, and this also leads to an increase in the cost of the entire project.

IN ORDER TO IMPLEMENT NEW TECHNOLOGIES AND USE EQUIPMENT OF THE NEW GENERATION, TRAINED STAFF IS NEEDED. IN THIS PLAN IT IS NECESSARY TO CHECK BI GROUP. THEY TRAIN THEIR SPECIALISTS, NOT CONTRACTED ORGANIZATIONS, BUT THEIR STAFF MASTERS, DESIGNERS AND SO FURTHER.

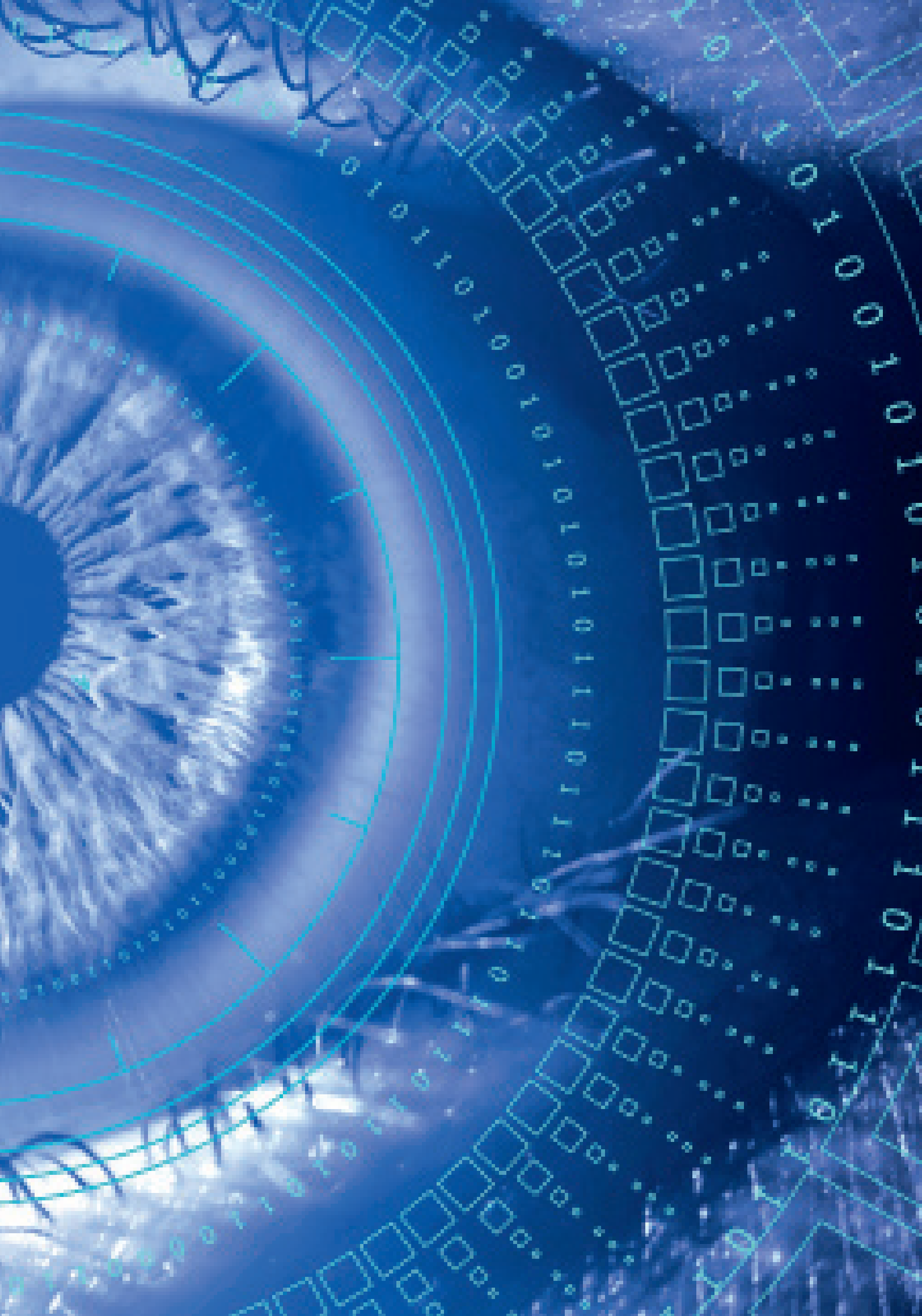
Yes, they have a school, short and long term courses. For other companies, training takes place in reconnaissance mode, everything has to be learned right in the process, so that the work is of high quality and at the same time economical. If we talk about the introduction of new products into production, then often foreign partners help Kazakh companies.

For example, in our company, every two to three years we update all equipment, technologies, tools. And if we do not know something, then we turn to our partners in Turkey for help, they have a plant for the production and processing of plastic and aluminum profiles. A specialist comes to us, who trains our employees right in the shop, for about two weeks, then he takes an exam to check how the skills were learned by our employees. We turn to our Kazakhstani companies, tool suppliers, they also teach our employees, usually it takes no more than one day. Of course, using innovations is always a certain risk, but if you do not take risks, then there will be no results. A person is always ready for changes if there is confidence that the changes will be positive and bring profit in the end. Occupations of a certain level, for example, operators, small assemblers, welders, assemblers, can become irrelevant over time. As for the designers who make calculations for certain materials, they can also leave the scene, as they say, if you use Revit Autodesk or ArchiCAD Graphisoft and other programs correctly. These programs have not yet reached us in full, although they have been used in the world for over 20 years. It is easier for foremen on construction sites to use AutoCAD, and they do not know how to use other digital tools.

For example, if you take any construction project in the industry average, which has one project manager, two site managers and 4-5 foremen, each of them must have computers with Revit or ArchiCAD for everything to work correctly at the construction site. But in reality, everything happens differently. We have companies where one laptop is available at the facility in order to open AutoCAD or write some kind of application, but the same Revit or ArchiCAD is no longer loaded there, since the computer parameters are not suitable. It is clear why everything happens this way, because everything ultimately depends on money, so often there is not even normal WiFi on construction sites now.

SUMMING UP, I WOULD LIKE TO SAY THAT IT IS NECESSARY TO INVEST IN THE CONSTRUCTION SECTOR FIRST IN PEOPLE, IN THEIR TRAINING AND RETAINING, WITHOUT THIS WILL NOT PROGRESS FAR.

3. EXPERTS' VIEW INTO THE FUTURE OF CONSTRUCTION INDUSTRY IN KAZAKHSTAN



EXPERTS' VIEW INTO THE FUTURE OF CONSTRUCTION INDUSTRY IN KAZAKHSTAN

We have witnessed a rapid growth in the construction sector in Kazakhstan in recent years. In many ways, this growth was quantitative, extensive, so the next step for the industry is qualitative changes that will become possible only if the construction industry straddles the wave of technological changes that the Fourth Industrial Revolution brings with it.

Until recently, the construction industry throughout the world remained extremely conservative and did not change for a long time, which led to an exacerbation of the problem of low profitability and a deterioration of the industry's image in the eyes of the younger generation of specialists. But we are witnessing that the construction industry in the developed economies of the world has already entered an era of transformations that will redraw the entire industry to its core. Future events will show whether the construction sector in Kazakhstan can take advantage of the opportunities presented by the Fourth Industrial Revolution in order to stay afloat, avoid stagnation and continue its development. In order to hear the «voice» of the industry and understand the general prospects for the development of the industry, we interviewed just over 180 Kazakhstani construction industry experts who have been in the industry for more than ten to fifteen years. Let's make a reservation right away that for greater clarity of the data obtained, we calculated a simple index, the values of which range from -100 to +100. The legend of the index values for each forecast is shown below.

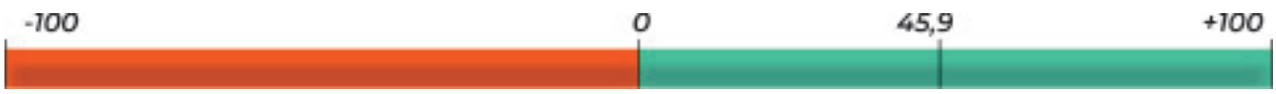
Table 3.1.
«Legend of index values»

FORECAST	INDEX VALUE FROM -100 TO 0	INDEX VALUE FROM 0 TO +100
Forecast 1. Assessment of the future of the industry.	The ratings «Negative» and «Uncertain»prevail.	The ratings «Positive» and «Stable» prevail.
Forecast 2. Assessments of the main problems of the industry.	Estimates of «Weak influence» prevail.	The ratings of «Strong influence» and «Average influence» prevail.
Forecast 3. Estimates of the current situation in the industry.	The assessments «Crisis situation» and «Unsatisfactory situation» prevail.	The ratings «Excellent position», «Good position», «Satisfactory position» prevail.
Forecast 3. Assessment of the industry's readiness for change.	The ratings «Definitely not ready» and «Rather not ready» prevail.	The ratings «Definitely ready» and «Rather ready» prevail.
Forecast 4. Impact assessment potential major events on the industry.	Ratings prevail «Will have a weak impact» and «Will not have an impact».	Ratings prevail «Will have a strong impact» and «Will have a medium impact».
Forecast 5. Assessment of the probability of risks in the future.	The «Low probability of risk» assessments prevail.	Ratings prevail «High probability of risk» and «Average probability of risk».
Forecast 6. Assessment of the probability of obtaining new opportunities in the industry.	The estimates of «Low probability of obtaining new opportunities» prevail.	Ratings prevail «High probability of getting new opportunities» and «Average probability of getting new opportunities».

1 FORECAST
THE FUTURE OF THE CONSTRUCTION INDUSTRY IN RK IS POSITIVE

The general opinion of experts about the future of the construction industry in the republic16 is positive, however, the index took a value of 45.9 points, that is, halfway to zero (borderline) value, which separates the zone of prevalence of positive assessments from the zone of prevalence of negative assessments.

Figure 3.2.
Index «Assessment of the future of the industry»



As we have already said, the housing construction market will be stimulated through two new state programs: the Bakytty otbasy (Happy Family) housing program and the 7-20-25 new housing mortgage program for every family.

These programs should stimulate demand in the housing market.

Civil construction will also be stimulated by the state: the Nurly Zhol infrastructure development program for 2020 - 2025, the plans of the Ministry of Health of the Republic of Kazakhstan to build 16 large hospitals, the government's plans to increase the share of renewable energy sources in the total energy balance of the country from 1.3% in 2019 to 50% by 2050.

In addition, it is assumed that the share of local content in construction will be increased to 95%, which means that funds will

[16] Question 4
[17] Sources: https://forbes.kz//process/property/pravitelstvo_kazahstana_vozlojilo_bolshie_ekonomicheskie_nadejdyi_na_na_stroitelnyiy_sektor/?

be invested in the development of local production. Today, the market needs construction products of basic materials worth 669 billion tenge, while imports are worth 339 billion tenge. It is quite understandable that the government wants to reduce the share of imports by 54%. To achieve this goal, 33 new projects have been launched[17].

As we can see, the construction sector in the near future will be loaded with both work and investment. Nevertheless, experts are cautious about the future of the industry.

2 FORECAST

THE MAIN PROBLEMS OF THE INDUSTRY THAT HINDER ITS DEVELOPMENT – WEAK FILLING WITH NEW TECHNOLOGIES, LACK OF QUALIFIED PERSONNEL, LOW WAGES IN THE INDUSTRY AND LOW-QUALITY LOCAL PRODUCTION

In order to identify the problems of the domestic construction sector that can most strongly affect its development, a number of problems were tested for the degree of negative impact.

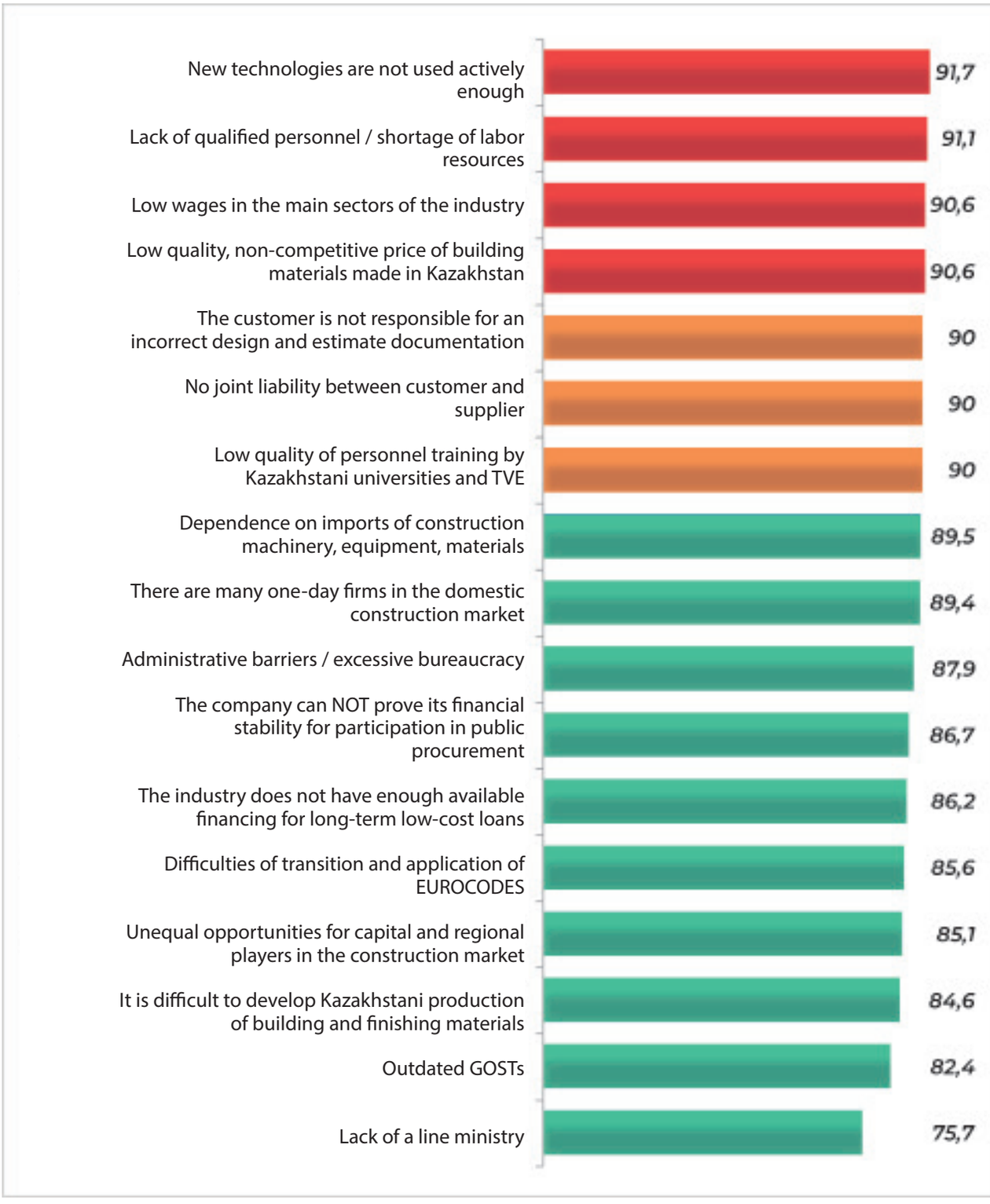
Fundamental factors holding back the development of the industry:

- insufficient use of new technologies,
- shortage of qualified personnel / shortage of labor resources,
- low quality,
- uncompetitive prices for building materials produced in Kazakhstan and low wages in the main sectors of the industry.

The value of the index came close to the maximum mark of +100 points in the zone of assessments «Strong impact of the problem» and «Average impact of the problem». In short, the technological backwardness and the declining level of competence in the industry are the obstacles that will continue to hold back the development of the industry.

Chart 3.1.

«Index for assessing the impact of problems on the industry»[18]



[18] The higher the index value, the more experts gave the problem a high or average value.

3 FORECAST

THE CURRENT CONSTRUCTION SITUATION SHOULD CHANGE IN ORDER TO INCREASE THE INDUSTRY'S PREPAREDNESS FOR INEVITABLE CHANGE

The most vulnerable areas of the Kazakhstani construction industry at the moment are the production of construction machinery and equipment, development (R&D) of construction machinery and equipment and training (universities, TVE) for the construction industry.

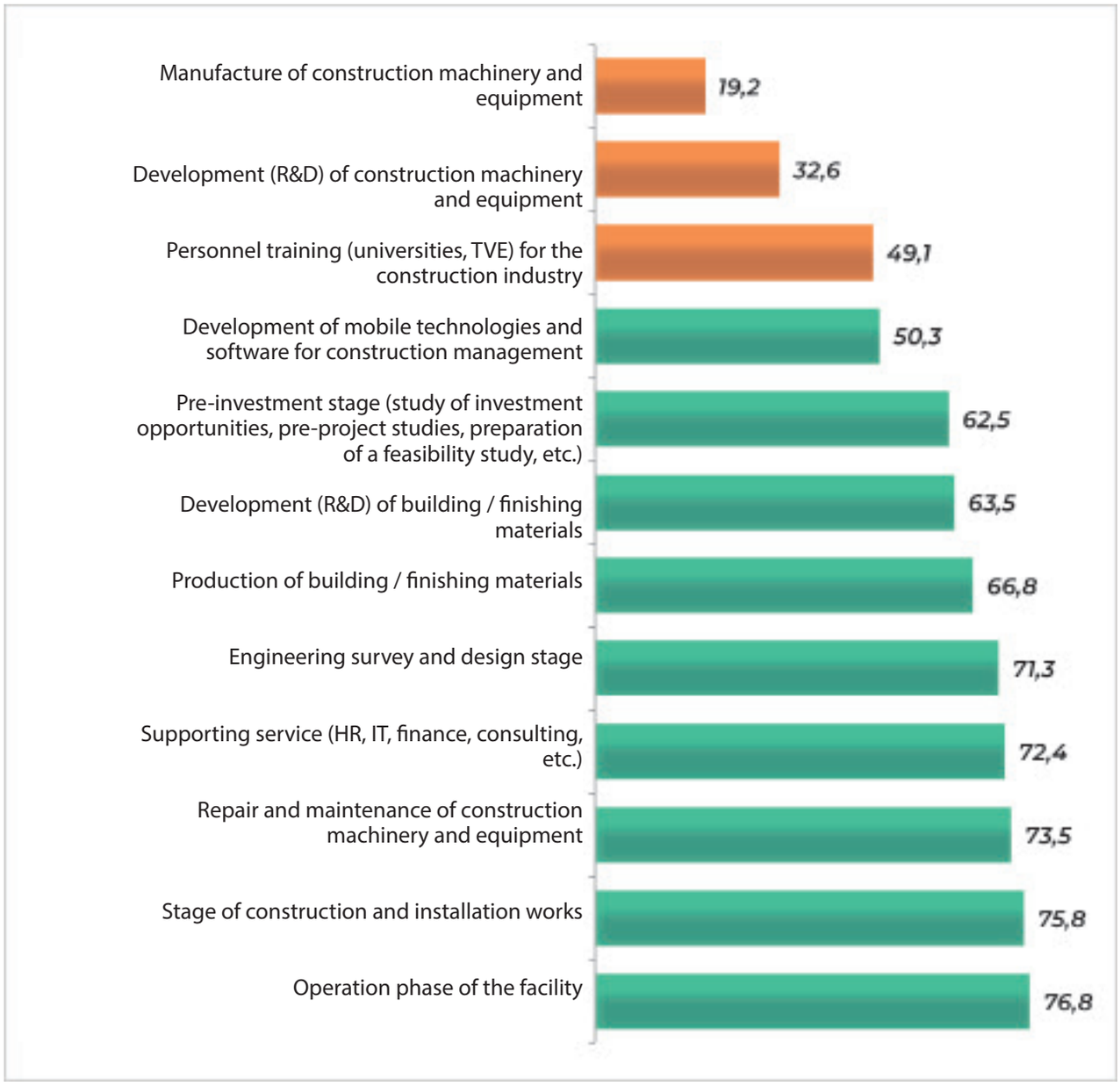
The values of the indices for these three positions came close to the area of estimates

«Crisis»,
«Unsatisfactory position».

In short, in order to enter a new era, the construction industry must actively develop high-tech redistributions and the quality of professional training.

Chart 3.2.

«Index of assessment of the current situation in the domestic industry»[19]



In the meantime, experts are very cautious in assessing the readiness of the construction industry for changes: the index took a value of 14.9 points, very close to the zone of prevalence of negative assessments ("Definitely not ready" and "Rather not ready").[19]

Figure 3.3.

Index «Assessment of Industry Readiness for Change»

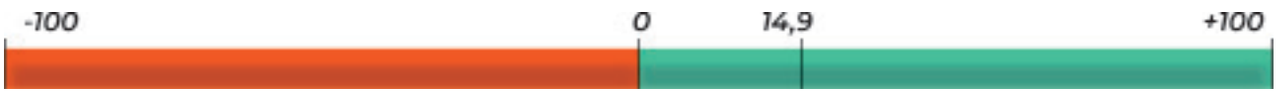
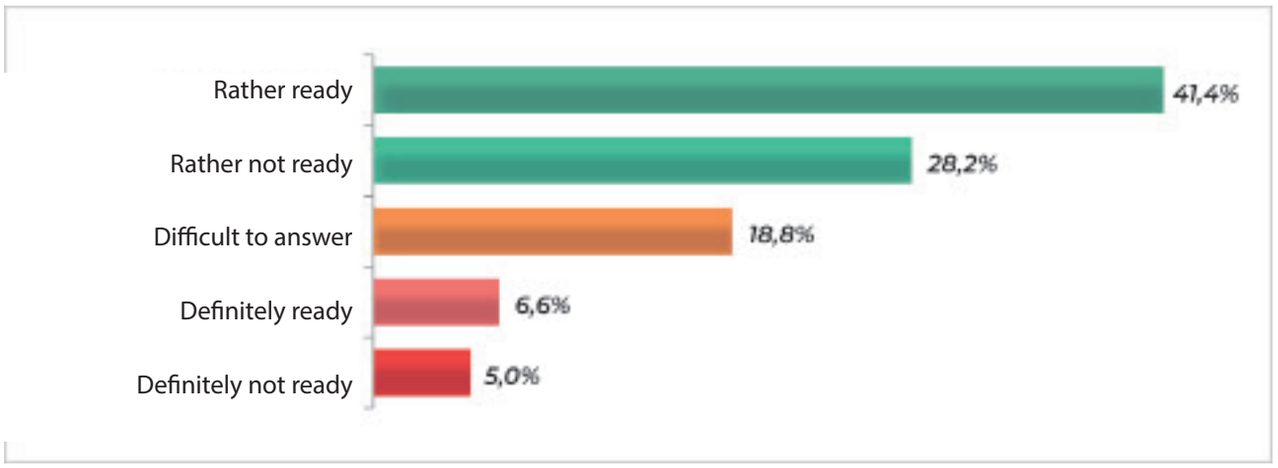


Chart 3.3.

«Do you think the construction industry of Kazakhstan as a whole is ready for the upcoming changes in the industry»[20]



[20] Question 13.

[19] The lower the index value, the fewer experts gave a positive or neutral assessment

4 FORECAST

THE CONSTRUCTION INDUSTRY WILL CRITICALLY DEPEND ON THE ECONOMIC SITUATION IN THE COUNTRY AND STATE ORDERS

The expert community unambiguously points to the need for technological modernization of the industry, to increase the level of personnel training, to maintain and develop domestic R&D and the development of local production.

However, assessing the strength of the impact of potential major events on the development of the industry in the coming years, experts still attach decisive importance to large government orders in the first place. Such large infrastructure plans of the government as: increasing the share of renewable energy sources from 1.3% in 2019 to 50% by 2050 and increasing the share of republican, regional and district roads in good and satisfactory condition to 100% and 95% by 2025 , got the largest index values.

The only thing that can be stronger than the government and its generous orders is the economic crisis due to the fall in oil prices, the reduction in the revenues of the state budget and citizens (this event will have a very strong impact on the industry, the index of 74.6 points is close to its maximum value +100 points in the zone of assessments «Will have a strong impact» and «Will have an average impact»).

It is noteworthy that such innovations as building information modeling (BIM) and blockchain (E-Qurylys), which are already being implemented at the request of the state, will not have a strong impact, according to experts. The implementation of the blockchain (E-Qurylys), a truly important event for the entire industry, is rated very low by experts; the index value of 39.3 points is located close to the areas of estimates «Will not have an impact» and «Weak impact».

Chart 3.4.

«Index for assessing the impact of potential major events on the industry.»

5 FORECAST

RISKS IN THE DOMESTIC MARKET ARE HIGH AND THE IMPLEMENTATION OF ANY RISK CAN SIGNIFICANTLY HIT THE INDUSTRY IN THE FUTURE

What are the risks of the future of the industry?

What scenarios are likely to shake the industry?

We tried to collect all internal risks into several groups:

1 GROUP OF RISKS «UNDEVELOPED CONSTRUCTION INDUSTRY»:

The production of building and finishing materials will not develop further.

Local production costs will remain high.

Entrepreneurs will NOT have any incentives to develop the production of equipment, materials.

The construction market will be monopolized.

Lack of competition in the market will lead to its stagnation and technological lag.

2 GROUP OF RISKS «UNDEVELOPED R&D AND PROBLEMS OF PROFESSIONAL EDUCATION»:

Lack or disappearance of research institutes, laboratories, critical deterioration in the quality of personnel training.

Further decline in the number of qualified personnel at all levels.

3 GROUP OF RISKS
«INFLUENCE OF THE STATE»:

The state will introduce new rules for regulating the industry, this will lead to a reduction in the market.

Government programs to stimulate the industry will NOT achieve their goals, the construction market will shrink.

4 GROUP OF RISKS
«STATE OF ECONOMY»:

Falling consumer demand from citizens.

Reduced investment in fixed assets in the construction industry.

Sharp rise in prices for equipment and construction / finishing materials.

Deteriorating economic situation in the country due to falling oil prices.

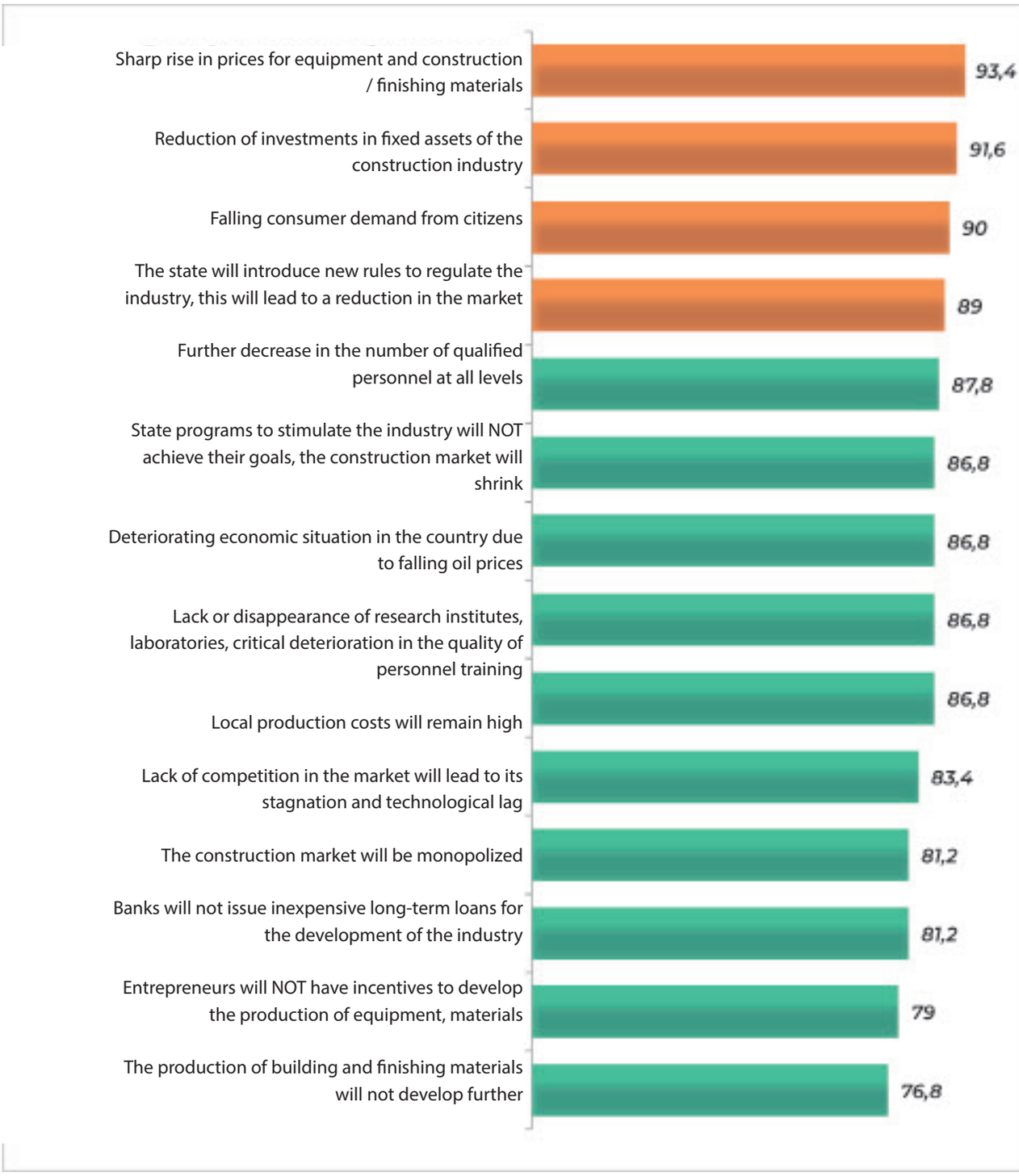
Banks will NOT issue inexpensive long-term loans for the development of the industry.

Realization of virtually any risk can have a significant impact on the industry. The values of the indices for all risks are above 70 points, that is, they are close to the maximum value of +100 points in the area of assessments "Average probability of risk" and "High probability of risk".

Experts agreed that the main sources of danger for the industry are a sharp jump in spending, amid falling consumer demand and depletion of investment in the industry, as well as unexpected actions by the government as the main regulator.

Chart 3.5.

"Index for assessing the likelihood of risks in the industry".[21]



[21] The higher the value of the index, the more experts believe that the probability of a risk occurrence is high or medium.

6 FORECAST

THE CONSTRUCTION INDUSTRY SHOULD AND CAN USE NEW OPPORTUNITIES FOR ITS DEVELOPMENT

How can the construction industry prevent negative scenarios from occurring?

How to respond to potential risks in the industry?

According to experts, three opportunities that the construction industry can and should take advantage of will contribute to its development in the near future:

Introduction and use of new technologies, innovative equipment.

Improving the quality of professional training for the construction industry.

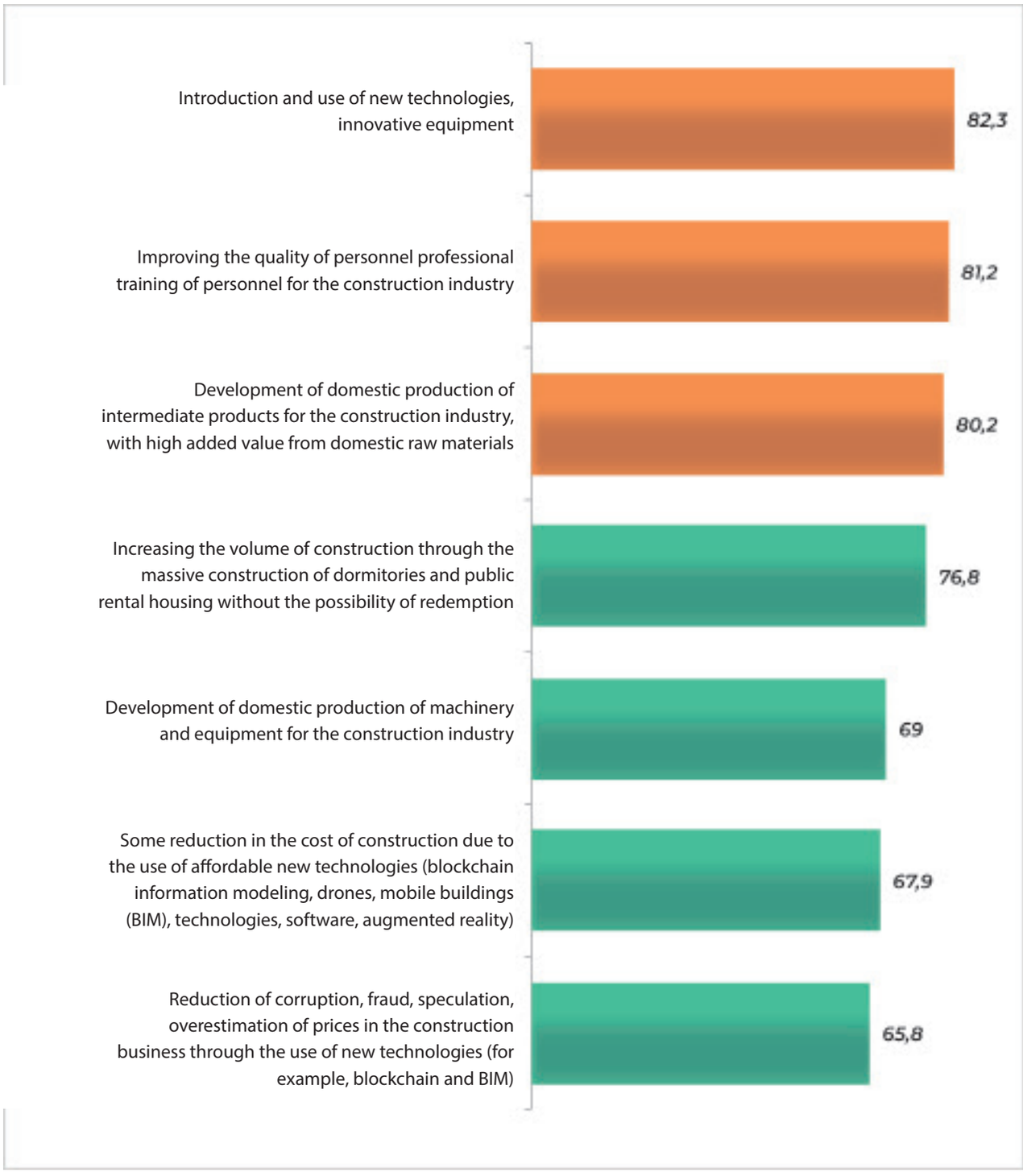
Development of domestic production of intermediate products for the construction industry, with high added value from domestic raw materials.

The value of the index for these three positions came close to the maximum value of +100 points in the areas of assessments «High probability of obtaining new opportunities» and «Average probability of obtaining new opportunities».

Construction companies have other opportunities that the time has come to take advantage of: it is necessary to introduce new technologies in order to reduce the cost of construction and reduce the level of corruption (for example, using blockchain). But the state should, for its part, support the construction industry through large orders and the development of local production.

Chart 3.6.

«Index for assessing the likelihood of new opportunities for construction companies».[22]



[22] The higher the index value, the more experts believe that the likelihood of new opportunities for companies is high or medium.

4. TECHNOLOGICAL RENEWAL OF THE INDUSTRY FOCUSED ON DIGITALIZATION

4.1.
TECHNOLOGICAL RENEWAL OF THE INDUSTRY FOCUSED ON DIGITALIZATION

In the modern world, the border between the physical, digital and biological worlds is blurring - this is the essence of the Fourth Industrial Revolution («Industry 4.0»), of which we are witnesses and contemporaries. Synergy of new advances - artificial intelligence (AI), robotics, Internet of things (IoT), 3D printing, genetic engineering, quantum computing, etc. - creates a wave of technologies of the Fourth Industrial Revolution, which change not only the daily life of people, but also radically transform entire industries and sectors of the economy.

The impact of the Industry 4.0 phenomenon on the construction industry is still minimal and the industry still has to redesign its value chain - from design work to construction site work - under the influence of new technologies. However, we can already say that some of the fundamental technologies of the Fourth Industrial Revolution are being applied in the construction industry. The introduction of some new technologies does not require significant financial investments and therefore they quickly pave the way into the industry, some innovations may be available so far only to large players in the market precisely because of their relative high cost.

Of all the technologies that are already in use or are just beginning to be used in the global construction market, only a few of them are likely to come to Kazakhstan in the medium term. Let us explain the reasons for this selectivity.

In 2019, almost half of the volume of work in the construction sector of Kazakhstan was carried out by small enterprises, and the volume of investments in domestic construction amounted to only 1.02% of the total volume of investments in fixed assets.

Objectively, the construction market of Kazakhstan is ready to adopt technologies that do not require significant financial costs, significant costs for training specialists or building the necessary auxiliary industries or industries. These fast-moving innovations include, first of all, digital technologies. The rapid penetration of digital technologies is also facilitated by the understanding at the state level of the importance of digitalization of the economy of Kazakhstan (in 2017, the Digital Kazakhstan program was adopted).

It is the state that has mandatorily introduced the use of two digital technologies in the construction industry in Kazakhstan - building information modeling (BIM) and blockchain. In 2016, the Committee for Construction, Housing and Utilities of the Ministry of National Economy of the Republic of Kazakhstan approved the State Standard for determining the cost of work for construction in the Republic of Kazakhstan. Clause 8 of the State Normative Act actually requires the development of design estimates using BIM technology. In addition, within the framework of the new Nurly Zher program for 2020-2025, housing construction will be reflected in an electronic system (E-Qurylys unified information system) using blockchain technology.

Let's take a look at how global trends affect the construction industry and try to highlight industry trends.

It is quite expected that the next steps of construction companies will be the further implementation of digital technologies: augmented and virtual reality (AR / VR), drones, mobile applications and construction management software.

1 TREND
GROWING DEMAND OF THE CONSTRUCTION INDUSTRY FOR TECHNOLOGICAL RENEWAL

Today, new technologies in construction are being developed more quickly than ever. What ten to twenty years ago seemed like technologies of the distant future, today can already be seen on construction sites around the world.

Unlike most construction companies, which still do NOT make significant investments in the development of new technologies, venture capitalists see potential in new technologies for the construction industry.

In the summer of 2019, Brick & Mortar Ventures, LLC (San Francisco, USA)1 announced an investment of $ 97.2 million2 in startups that specialize in the development of technologies in the field of architecture, engineering, construction and facility management. It is interesting to note that Brick & Mortar Ventures itself has raised the necessary funds from companies that are part of the "construction value chain".

This suggests that, in fact, construction, as a business, as an industry, is already ready and is extremely interested in major technological innovations.

Among the sponsors are Brick & Mortar Ventures:

manufacturer of special materials Ardex;

giant in Autodesk software;

building materials company CEMEX;

Ferguson Ventures is the venture capital arm of a huge US sanitary ware distributor;

FMI company specializing in management consulting for engineering and construction;

Obayashi, a large Japanese construction company;

Sidewalk Labs, which specializes in urban innovation (owned by Alphabet; formerly Google) and United Rentals, one of the world's largest equipment rental companies.

The example of an American venture capital company from

[1] Brick & Mortar Ventures, LLC is an American venture capital firm that specializes in investments in the development of software and hardware solutions for architecture, engineering, construction and asset management.
[2] SOURCE: https://www.inman.com/2019/08/13/new-97m-venture-fund-to-focus-on-construction-technology/

Silicon Valley that invests in construction technologies can demonstrate the dynamics of the creation and penetration of new technologies into the construction industry.

During the foresight sessions, Kazakhstani experts in the construction industry also noted "the growing demand for new technologies and materials" as one of the key trends in the construction industry. For example, micro-trends were highlighted: "the need to monitor the main physical and mechanical properties of building materials in real time using digital technologies", "increasing the speed of delivery of building materials due to the development of UAVs", "increasing the speed of performing monolithic works" and "increasing the spread of modular architecture «,» transition to an independent system of conformity assessment of buildings, infrastructure structures.

On our own behalf, we add that the new technologies of the Fourth Industrial Revolution are primarily digital technologies. Let's look at the example of the next industry trend - "The growing demand for digitalization of the construction industry", how digitalization and the construction industry relate.

2 TREND
GROWING DEMAND FOR THE DIGITALIZATION OF THE CONSTRUCTION INDUSTRY

The construction industry is finally entering a new technological era. The onslaught of digitalization on the industry around the world is only growing.

Despite the fact that the players in the construction industry are still confused and cautious about changes and new technologies, it is already necessary to develop a digitalization strategy for the industry now in order to stay on the crest of the wave in the future. It is quite expected that construction-digital technologies «,» an increase in the speed of delivery of building materials due to the development of UAVs «,» an increase in the speed of implementation of monolithic works «and» an increase in the spread of modular architecture «,» transition to an independent system for assessing the conformity of buildings, infrastructure structures. « On our own behalf, we add that the new technologies of the Fourth Industrial Revolution are primarily digital technologies. Let's look at the example of the next industry trend - "The growing demand for digitalization of the construction industry", how digitalization and the construction industry relate. Utilities started by setting up innovation labs and launching so-called proof-of-concept (POC) studies to test possible options for introducing new technologies without risking significant investments. But the possibilities of this stage have already been

exhausted and the time has come for active action, this is the only way to ensure long-term success in the future.

The possibilities of using «numbers» in work are numerous! Specifically for contractors in the construction industry, three areas can be distinguished:

Interactive workflows. Virtual, augmented and mixed reality, on-site electronic documentation, associated work schedules and immediate adjustments to plans - all of which make it possible to track all the changes that have occurred. The efficiency of work processes can be greatly improved through more efficient, transparent and faster collaboration.

Interconnected machinery, equipment and workers. The interconnected operation of machines and equipment (and even workers on construction sites) within the same system can improve energy efficiency, increase safety on the construction site, reduce delays in work and improve the quality of work. The possibilities of using robotics at the construction site are also being tested now (automation of repetitive tasks and exoskeletons for workers).

The use of large-scale machine production (industrialization) in construction.

Industrialization in construction is primarily the pre-production of components / modules for construction, the use of 3D printing (which makes it possible to significantly increase productivity).

As we said, digital penetration into the construction industry is just beginning. Therefore, we will provide some predictive statistics[3]. According to the World Economic Forum, over 10 years, full-scale digitalization of work processes in the industry will help save USD 0.7-1.2 trillion (13-21%) in the design, construction and construction stages, and during the operation phase, the savings can be 0. USD 3-0.5 trillion (10-17%). Artificial intelligence will help increase construction industry profits by 71% by 2035, according to consultancy Accenture[4]. Artificial intelligence in the construction industry is projected to reach $ 4.51 billion by 2026, according to a consulting company.

During the foresight sessions, Kazakhstani experts also noted the “growing demand for digitalization” as a key trend. For example, micro-trends were highlighted: “automation of the development of design and estimate documentation” and “implementation of information modeling technologies for construction objects (BIM)”, “increased use of the Internet of things, sensors integrated into smart grids”.

Now let’s take a closer look at technological innovations that are already in use in the construction industry or are just starting to be used.

EXAMPLES OF USED TECHNOLOGIES

BUILDING INFORMATION MODELING (BIM).

A McKinsey study found that 75% of companies adopting BIM reported a positive return on their investment. Why is Building Information Modeling a step forward for the construction industry? BIM - allows for all stages of a project (planning, design, construction, operation / repair, disposal) to collect and analyze the necessary data (architectural, design, technological and economic), while the data is analyzed interrelated and interdependent. The object under construction is designed in fact as a single whole for the entire life cycle.

Changing any one parameter entails an automatic change of the rest of the parameters and components associated with it, including drawings, visualizations, specifications and a timetable.

With the help of this technology, it is possible to build an object with all the infrastructure in virtual reality from start to finish even before the start of real construction, which makes it possible to detect and eliminate many of the shortcomings and problems that arise at the construction site.

BLOCKCHAIN.

Autodesk. Inc. a software provider in architecture, design, construction, manufacturing, plans to implement Blockchain technology to increase trust and reduce corruption in the construction industry. Forbes Council member Amir Balukh is confident that blockchain will significantly affect the construction industry. Blockchain will become a powerful component in providing a safer, faster and more efficient

[3] Source: https://constructionblog.autodesk.com/construction-industry-statistics/
[4] Source: https://www.accenture.com/t20170620T055506__w__ /us-en/_anmedia/Accenture/next-gen-5/insight-ai-industry-growth/pdf/Accenture-AI-Industry-Growth-Full-Report. pdf?la=en

workflow for all parties involved. How can a technology originally associated with cryptocurrency change business processes in the construction industry?

Smart contracts (blockchain) will provide all participants in a specific project with a common system for doing business, allowing them to buy, track and pay for services. Smart contracts will be a universal tracking system with rules and deadlines set and the blockchain enforces them.

This system will enable fast closing of deals, increased security, improved project tracking and supply chain automation. In addition, the use of blockchain in construction can help significantly reduce the corruption component of projects. So, the CEO of Autodesk. Inc. (Andrew Anagnost) "invites companies to use blockchain and pay attention to smart contracts and distributed ledger-based identity systems.

The code of such a smart contract can describe the construction financing logic.

For example, after a part of the building is completed, the blockchain sends a signal to the bank, which automatically transfers the next tranche of funds to the contractor from the escrow account. « Another advantage of using blockchain is to increase the efficiency of BIM: the blockchain will provide payment for work only if the object is built strictly in accordance with the digital plan (BIM); blockchain will allow BIM information to be updated in real time (BIM currently uses peer-to-peer networks to exchange information). Thus, the use of blockchain makes all partners on a construction project responsible for the implementation of the project.

AUGMENTED REALITY (AR).

Construction companies are already using gadgets / headsets, mobile augmented reality apps. How and why is augmented reality technology becoming indispensable in the construction industry? The new technology allows you to plan and modify a project much faster and more efficiently: using AR, 3D models are created directly in a 2D plan. In combination with software for 3D modeling and BIM, detailed interactive models of the object are created, changes are made, errors are corrected in the project even before the start of construction. Automation of measurements: using AR, the height, width and depth of objects are measured, this data is included in the object model, which increases the accuracy of the object under construction; accurate measurements of the object

allow you to effectively plan labor costs and material costs for construction. Measurements in AR make it possible to continuously compare the actual dimensions of the facility under construction with what was planned in the 2D plan and, if necessary, correct discrepancies in order to avoid higher costs and delays in the future. Information about the project is available directly at the construction site: AR makes it possible to combine all digital information with documentation in one virtual reality gadget: information about the location of pipes, walls, exits, switches and ventilation is available layer by layer directly on the construction site, this allows you to track the accuracy of construction throughout the project. Collaboration on a project: AR allows different teams (carpenters, electricians, plumbers, welders, designers and managers) to collaborate in real time, without the need for a personal presence on the construction site. On-site and off-site specialists can consult, correct errors and / or make changes, which reduces the time and cost required to make a decision. Safety training: Using an AR headset, workers can go through virtual training, instructions and safety scenarios. This direct learning style not only improves security awareness and provides intuitive learning, but also reduces training costs and downtime.

DRONES.

International construction companies such as Kier, Balfour Beatty, Vinci Construction and Mitie have begun using drones as a tool at the construction site. The synergy of drones and Artificial Intelligence (AI) is now actively developing. San Francisco-based Skycatch creates software that independently captures, processes and analyzes data from unmanned aerial vehicles obtained from aerial photographs. The company's

software turns these aerial photographs into orthophoto, 3D grids, or infrared images for a holistic view of the land being surveyed. Japanese construction giant Komatsu is already using Skycatch-integrated drones in more than 5,500 workplaces.

How and what exactly are drones used for? Conducting a topographic survey: visual data collected by drones can help get a complete picture of the entire site before construction begins; this data can show possible drainage points, changes in altitude, and can help determine the best places to build, dig ditches or stockpile materials.

Quality and reliability of work on the construction site: Maps, which are regularly generated using drones, allow the project manager to monitor the progress of work on the construction site (identify overloads and delays in construction, monitor labor productivity, investigate the causes of delays in work, move equipment to those areas of the site that need it), which allows you to avoid exceeding the project budget. Communication and management: photos, videos, 3D models and orthomosaic maps created with drones give clients a complete picture of how construction is progressing day after day.

The visual information regularly collected by drones is always up to date.

Improving overall safety: Collecting visual data with drones is significantly cheaper, so data can be collected much more frequently, which allows you to constantly monitor the changing conditions at the construction site and thereby monitor the level of worker safety and prevent unauthorized access of civilians to the construction site.

CONSTRUCTION ROBOTICS.

The use of robots in industry is no longer news and it is quite expected that the construction industry will adopt the advances in robotics.

Robots in construction can build walls, such as the HadrianX brick placing machine from Australia's Fastbrick Robotics Ltd. The machine uses an intelligent control system combined with a computer-aided design system to calculate the amount of material and movement needed to lay the bricks.

Robots such as the Hadrian and SAM100 from American company Victor promise to

reduce operating costs and losses, as well as provide a safer work environment and increase productivity. Hadrian can build the walls of a house in one day, which is much faster than conventional methods. Autonomous equipment can transport construction materials: Volvo, for example, is working on an autonomous forklift that can move heavy loads. The forklift does not have a driver's cab and instead uses digital technology to detect people and obstacles while on the move. Built Robotics offers autonomous bulldozers and excavators.

AI guidance systems guide equipment to its destination and ensure the required work is done safely and accurately. Smart robots use imaging technology: Construction robotics and drones using sensors with Global Positioning System technologies can provide important information about a construction site. Combined with artificial intelligence, it becomes possible to predict what tasks will be required. For example, a small robot from Doxel Inc. inspects a facility under construction, and the information it collects is used to identify potential errors and problems early.

Construction robots can be controlled remotely: Spanish company Scaled Robotics offers construction robots that can be remotely controlled using mobile devices. An unmanned ground vehicle (Husky) can navigate a construction site and receive important information using multiple sensors. The data is transferred to the cloud, where it is used to build the information modeling (BIM) of the project.

Surveillance, inspection and verification robots: For example, by donning a VR headset, viewers can see the live feed from the drone, so project managers do not even need to be on the construction site to see everything that happens.

MODULAR STRUCTURES.

Marriott, one of the world's largest hotel companies, plans to open the world's tallest modular hotel in late 2020. It will consist of 26 floors and will be completed in just 90 days. In China, in 2012, in Huan province on the shores of Lake Dongting, a hotel with a height of 30 floors and a total area of 17 thousand m2 was built in 15 days. The hotel was built using modular construction technology; the final assembly of the building required a crew of 200 people and one tower crane. The Chinese company BSB (Broad Sustainable Building) carried out the project development and construction of the facility. In 15 days, not only was the hotel erected, but the finishing and «filling» of the building was completed.

What are the essence and strengths of modular construction? Modular design involves the production of standardized construction site components in an off-site factory. The use of this technology reduces the overall construction time: the production of modules and the laying of the foundation on the construction site can be carried out simultaneously, while the assembly of finished modules is faster than building with traditional methods, so projects are completed 50-60% faster than with conventional construction. In addition, the risk of construction delays due to weather conditions is also reduced by 60-90%. Buildings are built faster and commissioned faster, accelerating the return on investment.

Total cost savings:

the prefabricated construction method allows you to reduce costs at each stage due to serial production: savings on materials at the procurement stage, on labor at the construction stage, on the efficiency of installation and standardization of premises; also, the reduction in construction time leads to a reduction in overhead costs.

Environmental friendliness:

modular structures are manufactured on a highly

organized assembly line, this minimizes the amount of waste generated, and prevents pollutants from entering the soil, air or groundwater.

Safety:

modular construction significantly reduces site disruptions by allowing 80% of all work to be done off-site, resulting in increased overall safety and reliability on site.

APPLICATION OF 3D PRINTING

This is a shorter supply chain and a faster design process. On-site 3D printing means that various time-consuming steps can be eliminated from the design process. The building design process involves the work of many parties: architects, engineers, contractors, clients and project implementers.

With 3D printing, the work of all of these parties can be integrated into the work of a single architect, and with simulation and modeling techniques, the structural integrity of the entire design process is ensured. 3D presentations allow you to see the design of an object and easily make the desired changes. Less logistics and less waste: According to contractors, 3D printing can eliminate the negative aspects of transport logistics. Many parts are damaged during transportation, and the parts are specially designed to withstand safe transportation and lifting, all of which can be avoided by printing everything needed on the construction site. Also, 3D printing eliminates the need for wooden molds, which are used in traditional construction, because in 3D printing, raw materials are directly cast into the structure. Easier and more efficient piping and electrical installation: When building with traditional methods, heating, insulation, plumbing and electricity systems require labor-intensive on-site installation. When 3D printing is used, some of these systems can be integrated into the 3D printing process.

At the moment, the main controversy about the use of 3D printing concerns the question of whether this technology can be a real solution to the housing crisis. The use of 3D printing is especially attractive as it can significantly reduce labor costs and construction time. For example, in 2018, a team of four American Marines, using 3D printing method, built a concrete barracks building in just 40 hours. Moreover, using traditional construction methods, it would take five days and the work of 10 people to build the same barracks from wood. The main factors that hinder the development of this technology on a large scale are the high cost of the 3D printer itself and its impressive size,

the high cost of special working mixtures, difficulties in mounting various communications, fears of cracks appearing during long-term operation of such structures. However, there is a significant demand for construction 3D printers in specialized fields.

Fresh examples of large-scale application of new technology: for the EXPO in Dubai (UAE), a pavilion will be printed in 3D format to welcome visitors to the exhibition. In southern Mexico, 50 houses are under construction using a giant 3D printer; however, it takes 24 hours to build one one-story house.

EXOSKELETONS.

Construction work is often hard, exhausting physical labor. Exoskeletons are designed to make work easier and safer. At the moment, there are various examples of the use of exoskeletons, for example, «power gloves» (for example, from Bioservo), which are used to improve grip strength and agility in tasks such as drilling. However, most exoskeletons are full-body suits (e.g. Guardian® XO® from SARCOS): one industrial exoskeleton offers a 20-to-1 increase in physical strength, i.e. when lifting a 200 pound load, a person in an exoskeleton will experience only 10 pounds of lift. The use of exoskeletons is quite promising: this innovation allows people to avoid industrial grasses and work without overloading.

EXAMPLES OF TECHNOLOGIES PROPOSED BY KAZAKHSTANI EXPERTS

The professionals of the domestic construction industry made several accents, discussing at foresight sessions, the spread of digital technologies and other new technologies in the construction industry in Kazakhstan:

- «3D printing», «Unmanned aerial vehicles (UAVs)», «Monitoring / Sensors /

Scanners»,
«Robots».

TECHNOLOGY GROUP «3D PRINTING» INCLUDES:

Print low-cost houses with a 3D printer using environmentally friendly construction materials.

3D printing of monolithic structures.

3D Design Automation: Design Automation is needed to help the printer operator monitor and correct failures in the 3D printing process of structures.

UNMANNED AIRCRAFT (UAV) TECHNOLOGY GROUP INCLUDES:

1. UAVs of increased payload: today, UAVs are mainly suitable for the transportation of small-sized cargo, weighing up to 400 g. For the massive use of UAVs in construction logistics, it is necessary to increase their carrying capacity many times.
2. Smart navigation of UAVs and low-altitude roads will develop with the massive use of UAVs in construction (and not only) logistics, which will require the creation of safe routes for their movement, airspace at low altitude.

THE MONITORING / SENSORS / SCANNERS TECHNOLOGY GROUP INCLUDES:

1. Using sensors to track the energy efficiency of buildings: this technology will be responsible for reducing energy use. For example, when there is no need to use energy: if people leave any room / room, the sensor gives the command to turn off the air conditioning of the room (in case of hot weather), or turn off the heating (in case of cold weather).
2. Using scanners to check the quality of building materials in production. Also, these scanners will be used as an «X-ray» for residential buildings: for example, to determine the location of cables in order to detect their breakdowns or to determine the degree of wear and tear of building materials.
3. Non-destructive control methods.
4. Remote control monitoring.
5. Internet of things for monitoring.
6. Automated monitoring using sensors.

TECHNOLOGY GROUP «ROBOTS» INCLUDES:

1. Use of robots in production and on a construction site: robots will perform physically demanding, routine work, and will also be used in hazardous work areas.
2. Machine learning for robots.
3. Claytronics.

OTHER TECHNOLOGIES PROPOSED BY KAZAKHSTANI EXPERTS:

BIM (TIMSO): modeling of buildings and any infrastructure objects (engineering networks, roads, railways, bridges, ports and tunnels, etc.).

Internet of Things and 5G StarLink.

Generative design.

Augmented Reality (AR).

Computer technologies that will be used to record the width and length of the road, as well as to fix the defects in the road surface that need to be repaired.

NANOTECHNOLOGIES OF BUILDING MATERIALS, FOR EXAMPLE:

nanotechnology with the use of coal powder for the production of asphalt concrete, the technology will reduce the cost of asphalt concrete and increase its reliability;

nanocement: in cement, which is widely used now, cement particles interact in the usual way; in the production of nanocement, due to fine crushing, interaction occurs at the nano-level, which leads to an increase in strength, a decrease in production costs, as well as an acceleration of cement hardening.

HIGH STRENGTH AUTOCLAVE CONCRETE:
today it is used in construction due to its lightness, quick erection and improved thermal properties. However, this material is less durable (crumbles). One of the applications: this concrete can be poured into the middle layers of structures together with ordinary concrete, which can compensate for the strength, and at the same time increase the thermal insulation.

Another use case is the use of this product as fill soil when laying the foundation instead of sand, which will lead to a decrease in the use and devastation of fertile land.

MAGNETIC CONNECTION OF MODULES
can be used to increase the bond strength of modular structures.

The use of technology is hardly possible at this stage, since the question of the effect of a magnet, especially an electric one, on human health has not been studied. The possibility of using this technology, its intended purpose will depend on how safe the magnetic connection technology is.

WE HAVE SEEN THAT THE CONSTRUCTION INDUSTRY IS VIRTUALLY INTERESTED IN TECHNOLOGICAL UPDATE. THE MOST DIFFERENT TECHNOLOGIES INCLUDING DIGITAL ARE ALREADY AVAILABLE FOR USE.

NOW LET'S UNDERSTAND WHAT MAKES THE CONSTRUCTION BUSINESS TO START WORKING IN A NEW WAY. RUNNING FORWARD, LET'S SAY, LOW PROFITABILITY, LACK OF STAFF, DEPLETION OF NATURAL SOURCES OF RAW MATERIALS - THERE ARE DRIVERS FOR SEARCHING NEW SOLUTIONS AND CHANGE FOR THE BETTER.

4.2.
LOW PROFITABILITY AND DEPLETION OF INDUSTRY RESOURCES

3 TREND
THE PROLONGED STAGNATION OF THE INDUSTRY PROFITABILITY APPROACHES ITS DECLINE

The profitability of the construction industry in the world has remained unchanged or even declined over the past 25 years. KPMG interviewed 109 CEOs of companies that carry out capital projects.[23]

According to the collected data, 69% of the respondents indicated that poor performance of the contractor is the single main reason for the low profitability of the project. According to Autodesk and Dodge Data & Analytics, 66% of general contractors incur additional costs associated with overtime / second shifts; three-quarters of each project incurred additional costs, with half of all projects extending the deadline.[24]

[23] Source: https://assets.kpmg/content/dam/kpmg/pdf/2015/05/construction-survey-201502.pdf
[24] Source: https://constructionblog.autodesk.com/construction-industry-statistics/

This situation is due to several factors. The construction market is usually represented not only by large players, but also by small companies, which most often operate with low profitability and this circumstance does not allow them to invest in new technologies that would lead to an increase in productivity in the long term. The rising cost of skilled labor in an industry that is still labor intensive is also reducing overall profitability. Delays in project implementation and the associated cost overruns are usually the result of errors in the organization of work on the project, a low level of risk management and planning.

However, the construction industry has developed a resource of extensive development, approaching the line beyond which there are only two paths - technological renewal or stagnation and decline.

In free societies, with developed market economies, the choice is always made in favor of large-scale technological renewal. This explains the development of the next industry trend - «Growth of venture capital investments in new technologies for the construction industry»

4 TREND
GROWTH OF VENTURE CAPITAL INVESTMENTS IN NEW TECHNOLOGIES FOR THE CONSTRUCTION INDUSTRY

In order for the construction site to change and profitability to increase, new technologies are needed. This is where venture capitalists come in. It is venture capital investments that build bridges between the results of scientific research and the commercial implementation of new technologies. In 2019, The Wall Street Journal announced that venture capitalists are «pouring money» into startups that use technology to make commercial and residential construction faster and easier. Investments in private construction technology companies in the United States rose from $ 352 million in 2016 to over $ 6 billion in 2018, according to research firm CREtech25. There

[24] Source: https://constructionblog.autodesk.com/construction-industry-statistics/
[25] https://www.cretech.com

is a boom in investment in new technologies.

However, no matter how fantastic the achievements of the Fourth Industrial Revolution may be, in the short term, human participation in work processes will not be completely ruled out. Therefore, both at the construction site and in the office of architects, designers and designers, people, professionals in their field will work.

Another question is whether the construction industry will be able to continue to attract the required number of specialists.

Consider this issue in the next industry trend - «Reducing the number of personnel in the construction industry.»

5 TREND
REDUCTION OF PERSONNEL IN THE CONSTRUCTION INDUSTRY

Global According to estimates by the Global Construction Perspectives and Oxford Economics, by 2030 the volume of construction worldwide will grow by 85% to 15.5 trillion. dollars[26], while three countries (China, USA and India) will account for 57% of the total global growth in the construction industry. Following the growing demand for construction, the supply of labor in the construction sector should grow. However, things are not entirely simple.

A recent study by two companies in the US construction business (Associated General Contractors of America and Sage Construction and Real Estate) found that nearly a quarter of respondents (22%) believe it will be difficult to find permanent and hourly workers in the construction sector. A 2018 construction market survey by British consultancy Turner and Townsend International[27] found that labor shortages are becoming an increasingly common feature of global construction. A 2018 report noted that 27 markets around the world experienced a skill-power shortage, more than in 2017.[28]

Why is this happening? If we consider the construction industry

[26] Source https://www.pwc.com.tr/en/hizmetlerimiz/altyapi-yatirimlari/yayinlar/pwc-global-construction-2030.html
[27] https://www.turnerandtownsend.com/
[28] Source: https://www.khl.com/international-construction/constructions-skills-shortage/138380.article

in economically developed countries, where wages are higher, job opportunities are wider, and the proportion of the young population is slowly declining (the phenomenon of demographic aging of the population), it becomes increasingly difficult to attract young people to the construction industry. The widespread introduction of labor automation, technological re-equipment of the industry can be a response to this challenge of the time.[29]

In countries with a different economic and demographic situation (low or low wages, high unemployment, a significant proportion of the young population), labor resources for the construction industry will remain in abundance.

In such conditions, the automation of labor makes no sense either from an economic or a social point of view. Here, the problem of the quality of personnel training at all levels comes to the fore: managers, engineering and technical personnel, workers.

The problem of personnel inflow into the industry is not the only problem of resources in construction, the shortage of natural raw materials is another challenge that will have to be dealt with in the near future.

6 TREND
EXTRACTION OF NATURAL RAW MATERIALS FOR THE PRODUCTION OF BUILDING MATERIALS

Natural resources are currently being depleted due to traditional and unsustainable methods of extracting raw materials. According to experts from KPMG, the business efficiency of 96% of companies in the world will suffer from a shortage of raw materials.30 Therefore, the idea of 'urban mining' is already developing. What does this mean? The world's deposits of raw materials have changed their location. Nature can no longer be the only source of primary raw materials for the production of building materials. Anthropogenic structures (primarily buildings, infrastructure facilities, industrial waste) are the "deposits" of the new era.[31]

For example, Germany contains over 50 billion tons of man-made material in the form of goods or waste, and this volume is currently growing at a rate of 10 tons per year per inhabitant. All this volume of anthropogenic stock can be processed and re-launched into the production process. In order for the idea of urban mining to be fully realized, it is necessary that the process of production of building materials be transparent.

In this regard, the role of architects acquires an additional function: they must be well informed about how building materials are produced, whether these materials are suitable for further processing, what are the costs of producing and processing specific building materials, as well as what are the costs of operation and maintenance of facilities, which are built from these materials, the costs of demolition and disposal of these objects. [32]

The past twenty years of the XXI century and the new industrial revolution brought new people to the world stage - generation Z - carriers of new ideas. What do we mean? Post-millennials are focused on greening production and, in general, on greening human life. Let's get this straight...

[29] Source: INTERNATIONAL LABOUR ORGANIZATION (2001). The construction industry in the twenty first century: Its image, employment prospects and skill requirements.
[30] Source: Simon Ha (2015). Construction industry market segmentation: Foresight of needs and priorities of the urban mining segment
[31] Source: https://www.archdaily.com/929560/we-must-understand-buildings-as-intermediate-deposits-of-raw-materials
[32] Source: https://www.archdaily.com/929560/we-must-understand-buildings-as-intermediate-deposits-of-raw-materials

4.3.
COURSE ON GREENING THE INDUSTRY

7 TREND
GROWING POPULARITY OF «GREEN BUILDING»

The new generation of producers and consumers is Generation Z. Young people of this generation, like no one else before, attach great importance to the problem of ecology and the search for environmentally friendly solutions. According to Amnesty International, for young people, climate change is the most pressing issue of our time. The new Future of Humanity study, which involved more than 10,000 people aged 18-25 from 22 countries, shows that 41% of respondents named global warming as the most important problem facing the world. Moreover, young people believe that their governments should take the well-being of citizens more seriously than economic growth (63%).[33] Young people not only proclaim lofty conservation ideas, but they are willing to pay more for environmentally friendly products. And as Greg Petro, CEO of consulting company First Insight[34], notes: «Compliance with the principles of sustainable development is becoming an integral part of the buying decision, this trend will only intensify in each next generation

of consumers.»

It is quite natural that the idea of «green building» is not a momentary fashion, but a full-scale movement that will be driven by new generations of builders (contractors) and customers.

The construction industry around the world is one of the largest consumers of raw materials and resources. According to the American Institute Worldwatch, which analyzes global environmental problems, 40% of stone, sand and gravel, 25% of timber and 16% of water in the world are spent annually in the construction of buildings. A large amount of energy is spent on the production and transportation of building materials and on the construction of the buildings themselves, while all this is accompanied by the release of large volumes of greenhouse gases. For example, in the countries of the European Union, during the construction, operation and demolition of buildings, about 50% of the total energy demand is consumed, and almost 50% of CO2 emissions are also accounted for during all stages of the life cycle of buildings.[35]

A more detailed breakdown was provided by researchers from Hong Kong. They analyzed the volume of greenhouse gas (GHG) emissions by source using the example of the construction of the One Peking office skyscraper. It turned out that in general, three sources (1. production of building materials, 2. their transportation and 3. energy consumption of construction equipment) account for 98.6% -99.2% of total GHG emissions. At the same time, the largest amount of CO2 emissions falls on the production of building materials (81.6-86.7%), when transporting building materials, 6.1-8.4% are emitted, and the energy consumption of construction equipment emits 6.4-8.6% of CO2.[36] The existing problems of the low environmental friendliness of the construction industry are balanced by the gradually expanding «green» movement in the industry. The most striking example of greening the construction process is, of course, the so-called «green building» and the environmental standards associated with this movement (for example, the LEED, WELL and FitWell certification systems). Let's say a few words about the most famous and widespread LEED eco-standard. This certification was developed by the United States Green Building Council (USGBC). The first standard was developed in 1998. LEED is now an internationally recognized green building certification system. LEED certifies that a building was designed and built using technologies that deliver high levels of energy savings, water

[33] Source: https://www.forbes.com/sites/emanuelabarbiroglio/2019/12/09/generation-z-fears-climate-change-more-than-anything-else/#1c15d180501b
[34] https://www.firstinsight.com/about-first-insight
[35] Source: Greenhouse gas emissions in building construction: A case study of One Peking in Hong Kong Hui Yan, Qiping Shen, Linda C.H. Fan, Yaowu Wang, Lei Zhang
[36] Source: ibid.

efficiency, CO2 reduction, indoor environments and resource efficiency.

If we talk about the prospects for greening the construction industry, let's turn to the leaders of this movement. In 2018, the United States Green Building Council (USGBC) 37 together with Dodge Data & Analytics38 released a report on global green building trends. The report was based on the expert opinion of 2,078 architects, engineers, contractors, investors, consultants from 86 countries.[39]

According to the results of the study, the volume of «green» construction in the world continues to grow. Almost half of the experts are confident that most of their construction projects in the next few years will be exactly «green».

According to Mahesh Ramanujam, President and CEO of the US Green Building Council, "Green building is now a trillion dollar industry, and the popularity of green building is fueled by the growing desire of people to live and work in sustainable buildings. Over the past 25 years, LEED certification has helped change construction methods. However, the ultimate goal of the «green» movement is to improve the living standards of people, for which the entire volume of buildings in the world (existing and under construction) must be brought in line with the requirements of sustainable development.

Kazakhstani experts, during the foresight sessions, also noted the «growing need for sustainable development» as a key trend. For example, the following micro-trends were highlighted: "Growth in the use of ecological building materials", "Growth in the need for recycling of construction waste", "Reducing the energy intensity of production in construction". To demonstrate the implementation of the concept of «green» building with specific examples, we will tell you about several environmentally friendly / sparing technologies.[40]

So, first of all, the use of solar energy. Strictly speaking, the use of solar energy is nothing new anymore. The rate of spread of this technology is impressive. In the past decade alone, the US solar industry has grown at a CAGR of 49%.

Government policies (tax deduction on solar investments), rapid cost reductions and growing demand for clean electricity in the private and public sectors have contributed to the fact that more than 81 gigawatts (GW) of solar energy is already being generated nationwide, enough to provide 15,7 million homes.[41] Green building uses passive and active solar heating systems. Solar radiation is absorbed by solar panels and converted into thermal energy - this is an active solar heating system. In a passive

[37] https://www.usgbc.org/
[38] https://www.construction.com/
[39] Source: Dodge Data & Analytics. Smart Market Report: World Green Building Trends 2018.
[40] Source: https://constructionclimatechallenge.com/2019/02/19/top-sustainable-technologies-in-green-construction/

heating system, the focus is on the technical features of the building itself, in which surfaces absorb heat per day and then slowly release it.

The next green building concept is biodegradable materials. Why are they important?

Most traditional construction methods result in a build-up of waste and toxic chemicals that take hundreds of years to degrade and decompose. Therefore, biodegradable building materials help to limit the negative impact on the environment, as they are easily destroyed without the release of toxins. Here are a few examples of a new generation of building materials: bioplastic made from soybeans, linoleum made from natural materials (linseed oil, natural resin, crushed cork dust, wood flour and powdered limestone), concrete made from desert sand, and not from the fine white sand that is traditionally used in construction (the reserves of which are already being depleted).

The organic binders in this new concrete make the product biodegradable, and the concrete is recyclable and reusable over several life cycles, reducing material waste. The use of bamboo, which grows more than a meter in length a day, grows back after harvest and is two to three times stronger than steel. Medium Density Fiberboard (MDF) made with potato starch resin is an ecological alternative to MDF, which uses formaldehyde.

Organic mycelium brick. The mycelium is the vegetative part of the fungus, made up of hundreds of intertwined fibers produced by the spores, making it an incredibly durable material when dried.

When combined with agricultural waste in the mold, the culture of fungi forms organic brick that can be used in construction and which subsequently decomposes and returns to the carbon cycle.[42] Another example of innovation in the production of building materials is a new type of building brick. Researchers from Heriot Watt University presented the K-Briq in January this year. This groundbreaking product has two important differences:

1. the production of K-Briq emits one tenth of the CO2 emissions of the traditional production method (firing),
2. K-Briq brick is made from 90% construction waste. At the same time, the new product weighs, looks and functions just like a regular brick.

[41] Source: https://www.seia.org/solar-industry-research-data
[42] Source: https://www.archdaily.com/893552/8-biodegradable-materials-the-construction-industry-needs-to-know-about

EXAMPLES OF TECHNOLOGIES PROPOSED BY KAZAKHSTAN EXPERTS

The professionals of the domestic construction industry made two main accents, discussing at the foresight sessions, the greening of the construction industry in Kazakhstan: «Recycling / Recycling» and «Energy Saving».

PROCESSING / RECYCLING / CLEANER PRODUCTION TECHNOLOGY GROUP INCLUDES:

Filters for air purification in residential buildings: such filters are already in use in Switzerland. Today, people are interested not only in comfortable living conditions, but also in safe housing for health (this requirement will become especially relevant after the coronavirus pandemic).

Recycling (filtration) of water and its further use as process water, for example, for the production of building materials.

Molecular crushing of used building materials. After dismantling the building, the concrete can be split into sand, cement and other elements, the resulting elements can be used to re-produce building materials.

Construction of roads from recycled plastic, which will give a second life to plastic waste. The technology will not only reduce the cost of road construction, but will also become one of the solutions to environmental pollution with plastic. However, this technology needs to be adapted to the country's weather conditions.

Lean manufacturing technologies: 1. Recycling of building materials residues (recycle, not throw away); 2. Accurate consumption of building materials, for example, by creating a holographic sketch of an object under construction or by using 3D printing.

Improving the environmental friendliness of cement production: cement kilns emit chemical compounds and dust hazardous to nature and human health into the atmosphere, and production is energy-intensive; therefore, cement production technology must be made environmentally friendly.

ENERGY SAVING TECHNOLOGY GROUP INCLUDES:

Thermochromic roofs and airgel insulation: roofs that are covered with mortar also change color from black to white during the summer, thus repelling 80% -90% of the sunlight. In the cold season, the color of the roof changes from white to black, while the sunlight is captured as fully as possible. An analogue is airgel insulation (airgel is also called «frozen air» or «frozen smoke», airgel is an ordinary gel, but

instead of a liquid component, a gas is used in this gel). The use of airgel increases thermal insulation by more than 40%.[43]

Passive house: These houses save up to 90% of the energy needed for heating and cooling compared to conventional buildings. Savings come from good window insulation, well-insulated exterior walls, roofs and floor slabs that keep the house warm in winter and protect it in summer.[44]

Special double-glazed windows that absorb solar energy, which is used to heat the room.

Renewable energy sources.

Accumulation and exchange of electricity: devices that allow you to manage the balance of electricity at the household level. For example, in Norway, households that have renewable energy batteries can sell surplus energy to the state (at a price slightly below the market price).

Kazakhstan does not yet have the appropriate infrastructure, equipment and legal framework.

In Kazakhstan, a person who has installed wind generators on their site will be fined for distributing energy to other people.

Greening the construction industry is a growing trend. Some elements of this movement are already a little more developed than others.

However, already now we can confidently assert that this trend is a response to the challenges of the new time, and the need for greening will only intensify under the pressure of new ideas from generation Y and Z.

[43] Source: https://remontyes.ru/6163-innovacii-v-stroitelstve-aerogelevaya-izolyaciya.html
[44] Source: https://www.passipedia.org/basics/what_is_a_passive_house

4.4.
GENERATION Y AND Z AND THEIR RULES OF THE GAME

8 TREND
THE IMPENDING GENERATION OF PROFESSIONALS IS A GROWING CHALLENGE FOR THE CONSTRUCTION INDUSTRY

We emphasize once again that the construction industry, in its stagnation, has finally approached a certain line. The prosperity or decline of the construction sector in the future largely depends on how the leaders of the industry in a particular country decide for themselves now the question of the development of the industry, whether they dare to cross the Rubicon or not.

If in the USA the industry has already begun to actively renew itself and venture capital has already poured into the industry, in Europe the awareness of changes is just beginning.

The situation in construction in the UK is a vivid illustration of the global state of affairs in the industry. In February 2016, commissioned by the government, Cast Consultancy[45] examined the current state of the

art in the industry. The general conclusion of the study is reduced to the appeal - «Modernize or die.» Unless the curricula and teaching methods for building specialties are modernized, if the industry does not innovate, and if the culture of research and development (R&D) is not fostered, the construction sector will inevitably decline.[46]

Why is modernization in a broad sense important if we are talking about the approaching change of generations of specialists? First, post-millennials (Gen Z) already account for 25% of the global recruiting market[47], and this share will only grow every year. These are the specialists on whose shoulders the industry will be held for the next decades. In addition, post-millennials are the first generation completely digital, they do not remember the time when there was no Internet, they are also called digital natives. Therefore, in order to recruit Gen Z professionals, an employer must offer many technical options.

What do we mean? First, we need to make the workplace "smart."[48] No one doubts that the importance of smart technologies will only grow from year to year, and post-millennials will become the generation that drives this market forward. Secondly, Gen Z people, like millennials, appreciate the opportunity to continually improve their professional skills, they are ready to continue learning after graduation.

However, the first link in the chain of changes in the construction industry is the renewal of teaching methods for construction specialties in educational institutions (higher and TVE). How? The answer is virtual reality-based learning. This, in turn, will shift the focus from the faculty to the students themselves, who study in a virtual or virtual-realistic mixed environment. More specifically, immersion virtual reality (VR) and 3D gaming virtual and augmented reality (VR // AR) have tremendous potential to increase student engagement, interaction and motivation in the learning process.[49] Once they start working, post-millennials should be able to increase their qualifications on an ongoing basis. The arsenal of teaching methods should include online training, and even informative YouTube videos about processes in the workplace or in general in the industry.

The next step on the road to change is to innovate in the industry. A construction company working with the most modern and "smart" technologies will be more attractive to the younger generation of professionals. As Chad Hollingsworth of Triax Technologies (developing IoT technology for the construction industry) explains: «Mille - nials have grown in relation to technology ... They expect new technologies to help them do their jobs better, help them get rid of manual labor processes.»

[45] http://www.cast-consultancy.com/
[46] Source: https://www.designingbuildings.co.uk/wiki/Farmer_Review_2016:_Modernise_or_die.
[47] Source: https://rb.ru/opinion/post-millenialy/
[48] Source: https://www.financialexecutives.org/FEI-Daily/August-2019/How-Generation-Z-Is-Transforming-the-Workplace.aspx
[49] Source: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6025066/

Within the framework of this industry trend, Kazakhstani experts, during the foresight sessions, also noted "an increase in the need for modernization of the vocational education system". For example, the following micro-trends were highlighted: "The growing need for restructuring and updating training programs in universities and colleges", "The growing need for the introduction of short-term, narrow-profile online education for retraining or upgrading the qualifications of workers".

We see how post-millennials are reshaping the professional environment for themselves, for their values, but they are changing the rules of the game for everyone else.

Let's understand the industry trend «Consumer preferences are changing, so get used to it!»

9 TREND
CONSUMER PREFERENCES ARE CHANGING, SO GET USED TO IT!

The construction industry is supported by two pillars - civil construction and construction of buildings (residential and non-residential). All the variety of objects that are created by the construction industry is important and necessary for the economy and for society as a whole, but housing construction and everything related to it (search for housing, purchase or rent, mortgage, etc.) occupies a special place in everyday life of all people. The changes that came with the Fourth Industrial Revolution have made their way to this part of the construction industry. Until a certain point, consumers put up with the fact that any transaction to buy / sell real estate usually takes a lot of time and effort, simply because there was no other way out. The penetration of the Internet into the real estate market is gradually changing consumer behavior as well: potential buyers and sellers are striving for faster and simpler digital solutions.

For example, in 2018 Austin launched an online platform for buyers, builders and developers - myHouseby.[50].

[50] https://myhouseby.com/about-us/

Buyers on this platform can choose the layout of the house, select the construction area, use virtual reality tools to adapt the house to their tastes and financial capabilities, find out the final cost of the house, and all this can be done even before construction has begun. What does this give both parties to the transaction? Construction companies gain access to a large number of potential buyers, while reducing the burden on the company itself, since there is no need to directly contact buyers. Consumers get more control at the stage of designing houses, setting the price of the house. And by the time the developer and the buyer begin to discuss the deal, both sides already have a clear understanding of the parameters, quality and price of the product - the house, which makes the sale and purchase process easier and faster.

Construction companies are not the only ones preparing for the technological change in the real estate market. Lending institutions, another industry closely related to construction, are also in the midst of significant changes. Future-oriented lenders are not resistant to innovation. They quickly realized that technology-based online financial products had significant benefits. One of these benefits is advanced analytics that can be used to identify and resolve misunderstandings between businesses and consumers. The expertise of loan officers is still in demand, but technology (data analytics) helps lenders to better understand the needs and capabilities of their clients, and then «reshape» their products for clients with greater efficiency for both parties (lenders and clients). Many insiders in the credit industry are confident that these technological changes will help us cope with the ever-changing dealings of the housing market.

And now that tech giants like Zillow[51] have jumped into lending by buying their own mortgage companies, more changes are expected. Real estate startups are taking the iBuyer movement to the next level. First, let's explain

what the iBuyer movement is. The companies that run the iBuyer model base their businesses on using sophisticated algorithms to predict the value of individual homes.[52] The basic idea is that a company estimates the value of a home and makes a purchase offer to the seller. If the seller accepts the offer, then the company takes on the burden of owning, marketing, and reselling the home. Predictive algorithms combined with traditional economies of scale allow these companies to buy and sell homes more efficiently than traditional methods have hitherto.53
The iBuyer movement, being a relatively new phenomenon in the market, continues to develop actively. In the fall of 2019, two major US real estate companies (Realogy and Home Services of America) launched a joint program ('RealSure') in which Realogy real estate agents will be able to bid home sellers as soon as a listing is posted. This offer is valid for 45 days, at the same time (for all 45 days) the house will also be sold publicly by the real estate agent.

WE SEE HOW THE PENETRATION OF DIGITAL TECHNOLOGIES INTO THE REAL ESTATE MARKET GIVEN THE IBUYER MOVEMENT THAT CREATIVELY CHANGED HOW PEOPLE SELL AND BUY REAL ESTATE BY PROVIDING BOUTIMAL PROPERTY.

[51] Creation and management of online real estate databases (https://www.zillow.com/corp/About.htm)
[52] Source: https://www.opendoor.com/w/guides/what-is-an-ibuyer
[53] Source: https://www.nytimes.com/2019/05/07/business/economy/ibuying-real-estate.html

5. IMAGE OF THE FUTURE AND FORECASTS FOR THE DEVELOPMENT OF THE CONSTRUCTION INDUSTRY IN KAZAKHSTAN

IMAGE OF THE FUTURE AND FORECASTS FOR THE DEVELOPMENT OF THE CONSTRUCTION INDUSTRY IN KAZAKHSTAN

Who shapes the future of a particular industry, what forces influence the development of events?

First, global MEGA trends, which we discussed above. However, to complete the picture, it is necessary to take into account the activities of companies, the dynamics of the spread of new technologies and the role of the state. Many companies make up the industry itself, and the international spread of technology is a major source of technological development and economic growth. State, in turn, it sets the rules of the game that are mandatory for all market participants to comply with.

The main «fabric» of the industry is still companies and their customers.

Up to a certain point, it was considered that the main and only goal of a particular company or Corporation is to make a profit. But as the Fourth industrial revolution spreads, more and more business leaders take into account not only the interests of their corporations and take responsibility not only for the private interests of shareholders and stakeholders in the industry.

Global business leaders first presented a new understanding of their role at the business Round table of the American non-profit Association, and then at the world economic forum in Davos in 2019. This is how the CEOs of leading American corporations described the new principles of their companies ' work in the changing conditions of the XXI century:»... in the process of joint and sustainable value creation, the company serves not only its shareholders, but also all interested parties - employees, customers, suppliers, the local population and society as a whole...» in short, companies in their work are already guided by something more than winning the competition and achieving a high EBITDA value.

When will this global movement («Corporate social responsibility») begin to determine the development vector of a particular industry, for example, the construction industry? In fact, this is already happening.

In the fourth section of the Atlas, we told You, dear reader, about global trends: the course on greening, the y and Z values and the rules of their game.

Along with other mega-trends, these forces are already in action, they are already having an impact.

It is safe to say that awareness of the new realities of the XXI century and the Fourth Millennium- the new revolution in the business community and in society as a whole has already been achieved, and now it is only a small matter to adopt as many new technologies as possible that will allow specialists and industries to work within the new paradigm.

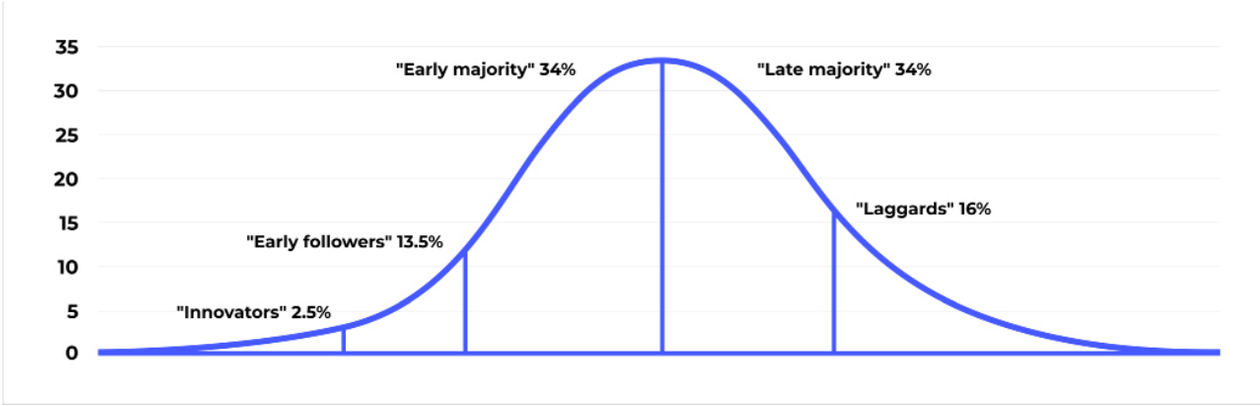
And here we come close to the problem of introducing innovations.

Let's make a reservation right away that the primary sources of new technologies are a small number of economically developed countries, where the main efforts in the field of research and development are concentrated. This, in turn, means that most countries most often rely on the introduction of technologies borrowed from abroad. This is the current state of Affairs in the world. For example, in OECD countries, new technologies are most often also borrowed. Recall that the OECD is mainly European countries.

Moreover, in most countries of the world, productivity growth of 90 percent or more depends on the introduction of new technologies. Thus, the nature of technological changes around

Figure 5.1.

Five stages of the spread of innovations by Everett Rogers



the world and the level of labor productivity significantly depends on the international spread of technologies.

Under the right circumstances, new technologies will be distributed by diffusion, i.e., the transition from one technology or product to another will occur in accordance with a uniform or cumulative normal distribution. According to the classification of ewett Rogers, who formulated the theory of innovation propagation, there are five stages of innovation propagation.

At first, the speed of innovation implementation is very low, only 2.5% of the professional community in the industry accepts new technologies – these are «innovators».

Then the companies (and about 13.5% of them) that are among the first in the industry to evaluate the benefits of innovations are connected, and only when the benefits of innovations are already widely known in the industry, does the massive introduction of new technologies begin («early majority» and «late majority»).

What should be the «right circumstances» for the innovation to unfold in full force?

First, the new technology must indeed be significantly superior to the idea, program, or product that it is intended to replace.

Second, the innovation must be consistent with the values, experience, and needs of potential participants.

Third, innovation should not require a huge effort to understand and implement.

Fourth, the who innovation can be tested or used experimentally before its implementation becomes mandatory.

Finally, innovation should produce tangible results.

Now is the time to reveal the role of the state in the process of spreading or erecting barriers to new technologies. The government can actively promote the introduction of new technologies or completely block this process. For example, if the state is interested in promoting new technologies, this often occurs in projects commissioned by the government or in areas where state participation is present (for example, air transportation). Subsidies are also an effective tool if the state is interested in developing new technology «from scratch». However, the effect will be more devastating if the state, for some reason, considers the penetration of new technologies undesirable. So what does desire or desire depend on- how can the government help the process of innovation penetration? The answer is simple and obvious. Barriers are erected when lobbying efforts from interested parties outweigh the benefits of introducing new technologies. At the same time, the government fixes the existing status quo with specific measures (for example, laws or tariffs) to protect these interests. Resistance to new technologies from specific interest groups is explained by the fact that they own assets that are intended for existing technologies, and when innovations are introduced, they incur significant losses. Armed with these tools, let's first try to analyze the overall prospects for the development of the construction industry in Kazakhstan in the medium-term perspective.

GENERAL OUTLOOK FOR THE DEVELOPMENT OF THE CONSTRUCTION INDUSTRY IN KAZAKHSTAN FOR THE NEXT 10-15 YEARS.

All the forces that shape the future of the industry in economically and politically developed countries.

Free countries are a kind of standard or basic model. Of course, it is not quite right to try this basic model on Kazakhstan's realities. We simply won't get a live scene of developments in the industry. Therefore, we will try to distinguish from the basic model those elements that are relevant for our country.

While in the basic model, companies are guided in their work not only by the profitability of production, but also by the interests of society as a whole, in the Kazakh model, the issue of productivity is still the first and Central one. But at the same time, the Kazakh expert community already understands that the change of generations of specialists (i.e., an increase in the

Borrowing new technologies, as well as for the whole world, remains an important resource for increasing productivity in the domestic industry. The technological achievements of the Fourth industrial revolution will help.

share of generation Z people) and the growing need for greening technologies will change the domestic construction industry.

In this regard, our situation is no different from most countries in the world. However, there are certain nuances that we will consider later.

The role of the state in promoting new technologies in Kazakhstan cannot be clearly defined. On the one hand, not so long ago it was the state (through the construction Committee the state program «Nurly Zher») obligated construction companies to use such innovations as building information modeling (BIM) and blockchain (unified information system E - Qurylys). On the other hand, there are certain interest groups that may suffer financially as a result of the large - scale introduction of new technologies.

Considering the impact of all factors on the development of construction in Kazakhstan in the medium term – MEGA trends, industry trends, the activities of companies, the spread of new technologies, the role of the state - it is safe to place special emphasis on such factors as:

profitability in the industry,
human resources

The problem of low profitability of the industry is still relevant, but this has not yet paralyzed the development of the industry. However, over time, the issue of low returns will not resolve itself. Moreover, the resource of intensive development of the industry will soon be exhausted and the problem of increasing the economic return of the industry will become more acute than ever. The industry itself and the government will come to realize that the problem needs to be solved by other means, namely, the introduction of new technologies.

Another point. It can be assumed that the construction industry in Kazakhstan uses the last opportunities to remain labor-intensive at the expense of capital intensity. So far, production relies more on human labor and less on the use of new technologies (new generation of machinery and equipment, construction materials, digital technologies). However, the further we push the forecast line, the more acute the issue of the industry's transition from a labor-intensive model to a capital-intensive one becomes.

What is the reason for this?

Already, the population of Kazakhstan is considered to be aging according to the UN methodology: in 2019, the share of Kazakhstanis over 65 years of age exceeded the barrier of 7% and amounted to 7.5%. This means that fewer young people are entering the labor market, so specialists and workers who are currently employed in the

industry will work longer. Sooner or later, the number of employees in the industry will still decrease, people will retire, and it will be much more difficult to replace their work. The hope that the neighboring countries of Central Asia (first of all, Uzbekistan and Kyrgyzstan) will remain sources of replenishment of the labor force for the industry is also likely to be fully justified, since similar demographic processes are taking place in these countries of the region.

It is safe to say that the transition of the industry to a new era will not be easy. The introduction of new technologies will give the desired result only if the industry already has a certain level of expertise: qualified personnel, sufficiently well-developed R & d, a developed system for training professional personnel, local production, etc.

At the moment, there are highly technological changes in the domestic industry (R & d, production of machinery and equipment, development of mobile applications, production of building materials) they are already significantly behind in development. There is a problem of lack of professional personnel and low quality of their training. All this reduces the industry's readiness for the upcoming changes. Therefore, the professional community has already formed an understanding that investment in professional training, in local production of building materials, machinery, equipment, etc.cannot be avoided.

It is quite expected that in the current conditions, the industry still sees the source of its profitability in the near future as generous government orders (for example, the construction of large infrastructure facilities). But even this source of extensive development is under attack.If the prices of equipment and materials rise sharply, if companies can't invest-

If the state changes something in the rules of the game in the market (for example, introduces some new standards, requirements), then the implementation of at least one risk can be a shock to the industry.You can reduce risks only if you actively use new opportunities.

What are these opportunities?

This is the introduction and use of modern technologies and equipment, improving the quality of professional training and the development of domestic production. We can say that the circle is closed. The desire to use the old proven methods and rely on the independence of the most important client of the industry – the state-is quite understandable, but not promising. No matter how much the industry tries to follow recipes from the past, the state of Affairs within the industry forces construction companies to repeatedly answer the question: «Modernization or stagnation and decline?».

AT THE TURN OF THE YEARS 2020-30

The construction industry of Kazakhstan will actively use the technological innovations that the Fourth industrial revolution can offer, primarily information and» green « technologies.

AT THE STAGE OF ENGINEERING SURVEYS AND DESIGN

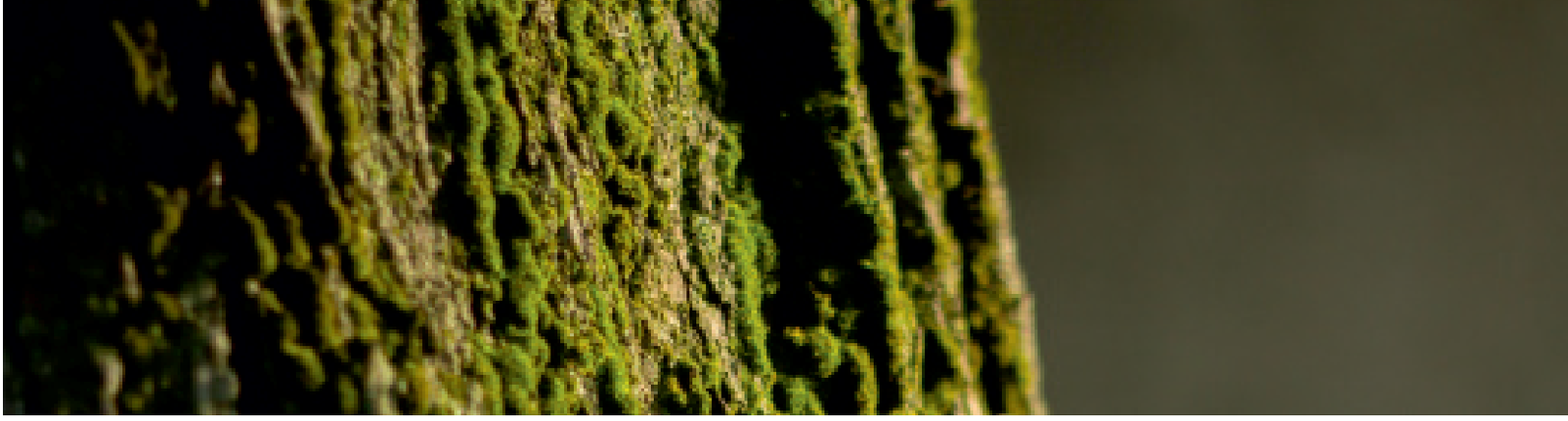
construction companies will use building information modeling technologies everywhere. The construction object will be designed as a whole by all involved specialists almost in parallel for the entire life cycle of the object, which will improve the quality of work and reduce the time required to prepare design and estimate documentation. You can make additions or changes to the project without fear of making a mistake, since changing any parameter will automatically change the other parameters and components associated with it, including drawings, visualizations, specifications, and the calendar schedule.

The project will have a high level of detail, the duration of construction and its cost will be taken into account, this will increase the accuracy of estimating the project execution time and its total cost.

If necessary, during the design process, the capabilities of artificial intelligence will be used in order to create the maximum possible number of alternative solutions to the project, based on the set goal and design parameters, the specialist will only need to set the initial values and choose the most appropriate project option.

The construction object can be «built» in virtual reality even before the start of real construction and installation works. At this stage, the gadgets of full and virtual reality will be used by both the designers themselves and the project's customers, which will allow them to «see firsthand» all the hidden design problems and take into account the customer's requirements and wishes as fully as possible.

Big data analysis will be actively used in the routine work of construction companies. This analytical tool will allow you



to: predict the future results of a particular project, identify potential risks, improve project management, reduce costs and time for project implementation, determine the best management strategies for the company itself, and monitor the work of numerous contractors.

Over the next decade, engineering companies in Kazakhstan will significantly increase their level of competence and professionalism. The quality of project management will significantly improve and develop. Technical and author supervision will be tightened and strengthened.

In the future, the institution of self-regulating organizations will be highly developed, which will help the customer (investor, or just a potential buyer of real estate) to create professional requirements for the performer. Performers will be highly qualified and their equipment will be high-tech in the field of research and not only.

A register will be created, which will include the best professionals in their field, who will be able to help the customer and be a highly qualified «bridge» between the customer and the performer. These will be not only individual scientists, but also professional associations (for example, architects), but already recognized either at the world or European level.

The design of houses, and especially of apartments, cannot be unified due to the increasing demands of consumers for design. Designers will be invited in advance to design apartments, even before receiving apartments with rough finishing.

The appearance of many different new technologies on the market will sooner or later lead construction companies to the problem of choosing a certain technology from a variety of similar options.

This means that the company will develop a special competence that will allow you not to get lost in the sea of technological innovations and not lose in the competition.

A significant proportion of the construction company's operations will be carried out in the digital space, which means that cybersecurity issues will become vital. In order to prevent theft of intellectual property (for example, the original design of an object), as well as all information about technical solutions, financial costs, etc., the company needs to build a reliable data protection system in all segments of the company's work.

AT THE STAGE OF CONSTRUCTION AND INSTALLATION WORKS

the company will actively use the following tools, equipment and ideas:

- UAVs,
- artificial intelligence,
- building information modeling,
- blockchain,
- construction robotics and exoskeletons,
- modular construction,
- 3D printing,
- as well as green technologies and the Internet of things.

Before starting work, the site selected for construction is studied using drones, which make aerial photos into orthophotos, and artificial intelligence turns this data into 3D grids or IR images to get a complete picture of the land under study.

The organization of the entire complex of construction and installation works will be carried out using a digital platform that also allows you to track the quality of work performed on construction sites. All deviations are immediately recorded by the platform and tasks are formed to eliminate detected deviations from the digital model of the object.

Drones are used as a tool for tracking the quality and reliability of work on the construction site: photos, videos, 3D models and ortho-mosaic maps created using drones give performers and customers a complete picture of how construction is progressing day by day.

Construction companies will actively use blockchain (smart contracts), for example, the code of such a smart contract can describe the logic of financing construction. In particular, upon completion of work at a certain technological stage, the blockchain sends a signal to the Bank, which automatically makes the next payment to the contractor.

The blockchain will allow, among other things, to increase the efficiency of the information model of the object under construction, in particular, payment to the contractor will be made only if the object is built in strict accordance with the digital model of the object.

Heavy and dangerous types of work on the construction site will be performed by construction robots, which will be controlled remotely by operators, and the equipment will be autopiloted, for example:

- the robot will lay down bricks during the construction of walls,
- the Autonomous cargo lift will use AI to move heavy loads,
- Autonomous bulldozers and excavators will operate on the site.

Those few workers who will still be involved on the site will use exoskeletons if necessary.

Modular construction and 3D printing will be developed in the Kazakhstan market. these technologies will allow you to build objects as quickly as possible, while

the loss of time and materials will be minimized.

A separate topic will be the application of green technologies in the Kazakh construction industry. Green building standards (for example, LEED, BREEAM, DGNB) will become actively used. More and more new and existing civil construction projects will be certified according to international «green» standards. In the case of new construction, «green» meters will be immediately laid at the design stage.

In the case of existing residential and administrative buildings, compliance with «green» standards (for example, in terms of energy saving) will be achieved through renovation. The whole process will be accompanied by the development of a green economy. energy, energy-saving technologies, technologies for the production of environmentally friendly building materials and for the processing of construction waste.

In the private residential sector, the popularity of «smart homes» will grow, although at a moderate pace: apartments and houses will be equipped with individual life support systems, «tailored» to the specific needs of a person and their budget.

Among the infrastructure projects in the industry, the construction of «smart roads» will be actively developed: with the help of the Internet of things technology, drivers, cars and the road itself will be United in a single network in order to improve traffic safety, reduce traffic jams and congestion, and reduce environmental pollution from exhaust gases.

IF WE TALK IN GENERAL ABOUT THE CONSTRUCTION INDUSTRY OF KAZAKHSTAN, WE CAN NOTE THE FOLLOWING POINTS:

in the future, the domestic «silicon valley» will Appear in the construction industry: laboratories and research institutes will work in close conjunction with construction companies and related industries (for example, the production of building materials). In particular, R & d organizations will develop technologies for orders from construction companies and related industries, and the developments will be quickly implemented in production.

Programmematic training in universities, institutes and colleges will continue to develop in close cooperation with the business environment of the construction industry (private construction companies, etc.). Dual education in construction specialties will reach a qualitatively new level. In more detail, immersive virtual reality(VR), 3D gaming virtual reality and augmented reality (VR/AR) will be widely used in the process of teaching students. The focus will begin to shift from the work of the teacher to the efforts of the students themselves, who will study in a virtual or virtual-realistic mixed environment.

The workplace of professionals in the construction industry, whether they are architects, designers, foremen or workers, will be fully

equipped with «smart» technologies and equipment.

Production related to the construction industry will be located outside the city (at a distance of at least 60 km from cities) in order to comply with environmental standards. This requirement will not apply to those types of production that are environmentally friendly, they can be located within the city.

Factory operations will be automated and Robo - tized in combination with remote production management and robots. For example, robots will be used in the extraction of raw materials for the production of construction materials.

Economic diversification will stimulate the development of domestic production, and this will be accompanied by the construction of industrial facilities, infrastructure facilities, and the involvement of domestic R & d, personnel, and raw materials.

The described image of the future can be attributed to the most complete scenario in the industry: companies strive to introduce innovations, technologies quickly penetrate the market and specialists can quickly learn and start applying them, and the state only contributes to the modernization of the industry.

However, the real course of events and the real future of the industry can develop according to one of three scenarios: «Middle way», «Ideal future» and «Stagnation and decline». Let's look at each of them in more detail.

SCENARIO FORECASTS FOR THE DEVELOPMENT OF THE CONSTRUCTION INDUSTRY IN KAZAKHSTAN FOR THE NEXT 10-15 YEARS.

THE SCENARIO OF THE «MIDDLE WAY»

MONEY.

In the near future, the construction industry in Kazakhstan maintains positive growth rates. The main drivers of growth in the industry will be government orders for the construction of large infrastructure facilities. The share of the construction industry in the Republic's GDP remains at the current level of 5.5% with the prospect of a slight increase (by 1-2%).

Major players in the market will be able to maintain and build up to a certain level of competence of their employees, who will be able to work with new technologies (including digital ones): building information modeling (BIM) in conjunction with Big Data technology, augmented and virtual reality (AR/VR) technologies, blockchain, the use of drones and partial use of construction robotics.

In response to the threat of external and internal risks (devaluation of the national currency, rising prices for imported construction materials materials and machinery / equipment) the government and large companies will invest in the development of Kazakhstan's R & d in construction and production of building materials (while reducing the import component in the local production of construction materials).

TECHNOLOGIES AND PROFITABILITY.

Accordingly, the level of use of information and communication technologies in the construction industry will grow at a moderate pace.

In particular, the share of construction companies that use: digital technologies in the production and analysis of big data (Big Data) may grow to 6% 54, these technologies are closely interrelated, so the share will increase to one level.

Perhaps the same share (6%) of construction companies will use robotics (mainly, the use of collaborative and service robots will expand), but much depends on filling the labor market with human resources. To complete

[54] Roland Berger (2016). Building Europe's road «Construction 4.0». Digitization in the construction industry.

the picture, we present the statistics of 2019 as a basic indicator: digital technologies are currently used by only 2.9% of domestic construction companies, big data analysis is done by 0.9% of companies, and robotics is used by only 3.3% .

The gradual introduction of digital technologies at the initial stage will help to keep the industry's rents from falling. Over time, the accumulation of competence in the industry (the growth of staff professionalism) will allow for the full use of digital technologies, which leads to a moderate increase in productivity.

LABOR.

According to the forecast of the United Nations population Fund, Kazakhstan» until 2050, the age structure of the Republic's population will continue to change in the direction of demographic aging. However, due to the de - formation of age pyramids, there will be fluctuations in the number of some age groups. In particular, «starting from 2022, the number of young people aged 20-24 will steadily increase until 2040. In just the next 15 years, the proportion of young people aged 15-24 will increase from 20% to 27% of the total population aged 15-64. «Thus, in the near future, the construction industry is not likely to experience an acute shortage of labor resources.

Working in large construction companies will be attractive for the younger generation, as the production process it will be at

[55] Source: Committee on Statistics of the Ministry of National Economy of the Republic of Kazakhstan. Bulletin of 2019 «On the use of information and communication technologies at enterprises of the Republic of Kazakhstan».

[56] Source: Committee on Statistics of the Ministry of National Economy of the Republic of Kazakhstan and the UNFPA. «We, Kazakhstan». Resume. Analysis of the population situation in the Republic of Kazakhstan. https://kazakhstan.unfpa.org/sites/default/files/pub-pdf/UNFPA_Report_20pager_web_RU_0.pdf.

least partially modernized. In addition, market leaders will try to «improve» the professional training of their employees (using modern training methods), which will also become a magnet for young specialists.

if the penetration of digital technologies (for example, blockchain) threatens the profit of certain groups of interests at any technological redistribution in the industry. In other cases, the government will not erect barriers to the penetration of new technologies into the industry.

STATE.

The government will still respond to the signals of lobbyists

SCENARIO «IDEAL FUTURE»

MONEY.

Certain structural changes will take place in the Republic's economy, and new sources of state revenue will appear (and, accordingly, the Republic's budget will be replenished). The national and local budgets will allocate significant funds for the implementation of infrastructure projects. The share of construction in the Republic's GDP in absolute terms will grow following the increase in the country's GDP as a whole, while the share in percentage terms will not increase significantly.

COMPETENCE IN THE INDUSTRY.

Competence in the industry will be accumulated primarily in the private sector (in large and medium-sized construction companies). Over time, dual education in the Republic will receive a new impetus. The level of professional training in higher Education institutions and higher education Institutions is being «raised» to the level of competence of market leaders (large advanced construction companies on the market). The increased level of competence in the industry will allow you to quickly implement complex and advanced technologies. First of all, the industry is adapting its work to the latest generation of digital technologies.

Market leaders will gradually shift from investing in professional training of their staff to investing in R & d and local production. Rigid boundaries between industries will be erased (for example, a construction company may enter the education or R & d market, or mortgage lending, etc.).

AND PROFITABILITY.

Borrowing new technologies will still be the main source of increasing rents in the industry.

However, as the volume of knowledge and experience in the domestic construction industry increases, as well as in response to market needs, domestic R & d institutions will begin to produce a local intellectual product: first of all, local cost - effective technologies for the production of high - quality construction and finishing materials will appear. The profitability of construction will no longer be the Central problem of large companies. A new understanding of their role in the economy and in society will replace wild capitalism. Environmental issues of production will move from the theoretical plane to the practical one: reducing energy consumption and CO2 emissions during construction and installation works and the production of materials will be on the agenda. New generation requests for «green construction» will become a new fashion among the leaders of the construction market. customers will have the opportunity to influence the creation of a product (construction object) even at the design stage.

LABOR.

Taking into account the forecasts of the United Nations population Fund for Kazakhstan for the next 15 years and the favorable situation in the economy and industry, the ratio of supply and demand in the labor market in the construction industry will change over time. At the beginning of the period, the industry will absorb the entire supply of labor, but over time, the demand for labor will gradually decrease due to automation and robotization of labor.

STATE.

The government will actively promote the introduction of new technologies if their proven effectiveness (economic and environmental). However, along with economic and environmental efficiency, the social effect of a particular new technology will also be calculated. It is quite possible that over time,

the government will seriously consider the idea of introducing an «Unconditional basic income» for citizens of the Republic. Since

efforts to retrain the released personnel may not be successful.

THE SCENARIO OF «STAGNATION AND DECLINE»

MONEY.

The state will abandon plans to implement major infrastructure projects, due to the steady fall in oil prices and reduced public spending. National holdings and large companies in the oil sector will also reduce the volume of orders in the construction industry. Orders for construction by private companies and individuals will not do anything for the industry, and the flow of investment in the industry will almost dry up. The country's GDP will decline, as will the share of the construction industry in GDP.

COMPETENCE IN THE INDUSTRY.

The industry will shrink significantly, and many companies will leave the market. There will only be a few big players left in the market, but their operations will also be reduced. Since the scale of the industry will significantly decrease, the scale of major players will also decrease accordingly. Neither private companies nor the state will be able to maintain and develop the level of competence in the industry through the system of professional training (Universities, TVET).

Kazakhstan's R & d and local production of construction materials, machinery and equipment will be reduced to a minimum.

TECHNOLOGIES AND PROFITABILITY.

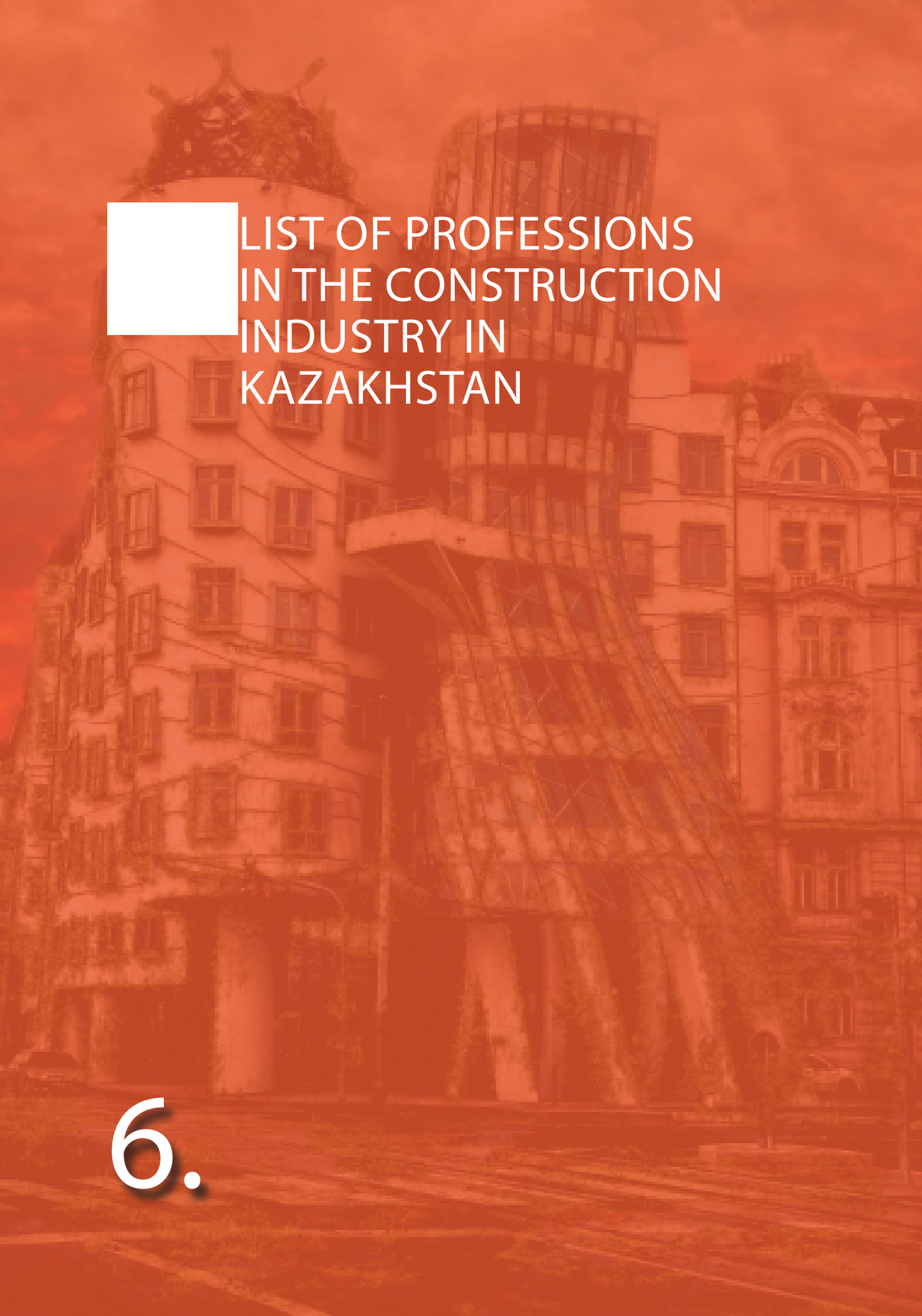
The penetration of new technologies, especially digital technologies, will slow down and stop expanding. However, the remaining companies on the market will actively look for ways to maintain their rents at the level necessary for survival.

LABOR.

Taking into account the forecasts of the United Nations population Fund for Kazakhstan for the next 15 years and the economic situation in the country and industry, the supply in the labor market will exceed the demand.

STATE.

The «economic pie» is shrinking, so the struggle of influence groups for a share in this pie will only escalate. Any new technologies that may jeopardize the source of profit in the industry will be strictly blocked by the government (through laws, tariffs, regulations, etc.).



6. LIST OF PROFESSIONS IN THE CONSTRUCTION INDUSTRY IN KAZAKHSTAN

LIST OF PROFESSIONS IN THE CONSTRUCTION INDUSTRY IN KAZAKHSTAN

The spread of new technologies of the Fourth industrial revolution, unprecedented demographic changes, socio-economic upheavals-all these forces radically reshape entire industries, business models, change the competencies and skills that are in demand in the market and reduce the «shelf life» of existing professional knowledge and skills.

The penetration of new technologies may have different effects on professions that already exist in the industry. On the one hand, a particular profession may become hopelessly outdated and the need for it will actually be reduced to zero.

For example, the trade in natural ice was a branch of the world economy for almost the entire nineteenth century, but as soon as artificial ice factories began to appear, the professions of mining, transporting and selling natural ice began to recede into the past, until they disappeared along with the industry itself.

On the other hand, the introduction of new technologies may allow a person to switch to other tasks and this in turn will lead to a change, transformation of the profession, but not to its complete disappearance. The transformation of a profession and the emergence of a new profession are often interrelated. New professions appear when employers need employees to perform tasks that have never been performed before.

Usually, these new tasks are added to official duties in existing professions. However, if these tasks become more complex and their impact on the overall result of work increases, then over time a new profession is formed.

Let's demonstrate this process with an example. In 1990, scientists began to decipher the human genome, were collected stunned-changing volumes of biochemical data. To organize this data, employers first turned to computer experts or biologists who had some computer knowledge. But as the need for specialists who know both biology and computer science grew, the new specialty «bioinformatics» finally took shape as an independent profession.

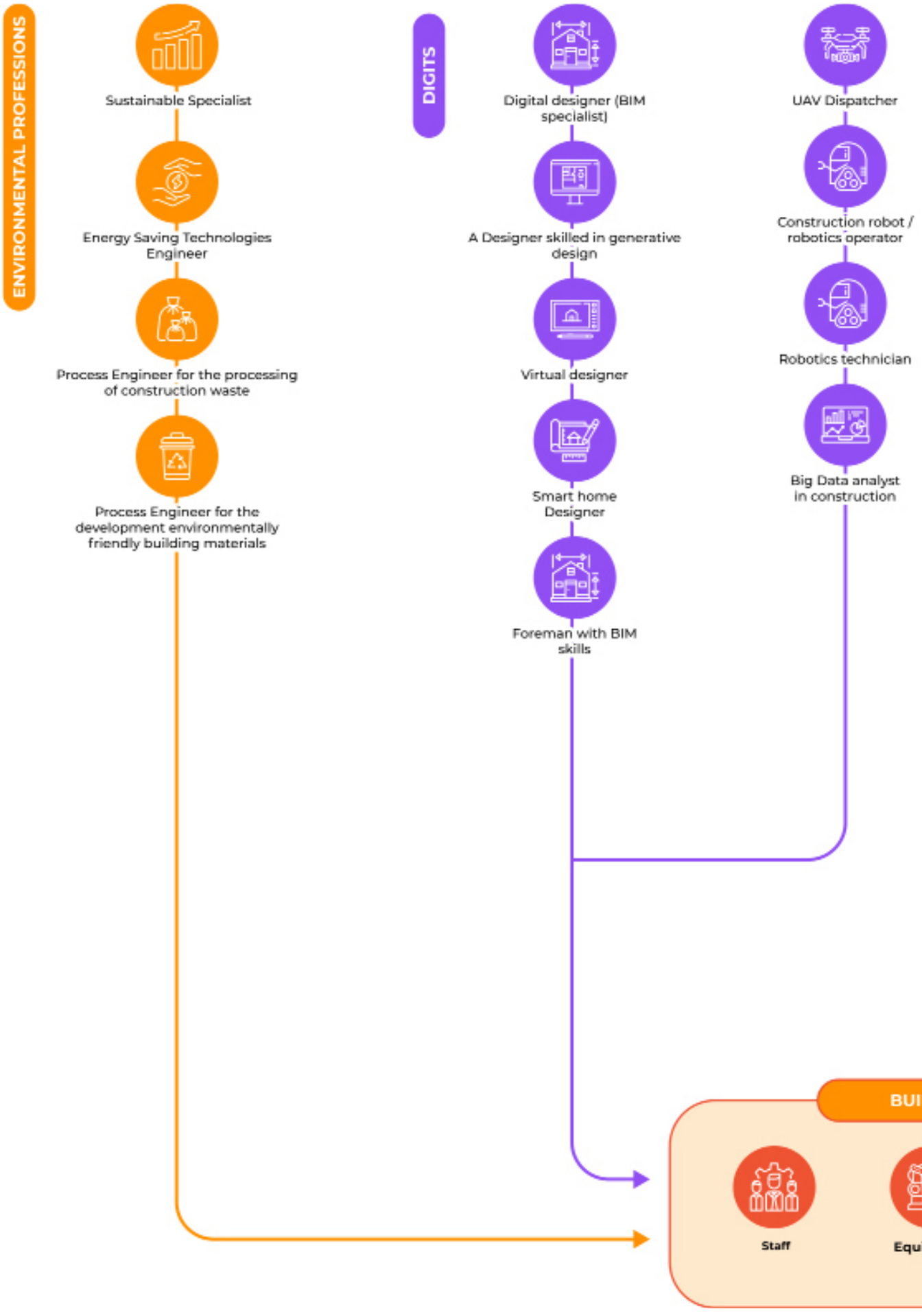
So, from a small side line – « a biologist who can process data arrays with the help of computer programs — bio-Informatics has become a popular profession in the labor market and a training program in higher education institutions.

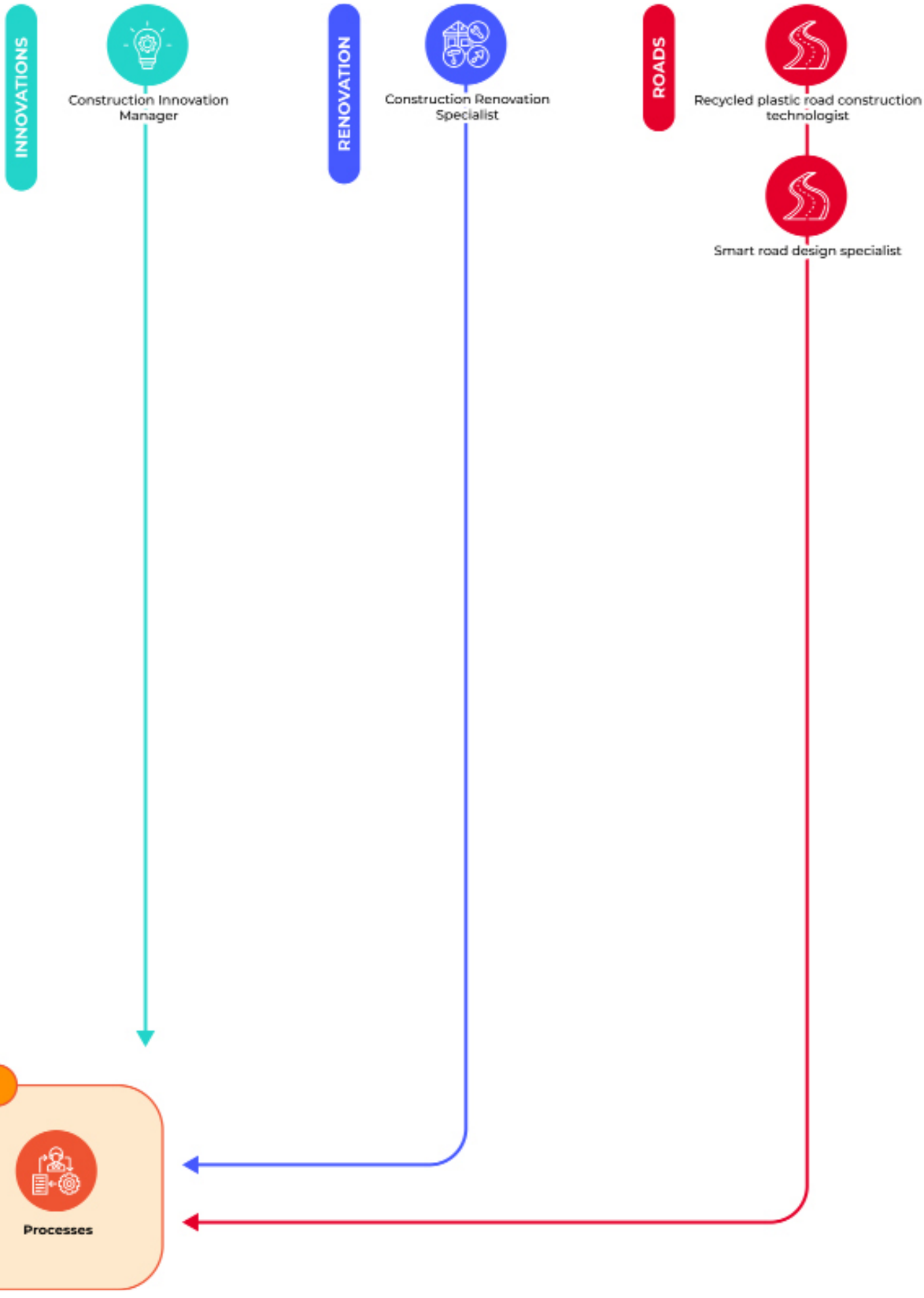
Taking into account all the trends and features of the socio-economic and political situation in Kazakhstan, we tried to determine as accurately as possible what new professions may appear in our construction industry within 10-15 years, which professions will be transformed during this time, and which are likely to become a thing of the past.

[57] Sources: https://www.bls.gov/careeroutlook/2002/fall/art02.pdf

NEW PROFESSIONS IN THE CONSTRUCTION INDUSTRY

6.1.


ENVIRONMENTAL PROFESSIONS
Sustainable Specialist
Energy Saving Technologies Engineer
Process Engineer for the processing of construction waste
Process Engineer for the development environmentally friendly building materials
DIGITS
Digital designer (BIM specialist)
A Designer skilled in generative design
Virtual designer
Smart home Designer
Foreman with BIM skills
UAV Dispatcher
Construction robot / robotics operator
Robotics technician
Big Data analyst in construction
BUILDING
Staff
Equipment

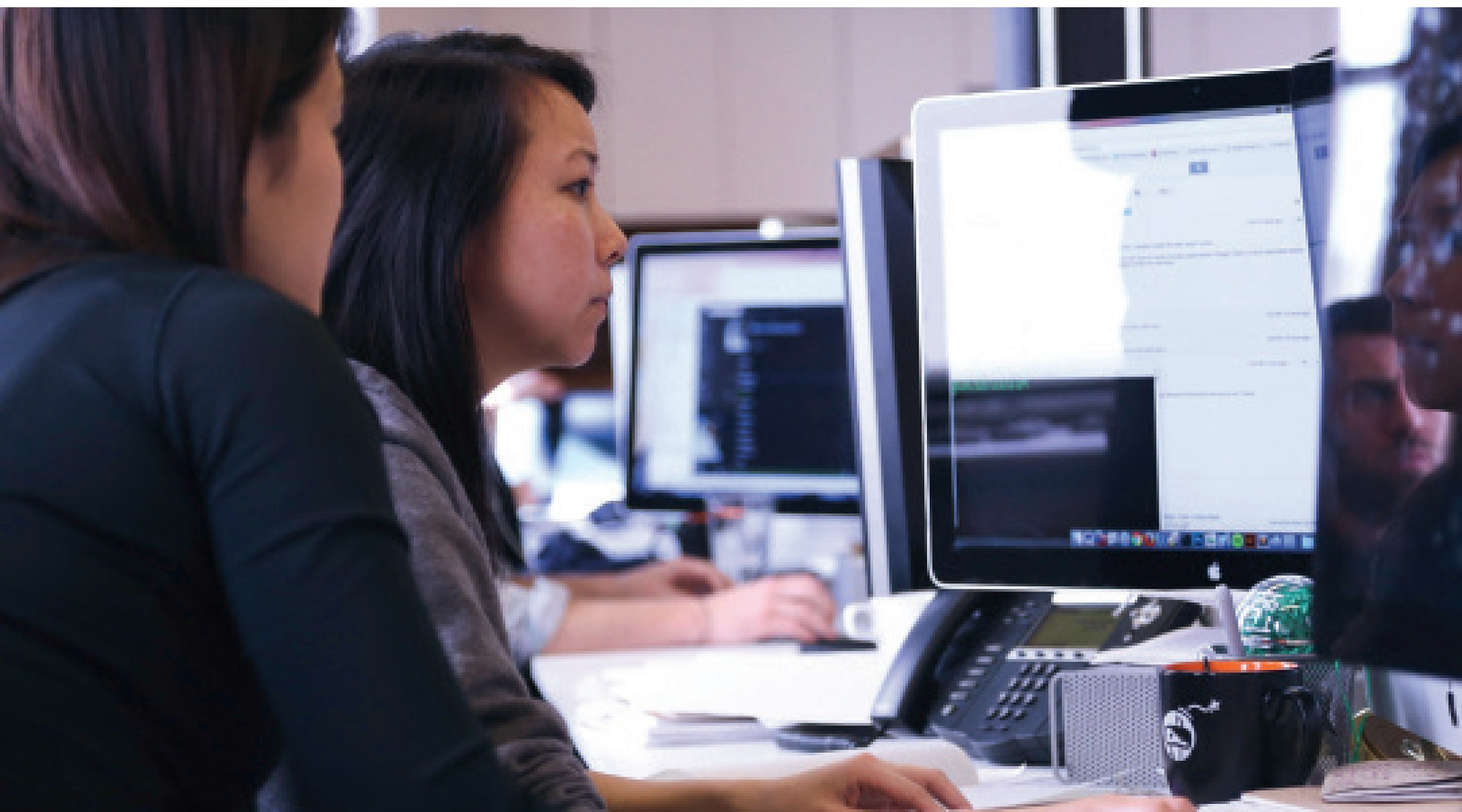

INNOVATIONS
Construction Innovation Manager
RENOVATION
Construction Renovation Specialist
ROADS
Recycled plastic road construction technologist
Smart road design specialist
Processes

6.1.
NEW PROFESSIONS IN THE CONSTRUCTION INDUSTRY

During the foresight sessions, professionals of the Kazakhstan construction industry identified several groups of new professions:

«Digit».
«Environmental professions».
«Innovations».
«Roads».
«Renovation».

1. «DIGIT»



1

DIGITAL DESIGNER
(BIM SPECIALIST)

the Designer uses building information modeling (BIM) technology to collect and comprehensively process all architectural, design, technological, and economic information necessary for each stage of the project (development, design, construction, operation / repair and disposal). Even before actual construction begins, a BIM designer (together with other project participants) can virtually build an object with the entire infrastructure from start to finish and make an accurate cost analysis of the entire building/object lifecycle.

APPEARANCE HORIZON

2025

NOVELTY of the profession

can create a 3D model of an object under construction and combine other sections of information (design, technical, economic) about the construction object into a single database.

KEY competence

Higher education in any of the fields: «construction», «architecture», «design», «engineering», «automated design system», etc.

Knowledge and ability to work in specialized software (for example, Revit, Navisworks).

TRENDS

Digitalization of the industry.

SUPERPROFESSIONAL skills and abilities

Systems thinking.

Cross-industry interaction.

Project management.

Lean production.

Design, programming and maintenance of robots.

Ecological thinking.

2

DESIGNER
WITH THE SKILL OF USING GENERATIVE DESIGN

APPEARANCE HORIZON

2025

TRENDS

Digitalization of the industry

KEY competence

Higher education in any of the fields: «construction», «architecture», «design», «engineering», «automated design system», etc.

Knowledge and ability to work in specialized software (for example, Revit).

The designer or engineer enters the design goals, i.e. the description of the result to be obtained, into the generative design software. In addition to the design goal, the specialist determines the design parameters, such as performance characteristics, spatial requirements, materials, production methods, and cost constraints. The software explores all possible solutions, quickly creating alternatives. The program tests each solution and learns from each iteration what works and what doesn't. The specialist selects the project option that best suits the customer's taste, available resources, and so on.

NOVELTY of the profession

Using the power of Artificial Intelligence and cloud computing, gen-erative design allows engineers to create thousands of design options. The content of the designer's work is changing, the engineer no longer has to create and evaluate the initial models of the building object, but now he needs to choose the best design based on informal criteria.

SUPERPROFESSIONAL skills and abilities

Systems thinking.

Cross-industry interaction.

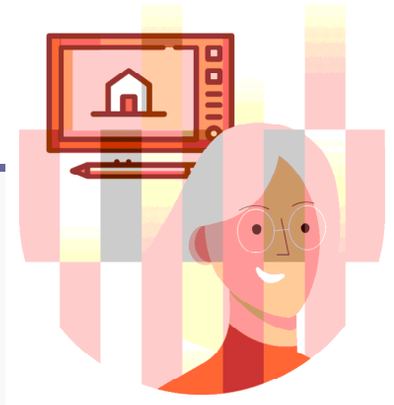
Project management.

Lean production.

Design, programming and maintenance of robots.

Ecological thinking.

3



VIRTUAL DESIGNER

Creates an information model of a building object that has a high level of detail, such as LOD 500 (Level of Development – description of design requirements at each stage). Links the resulting 3D model to the corresponding tasks of the construction schedule. Identifies and resolves dynamic space-time conflicts and optimizes project performance.

APPEARANCE HORIZON

2025

TRENDS

Digitalization of the industry

KEY competence

Higher education in one of the fields: «architecture», «engineering» or «construction technologies».

Skills in software used for virtual design and construction (for example, Revit, Navisworks, Microsoft Project, Primavera).

Skills in 3D visualization programs in design and construction (for example, SketchUp, Inf raWorks).

NOVELTY of the profession

The work of a virtual designer is a new dimension of building information modeling: information about the schedule of work and the cost of work is added to the three - dimensional model.

SUPERPROFESSIONAL skills and abilities

Systems thinking.

Cross-industry interaction.

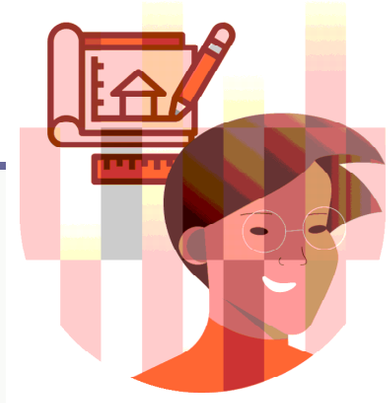
Project management.

Lean production.

Design, programming and maintenance of robots.

Ecological thinking.

4



SMART HOME DESIGNER

a smart home Designer designs, installs, and configures an individual's home / apartment life support system to meet a person's specific needs and budget. Such a system, with a single control center via a mobile application, can combine, for example, household appliances, security system, lighting, climate control, audio system, energy and water supply, etc.

APPEARANCE HORIZON

2025

TRENDS

Digitalization of the industry.

KEY competence

Higher education in computer engineering, electrical engineering, mechanical engineering or related engineering fields .

The following knowledge and skills : development of a draft and then a detailed project, selection of the necessary intellectual systems, installation of the system, analysis of the work performed and monitoring of the progress of work.

NOVELTY of the profession

Understands such areas of digital technologies as predictive algorithms, logical inference machines, and deep learning networks. Developments in these areas will influence smart home technologies: for example, the face and voice recognition system will identify various family members, provide informed answers to open questions, and change settings and launch systems to create an ideal living environment without the need for any interaction with a person.

SUPERPROFESSIONAL skills and abilities

Systems thinking.

Cross-industry interaction.

Project management.

Design, programming and maintenance of robots.

Client orientation.

5

FOREMAN
WITH THE SKILL OF WORKING IN BIM

APPEARANCE HORIZON

2025-2030

TRENDS

digitalization of the Industry.

KEY competence

Higher education in any of the fields: «construction», «architecture», «urban planning».

Knowledge and ability to work in specialized software (for example, Autodesk BIM 360).

The foreman organizes the production of the entire complex of construction and installation works using a single digital form in real time (for example, Autodesk BIM 360) and monitors the quality of construction in collaboration with the entire team using software (for example, BIM 360 Build).

NOVELTY of the profession

The specialist manages the construction process, monitors the quality of work, monitors key indicators and deadlines at any level-from the General (the entire construction site) to the individual (a specific worker on any site).

SUPERPROFESSIONAL skills and abilities

Systems thinking.

Cross-industry interaction.

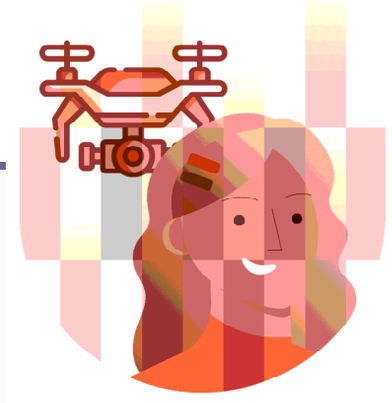
Project management.

Lean production.

Design, programming and maintenance of robots.

Work with people.

6



UAV DISPATCHER

APPEARANCE HORIZON

2025

TRENDS

Digitalization of the industry.

KEY competence

Higher education in computer science.

Mathematical modeling.

ICAO 10019 guide to remotely piloted aircraft systems.

The specialist is involved in the creation of the «low-altitude roads» system. Designs UAV movement routes on and off the construction site, ensuring collision-free navigation. Knows and is able to apply methods of preventing collisions of aircraft (for example, 1. static hovering of the device to miss another device, 2. changing the altitude of the device, or 3. completely changing the flight path of the device).

Is able to simulate the problem (movement of vehicles in traffic) and achieve the optimal navigation option for a fleet of vehicles using, for example, mixed integer linear programming. Can develop heuristic algorithms with various conceptual constructions to solve the problem of trajectory planning with a higher convergence rate.

NOVELTY of the profession

Control and ensure safe, stable and economical UAV movement in the air: all these functions are still to be developed. The professional skills and competencies of the UAV dispatcher will be developed as they progress through the following stages: initial integration into airspace, integration into air traffic, clear and understandable organization of air traffic, the emergence of legal and technical regulations, the creation of on-Board and ground equipment, etc.

SUPERPROFESSIONAL skills and abilities

Ability to work in conditions of uncertainty.

Design, programming, and maintenance of robots.

7

OPERATOR

CONSTRUCTION ROBOTS/ ROBOTICS

The construction robot operator can set up, operate, and maintain the machine. The operator enters pre-programmed instructions that the robot uses to perform the necessary work. The operator can also check the operation of the machine and make adjustments if necessary. The operator can set different components for the robot, depending on the specifics of the work that the robot must perform.

APPEARANCE HORIZON

2030-2035

TRENDS

Digitalization of the industry.

KEY competence

Specialized secondary education (for example, in the specialty «operator of machine tools with software control»).

Operations with robots.

Configure frames.

Write, modify, and execute basic programs.

Offset, backup, restore, create and modify simulations.

NOVELTY of the profession

Writes a program for the robot, loads the text program into the robot, debugs and corrects, and can work in 3D and CAD models.

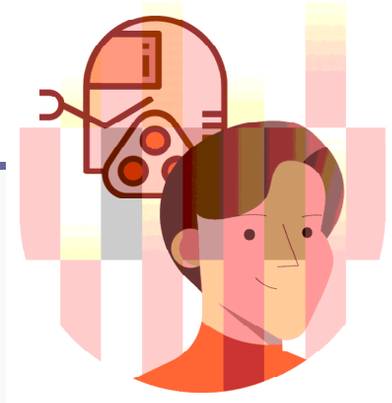
SUPERPROFESSIONAL skills and abilities

Systems thinking.

Design, programming and maintenance of robots.

Ecological thinking.

8



TECHNICIAN
ON ROBOTICS

Robotics technicians perform the initial installation of the robot and subsequent maintenance and repair. After being trained in computer programming, they can perform low - level programming and re-programming of robots.

APPEARANCE HORIZON

2030-2035

TRENDS

Digitalization of the industry.

KEY competence

Secondary professional education in the field of robotics.

Knowledge in the fields of: microprocessors, hydraulics, Pneumatics, electronics, programmable controllers, circuit analysis, mechanics, sensor systems / feedback systems.

Knowledge of CAD/CAM systems (computer - aided design systems/ computer - aided manufacturing systems).

NOVELTY of the profession

They act as a link between robotics engineers and customers who purchase machines. They help engineers-technologists, mechanical engineers and electronic engineers at all stages of design, development, production, testing and operation of robots.

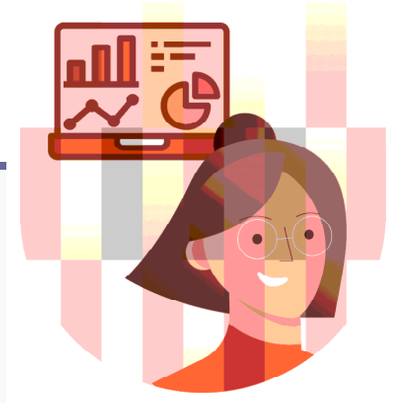
SUPERPROFESSIONAL skills and abilities

Ability to work both in a team and independently.

Analytical thinking style.

Programming.

9



BIG DATA ANALYST
IN CONSTRUCTION

Collects and accumulates data from disparate sources, cleans it, systematizes it, processes it, and analyzes it to extract valuable insights and information. The Big Data analyst in construction helps predict future results, identify possible risks, improve project management, reduce project costs and implementation time, determine the best company management strategies, and monitor the work of numerous contractors.

APPEARANCE HORIZON

2025-2030

TRENDS

Digitalization of the industry.

KEY competence

Higher education in one of the following fields: «cyber - physical systems», «mathematics», «statistics», «computer engineering», «operations research», «engineering Sciences».

Processing, cleaning and checking the integrity of data used for analysis.

Use of statistical methods for analyzing large amounts of data using advanced analytical methods.

Presentation of analytical data with high - performance visualization.

NOVELTY of the profession

The use of big data analysis in the construction industry is still a matter of the future, but now there is an understanding of the tasks that this analytical tool will help solve.

SUPERPROFESSIONAL skills and abilities

Systems thinking.

Cross-industry interaction.

Project management.

Design, programming and maintenance of robots.

Client orientation.

2. «ENVIRONMENTAL PROFESSIONS»

10

SPECIALIST ON
SUSTAINABLE DEVELOPMENT

APPEARANCE HORIZON 2025-2030

TRENDS

Course on decolorization of the industry.

KEY competence

Higher education in one of the areas of «architecture», «design», «civil engineering».

Knowledge and experience in applying environmental certification standards and methods (for example, LEED, BREEAM, DGNB).

Energy audit (for example, ASHRAE levels 1 and 2).

Energy modeling of buildings and BIM.

Development and implementation of eco-friendly solutions for energy supply, water supply, waste management, resource conservation, selection of eco-friendly materials, etc.

The specialist is professionally versed in assessment tools and standards that help assess the environmental performance of a building (for example, LEED, BREEAM, DGNB certification systems). In accordance with the selected certification system, the design criteria for an eco - friendly building are established. Assists construction teams in project implementation in accordance with environmental standards. The main goal of the expert – design and construction of energy - saving buildings to meet the client's objectives and the needs and welfare of the residents, Oud - LAA special attention to minimize their the who actions on the environment and ecology: development and implementation of sustainable solutions for energy, water, waste management, resource conservation, selection of sustainable materials, etc. For existing buildings, the specialist conducts an energy audit and recommends necessary improvements before re-commissioning the building.

NOVELTY of the profession

Holistic approach to the design of a green building: the specialist takes into account the entire life cycle of the building, from the earliest stages of design, construction and operation to demolition.

SUPERPROFESSIONAL skills and abilities

Systems thinking.

Cross-industry interaction.

Project management.

Design, programming and maintenance of robots.

Ecological thinking.

Lean production.

11

ENGINEER
SAVING TECHNOLOGY

APPEARANCE HORIZON 2025-2030

TRENDS

Course on decolorization of the industry.

KEY competence

Higher education in one of the fields «machine building», «civil engineering», «electrical engineering».
Energy-saving technologies (materials and structures), technologies of alternative energy sources.
Development and implementation of an energy saving program in the municipal sector.

The specialist identifies and records opportunities for improving energy efficiency in buildings under design and construction, as well as opportunities for using renewable energy sources (for example, solar energy). Develops recommendations for improving the energy efficiency of buildings, develops recommendations for possible use of renewable energy sources (for example, the use of solar panels).

NOVELTY of the profession

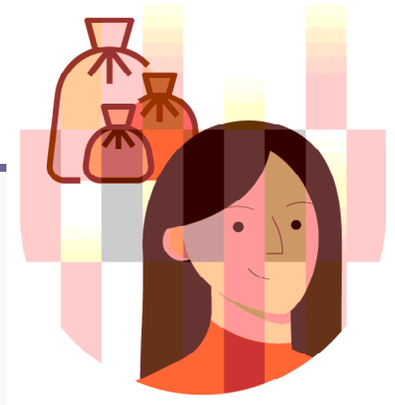
The specialist has a comprehensive approach to improving the energy efficiency of a building: he knows and applies technologies to reduce energy costs for «heating, hot water supply, air cooling in air conditioning systems, artificial lighting».

SUPERPROFESSIONAL skills and abilities

Systems thinking.
Lean production.
Client orientation.
Ecological thinking.

12

ENGINEER-TECHNOLOGIST
CONSTRUCTION WASTE RECYCLING



The process engineer analyzes the morphological composition of construction waste (finds out what components the construction waste consists of) and analyzes the chemical composition of a particular waste component. Based on the results of data analysis, it selects appropriate technologies for waste recovery or recycling. Supervises the process of collecting (or dismantling) and sorting materials for recovery or recycling.

APPEARANCE HORIZON

2030-2035

TRENDS

Course on decolorization of the industry.

KEY competence

Higher education in one of the fields of «chemistry», «biology», «ecology», «physics», «construction», «engineering», «materials science».
Knows the norms Of the environmental code of the Republic of Kazakhstan concerning waste of construction materials.

NOVELTY of the profession

The specialist works in the closed-Loop Economy paradigm (not in the Linear Economy paradigm). The specialist understands technologies for processing construction waste that was formed during new construction, during major repairs and reconstruction of buildings, and defects in the production of building materials and products.

SUPERPROFESSIONAL skills and abilities

Systems thinking.

Cross-industry interaction.

Project management.

Lean production.

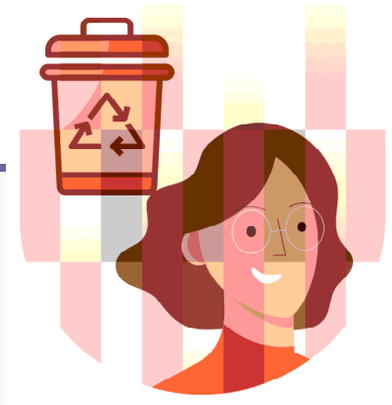
Design, programming and maintenance of robots.

Ecological thinking.

13

ENGINEER-TECHNOLOGIST

DEVELOPMENT OF ENVIRONMENTALLY FRIENDLY BUILDING MATERIALS



Develops technologies for the production of cost-effective, environmentally friendly building materials from renewable natural resources; with a low carbon footprint in the production of construction materials; suitable for subsequent processing.

APPEARANCE HORIZON

2030-2035

TRENDS

Course on decolorization of the industry.

KEY competences

Higher education in the field of materials management (for example, in the specialty «Advanced materials engineering» / Advanced Materials Engineering).

NOVELTY of the profession

The specialist works in the closed-loop economy paradigm (not in the Linear economy paradigm). Develops the characteristics of building materials that will allow their further processing , while the production of materials is carried out from clean, renewable resources.

SUPERPROFESSIONAL skills and abilities

Systems thinking.

Cross-industry interaction.

Project management.

Lean production.

Design, programming and maintenance of robots.

Ecological thinking.

3.«INNOVATION»

MANAGER
ON INNOVATIONS IN CONSTRUCTION

He is well versed in technological innovations that are available on the market and ready for use in the construction industry.

APPEARANCE HORIZON

2025-2030

TRENDS

Growing demand for technological renewal of the industry

KEY competence

Higher education in one of the fields of «architecture», «design», «civil engineering», «advanced materials science».
Understands the economy of the enterprise.
Fluent in English

NOVELTY of the profession

The innovation Manager's expert opinion is taken into account throughout the entire life cycle of the construction project (design, construction, operation, demolition/ dismantling).

SUPERPROFESSIONAL skills and abilities

Systems thinking.
Cross-industry interaction.
Project management.
Lean production.
Ecological thinking.
Client orientation.

4. «ROADS»

15

TECHNOLOGIST
CONSTRUCTION OF ROADS FROM RECYCLED PLASTIC

APPEARANCE HORIZON **2025-2030**

TRENDS

Course on decolorization of the industry.

KEY competence

Higher or secondary special education in the specialty «construction of automobile roads and aerodromes».

Professionally versed in the features of materials used for the production of road surfaces, has the skills to produce high-quality mixtures for road surfaces.

Knows and is able to apply various technologies of using plastic (commercial and home use) as an additive to the asphalt concrete mix in the production of road surfaces. Understands existing technologies, such as those of MacRebur® or Green Mantra .

Knows and is able to apply the technology of processing plastic waste for the production of hollow slabs that are used to lay the roadbed (for example, the technology of the company VolkerWessels).

NOVELTY of the profession

For the active use of this technology, one important condition is necessary – a well-established and working system for separate collection of household and commercial garbage. The technologist cannot directly influence this process, however, the very possibility of introducing a new technology depends on the efforts of citizens and local Executive bodies.

SUPERPROFESSIONAL skills and abilities

Cross-industry interaction.

Project management.

Lean production.

Ecological thinking.

16

SPECIALIST
FOR THE DESIGN OF «SMART» ROADS

Professionally versed in the latest intelligent road transport components of the «Smart road».

Know the benefits of using those or other decisions, e.g. applications of IOT technology, which helps vehicles, roads, svetovo - frames and street signs is automatically adapted - act to changing conditions, to help drivers to improve driving safety, reduce traffic congestion and the Torah, to reduce environmental pollution.

APPEARANCE HORIZON

2025-2030

TRENDS

Digitalization of the industry.

KEY competence

Higher education in the field of «cyberphysical systems».
Ability to work with wireless sensor networks and cloud technologies.
Ability to process and analyze big data.
Ability to ensure the cyber security of the Internet of things.

NOVELTY of the profession

The specialist is able to find different solutions that connect drivers, cars and the road in a single network using IoT technologies.

SUPERPROFESSIONAL skills and abilities

Systems thinking.

Cross-industry interaction.

Project management.

Lean production.

Design, programming and maintenance of robots.

Ecological thinking.

5.«RENOVATION»

17

SPECIALIST
ON RENOVATION IN CONSTRUCTION

Professionally versed in technological innovations in construction, architecture, and urbanism. It examines the possibility and recommends specific new technologies and materials that should be used for the modernization / reconstruction of existing buildings (residential, administrative and industrial buildings, social facilities). For example, modernization of power supply, water supply, sanitation, and air conditioning systems.

APPEARANCE HORIZON

2025-2030

TRENDS

Digitalization of the industry.

KEY competence

Higher education in one of the fields: «architecture», «engineering « or»construction technologies». Knowledge and ability to work in specialized software (for example, AutoCAD MEP, Revit, and Navisworks).

NOVELTY of the profession

A renovation specialist is important in the case of preserving the historical centers of cities, as well as in cases of correcting low-quality new construction.

SUPERPROFESSIONAL skills and abilities

Systems thinking.

Cross-industry interaction.

Project management.

Lean production.

Design, programming and maintenance of robots.

Ecological thinking.

Working in an uncertain environment.

TRANSFORMING PROFESSIONS IN THE CONSTRUCTION INDUSTRY

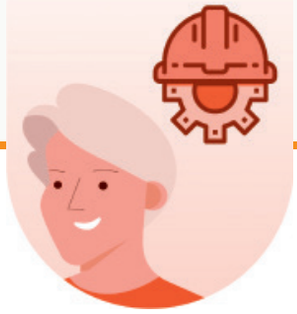
6.2.

6.2.
TRANSFORMING PROFESSIONS IN THE CONSTRUCTION INDUSTRY

The speed of emergence and implementation of various technologies of the Fourth industrial revolution is unprecedented. There is no time to build up. We need to upgrade or leave the market. This is exactly what will happen or is already happening to the professions that now form the backbone of the agricultural industry. Despite the fact that the Foundation of the industry remains unchanged - human labor and natural resources- tools and ideas are already changing! Increasingly, a smart machine will be placed between a person and the object of their work, but it still needs human guidance and care, but this will not last long...

2025

01



CIVIL ENGINEER

CIVIL ENGINEER 2.0

TRIGGER

The penetration of digital technologies into the construction industry.

The tools of civil engineers will change under the influence of digital technologies (for example, BIM, generative design, etc.): whether it is working in a project organization or directly on a construction site. All participants in the design process (architects, engineers, designers, contractors and subcontractors) will interact in a common digital model of the object. The construction process and quality control of the work performed will also be fully controlled with the help of specialized programs, such as Autodesk BIM 360, BIM 360 Build.

Digital technologies will continue to change the way civil engineers work, whether working in a design organization or directly on a construction site. All participants in the design process (architects, engineers, designers, contractors and subcontractors), regardless of the software used, will have the opportunity to interact in a common model.

The choice of a particular design participant will depend on their level of expertise, not on the software they use.

The construction process and the quality of the work performed will also be fully controlled using specialized software, such as Autodesk BIM 360.

DIFFERENCE

Project participants can work together and do not depend on the specific software used, continuous coordination of the work of different participants (constant data exchange), reduce the number of interaction errors, and the work of all project participants is transparent.

2025

02

SPECIALISTS - PROFESSIONALS IN THE FIELD OF TECHNOLOGY

TRIGGER

Эффективность цифрового подхода по сравнению с традиционными.

DIFFERENCE

Digital technologies allow you to achieve great results with less effort.

Materials science, Metrology and standardization, design and estimate documentation, labor protection- these areas are already undergoing changes under the influence of digital technologies. 3D modeling engineers are part of digital technology.

In materials science, many workflows are already programmed or simulated on computers during the digitization process, and virtual materials can be tested on a computer before they are produced.

In the near future, we will see the emergence of a new industry - «computing material management».

COMPUTATIONAL MATERIALS SCIENCE ENGINEER

Virtual models will be widely used in Metrology. A digital calibration certificate will soon be created, which is being developed on the basis of a virtual coordinate measuring machine that allows you to simulate the measurement process.

VIRTUAL METROLOGY ENGINEER

In the field of standardization, digital standards are already being created-systems that help the developer create new standards, while discussing and coordinating them with other experts in real time.

DIGITAL STANDARDS ENGINEER

In the field of occupational safety, the focus will be on risk assessment using digital technologies.

ENGINEER-ESTIMATOR 2.0

ENGINEER FOR INDUSTRIAL SAFETY, LABOR PROTECTION AND SAFETY 2.0

the preparation and verification of estimates is already done by professionals using specialized software.

2030

03

ARCHITECTS OF BUILDINGS AND STRUCTURES

ARCHITECT 2.0

TRIGGER

The growing importance of ecology.

the Mechanistic and technocratic thinking that still guides architects today is gradually becoming a thing of the past. The ideas of sustainable (environmental, economic and social) development change the purpose of the architect's work. Sustainable architecture « seeks to minimize the negative impact on the environment by improving the efficiency of buildings and structures, moderate use of materials and energy in the development of the environment.».[1]

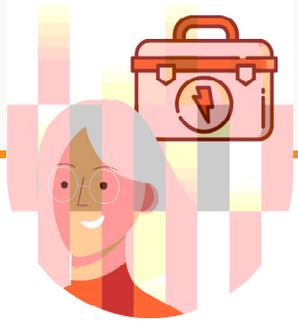
DIFFERENCE

New design approaches are designed to reduce the impact of the artificial environment on natural resources, the natural environment, should contribute to social sustainability and at the same time should be cost - effective.

[1] Source: A.A. Gudkov, O.V. Morozova. Modern trends in the master's degree training of an architect. Part i. Sustainable architecture and digital design technologies.

2030

04



ELECTRICAL ENGINEER

ENGINEER OF SMART POWER SUPPLY NETWORKS

The operation of power systems is changing as digital technologies become more widespread. Smart Grid technologies are being gradually introduced. On the one hand, the operating conditions of power grids are changing and in order to avoid energy blackouts, the control system must also change. On the other hand, the transition to alternative energy sources is impossible without the use of Smart Grid. In addition, smart grids 2 allow you to differentiate energy tariffs. Digitalization will change the facilities that generate energy, as well as the system of transmission and distribution of energy. All this will be related to receiving and processing Big Data.

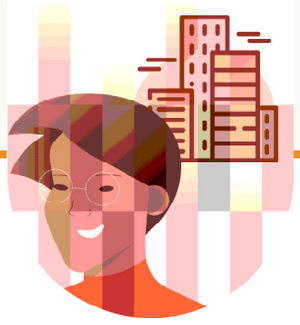
TRIGGER

The changed operating conditions of power grids, consumer requests, the course towards greening the industry as a whole.

DIFFERENCE

Smart Grid technology implies building a single one-level automated control system. Decisions will be made much faster, and the involvement of professionals will only be necessary if anomalies occur or if deep analysis is necessary.

2030



05

DESIGNERS, URBAN PLANNERS AND OTHER DESIGNERS

URBAN PLANNER 2.0

Digital technologies, in particular virtual and augmented reality, will change the approach to design. The design process will take place in the space itself. Wearing virtual reality glasses and using a manipulator, the designer can immediately try out several solutions and choose the most suitable option for the designed object.

TRIGGER

The penetration of digital technologies into the construction industry.

DIFFERENCE

Now designers create 3D models of building objects as close as possible to their physical counterparts. However, you can only visually evaluate these models on a computer screen. Virtual reality allows the designer to be in the same environment with the object that he is designing, and there is a possibility of interaction.

2025

06

SURVEYORS, CARTOGRAPHERS AND SPECIALISTS-PROFESSIONALS OF RELATED OCCUPATIONS

TRIGGER

The needs for various geoinformation are constantly changing. Customers need prompt and accurate information on request – all this stimulates the development of laser scanning. The changing attitude of residents to the city, to their experience of living in the city, expands the range of use of traditional tools (for example, maps of the area). The use of neural networks and machine learning will reduce the cost of creating vector maps (in particular, the cost of recognizing objects).

DIGITAL SURVEYOR

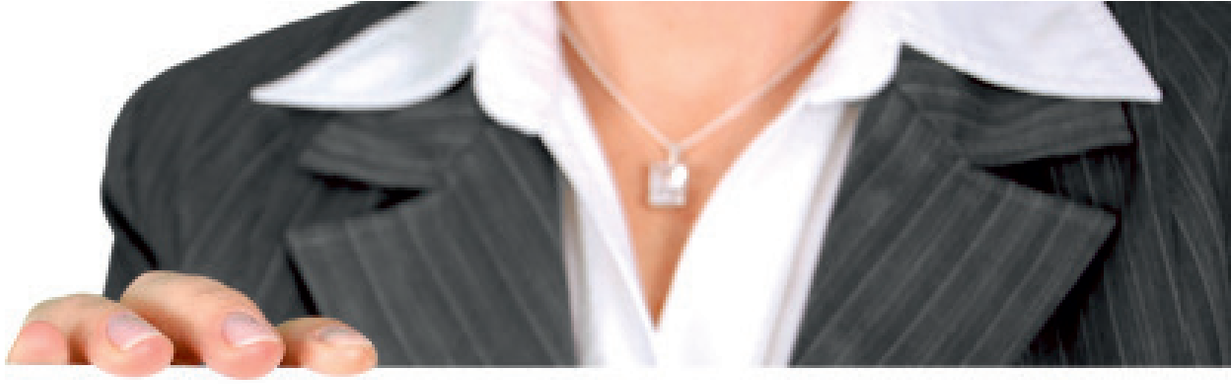
Geodesy and cartography will continue to change under the influence of digitalization. Geodesic measurements will increasingly rely on three - dimensional laser scanning and point cloud processing; these technologies make it easier to build 3D models of the objects being measured.

DIGITAL CARTOGRAPHER

As the concept of «smart city» becomes more complex, digital maps will not only perform utilitarian tasks (for example, which route is faster to get from point A to point B), but also serve the emotional comfort of living in the city. For example, we will develop such types of city maps that will show the user the most picturesque routes to the city's attractions, maps will show the city as a soundscape (some areas of the city are quiet and calm, and some, on the contrary, are always noisy and lively, etc.). In addition, neural networks and machine learning will be used to create vector maps.

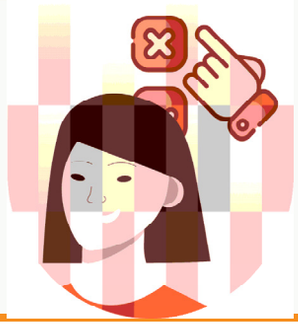
DIFFERENCE

Laser scanning of geodesy, in contrast to the use of traditional methods, greatly simplifies the construction of 3D models of shooting objects, the data is obtained with high accuracy, while time and money costs are reduced. Maps are no longer just tools for navigating the terrain. Maps of modern cities will become navigators not only in the physical space of the city, but also in the atmospheric and emotional space.



QUALITY CONTROL

2025



07

INSPECTORS OF CONSTRUCTION WORKS, QUALITY CONTROL AND LABOR PROTECTION

DIGITAL CONSTRUCTION INSPECTOR, DIGITAL FIRE INSPECTOR, DIGITAL CONTROL INSPECTOR QUALITY AND SAFETY STANDARDS

TRIGGER

Construction projects are becoming more and more complex and voluminous, violation of the deadlines for the execution of works and losses in the quality of construction are associated with

The entire process of construction control is associated with the turnover of a large number of documents, which in turn affects the cost, timing and quality of work. Coordination errors, loss of information about defects- this is an incomplete list of problems that arise during construction control. The only solution to the problems that arise is automation: a single information space is created in which inspectors register violations in real time, and the contractor receives an order to eliminate the violation.

DIFFERENCE

Information about registered violations and elimination of violations is recorded in real time; time and material resources for monitoring construction work are saved.

2025

08

OPERATORS FOR THE PRODUCTION OF CEMENT, STONE AND OTHER MINERAL MATERIALS

THE OPERATOR OF ADDITIVE MANUFACTURING IN THE CONSTRUCTION

The penetration of additive technologies into the production of building materials will change the essence of the work of specialists in this field. Using 3D printing, it will be possible to produce components of complex construction projects. If it is now possible to print a small house using such a printer, then in the near future more complex objects will be built, such as bridges, with the help of components printed on 3D printers. The direction of Direct Digital Manufacturing (Direct Digital Production) in the production of building materials is already developing.[57]

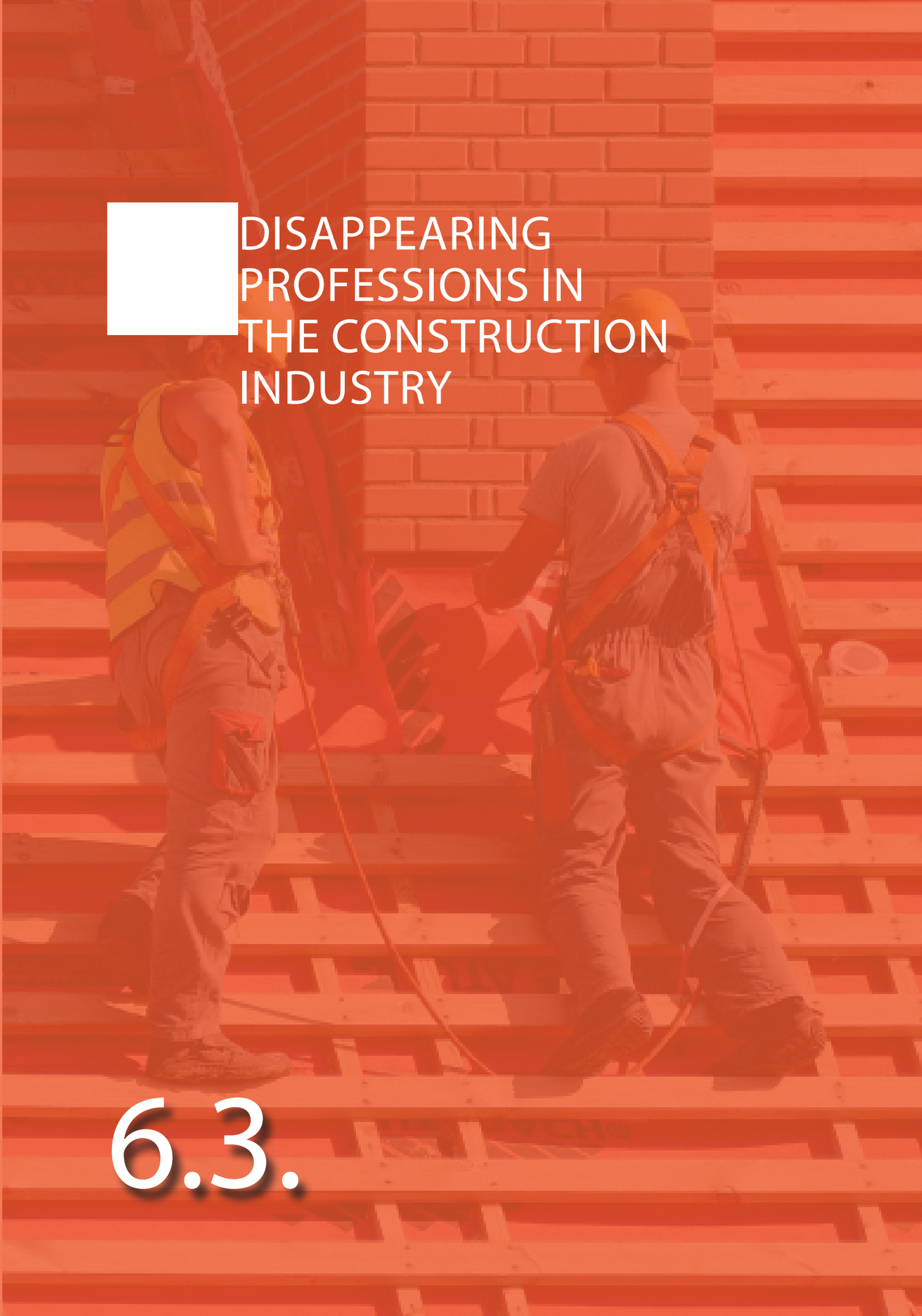
TRIGGER

The penetration of digital technologies into the construction materials production industry.

DIFFERENCE

The model of the required component for the construction of an object (for example, a bridge) is first designed in 3D, then this digital model is used directly for the production of this component. Direct digital production uses additive manufacturing, computer-aided digital control machines, automated manufacturing, and computer-aided design.

[57] Source: Мьge Tetika, Antti Peltokorpia, Olli Seppдnena, Jan Holmstrцmb. 2019. Direct digital construction: Technology-based operations management practice for continuous improvement of construction industry performance (https://acris.aalto.fi/ws/portalfiles/portal/36909722/1_s2.0_S0926580518310914_main.pdf)



DISAPPEARING PROFESSIONS IN THE CONSTRUCTION INDUSTRY

6.3.

2025

1

DRAFTSMEN

The design of construction projects, and then the production of the necessary components for the construction of the object in the near future will be completely carried out using digital and additive technologies. The need to «translate digitized working drawings into printed form» or «print out drawings» will be a thing of the past forever.drawings» will be a thing of the past forever.

2030

2

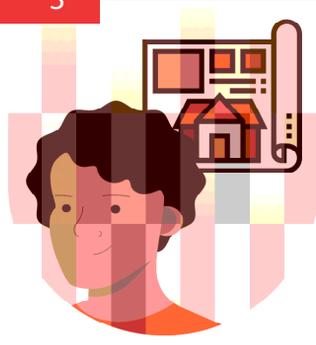
TECHNICIAN
FOR STANDARDIZATION

Digital standards in standardization – these technologies are changing the nature of work in this area, the functionality of technical personnel is gradually being replaced by the capabilities of specialized software.

2030

3

LINERS
AND FITTERS

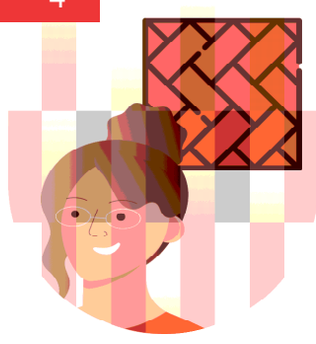


Improvement of additive technologies will sooner or later make it possible to «print» the necessary components of structures, and the widespread use of modular construction will make the work of the rebar and concrete worker practically unclaimed. The work of the veneers will eventually be replaced by construction work.

2030

4

RELATED OCCUPATIONS
BRICKLAYERS AND WORKERS



Even now, bricklaying robots are used in construction, modular construction and 3D printing of buildings are used, and over time, the manual labor of a bricklayer will become little in demand or will be robotized.

2030

5

STONES AND STONECUTTERS
HANDLERS

All types of work related to stone processing and stone cutting will be performed by robots. Even now, robots can sort, slice, mark, and so on.over time, all these robot skills will be applied to working with stone.

2030

6

CONCRETERS AND WORKERS
OF RELATED OCCUPATIONS

The work of the concrete worker will be «integrated» into the technological process during the production of modules or 3D furnaces. Separately, the concrete worker's work will «dissolve» in new technologies (modular construction and additive technologies).

2035

7

BUILDERS AND INSTALLERS
AND WORKERS OF RELATED OCCUPATIONS

The essence of construction and installation work will gradually change with the spread and widespread use of modular construction, construction robots, and additive technologies. The need for manual labor on the construction site of people over time will first be reduced to a minimum, and then will become a thing of the past.

2030

8

ROOFERS

The expansion of modular construction and the growing popularity of low-rise construction will change the approach to roof construction in the construction of new buildings. The need may remain only for roof repairs on existing buildings.

2030

9

FLOOR DECKERS
AND TILE MAKERS

The need for the work of floor deckers will decrease with the spread of modular construction, the work of tile workers will either «dissolve» in the technological process of modular construction or will eventually be robotized.

2030

10

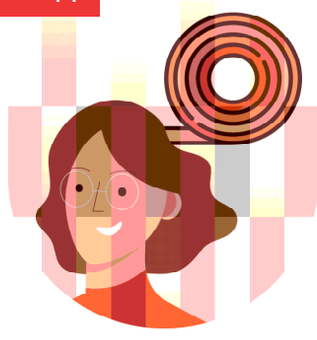
PLASTERERS

Robots (with machine vision) will learn how to apply decorative and protective coatings made of shtuka-Turki, cement and similar materials inside or outside structures.

2030

11

ISOLATORS



Development of modular construction and additive technologies- technology will change the approach to equipping of construction facilities insulating or sound-absorbing materials. These types of work will be performed at the stage of module manufacturing or 3D printing.

2030

12

GLAZIERS

The development of robotics and the expansion of the use of modular construction will first minimize the need for manual labor of glaziers, and in time the need for this labor will become a thing of the past.

2035

13

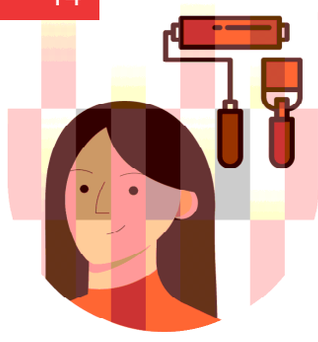
CONSTRUCTION PAINTERS

the development of modular construction, the development of construction robots will sooner or later replace the manual labor of painters.

2035

14

VARNISHERS,
PAINTERS AND OTHER PAINTERS



Finishing works and applying protective coatings to structures will be performed by construction robots in the near future.

2030

15

WELDERS AND GAS CUTTERS

Welding on the construction site – this type of work will be performed by specialized robots. Already in 2018, Shimizu Corporation (Japan) introduced a robot for welding. This robot has already been used in the construction of a high-rise building.

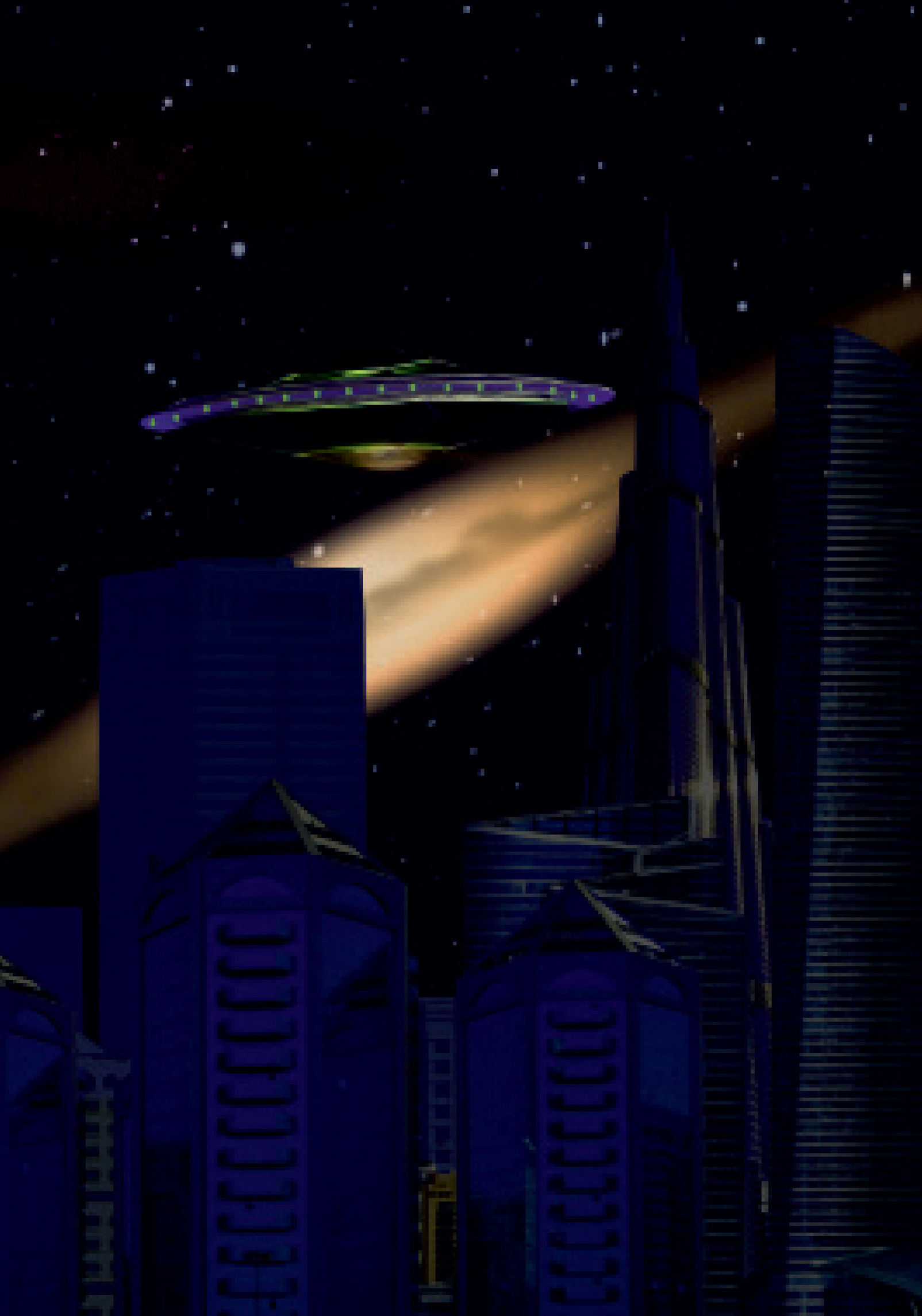
2035

16

TRUCK
DRIVERS

In the near future, trucks will be equipped with an autopilot system, but this system will still be operated by a human (driver). The technology of auto pilot will simplify the process of driving. However, the ultimate goal of all this technology is to create vehicles that can operate completely autonomously. This means that truckers will eventually be pushed out.

7. COMPETENCIES OF FUTURE PROJECT MANAGERS IN THE CONSTRUCTION INDUSTRY



7.1.
COMPETENCIES OF FUTURE PROJECT MANAGERS IN THE CONSTRUCTION INDUSTRY

The rapid development of technologies of the Fourth industrial revolution, including digitalization, automation, expanding access to information, changing generations of specialists and workers in the industry, changing organizational structures for construction projects, environmental standards-these are the driving forces that change the requirements for the professionalism of employees in the construction industry.

The most difficult barrier for professionals of the future, of course, will be digitalization and automation of production. People will be replaced by artificial intelligence and machines. But these latest scientific achievements will not be able to replace the human being in all areas. Therefore, in order not to get lost and find their place in the labor market in the future, young people already need to they need to master the competencies and skills that will make their work irreplaceable. What do we mean? Of course, the need to acquire professional knowledge and skills at an Institute, vocational school, or University will not disappear. This is a kind of «Pro-launch» to the labor market. But in order to win the competition with machines, it is necessary to develop the ability to communicate with different people and the ability to work in a team, to train the willingness to solve problems and the desire to think outside the box. These recommendations are universal for all professional fields of activity.

Let's first understand what competence is. According to the «European qualifications system» «competence-proven ability to use knowledge, skills, personal, social and / or methodological abilities in work or training situations, as well as in professional and personal development. The term «competence» is broader and refers, as a rule, to the ability of a person, who is faced with new situations and unforeseen difficulties, use and apply knowledge and skills independently.

But back to the construction industry. At the core of any project are specialists who are actually responsible for everything that happens on the construction site - project managers. They are responsible for managing the entire process, starting from the planning stage and approval of project documentation and ending with the commissioning of the object.

THE ROLE OF THE PROJECT MANAGER (PM) ON THE CONSTRUCTION SITE IS CHANGING IN THE WAKE OF CHANGES IN THE INDUSTRY AS A WHOLE.

Over the next ten to fifteen years, the project Manager in construction will become a specialist of a broader profile than today.

Of course, the PM will continue to monitor engineering work, procurement (logistics), and personally manage the construction of facilities. However, the future will require him to be a leader with well-developed communication skills. The project Manager must become a professional who can build and maintain all the important relationships on the project, as well as be able to motivate, engage and develop other people.

[58] Source: https://www.researchgate.net/publication/261651752_Organizational_structures_in_the_construction_industry
[59] https://ec.europa.eu/esco/portal/escopedia/Competence

CONSIDER

MORE DETAILED COMPETENCIES,
KWHICH A PROJECT MANAGER SHOULD HAVE
IN THE CONSTRUCTION INDUSTRY IN THE FUTURE[60]

TECHNICAL COMPETENCE:

1. A professional has knowledge in several areas:
   • technical science,
   • project management,
   • construction;

   at the same time, knowledge in any one field must be fundamental.
2. The Professional has a practical / applied understanding of the technologies that are applied during the construction project, knows how to use these technologies, and can ensure that these technologies are effectively applied by the team that

MANAGERIAL COMPETENCE:

1. A professional has a deep understanding of the business. Clearly understands the strategic goals of the parent company and translates these goals into practical actions during the project implementation.
2. A Professional understands what a project management is. Knows and uses best practices, processes, and procedures for successful project execution.
3. Professional you - tune the knowledge network. Creates and maintains a network of knowledge inside and outside the team and organization.
4. A Professional controls the risks at all times. Constantly monitors known and unforeseen strategic and operational risks, thus maintaining rapid response readiness.

[60] Source: http://ascpro0.ascweb.org/archives/cd/2015/paper/CERT349002015.pdf

COGNITIVE COMPETENCIES:

1. A Professional builds communication effectively. He listens to understand, and is able to clearly and convincingly present ideas and complex concepts to a wide range of listeners.
2. Professional possesses emotional maturity. Understands and controls emotions while simultaneously showing empathy for others and using these skills to lead others.
3. A professional knows how to take difficult decisions. He thinks analytically, conceptually, and adaptively, and can understand and understand new information at different levels of its detalization.

LEADERSHIP COMPETENCIES:

1. Professional welcomes and supports raznost - multi-stakeholder thinking. It uses the power of diversity to capitalize on cultural differences, genetic differences, different experiences, and generational differences.
2. The Professional builds collaborative relationships with clients, colleagues, global knowledge networks, subordinates, and management to achieve business goals.
3. to achieve the goals set, the professional uses the world war II treatment tool: encourages team work, equalizes differences, and uses different talents of people.
4. A professional Takes on the role of a mentor. Continues to train, train, and mentor employees to help them achieve personal and team success and grow the next generation of professionals.
5. A Professional builds trust in the broadest sense of the word. Manages people and processes so that people in a stressful situation can confidently rely on themselves and their competence.

7.2.
THE COMPETENCE OF THE FUTURE UNIVERSAL FOR ALL INDUSTRY PROFESSIONALS

The construction industry is not just project managers at the construction site, it is all a lot of specialists and workers who are involved in the process of creating an object at different stages. Let's look at the competencies that are universal for everyone who will work in construction in the near future.

This Atlas has identified the key competencies that will be needed by specialists in the construction industry of the future.

All key competencies were divided into four categories:

1. Social and personal communications;
2. Thinking styles;
3. Technical skills;
4. Functional competencies in the field of corporate governance.

1 SOCIAL SKILLS

It is not enough for a specialist of the future to be able to work with machines (machinery, equipment), he needs to be able to manage himself and interact with other people.

With the development of technology, there will be a growing demand for building a reliable communication network to meet emotional needs.

Social networks, new production communities, and temporary project teams will require specialists to be able to negotiate and cooperate, present, moderate, and facilitate the work of groups.

These skills will become a separate vector of training and self - improvement of the future specialist.

2 THINKING SKILLS

Experts agree that more and more of the processes and functions will be fulfilled-use robots and artificial intelligence. By 2030-2040, a person will lose out to a machine in performing typical tasks. How do we win the competition? Thinking is one of the few areas where machines have not yet penetrated. Critical, creative, systematic, and other styles of thinking are available only to humans and will remain their monopoly for the foreseeable future. Even today, specialists of the future should purposefully develop in itself, thinking styles and techniques. Only in this case will we be able to gain a foothold in the future with machines and make them assistants that collect data for us and perform simple functions for us and those that are easy to algorithmize.

3 TECHNOLOGICAL SKILLS

In the middle of the last century, computer experts believed that by the beginning of the twenty-first century, computer literacy would be just as necessary for humans, like the ability to read and write. We see that their forecasts have come true. Digitalization gives a person a volume of information thousands of times greater than it was at the beginning of the century. A large amount of poorly structured data is called big data. This data contains information on the basis of which the Manager will be able to make more informed and more objective decisions. The volume of information is growing every year, but without processing this information is useless.

Therefore, specialists who can identify data collection points and tools and structure the data will be in demand and analyze them and provide structured information to the Manager for decision-making.

4 CORPORATE SKILLS

The core of industrial companies of the XX century was a factory and a Corporation. These are large organizations that can unite a large number of specialists and organize mass production. According to experts, the core of business in the XXI century will be digital platforms. On the horizon of 10-15 years, we will get a synthesis of organizational models of the XX and XXI centuries.

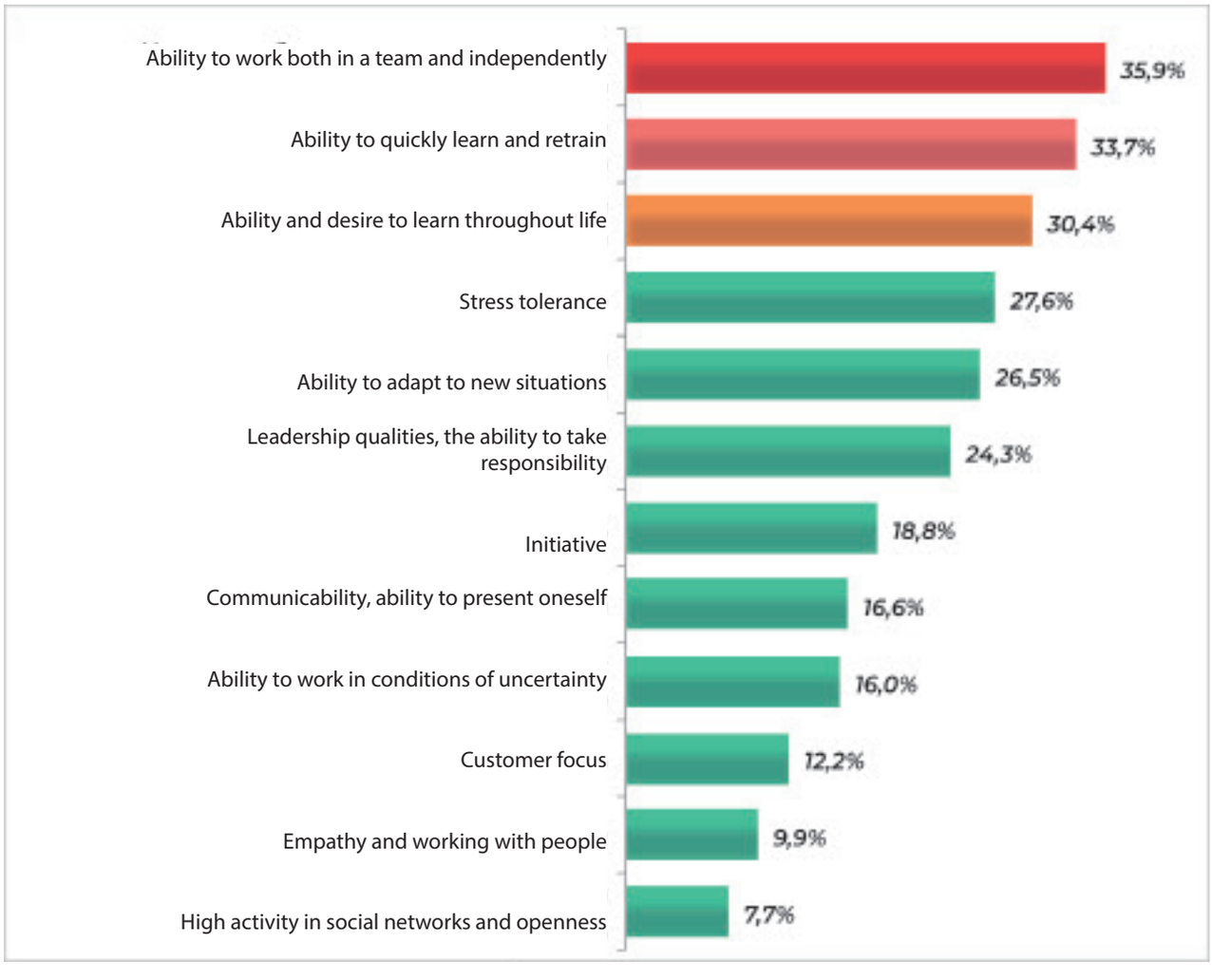
Modern corporations are uncooperative and overly hierarchical. If an employee wants to make a proposal, it will take a long time to go through all the approval stages, change the existing regulations, and overcome inertia and resistance to change. The lower the employee's position in the corporate hierarchy, the more difficult it is to complete these procedures. The key to success in competition is fast decision-making and implementation. In the future, the demand for this speed will only increase.

To overcome this disadvantage, modern corporations are changing their management style. Organizations of the future provide all dedicated employees who have an innovative idea of improvement with the opportunity to Express themselves, regardless of their position in the hierarchy. To take advantage of this opportunity, an employee needs to master a number of skills: management, Agile planning. Employees who have ideas for improvements and can organize themselves to implement them will be the driving force for future companies.

Leading experts of the construction industry in Kazakhstan identified several positions in the group of social and personal competencies that a professional should have in the near future. First of all, in order to be in demand and successful in the construction industry of the future, specialists of all levels need to be able to work both in a team and independently, in addition, they need to be ready for rapid training and retraining and at the same time learn/retrain throughout their working life.

Chart 7.1.

SOCIAL AND PERSONAL competencies that are in demand in the construction industry in 10-15 years



In order to find solutions quickly in a changing world filled with different people and the latest technologies, you need to be able to use different styles of thinking.

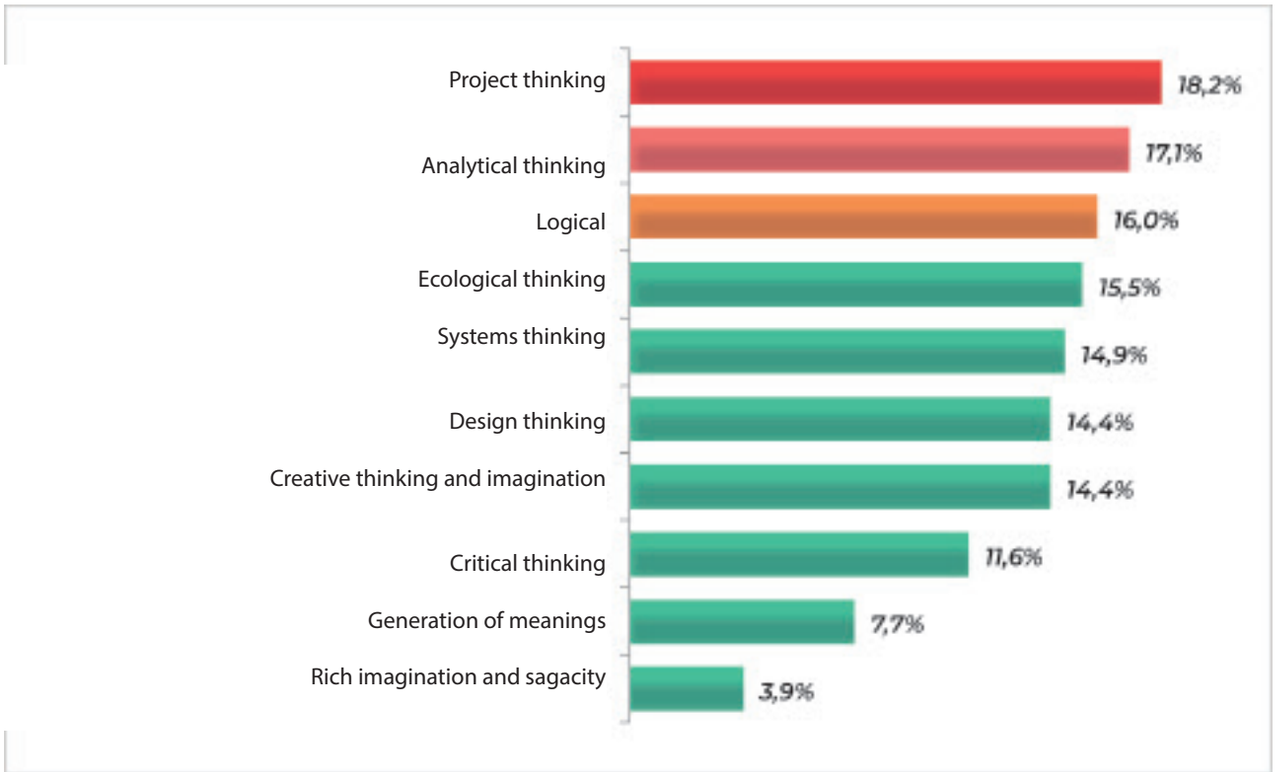
The experts focused on three of them: project thinking, analytical thinking, and logical thinking.

The choice of experts is quite reasonable. On the one hand, a specialist, whether an architect, designer, project Manager, or worker, needs to accurately understand and almost anticipate the development of events if the problem or problem is solved in one way or another. In a word, you need to be able to see the development of the situation in perspective. And to do this, it is important to develop project thinking.

On the other hand, some problems and tasks may require a creative approach, and some may require only a clear, methodological approach. Both ways of solving the problem require an analytical style of thinking. Working in an environment that is filled with the latest achievements of scientific and technological progress, fully requires logical thinking from the specialist. These people are not guided by assumptions or preconceptions or what seems right. Logically thinking people, experts observe and analyze, and then draw conclusions based on the data obtained. They can justify their strategies, actions, and decisions based on the facts they have gathered.

Chart 7.2.

Employee THINKING STYLES
that are in demand in the construction industry in 10-15 years



The whole idea of the current changes in the world and in the industry is based on an indisputable fact – the impending wave of digital technologies.

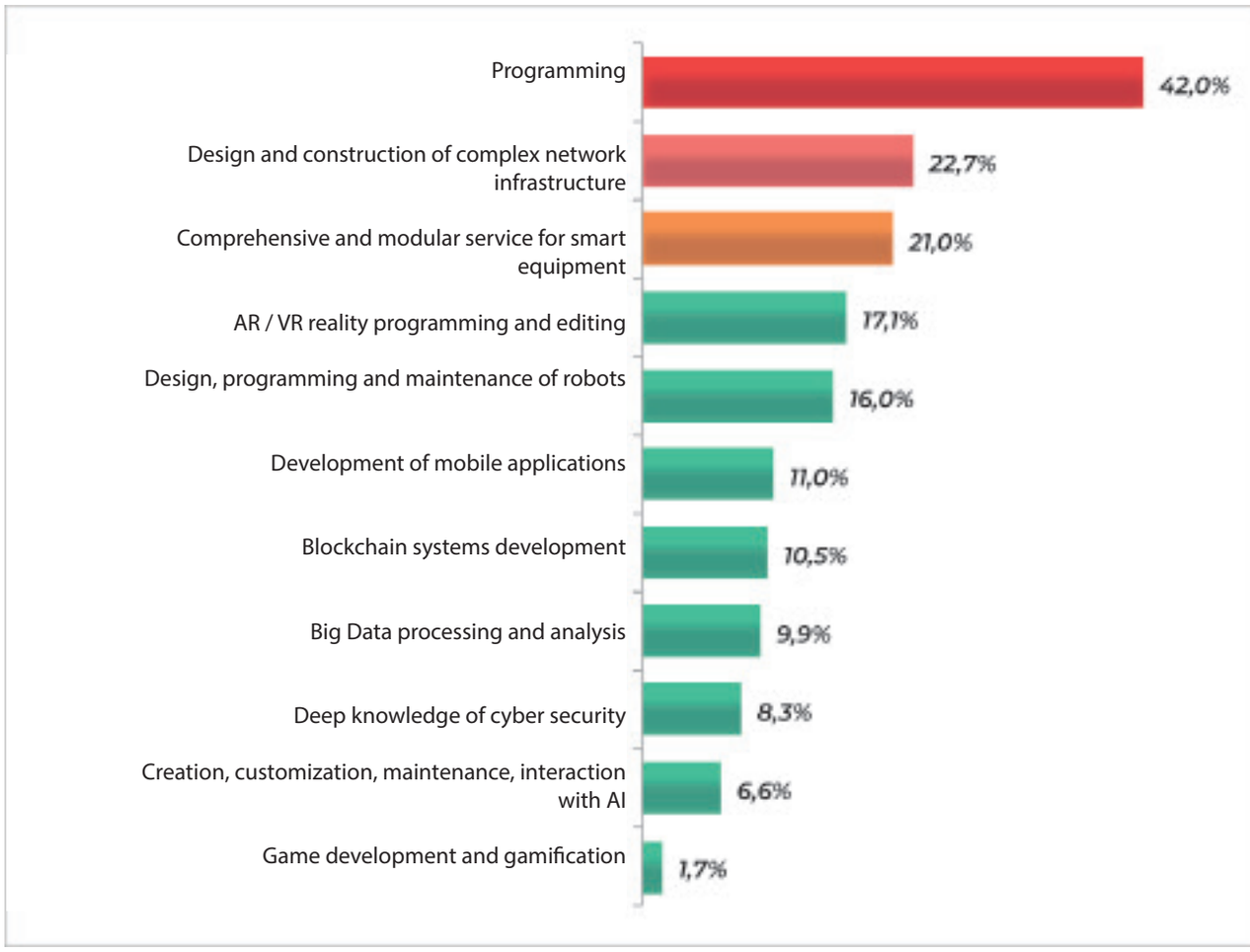
Therefore, it is quite expected that experts have identified the ability to program as the most important competence for specialists in the near future. Following programming, experts consider it important to be able to design and build a complex network infrastructure.

Why is this important?

Digital technologies are primarily an abundance of data, and the ability to work effectively and safely with this data is allowed by a professionally built network infrastructure.

Chart 7.3.

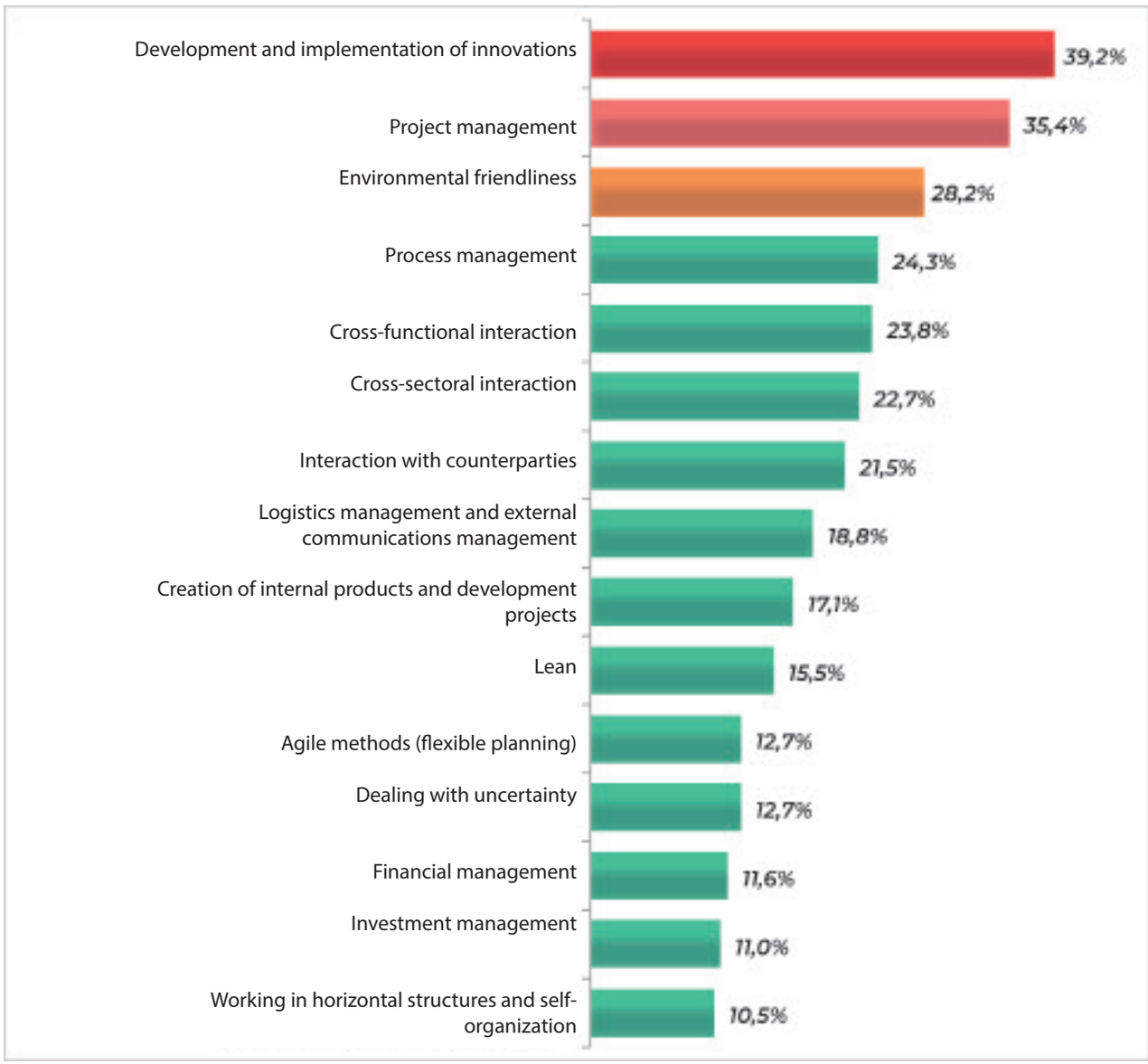
Компетенции, востребованные в строительной отрасли через 10-15 лет, для работы с НОВЫМИ ТЕХНОЛОГИЯМИ

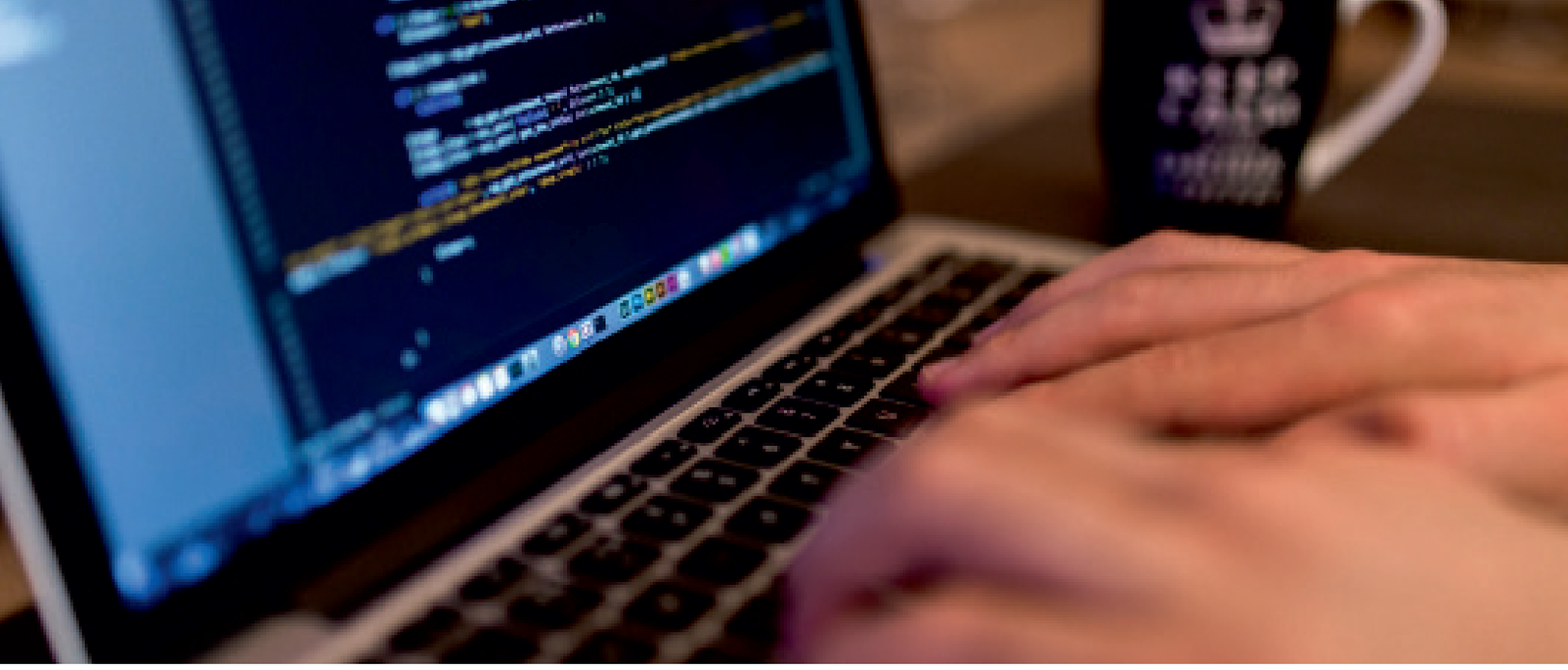


The fourth industrial revolution forces us to reconsider the foundations on which the work of companies and corporations is based. We have already said that the world's business leaders have a new understanding of the principles of their companies, and now business works in the interests of customers, employees, suppliers, and communities, and not just their own shareholders. This movement corrects the principles of corporate governance.
It is not surprising that almost a third of the experts surveyed identified «environmental Friendliness» as an important principle of company management. Most experts understand that the development and implementation of innovations is the key to the success of companies in today's rapidly changing environment. And the importance of project management will remain in all conditions, its value for the construction industry is permanent.

Chart 7.4.

Competencies that are in demand in the construction industry in 10-15 years, in the field of CORPORATE GOVERNANCE





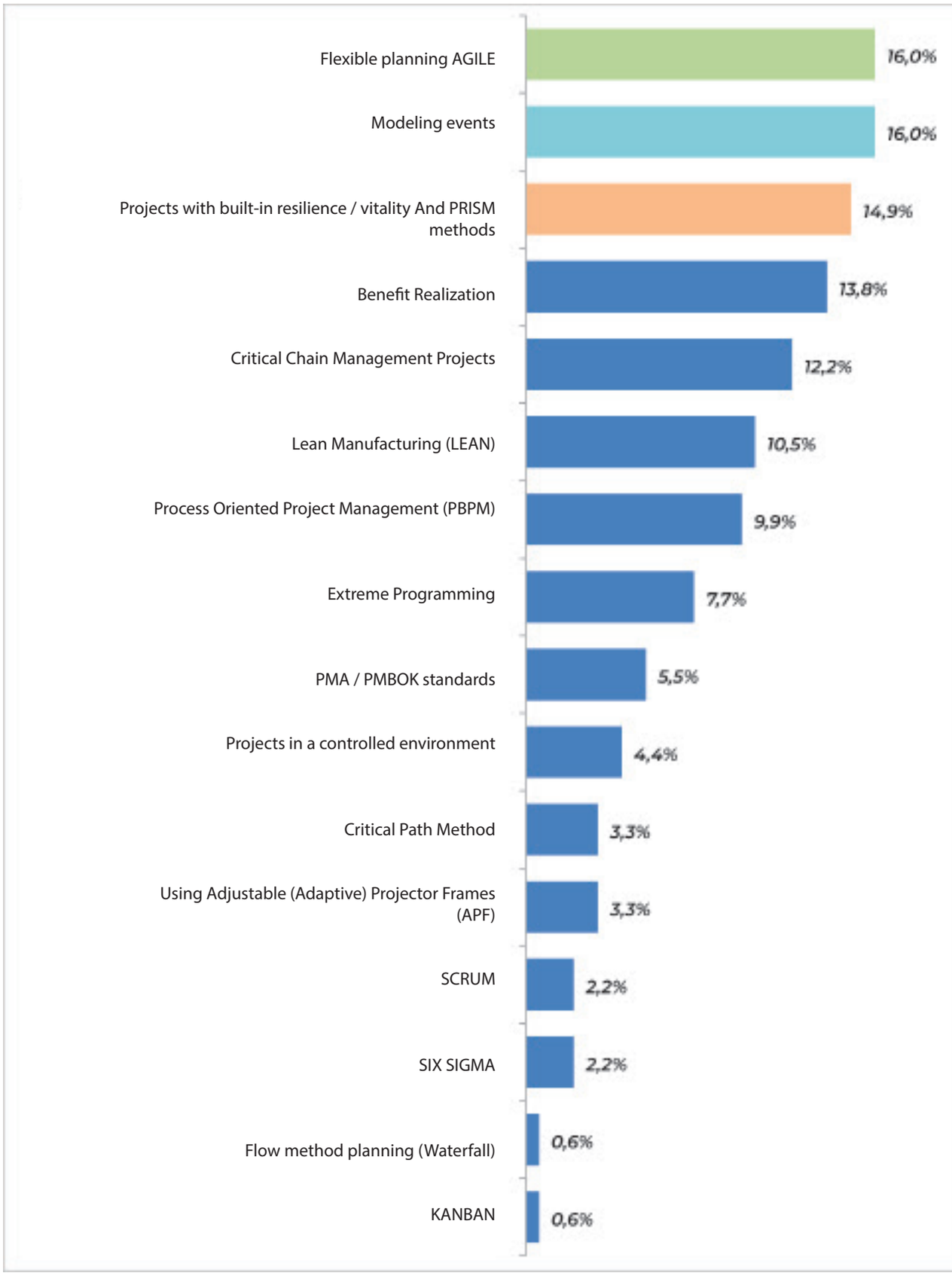
As we have already said, the value of project management for the construction industry is continuous. Each construction project is a certain amount of time, amount of work and resources. But as we know, construction projects are almost always accompanied by uncertainty, errors, prolongations, and budget overruns. It is quite expected that experts in the construction industry attach great importance to the «agile Planning agile» competence, because the Agile approach allows you to quickly adapt to changes.
We have already mentioned that a construction project is almost always accompanied by uncertainty. This factor is always present and must be taken into account when planning the entire project. Traditional planning methods (for example, the critical-path method) cannot fully take into account the uncertainty factor, since they are deterministic in nature.

Common and familiar planning methods involve using only one variable to estimate the amount of time required to complete any type of work on a project, or even the entire project. Therefore, an event Chain Methodology was developed to model risks and uncertainties. The ideas of the new time (for example, «corporate social responsibility») that came with the Fourth industrial revolution were also reflected in new project management methods (PRISM methods). Companies understand that using best practices in one area of business cannot compensate for the damage that has been done in another area of business. Therefore, the company that uses PRISM bears its part of responsibility for the observance of human rights, compliance with the labor code, respect for nature and the fight against corruption[62].

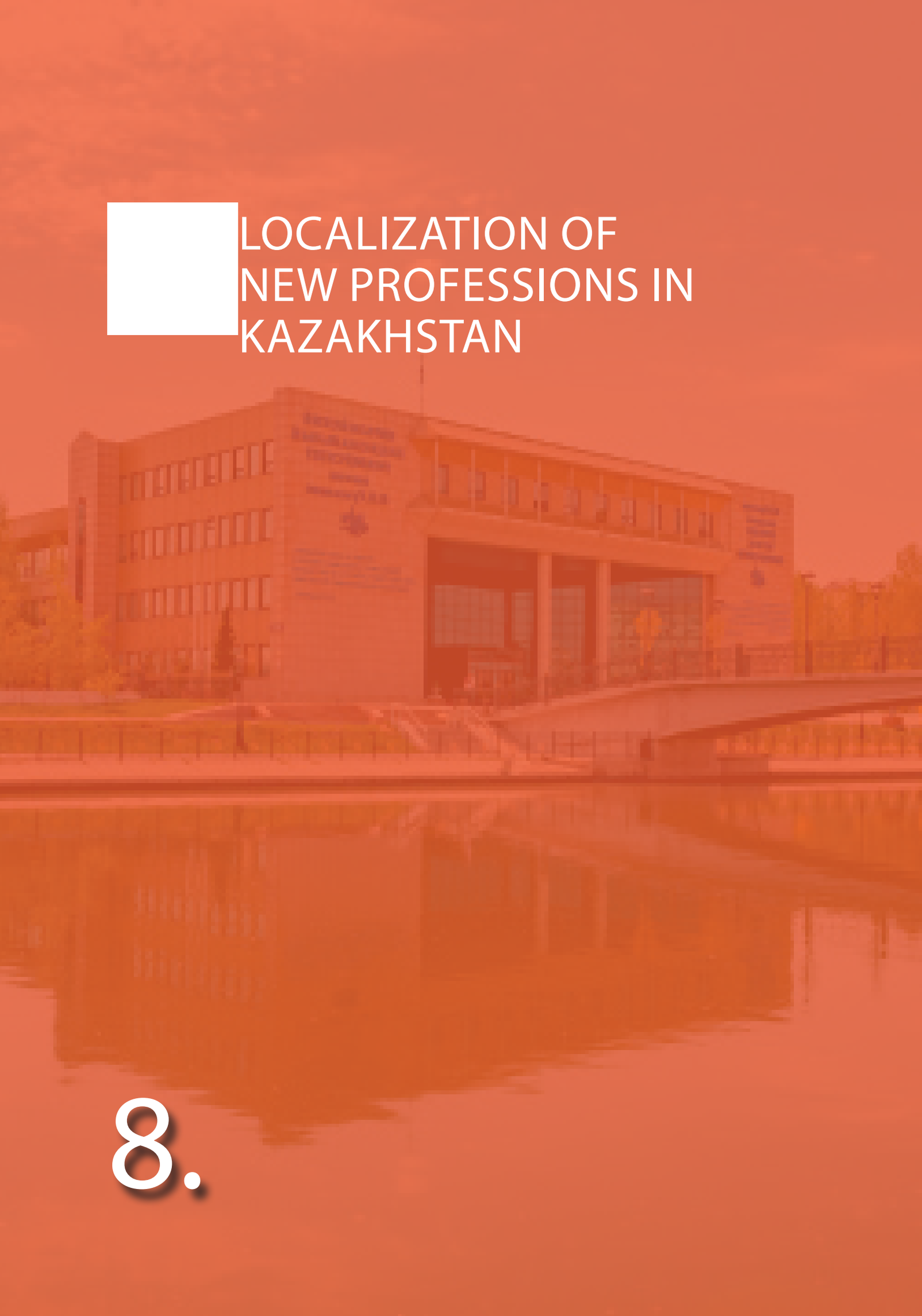
[61] Source: Pranam B, Madhusudan G Kalibhat, Sudharshan KR. 2014. A Comparison Study Between Event Chain Methodology And Critical Path Method In The Construction Industry
[62] Source: https://greenprojectmanagement.org/prism-methodology

Chart 7.5.

PROJECT MANAGEMENT competencies that are in demand in the construction industry in 10-15 years



8. LOCALIZATION OF NEW PROFESSIONS IN KAZAKHSTAN



LOCALIZATION OF NEW PROFESSIONS IN KAZAKHSTAN

The next stage in the development and implementation of the Atlas of new professions in Kazakhstan is the localization of new professions (professions of the future) in the construction industry of Kazakhstan, which were developed and proposed by leading experts in this industry.

Table 8.1.

Rating of universities for localization of new professions in the construction industry of the Republic of Kazakhstan.*

	Univercities	Ranking	Number of new professions
1	International educational corporation	3.47	9
2	Gumilyov Eurasian National University	3.46	16
3	Pavlodar State University named after S. Toraigyrov	3.44	13
4	Goncharov Kazakh Automobile and Highway Academy	3.39	2
5	Ekibastuz Engineering and Technical Institute named after Academician K. Satpayev	3.20	5
6	Atyrau Engineering and Humanitarian Institute	3.16	3
7	North Kazakhstan State University named after M. Kozybayev	3.06	9
8	Zhangir Khan West Kazakhstan Agrarian Technical University	3.02	5
9	Atyrau University of Oil and Gas named after S. Utebayev	2.97	6
10	Auezov South Kazakhstan State University	2.96	14
11	Kazakh University of Ways of Communication	2.954	4
12	Karaganda State University	2.953	8
13	Rudny Industrial Institute	2.943	3
14	Central Asian University	2.942	7
15	Aktobe Regional State University named after K. Zhubanov	2.92	3
16	West Kazakhstan Innovation and Technological University	2.91	3

*SOURCE university rankings[63]

[63] https://atameken.kz/uploads/content/files/%D0%A1%D1%82%D1%80%D0%BE%D0%B8%D1%82%D0%B5%D0%BB%D1%8C%D1%81%D1%82%D0%B2%D0%BE(3).pdf

Table 8.2 shows 17 new professions in the construction industry, as well as educational specializations, on the basis of which it is possible to expand the localization of new professions.

Localization of new professions is an event aimed at developing educational and methodological materials and special training practices for teaching knowledge, skills and competencies for new tasks of the industry.

Table 8.2.

The liver of the faculties necessary for the localization of new professions in the construction industry of the Republic of Kazakhstan.

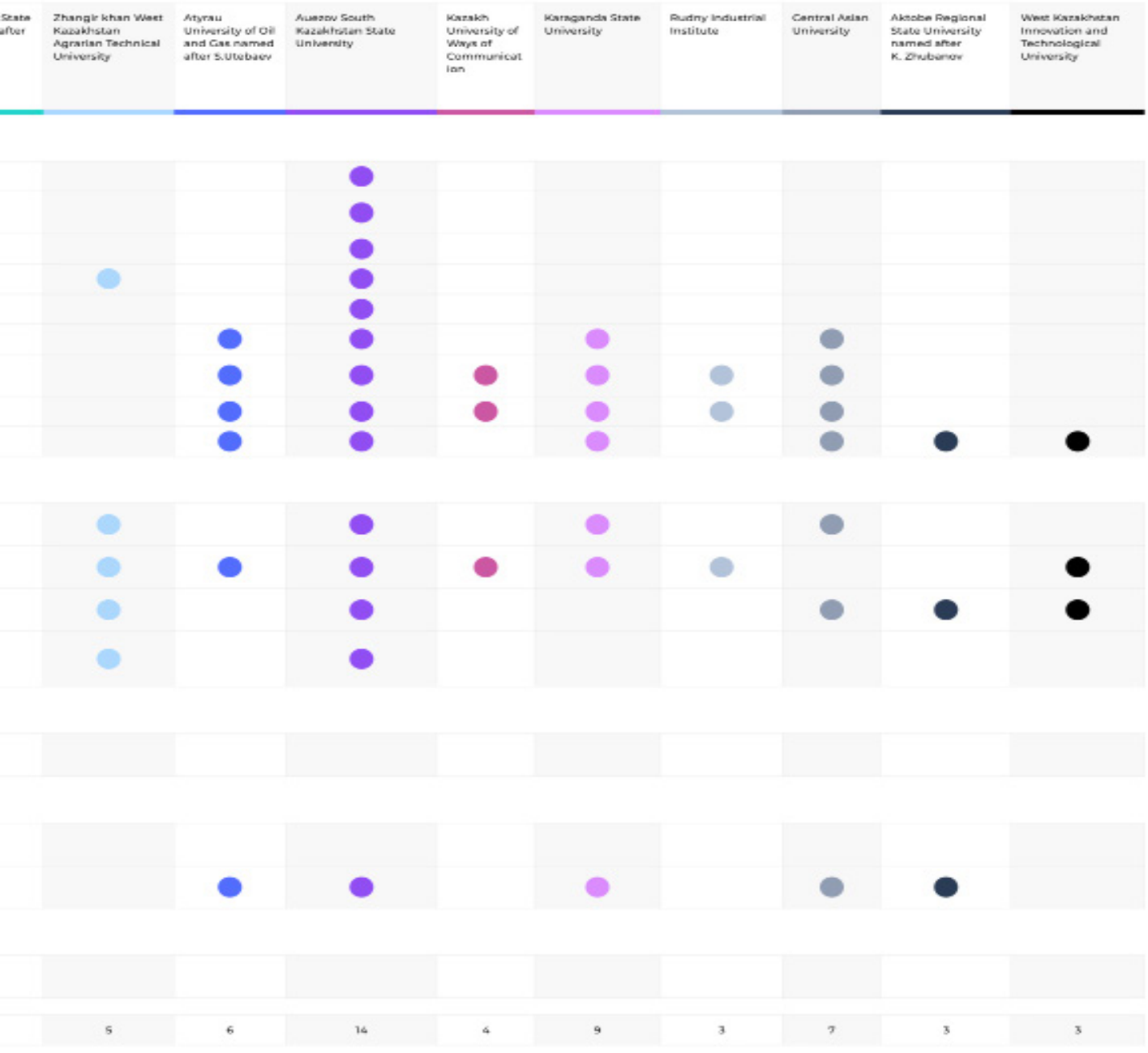
	Profession	The list of faculties and departments necessary for the localization of new professions in the industry
1	«DIGITAL»	
1.1	Digital designer (BIM specialist)	5B072900-Construction 5B042000-Architecture 5B075200-Engineering systems and networks
1.2	A designer skilled in generative design	5B072900–Construction 5B042000-Architecture 5B075200-Engineering systems and networks 5B070400-Computer equipment and software
1.3	Virtual designer	5B072900–Construction 5B042000-Architecture 5B075200-Engineering systems and networks 5B070400-Computer equipment and software
1.4	Smart Home designer	5B072900–Construction 5B042000-Architecture 5B075200-Engineering systems and networks 5B073100-Life safety and environmental protection, 5B070300-Information Systems 5B070400-Computer equipment and software

	Profession	The list of faculties and departments necessary for the localization of new professions in the industry
1.5	Foreman with BIM skill	5B072900-Construction 5B042000-Architecture 5B075200-Engineering systems and networks 5B070300-Information Systems
1.6	UAV Dispatcher	5B070300-Information Systems 5B070200-Automation and control
1.7	Construction robot / robotics operator	101204-Flexible automatic lines (specialty is at the Department of Robotics and Mechatronics) 5B070200-Automation and Control 5B072900-Construction 5B070400-Computer equipment and software
1.8	Robotics technician	101204-Flexible automatic lines (specialty is at the Department of Robotics and Mechatronics) 5B070200-Automation and Control 5B072900-Construction
1.9	Big Data analyst in construction	5B072900-Construction 5B070400-Computer equipment and software
2	«Environmental» professions	
2.1	Sustainability Specialist	5B060800-Ecology 5B073200-Standardization and certification 5B072900-Construction
2.2	Energy Saving Technologies Engineer	5B071800-Electric power industry 5B072400-Technological machines and equipment (by industry) 5B072900-Construction
2.3	Process engineer for the processing of construction waste	5B072900-Construction 5B060800-Ecology

	Profession	The list of faculties and departments necessary for the localization of new professions in the industry
2.4	Process engineer for the development of environmentally friendly building materials	5B072400-Technological machines and equipment (by industry) 5B072900-Construction 5B060800-Ecology 6M073000-Production of building materials, products and structures 6M074000-Nanomaterials and nanotechnologies (by application areas)
3	«Innovations»	
3.1	Construction Innovation Management	6M074000-Nanomaterials and nanotechnologies (by application areas) 5B072900-Construction 5B073000-Production of building materials, products and structures
4	«Roads»	
4.1	Recycled plastic road construction technologist	5B072900-Construction 5B073000-Production of building materials, products and structures, 6M074000-Nanomaterials and nanotechnologies (by application areas)
4.2	Smart road design specialist	5B072900-Construction 5B070400-Computer equipment and software
5	«Renovation»	
5.1	Construction renovation specialist	5B072900-Construction, 5B073000-Production of building materials, products and structures, 6M074000-Nanomaterials and nanotechnologies (by application areas)

TABLE 8.3.
LOCALIZATION OF PROFESSIONS OF THE FUTURE OF THE CONSTRUCTION INDUSTRY IN THE UNIVERSITIES OF THE REPUBLIC OF KAZAKHSTAN (UNIVERSITY NO. 1-16)

№	Name of profession	International Education Corporation	Gumilyov Eurasian National University	Pavlodar State University named after S.Toraigyrov	Goncharov Kazakh Automobile and Highway Academy	Ekibastuz Engineering and Technical Institute named after Academician K.Satpaev	Atyrau Engineering and Humanitarian Institute	North Kazakhstan University named M.Kozybayev
Direction "Digital"								
01	Digital designer (BIM specialist)	●	●					●
02	A designer skilled in generative design	●	●					●
03	Virtual designer	●	●					●
04	Smart home designer	●		●				
05	Foreman with BIM skills	●	●	●			●	●
06	UAV Dispatcher		●	●		●		
07	Construction robot/robotics operator	●	●	●		●	●	
08	Robotics technician		●	●		●	●	
09	Big Data analyst in construction	●	●	●				●
Direction ""Environmental" Professions"								
01	Sustainable Specialist		●	●				●
02	Energy saving technologies engineer		●	●		●		●
03	Process engineer for the processing of construction waste		●	●				●
04	Process engineer for the development of environmentally friendly building materials		●	●				
Direction "Innovation"								
01	Construction Innovation Management		●					
Direction "Roads"								
01	Recycled plastic road construction technologist		●		●			
02	Smart road design specialist	●	●	●	●	●		●
Direction "Renovation"								
01	Construction Renovation Specialist	●	●					
	Total:	9	17	13	2	5	3	9


State after
Zhangir khan West Kazakhstan Agrarian Technical University
Atyrau University of Oil and Gas named after S.Utebaev
Auezov South Kazakhstan State University
Kazakh University of Ways of Communication
Karaganda State University
Rudny Industrial Institute
Central Asian University
Aktobe Regional State University named after K. Zhubanov
West Kazakhstan Innovation and Technological University
5
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3

9. CONCLUSION

CONCLUSION

Строительная отрасль Казахстана неразрывно связана как с экономической жизнью всей страны, так и с жизнью каждого человека в республике. Дома и административные здания, дороги и плотины, линии электропередач и многое другое – все, что делает возможным работу экономики и жизнь людей – все это строительство. Важность отрасли трудно переоценить.

The construction industry of Kazakhstan is inextricably linked with the economic life of the entire country, as well as with the life of every person in the Republic. Houses and administrative buildings, roads and dams, power lines and much more – everything that makes possible the work of the economy and the lives of people-all this is construction. The importance of the industry cannot be overstated.Now the industry is a workplace for more than half a million Kazakhstanis. The success of the industry is the success of the entire economy of the Republic and the provision of housing for every citizen of Kazakhstan.

Expert surveys and discussions at foresight sessions clearly showed that the industry has a clear understanding of the forces that are changing the construction industry now and will reshape the industry in the near future.

First of all, the current state of the construction industry is determined by the two most important trends - the need to increase the profitability of the industry and staffing. In addition, the industry is affected by the need for greening production.

In response to the destructive pressure of trends, another one is unfolding - digitalization and a growing demand for technological renewal of the industry.

Speaking about the digitalization of the industry, first of all, we mean the use of building information modeling technologies, including AR/ VR technologies, blockchain, construction robotics and additive

technologies (3D printing).

The listed digital technologies, with initial large investments, allow to increase the profitability of production, reduce labor intensity, eliminate corruption, accurately assess the financial and material costs and time of the project, reduce the dominant prolongation of the project, etc. Of course, digitalization and robotization of the industry will be based on these two pillars – digitization and automation of engineering survey and design stages, as well as construction and installation work.

The problem of increasing economic returns will not remain in the focus of attention of Kazakhstan's construction companies. The industry will either cope or go into final decline (but this is unlikely to happen). Sooner or later, the issue of increasing the greening of production in the construction industry will become acute.

Kazakhstan is already taking the first steps towards «green building» (certification according to green standards LEED and BREEAM). Despite the fact that the share of « green buildings «is still very small, but in the conditions of increasing maintenance costs (for example, rising electricity tariffs), some elements of» green construction « will begin to be actively implemented - for example, energy efficiency technologies.

Local construction materials production will adopt new products and develop its own environmentally friendly materials that are produced without the use of toxic components and do not require a huge amount of energy during production. Construction waste recycling is being started. Over time, construction companies will come to realize that the relative high wages they can offer their employees will not attract the next generation of specialists and z in the industry. They have grown up with new technologies and are not inclined to return to the twentieth century, even for the opportunity to earn money. Therefore, the workplace of any employee throughout the entire technological chain will have to be equipped with the tools of «smart» technologies as much as possible. This is especially important at the stage of construction and installation work. After all, the quality of work on this cutting determines the profitability of the entire project as a whole.

The recruitment process will start at the stage of training in higher and secondary specialized educational institutions. The training programs and methods will be developed in close cooperation with the business environment of the construction industry. The effectiveness of dual education will increase significantly. Immersive virtual reality(VR), 3D gaming virtual reality, and augmented reality (VR//AR) will be the tools for teaching students in construction jobs.

The final chord of the work with the expert community was the list of new professions that will appear in the future 10-15 years in the domestic construction industry. Seventeen new professions will be at the heart of the industry's changes. Everything will, as expected, develop around «numbers», «ecology», «innovations»and « renovations».

ALL THE ACCUMULATED INFORMATION SERVES AS A GUIDE FOR PEOPLE WHO WILL WORK IN THE CONSTRUCTION INDUSTRY OR ARE ALREADY PART OF THE INDUSTRY, IN ORDER TO CLEARLY UNDERSTAND WHAT IS WAITING FOR EVERYONE BEHIND THE IMMINENT TECHNOLOGICAL GATE AND HOW TO PREPARE FOR THIS MEETING.

10. THE RESEARCH TEAM OF THE PROJECT

THE RESEARCH TEAM OF THE PROJECT

*Members of the research team that performed work within the framework of the project «Atlas of new professions and competencies of the construction industry of the Republic of Kazakhstan»

1. Madenov Baurzhan Eserkegenovich	Head of project team
2. Kurganbaev Erdos Turamuratovich	Deputy head of project team
3. Suini Dzhon A.	International expert
4. Imanberdiev Rasulzhan	International expert
5. Abuov Bauyrzhan	National expert
6. Ajtmagambetov CHingiz Rashidovich	National expert
7. Matchanov Erzhan	National expert
8. Ajsautov Askar Sadykovich	National expert
9. Abdykaparov Baurzhan	National expert
10. Syzdykov Teleutaj Usenovich	National expert
11. Sabitova Al'mira Sabitovna	National expert
12. Tumeshbaev Amirhan Keneskhanovich	National expert
13. Shajmerdenova Sabina	National expert
14. Shortan Sayat SHortanuly	National expert
15. Burabaev Altaj Kudajbergenovich	National expert
16. Baurzhan Abubakirov	National expert
17. Sagnaeva Ajnur	National expert
18. Malikova Makpal Tattinbekovna	Junior consultant
19. Tajmagambetova Mahabat Bauyrzhanovna	Junior consultant
20. Kaldybekov Suindik Usenovich	Junior consultant

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1. Abugali Serzhan
2. Akanov Elik
3. Akylov Aknazar
4. Aldiyarov ZHumadil
5. Amirbaev Erik
6. Ajtbaev Koblanbek
7. Ajdarbekov Esenbek
8. Akazhanov El'dar
9. Alpysbaev Melik
10. Anastasov Ivan
11. Aspanbetov Daulet
12. Berdashev Baurzhan
13. Borisov Vladimir
14. Bisarova Myuash
15. Vonda Ol'ga
16. Daurenbek Kanat
17. Doskenov Talgat
18. Dosaev Nurzhan
19. Dyusembaev Izim
20. Ereshchenko Olesya
21. ZHanabaev Turmahan
22. ZHanshuakova Raushan
23. ZHarylgapov Sabit
24. ZHolshybaj Asemkul
25. Zaitova Svetlana
26. Igenbaev ZHanserik
27. Il'yasov Serik
28. Kabzhan Zarina
29. Kaltaeva Fatima
30. Kan Liliya
31. Kapakova ZHemis
32. Kartbaj Agataj
33. Kenzhebaev Nurlan
34. Kosenko Irina
35. Kubegenov Kural
36. Kulmanov Kalizhan
37. Kumarov Nurzhan
38. Magambetova Nadiya
39. Mukanova Ajgerim
40. Murtaza ZHanbolat
41. Omarbekov Talant
42. Omarova Dina
43. Orazbaev Rahmanali
44. Ospanov Alpamys
45. Ojshibaev Erkinbek
46. Parahin Oleg
47. Sadvakasov Dzhanybek
48. Sakanov Darhan
49. Sapargaliev Hisameden
50. Sauranbaev Eraly
51. Serzhanov Nurshat
52. Stanevich Viktor
53. Sulejmenov Ermek
54. Syzdykov Kajrat
55. Tazhkeeva Asel'
56. Turgunbaev Medet
57. Tyan Olesya
58. Umarova Gulzhamal
59. Usenkulov ZHenisbek
60. Hasanaeva Assol'
61. SHahnovich Aleksandr
62. SHirokova Mariya
63. SHin Elena

INDUSTRY EXPERTS REPRESENTED THE FOLLOWING COMPANIES:

National Association of the construction industry of the Republic of Kazakhstan «

Union of builders of the Republic of Kazakhstan and Central Asia»

ALE «national Association of designers of Kazakhstan»

ALE «Association Insured - payers of Kazakhstan»

RAUL «Association of Builders of Kazakhstan»

OO «Union of Construction Industry of Kazakhstan»

ULE «Union of engineering companies of the Republic of Kazakhstan»

SRO ULE «Union of Kazakhstan Optovikov»

«Atameken»

SRO ULE «Kazakhstan the registry»

RSE «Gosexpertiza»

Committee for construction and housing and communal services Ministry of industry and infrastructure development of the Republic of Kazakhstan

RSE na PHV «Republican center for state urban planning and cadastre «

RSE «national center for quality of road assets «

NAO «State Corporation» Government for citizens « Department of land cadastre

NAO « state Corporation «Government for citizens» real estate Department

Akimat of Pavlodar

West Kazakhstan agrarian and technical University named after After Zhangir Khan

Kazakh head architecture and construction Academy

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Kazakh automobile and road Academy named after L. B. Goncharov

Kokshetau state University named after sh. Ualikhanov

S. Toraighyrov Pavlodar state University

South Kazakhstan state University named After M. Auezov

Kazakh research and design Institute of construction and architecture JSC

Kazakhstan road research Institute JSC

Amir Zhoba LLP»

At&M LLP

RenSer Technologies LLP»

Roots Architecture & Design LLP

SKTL LLP

Academy of engineering services LLP»

LLP «Almatygorsvet»

LLP «Doris»

Kazgiproneftetrans Engineering Company LLP

Kausar Zhoba LLP

Kurylys Company LLP Komek «

«Kyzyl Shyn» LLP

«research Institute» Almatygenplan « LLP

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