Ministry of Science and Higher Education of the Republic of Kazakhstan

Al-Farabi Kazakh National University

UDC 005.342:004(574)(043)

On the rights of the manuscript

SEITKAN GALIYA GAZIZKYZY

Features and Mechanisms of Managing The Formation of Digital Hubs in Kazakhstan

Specialty: 8D04105 – Innovation Management

Thesis for the degree of
Doctor of Philosophy (PhD)

Scientific advisers
PhD,
Bekturganova M. S.

Dr., Professor
Muazzam Ali Khan Khattak

Republic of Kazakhstan
Almaty, 2025

CONTENTS

NORMATIVE REFERENCES……. 4
DEFINITIONS…… 5
DESIGNATIONS AND ABBREVIATIONS…… 6
INTRODUCTION…… 8
1 FOUNDATION OF DIGITAL HUB DEVELOPMENT: THEORY, MANAGEMENT, AND METHODOLOGY…… 14
1.1 Evolution and economic essence of digital hubs…… 14
1.2 Digital hub establishment management……... 19
1.3 Foreign experience in managing the establishment of digital hubs……. 34
1.4 Methodological basics of establishment the digital hubs and the author's digital maturity assessment model……. 45
2 ANALYSIS OF THE CURRENT DEVELOPMENT OF DIGITAL HUBS IN KAZAKHSTAN…… 57
2.1 Analysing digital potential in the regions and industries of Kazakhstan…. 57
2.2 Assessment of digital hubs in the regions of Kazakhstan…… 74
2.3 Problems of digital hub management in Kazakhstan……... 91
3 PRIORITY DIRECTIONS FOR IMPROVING THE MANAGEMENT OF DIGITAL HUBS ESTABLISHMENT……... 97
3.1 Recommendations and mechanisms for managing the establishment of digital hubs in Kazakhstan……. 97
3.2 D-BEST model, scale and criteria for managing the establishment of digital hubs in Kazakhstan……. 107
CONCLUSION…….. 114
REFERENCES…….. 117
APPENDIX A - Reference on the application of the thesis materials (act on the implementation of practical results)……..... 131
APPENDIX B - Reference on the application of the thesis materials (application notes)…….. 132
APPENDIX C - Reference on the application of the thesis materials (dynamic tables of indicators)…… 133
APPENDIX D - Reference on the application of the thesis materials (dynamic tables of indicators)…… 134
APPENDIX E - Reference on the application of the thesis materials (dynamic tables of indicators)…… 135
APPENDIX F - Reference on the application of the thesis materials (dynamic tables of indicators)…… 138
APPENDIX G - Reference on the application of the thesis materials (dynamic tables of indicators)…… 140
APPENDIX H - Reference on the application of the thesis materials (dynamic tables of indicators)…… 141
APPENDIX I - Reference on the application of the thesis materials (dynamic tables of indicators)…… 152
APPENDIX J - Reference on the application of the thesis materials (dynamic

tables of indicators)…….... 154
APPENDIX K - Reference on the application of the thesis materials (dynamic tables of indicators)…… 156
APPENDIX L - Reference on the application of the thesis materials (dynamic tables of indicators)…… 158
APPENDIX M - Reference on the application of the thesis materials (dynamic tables of indicators)……. 159
APPENDIX N - Reference on the application of the thesis materials (dynamic tables of indicators)…… 160
APPENDIX O - Reference on the application of the thesis materials (dynamic tables of indicators)…… 161
APPENDIX P - Reference on the application of the thesis materials (dynamic tables of indicators)…… 163
APPENDIX Q - Reference on the application of the thesis materials (dynamic tables of indicators)…… 165
APPENDIX R - Reference on the application of the thesis materials (dynamic tables of indicators)…… 168
APPENDIX S - Reference on the application of the thesis materials (dynamic tables of indicators)…… 170
APPENDIX T - Reference on the application of the thesis materials (dynamic tables of indicators)……..... 186
APPENDIX U - Reference on the application of the thesis materials (dynamic tables of indicators)…… 204
APPENDIX V - Reference on the application of the thesis materials (dynamic tables of indicators)…… 214
APPENDIX W - Reference on the application of the thesis materials (ethical approval)…… 215

NORMATIVE REFERENCES

The following standards have been referenced in this thesis:

1. Message of the Head of State Kassym-Jomart Tokayev to the nation of Kazakhstan “Unity of the nation and systemic reforms - a strong basis for the prosperity of the country”, September 1, 2021.

2. On approval of the Concept of digital transformation, development of information and communication technologies industry and cyber security for 2023 - 2029 years. Resolution of the Government of the Republic of Kazakhstan dated 28 March 2023 No. 269.

3. State Program “Digital Kazakhstan”. Resolution of the Government of the Republic of Kazakhstan dated 12 December 2017 No. 827.

DEFINITIONS

The following definitions apply in this thesis study:

Digital hubs – an ecosystem, a space that represents a hub for innovation and digitalization through the provision of a portfolio of services for local organizations such as universities, research institutes, medium and small enterprises, and digitally-enabled businesses, state and local government, with the purpose to boost its digitalization by solving its problem.

Digital technologies – a set of tools and methods including software, computing devices, telecommunication and network systems for digital processing, transmission and storage of information. The main components of digital technologies are virtual reality, blockchain, 3D printing, big data, cloud computing, internet of things, machine learning.

Digital transformation – a strategic planning process involving the application and use of digital technologies in organizations to change its operations, mechanisms and business models.

Digitalization – the process of digitising data into a digital format.

Innovation ecosystem – a dynamic and complex network of interactions between actors, public organizations, research institutions, incubators, venture capital funds, and other stakeholders, facilitating the commercialization, diffusion and creation of innovations.

Management – a set of means, methods, forms and principles of management to achieve the set goals and strategic objectives and maximise productivity, including processes of control, planning, motivation and organization of information, material, human and financial resources.

Management mechanisms – a set of means and methods of the management system, for purposeful impact of movement on the management object to achieve the objectives of the organization.

DESIGNATIONS AND ABBREVIATIONS

AI	Artificial Intelligence
ARM	Advanced RISC Machines
ASI	Agency for Strategic Initiatives
BIM	Building Information Modelling
CGI	Computer-Generated Imagery
CIS	Commonwealth of Independent States
CRM	Customer Relationship Management
DC	District of Columbia
DEA	The Digital Economy Act
Dec	Digital Economy Country
DIH	Digital Innovation Hub
DOCSIS	Data Over Cable System Interface Specifications
DSL	Digital Subscriber Line technology
EDB	Economic Development Board
EDIH	European Digital Innovation Hub
EFPP	European Federation for Psychoanalytic Psychotherapy
EOSC	European Open Science Cloud
ERDF	European Regional Development Fond
ESIF	European Structural and Investment Funds
EU	European Union
FCFA	Franc CFA
FEZs	Free Economic Zone
Fintech	Financial Technology
FOCL	Fibre Optic Communication Line
GDP	Gross Domestic Product
GDS	Global Distribution System
GEF	Global Environment Facility
GEPP	Global Epidemic Prevention Platform
GPS	Global Positioning System
HLD	High-Level Design
IBM	International Business Machines
ICBC	International Center of Boundary Cooperation
ICC	International Chamber of Commerce
ICPS	International Center for Border Cooperation
ICT	Information and Communication Technologies
IDI	Industry Digitisation indicator
IoT	Internet of Things
IT	Information Technologies
ITU	International Telecommunication Union
JSC	Joint Stock Company
KIDF	Kazakhstan Investment Development Fund
KOVA	Korean Venture Association
KPI	Key Performance Indicator

KPMG	Klynveld Peat Marwick Goerdeler
LLP	Limited Liability Partnership
MCIT	Ministry of Communications and Information Technologies
MDIAP	Ministry of Digital Development, Innovation and Aerospace Industry
MIIT	Ministry of Industry and Information Technology
MNC	Multinational Corporation
MRR	Monthly Recurring Revenue
NDRC	National Development and Reform Commission
PCAST	President Council of Advisors on Technology and Science
PPP	Public-Private Partnerships
PTE Ltd	Private Limited
QQ	Quick Question
R&D	Research and Development
RK	Republic of Kazakhstan
ROA	Return on Assets
ROE	Return on Equity
ROK	The Republic of Korea
RTO	Research and Technology Organization
SCO	Shanghai Cooperation Organization
SEZ	Special Economic Zone
SME	Small and Medium-sized Enterprises
ST-KZ	KZ Standard
TAE	Transasia-Europe
TASIM	Trans-Eurasian Information Superhighway
TCFO	TransCaspian Fibre Optic
TNC	Transnational Corporation
UK	United Kingdom
UNDP	United Nations Development Program
UNEP	UN Environment Program
USA	United States of America
USAID	United States Agency for International Development
XaaS	Anything as a service

INTRODUCTION

General characterisation of the work. The dissertation research is devoted to the study of the management of the establishment of digital hubs, its features and mechanisms in Kazakhstan.

Relevance of the topic of research. Digitalization and its main processes have touched many aspects of life, including social and economic aspects. Today in many countries, including Kazakhstan, there is an emphasis on digital technology. Kazakhstan is assessed as medium in its digitalization level, and has opportunities to increase its level and enhance its competitiveness at the global level. This requires the adoption of comprehensive approaches to establish processes, implement measurements, and define directions in order to produce focused regulations, implement state programs, and create national growth strategies to successfully accomplish the desired goals. Since 2017, the program "Digital Kazakhstan" was implemented for 2018-2022, which aimed to accelerate the development of the country's economy and improve the living standards of the population through the use of technological innovations in the near future [1]. Additionally, the program sought to establish favourable circumstances for transitioning the economy of country towards a completely new growth path, ultimately resulting in the establishment of a futuristic digital economy in the long run. Currently, the portal e-government was functioninal throughout the country. The president of the country emphasized in the message to the nation from 1st September, 2021 that Kazakhstan must become a digitl hub [2]. Since then, the Concept of digital transformation, development of information and communication technologies industry and cyber security for 2023 - 2029 years was accepted [3].

Exactly in order to make the interaction between citizens and the state comfortable, simple, accessible and understandable the concept of e-government was developed. It is vital to establish digital conditions and factors that include: strengthening of the role of information and communication services in the world market and support of domestic enterprises and companies engaged in production and export of information services to improve the competitiveness of the information industry and economic modernization of our country. Also, a crucial element in digital development of the state are the issues of teaching people digital skills, access to the Internet, the availability of devices and equipment for connecting to the Internet and others. World practice has shown that successfully functioning digital hubs are actively developed and managed in an economy built in an environment of innovative receptivity and continuously developing innovative production. Involved stakeholder cooperation in digital or technology hubs promotes innovation and competitiveness.

Degree of elaboration of research topic. The works of following authors indicate about scientific interest in the questions of management of the establishment of digital hubs, Kireyeva A. [4], Ashmore F. [5], Price L. [5], Deville J. [5], Atiase V. [6], Kolade O. [6], Liedong T. [6], Casorati A. [7], Verbeek A. [7], Littlewood, D. [8], Kiyumbu W. [8], Rundel C. [9], Salemink K. [9], Strijker D. [9], Sassanelli C. [10], Panetto H. [10], Terzi S. [10], Doumeingts, G. [10], Ujwary-Gil, A. [11], Florek-Paszkowska, A. [11], Virkkunen R. [12], Still, K. [12], Rosso, L. [12], Lanz, M. [13], Latokartano J. [13], Pieters R. [13], Dyba, M. [14], Dyba, O. [14], Oliynyk,

A. [14], Gernego, I. [14], Georgescu, A. [15], Tudose, M. [15], Avasilcăi, S. [15], Hervas-Oliver J. [16], Gonzalez-Alcaide, G. [16], Rojas-Alvarado, R. [16], Monto-Mompo, S. [16], Kalpaka, A. [17], Sörvik, J. [17], Tasigiorgou, A. [17], Rissola, G. [18], Gavkalova N. [19], Gladysz B. [19], Quadrini W. [19], Asplund F. [19], Ramli, M. [19], Detzner P. [19], Deville J. [19], Dragic M. [19], van Erp T. [19], Price L. [19], Robertsone, G. [19], Terzi, S. [19].

The research of these authors contributes to the creation of particular theoretical basis of this research. However, there are questions left for the constant discussion, in particular management of the establishment of digital hub.

Till present, the level of research of this field is critically low. That is why the subject is needed for further research development with the orientation on the search of new ways, methods and mechanisms of the establishment of digital hubs.

These obstacles defined the choice of theme, its purpose and tasks of the thesis research.

The purpose and tasks of research. The purpose of this thesis research is to determine the theoretical and methodological basis and provide tangible suggestions for enhancing management of the establishment of digital hubs in regions of the Republic of Kazakhstan.

According to the purpose of the research, the following tasks were addressed:

-to investigate the concepts and models of digital hub creation by systematising theoretical perspectives;

-to consider global experience in regulating the management of the advancement of digital hubs, taking into account adaptation to the conditions of Kazakhstan;

-to substantiate the methodological basis for the creation of digital hubs;

-to assess the current state of digital hubs located in Kazakhstan;

-to analyse the digital potential of regions of Kazakhstan;

-to identify the problems of established digital hubs;

-to provide mechanisms of management and fundamental directions for the establishment of digital hubs;

-to propose model pillars, criteria, and scale for management of the growth and establishment of digital hubs in Kazakhstan.

The object of research. The object of study is the established digital hubs in Kazakhstan, including their functionality and influence on the evolution of digital infrastructure and the regional economy.

The subject of research. The subject of the study is management of relationships in the process of formation, development, and integration of digital hubs in the country's regions, including their role in increasing the level of digitalization and economic growth.

Theoretical and methodological base of research. The theoretical and methodological basis of the research consists of the conceptual foundations of digital hub establishment management, research of foreign and domestic scientists on the issues of digital hub management.

The dissertation research was carried out on the basis of system and structural approach with the use of the following quantitative and qualitative methods: generalisation, systematisation, comparison, historical and logical - to study the economic es-

sence of the concept of management of digital hubs establishment (paragraph 1.1, 1.2), analysis of foreign experience of digital hubs establishment (paragraph 1.3), research methodology (paragraph 1.4); statistical analysis, calculation of economic efficiency of Astana-hub (paragraph 2.1, 2.2); correlation-regression analysis to assess the impact of ICT costs on digital hub members, test (paragraph 2.2) method of integral index to identify the uniformity of indicator values across regions (paragraph 2.2); identifying existing problems and conducting a survey among undergraduate students to assess the percentage of future specialists in ICT and digitalization (paragraph 2.3); proposing recommendations and mechanisms for managing the creation of digital hubs in the regions (paragraph 3.1); proposing a methodology for evaluating the performance of digital hubs on a five-point scale and criteria and proposing the D-Best model (3.2).

SMART PLS-4 program was used to process statistical data for correlation and regression analysis, in particular to calculate the correlation matrix and descriptive statistics, Microsoft Excel program was used to calculate the integral and average integral index of regions, using the Z-score normalization of data values.

Information base of the research. The information base of the dissertation research was primary and secondary data.

Sources of primary data: case study of the stage hubs, questionnaire survey of bachelor's degree graduates. Sources of secondary data: statistical data of the Bureau of National Statistics of the Agency for Strategic Planning and Reforms of the Republic of Kazakhstan, analytical reports of the Ministry of the Republic of Kazakhstan, financial reports of Astana-hub, dissertations of foreign and Kazakhstani scientists, international scientific databases DOAJ, Scopus, Academia, Sci-Hub.

Scientific novelty. In the course of the thesis research the following scientific results defining its scientific novelty were obtained:

1) The author's vision of the concept of ‘digital hub’ from the point of view of innovation management is shown and substantiated;

2) The impact of ICT expenditures on various indicators related to the establishment of digital hubs was thoroughly analyzed. The findings indicate that while ICT expenditures do not significantly affect the level of innovation activity of enterprises and the number of universities, they do have a substantial impact on the number of research organizations, as well as the number of active small and medium-sized enterprises and enterprises overall;

3) The digital potential of the regions of the Republic of Kazakhstan for the establishment of digital hubs in these regions has been assessed;

4) Management mechanisms for the establishment of digital hubs in Kazakhstan are proposed: structural and technological, innovation, investment, institutional and social;

5) Based on the results of the survey conducted on the management of digital hub establishment, an estimated percentage of graduates intending to pursue careers in the field of digitalization was determined;

6) The current status of digital hubs activities is analysed;

7) The main elements of the model of management of the establishment of digital hubs in Kazakhstan are proposed;

8) Recommendations for improving the management of the establishment of digital hubs in Kazakhstan were developed.

The main scientific provisions for defense:

1) The concept of a digital hub is defined as a center that drives activities focused on the implementation of the "triple helix" model, which encompasses the collaboration between government, academia, and business to foster innovations and startups through the application of digital technologies. Participants and partners of the digital hub include universities, R&D organizations, research institutes, laboratories, technoparks, incubators, accelerators, public administration entities, and other stakeholders. The concept is substantiated and presented as a critical component of the innovation ecosystem;

2) To determine the level of development of digital hub management, a methodology is proposed to evaluate the performance of digital hubs according to a scale and criteria calculated on five points. According to this methodology, the level of development of hubs is average;

3) The employment of the integral index in the study enables a thorough evaluation of Kazakhstan's regions' digital potential. This evaluation encompasses the multidimensionality of key indicators, including the utilization of digital technologies, the digital literacy of the population, and the contribution of ICT to the economy. The method employed provides an objective ranking of regions, reveals disparities in digital development, and substantiates strategic measures to eliminate digital inequality;

4) The following mechanisms have been scientifically substantiated and developed for the development of digital hubs: the structural and technological mechanism, the mechanism of innovation, the investment mechanism, the institutional mechanism, and the social mechanism;

5) An online platform is proposed in the form of a website with a map of the hubs located across the RoK, including digital and IT hubs.

Theoretical significance of the results of the study. The theoretical significance of the study lies in the addition and clarification of the concept of digital hub, the definition of functions and existing contradictions of management of the creation of digital hubs. The theoretical basis was formed by scientific works of domestic and foreign scientists, practitioners, devoted to the development and creation of digital hubs, the development of conditions and ICT-industry in the field of innovation management. Theoretical and methodological justification for the development of mechanisms and processes of management of the establishment of digital hubs, as well as the justification of recommendations for the implementation of mechanisms and directions to the development of digital hubs in Kazakhstan. The results obtained in the course of the dissertation research are important for the development of theoretical and methodological foundations for the study of digital hub establishment management. In the course of the research new knowledge about the methodology of evaluation of digital hubs establishment with the help of five-point scale and criteria has been obtained. The results of the dissertation research can become the basis for setting new research tasks.

Practical value of the results of the study. The practical significance of the study lies in the substantiation of recommendations for the development of mechanisms and directions in the management of the establishment of digital hubs in Kazakhstan. The thesis materials can be used in reading courses: "Innovation management", "Technology transfer and mechanisms of its regulation", "International technology transfer", "Features of digital economy management", "Commercialization of intellectual activity results", "Strategic innovation management" at universities of economic profile. Also, the practical significance of the study lies in the fact that the proposed mechanisms, directions and methodology for assessing the performance of digital hubs can be applied in the process of establishment of digital hubs in the Republic of Kazakhstan (Annex A).

Relation of this work with another research works. The dissertation research was carried out within the framework of the projects "Priorities and mechanisms of inclusive regional development of Kazakhstan in the context of overcoming economic recession" (grant of the Ministry of Education and Science of the Republic of Kazakhstan, AP09259004-OT-23, 2021-2023).), "Investigation of the influence of economic, social and environmental factors on the relationship between urbanization and greenhouse gas emissions", (grant of the Ministry of Education and Science of the Republic of Kazakhstan, AP19576071, 2023-2025), "Strategy for the development of regional potential of Kazakhstan: assessment of socio-cultural and economic potentials, development of roadmap, models and development scenarios" (grant of the Ministry of Education and Science of the Republic of Kazakhstan, BR18574240, 2022-2024).

Approbation of the research results. The main provisions of the dissertation were discussed at scientific and methodological seminars of the Higher School of Economics and Business of the Kazakh National University named after Al-Farabi.

The main results of the dissertation research were reported and presented at the international scientific conference of students and young scientists "Regional economy and vectors of demographic and socio-economic development" (Almaty, Kazakhstan); international scientific-practical conference "Economics and Management of the Emerging Market Innovation Space" (Moscow, Russia), "Paradigm of Sustainable Economic Development in the Context of Global Change: Challenges, Consequences, Opportunities" (Almaty, Kazakhstan); "Science: theory and practice" (Astana, Kazakhstan).

Publication of the research results. The main provisions and conclusions put forward for defense were reflected in 10 scientific papers, of which 1 was published in a journal with a non-zero impact factor and included in the international information resources Scopus and Web of science, 5 - in scientific editions recommended by the Committee for Quality Assurance in Education and Science of the Ministry of Education and Science of the Republic of Kazakhstan, and 4 reports in the proceedings of international scientific-practical conferences.

Structure and volume of the thesis. The structure of the thesis reflects the logic, the order of the research and the algorithm of solving the set tasks. The dissertation consists of the content, notations and abbreviations, introduction, three chap-

ters, conclusion, list of references and 21 appendixes. The volume of the dissertation research is 215 pages, including 17 tables, 35 figures, 4 formulas, 174 references.

1 FOUNDATION OF DIGITAL HUB DEVELOPMENT: THEORY, MANAGEMENT, AND METHODOLOGY

1.1 The evolution and economic essence of digital hubs

Digitalization became a factor in transforming organizational management and business models. As new forms of digital ecosystems emerged, the demand for new management instruments and concepts rose. As new forms of digital ecosystems emerged the demand on new management instruments and concepts rose.

Increasing the competitiveness of the national economy is one of the priority goals of the country's development of public administration. Innovations contribute to the development of competition and, in general, the national economy, as shown in countries such as the USA, Great Britain, Korea, Japan, and others. Innovations are developed in research institutes using the approbation of new ideas. Today, innovation management plays a vital role in the growth of the state economy, the GDP growth of the population, and the development of the population's welfare.

Cluster Zones

Cluster Zones are the prototype of innovation creation. Clusters are groups of organizations situated near one other, such as research institutes, universities, medium and small-sized firms, infrastructures, companies, and suppliers of relevant equipment and components. The purpose of these clusters is to enhance the competitiveness of both the cluster as a whole and the individual companies inside it. Indicators of characteristic features of clusters are 1) labor potential; 2) availability of suppliers close to the organizations; 3) skilled workforce; 4) available capital; 5) availability and access to services; 6) availability of equipment suppliers; 7) association structures; 8) availability and network formation; 9) entrepreneurial energy; 10) training, innovation; 11) leadership and collective vision [20]. The cluster structure is as follows: 1) trade associations – distribution companies; 2) industrial enterprises – scientific institutes – research and development centers; 3) service companies – customers – suppliers – manufacturers; 4) financial institutions – insurance organizations – marketing organizations.

The cluster provides an opportunity for dialogue between various institutions and public institutions, thus including strategic alliances of organizations with consumers, consultants, technology brokers, research institutes, and universities. M. Porter was the founder of the cluster concept. The author gave the following definition: "geographical concentration of interrelated companies, specialized suppliers, service providers of companies in related industries and relevant institutions (e.g., universities, standardization agencies and trade associations) in a certain area that compete and at the same time cooperate" [20]. However, the emergence of the cluster idea is attributed to 1970 and characterized by the works of the Spanish scientist Lasuen J.R. Porter counts three types of industries: non-market (local) industries, raw material and basic industries. Raw material industries are, in one way or another, oriented to external markets. Local industries serve only local needs (education, social services, real estate). Moreover, basic industries may or may not have representation in external markets. Strong competitive advantages are formed on the basis of core industries [20].

Free Economic Zones.

Free economic zones (FEZ) are those economic zones representing a particular area of the country, enjoying measures to stimulate startupstartups and businesses and also having preferential taxation [21]. FEZ is a geographically defined and limited space with several location-specific advantages [22]. In 1959, an industrial zone was established in Ireland. Export processing zones, the initial forms of FEZs, were created to promote exports and attract investments, primarily foreign. "Economic Zone 1.0" was the name given to this type of FEZ, which became famous in the following countries: Bangladesh, El Salvador, Dominican Republic, Taiwan, Mauritius, China, Korea, and Vietnam. The main objectives of Economic Zone 1.0 were favorable taxes and the attraction of investments.

Later, in a globally unstable world, free economic zones called "Economic Zone 2.0" appeared. These economic zones were multifunctional, large, and linked to local economic facilities. With the advent of Economic Zone 2.0, economic growth in Asian countries took place, leading to the beginning of market changes in economies. Next came Economic Zone 3.0, which combined the experiences of the previous two economic zones. They were called eco-industrial parks, which aimed to attract investment in the changing erade regulations and international policy growth [23]. Economic Zone 4.0 is a transformation of FEZs towards providing financial and trade services with high-added value. An example is the Shanghai Free Trade Zone (China, 2013). With the advent of the fourth industrial revolution, Economic Zones 5.0 have emerged. This zone is specified by the digitization of the zone and the services it provides, including registration, licensing, and integrated services. Automated customs service makes the operation of FEZs much easier. For instance, Malaysia launched its first digital free trade zone in 2017 in collaboration with Alibaba, Maybank, and other corporations so that SMEs could enter the e-commerce market through the business environment [24].

This paragraph delineates five sequential phases in the evolution of free economic zones (FEZs) concerning their functions, integration with the local economy, and the escalating complexity of activities. Each stage represents the evolution of free economic zones from basic forms with limited integration to complex, high-tech centers that play a significant role in the regional economy. The economy's dependence on external factors and the vector of development has shifted to using of digital technologies and their application to improve efficiency and quality of life. Five stages of FEZ development, which have undergone changes related to innovation, integration with the local economy, and increasing complexity.

In the FEZS 1.0 stage, the functions of the free economic zones were limited by the weak connection with the local economy, with functions aimed at attracting investment and exporting products. A weak link to the local economy drives long-term regional development.

In the FEZS 2.0 phase, different economic sectors are included in FEZs by improving the integration of free economic zones with the local economy. Due to the improved integration of free economic zones with local economic processes, local businesses increase.

During FEZS 3.0, sustainable development principles are introduced in FEZs, aiming at long-term economic stability.

The FEZS 4.0 stage is characterized by economic reforms. New technological solutions and innovations are increasing, as is the share of enterprises with high-value-added services.

The FEZS 5.0 stage is characterized by a digital breakthrough, influenced **by** digitalization and the introduction of digital technologies in the economic, public, health, cultural, manufacturing, services**,** and other sectors. This stage is characterized by creating of technologically and intellectually advanced zones and smart cities [25].

TECHNOPARK

Technopark is a type of sciencepark on the territory of which small-scale production is possible [26]. The functioning of technoparks significantly impacts the development of regional and national economies through the production of services or products with high added value, through the commercialization of knowledge, intellectual property obtained in research organizations, universities. Technoparks are structures that unite innovative companies with research institutes. The legislation provides several supporting mechanisms for technoparks' activities [27]. A technopark is a specialized infrastructure complex or territory designed to promote innovation and development in knowledge-intensive industries. It focuses on knowledge-intensive enterprises, startups, research centers, and laboratories, fostering interaction between science, business, and the state. The main goal is to facilitate new technologies' development, implementation, and commercialization. Technopark includes organizations such as a scientific center, small businesses and production. In technoparks, intellectual property or scientific developments are commercialised. **The** research center plays a significant role in forming a technopark.. In countries such as Japan, the USA, and Western Europe, the main attribute of technoparks in the form of science centers is universities. One example is Stanford University, which became the key to the development of Silicon Valley. Universities in these countries provide training for students and conduct serious scientific research.

Technoparks perform the following functions: training of technopark personnel (to work in technoparks: economists, managers); development of scientific discoveries, ideas, and technologies; provision of personnel (teachers, students, master's students, doctoral students); possibility for technopark employees to work in scientific centers. The difference between business incubators and technoparks is that they carry out their activities in one or more buildings. In contrast, technoparks have land plots, allowing clients to construct offices and industrial premises. Technopark integrates science and production, where engineers, scientists, investors, and innovation managers gather [28]. The fundamental concept guiding the operations of a technopark is the premise of "from invention to market." Technoparks' main clients are small and medium-sized enterprises at different stages of commercialising intellectual property and scientific developments. Job creation is the main achievement of technoparks' activity.

Technoparks have two main functions, which are divided further into subfunctions. The two main tasks are manufacturing products and innovation culture. Manufacturing products lead to the commercialization of intellectual property, while inno-

vation culture is divided into the development of local, medium, and small organizations and the industrial development of scientific knowledge [29].

Scientific Parks

Scientific parks are complexes of territorial and scientificproduction types, having a production zone and a research center [30]. An example of a science park in the USA is Highway 128, Silicon Valley; in Great Britain, an example of a science park is the M4 Corridor. In 1945, Terman was given an area of land next to the university to solve industrial problems; the first to provide this idea was a professor of electrical engineering, Terman Frederick; he called this area a "research industrial park," later called a science park. Incubators (several buildings or buildings for a limited period to accommodate small organizations and client companies) are one of the components of existing science parks. Developments of the science park are brought to prototype; if a series of products are manufactured, then they are sent outside the park. The Park consists of the following physical components: 1) The intellectual and human resources of the research institute; 2) The built environment and land area; 3) Industrial companies; 4) The organizational and managerial framework (overseeing all operations within the park). (taking products as the potential of the research center); 5) institutions of industrial and household support. One of the significant elements of the science park is the research center. The role of research center is played by universities awarding Master's and Doctor's degrees. Public funding also plays a phenomenal role in an active science park.

The features of the science parks are as follows: 1) developed infrastructure, 2) government support, and 3) technology concentration.

Technological Hubs

Hub (node, branching) means a place of intersection, node, or place of redistribution [31]. Also, the "hub" is considered a central node of transport infrastructure. The following examples are the airport hub, at the intersection of international transport corridors, the seaport hub, the gas hub, and the industrial hub. In IT, a hub means an information center that distributes devices and information or a distribution point (network hub, USB). A combination of different kinds of activities or concentrations of traffic flows in a particular space is called a hub (flows of ideas, people, products, information, services, goods, and capital) [32]. The "hub" is a community of professionals gathering to exchange ideas and experiences. A region or space with a high density of startupstartup companies that is part of the economic infrastructure community.The number of commercialized products measures the success of a hub. Free production infrastructure that meets the needs and demands of startupstartup teams for trial production of innovative products and prototyping for product presentation to clients [33]. The activity of the technology hub provides a complete package of services, from selecting projects by experts in their field and working with teams in the form of education and training to launching a pilot project and financial management. The venture capital industry is famous for the activities of technology hubs - for example, Moscow Corporate Innovations Hub, Neboplaza in Ekaterinburg, and StartHub. Technology programs and services include filling the space with methods and tools of a technological nature. Companies working with faculty and students on common projects suggest industry collaboration. The startup acceleration function

involves working with startup mentors to provide direction for further development to SMEs and others. Due to the space available for the activities of the technology hub, office-type premises are offered. The value of the technology hub is to provide an innovative and creative environment for the development of startups. In this context, the hub acts as a network through which like-minded people and members communicate to produce results from research to development and commercialization. Bringing together different businesses to create a community and implement programs and projects through knowledge sharing, experts, mentoring, testbeds, and bringing products to market is the main objective of hubs. There are also collaborative technology hubs such as the European Institute of Innovation and Technology and the Urban Tech District in Dubai in alliance with China, the USA, the UK, and Japan.

Innovation Hubs

Social communities are considered innovation hubs, research centers, and spaces for work, gathering the correct information on the management of the latest technology developments and allowing mentoring of less experienced organizations in science and industry. Innovation hubs are also considered innovation infrastructure, particularly the set of resources and organizations involved in innovation activities. Innovation hubs include organizations: production and technological facilities such as incubators, technoparks, centers, free economic zones, clusters, and platforms; financial (budgetary funds, venture capital funds, private business angels, extra-budgetary, private funds). Managers and researchers are gaining skills at universities and professional development programs, indicating that human resources play a substantial role. Access to information is also vital, with regional innovation resources and the Internet serving as valuable avenues for knowledge. The ultimate goal of these ecosystems is to bring innovations to market, both on a national and regional level. Finally, the success of these ecosystems relies on established conventions and practices within those markets. Some organizations may establish hubs for innovation to foster the growth of innovation. Innovation centers promote the development of an innovative ecosystem. The scope of the setting for innovation might range from an individual facility or department within a corporation to clusters and regional areas. An innovation hub's role is effectively integrating its various components: experts, physical space (a specific location), and society [34, 35]. Innovation centers should be provided with a means of obtaining equity and venture money, conducive conditions for fostering a creative environment, and access to networks.Nevertheless, there is a risk of diminishing the significance of innovation hubs, as these hubs are situated in specific geographic locations and require rented space. In contrast, high-speed broadband internet enables activities to be conducted from any part of the world. Regarding regional management, establishing innovation hubs as platforms for sharing and implementing innovative ideas and creating development centers contribute to enhancing the connection between the business sector and academia.

Japan has devised a strategic plan for advancing of technology, science, and innovation from 2014 to 2030, known as the "Innovation Gateway to Build the Future." This plan includes the establishment of hubs in specific regions. Some examples of FrenchTech hubs of innovation may be found in New York, Moscow, and Tokyo.

1.2 Digital hub establishment management

The development of the conceptual foundation for establishing digital hubs may be traced to 1959, when the initial incubator was established in the manufacturing center of Batavia. The primary objective was to foster collaboration among organizations and support firms in creating innovative ideas and startups [36]. The concept of beneficial cooperation, collective endeavors , and cooperation originated in the USA and was adopted by the European Union members in the 1980s. The academic and economic ecosystem of innovation refers to the collaborative development of shared projects to achieve social and financial goals. Since the 1990s, innovation ecosystems have continuously evolved, creating and delivering of new digital technologies. This evolution involves the implementation and application of these technologies in production, the generation of new ideas, the provision of software services, and the exploration of potential collaborations and partnerships [37]. The innovation ecosystem is characterized by an integrated framework that fosters the creation and growth of certain areas of activity. Initially, collaborating organizations offered support to individuals across all sectors of business. In recent years, associative organizations and institutions have increasingly focused on fostering the growth and advancement of startups and new companies.

Associations that provide assistance and support to organizations have their roots in the establishment of clusters, incubators, digital innovation hubs, networks of businesses, accelerators, technology parks, transfer parks, industrial parks, venture capital funds, industrial federations, centers for testing, transferring and implementing digital technologies, collective structures [38], customer unions [39], and other types of formal associations and business collaborations. The EU defines digital hubs as comprehensive centers that facilitate the digital transformation of many kinds of organizations. The digital capabilities of firms have a substantial influence on the development and competitiveness of the enterprise, exerting a significant impact on the company's business strategy in a dynamic market.

The history of establishing digital or technology hubs began in the mid-1990s with gatherings of programs to discuss technologies of interest to them, ranging from robotics to biohacking. The first programs meeting space arose in Berlin. One of the oldest technology hubs was a C-Base Hub (established in 1995). In its early days, the tech hub operated as a venue, then became a huge space hosting conferences, performances, festivals, and more. Residents of technology hubs include startups, entrepreneurs, investors, and others [39]. Below, a table of the evolution of innovation ecosystems is presented.

Table 1 – Evolution of innovation ecosystem.

1990-1999	2000-2010	2011-2017	2018- up to the present time
Public financing of basic infrastructures (territorial indivisibility, joint industries, etc.)	International events for digital co-operation	Development of social networks (mail.ru, Facebook, VK, etc.), development of cloud technology, Web 2.0	Robotics, smart equipment development, 5G
Software development (Microsoft	Public, private capital investments	Development of IoT (smart devices), artificial intelli-	Developing the concept of smart cities

Office, Cambridge animation systems, etc.)		gence, additive technologies, data processing.	
The Internet	Accessibility of the global marketplace through the Internet	Crowdsourcing, organization of venture capital groups, private capital investments (investors, business angels)	Virtual and digital transformation
Technology transfers	Development of software industry, mobile internet, e-commerce market	Industrial e-business development (XaaS - an integrated cloud model in which platform solutions, software products, computing power, and business functions, provided to users in an on-demand service format).	Sharing economy
	Mobile development industry, phones, digital innovation, smart living (banking, real estate).	Developing funding for digital projects, digital hubs	The 4th industrial revolution
		Development of virtual environments, virtual events	
		Development of internet banking, digital marketing, automotive industry	
Note – Designed by author using source [35]			

The concepts of innovation and digitization have been known for decades and have now been embraced by the actors of the world. In the digitization framework, various strategies are ensured and applied worldwide, including establishing of hubs that occur as digital centers providing different services to local companies and organizations. In other words, managing digital hubs provides the actors and stakeholders with a general platform in which it is possible to use testing systems in the form of test beds, to find investment, to get information and knowledge, receive training and apply digital technologies of a particular region's enterprises and organizations. As defined by the European Union, digital or technology hubs coordinate different partners in the innovation and digitalization ecosystem. The ecosystem includes actors such as universities, research institutes, technology organizations, chambers of commerce, accelerators and incubators, industry associations, the government, and regional development agencies. Managing the establishment and development of digital hubs plays an important role in developing of digitalization regions' industries to support economic growth and improve competitiveness. The essence of creating of digital hubs is that the hubs provide services to companies in terms of developing more competitive services, products, and business processes using digital technologies. Access to technology and expertise in the region to support SMEs is integral to developing of digital hubs in the region. Managing the development of digital hubs in the regions allows an opportunity for SMEs to try out, test, and experiment with digital innovations [40]. Implementing digital transformation in enterprises begins with a clearly defined digital business strategy, which provides a concrete action plan for the digitization of the enterprise or organization [41]. According to a study conducted by Swiss scholars, it had been determined to gain a minimal level of digitization of enterprise, the conditions that follow must be fulfilled: 1) a website owned by

an organization; 2) a pre-designed marketing plan specifically for online platforms; 3) engaged in social media platforms; 4) active digital communication channels; 5) the use of e-commerce; 6) the use and application of software solutions (CRM); 7) the application and use of technologies (big data, cloud) [42]. The center's administration can achieve a greater level of interaction and association with clients, improved efficiency, enhanced competitiveness, and expanded capacity for employees by meeting these requirements. The use of specific digital technologies, or one digital technology, will be a determining factor in developing general tools and policies in a particular sector of the economy. The development of national and regional strategies for "smart cities and specialization" requires the development of an innovation ecosystem in which the performance of these functions by the administration of hubs plays a significant role. Establishing and managing digital hubs contribute to the strengthening and developing the innovation ecosystem [41, 42]. Nevertheless, the application of digital technologies faces financial constraints and challenges in creating these systems. Based on the statistics presented in the annual report of the European Comission, it was observed that the percentage of heavily digitalized firms fluctuates between zero and five. According to a study, 60% of major sectors and 90% of medium-sized enterprises are falling behind in digitalization [43]. Efficient and swift implementation and utilization of digital technologies in an organization depends on several factors, which include: 1) the economic sector; 2) the size of the enterprise; and 3) the geography and location of the digital hub establishment. Among the medium and small enterprises, there are also some organizations whose management does not inform them about the status of digitalization, or they are waiting for an opportunity to adopt and apply the technology. This suggests that organizations and enterprises can be both active and passive. Digital hubs perform the following functions: 1) support the utilization and advancement of digital skills in practice; 2) support customers' access to digital hub resources and competent professionals; 3) support the organization and conduct of experiments and testing of digital technologies; 4) support cooperation between organizations; 5) support the search for potential investors and provide funding; 6) to link with business angels and investors, seek funding for the digitalization of businesses, and provide a permanent link between users and innovation providers along the value chain [44]. To ensure optimal performance and foster innovation inside the company, it is imperative to offer ongoing seminars, training, and courses to its staff. There exist specific criteria for assessing the stage of digital transformation in an organization. These criteria consist of: 1) organizing the strategy of digitalization modifications in line with business demands, both in the short-term, present, and long-term; 2) evaluating the organization's digital maturity; 3) endorsing the implementation of initiatives for training staff members [45]. These types of training and staff development promote the acquisition of specific professional skills , thereby enabling employees to develop their visions and the ideas that emerge from the training, which are oriented toward consumerization.

When the question of developing digital transformation in an organization arises, the most important possible barriers are significantly discussed by enterprise management. First of all, this is the financial issue of whether the management of the organization can afford to buy expensive digital technology whether it can afford high-

ly qualified specialist trainers to deliver digital skills training to employees, whether it can afford the cost of installation, additional materials to apply digital technology, and so on. Secondly, it is a matter of strategic planning for the organization, which sets out the right kind of digital technology (there may be doubts and hesitation about one digital technology, so that the management of the enterprise cannot decide which one to buy), aspects of investment (where to invest, how much to invest, whom to work with), and protection and development issues of existing digital investments. When considering the development of digital transformation in an organization, the above factors should be identified first. However, the sector of economic activity, the region or country in which the organization operates [46], and the company's size is also essential in carrying out and using digital technology.

Based on the European Commission's development strategy, digital hubs will be formed to test existing ideas and technologies for further investment. This means that by forming a digital hub and providing services, it is possible to liquidate an unsuccessful idea, during which the funds allocated to it will be allocated to another area for testing, which will show definite improvements and results. Depending on the purpose of forming digital hubs in a region, they can either form a core part of the research and development activities of an enterprise or organization in the region or supplement in the value chain for innovation and research of all kinds. The position of digital hubs in the ecosystem is significant, as the main activities of digital hub management are the implementation and application of digital technologies in enterprises and businesses, the provision of best practices in the application of digital technologies, support in offering digital literacy to employees of organizations and businesses, support in holding various creative workshops, trainings, co-working spaces, open access to available digital technologies, testing, skills, competencies, and resources, including assistance in finding financial resources. Digital hubs test digital technologies, develop creativity, analyze business models, and generate creative ideas, ensuring project worthiness and fostering innovation in service delivery and activities. The operations of hubsare aimed at implementing and appl ying innovations and creativity in the digital environment [47].

Digital hubs are regional or national platforms for digitising enterprise business, generating various creative ideas, and testing the application of digital technologies. The setting up of hubs in regions as micro-ecosystems can contribute to the further expansion of hubs as a component of a macro-ecosystem of business, becoming a participant in the network. The management of digital hubs also offers and analyses best practice cases to prevent possible mistakes in the past [48, 49, 50]. Today, digitalization is taking over all spheres of human activity, so the development of innovative projects in the digital age is significant and relevant. The activities of digital hubs are designed to offer quality digital transformation services to organizations, including universities, research institutes, industrial enterprises, local companies, and government organizations; to organise new digitalization projects; to offer funding for these projects; to support the development of digital skills and competencies among digital employees; to participate in strategic tasks and strategy building in general; and to shape innovative ecosystems.

The study of digital or technology hubs shows that users have a very high appreciation for such hubs, which provide access to experts in the field and technology, as well as the use of ICT in business. The creation of technology hubs has shown its value, where new ideas and new technologies are offered. The establishment of digital hubs ensures that organizations, businesses, and companies can make effective use of digital opportunities. The activities of the digital hub are aimed at entrepreneurship, business, and innovation. As we know, the objective of these areas is economic growth and poverty alleviation. Today, when digitalization is taking over the whole world, it is important to keep up with the world and move in this direction. So, according to the message of the President of the Republic of Kazakhstan dated September 1, 2021, Kazakhstan should be the central digital hub in Eurasia. The main reasons for the creation and growth of digital hubs include: 1) attracting different partner members with different expertise through digital hubs; 2) localising the global business culture; 3) collaborating and creating communities led by experienced business people; and 4) allowing freedom and creativity in both the digital space and the physical space. Managing the establishment of digital hubs involves a set of management functions, such as planning, organising, motivating, and controlling networks of technology organizations, universities, research organizations, technology providers, and others that join forces to improve and offer tailored solutions to different companies [51]. A virtual selection environment, an association of different organizations that complement each other with resources and specific skills, can be called a digital hub [52]. To date, there are six hundred and sixty-four active digital innovation hubs in thirty-nine countries in Europe. These digital hubs are listed in the European Union Directory of Digital Innovation Hubs [53]. As the interconnection of agents, technologies, and research hubs is a complex and time-consuming process due to location, there are specific ways of solving it. The services offered by digital hubs include access to the latest technology, expertise, knowledge, testing, and experimentation of particular business processes, business models, products, and services. Using digital technologies to improve a company's business process contributes to synergies between other critical technologies like nanotechnology, advanced materials, and biotechnology. The provision of these services is highly relevant for enterprises with relatively low levels of digitalization and for enterprises with insufficient resources and staff to address the challenges of digitalizing enterprise business. When managing the creation of digital hubs, one of the main factors in their development is to focus on both advanced digital technologies and a specific sector of the economy, for example, construction, agriculture, textiles, education, and others. The location of a digital hub and companies in the same region is an essential factor for the rapid and effective implementation of tasks that need to be carried out through digital technologies. The model of a digital hub is presented in Figure 4.

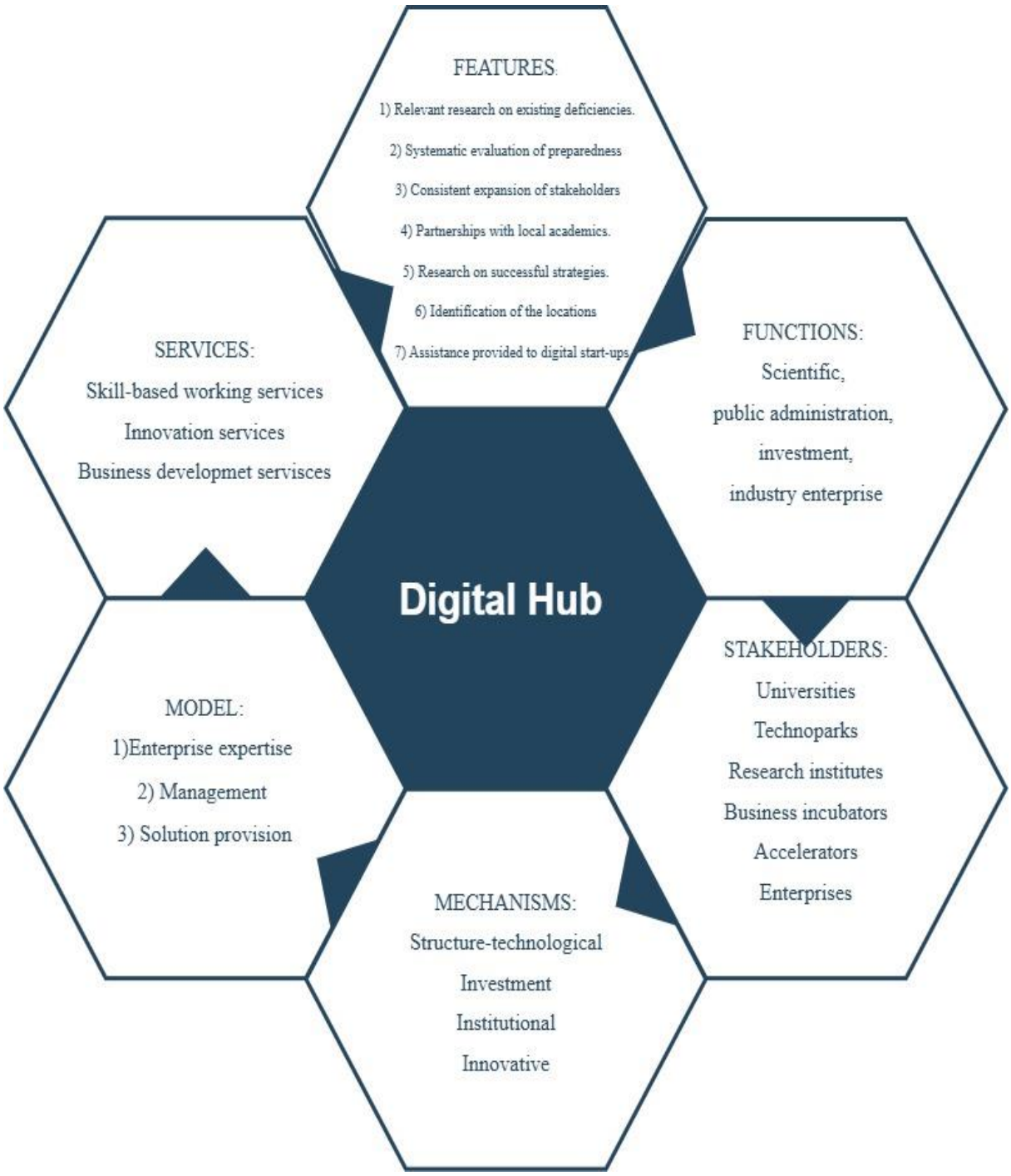


Figure 1– The model of the digital hub

Note – Designed by the author based on the source [54]

The main difference between digital hubs and innovation ecosystems is that digital hubs provide services to individual customers in the region, while innovation ecosystems provide access to services to a wide range of partners.

The features of management in the establishment of digital hubs are the involvement of organizations as follows:

-Research institutes, technology centers, and universities, provide access and expertise to industry;

-Small and medium-sized enterprises have services to digitise business processes, business services and business products;

-Accelerators and incubators help startupstartups scale up and grow;

-Associations andcluster organizations; finding investors for funding;

-Local public administration. Development of strategies, programs, and specialization plans [55].

The peculiarity of managing the establishment and growth of digital hubs in the region is that it involves bringing together all the participating partners in a particular region, followed by developing a set of services provided by the hub in support of local companies. As a result of the services provided by the hub, the participants develop technical solutions that promote innovation in companies and increase competitiveness.

The vision and mission of digital hubs are based on the industry needs of the region. Managing the establishment of digital hubs is not only about providing services and solutions for customers but also about fulfilling the digital hub's mission. The value of managing the establishment of digital hubs includes the areas presented in Table 2.

Table 2 – Direction of management the establishment of digital hubs

№	Directions
1	Availability and provision of access to highly 25pecialized infrastructures and platforms;
2	Ability to market the business, proactively finding a segment of customers and clients;
3	Possession of know-how information covering different disciplines (technical, non-technological, etc.)
4	Understanding the needs of small and medium-sized businesses;
5	Working with companies at all levels of digital maturity;
6	Helping to understand business transformation and business models; helping with business model transformation;
7	Assessment of current and future skills needs; appropriate support;
8	Assistance in finding a source of funding; access to external funding and provision of funding;
9	Mediation between industry needs and relevant technology providers.
Note – Collected by the author from the source [56]	

The partners of the digital hubs have to translate these features into a uniquevalue proposition with original services to support companies in the region. The services are divided into three categories: 1) Business development services, helping to apply innovative solutions; assessing possible risks and impacts on business, managing emerging risks and changes; 2) Innovation services: identifying digitization opportunities; developing and validating innovative solutions using advanced digital technologies; 3) Digital skills work services, by enriching human capital aimed at developing innovation capacity [57].

The services provided by technology or digital hubs are also presented in Table 3.

Table 3 – Service portfolio of digital hubs

Skills-based working services	-Technical training and skills development; -Finance and business training and skills development; -Management training and skills development.
Innovation services	-Assessment of digital maturity, digital needs; -Access to expert knowledge; -Awareness of digital technologies, sufficiency of information and data; -Use of best practices, innovations; -Availability of access to infrastructure and platforms; -Collaborative research.
Business development services	-concept development; -strategy development; -Mentoring and business coaching; -mediation and cooperation; -availability of funding; facilitating access to funding; - assistance and support to startupstartups.
Note – Collected by the author from the source [58]	

A more specific description of the services provided by digital hubs is given below:

1) Digital awareness, sufficiency of information and data; objective interaction in the business community for understanding the benefits and opportunities of digitalization. Managing the creation and development of digital hubs facilitates companies' assessment of current conditions and efforts to improve competitiveness and combat global threats and trends. Identifying point A (where the company is at) and point B (where the company aspires to be), and articulating true needs will enable companies to remain competitive in the marketplace;

2) Assessment of digital maturity and digital needs; diagnosis of digitization needs; diagnosis of company readiness in the use and application of digital technologies; identification of potential innovative solutions; reporting on the level of digital maturity regarding advanced digital technologies. Innovation Scouting entails understanding and awareness of needs, digitisation, and showcasing successful examples of digitisation of business processes, services, products, and business models. Channels for innovation scouting include trade fairs, social media, and exhibitions. Innovation Scouting is handled by innovation scouts trained in innovation management. Defining a vision and developing a strategy for the company. A company's vision plays an important role in its competitive functioning in the market. With a specifically defined vision, the company needs a customer segment and a vision of the digital future; company management creates a development strategy much faster. The management of digital hubs promotes the development of companies' business models with the use of digital technology and digital services in the company's products and services. Working directly with the client, it is possible to refer the client for highly specialised advice and assistance within the digital hub ecosystem. In some cases, to develop a common view and understanding, producers and end-users should be brought together to discuss emerging issues further;

3) Mediation and cooperation. To work with companies, understand their gaps and problems related to digitisation, and develop innovative solutions offering service providers and the necessary technology whose assistance is needed to implement the solution. These activities can be achieved through physical meetings and di-

rect contact with stakeholders. For example, stakeholders can be investors, supply chains, SMEs, regions, and others. As a result of the events, the necessary contacts are established, information is made available, and solutions to problems and experiences related to innovation are shared. The role of large companies is key to supporting small and medium-sized companies in their supply chains. Support formats for large companies also include workshops, innovation hackathons and camps, road shows, and others;

4) Availability of access to expert knowledge and infrastructure for digital hub participants. The help of technology users and suppliers to validate the approach will be helpful for both the user and the provider. The user assesses how beneficial a particular approach will be. The provider, in turn, can apply the approach to another, earlier client according to need. This experience contributes to the creation of best practices that can be applied in other situations that arise;

5) Mentoring. This service is defined by the fact that after testing, the next level will follow, for which this service is required. For example, it could be scaling experience, access to finance, and how to find funding, startups experience, incubator services, marketing, feature and value analysis, business expertise, internationalisation, market assessment, trend analysis, value creation, and others.

6) Access to finding and sourcing funding, as well as investor preparation services. Supporting tartups in accessing regional, national, and state funding;

7) Conducting joint research. In cases where client companies are interested in particular research, the digital hubs can serve as a link to specialists in universities and technology organizations and can also carry out the research directly;

8) Management training and technical training. To work with digitised goods, services, products, business processes, and workforce business models, an understanding of the nature of working with such data is essential. Working with digitised business models, processes, products, services, and commodities substantially reduces the time to work [58].

Shortly, support and assistance of digital hubs are providing expert knowledge, provision of technology blocks, provision of pilot lines for production, provision of facilities for testing, and providing live labs for testing [58].

Characteristics and methods of offering services by digital hubs include: 1) bundling existing services, complementing existing services; 2) creating an ecosystem.

Existing infrastructure in the region, in particular cooperation with service providers, research institutes, technology organizations, universities, incubators/accelerators, business support centers, and others, plays a key role in managing the establishment and development of digital hubs. When managing the creation of digital hubs, it is important to consider that the activities and services provided by hubs should fill gaps in advice and forms of support, but not replicate existing forms of advice and support measures. One of the features of digital hub establishment is to reach hard-to-reach companies for digital transformation, offering step-by-step services and a concrete pathway to the digital transformation of the enterprise. The individual digital hub has a specific approach and classification of services offered. As the demands of an organization evolve, it is significant to clearly distinguish services among separate digital hubs. An exemplary instance of a very efficient hub is

the Digital Hub located in Dortmund. The primary focus area of the hub is logistics. The hub provides a diverse array of services to its clientele, encompassing thirty hub activities and services. The activities and services offered by this hub are organised into 10 distinct groups, which are labelled starting with the "inspiration" group to the "scale up" category [59, 60].

The digitization state evaluation is a crucial function for overseeing the establishment and growth of digital hubs. The company evaluates its stage of development to plan for the future. The goal is to identify the company's specific needs and overall businessrequirements. To assess its progress, the organization offers two approaches: a survey conducted by experts or a self-help tool for management use. The survey evaluates the company's ability to integrate technology into its operations and identifies requirements. It provides insights into the organization's digital maturity level. Offers tailored consultations within the hub's ecosystem. For example, it provides recommendations to entities in the sector, including small and medium-sized enterprises, consulting firms and similar businesses. One such example is the Mittelstand 4.0 Kompetenzzentrum Dortmund (hub), which assesses companies'digital maturity using five stages of a maturity ladder.

A key aspect of managing the development and expansion of centers involves testing the use of technology in a controlled lab environment before deploying it in real-world operations. The field of digital hub management often lacks practical research at its core. Yet opportunities arise to conduct research when customers face issues. Access to testing pilot programs and experimental facilities is essential for validating technologies.

University students should obtain a pertinent credential and be familiarized with the advancements in digitalization administration and digitalization capabilities. Industries and businesses should convey their prospective demands to academics and actively contribute to designing undergraduate, graduate, and doctoral curricula. They should also participate in creating specialised courses for learners from various disciplines, considering the impact of digitalization on every facet of human existence. Providing young staff members with opportunities for education in digital technology is crucial, as is offering growth options for staff members in all positions. Managers are enhancing their abilities in change leadership, economics, and business model skills. To facilitate discussions on education and training requirements, it is crucial to establish communication and maintain regular feedback with the business sector and industry.

Digital hubs efficiently advertise digital services and technology by operating not only in the online realm but also in other spaces. When managing the establishment and development of digital hubs, it is essential to consider not only the hub's geographical location, but also the concentration and and quality of enterprises in the surrounding populated areas. A key advantage of operating hub lies in its capacity to offer access to advanced technological resources such as test beds, demonstrators, experimental lines, and other infrastructure either in-house or through affiliated partner organizations within the broader digital hub ecosystem [61].

In the present day, it is challenging to conceive of a corporation that does not utilise and implement digital innovation. Corporation management must not only

consider the business case for implementing digitalization, but also come to a deep understanding and awareness of the implications of digitalization for the business sector, and consider issues such as monetization and sustainability. Creating a digital culture, teaching digital culture, and business models will be as important as technology. Creating a digital culture involves developing an entrepreneurial mindset and empowering the company headquarters.

One of the services digital hubs provide to startups and SMEs is access to national, state, and regional funding in line with national, state, and regional strategies for a specific specialization. Also, the management of digital hubs can assist in explaining and clarifying SME strategies to banks, business angels, and private investors to provide funding for the transition to the next level of digital maturity [62].

Public awareness of digitalization should also be included among the main services provided by digital hubs. In this case, it is important to consider job creation due to digitisation processes, job cuts, skills development issues, training issues, health care benefits, reducing the cost of service delivery by health facilities, improving the quality of human life, food safety issues, security issues, and privacy issues [63].

In managing the establishment and development of digital hubs, the theoretical benefits and value of hub establishment are clear, but questions arise about the successful implementation of these hubs in practice. Questions concerning the factors in the creation of digital hubs in the region, the implementation of digital hubs in practice, the creation of a network of digital hubs throughout Kazakhstan, and support and financial assistance to digital hubs.

The first step in managing the establishment of a digital hub is to determine the needs at the regional level, as well as the development of a regional model for the functioning of the hubs. The development of a regional model for a digital hub identifies the industries in the region that need to be digitized, as well as the companies that are part of these industries. A regional model of a digital hub is crucial for addressing industry development issues in the region. This model involves identifying the region's specialization, characteristics, and critical assets, such as 3D printing, 3D modelling, agricultural and industrial sectors, and infrastructure. The development of a digital hub requires cooperation between hubs, local government, and national agencies to develop necessary tools and services. A collaborative partner relationship is formed to bring together digital technology providers and user industries, identify and meet the needs of local companies, engage the value chain, ensure cooperation and communication with other platforms and hubs, and animate networks both locally and in the ecosystem [64].

To create a common vision and mission and define short-term, medium-term, and long-term goals, participants in the digital hub must be involved in the government process. Building the digital hub's business model is a major part of activity planning, reflecting the funding of services and the sustainability of the initiative. There are various types of business models, including mixed funding, which combines private and public sources of funding to build and maintain infrastructure, purchase equipment and machinery, and hire highly qualified staff; sources of revenue are contract-based R&D, membership fees, testing, training, and service brokering.

Public services and goods can be subsidised because they represent knowledge and information with positive effects. Buyers who are willing to pay the market price for a product receive private services and goods [65].

The financial plan and business model of a hub containing a combination of functions and different services attracts the attention of investors and banks to create or expand existing infrastructures. Company reputation, image, asset ownership, governance, and management models play an essentialrole in shaping a mixed-financing business model [66]. Public financing means obtaining and using funds directly from public sources in order to reduce the risks of private investors. Financial risk guarantees both direct financial and indirect returns on investment. When managing riskreduction from private investment in industry, the leverage effect in digital hubs will be more significant than in previous private investments. Increasing returns from different experiments and reducing costs imply the use of specific shared infrastructures. The more capacity a hub is used and the more successful the hub facilities are, the more private investors and funds pay for services. For example, the European Commission's Horizon 2020 program can fund cross-border cooperation and services. There are funds such as ERDF, ESIF, EFPPandothers to finance local public services and goods [67, 68].

The third step in managing the establishment of digital hubs is the available infrastructure. For example, it can be specific projects or existing initiatives for the establishment of digital hubs in a region.The integration of available projects and initiatives in the area will create opportunities for the establishment of a digital hub, in particular, the experience of providing services to companies. Identifying specific services is the fourth step in managing the establishment of digital hubs. Before investing in technology, company management should experiment with the use and application of the technology. The direct participants in the experiment are users such as agriculture, furniture, automotive, and suppliers (ICT, startups, mechatronics, and others). The cooperation of small and medium-sized enterprises with digital hubs predetermines an environment in which incentives and motivation play an important role. For example, incentives such as innovation grants or innovation vouchers can be used to attract companies to the digital hub activities. These activities are funded by regional or national institutions. Cooperation of digital hubs with other digital hubs is mutually beneficial, providing additional services, helping companies to find customers and business partners, helping to provide sites for experiments, holding joint events, and others. The next stage in managing the creation of digital hubs is to strengthen cooperation and establish various links. Networking with other digital hubs means gaining access to various complementary services and opportunities, developing new tools and services, and building competencies through mutually beneficial cooperation.

The sixth step in managing the establishment of digital hubs is service delivery and impact assessment. Once service delivery has been launched in the digital hub, it is essential to have indicators against which the services' impact on the customers can be measured. The main criterion for assessing the impact of service delivery can be described as the impact on the business of client companies in the region and the attraction of private investment by client companies in the region. The way of co-

operation: 1) Development of common training solutions and services, activities and tools; 2) Developing a service delivery approach; 3) Introduction of exchange programs in digital hubs, between companies; 4) Analysis of best practice digital hubs in the regions; 5) Development of an innovation voucher [69, 70].

Signs of a Sustainable Digital Hub Ecosystem are the following: 1) A portfolio of diverse services, in line with the needs of the industrial sector in the regions; 2) Geographical location of the hub for collaboration with local research institutes, incubators, laboratories, universities, educational institutions, supply chains and others as part of the region's performing ecosystem; 3) Activity on the part of client companies requesting services; 4) Local entrepreneurial culture, retaining leaders, talent in the region; 5) A thriving ecosystem of innovative enterprises; 6) Active cooperation with hubs from other regions, either as a service provider or as a recipient; 7) Governance based on a mixed business model, combining private and public funding [71, 72].

At the beginning of the eighth millennium B.C., Çatal-Hüyük arose as the first cluster. It produced hand tools and was an expert in non-ferrous metallurgy [73]. In 1547, the first free economic zone, "free port," was opened in the port of Livorno [74]. Bell Labs (Bell Laboratories) was the name of the first "innovation hub" that appeared in the early 1900s. Situated in Murray Hill, New Jersey, USA, it was founded in 1925 as a research branch of the Bell Telephone System Company, which is currently a part of AT&T [75]. In the US state of California, the first technopark opened in 1951. Known as Silicon Valley, it was situated on the Stanford University campus [76]. In 1951, the first science park opened in California, USA. It was the Stanford Research Park, an initiative that the City of Palo Alto and Stanford University jointly undertook [77]. Europe was the birthplace of the first technology hubs, with Berlin being the central location. One of the earliest and least formal non-profit hubs, C-Base, was established in 1995 and is still strong today [78].

The evolution of digital hubs began in the 15th century, beginning with the creation of clusters and ending with digital innovation hubs today. Table 4 summarises the differences between these terms.

Table 4 – Difference between terms and peculiarities in the context of the establishment of digital hubs

Term	Definition	Differences and features
Cluster	Clusters are organizations located in the same geographical area, such as universities, research institutes, small and medium-sized enterprises, companies, infrastructures, and suppliers of components and equipment, that aim to increase the competitiveness of the cluster and specific companies [20].	1)Connectedness of cluster participants, connected by complementarity and commonality (specific sphere of activity, companies located on the same territory) [20]. 2)System, value as a system of interconnected institutions and firms [20]. 3)Geographical proximity [20].
FEZ	Free economic zones are those economic zones representing a certain area of the country, enjoying measures to stimulate startups and businesses, and also enjoying favourable tax treatment [21].	1) FEZs are related to creating special conditions for economic activity in certain territories.
Technopark	Technopark is a science park where small-scale production is possible [26, 27].	1) It is an organization created to create a favourable environment for developing knowledge-

		intensive innovative enterprises. 2)Technopark helps to commercialise the results of scientific research. 3)It provides infrastructure and administrative and legal conditions for residents.
Science Park	Science parks are territorial and scientific-production complexes, with a production zone and a research center in them [30].	1) It is a specially organised area for the location of new production facilities. 2)Science parks provide energy and infrastructure and are managed by specialised companies. 3)They facilitate the commercialization of the results of scientific research.
Technological Hub	Free production infrastructure is needed to meet the needs and demands of startup teams for trial production of innovative products and prototyping to present products to customers [31, 32, 33].	1) Development and implementation of technologies in various spheres (manufacturing, information technologies, medicine, etc.). 2) Supporting companies in technological development. 3)Organization of training programs and events.
Innovation Hub	Brookings Institution has given the following definition of innovation hubs as "geographic areas where leading-edge anchor companies cluster and institutions and connect with startups, schools, business incubators and accelerator. These places are physically compact, transit-accessible, and technically-wired and offer mixed-use housing, office and retail." [34].	1)Concentration of organizations in one specific area; 2)Hub activities in one region. 3)Development of research and development. 4)Assistance to innovative startups and companies. 5)Attracting investments for innovative projects. 6)Training and support for entrepreneurs.
Digital Hub (Digital Innovation Hub)	A Digital Innovation Hub (DIH) is a support facility that helps companies to become more competitive by improving their business/production processes as well as products and services by means of digital technology. DIHs act as a one-stop-shop, serving companies within their local region and beyond to digitalise their business [35].	1)Provides services as a one-stop-shop; 2)Based on the use of digital technology; 3) The location of organizations amongst each other is not important; 4)The result of the activity-innovation; 5)Encompasses all sectors of the economy.

The definitions of the terms “digital hub” and “digital innovation hub” are collected in Table 5. Definitions from technical reports: Roundtable on Digitising European Industry: Working Group 1 - Digital Innovation Hubs, Financing the digitalization of small and medium-sized enterprises: The enabling role of digital innovation hubs, Report from Lincoln University, CORA Digital Hub Guide, the European Commission and from papers are presented.

Table 5 – Definition of the term “digital innovation hub”

Author/Work/Paper	Definition
Roundtable on Digitising European Industry: Working Group 1 - Digital Innovation Hubs	A Digital Innovation Hub (DIH) is a support facility that helps companies become more competitive by improving their business/production processes, products, and services through digital technology. DIHs act as a one-stop-shop, serving companies within their local region and beyond who want to digitalise their business.
Financing the digitalization of small and medium-sized enterprises: The enabling role of digital innovation hubs © European Investment Bank, 2020	Digital innovation hubs serve as important, regional multi-partner coordinators. They are situated at the heart of the innovation and digitalization ecosystem and comprise a wide variety of organizations, including research and technology organizations (RTOs), universities, industry associations, chambers of commerce, incubators and accelerators, regional development agencies and governments. As a first-line, local access point, they play a critical role in facilitating the digitalization of European companies across industries and regions.

Ashmore, F., Price, L., & Deville, J. (2019). Be Bold. Be Innovative. Be a Digital Hub, A CORA Project Report, Lincoln: The University of Lincoln.	Digital hubs are physical spaces with access to superfast broadband alongside community—and business-focused services. They provide digital connectivity, support the development of digital skills, and encourage the use of emergent digital technologies. Digital hubs aim to enhance the local digital environment and can be available to the public, businesses, local authorities, or a combination of the two.
09.01.2019 CORA Digital Hub Guide An operational guide to setting up and running a Digital Hub	"A physical space, which can be fixed or mobile, focused on digital connectivity, digital skills and/or emergent technologies. The space will be available to either the public, businesses, or local authorities (or a combination) with the aim of enhancing the local digital environment"
Digital Innovation Hubs for Enhancing the Technology Transfer and Digital Transformation of the European Manufacturing Industry	The main reason for developing the DIH concept is to facilitate the digitalization of the European industry. The level of digitalization of industry remains uneven, depending on the sector, country, and size of the company.
Report on Digital Innovation Hubs, 2018, European Comission	Digital Innovation Hubs (DIHs) are not-for-profit one-stop-shops that support companies, notably SMEs, and the public sector in their digital transformation. At the core of the DIH there is normally a research & technology organization (RTO) or university lab offering in collaboration with partners, services such as: - Test before invest: Experimentation with new digital technologies – software and hardware (e.g. artificial intelligence, High Performance Computing, Cybersecurity, Blockchain…) ; – to understand new opportunities and return on investments; - Skills and training to make the most of digital innovations: bootcamps, traineeships, exchange of curricula and training material; - Support to find investments; - An innovation ecosystem and networking opportunities.
Riikka Virkkunen (2019), Digital Innovation Hubs in Finland	DIHs are intended to be one-stop shops that support companies, particularly SMEs, in their digital transformation. DIHs are multi-actor networks or ecosystems that often focus on regional innovation and business development.
European Commission: Smart Specialisation Platform, 2017	A support center that helps companies to be more competitive through the improvement of their business, services production, products, and services using digital technology.
EUROPEAN COMMISSION Artificial Intelligence and Digital Industry Technologies and Systems for Digitising Industry, European Digital Innovation Hubs in Digital Europe Program	A European Digital Innovation Hub (EDIH) is a single organization or a coordinated group of organizations with complementary expertise, with a not-for-profit objective, that supports companies—especially SMEs and mid-caps—and/or the public sector in their digital transformation.
Digital Europe Program	'European Digital Innovation Hub' means a legal entity selected in accordance with Article 16 in order to fulfil the tasks under the Program, in particular providing directly, or ensuring access to, technological expertise and experimentation facilities, such as equipment and software tools to enable the digital transformation of the industry, as well as facilitating access to finance. European Digital Innovation Hub shall be open to businesses of all forms and sizes, in particular to SMEs, midcaps, scale-ups and public administrations across the Union.
Note – Collected by the author from the sources [42, 43, 44, 45, 46, 47, 48, 49, 50, 51]	

According to the above theoretical literature review and structural analysis of existing digital hub definitions, a key limitation was identified. Most definitions identify digital hubs as coordination platforms or infrastructural nodes focused on startup support and digital service delivery. Those interpretations overlook the innovation management dimension and the broader level of hubs in regional development.

The scientific novelty of the author's approach lies in integrating the model of triple helix [80] as the basic framework of interaction within the structure of the digi-

tal hub. The author's definition accentuates the functional outcome of the hub, as an innovative product, service, or decision, as an output of innovation management.

Furthermore, the digital hub is conceptualized as a center and platform for interaction, but the author defines it as a driver for innovations, offering digital solutions to local organizations that respond to regional development issues and challenges, as the core of innovations lies in the creation and commercialization of innovative outcomes.

The author's definition added the function of generating an innovative service or product as a result of the solution provided by digital hubs. The "triple helix" model was integrated as a methodological basis of management. The new definition was linked to regional development as hubs operate at local, national, and global levels. In the case of Kazakhstan, the study was conducted emphasizing the establishment of hubs at the regional level.

Based on the literature review, the concept of a digital hub is defined as a center that carries out activities aimed at implementing the "triple helix" model, which includes cooperation between government, academia and business to promote innovation and startups through the application of digital technologies, to offer a solution to local organizations, in the form of an innovative product or service, as a component of innovation management. The participants and partners of the digital hub are universities, research organizations, laboratories, technoparks, incubators, gas pedals, public administration, and other stakeholders. The concept is justified and presented as an essential component of the innovation ecosystem.

The author's contribution lies in a functional, applied and regionally accentuated definition of the hub, based on an interdisciplinary approach in innovation management. This is a unique definition not found in existing international definitions.

1.3 Foreign experience in managing the establishment of digital hubs

Countries around the world actively formed digital hubs, as digital hubs become the core of innovation ecosystems. A Global Digitalization Index generated by Huawei assessed countries' digitalization index of a total of 77. It divided countries into the three categories: frontrunners (leading countries), adopters (middle leading countries), and starters. There were 22 countries in the "frontrunners" (from 2024). The countries USA (1st place-score 78.8), European Union countries: Sweden (3 place – score (74.5)), Finland (4 place – score 73.0), Denmark (5 place - score 71.8), Switzerland (6 place – score 71.4), Netherlands (7 place – score 69.7), China (8 place – score 69.2), United Kingdom (11 place – score 66.8), other countries of European Union were listed on the official website [79].

The selection of those countries was conditioned by institutional, economic, geopolitical, and technological relevance to Kazakhstan. Consideration of models of those countries would define what was suitable and reasonable in the national content.

The United States' involvement in the digital economy and the establishment of digital hubs

The United States was leading the way in the development of information and communication technologies (ICTs). IBM, founded in 1924, was a renowned industry

leader. Since the 1960s, Silicon Valley, a prominent center for high-tech enterprises in the information and communication technology sector in the United States, has experienced significant growth. Although Hewlett-Packard, the pioneering high-tech company, made its debut there in 1939, private industry in this region actively engaged with the US government's technology to acquire information and communication technologies.

Intel appeared in 1968, followed by Microsoft's entry into the ICT market in 1975. Apple opened in 1976, and Ogasle in 1977. The Stevenson-Widger Act on technological innovation was passed in 1980. According to this law, specialised units within government laboratories should be involved in transferring valuable commercial proposals to the private sector. There was also the Bayh-Dole Act, which was considered one of the best laws of the 20th century.

According to the law, universities started to profit from the research conducted. For innovative development, initiatives were proposed in 1980, such as: "Small Business Investment Company Reform", "Small Business Technology Transfer", "Small Business Innovative Research", and "Manufacturing Extension Partnership" [79]. The ICT sector started to grow with for-profit companies such as Google (1996), Amazon (1994), Facebook (2004), and Uber (2009). The National Manufacturing USA project and the American Manufacturing Revitalization and Innovation Act of 2013 were enacted. The NNMI, also known as the National Network for Manufacturing Innovation, was an essential sub-program for the use of ICT. The primary goal was to create a nationwide network of 15 research institutes that would facilitate industrial technologies. The Fraunhofer Society, established in 1949, inspired a program aimed at advancing and commercializing industrial technology through collaborations among businesses, colleges, and federal government organizations. In 2017, funding for projects, research institutes, and tax incentives for development and research were introduced [79]. Coincidentally, traditional industries were experiencing a decline in their rates of development. Over the previous two decades, the level of industrialization in the American economy decreased. The industrial sector's contribution to GDP decreased from 17% in 1997 to 12% in 2013 [80, p. 186]. Moreover, China was vigorously closing the gap with the US in several domains. The government had launched initiatives to promote the adoption of ICT, including the allocation of wireless radio waves, streamlining connectivity to the internet regulations, and migrating to electronic government. The Presidential Council of Advisors on Technology and Science (PCAST) had been revitalised, offering reports and policy suggestions about innovation, technology, and science.

The country's plan aimed at investing approximately one billion dollars to finance the program until 2022 [81, p. 191]. The overhaul of the STEM speciality training system commenced in 2014. The National Foundation of Science administers postsecondary and postgraduate programs. The U.S. Department of Education supervises primary and secondary education, and the Smithsonian Institution coordinates specialised training programs. Simultaneously, the United States was home to the largest multinational ICT enterprises. Government initiatives were currently being put into action around the nation. The National Institute for Innovative Additive Manufacturing was established in 2012 as a pilot initiative. In 2014, the Department

of Defence and the US Department of Energy decided to build more academies. Those institutions would prioritise combined photonics, digital design, processing, AI, and other relevant areas [81, p. 194].

The Internet was used by over 88% of the country's population [82]. However, international estimations indicate that the United States was no longer a frontrunner in this field. Based on the 2017 International Telecommunication Union (ITU) Internet Development Index, the country had been ranked 16th, while China had been ranked 80th [82].

In 2016, a total of 34 million individuals, who accounted for 10 per cent of the nation's general population, did not have access to high quality internet services. A substantial proportion of the population in rural areas, amounting to 39 per cent, was unable to use the internet due to the absence of internet connectivity.

In the United States, the primary challenges to digitalization were systemic disparities: the hesitancy to raise taxes on both individuals and corporations, and the government budget shortfall. Consequently, there was a scarcity of financial resources allocated to public innovation initiatives. China was increasingly competing in information and communication technologies, surpassing the US in exports of radio equipment, computer hardware, telephones, and computers. The US was relocating semiconductor production, the third most significant export product, to relocate production [83].

The United States declared its "Digital Economy Agenda" in 2016 [84]. The study highlighted that the advancement of the digital economy played a crucial role in fostering economic growth and enhancing the United States' competitive edge.

Hence, it was imperative to wholeheartedly endorse the proliferation of the Internet and acknowledge its role as a worldwide medium for disseminating information, doing business, and fostering innovation.

Tufts University conducted research titled "Digital in the COVID Era". The research showed the USA to be ranked second in the whole list. Such companies as Apple, Google, Microsoft, Amazon, and Facebook also played a huge role in digitizing business in the USA. There were also significant factors that affected the digitalization of the USA: 1) Support of the government (strategy, programs, funds, and so on); 2) Research and development works, which affect the formation of innovations.

Great Britain

In 2010, DEA (The Digital Economy Act) was enacted in the UK. In 2011, the Catapult system was invented by the state “Innovate UK”. The Catapult centers after five years of functioning had been analyzed. There were 10 centers of Catapult across the UK. That system was proposed to promote research activities using state and commercial funding.

Social platforms such as eSchools, Network Locum, and Ref-Me were the most popular ones in the UK. The dedication of Britons to the digitalization process had been seen through the leading positions of the British nation in education and healthcare sectors [86]. The maximum capacity of the Internet in the UK referred to 24Mbps, which was available using DSL cable lines, fibre, and DOCSIS 3.0.

There had been an organization that was titled “TechUK”. Assistance of the British Government had been provided through that organization, which was a mem-

bership one, composed of 850 electronics and IT companies, telecoms. The labour force of TechUK comprised 50% along with other endorsed organizations [85]. The video games Grand Theft Auto and Tomb Raider were as popular as the leaders of property investigation engines, Rightmove and Zoopla Property Group [86]. ARM Holding had been producing 95 % of microchips for phones worldwide.

The rail transport system in the UK had been performing Europe's largest project, "Crossrail". It was also built by the BIM principle. That project was officially completed in 2023 in the UK. The first outcomes of digitalization in the building sector were assessed in 2015. According to the the national experts in the building sector, the practical use and significant effect of the use of BIM or building information modelling technology had been stated.

It was revealed that those centers had a strong demand for government and private funding. Orlowski A. [87] highlighted Transport Systems, Digital, Future Cities, and Energy Systems to be the four centersthat needed to oversee and decide whether to fund the project or not.

The "Digital Strategy" was presented in 2017 in the UK. According to the strategy, seven areas had been outlined, the main purpose of which was to position the UK as the digital economy leader in the world. It comprised the formation of high-quality digitalization infrastructure, the access of the population to digital skills, digital transformation of enterprises, and others, leading to the establishment of five technological hubs to increase the competitiveness of the UK. For that, digital skills were crucial, that was why entities of the private sector, such as Barclays, Google, and Lloyds Banking Group, had participated in the process of training in digital skills. The government's intention was seen through its declaration of funding 17.3 million pounds sterling in research into artificial intelligence and robotics at universities.

By the Parliament of the UK, the initiative was aimed at establishing a digital center in each town, city, and village. That initiative's purpose was to make a networked community, where the central point was the hub. As one of those planned hubs, the "Unity Place" campus was expected to be opened in Milton Keynes. The digital hub was oriented to become the digital banking innovation center, designed by LOM architecture and design. The hub's focused field of enhancing was to be the banking sector mainly: Office, Property, Bank, Investment, Business, Longpost, and Construction. It was designed to provide job positions for a total of 5000. Comprising 37000 square metres. The rooms were constructed for approximately 100-125 workers. The structure of the hub consisted of 8 floors, three atria connected by four blocks. The first floor was intended for startups and small businesses. The top floors were mostly intended for Santander workers.

The technological giant of the USA, Google, had invested $1bn into the construction and establishment of the hub in Hertfordshire. It was expected to be completed in 2025. The local public administration supported Google's initiative.

To enhance Industry 4.0 standards, the Indian company Apollo Tyres established a Digital Hub in London. Digital technologies like machine and artificial intelligence were used in manufacturing to improve management processes. The hub would collaborate with the STEM internship program and the University of Glasgow.

China

On March 3, the 863 Plan was initiated by the government. Later, in 1988, the Torch program was implemented. Under those plans, China made great changes in the ICT sector and acquired digital technologies [88, pp. 90–91]. Governmental support to R&D costs and credence on internal resources of business was maintained [88, p. 93]. Within the framework of public-private partnership, the bond between science and manufacturing was investigated [88].

Instead of using the method in technology management: "import-production-import", it used the method: "import- adaptation- innovation". Shultseva [88] considered China to be the country with the ability to institute the Internet system, nationwide with its substantial corporations such as Baidu, Tencent, Xiaomi Tech, WeChat, QQ, Weibo, ZTE, Huawei technology, TP-Link, and NetEase.

The 11th Five-Year plan was approved by the State Council of China with the Directive for the Technological and Scientific development of the country for 2006-2020.

The insurance industry showed 46% to the digital sector, financial services – 40%, instrumentation – 47%, video and audio manufacturing – 45%, and cultural and office equipment – 59%. The service sector, 30%, accounted for the digital sector, agriculture sector – 6%, and industry sector – 17% in 2016. However, there were also regional disparities in China, indicating the highest internet penetration in Beijing and Shanghai – 70%, leaving behind the southwest – 40% and central regions – 50% in 2017.

In 2015, the strategy "Made in China 2025" was launched. Its main purpose was to make China a leading force in the industry. China aimed to become a testing ground and a global manufacturing hub by the year 2025, digitizing health, education, energy, trade, industry, finance, agriculture, transportation, e-commerce, logistics, and other sectors. To accomplish that aim, China planned to establish 10 data clusters.

The core of the computer network of China aimed to form those clusters to facilitate cooperation in the enhancement of cloud computing and big data to equalize the gap in computing between regions. The National Energy Administration, the National Development and Reform Commission (NDRC), the Cyberspace Administration of China, and the Ministry of Industry and Information Technology (MIIT) approved the establishment of ten hubs.

The timeline diagram shows the enhancement of China's digital economy initiatives in Figure 2.



Figure 2 – Digital economy initiatives of China
Note – Collected by the author from the source [87, 88]

Overall, it can be seen that the enhancement of the digital economy in China began earlier in 1986 with the initiative of the government. The government's strategies and plans played a pivotal role in the enhancement of the ICT industry and the digitalization of sectors.

European countries

The strategic program "The Digital Agenda" was launched in 2010 [89]. One of the primary aims of that strategic program was to boost economic growth in regions of Europe through the digital transformation of sectors, using digital technologies. In 2015, "Strategy for a Digital Single Market" was ratified [90]. The investment plan of the European Commission was endorsed in 2016 [91]. The Digital Market Strategy encompassed five fields and received an investment of 50 billion euros [91].

The platform, EOSC (The European Open Science Cloud), was exploited by 70 million scientists, 1.7 million academics, and tech-workers. That platform received 6.7 billion euros in investment for its realization.

For the establishment of regional and national digital hubs and enhancing the management of operating hubs, the budget of €5.5 billion was allocated. The purpose of hub functioning was to facilitate digitalization and digital transformation processes in industries, through providing the latest digital technologies, equipment, and opportunities for testing. In 2016, 500 million euros were allocated for the creation of digital hubs in the European Union at the expense of the program "Horizon 2020" [92]. The activities of hub formation and the implementation of the Digital Single Market were described in the annual report on the website of the European Commission. 38 policies had been launched with the concept of a Digital Single Market. 23 laws had been implemented [93]. Free Internet access points in public places, the development of online services, 5G technologies, and others had been created.

Disagreements about the introduction of a digital tax on cybercorporations and telecommunications had emerged [94]. France, Germany, Italy, the Netherlands, Belgium, and Luxembourg were the first countries to initiate the establishment of digital hubs; however, the creation of those did not guarantee their functionality (309 out of 500 hubs were functioning). A rapid development of digital hubs had been observed in Italy and Spain, while a slow growth trend had been noted in Estonia, Romania, Latvia, and Portugal. The Netherlands had emerged as a leader in this field, investing significantly in the formation and operation of 23 hubs [95].

The plan "Digitalization of European Industry" was implemented from 2014 to 2020. A budget of 100 million euros was allocated for the implementation of this plan. The concept of digital hubs had been in circulation since 2017 within various forums, marketing promotions, training sessions, webinars, and conferences [96]. In 2017, the European Union Convention on Hubs was also held in Madrid, Spain.

The Digital Europe program was being implemented for the years 2021-2027. A budget of 9.2 billion euros had been allocated for the multiplication and development of digital hubs across all regions of Europe. A budget of 97.9 billion euros had also been allocated for research projects in line with the Union's digitalization and transformation goals [96]. Innovation, research, and advertising were priorities in the implementation of the program.

The establishment of digital hubs had been demonstrated to encourage innovation and research. A transparent reporting system was one of the elements that contributed to the development of those hubs. They utilized the following channels: radio, television, reports, magazines, online directories, podcasts, and social media. Digital platforms served as the basis for the establishment of digital hubs, creating a virtual digital marketplace. One of the main tasks of an operating hub was to develop an effective business plan. Management played a key role in attracting investment, generating revenue, attracting competent staff, analyzing market data, developing a staff motivation system, the value of hub formation, and consumer needs. There were successful examples of an efficient business model applied in digital hubs [97]. Examples of operating hubs were presented in Table 6.

Table 6 - Examples of operating hubs

Title	Practical experience
IT4Innovations	1) Use of virtual prototyping of a particular product; 2) Optimisation of the production process.
BDIH	1) Confirmation of the prototype concept; 2) Robotic system solution in trauma care; 3) Application for two international patents; 4) New cybersurgery company.
Digital Hub Logistics	1)Accessible ordering of spare parts at the touch of a button, so that logistics are automatically triggered.
Lithuanian Digital Robotics Innovation Hub	1) Subsidiary company in Denmark; 2) Attracting business angels; 3) Funding from Innobooster.
DIGIHALL	1) Additional income of 1.1 million euros; 2) New 2 jobs; 3) Reduction and reduction of carbon footprint; 4) Savings in energy consumption of 20%.
Note – organized by the author from the sources [96]	

The table demonstrated hubs such as DIGIHALL, Digital Hub Logistics, BDIH, IT4Innovations, and Lithuanian Digital Robotics Innovation Hub with successful business models, as a result of which they have achieved practical results, as shown in the second column.

Direct communication with the European Commission had played a pivotal role in the establishment of digital hubs in Finland. The country had catalogs of digital hubs for finding partners, which allow authors of projects to test the creation of digital hubs and obtain financial support. In Finland, the concept of digital hubs was presented to working groups in 2016. Here, the sectors of the hubs were different: transport, energy, services, and production. Thus, in Tampere there was a hub aimed at the manufacturing sector, in Oulu - at the electronics industry.

Scientists had predicted that the demand would increase for robotics [97]. Business and the digital economy were built on ecosystems [98]. Big Data Value Association and EuRobotics highlight the attributes of ecosystems [99]: - stakeholder participation, cooperation with stakeholders; - alignment and analysis of problems; - alignment and discussion of national and regional interests; - a center in Europe, for sharing and coordination of digital technologies. Initiatives such as EuRobotics, Vision, and Manufuture have been implemented [100].

Cordis (database) was used to test digitized robots in Europe [101]. Also in Europe, the program “ICT - innovation for production” was implemented. As a result of this initiative, the projects L4MS, Reconcell [102], and Horse [103] were realized. The COVR [104], ESMERA [105], and ROBOTUNION [106] projects had been realized for implementing security systems in medium and small enterprises and benchmarking. Projects to establish hubs in the robotics industry had been implemented under the Horizon 2020 program: DIHsquared [107], RIMA [108], TRINITY [109], AGROBOFOOD [110], and DIH-Hero [111]. The TRINITY project was implemented, which aimed to create a network of hubs specializing in robotics and the Internet of Things.

Since 2016, the European Commission had invested 100 million euros in digital transformation initiatives, in particular for medium and small enterprises, with the Digitizing Industry Initiative [112]. Budget was being invested to increase interconnectivity between digital hubs, as one did not have all the digital technologies and services that medium and small-sized companies need. During the project period, 500 companies completed 370 innovation trials through 150 digital hubs.

In Italy, the Piano Nazionale Industria 4.0 program had been implemented [113]. The national policy Mittlestand 4.0 in Germany focused on digital hubs and digitalization [114]. The Netherlands focused on the agro-industrial sector, in particular the implementation of smart field laboratories [115].

The program “Smart Factories in the European Union Member States” was also implemented for the development of digital hubs [116]. Within the framework of this program, instructions and training were provided to 34 active hubs. Other regions were not left out of the state's attention; 1.5 million euros were allocated. The purpose of the budget allocation was to strengthen the industrial capacity of regions that had no plans to develop digital hubs. As part of the implementation of the Horizon 2020 program, there were criteria and requirements for companies in the region and the

public administration of the region. The requirements were as follows: 1) access to all local digital hubs through the European Regional Development Fund; 2) support for companies with high innovation potential through R&D.

In 2019, was initiated the “Digital Europe” program [117]. The program plan aimed to establish more digital hubs in order to use digital technologies to leverage economic benefits. The goal of the program was easy and guaranteed integration of digital technologies into the national economy and society. The European Regional Development Fund was responsible for the establishment of digital hubs. The Digital Europe Program Committee selected the hubs for funding and finalized the program. Digital hubs were funded on a location-specific basis by a regional body, a member state of the European Union. The main objectives and themes of the project were: 1) opportunities for hubs not funded by the program to participate; 2) creation of marketplaces for hubs and a network of hubs; and 3) rigorous analysis in selecting hubs for funding. The following criteria were taken into account for the allocation of the hub budget: 1) the amount of the grant; 2) availability of the necessary equipment, software; 3) action plan for the development of hub services; 4) highly competent staff for service activities of medium and small enterprises. The task of the European Commission in the implementation of the program was to announce the establishment of the list of organizations that would create hubs on the territory of member countries. The list of applicant organizations included only those organizations that had passed the stages of the national processes and had the competencies to manage digital hubs.

The selection process was carried out through the submission of applications, in which the candidates' proposals were spelled out. The commission selected high - quality proposals from organizations. Next, a final selection was made, where the creation of a network of hubs was considered, taking into account geographical location and technological coverage.

One of the successful examples within the project was the Spanish experience. Using 3-D printers, HPC Podoactiva had shown the practical application of innovation, in particular in the orthopedic business [118]. The firm used laser scanning technology of human feet and artificial intelligence. As a result, they managed to create medicinal insoles. 3D Scan Insole Designer was developed in cloud software for an additional fee. That innovation contributed to the increase of private clinics in Portugal, Mexico, Spain, and Italy. Those private clinics had distributed personalized insoles throughout the world. The firm had collaborated with the IT company INYCOM and participated in the I4MS project [119]. The BIFI digital hub provided access to high-performance computer resources. The hub itself was specialized in biocomputing and the study of complex systems. The next practical example was the collaboration of the digital hub CEA LETI with the enterprise ENCORE LAB [120]. As a result of the collaboration, a gadget with sensors monitoring the harvest in the field was created. The enterprise conducted a test inside the hub. The company developed a device that automatically sent indicators such as temperature, air humidity, soil, and others to the cloud. The farmer in charge was given access to the cloud to quickly make technical decisions.

Also, 82 digital hubs were selected in the countries of Italy and Poland [121]. The hubs were divided into two: already existing and just launching. Data on 82 hubs were studied on websites. According to the achievements of the hubs, they were assessed. On the S3 platform, 68 already functioning and 15 preparing for launch were collected and displayed. 14 Polish hubs were reflected on the platform, of which 7 hubs were just getting ready to launch. According to the conducted research, it was found that the digital hubs of Poland were more focused on business management [122]. When comparing hubs between the two countries, the first difference was the number. In Italy, there were 45, and in Poland, 7 functioning. The second indicator of comparison was GDP. However, it had small differences, showing in Poland - 2.4 * 10-5 digital hubs / million euros, in Italy - 2.6 * 10-5 digital hubs / million euros.

The European Investment Bank collected primary data analysis, in particular a survey entitled "Who is ready for the new digital era?". According to that study and the accompanying report, 66% of companies had implemented one of the digital technologies [123]. 200 digital hubs and more than 2,000 startups and SMEs in Europe took part in the testing between 2016 and 2020 [124]. The study revealed that 20% of medium and small-sized enterprises were at a high level of digitalization; thus, within 3 years after the implementation of the "Industrial Strategy", the European economy grew. Organizations that had implemented digital technologies were more privileged and had improved organizational efficiency.

In Portugal and Spain, the digital technology of the Internet of Things was implemented in the following sectors: “Infrastructure”, “Services”, “Construction”, and “Manufacturing sector”. In terms of digital technologies such as artificial intelligence and the Internet of Things, the indicators of those countries exceeded the European Union, but 3D printing was completely absent in the “Services” sector [125].

Comparative analysis of countries was presented in Table 7.

Table 7 - Comparative analysis of digital hub establishment practices

Country/region	Funding	Model of governance	Digital ecosystem and infrastructure	Industry	Key features
USA (Sillicon valley, Boston Tech Hub)	angel investors, venture capital, corporate R&D	private-sector-led, market-driven	strong university-industry links, highly developed innovation clusters	AI, ICT, FinTech, Biotech	minimal government intervention, strong entrepreneurial culture, international talent attraction, high startup dynamism
UK (Cam-	university	hybrid	high-quality	cybersecuri-	strong aca-

bridge Science Park, London Tech City)	funding, government R&D incentives, private sector investment		research hubs, integration with financial sector	ty, FinTech, AI, quantum computing	demia-industry-government collaboration, specialized in financial innovation and FinTech
China (Beijing Zhongguancun, Shenzhen, Hangzhou)	foreign investors, government grants, state-owned enterprises	public-private partnerships (PPP), state-controlled	large-scale industrial zones, state-driven tech ecosystems	e-commerce, 5G, ICT, AI, digital governance	rapid infrastructure development, heavy state involvement, focus on national digital sovereignty, Belt and Road Digital Initiative
European countries	local government funding in each country, EU Horizon funds, corporate partnerships	EU regulatory framework, public-private	smart specialization strategies, regulatory-driven innovation	green tech, industry 4.0, AI, cybersecurity	strong policy and regulatory alignment across member states,
Note – Compiled by author, using sources [81,87, 90, 115, 118]					

Comparative analysis of digital hub establishment practices of the USA, Great Britain, China, and European countries was illustrated above. According to that comparative analysis, the type of funding, model of governance, digital ecosystem, industry, and key features of each country were presented. The analysis highlighted that countries mostly had the same goals in digitalization: improving digital infrastructure, developing innovation ecosystems, and attracting competitive specialists, in spite of diverse funding and governance models. In the case of Kazakhstan, it would be better to apply a hybrid approach of those countries integrating a structured regulatory framework of European countries, expertise of the UK in high-tech clusters, FinTech, and business parks, dynamism of entrepreneurship of the USA, and government support and infrastructure of China.

1.4 Methodological basics of establishing the digital hubs and the author's digital maturity assessment model

The purpose of the section was to conduct a thorough study of the activities of digital hubs and determine the level of digital potential by region of the country. The study used both quantitative and qualitative research methods. As a result, the integral index method was developed to evaluate the digital potential of the regions in Kazakhstan, and a digital maturity assessment model was designed to assess the maturity level of functioning digital hubs. The use of those methods contributed to an in-depth study of the topic, thereby allowing for the development of recommendations.

For today, there was no established mechanism for assessing the level of digitalization in economic sectors [126]. In 2018, a taxonomy of digital intensity (a method for categorizing economic sectors) was presented. That taxonomy took into account the following indicators: the share of IT specialists in an organization, the share of revenue from online sales, and the share of expenses on intermediate ICT consumption, the share of investments in tangible and intangible ICT acquisitions [127]. Those subindices created an indicator of digitalization intensity when combined. To compare the levels of digitalization in economic sectors, the indicator calculated the arithmetic mean of the subindices. It is used in annual and quarterly reports of the Organization for Economic Cooperation and Development [128]. An index was calculated for each country and divided into the following quartiles: low, medium-low, medium-high, and high. Scientists also presented the Digitization Index of Industry to categorize industry firms [129, 130]. To assess the effect of digitalization, expert reviews were used, case studies were conducted, econometric methodologies were applied, and sensitivity analysis was also used.

Desk research, specifically data collection from journals, publications, official websites of digital hubs, and agencies was conducted by scientists Hervas-Oliver et al. The study by Kalpaka et al. was based on the analysis of the formation and activity of digital hubs, assessing the differences between European digital innovation hubs (EDIH) and digital innovation hubs (DIH). In South Africa, secondary data from the official websites of Africa Economic Outlooks, the World Bank, and World Economic Outlooks were used to study digital hubs.

Many studies used qualitative research methods. In particular, interviews with hub managers, analysis of the service portfolios of the hubs, questionnaires, and collection of data from websites. In Europe, there was S3P, Smart Specialisation Platform – a database for digital hubs.

The choice of correlation and regression method was justified by the fact that the method had not been used in the context of digital hubs. The main purpose of using that method was to identify the correlation between the variables, and whether there was a linkage between the factors. Also, the aim was to highlight factors mostly affected by hubs, to examine the cause-and-effect relationships between the parameters listed below.

The data was gathered from the Bureau of National Statistics into Excel. The main indicators from the tables were put in Excel, sorted by year, region, and period. Then, using the program Smart PLS – 4, the calculations were made.

The use of correlation and regression methods in the study was carried out to test the following research hypotheses [131]:

Hypothesis No.1: ICT costs affect the number and level of innovation activity of hub stakeholders (participants). The results of the study revealed that:

H1: ICT costs affect the number of operating legal entities (enterprises) of the RK by region and dimension - confirmed

H2: ICT expenditure affects the number of active SMEs - confirmed

H3: ICT spending affects the number of universities - not confirmed

H4: ICT spending affects the number of research organizations - confirmed

H5: ICT spending affects the level of innovation activity of organizations - not confirmed [132, p. 2-3].

Hypothesis No. 2 was tested using the integral index method.

H2: The level of digital potential in the regions is uniform; there were no statistically significant differences in the indicators of digital literacy, implementation of digital technologies in organizations, or differences in digital infrastructure.

The next hypothesis was tested using the anonymous questionnaire method, where the hypothesis was rejected. According to the results of the conducted questionnaire, about 80% of students plan ICT activities.

H3: Students at the undergraduate level, plan ICT activities less than 50%, studying in economics and management specialties.

H4: The economic efficiency of the Astana hub was high. The hypothesis was tested by evaluating the economic efficiency of the hub. The hypothesis is confirmed.

Data from the Office for National Statistics was gathered (2007-2023). The method of correlation and regression analysis was applied to test the first hypothesis. With the help of those analyses, the impact of ICT costs on the innovation activity of hubs was estimated [132, p.5].

To evaluate the first five hypotheses, the formula was used to assess correlation.

$$r_{xy} = \frac{\Sigma(x_i - x_{medium})(y_i - y_{medium})}{\sqrt{\Sigma(x_i - x_{medium})^2} * \Sigma(y_i - y_{medium})^2} \quad (1)$$

Where r_{xy} is the Pearson correlation coefficient,

x_i is the sampling element x,

y_i is the sampling element of y,

x_{medium} and y_{medium} are the selection elements of y and x.

The variables are selected as follows for the period 2007-2023:

Y is the cost of ICT,

X1 is the number of registered RK legal entities by size and region;

X2 is the number of active medium and small enterprises;

X3 is the number of higher education institutions;

X4 is the number of organizations performing R&D in units;

X5 is the percentage of the level of innovation activity [132, p.6].

Value meanings of hypothesis 1 were presented in table 7, ANNEX C.

Descriptive statictics were presented in table 8.

Table 8 – Descrptive statistics of indicators

Name	Mean	Median	Observed min	Observed max	Standard deviation	Excess kurtosis	Skewness	Cramer-von Mises p value
Y	4879545.267	3098212	534 858	23 707 936	5 962 418.203	6.543	2.584	0
X1	362 033.8	353 833	268 564	481 732	68 547.113	-1 3	0.353	0.294
X2	1 000 170.9	926 844	643 376	1 431 647	269 674.211	-1 565	0.131	0.167
X3	134.4	127	122	167	13.890	0.599	0.972	0.012
X4	396. 7	392	341	438	27.930	0.130	-0.659	0.277
X5	72.8	81	4	117	38.164	-0.885	-0.669	0.073
Note: Type of data – MET								

The use of descriptive statistics indicates the normality of data distributions, skewness, and outliers to analyze the data. Indicator values measure the interaction between variables. It can be seen that the meanings of X3 and X5 may indicate a significant deviation from normality of distribution, according to the meaning of Cramer-von Mises p value. According to the above table, the Cramer V coefficients of X10.294, and X4-0.277 at degrees of freedom = 2 indicate a moderate (or medium) relationship between the indicators. The correlation matrix is presented below in Table 9 [132, p.7].

Correlation matrix is presented in Table 9.

Table 9 – Correlation matrix

	Y	X1	X2	X3	X4	X5
Y	1					
X1	0,865423	1				
X2	0,949451	0,956166	1			
X3	-0,78011	-0,8714	-0,84254	1		
X4	0,072179	0,061451	0,111215	0,266531	1	
X5	0,753793	0,945528	0,888087	-0,87944	-0,13171	1

The Pearson correlation matrix is a table with the correlation coefficients between the variables. It measures the degree of linear relationship from -1 to 1. In the case of a value of 0, it shows the absence of dependence. It was found that Y indicators have a strong positive correlation with X1, X2, and a moderate correlation with X4. X3 and X5 have a negative correlation with Y[132, p.9].

The regression statistics are presented in Table 10.

Table 10 – Regression statistics of indicators

Item	**Meaning**
Plural R	0,956518414
R-square	0,914927476
Adjusted R-squared	0,867664963
Standard error	42652,74171

Observations	15

Plural R was a responsible variable of multiple correlation between two predictor variables. It indicated 0,96. Adjusted R-squared was the number of adjusted predictor variables in the model. R-Square was the coefficient of determination. The mean distance showed 42652.74171.

The ANOVA test is presented in Table 11.

Table 11 – ANOVA test

Item	df	SS	MS	F	Sifnificance F
Regression	5	176000000000	35217924863	19,35841772	0,000141881
Residual	9	16373307380	1819256376		
Totals	14	192000000000			

The number of regression coefficients was equal to the degree of freedom – 1. The P-value from the overall F-statistic represented the F value. F statistic was calculated as MS for the regression model. Significance F showed 0,000141881. It represented that the regression model was statistically significant, cause it was less than the usual significance level of 0.05 [132, p.9].

Overall regression significance was presented in Table 12.

Table 12 – Overall regression significance

Item	Coefficients	Standard error	t-statistics	P-Value	Bottom 95%	Top 95%
Y-intersection	215829,3386	302910,2745	0,712519042	0,494200147	-469401,3085	901059,9858
X1	1,005747703	0,758889966	1,325287919	0,217732121	-0,710980668	2,722476074
X2	0,522499798	0,161562228	3,234046739	0,010255958	0,157020646	0,88797895
X3	389,9517178	2107,791565	0,185004876	0,857327141	-4378,204069	5158,107504
X4	-1445,624976	614,860955	-2,351141285	0,043224193	-2836,537089	-54,71286215
X5	-42120,43271	18271,84737	-2,305209313	0,046600444	-83454,22311	-786,6423089

The data represented the results of multivariate regression analysis. It aimed to identify the dependence of the dependent variable (Y) on the independent factors (X1, X2, X3, X4, X5). X2 significantly and positively affects the Y. An increase in X2 leads to an increase in Y. X4 and X5 have a negative impact on Y. As those factors increased, the value of Y decreased. X1 and X3 are statistically insignificant; their influence was not confirmed by this model.

To test hypothesis no. 3, a questionnaire survey of undergraduate students was conducted in order to determine their interest and planning of activities in the ICT sphere, as there was a shortage of IT personnel in Kazakhstan. Students from the Higher School of Economics and Business, as well as the School of Information Technology (the names of the universities remain confidential), were selected.

The choice of the method was justified by the fact that no primary data on future specialists was found. The questionnaire was arranged in Google Forms and sent to 200 students. The link to the questionnaire was sent out to the deans of the depart-

ments, to the students of master's and doctoral degrees of anonymous universities. The aim of using the method was to identify how far young graduates planned to work in ICT sphere. It was revealed that more than 80% of them plan to work in the ICT. 170 questionnaires were returned out of 200 sent [133, p. 7-8]. A 16-question questionnaire was offered to students (Appendix C). The results showed that the shortage of specialists was not because they did not intend to work in the sphere, but in the specialties, education, and skills the ICT sphere was needed. Risks, mechanisms, and drivers of hubs in the country were proposed in the paper [134]. The role of R&D expenditures and its impact on innovation was also analyzed, showing the critical value of R&D expenditures to innovations [135]. Regional studies were also examined, and showed differences in ICT; depressed regions were identified [136, 137, 138, 139].

To evaluate hypothesis number 4, economic efficiency was evaluated. Return on assets, sales, equity, and current liquidity ratio were evaluated [140]. Data (financial report) of the Astana hub is taken from the official website of the hub, for the available 2018-2021. Data on other hubs were not active, and mostly there was no official website. The choice of the method was justified by the fact that to answer the question, whether the establishment of further hubs was necessary or not, was it effective to establish the hub, how was it economically effective.

To test hypothesis number 2, the integral index method was applied [141]. To assess the digital potential of regions of Kazakhstan, multiple technological and socio-economic indicators were consolidated into a single measure, based on an index approach. The choice of the integral method was justified by the fact that to identify the regions-leaders, and regions-outsiders in digital development in Kazakhstan, to further give recommendations for improving that situation.

The indicators are divided by time periods for 2010-2023, and for 2019-2023 by data availability. The following indicators were evaluated: 1) the share of medium and large enterprises using digital technologies (Table 12, ANNEX C) [142]; 2) digital literacy of the population aged 7 to 64 years (Table 13) [143]; 3) the share of Internet users aged 16-74 years (Table 14) [144]; 4) the structure of gross regional product: information and communication (Table 15) [145]; 5) Index of physical volume of gross regional product [146]; 6) Labor productivity by regions: information and communication (table 16) [147]; 7) Number of employed population by types of economic activities and regions for 2010-2023: information and communication (table 17) [148].

The scientific justification of the selection of indicators was that the ones reflect economic performance, digital infrastructure, workforce capacity, and technological adoption as key components of regional digitalization potential. The combination of factorsleads to a multidimensional and comprehensive evaluation.

For the calculation of the integral index of regions, Microsoft Excel was used. Normalization aggregation, and equal weighting [149, 150] methods were applied.

Z-score normalization was applied, as the indicators had diverse measurement units. The formula was applied:

$$Z_{ij} = \frac{X_{ij} - \bar{X}_{ij}}{\sigma_j} * (-1) \quad (2)$$

Where:

Z_{ij} - standardized value of indicator j for region i

X_{ij} - actual value of the indicator

$\bar{X}_{ij}$ - mean (average) value of indicator j

σ_j- standard deviation of indicator j

For the adjustment of the direction of the scale, the multiplication by (-1) was applied for indicators where more favorable conditions or lower values indicated better performance.

The steps were accomplished to calculate the standardization in Microsoft Excel. First of all, mean, standard deviation were calculated for each indicator j, entering in the end of each column =AVERAGE(C2:C295). Standard deviation was calculated entering in the end of each column =STDEV.P(C2:B295) (ANNEX N). Secondly, the standardization formula was applied (ANNEX O). To ensure methodology objectivity and distorting the results weighting was not applied in the study. Assigning arbitrary weights in the study could overemphasize some indicators while downplaying others. Then, integral index was calculated =N2+O2+P2+Q2 for each region's indicator (ANNEX P). Average index was calculated using the formula in Excel: =AVERAGE(R2:R16), for two time periods – 2019-2023 and 2010-2023 (ANNEX Q).

To construct the composite digital potential index of regions, the 7 indicators were standardized using the z-score method. To avoid subjectivity in the absence of empirical justification for differential weighting, all indicators of the study were treated with equal importance. The simple arithmetic mean of the normalized score was used to calculate the final index for each region. That aggregation method ensured comparability, consistency and interpretability across all regions of the country.

According to the assessment of indicators for the period 2010-2023 Astana and Almaty showed the highest performance, while for the period of time 2019-2023, digitalization indicators varied with nearly the same values across regions. That was justified by the fact that the digitalization indicators were more recent generated from 2019 in the Bureau of National Statistics. Detailed analysis was presented in chapter 2, subchapter 2.1.

Based on the D-Best model pillars (a detailed overview was presented in chapter 3), the criteria, indicators, and scale were proposed by the author to assess digital hub maturity.

The purpose of formulating thatscale was to guarantee the efficient administration and advancement of hubs, and the growth of the digital economy, and enhancing the country's competitiveness in the global market. The methodology for assessing a digital hub is proposed in Table 13.

Table 13 - Proposed assessment of a digital hub

Criteria	Evaluation process	Indicator
1. Strategic planning and adaptability	1 point: Absence of a well-defined plan for the advancement of hubs.	1. Availability of a strategic plan, its adaptation to regional and industry specifics (strategic planning document); 2.Website and reporting availability
	2 points: Preliminary strategizing without considering geographical particularities.	
	3 points: The overall plan is established, but there is little customisation to meet the particular requirements of each hub.	
	4 points: Specialised strategies have been created, considering the unique characteristics of different regions and industries.	
	5 points: Comprehensive strategic planning that includes consistent monitoring, review, and adjustment to accommodate changing circumstances	
2. Capital allocation and funding	1 point: Insufficient or nonexistent allocation of resources towards the advancement of hubs.	1.Availability of funds; 2.Availability of investors, investment; 3.Availability of private funding; 4.Investment volumes
	2 points: The first step is the provision of initial money, mostly sourced from public sources.	
	3 points: This investment opportunity involves a moderate level of commitment and is only available to a select number of private individuals.	
	4 points: The organization has ample financial resources due to substantial investments from private and international sources.	
	5 points: Robust investment assistance with a diverse array of financing options and incentives for investors.	
3. Infrastructure development	1 point: Insufficient infrastructure to enable digital hubs is a key issue in infrastructure development.	1.Availability of laboratories, incubators; 2.Availability of accelerators; 3.Availability of research institutes; 4.Availability of technoparks, datacenters
	2 points: Insufficient comprehension of hub requirements during the development of infrastructure initiatives.	
	3 points: Adequate infrastructure development with a few specialist resources.	
	4 points: The infrastructure is well-developed and includes technology parks, incubators, and research institutes.	
	5 points: A comprehensive and versatile infrastructure that completely satisfies the requirements of creative development.	
4. Human resource potential and education	1 point: There is a significant shortage of skilled professionals since there is a lack of specific training programs.	1.Level of specialist training; 2.Accessibility of educational programs, schools; 3.Trainings; seminars, courses in the hub; 4.Shortage of IT,
	2 points: The problem is caused by two variables: a shortage of educational curricula and competent specialists who are not sufficiently customised to meet the needs of the digital economy.	
	3 points: Educational courses and the availability of trained professionals are developing moderately. Initial efforts have been made to adapt these curricula to the precise demands of digital hubs.	

	4 points: Comprehensive educational initiatives involve frequently revised seminars and classes to boost the continued education of specialists; active connection with hubs to meet staff needs.	management economics graduates of bachelor's degree.
	5 points: The educational sphere has achieved an excellent level of development with a diverse range of specialised programs that aim to train and develop highly skilled professionals for digital hubs. There is a strong integration between educational institutions and digital hubs, including collaborative research projects and practices.	
5. Innovation activities and outcomes	1 point: Complete absence of innovative solutions and developments.	1. Total number of startups registered and supported in the hub; 2. Number of innovative products (new technologies, services and solutions) developed and implemented; 3. Number of registered patents created by startups and companies in the hub.
	2 points: Small innovation efforts with minimal impact on hub activities.	
	3 points: Moderate innovation activity, limited number of implemented technologies.	
	4 points: High level of innovation, including adaptation of technologies to the needs of the region and industry.	
	5 points: Excellent level of innovation activity, high number of successful developments, active participation in international projects.	
Highly Effective:	18 - 20: Digital hubs that fully satisfy all requirements, have a well-documented history of success, and have a substantial influence on the local community.	
Efficient:	14 - 17.9: Digital hubs that fulfil the majority of requirements, demonstrate a certain degree of success, and possess the capacity for expansion and long-term viability.	
Moderately Effective:	8 - 13.9: Digital hubs that partially match the requirements, achieve limited success, and need extra assistance and resources to enhance their effectiveness.	
Ineffective:	0 - 7.9: Digital hubs that fail to fulfil the majority of requirements, have little or no success and do not contribute to the digital innovation ecosystem in Kazakhstan.	

The relative importance of each criterion is reflected in its assigned weight. In this context, the formation of digital hubs is the overarching objective. In the proposed evaluation system, the weight distribution is as follows:

-Strategic Planning and Adaptability: 25%. Rationale: Strategic planning serves as the foundation for the long-term sustainability and adaptability of digital hubs.

-Capital Allocation and Funding: 20%. Rationale: Financing is a critical element for implementing the plans and ensuring the sustainability of the hub.

-Infrastructure Development: 20%. Rationale: The availability of specialized infrastructure provides the necessary foundation for technological growth and innovation.

-Human Resource Potential and Education: 20%. The following section presents a justification for the aforementioned argument. It is imperative that training and educational initiatives be implemented in order to cultivate the skilled workforce that is necessary for the digital economy.

- Innovation activities and outcomes: 15%. Innovation is a relevant criterion, though not as primary as the others. The availability of infrastructure, finance, strategies, and human resources is a significant factor in determining the importance of innovation. Consequently, it is given less weight than the other criteria.

Methodology for Calculating Scores and Ratings

Each criterion is evaluated on a 5-point scale: 1 - minimum, 5 - maximum. The final score is converted to a percentage or a 20-point scale for more detail.

Scores for each criterion are calculated on a scale of 1 to 5, by the levels suggested in the rating scale. The final rating of the digital hub is calculated based on the weighted sum of the scores.

$$\sum_{i=1}^{n}(P_i * W_i) \quad (3)$$

Where:

P_i= Score on criterion (1-5).

W_i= Criterion weight (in percentage converted to a decimal value).

Weighting values:

Strategic planning and adaptability: W=0.25

Capital allocation and financing: W=0.2

Infrastructure development: W=0.2

Human resource capacity and education: W=0.2

Innovation activities and outcomes: W=0.15

Calculation of the final score was conducted using weighted sum formula:

$$S_{20} = \sum_{i=1}^{5}\left(S_{20,i} * w_i\right) \quad (4)$$

Where:

S is the final score;

x_i- score on i-th criterion;

w_i- criterion weighting factor (in percent or fraction, the sum of all coefficients equals 1);

n - number of criteria (in this case 5).

Interpretation of the final results was based on the score obtained S, and the performance levels are determined:

Evaluation of the activity of digital hubs in the form of a scale with evaluation criteria on a 5-point scale is proposed by the author, and this scale was tested in the hub “Sifro”. The results are presented:

-Strategic planning and adaptability – 3 points out of 5, indicating the overall plan is established, but there is little customisation to meet the particular requirements of each hub;

- Capital allocation and funding - 4 points: The organization has ample financial resources due to substantial investments from private and international sources;

-Infrastructure development - 3 points: Adequate infrastructure development with a few specialist resources;

- Human resource potential and education - 1 point: There is a significant shortage of skilled professionals since there is a lack of specific training programs.

- Innovation activities and their results – 4 points: high level of innovation, including adaptation of technologies to the needs of the region and industry.

Applying the weighting factors:

Strategic planning: $w_1 = 0.25$

Funding: $w_2 = 0.2$

Infrastructure: $w_3 = 0.2$

Human resource capacity: $w_4 = 0.2$

Innovation activities and outcomes: w_5=0.15

Formula: $S_{20} = \sum_{i=1}^{5}(S_{20,i} * w_i)$, $S_{20} = (12 \cdot 0.25) + (16 \cdot 0.2) + (12 \cdot 0.2) + (4 \cdot 0.2) + (12 \cdot 0.15)$ = 3.0+3.2+2.4+0.8+1.8=11.2

Sifro Hub received a score of 11.4 and is categorized as Moderately Effective.

Scientific validity of the summative assessment was that on a 5-point scale with percentages: the final grade can be converted to a range of percentages (0-100%). On a 20-point scale, the final score was directly expressed as a percentage, which provided greater accuracy. For example, 11.2 was 55%.

By applying this methodology, criteria, and scale for controlling the establishment of these hubs, the nation may cultivate a prosperous digital economy and establish itself as a frontrunner in digital innovation and entrepreneurship.

An efficient framework for establishing digital hubs in Kazakhstan necessitates the careful examination of several issues, including economic, technological, educational, and social dimensions. A scale of this kind may be used to evaluate the preparedness of different areas to establish digital hubs, determine the allocation of investments and resources, and monitor the advancement and efficacy of management strategies. Presented below is an example model of a management scale, accompanied by a justification for its fundamental components.

To efficiently oversee the establishment of these hubs in the country, it is advisable to create a thorough assessment framework including many essential criteria. A scale of this kind would evaluate the present condition of projects, pinpoint areas that need improvement, and streamline the distribution of resources. The evaluation may be conducted using a five-point scale, where a score of 1 represents an inadequate degree of development or efficacy, and a score of 5 represents a high level of development or effectiveness.

The study employed both qualitative and quantitative methods to examine the context of establishing of hubs in Kazakhstan in depth. The justification of the methods was that the concept of digital hubs was new to Kazakhstan and had not been properly studied yet. Mostly, interviews and analysis of service portfolio were applied in foreign countries. But, in the case of Kazakhstan, firstly, the linkage between variables was examined to identify what stakeholders mostly affect ICT, which was the basis of digitalization and hubs. For the identification of the most valuable variables, the correlation and regression analysis were applied. Also, the hypothesis were tested and showed that mostly, the number of SMEs, enterprises, and R&D centers affect ICT expenditure more than other variables.

To assess the digital potential of the regions, the method of integral index was used in the study. The usage of the method aimed at uniting diverse indicators into one index, which showed the digital potential of the region to assess its readiness to establish the hub. The integral index method identified leader regions, Almaty and Astana, while other regions showed a lower index and nearly the same result. It was recommended by the author to strengthen the potential of the region by establishing a hub, and, according to the specifics of the region, to identify its leading sector. The hypothesis showed that there were differences between the indicators of the regions.

The survey was conducted to identify the interest and plans of graduate students to work in ICT. The results showed that more than 80% of students plan and aim to work in the sphere. However, the companies did not meet the qualities and skills of students with the reality. Most students did not know how to use them, and had never seen digital technologies. As the shortage of IT specialists was mentioned by the government, the survey was conducted and showed that the question was not about the purpose of specialists, but about the trend of knowledge they needed.

The interview with the director of "Sifro Hub" highlighted the aspects that couldn't be found on the Internet and were very specific on the topic. The organizational structure of the hub, including management of the hub, was provided and sent as a Word-file by the director. Also, it was mentioned that the shortage of web-designers was crucial. The interview with the director helped to look at the concept and nature of the "hub" from an insight.

The assessment model of the author was tested by the "Sifro Hub's" director. The results showed that the hub's maturity level consisted of 55%, lacking projects, as projects played one of the significant roles in assessing the maturity and development of the hub. The maturity model assessed the hub as a functional result of its development.

The applications of the methods were consistent with the goal and aims of the research. The research difference was that the case of Kazakhstan had not been properly analyzed yet, as the term "hub" was correspondingly new to Kazakhstan.

Conclusions of the first chapter

Industry 4.0 is a worldwide phenomenon that centers on the transformation, digitization, and use of digital technology across all aspects of life. Its primary goal is to enhance global productivity and efficiency. In the development of digitalization in Kazakhstan, President K-J. K. Tokayev highlighted the main strategic directions in the message to the nation on September 1,2021. One of the directions indicated by the president is the development of Kazakhstan as a digital hub of Eurasia. As part of the specialty "innovation management", the study was defined as the establishment of hubs in the country.

The first chapter of the thesis provides the evolution of the concept of digital hub development, the main functions performed by the head actors of digital hubs, the experience of foreign hub administration, and the theoretical and methodological rationale for assessing the level of digitalization.

Digital hubs are centers for providing digital services to local organizations and enterprises, and medium and small businesses to apply digital technologies in their activities. The range of services of each digital hub differs depending on a particular

digital technology or two or more digital technologies. The administration of hubs focuses on one sector of the economy, for example, education, trade, transport, air transport, the agricultural sector, and others. To date, 5 digital hubs are operating in Kazakhstan: 1) the Caspian Digital Hub, operating in the maritime sector; 2) the Parasat Digital Hub, operating in the agro-industrial sector at Akhmet Baitursynov University; 3) the Astana Hub; 4) the MOST IT Hub; 5) the Sifro Hub.

The origins of the digital hub concept can be traced back to 1959 when a business incubator was first created. From 1990 to 1999, the development of basic infrastructure financing by states, followed by the development of software such as Microsoft Office and others, concluded this period with the launch of the Internet and the transfer of technology. From 2000 to 2010, international meetings were held on the development of digital cooperation, and both private and public funding were discussed in the form of investment in specific projects to develop the Internet; there was the emergence of the mobile Internet, e-commerce, the development of technology such as phones, digital innovation, and others. The development of social networks, email, Vkontakte, and Facebook from 2011 to 2017, and the development of the digital hub, an essential digital infrastructure, involves the combination of additive technologies, artificial intelligence, venture capital, and initiatives that foster digitalization. Then, from 2018, there is the development of virtual transformation, robotics, 5G, sharing economy, and the fourth industrial revolution.

Foreign experience in the establishment of digital hubs shows the creation of the first digital hubs in European countries. To date, the European Commission is implementing digitalization programs Horizon, and various digital projects for the introduction of digital technology. The scientific community of foreign countries actively publishes articles on the development and analysis of existing and functioning digital hubs in their regions. Basically, global experience in the establishment of hubs considers the development of robotics, artificial intelligence, and cybersecurity as the main digital technologies contributing to the rapid pace of digitalization. Europe is adopting sophisticated digital technology, including additive 3D printing, to construct houses that have already accommodated their first residents. Also, digital technology, such as 3D printing, is used in almost all areas, ranging from medicine (making teeth in dentistry, parts) to construction (3D houses, apartments). Also, the experiences of Finland, Spain, Italy, Portugal, and others were considered.

The methodology for assessing digitalization shows various methods for assessing the development of digitalization, including various indices and sub-indices by which various indicators of digitalization are calculated. In particular, the methodology of digital hub management was considered as a definition and analysis of the range of services offered by hubs, analysis of test sites, the search for funding development for the organization, and assessment of the level of competence of the available specialists.

In this study, the author presented a method for assessing the digital readiness of regions for the establishment of digital hubs and a digital maturity assessment model.

2 ANALYSIS OF THE CURRENT STATE OF DEVELOPMENT OF DIGITAL HUBS IN KAZAKHSTAN

2.1 Analysing digital potential in the regions and industries of Kazakhstan

The adaptation of the meaning to the digital potential, as a component of innovation potential, allowed for its classification as scientific, infrastructural, technological, material, and technical resources (conditions) that enable market participants to perceive and advance digital technologies. In this instance, alongside the resource aspect of digital potential, there was a notable element highlighted, which is accountable for the ability to comprehend the prospects and outcomes of digitalization. The region must possess digital resources and well-developed digital infrastructure, and also efficiently use them in the operations of the authorities, economic organizations, and the region's population. In addition, the region's electronic assets enhance its potential for information dissemination, including the information resources of the area, such as information infrastructure, regional authorities, individuals, and economic enterprises. These resources were utilized to achieve the aims of territorial development.

Digital potential comprises physical infrastructure, technological capabilities, human and financial resources, and institutional support. It refers to the combination of digital infrastructure and administrative and socio-economic conditions that enable the effective utilization of digital technologies for territorial development. It represents the extent to which the introduction of digital technologies contributes positively to regional development while minimizing negative effects and advancing the quality of life for the population. According to the website “zakon.kz”, the Almaty Akimat and a Singaporean company have signed a memorandum of cooperation. On 28 July, an agreement of collaboration was signed between the Digitalization Department and the Singaporean company CrimsonLogic PTE Ltd during a press conference. This was undertaken as a component of the advancement of intelligent urban initiatives. A smart city project entailed the efficient integration of digital technologies into the business processes and subculture of a city. A prominent Singaporean corporation specialized in delivering digital government solutions throughout Singapore. Therefore, the authorities in Almaty made the decision to collaborate with it. The purpose of the memorandum was to establish a centralized data repository. The primary objective of the Almaty City Akimat in digitalization development was to establish a comprehensive ecosystem. That strategy entailed the consolidation of all information systems into a unified system for comprehensive administration. Kazakhstan and Singapore had agreed to collaborate on a platform for localizing their solutions, based on their experiences in Singapore.

Digital potential encompassed both the current level of development and the potential resources and opportunities to enhance the effectiveness of activities. Furthermore, it was imperative to consider the prevailing and potential limitations stemming from both the external and internal surroundings, specifically the conditions of international collaboration, socio-demographic elements, priorities of state (regional) policy, and government backing for the advancement of digital capabilities, among others.

Method of integral index was applied, for the following ICT and enterprise indicators: 1) Share of large and medium-sized enterprises using digital technologies (Table 12); 2) Digital literacy of the population from 7-64 years old (Table 13); 3) percentage of Internet users aged 16-74 years old (Table 14); 4) Structure of Gross Regional Product: information and communication (Table 15); 5) Index of physical volume of Gross Regional Product (Table 16); 6) Labor productivity by regions: information and communication; 7) Employed population by economic activity and region for 2010-2023: information and communication (Table 17).

The data presented in the thesis covers the most relevant periods, allowing for an analysis of digitization trends and the management of digital hubs. The inconsistency in the time periods for the different indicators is due to:

- *Limited statistical data available in some regions and sectors;*
- *Administrative and territorial reforms that have changed the structure of the regions (e.g., the creation of the Abay and Zhetysu regions);*
- *Different periodicity of data publication in official sources. The data were selected taking into account their significance and reliability for the study.*

The present study sought to analyze the dynamics of changes in the value of the integral index of the Abay region for the period 2019-2023. To this end, the key indicators of the region's digital potential were considered, such as the share of large and medium-sized enterprises in the manufacturing industry using digital technologies; the level of digital literacy of the population; and the percentage of Internet users aged 16-74 years old. The values were aggregated using the integral approach, which allowed for the calculation of an average index for each year. Results are presented in Figure 3.

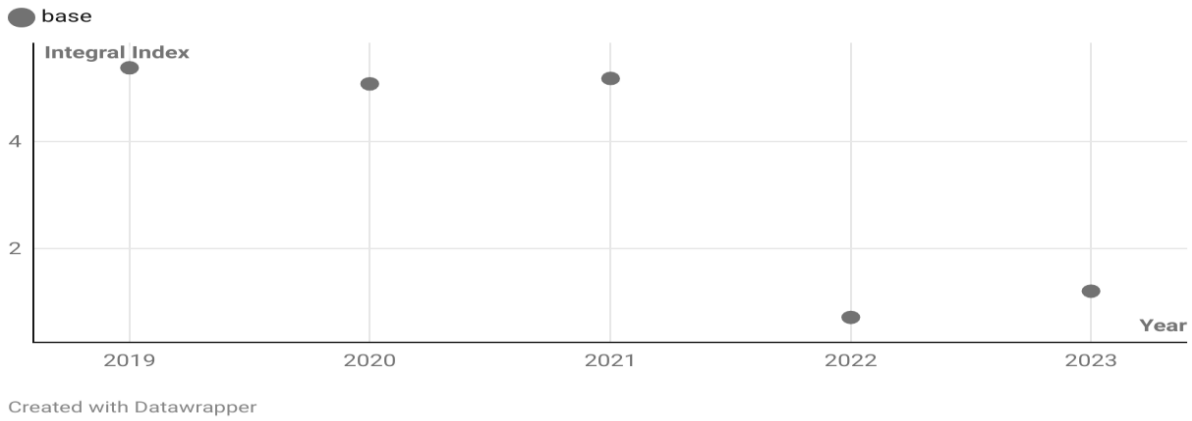


Figure 3 – Integral index of Abai region for five year period
Note – Organized by the author using software datawrapper

As can be seen from the table, in 2019 the meaning of integral index showed 5,38, in 2020 - 5,08, in 2021 - 5,18, in 2022 - 0,72, in 2023 - 1,21. The overall trend indicates a sharp decline in the digital potential of the Abai region during the five-years. Results are presented in Figure 4.

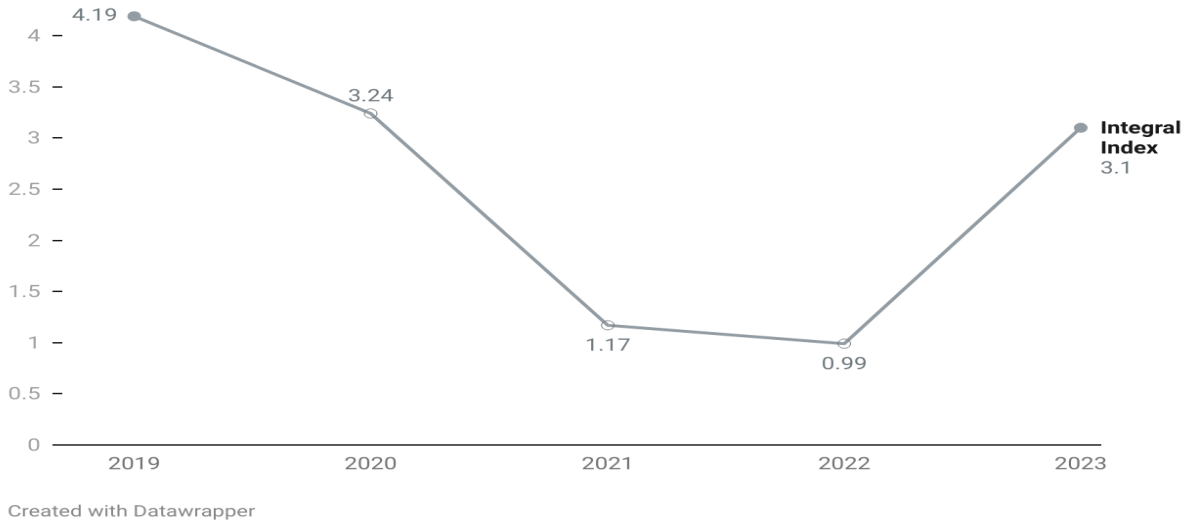


Figure 4 – Integral index of Akmola region for five year period
Note – Organised by the author using software datawrapper

The highest value is indicated in 2019, then the value drops significantly in 2020, showing the lowest value in 2022. In 2023, the value increased to 3.1.

Aktobe region's integral index of indicators: 1) Share of large and medium-sized enterprises using digital technologies (Table 7); 2) Digital literacy of the population from 7-64 years old (Table 8); 3) percentage of Internet users aged 16-74 years old (Table 9) for five-years.

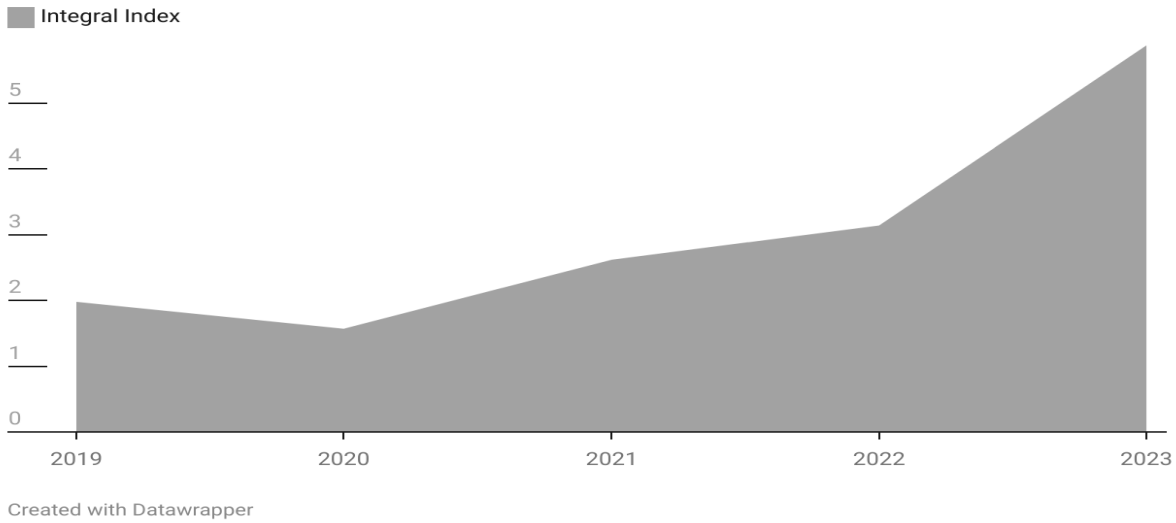


Figure 5 – Integral index of Aktobe region for five year period
Note – Organised by the author using software datawrapper

The integral index's meaning in 2019 showed 1,98, decreasing in 2020 to 1,57, in 2021 - 2,62, in 2022 - 3,14, in 2023 - 5,88. Overall, the number of graduates increases in the figure.

Almaty region's integral index for 2019-2023 is presented in Figure 6.

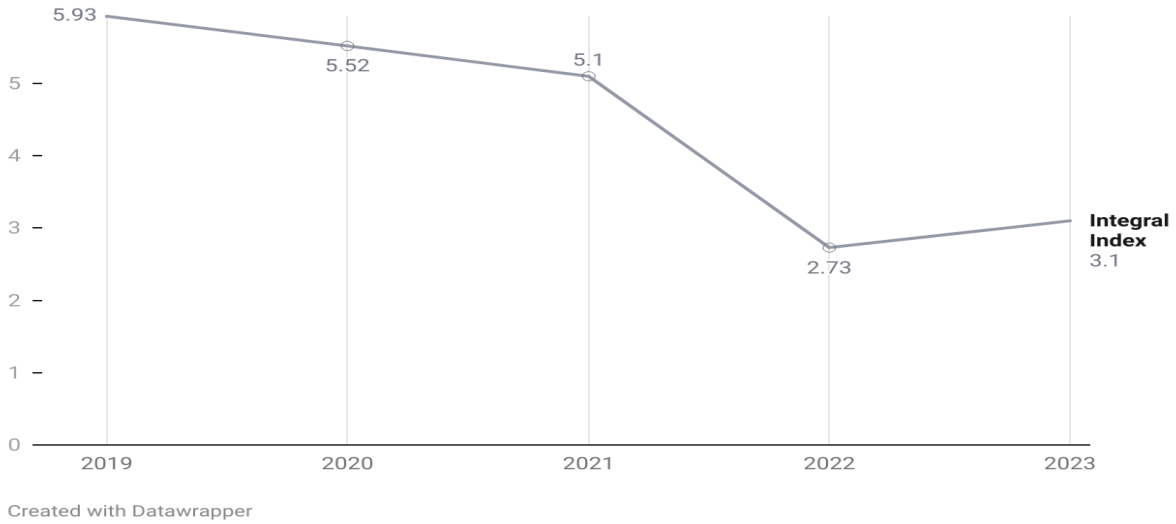


Figure 6 – Integral index of Almaty region for five year period
Note – Organised by the author using software datawrapper

Figure 6 shows a gradual decline from 2019 to 2023. The highest value was shown in 2019, indicating 5.93, further it gradually fell to 2.73, increasing to 3.1 in 2023.

The next figure shows the Atyrau region's integral index for 5-year period.

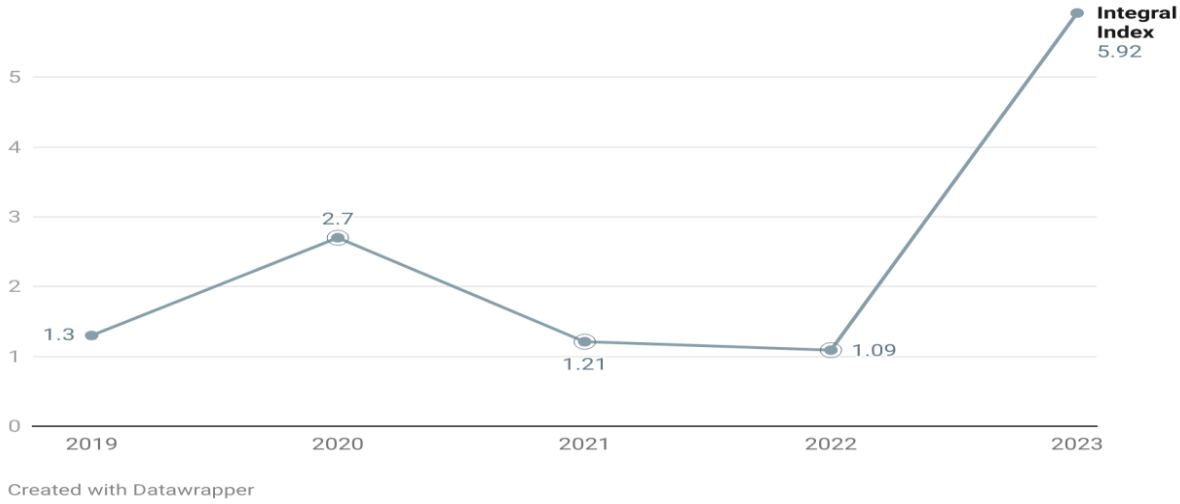


Figure 7 – Integral index of Atyrau region for five year period
Note – Organised by the author using software datawrapper

The meaning of the integral index of the Atyrau region rose from 1.3 to 2.7 in 2020, then it fell to 1.21. The sharp rise of the integral index of the Atyrau region is seen in 2023.

West Kazakhstan's integral index meanings for the years are illustrated in Figure 7.

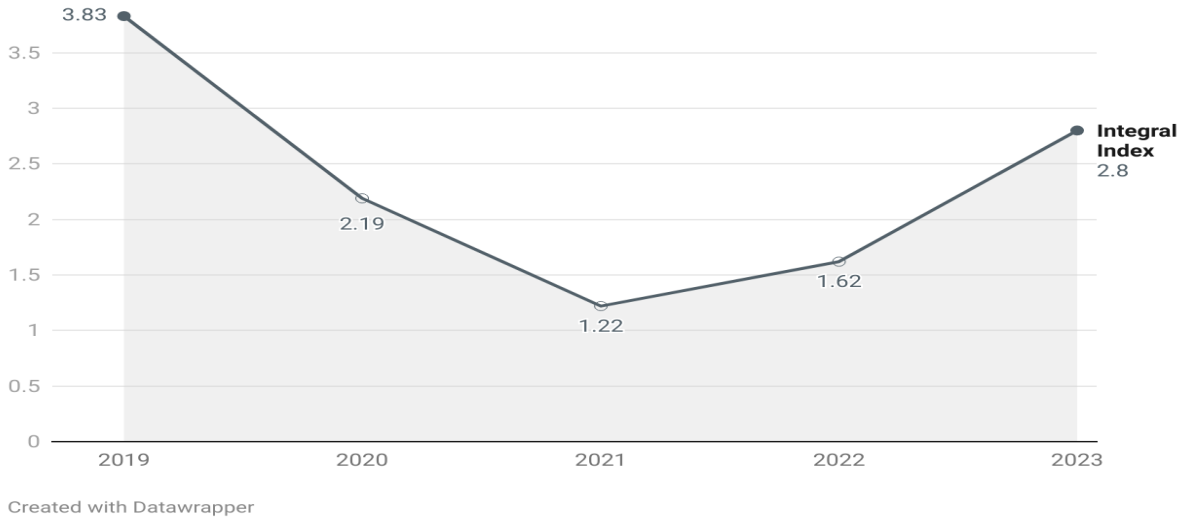


Figure 8 – West Kazakhstan region's integral index for five year period
Note – Organised by the author using software datawrapper

Figure 8 shows the highest peak in 2019, indicating 3.83. Then it fell gradually to 1.22 in 2021, and rose to 2.8 in 2023.

The integral index of the Zhambyl region is presented in Figure 8.

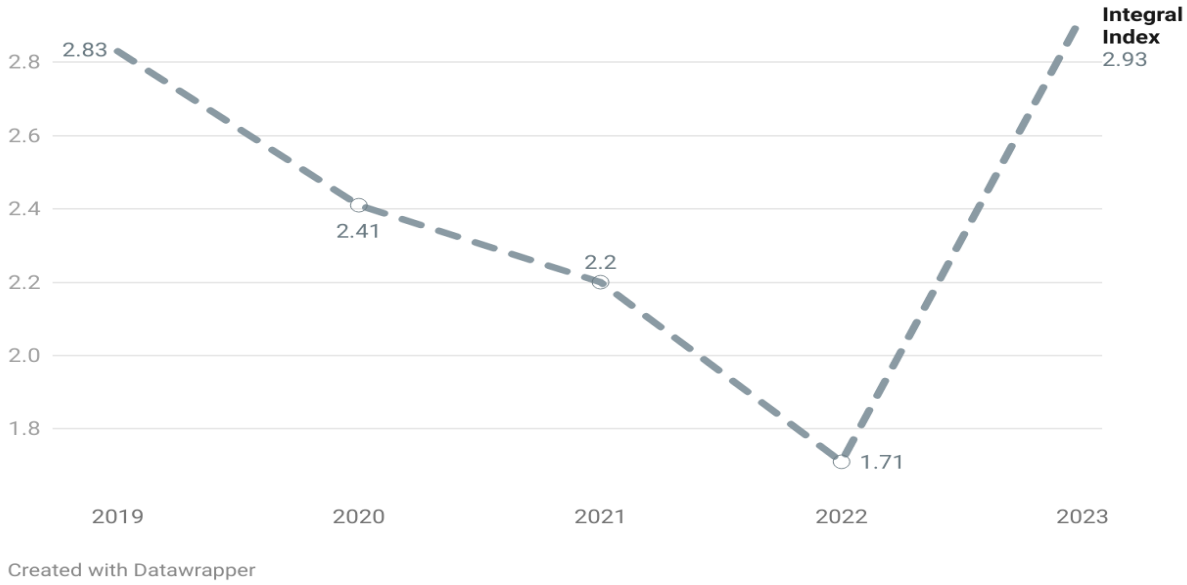


Figure 9 – Integral index of Zhambyl region for five year period
Note – Gathered by the author using software datawrapper

The overall illustration is nearly like the previous ones, from the highest value of 2.83, it gradually fell to 1.71 in 2022 and sharply rose to 2.93 in 2023.

Zhetisu region's values are presented in Figure 10.

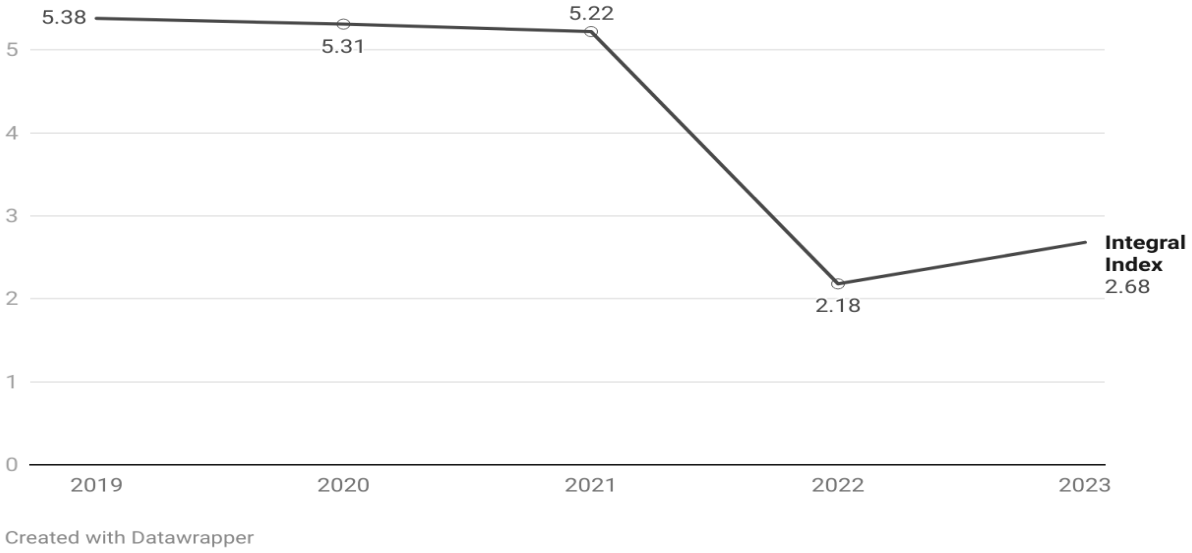


Figure 10 – Zhetisu region's integral index for 2019-2025
Note – Gathered by the author using software datawrapper

According to Figure 10, the highest peak is seen in 2019 – 5.38, and then it stays relatively stable till 2021 – indicating 5.22. In 2022, it indicates 2.18, slightly rising in 2023 to 2.68.

The integral index of the Karaganda region is shown in Figure 11.

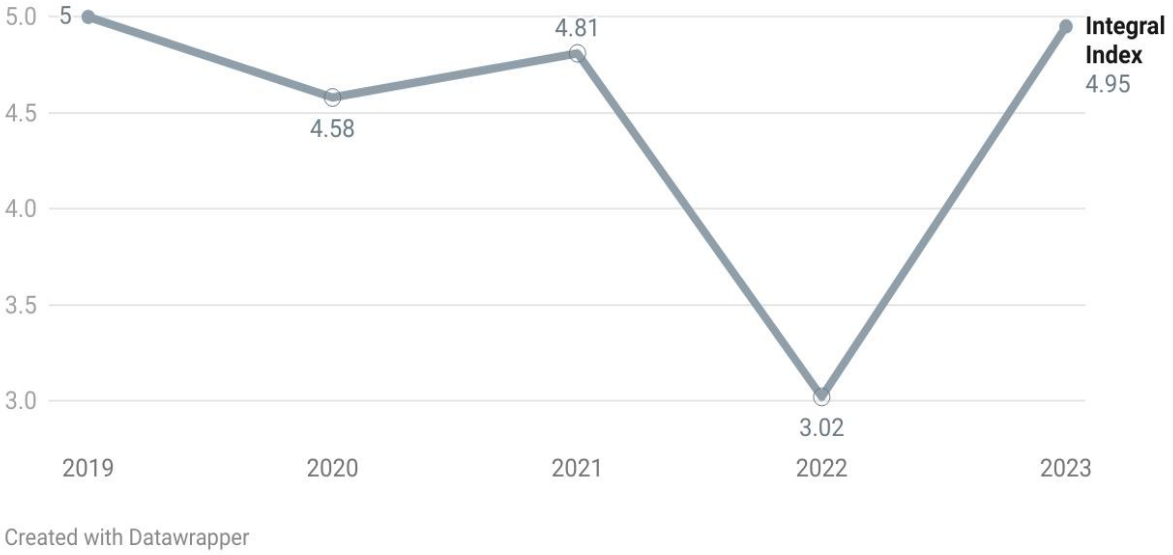


Figure 11 – Karaganda region's integral index for 2019-2023
Note – Gathered by the author using software datawrapper

The highest value is seen in 2019, showing 5. It reveals a modest decline in the index from 5.0 in 2019 to 4.58 in 2020. By 2023, the region demonstrated a remarkable recovery, with the integral index reaching 4.95, reflecting improvements and stabilization in key indicators. This fluctuation in the index underscores the region's resilience and the variability in its developmental trajectory.

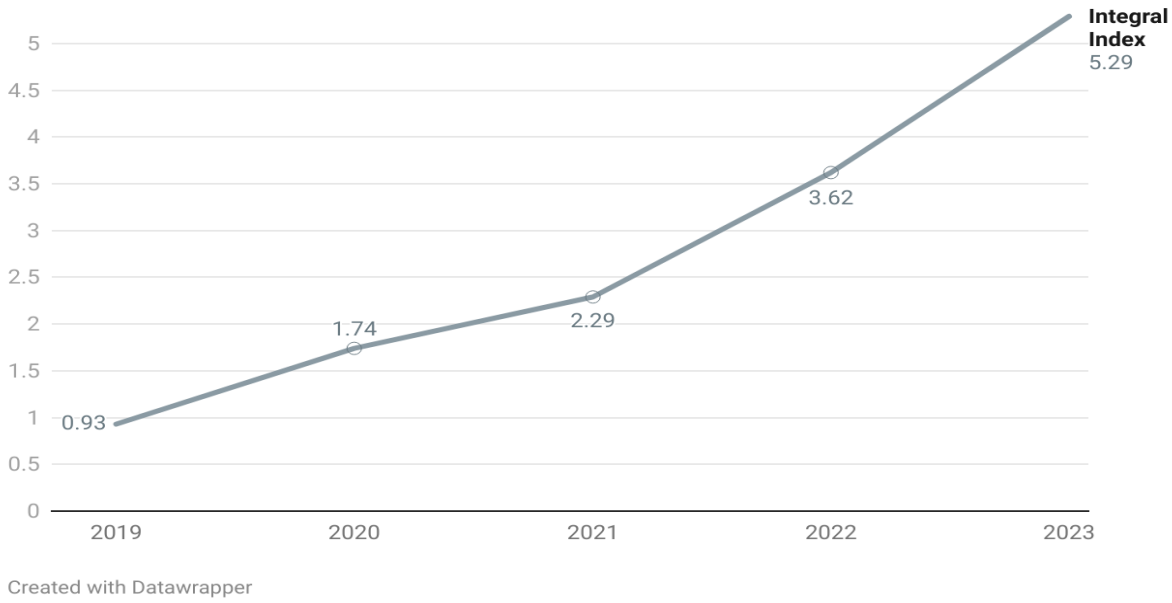


Figure 12 – Integral index of Kostanay region for five year period
Note – Organised by the author using software datawrapper

Figure 12 illustrates a gradual increase from 0.93 in 2019 to 5.29 in 2023 of Kostanay region's integral index over the five-years from 2019 to 2023.

The integral index of the Kyzylorda region is presented in Figure 13.

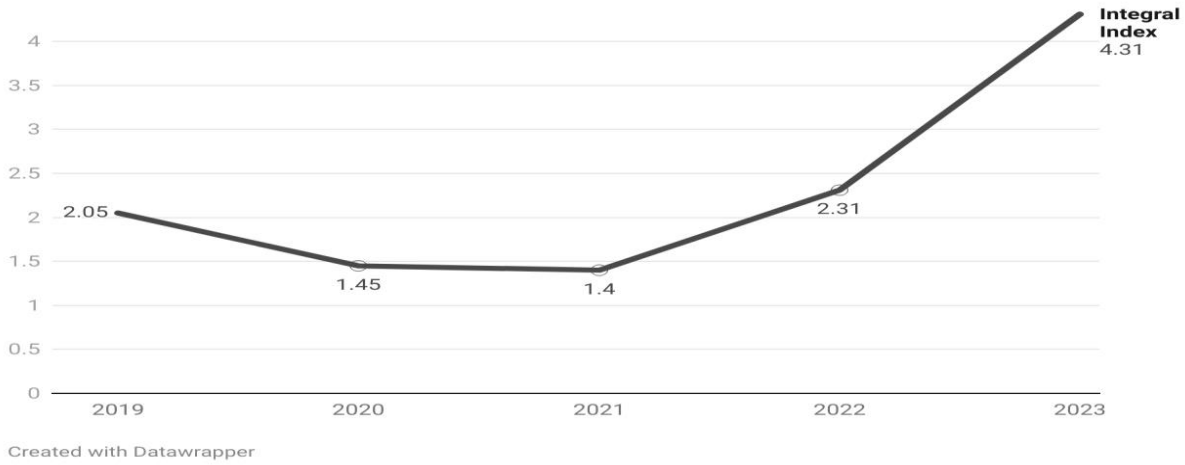


Figure 13 – Integral index of Kyzylorda region for five year period
Note – Organised by the author using software datawrapper

The trend begins with a moderate value of 2.05 in 2019, followed by a decline to 1.45 in 2020, and further to its lowest point of 1.4 in 2021. This decline is likely indicative of the challenges faced in the digital and socio-economic development during these years. However, starting in 2022, the index shows a significant upward trajectory, rising from 2.05 in 2022 to 2.31, and reaching a substantial increase to 4.31 by 2023. This recovery underscores the region's capacity to adapt and improve its digital and economic performance over time. The P-value is equivalent to 1, which indicates that there are no statistically significant differences in ICT contributions to GRP across the analysed regions.

The integral index of the Mangystau region is presented in Figure 14.

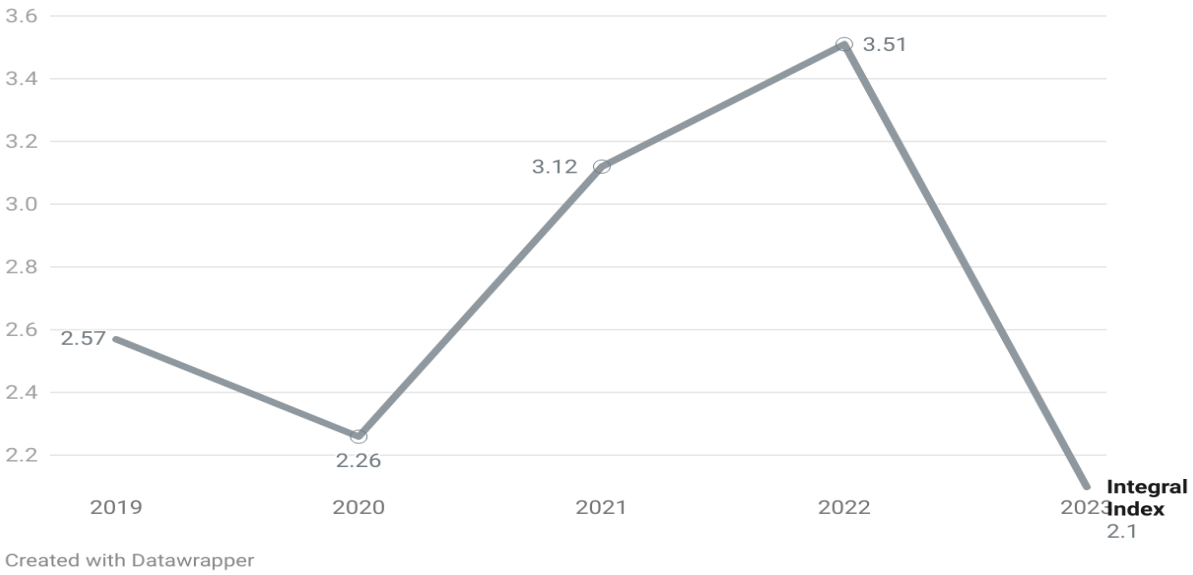


Figure 14 – Integral index of Mangystau region for five year period
Note – Organised by the author using software datawrapper

Overall, the chart shows a decline in 2020 to 2.26, then the meaning increases to 3.51 in 2022, showing a further sharp fall to 2.1 in 2023.

The integral index of the Pavlodar region is presented in Figure 15.

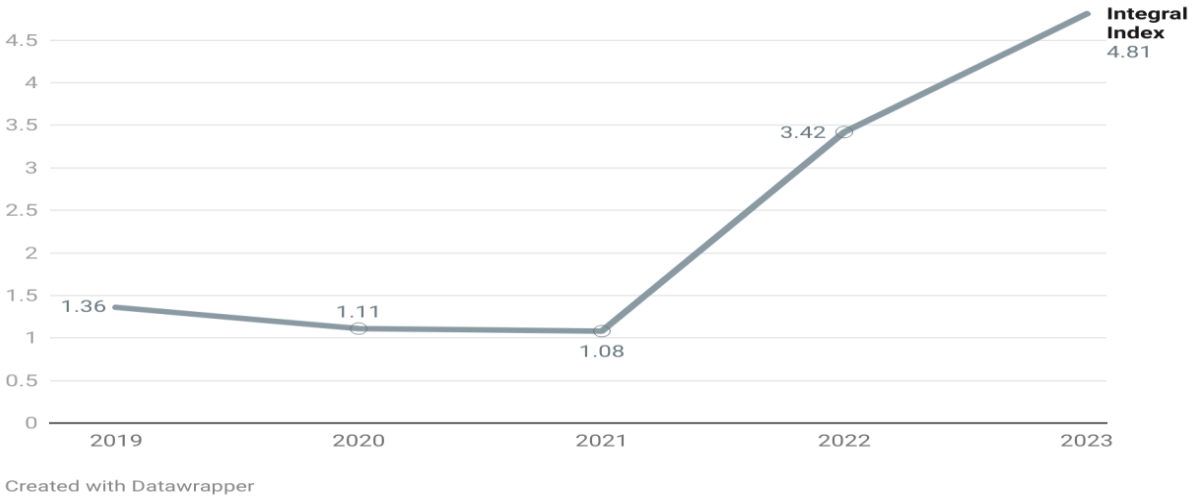


Figure 15 – Integral index of Pavlodar region for five year period
Note – Organised by the author using software datawrapper

From 2019 till 2021, a slight fall is seen, indicating 1.08, then the meaning increases to 3.42 in 2022 and reaches its peak in 2023 – 4.81.

The following chart shows the integral index of the North Kazakhstan region (Figure 16).

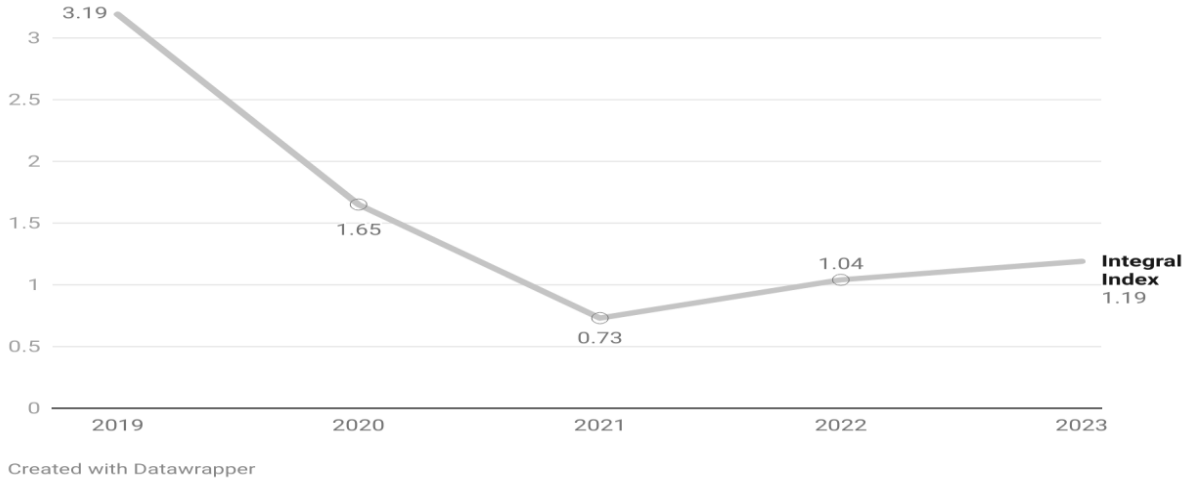


Figure 16 – Integral index of North Kazakhstan region for five year period
Note – Organised by the author using software datawrapper

The index commences at a relatively elevated value of 3.19 in 2019, but undergoes a precipitous decline, reaching a nadir of 1.65 in 2020 and subsequently declining further to its nadir of 0.73 in 2021. This precipitous decline signifies the substantial challenges confronted by the region in maintaining its digital and socio-economic potential during this period. However, a subsequent recovery is observed, with the index rising to 1.04 in 2022 and further to 1.19 in 2023. This modest rebound suggests a slow but steady improvement in the region's capacity for digital and economic development. In Kyzylorda Region, lower indices in certain years (e.g., 2020 with 89.2%) indicate stagnation or contraction, possibly linked to dependency on extractive industries.

Figure 17 represents the integral index of the Turkestan region for 2019-2023.

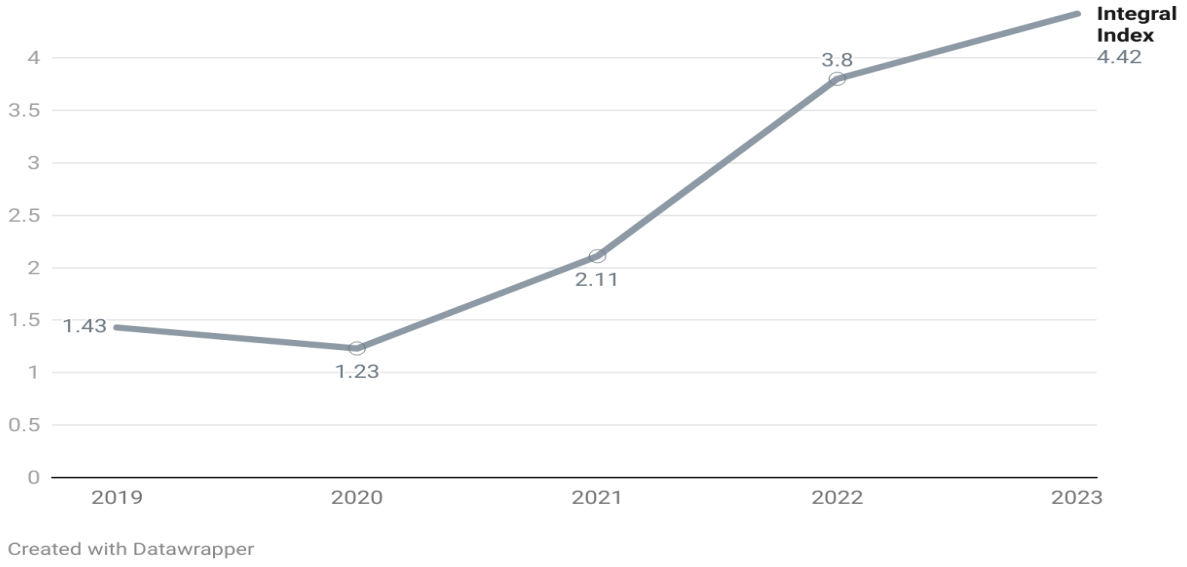


Figure 17 – Integral index of Turkestan region for five year period
Note – Organised by the author using software datawrapper

The chart illustrates a slight decline from 2019 to 2020, indicating 1.23. A gradual increase is seen from 2021 – 2.11 to 4.42 in 2023.

Figure 18 illustrates the integral index of the Ulytau region.

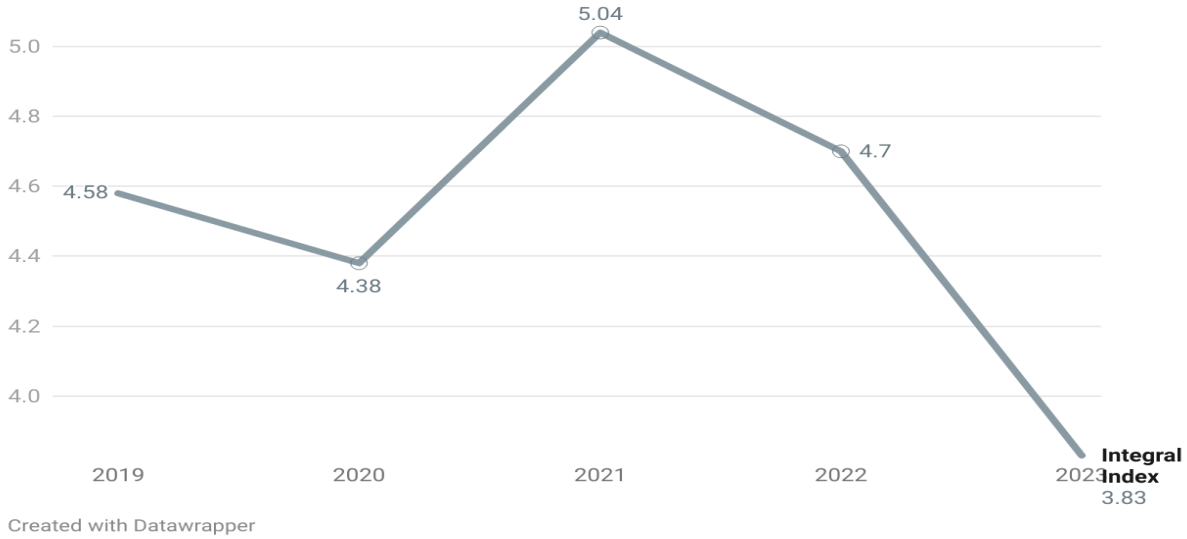


Figure 18 – Integral index of Ulytau region for five year period
Note – Organised by the author using software datawrapper

The meaning of the integral index of Ulytau region shows a slight fall from 2019 – 4.58, to 4.38 in 2020, rising to its highest peak in 2021 – 5.04. Then, the meaning fell to 4.7 in 2022, and finally reached its lowest point - 3.83 in 2023.

Figure 19 presents the integral index of the East Kazakhstan region.

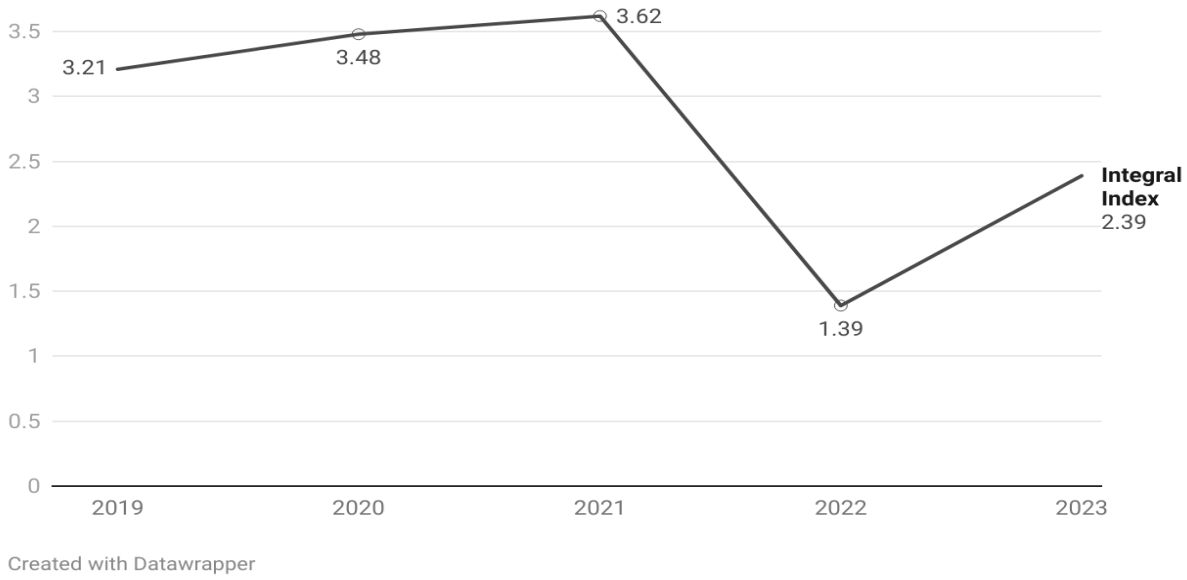


Figure 19 – Integral index of East Kazakhstan region for five year period
Note – Organised by the author using software datawrapper

The integral index of the East Kazakhstan region is presented in Figure 19. The meaning of the integral index starts with a relatively high position – 3.21 in 2019, then gradually rises to 3.62 in 2021. However, in 2021, a sharp decline is seen to 1.39. In 2023, the meaning slightly increased to 2.39.

Figure 20 shows the integral index of Astana.

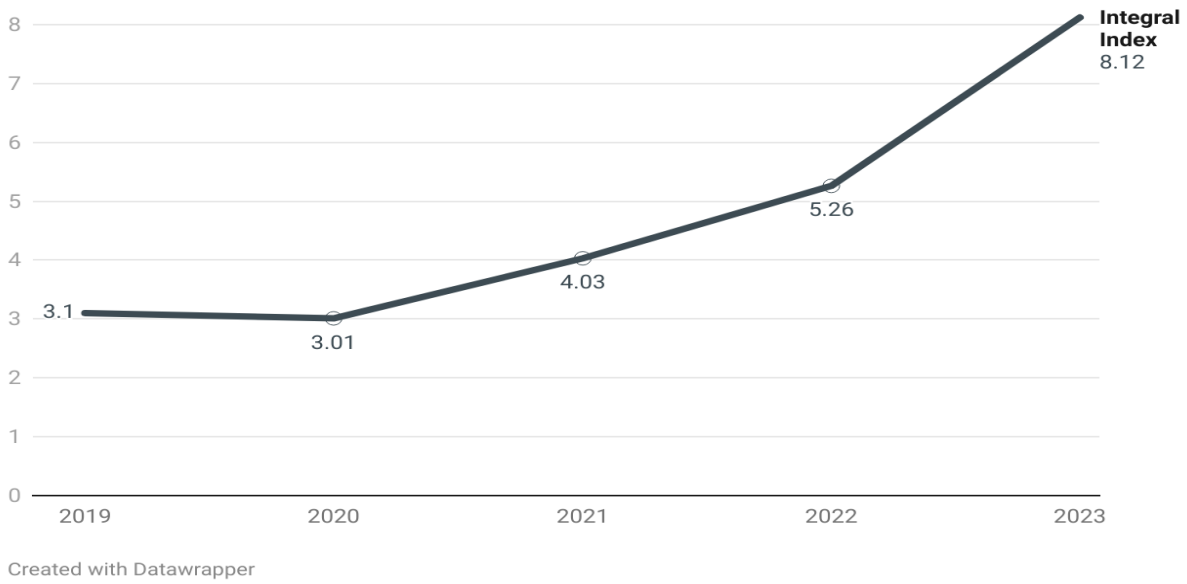


Figure 20 – Integral index of Astana for five year period
Note – Organised by the author using software datawrapper

The integral index of Astana starts with a point – 3.1 in 2019 and shows a steady increase from 2021 – 4.03, to 8.12 in 2023.

Figure 21 illustrates Almaty's integral index for five years.

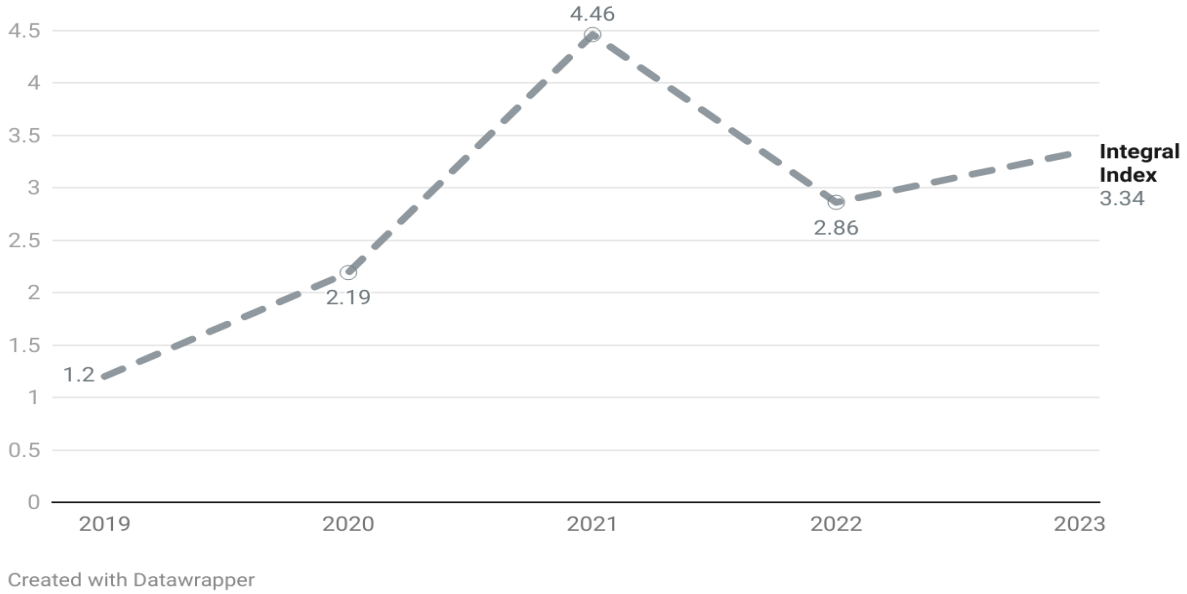


Figure 21 – Integral index of Almaty for five year period
Note – Organised by the author using software datawrapper

The meaning of the integral index of Almaty starts at a point of 1.2, steadily increasing to 4.46 in 2021. Then it fell to 2.86 in 2022, and slightly rose to 3.34 in 2023.

Figure 22 illustrates the integral index of Shymkent for 2019-2023.

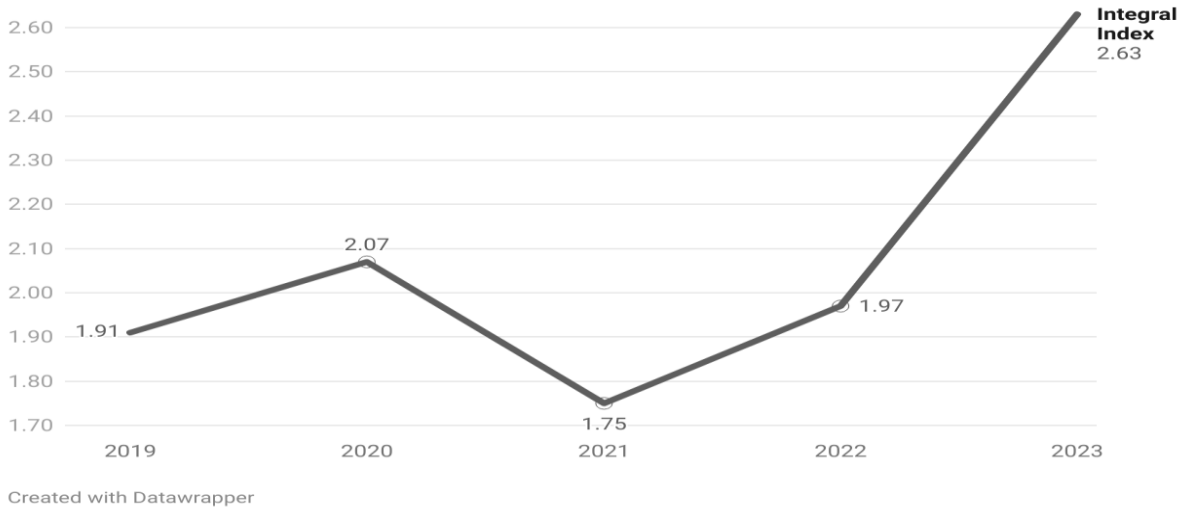


Figure 22 – Integral index of Shymkent region for five year period
Note – Organised by the author using software datawrapper

The graph illustrates the dynamics of the integral index for the Shymkent region over a five-years from 2019 to 2023, reflecting variations in the region's digitalization level. The index combines indicators such as digital literacy, technology adoption by enterprises, and regional labor productivity in the information and communication sectors. The observed trends indicate a period of decline followed by a gradual recovery, which is likely the result of external factors such as economic shocks, regional investment policies, or disparities in technology penetration. This trend underscores the need for targeted strategies to enhance digital adoption and infrastructure development.

The average integral index of regions for five years is illustrated in Figure 23.

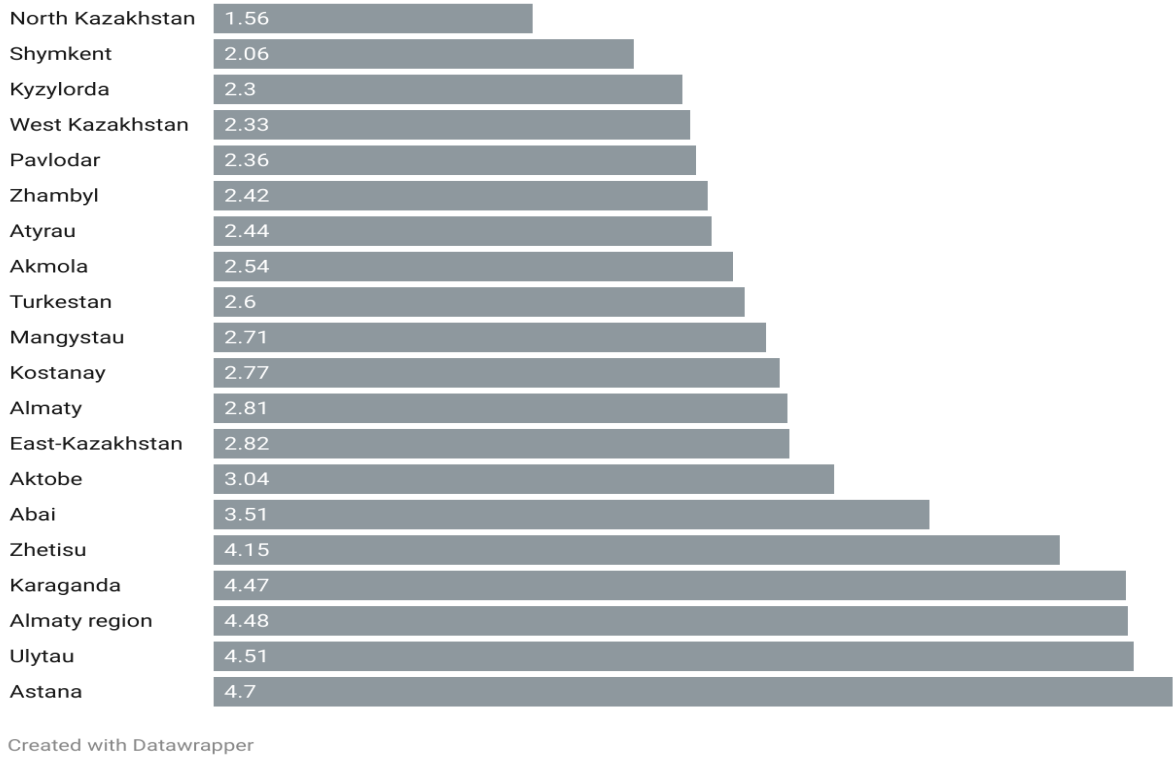


Figure 23 – Average integral index of regions of Kazakhstan for 2019-2023
Note – Gathered by the author using software datawrapper

High integral index indicators by region showed the following for 2019-2023: leading regions Astana (4.7), Ulytau (4.51), Almaty region (4.48), Karaganda (4.47), Zhetisu (4.15). Average growing regions in terms of digitalization: Abay region (3.51) and Zhambyl (2.41). The less developed regions were: Pavlodar (2.36), West Kazakhstan (2.33), Kyzylorda (2.3), Shymkent (2.06), North Kazakhstan (1.56).

An average index of regions of Kazakhstan is presented in Figure 24 for the data from 2010-2023.

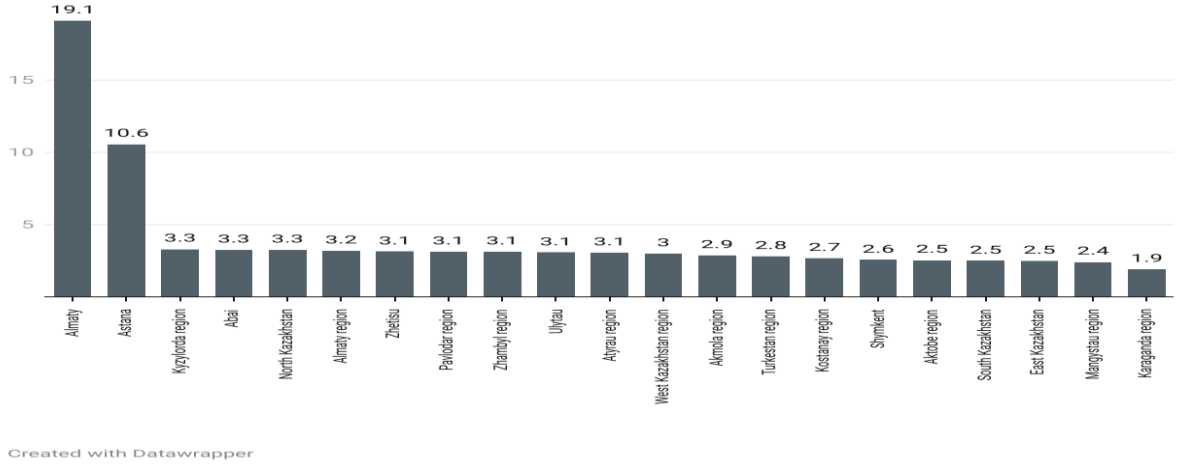


Figure 24 – Average integral index of regions of Kazakhstan for 2010-2023
Note – Gathered by the author using software datawrapper

According to the indicators for the long period 2010-2023 the ranking of regions is different from that for 2019-2023. The leading regions are Almaty (19.1), and Astana (10.6).

Conclusions on the assessment of the digital potential of Kazakhstan's regions.

The analysis of indicators for two periods of data availability showed that there is a digital divide between the regions of the country. While Astana and Almaty occupy leading positions as centers of digital transformation, northern and western regions demonstrated a moderate level of digitalization development. The southern regions showed a lower level of digitalization development.

By integrating regional strengths with strategic digital policies, Kazakhstan can foster a more balanced and sustainable digital ecosystem, positioning itself as a digital leader in Central Asia and beyond.

Formation of a regional digital hub

Each region needs a strategy of digital transformation and the creation of digital hubs to meet the needs and resources of each region.

For the successful development of digital hubs in the regions, it is important to take into account regional potential, peculiarities, and reserves. In managing the establishment of digital hubs, it is the presence of organizations such as universities, accelerators, scientific institutes, technoparks, incubators, enterprises, medium and small enterprises, public administration, and others.

It is proposed to form a financial, tourist, and cultural hub in Almaty and the Almaty region. Almaty is an attractive city for investors and tourists from different countries (Figure 25).

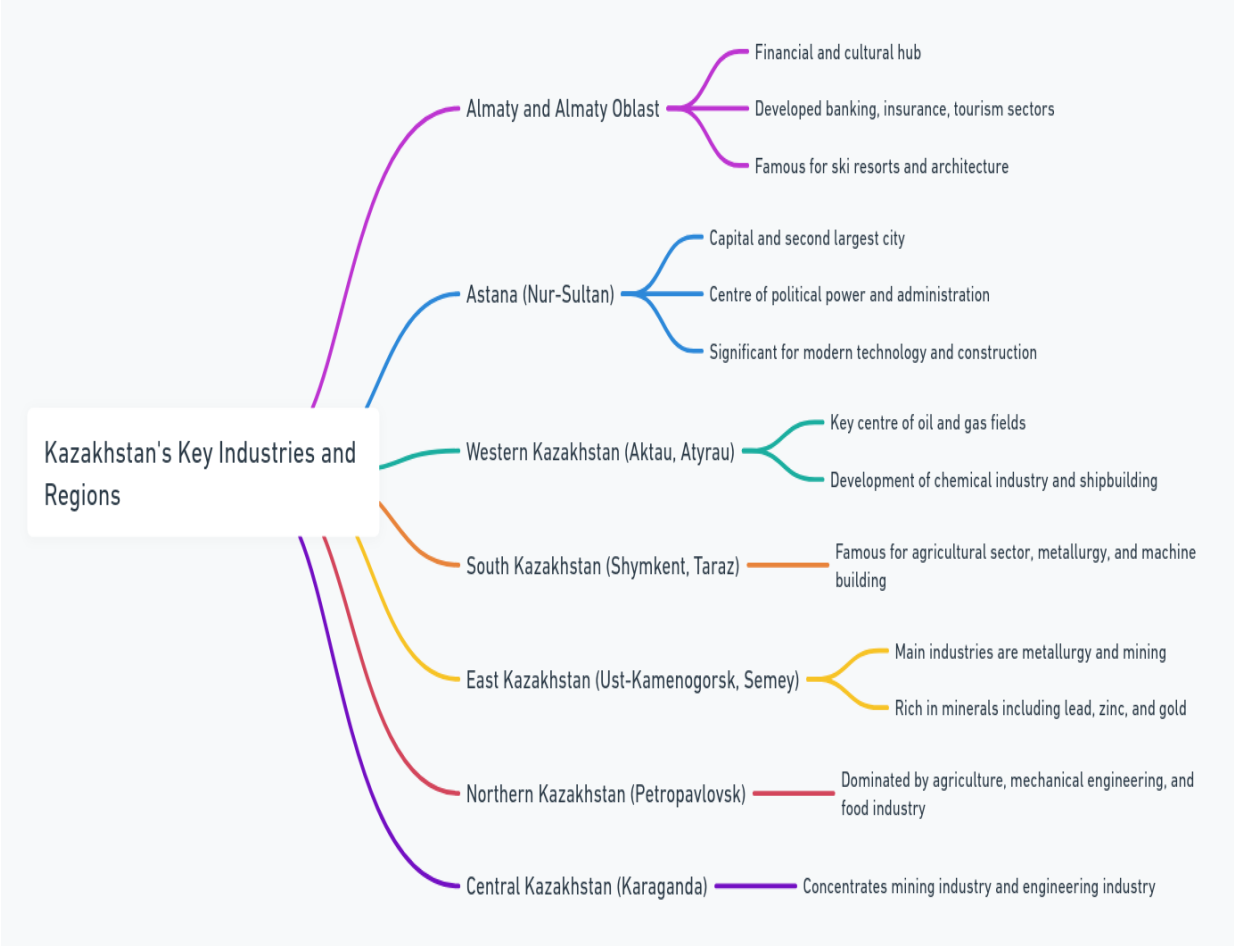


Figure 25 – Directions of establishment new digital hubs
Note – Organised by the author using software draw.io

In Shymkent, and Taraz, digital hubs focused on the metallurgical, agro-industrial, and machine-building sectors are proposed. The digital hub development of Almaty is presented in Figure 26.

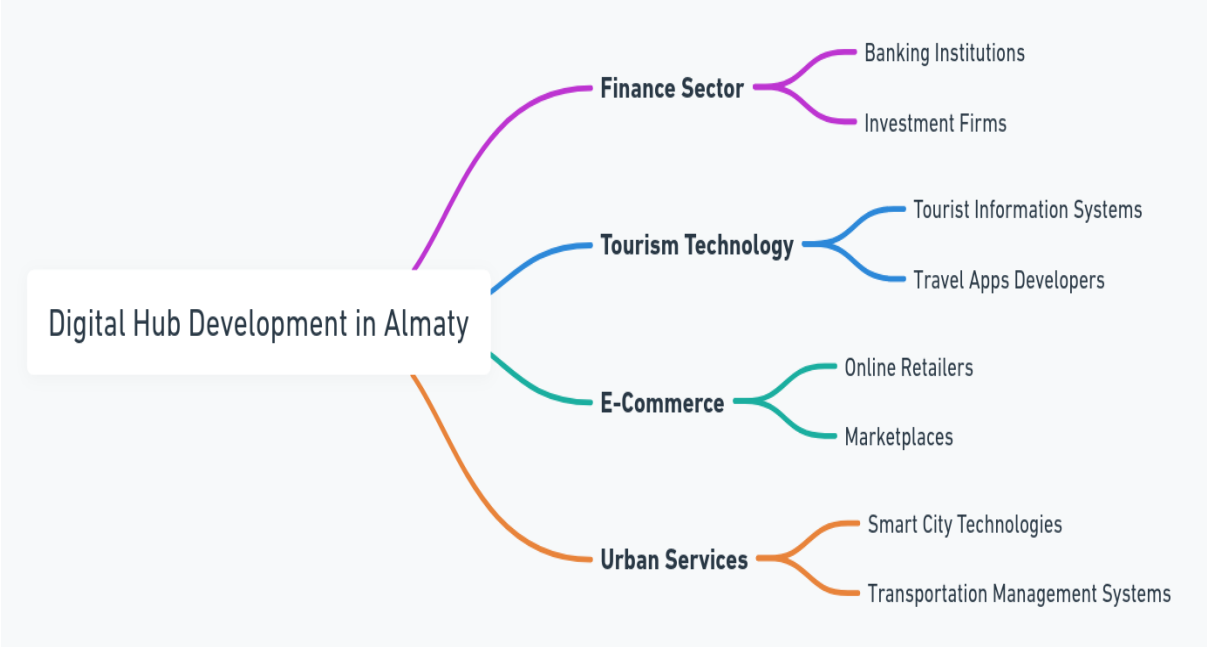


Figure 26 – Digital hub development in Almaty
Note – Organised by the author using software draw.io

Given its significance as a major hub for the oil and gas industry, this region offers opportunities to optimise the extraction, processing, and distribution of energy resources. Utilising artificial intelligence (AI) for data analysis and automation has the potential to greatly enhance the efficiency and safety of production processes. Digital hub development in Astana is presented in Figure 27.

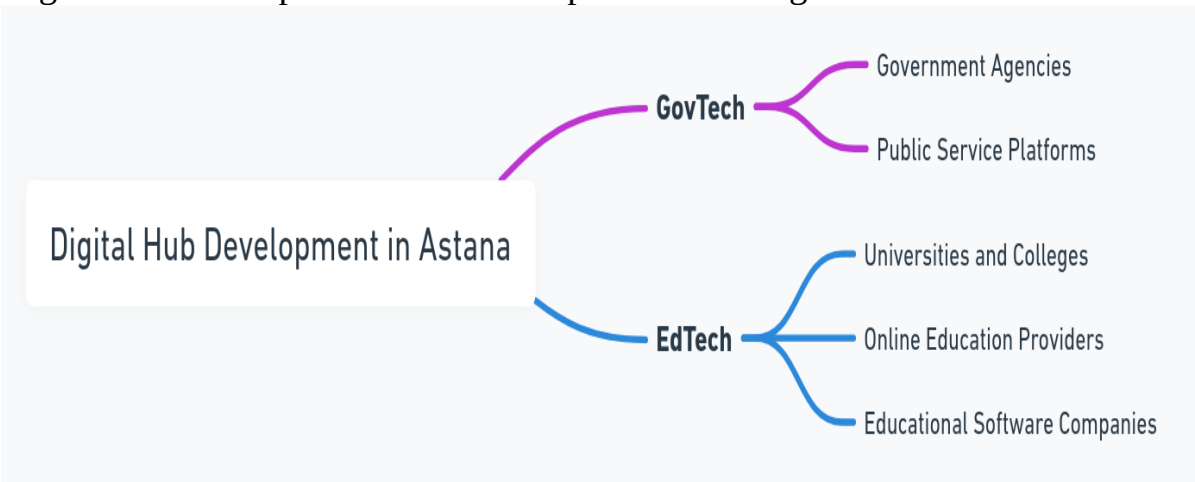


Figure 27 – Digital hub development of Astana
Note – Organised by the author using software draw.io

In Astana city, it is proposed to form a construction digital hub, as Astana is a young and politically administrative city and the capital of Kazakhstan. The construction of 3D houses and buildings would serve as a great opportunity for young people to acquire housing. In the regions of Atyrau and Aktau, it is proposed to form a digital hub focused on the oil and gas sector and chemical research. It is possible to create chemical laboratories with subsequent commercialization of intellectual property. The establishment of a digital hub in Astana, the capital of Kazakhstan, is motivated by many crucial digital and economic indicators that foster a conducive atmosphere for the advancement of innovation, technology, and entrepreneurship. Indicators of economic performance: Astana exhibits a high level of GDP per capita in Kazakhstan, suggesting significant economic growth and possibilities for investment in technology startups and innovative initiatives. Astana is a very appealing location for the establishment of digital hubs due to its ability to attract a substantial amount of foreign direct investment (FDI), which in turn draws cash; technological and innovation infrastructure - quantity of technoparks and innovation centers: Astana has many expansive technoparks and innovation centers that may serve as the foundation for the establishment of a digital hub.

The digital hub development of Western Kazakhstan is presented in Figure 28.

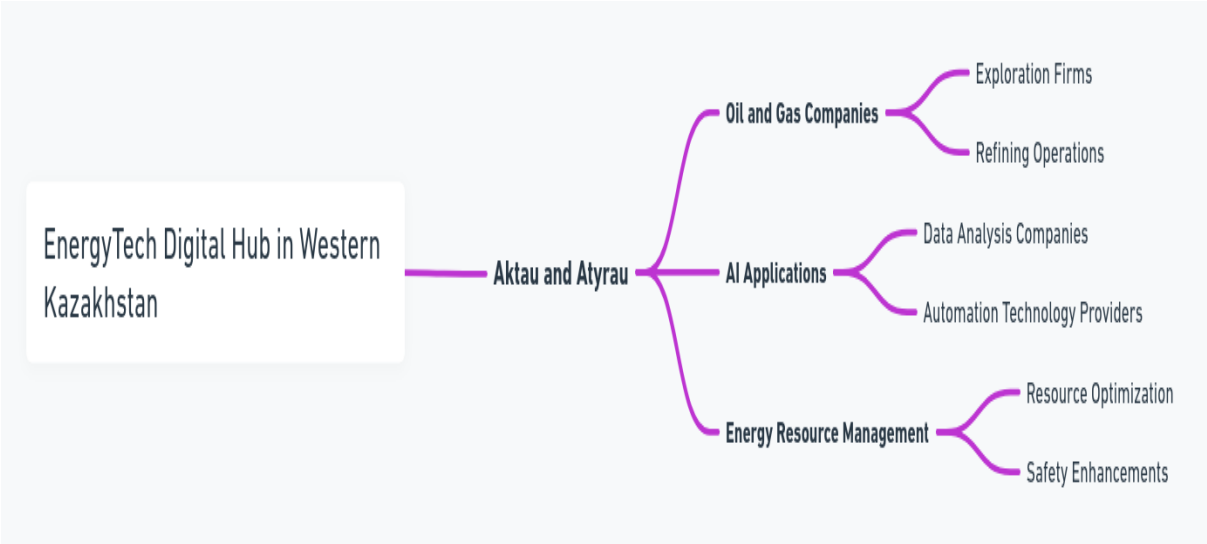


Figure 28 – Digital hub development in Western Kazakhstan
Note – Organised by the author using software draw.io

The mineral-rich region of East Kazakhstan, including Ust-Kamenogorsk and Semey, has the potential to greatly benefit from the establishment of mining technology hubs, known as MiningTech, which would facilitate the advancement and innovation in mining practices.

It will also promote the development of robotics in the region. Artificial intelligence and the Internet of Things may be used in the activities.

Also, in Semey city, it is possible to develop a digital hub in the medical sector. In this city, there is one of the strongest medical universities, NAO ‘Semey Medical University. In cooperation with the city's oncological dispensary, laboratories can create the necessary parts for the human body, including implants, cartilage, bone products, and others, to address the health issues of the population.

Implementing digital automation and robotization in industrial processes will enhance worker safety and minimise mining's environmental footprint (Figure 29).

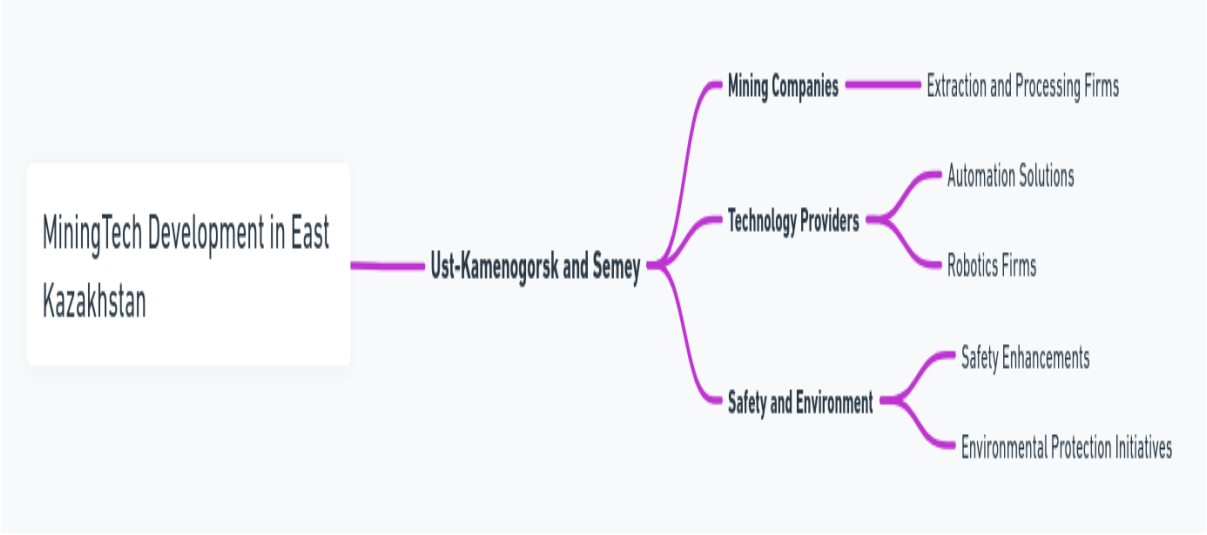


Figure 29 – Digital Hub development in East Kazakhstan
Note – Organised by the author using software draw.io

In Northern Kazakhstan, namely in Petropavlovsk, it is recommended to establish centers focused on digital advancements in agriculture, similar to those in Southern Kazakhstan. Additionally, using technologies to enhance the efficiency of transportation and distribution of agricultural products would be beneficial (Figure 30).

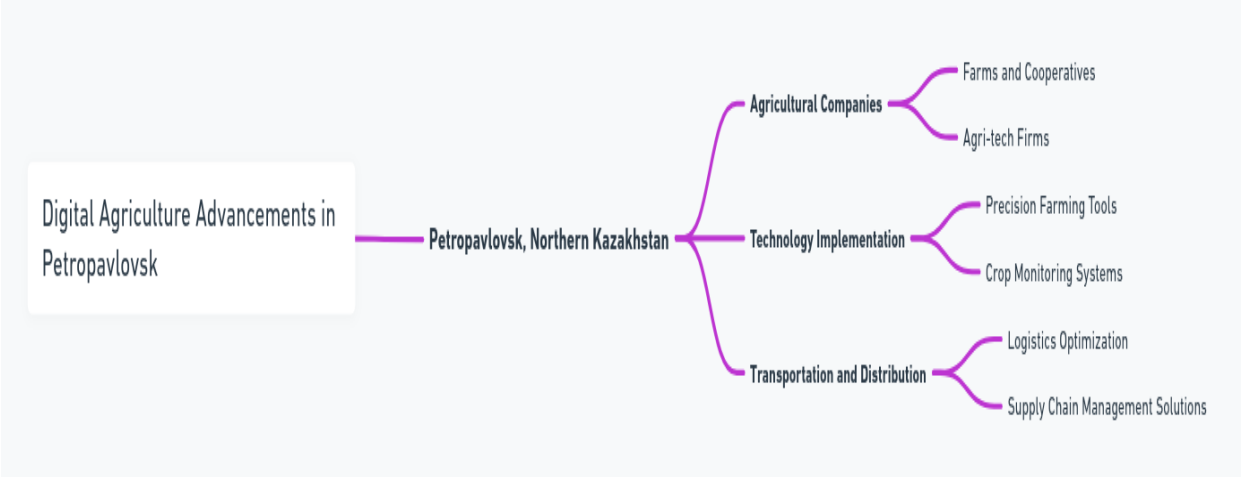


Figure 30 – Digital hub development in Northern Kazakhstan
Note – Organised by the author using software draw.io

The region of Central Kazakhstan, specifically Karaganda, has the potential to gain advantages from the advancement of industrial technologies (IndTech), particularly in the domains of mechanical engineering and metallurgy. Implementing digitalization in production processes can enhance operational efficiency and decrease expenses (Figure 31).

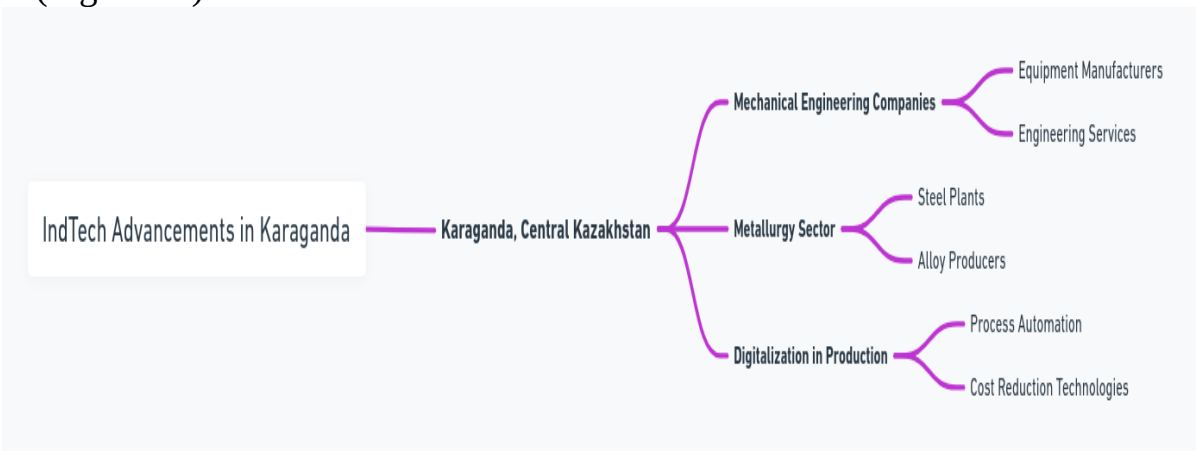


Figure 31 – Digital hub development in Central Kazakhstan
Note – Organised by the author using software draw.io

To assess the digital potential of regions in Kazakhstan, the secondary data for two different periods was taken from the Bureau of National Statistics. The integral index method was used to assess the digital potential.

From the analysis, it can be seen that the regional leaders are Almaty and Astana in Kazakhstan for the decade. However, other regions did not have such high results as those two cities. For the new digitalization indicators from the 2019 period, the higher values showed Astana, Ulytau, Almaty region, Karaganda, and Zhetisu, indicating nearly equal spread of resources between regions. However, Kyzylorda, Shymkent, and North Kazakhstan showed the lowest values.

To raise the digitalization indicators in regions, the strategy of developing digital hubs for each region must be applied, according to the region's strong sector and needs. For each region, alternative digital hubs were recommended to meet each region's needs, potential, and reserves. The study showed that the differences in the indicators of digitalization between regions are statistically significant.

2.2 Assessment of digital hubs in the regions of Kazakhstan

Digital hubs in Kazakhstan include Parasat Hub, Caspian Digital Hub, Astana Hub, Sifro Hub, and MOST IT Hub. For regional analysis, Astana Hub, Caspian Digital Hub, Parasat Hub, Sifro Hub, and MOST IT Hub were selected as case studies. Astana Hub also developed IT hubs in all regions of Kazakhstan.

The analysis of digital hubs was conducted using a case study method. Firstly, the official websites of hubs were analyzed. Astana Hub [151] and MOST IT [152] hubs had official websites. Astana Hub's financial reports (2018–2021) were examined to assess annual economic efficiency. The information about Parasat Hub was examined on the official website of Akhmet Baitursynov University page [153]. Mostly, on the other hubs, the information was provided on news websites, as they hadn't functioned properly yet, but were at the stage of establishment. The interview with the director of "Sifro hub" was conducted. The purpose of interviewing the director of "Sifro Hub" was to examine the hub's management, organizational structure, products, the history of its establishment, their outputs, and to identify its problems and to look at the object of the study from the "business" side. The findings were presented below, in the description the hub's case. The author's assessment methodology was validated in "Sifro hub". The credentials of the analysis were goal, objectives, field, direction of development, output, and stakeholders-partners.

Parasat Agro Ltd.

Parasat Agro Ltd.[154] was a component of the State Program "Digital Kazakhstan," was officially approved by Resolution No. 827 of the Government of the country in 2017, on December 12. The main goals of that effort were to promote the use of digital technology in government operations, integrate digitalization into various industries, carry out the digital Silk Road project, and improve the development of human resources. The Digital Hub had executed the goal of the Program - the process of converting industries and the electric power industry into digital systems.

The Digital Hub was responsible for implementing the scientific and technical plan "Scientific and methodological support of digitalization and information and

technology growth of the mining and metallurgical complex of Kazakhstan" from 2020 to 2022.

The Kostanai Flour Milling Cluster project aimed to digitalise the region's industry and tackle various critical challenges, such as the shortage of skilled workers in the flour milling sector, inadequate infrastructure for knowledge and information exchange, insufficient logistics for market growth, and surplus capacity for wheat processing.

Efforts were currently being made to tackle the difficulties associated with the digitalization of agriculture.

Projects were being executed with the hub (019 BP) as a foundation. 1) Implementing cutting-edge technology to enhance the genetic capacity and safeguard the population of Kustanai breed horses at the farm of "Kazak tulpary" LLP; 2) Implementing an advanced digital feeding system in livestock complexes of the Kostanay area, demonstrated by Olzha Agro LLP.

Regarding the advancement of financial technologies and the use of electronic transactions instead of cash, Parasat Hub held a seminar in September 2019 titled "Transition to a complete cashless economy: actualities and prospects." The webinar featured officials from banks, the tax department of Kostanai city, medium—and small-sized enterprises, and the Chamber of Entrepreneurs of Kostanai region. Participants engaged in discussions regarding the executed projects on the transition of Kazakhstan to a cashless economy and the implementation of smart applications for online payments [155].

The implementation of the program tasks encountered issues: 1) Acquisition of consumables via public procurement; 2) Establishment of a physico-chemical research laboratory.

The implementation of the 6th task, which was focused on the relationship between the state and its inhabitants, involved the grant of 100,000,000 tenge from the MES RK offices for the transfer and commercialization of innovations. The objective was to attract an international firm between 2019 and 2020.

The digital hub "Parasat" at Kostanay State University, in collaboration with the Department of Agriculture and Land Relations, the Department of Informatisation, and the Department of Education of the Akimat of Kostanay region, had worked on a short-term training program for agricultural specialists. The program aimed to educate professionals in the field of agriculture about digital technologies used in agricultural production. That initiative was by resolution No. 96 of 10 April 2. The problems and solutions for the hub were the following: 1) Lack of Infrastructure: The hub faced challenges related to an underdeveloped technological infrastructure. Suggested solutions include: developing technology parks, upgrading IT facilities, collaborating with universities to enhance infrastructure; 2) Limited Funding: Insufficient financial resources were a key obstacle for the hub's growth. Potential strategies to address that include: government grants to provide financial support, seeking additional investors for funding and resource allocation; 3) Insufficient Talent Pool: a limited pool of skilled professionals in the region hinders progress.

Solutions Proposed for Kostanai Hub "Parasat": 1) talent development: focused on improving human resources through IT bootcamps and workshops to upskill local

talent, exchange programs to enable knowledge sharing and exposure to global practices; 2) building infrastructure: strengthening the physical and digital infrastructure through: smart city initiatives to create a tech-friendly ecosystem, establishing public-private partnerships to pool resources for infrastructure development; 3) enhancing financial support: expanding financial opportunities for the hub through: organizing investor meetings to secure funding from private and public sectors; leveraging crowdfunding platforms to gather resources from a broader audience.

Seminars on current digitalization issues were being conducted as part of the execution of the task to digitise internal activities of state bodies, by the memorandum between Kostanay State University named after A. Baitursynov and the Academy of State Administration under the head of state. Issues in the execution of the programs: challenges with the registration of paid services by the administration of the hub. The effort to ensure information security in the field of ICT, the Hub's staff organized seminars on topics such as big data analysis and the fundamentals of cybersecurity.

The Hub's objective was to enhance digital literacy in secondary, technical, vocational, and higher education. The IT Hub's objective was to cultivate highly skilled IT professionals by providing both domestic and international training programs that align with the demands of companies in the job market.

Immediate plans for the IT Center: 1) Organising IT technology platforms for children's summer leisure activities to cater to their varied interests and needs; 2) Providing IT support for projects at the Digital Hub "Parasat"; 3) Collaborating on an application to bring in foreign experts to enhance the skills of IT specialists and teachers through the SES (Senior Experten Service); 4) Creating a theme and preparing a joint application to participate in the Jean Monnet project under ERASMUS+.

The long-term activities of the IT Center include: 1) collaborating with regional, national, and international IT companies to align with the demands of the job market; 2) fostering the growth of the region's information and communication technology sector by providing extensive training, development, and support for young individuals in the digitalization of economic sectors; 3) advancing research and scientific work in various areas of information technologies; 4) establishing comprehensive partnerships with IT centers at different levels, such as IT classes, interregional IT centers, and Astana HUB. The HUB was enhancing the literacy (digital) of the public through training and retraining.

During the summer, training sessions were arranged in many directions. Those courses covered: 1) the foundational principles of 3D modelling, including the creation of three-dimensional models using software such as Creo and Google SketchUp. It also included instructions on preparing a model for 3D printing; 2) the basics of web design were taught, which included an introduction to the Internet world and the fundamentals of web page development. Students learned about working with hyperlinks and creating a thematic website. The course provided an introduction to the basics of cyber sports, using Dota 2 as an example. Topics included the rules and requirements of the game, strategies for success, and practical training to improve game skills. The Hub was actively facilitating the advancement of cutting-edge development platforms. To achieve that goal, the developers actively participated in the creation of the Republican roadmap for the advancement of the innovation ecosystem in

the field of information and communication technologies. As part of that plan, it was aimed to convert the Digital Hub "Parasat" at Kostanay State University, named after A. Baitursynov, into a technopark-digital hub. Promoting the progress of technical entrepreneurship,cultivating a culture of startups, and supporting research and development.

The “Student Entrepreneurial Ecosystem" was initiated in the hub [155]. The stages of the "Student Entrepreneurial Ecosystem" were as listed below: 1) identifying key entrepreneurship domains; 2) identifying a strategy for the university; 3) implementing education about entrepreneurship; 4) building an infrastructure and community that was favourable for business; 5) providing training for the faculty. The main goals were: 1) creating an innovative teaching method; 2) creating a successful business environment; 3) promoting and cultivating an entrepreneurial mindset.

The organization's primary activities encompass organising and facilitating meetings with successful business professionals in the city and region, cultivating the development and advancement of startup initiatives, maintaining continuous partnerships with entrepreneurs and entrepreneurial institutions, establishing a collection of startup projects, and providing guidance to students in preparing applications for various contests, olympiads, and creative competitions.

The Digital Hub was actively collaborating and interacting with partners from across the world: The United States Agency for International Development (USAID) and the United Nations Development Program (UNDP) were working together on a project titled "Support for sustainable land management of steppe and semi-arid zones of Kazakhstan through integrated territorial planning and agro-ecological incentives". The Project Implementation for 00095082 GEF/UNDP/Government of the country aimed to support sustainable land management in steppe and semi-arid zones of Kazakhstan through integrated territorial planning and agroecological stimulation. The objective of that project was to generate a need for cutting-edge solutions.

The following initiatives were conducted as an output of the hub:

- A new institution, known as the Kazakhstan-German Center for Technology Transfer and Entrepreneurship Support, had been created.
- Bourgault, a Canadian business, contributed to the agro-industrial complex by transferring new technology through the donation of sowing equipment worth 1.5 million tenge.
- The Gaiker cluster in Spain specialised in the processing of flour and was situated in the Kostanay region. The creation of a specialised center aimed at promoting knowledge and accelerating technological advancements.
- Consequently, the livestock industry had initiated the implementation of "smart farms" for dairy farming in Sadchikovskoye LLP, meat farming in Terra LLP, and poultry farming in Zhas Kanat 2006 LLP. Trojana LLP and Karkyn LLP introduced enhancements in the field of agricultural farming. To include digital technologies, the necessary equipment was acquired, and specialists from Kostanai State University were enlisted to construct a specialised digital center named "Parasat". The procedure was being conducted to develop an algorithm that would allow for the customisation of digital technologies and systems to meet the specific climatic and production needs of the region.

- In addition, a software product named "Supervisor's Panel" had been developed and implemented. A consolidated dataset for the "Socio-Economic Indicators" segment had been created and approved for use by all collaborating companies and departments involved in the project.
- The process of converting fields into digital format was nearly complete. Currently, a total of 5.8 million hectares, or 97.1% of the specified agricultural area, had been transformed into a digital format.
- A comprehensive electronic system for receiving grain had been implemented. In 2018, JSC "NK" Prodkorporatsiya" purchased 108 thousand tonnes of grain using these receipts.
- The mineral fertiliser subsidy and livestock support schemes had been fully automated. There were intentions to implement automation in processes associated with herbicides and to provide financial support by reducing interest rates on loans and leases.
- An initiative to digitalize the agro-industrial complex as a pilot project was implemented in the Kostanay region. The main goal was to merge the fields of IT and business, creating a cohesive organization while also developing a substantial platform for improving the skills of agricultural workers. According to Kursiv, farmers exhibit a predilection for traditionalism and prudence when making acquisitions of novel products.
- The digital hub in Kostanay district, Kazakhstan, was demonstrating the advantages of technological advancements in agriculture. A Russian-made weather station was installed at the Experimental Farm "Zarechnoye" in Kostanay district, costing 1.5 million tenge. The station transmitted data through a special program to the computers of the hub and the farm director, with 20 sensors determining precipitation, intensity, air temperature, solar exposure, soil temperature, moisture level, and the lack of micro- and macroelements. Some sensors were installed directly on the plant, allowing for crop condition assessment and forecasting for pests and diseases.
- The hub continued to demonstrate technical innovations, such as an interactive panel in the form of a large touch screen, making lectures by scientists more accessible to interested listeners. The equipment moved between farms free of charge, with the duration decided jointly by scientists and agricultural producers.

The center intended to conduct retraining and improve the qualifications of agricultural workers and was ready for specialized courses, seminars, webinars, and distance learning for remote regions. Six scientific laboratories were already working at the university, and the staff was planning to expand to nine.

The project in the Kostanay region aimed to establish a close link between science and production.

Caspian Digital Hub

On May 15, 2020, a meeting took place in Kazakhstan to discuss the proposal of establishing the Caspian Digital Hub in the Mangistau region.

The meeting was attended by representatives from the Embassy of Kazakhstan in the UK, as well as the ministries of foreign affairs, digital development, innovation

and aerospace industry, industry and infrastructure development, Energy RK, Akimat of Mangistau region, JSC "NC "KAZAKH INVEST", Private Equity Fund KIDF, and JSC "Transtelecom" [156].

The Trans-Eurasian Information Super Highway (TASIM) was a localised endeavour to create a fibre-optic line that would link Western Europe to East Asia by traversing several Eurasian countries.

The project known as "Caspian Digital Hub" entailed installing a fibre optic communication line (FOCL) on the seabed of the Caspian Sea, laying an underwater fibre-optic cable, and establishing two data processing centers in Aktau and Baku. The implementation of the project established a communication channel for transmitting data from Europe to Asia, passing through Azerbaijan and Kazakhstan.

The initiative aimed to foster an open information society and enhance Internet services throughout the Eurasian region, while positively influencing the economic development and diversity of the countries in the region. The cable's length would be around 400 km, with a minimum data transmission capacity of 4-6 terabits per second. A consortium had been formed between the telecommunications providers of the two nations to construct the Trans-Caspian backbone. A joint working group had been established and a collective agreement titled "On the organization of assistance in the joint construction, ownership, and organization of joint use of fibre-optic communication lines on the Caspian Sea bed along the route Azerbaijan-Kazakhstan by telecom operators of the Republic of Azerbaijan and the Republic of Kazakhstan". The construction was signed on 19 March 2019. Israel, Turkey, Georgia, Belarus, Moldova, Afghanistan, Kazakhstan, Kyrgyzstan, Uzbekistan, Sri Lanka, and New Zealand had joined the resolution as co-sponsors [157].

To ensure a continuous power supply to data centers, it was essential to have a nearby power plant that operated on either gas or renewable energy sources. In addition, it was important to address various organizational matters, create a strategic plan, and foster strong collaboration among stakeholders to successfully execute the project.

Key strategies and focus areas for the Caspian Digital Hub:

1. Financial Support Strengthening:

- Investment Climate Improvement: Creating favorable conditions for investors to support digital projects and innovation in the region.

- Venture Capital Incentives: Providing incentives to venture capitalists to increase funding opportunities for startups and innovation-driven enterprises.

2. Reduction of Regulatory Barriers:

- “Regulatory Sandboxes”: Establishing controlled environments where startups and enterprises could test new technologies without being burdened by strict regulations.

- Legislation Reform: Adopting legal frameworks that promote digital innovation and remove outdated bureaucratic obstacles.

3. Human Capital Development:

- Educational Programs: Designing and implementing educational initiatives to train individuals in the skills required for the digital economy.

- Mentoring and Internship Programs: Providing opportunities for mentorship and real-world experience through internships to build practical knowledge and expertise.

4. Infrastructure and Technological Resources Development:

- Technoparks Construction: Building technology parks to provide startups and enterprises with modern facilities and a collaborative environment.

- Partnership with International Companies: Collaborating with global corporations to bring advanced technologies and expertise to the region.

5. International Cooperation:

- Cooperation Agreements: Establishing agreements with other nations or international organizations to promote cross-border collaboration.

- Support for Product Commercialization: Facilitating the commercialization of locally developed digital products on global markets.

KAZAKH INVEST launched a discussion regarding prospective preferences, risks, and ways to provide service assistance to potential investors. As an institution that attracted investments, KAZAKH INVEST offered assistance to investors throughout the entire project implementation process. In addition, the meeting attendees expressed many requirements that, if addressed, would facilitate the engagement of foreign investors and major client organizations, including multinational corporations, in redirecting their traffic to the end user. Those include renowned global technology giants like Microsoft, Google, Amazon, Facebook, and Apple, along with Kazakh companies.

The objective of the hub was to establish a digital pathway connecting Europe to China via the Azerbaijan-Kazakhstan route, which would traverse the Caspian Sea bed from Azerbaijan to Kazakhstan. Azer-Telecom, a subsidiary of Bakcell, the first mobile provider in Azerbaijan, would construct the Trans-Caspian Highway on the Azerbaijani side, while Transtelecom and KazTransCom would be responsible for its construction on the Kazakh side. But the construction had not been completed yet.

It would be the largest hub in the Caucasus and Central Asia. The HLD (high-level design) had been fully designed, and a thorough roadmap had been approved. Once the research work was completed, the optics would be directly laid on the bed of the Caspian Sea. The initiative aimed to enhance connectivity for access to the Internet and digital services for the 1.8 billion individuals residing in the Middle East, Caucasus, and South and Central Asia.

Kazakhstan would directly profit from the establishment of a digital hub through increased foreign investment in infrastructure projects, technological advancements, job creation, and the attraction of foreign enterprises to operate within the country. The establishment of a digital center in the Caspian area would enhance and solidify the existing bilateral connections between China and Kazakhstan. By utilising the Khorgos International Center of Boundary Cooperation (ICBC), Chinese enterprises had gained advantageous access to the Eurasian market, allowing them to establish a presence in Kazakhstan and secure residence for the largest Internet companies.

Astana Hub Ventures Ltd.

Astana Hub Ventures Ltd. [158] was the predominant technopark for IT startups in Central Asia. It fostered an environment conducive to the unhindered growth of

both domestic and international technology enterprises in Kazakhstan. As per Article 293 of the Code of Tax of the Republic of Kazakhstan, which was amended by paragraphs 4-3 as per the legislation of the Republic of Kazakhstan, specifically, the Law issued 26.12.18, No. 203-VI, effective from 1 January 2019 until 1 January 2029.

Astana Hub had served as a platform for the advancement of both domestic and international technology enterprises in Kazakhstan. The Hub was located in Astana. It united skilled IT professionals from around the globe and assisted at every phase of their project's development. The network comprised 900 IT enterprises and startups that collaborate and communicate with one another [158].

Astana Hub offered solutions to various inquiries, such as where to initiate, where to locate the organization, how to construct a company model, and how to assess market demand. Additionally, it provided guidance on entering the global market and achieving leadership in the industry.

The participants of the international technical park "Astana Hub" lowered the amount of corporate income tax payable to the budget by 100% of the amount computed according to Article 302 of the Code. For that Code, entities designated as participants of the international technopark "Astana Hub" must concurrently satisfy the criteria set forth herein: They must be duly registered as participants within the "Astana Hub" framework under the information technology statutes promulgated by the Republic of Kazakhstan. Their revenue stream should be derived exclusively from engaging in principal operations within the information and communication technology sector. Astana Hub offered initiatives in two domains: education and business. Educational programs provided valuable skills for budding IT entrepreneurs, whilst business programs were tailored for individuals who had already initiated their ventures and needed to enhance their company's performance. The programs were often updated; thus, it was advisable to monitor Technopark's website for application updates. Educational activities include the firm School, which had been focused on the process of founding a firm. That school covered topics such as testing a concept with minimal investment, building a minimum viable product (MVP), strategies for effective project presentations, and common mistakes made by startups. The Freelance School offered comprehensive instruction on fundamental aspects of freelancing, including a portfolio, which was essential for the hub’s development, job hunting strategies, client collaboration, efficient time management, and competitor evaluation. No Code School had specialised in the development of web services and apps without the need for programming. Techpreneurs was an accelerator that provided support and guidance to businesses at every level of development. That included personalised tracking and consultations, seminars and master classes, as well as monthly diagnostics. The Regional IT Hub was an initiative designed to support entrepreneurs in the region by assisting in developing business procedures, expanding their operations, and obtaining funding. The authorised body in the field of informatization, in coordination with the central authorised body in the field of state planning, the authorised body in the field of state support of industrial and innovative activities, and the authorised body, should approve the list of priorities in information and communication technologies and the criteria for their production. Technopark provided a digital request for involvement that attendees were required to complete on its

official website. The certificate of registration was granted within a period of five working days, and the list of those who took part was made available on the website after it had been approved. That procedure guaranteed a seamless and effective registration for attendees. The RK Tax Code did not have a specific mechanism for registering in the ICC Astana Hub. On 2 July 2021, the Minister responsible for overseeing the areas of Innovation, Digital Development, and Aerospace Industry in the Republic of Kazakhstan issued Order № 233/H/K, which authorised the use of specific forms for gathering administrative data [159]. Participants of the International Technology Park "Astana Hub" were required to submit the form Index: 2-SIS. That form was designed to gather administrative data on investments in startup enterprises. The Deputy Ministry of the nation's Innovation, Digital Development, and Aerospace Industry had modified and broadened the Order of the Minister of Information and Communications, issued on 26 September 2018, in order to authorise laws for the functioning of the International Technological Park "Astana Hub". Technopark was operated with the following functions: 1) Offering acceleration and technological business incubation services to participants of Technopark; 2) Providing marketing and other services to participants of Technopark; 3) Offering consulting, informational, analytical, and instructional services to encourage the growth and progress of Technopark participants; 4) Engaging in partnerships with international organizations and foreign counterparts to secure educational, information, and financial resources; 5) Encouraging international persons and residents of Kazakhstan to engage in activities of Technopark; 6) Enrolling participants of Technopark and issuing relevant supporting documents; 7) Providing housing and establishing living conditions for individuals undergoing acceleration in Technopark; 8) Aiding in the preparation and coordination of events that aim to promote progress and development in the business industry, with the objective of fostering collaboration among Technopark participants; 9) Providing education and training to individuals with the necessary skills and knowledge in the area of information and communication technology, in accordance with country’s legislation; 10) Offering financial assistance for industrial-innovative initiatives undertaken by participants of Technopark in the realm of information and communication technologies; 11) Creating investment funds or purchasing ownership shares in investment funds. Technopark, a telecommunications technology center in Astana, welcomed individuals from both inside and outside of Kazakhstan. In order to register, an organization must not have any subsidiary divisions and must be engaged in priority activities specifically connected to ICT. It was not allowed for national corporations, state management holdings, or subsidiaries to own more than 50% of shares in their authorised capital and the company's share. In addition, the entity must abstain from engaging in underground extraction or taking part in a particular economic area. In order to register, candidates must possess legal capacity and be actively involved in the Technopark. Participation was available to anybody, regardless of their residency status, both within and outside of Kazakhstan. Technopark participation criteria: 1) Absence of branches, except representative offices; 2) Legal personality required; 3) Not implementing investment priority projects as per Article 284 of the Entrepreneurial Code of the Republic of Kazakhstan; 4) Not a subsoil user or participant of a special economic zone; 5) Not owning 50% or more shares of a le-

gal entity owned by the state, national management holdings, national holdings, and national companies; 6) Carrying out priority activities in ICT as per the List of priority activities approved by the Minister of Digital Development, Defence and Aerospace Industry; 7) Not being an excise taxpayer as per Article 461 of the Code of the Republic of Kazakhstan. Paragraph 10 of the Order will provide additional information on the procedure for organising educational activities to train skilled persons in the field of ICT. The Order was enforced starting on September 7, 2022 (released on 27 August 2022). To register for the Astana Hub, applicants must submit documents such as a state registration document, business plan, tax indebtedness certificate, company office documents, and employee information. Participation status would be available for free and required registration on astanahub.com, an online application, and a 15-day decision-making process. After completing the agreement, a certificate confirmed participation in the technopark. Submissions were accepted in Kazakh, Russian, or English. The Commission had the authority to deny registration if the company was not involved in a prioritised ICT activity, resold access to a product without proper rights, sold goods without the necessary ST-KZ or industrial certificates, or failed to provide a complete and detailed business plan. The International Technopark of IT Startups oversaw 13 regional IT Hubs. So far, a total of 13 regional IT hubs had been formally established and were currently operating successfully (Figure 32).

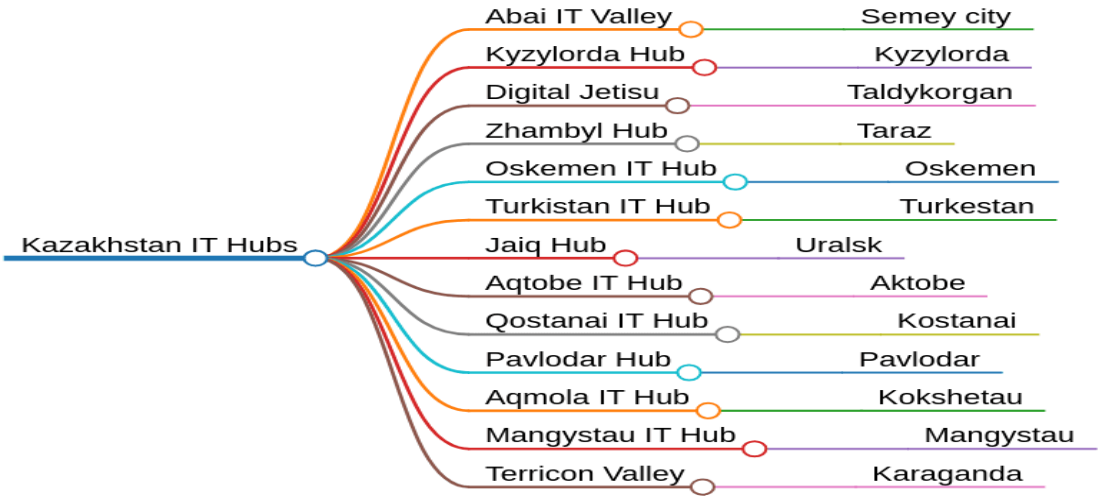


Figure 32 – Regional IT hubs
Note – Organised by the author software draw.io

Astana Hub, a leading IT hub, had 526 new member businesses in 2022, with 173 having foreign capital. Those IT enterprises created employment opportunities for 7,805 individuals, with nearly 2,500 being non-citizens. Over half of the funding was derived from residents' contributions, but a goal of financial independence without relying on government funding was being set within six months. The state's budget was allocated towards leasing office space within the EXPO territory, but the aim was to decrease the leasing area and rent out the remaining space to other enterprises at market rates. The merger of Tech Garden and Astana Hub Autonomous Cluster Fund aimed to maximize resources and provide a cohesive support system for

IT entrepreneurs. The aim was to have a unified interface catering to all participants in the startup economy. The newly formed organization was named Astana Hub Autonomous Cluster Fund, retaining its established brand recognition both domestically and internationally. The success of an IT entrepreneur from the Terricon Valley IT hub in Karaganda, supported by local akimat, was expected to serve as a model for other regions in Kazakhstan as the hub's growth, development, and tangible outcomes demonstrate its potential. Regional projects leveraged the resources of the Ministry of Digitalization, Astana Hub, akimats, and private businesses. As an illustration, in Aktobe, a compact IT center measuring 500 square metres was created with assistance from Freedom Finance. Each region was assigned a community manager who was responsible for building the local community and organising educational and business programs. That established a specific pathway for talented individuals, where the most exceptional individuals from different regions had the opportunity to participate in flagship courses - Silkway Accelerator and Hero Training. In 2023, a collaboration with Google for Startups was established to create an accelerator program. There were three occurrences of batches. The event's outcomes were as follows: the combined appraisal of the startups that took part surpassed $400 million, and the monthly recurring revenue (MRR) reached over $3 million, as noted by Digital Business. The Hero Training course, in collaboration with Draper University, had been initiated. Currently, 15 firms had participated in that program, and our ultimate goal was to send a total of 30 entrepreneurs to the Valley annually. The objective of those hubs was to foster the creation of cutting-edge initiatives in various regions and to provide training for IT professionals. Furthermore, those platforms were a hub for establishing local IT communities and facilitating the convergence of startups, investors, and mentors. The primary objective of regional IT centers was to facilitate the initiation of startup ventures for young entrepreneurs, particularly during the early stages. In that Address to the nation, President Kasym-Jomart Tokayev highlighted the significance of enhancing the innovation ecosystem at the provincial level. In addition, the TechOrda program had successfully incorporated 8 new IT schools, thereby enhancing the professional advancement and progress of individuals involved. Astana Hub had opened regional IT hubs in Kyzylorda and West Kazakhstan regions to develop local innovation projects, train and educate IT personnel, and create regional IT communities. The hubs hosted competitions among startup projects like Idea Battle and Startup Talapker, incubation programs for startups at the idea and product creation stages, and broadcast all educational and business programs of the Technopark. The facility included an IT center, laboratory complex, conference hall, co-working space, game zone, and various other specialised areas. Qostanai IT Hub offered educational classes for startup projects and IT enterprises, along with a range of incubation programs, hackathons, and events.

The initiative to automate the operations of block-modular boiler houses, which had been implemented in many villages in the Kostanay area, had garnered considerable attention. That strategy allowed for the preservation of fuel, the efficient use of human resources, and, most importantly, improved the security of the heat source. Every regional IT center in Kazakhstan had served as a focal point for innovation and

original thought, attracting young entrepreneurs, programmers, and other members of the IT community.

The objective of regional IT-hubs in Kazakhstan was to foster the development of a startup culture and IT community. While visiting the Aktobe region, the facilities of IT Hub Aqtobe were officially endorsed, and plans were made for the layout, roadmap, and key performance indicators (KPIs) for the year 2023. The program incorporated the Zhansugurov Startup Academy, No/Low Code School, and Freelance School course, which focused on fundamental aspects of entrepreneurship. Astana Hub sought to foster the expansion of local IT communities by establishing welcoming environments for fledgling business owners. Astana Hub, the International Taraz Innovation Institute, and the Akimat of the Zhambyl region inked a deal. Zhambyl region hosted the first-ever regional IT Hackathon-2023, which included panel discussions about issues related to the IT sector and the Startup Orda project. The program aimed to demonstrate that startup culture and IT movement exist beyond the cities of Almaty and Astana. The Shymkent IT Association highlighted the need for infrastructure to develop local IT communities, a startup movement, and staff training. Currently, the IT business was concentrated in Almaty and Astana, with 926 billion tg of IT services provided within Kazakhstan last year. However, 80 percent of Kazakhstan's residents lived outside those cities. To start an IT career or digital business, Digital Business was being studied.

According to government statistics, the overall volume of IT services within Kazakhstan last year amounted to 926 billion tg. Nearly 90 per cent of this sum was concentrated in the two major cities, which serve as the primary markets. Nevertheless, the majority of Kazakhstan's population, amounting to 80 per cent, resided in areas outside of the two main cities.

Terricon Valley had established cooperative agreements with these educational institutions. Here were some statistics and information regarding the past two years of the "valley's" operations: Approximately 8,000 individuals had received training during hub events; over 500 individuals were successfully employed in digital firms in the Karaganda region as a result of the events that took place; Over 700 entrepreneurs participated in ten-week training sessions. Over 150 enterprises and startup initiatives participated in the acceleration program. Throughout the program, they managed to generate an additional income exceeding 192 million tenge. Over 200 projects participated in the incubation program. Throughout the initiative, the entrepreneurs generated a revenue of about 46 million tg, starting from virtually nothing. Starting in 2021, the Terriconovaya Valley IT hub had been actively collaborating with Astana Hub on accelerator initiatives focused on Smart City and Scalerator. Through a collaborative approach with experts and trackers in the "valley", entrepreneurs had successfully established agreements with firms to create the Smart City system. Additionally, they had secured export contracts with European, American, and Turkish companies, amounting to over $400,000.

The hub aimed to foster a technological startup ecosystem and a collaborative IT community in the region, with the support of government, business representatives, and ambitious civil society members. Astana Hub engaged in active collaboration with local government bodies, providing support to those who were interested in fos-

tering technical entrepreneurship in their region. Astana Hub not only established hubs but also coordinated other activities throughout the regions, including hackathons, Olympiads, Pizza Pitch, and forums. The regional development office of Astapa Hub had provided support for the establishment of multiple new private IT schools, including Jetisu IT Hub, Dosti School, Ver-tex School, S-Tec LLP, Jump Lessons, and Insoft.shymkent. Those schools were actively engaging in the Tech Orda project. It was highlighted that there were already 20 private IT schools in various areas of the country. The development formula consisted of the collaboration of the government, private initiative, and big enterprise. Astana Hub currently catalyzed for regional growth. However, the involvement of additional local stakeholders was also significant. To expedite and expand the implementation of beneficial transformations. The case of Terricon Valley in Karaganda and MOST Hub in Almaty exemplifies the significance of entrepreneurial vigour and private initiative in fostering the growth of the local ecosystem. Without state support in the form of specific contracts from local akimats, such as those in Karaganda and Almaty, and organizational support from key institutions like Astana Hub and ICRIAP, regional initiatives might lack the necessary sustainability. The increase in the IT manpower funnel in the country would benefit huge technology businesses. Companies like EPAM, which received tax preferences in Kazakhstan, should play a more active role in the advancement of those areas. Telecom operators and banks could sponsor regional hackathons to bring their IT and business tasks to the region. They could also take talented people from the regions for internships at the head office. Large companies could benefit from opening development centers in the regions due to the cost-of-living difference. By helping to develop regional IT hubs, they could break the vicious circle of IT personnel shortages in regions.

To assess the effectiveness of Astana Hub, an analysis to determine the feasibility of further establishment of digital hubs, as well as to assess their contribution to the development of both the hub itself and the social and economic benefits to the community. The effectiveness assessment identified how successful Astana Hub was in terms of its impact on the innovation ecosystem, support for startups and technology companies, as well as determining its social and economic impact on the local community and national economy. For the assessment of the economic efficiency of the Astana hub, the values of indicators for the available financial statements and balance sheets for 2018 and 2021 were summarised below in KZT thousands.

According to the results of the assessment of the economic efficiency of the technopark, it was concluded that the management of the park was stable and attractive to investors, had good current liquidity, and high profitability indicators for 2018-2021.

Evaluation of economic efficiency for 2018-2021. To begin with, a table with data for calculation in thousand tenge is presented (Table 14).

Table 14 - Evaluation of economic efficiency for 2018-2021 of the Astana hub

Title	2018	2019	2020	2021
Net Income	153 192	44 381	388 389	556 554

Total Assets (for the beginning of the year)	61 715	330 114	1 181 638	2 163 140
Total Assets (for the end of the year)	330 114	260 770	2 163 140	4 752 062
Equity (for the beginning of the year)	61 715	165 668	69 524	457 913
Equity (for the end of the year)	330 114	121 287	457 913	1 014 467
Current Assets	303 370	191 563	1 120 736	2 609 855
Current Liabilities	164 446	139 483	954 863	2 560 711
Revenue	234 604	1 320 259	1950 279	3 702 132
	The results of assessment			
ROA	78.21%	31.15%	23.22%	16.10%
ROE	78.21%	42.91%	147.28%	75.60%
Current liquidity ratio	1.84	1.26	1.17	1.02
Profit Margin	65.32%	26.54%	19.92%	15.03%

In general, the values of the indicators for 2018 to 2021 showed high economic efficiency. Return on assets showed a peak in 2018, and showing 78.21%, dropping 31.15% in 2019, and illustrating 16.10% in 2021. The values of Return on equity illustrated a high value in 2020, showing 147.28%, and the lowest value in 2019, showing 42.91%. The value of the current ratio indicator presented a gradual decline from 2018, from 1.84 to 1.02. A gradual decline was also presented in the return on sales, from 65.32% to 15.03%.

SIFRO LLP

There was also the hub called “SIFRO Limited Liability Company” [160] which is located in Shymkent. The hub aimed to make the city of Shymkent a leading innovative center at the national level.

The hub had such services as training courses, an Academy school for pupils to increase their digital skills, and conditions for IT youth to make business projects. From digital technologies, the management of the hub used robotics and CGI for creating anime. The management of the hub is presented in Figure 33.

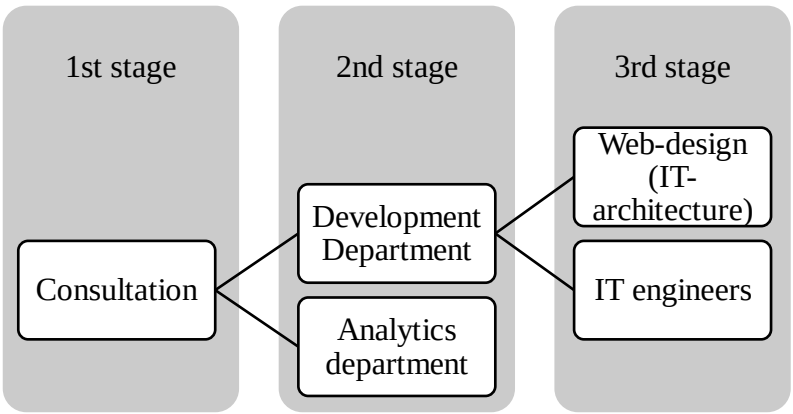


Figure 33 – The management of Sifro hub

Validation in “Sifro Hub”:

Sifro Hub builds IT products, including:

- Website development and promotion;
- CRM systems;
- Mobile applications;
- Game development;
- 2D and 3D animation;
- Other digital products.

Organizational structure of the hub:

1) Hub Director. Responsible for overall management, strategic planning, and coordination of all departments.

2) Sales and Marketing Department

- Serves customers seeking hub services;
- Conducts free IT consultations;
- Identifies customer needs and directs them to the appropriate departments.

3) Development Department

The main department of the hub, which employs:

1. Web Designers:
   - Creates the concept and design of the product.
2. Web Architects:
   - Develop business processes for designers and programmers;
   - Play a key role in creating a quality product.
3. Full Stack Programmers:
   - Versatile specialists who do both frontend and backend development.

4) CGI studio:

- Developing 2D and 3D animations;
- Creating computer games;
- Production of animated films and videos.

The department employs:

1. Graphic designers:
   - Create visual concepts.
2. Motion designers:
   - Develop animations.
3. 3D specialists:
   - Model and texture objects.
4. Game Engine Programmers:
   - Create software components of games.

5) Front office. Service staff to provide administrative support and ensure the hub is running comfortably.

6) Programming school. A training center aimed at training future employees of the hub. Main areas of focus:

1. Development and promotion of websites;
2. 2D and 3D animation;
3. Computer games development.

- Students work on real orders and projects;
- Gain marketable practical skills.

Hub Residents

5 residents were working in the hub:

- 2 of them work in the CGI studio;
- The rest were in the development department.

Technology

- Utilizing the latest technologies, including meta-universe development and modern programming languages.
- More than 20 patents for the development of various projects.

The management of the hub assessed its activity with the methodology of evaluation based on criteria and an evaluation scale. The results are presented:

-Strategic planning and adaptability – 3 points out of 5, indicating the overall plan is established, but there is little customisation to meet the particular requirements of each hub;

- Capital allocation and funding - 4 points: The organization has ample financial resources due to substantial investments from private and international sources;

-Infrastructure development - 3 points: Adequate infrastructure development with a few specialist resources.

- Human resource potential and education - 1 point: There is a significant shortage of skilled professionals since there is a lack of specific training programs.

MOST IT Hub Almaty Limited

MOST IT Hub Almaty Limited [161] was an innovative space in Almaty that was focused on supporting the activities of startups, technology companies, and entrepreneurs. The Hub provided a range of flexible workspaces, conference rooms, smart offices, and specialized areas for meetings and events [162].

Features and management of the hub were that the space supported a digital platform for booking resources, requesting services, and coordinating events. The hub was managed through a digital app to integrate with payment systems, track bookings, and collect analytics.

The organizational structure of MOST IT Hub was based on a linear-functional model, incorporating elements of a project structure. The aforementioned characteristics were elucidated as follows: the management structure was based on a clear hierarchical system, beginning with the Hub Director, who established the strategic direction and was accountable for critical decisions. The director engaged in interactions with the heads of pivotal functional units, including those responsible for operations management, marketing, IT support, and maintenance.

The organizational structure of the hub was as follows:

-The position of Hub Director (CEO) was responsible for the overall strategic leadership and key decision-making within the organization. The role of the Hub Director was to provide overall strategic leadership and to make key decisions;

-The formation of collaborative relationships and the recruitment of new residents. The monitoring of financial and operational indicators was also a responsibility of this role;

-The role of the Operations Manager (COO) was to oversee the implementation of operational procedures and processes, ensuring the smooth functioning of the organization's operations;

-The management of day-to-day operations. The optimization of work processes and the assurance of the seamless operation of the hub were of paramount importance;

-The role of the Marketing and PR Manager was to oversee the implementation of marketing and public relations strategies, ensuring that the company's image was projected positively and that the public was informed of the company's activities. The role also entailed maintaining social media accounts and coordinating media coverage to promote the hub.

-The role of the Chief Technology Officer (CTO) was to:

-The provision of technical assistance about the infrastructure of information technology;

-The implementation and management of digital services, including resident platforms and analytical tools, will be carried out;

-Mentors and consultants were available to provide guidance and assistance in, the organization of workshops and events. Assisting nascent businesses in the development and acquisition of investment capital.

Cross-Border Centers (Hubs)

As stated by the Ministry of Trade, the establishment of the Central Asia ICC would catalyze the development of new industries specialising in the manufacturing of agricultural and industrial goods. Additional services for the transportation of products will also be offered. The bilateral commerce volume between the states had the potential to increase to $10 billion. According to the government's previous statement, that amount reached $5 billion in 2022 [163].

A second hub, specifically an industrial trade and logistics complex, was set to be established in Zhambyl region. The site would be situated on the frontier between Kazakhstan and Kyrgyzstan. The center's inauguration was planned for the third quarter of 2026.

Initially, it was anticipated that this facility would contain state-of-the-art storage facilities for fruit and vegetable products. That would facilitate the advancement of processing agricultural and industrial goods, as well as foster industrial collaboration between the two nations.

The third hub, known as the Eurasia cross-border commerce center, would be established on the border between Kazakhstan and Russia. The launch was scheduled to take place in the Western part during the third quarter of 2025. The center would prioritise collaboration with the border regions of the northern country. The projected estimate was that it would reach a total of 30 million individuals. That hub could focus on markets in Eastern Europe.

The Ministry of Trade had stated that the establishment of hubs would lead to a growth in bilateral trade and economic links with neighbouring nations. Business connections between manufacturers and entrepreneurs in the states specified above would also increase, as would mutual trade turnover.

Kazakhstan as a digital hub

A total of 194 innovative startup concepts from various locations were showcased [164]. Furthermore, 7 forums specifically dedicated to the dissemination of knowledge and exchange of ideas in the field of information and communication

technology were successfully coordinated in various regions. A significant milestone in the advancement of the IT industry was the establishment of 8 new IT schools, which were effectively included in the TechOrda initiative, thereby enhancing their ongoing professional advancement and progress [165]. Within the context of that research, parties would enhance chances for the growth and cultivation of IT capabilities. They would organise educational events, making use of Huawei's knowledge and resources, such as training courses, seminars, and forums, to enhance IT literacy. Huawei Technologies Kazakhstan was ready to support the comprehensive development of Kazakhstan's digital economy by implementing digitalization in urban and agricultural facilities, providing advisory services on high technology implementation and research, and leveraging existing ICT infrastructure. The company aimed to expand and improve digital services to the population, as stated by the General Director of Huawei Technologies Kazakhstan.

Digitalization in Kazakhstan has been progressing well compared to previous years. IT hubs and digital hubs were developing and launching in the country.

The assessment of hubs was based on the information available, official websites, available financial reports, and interview. The credentials of the analysis were goal, objectives, field, direction of development, output, and stakeholders-partners. Digital hub “Parasat” has been working since 2017 and has shown its output, presented above. The hub’s work might be concluded as stable. The hub’s sector was agro-industrial and educational. The Caspian Hub was planned to be opened in 2026, that was why the main information about its launch was provided in the study. The Astana hub and MOST IT hub had their websites. According to the financial report of the Astana hub, the economic efficiency of the hub was calculated, and showed high economic efficiency, to conclude that the establishment of hubs was not a privilege but a requirement of the digitalization processes and the XXI century. The case study of “Sifro Hub” gave a full picture of the inner processes and management of the hub. Also, the author’s maturity assessment model was validated in the hub.

However, every hub faced problems which were presented in 2.3 subchapter, to give further recommendations for improvement and directions of establishment for new digital hubs.

2.3 Problems of digital hub management in Kazakhstan

Kazakhstan's position in the startup ecosystem rating was relatively low, as it was rated 75th out of 100 nations worldwide [166]. That placed Kazakhstan among the thirty countries with the lowest rankings. The country was outperformed not only by wealthy nations but also by numerous emerging nations, encompassing both CIS countries as well as African and Asian countries. For instance, Kazakhstan was surpassed not only by Georgia, Belarus, Armenia, Ukraine, and Russia, but also by Vietnam, Kenya, and Nigeria.

Problems of the Hub - Astana

The objective for Astana Hub entailed positioning itself as a central node within the ecosystem for fostering innovative ideas, generating groundbreaking IT companies, and recruiting a significant number of young and bright IT professionals from around the globe. Furthermore, to encourage and entice creative concepts, residents

of Astana Hub were provided with tax incentives (tax exemption) together with streamlined registration based on the principle of extraterritoriality. Nevertheless, the operation of the Hub elicited numerous inquiries and uncertainties. As per the audit conducted by the Accounts Committee, a substantial portion of the funds allocated to Astana Hub for the purpose of promoting socio-economic stability and cultural development of the state was being used to pay for the rent of premises from JSC National Company "QazExpoCongress" (including utilities) and salaries. In the fiscal year of 2019, the aggregate expenditure amounted to 874.1 million tenge, constituting 66.2% of the total state-allocated resources. The following year, the expenditure surged to surpass 1 billion tg, which comprised 52.5% of the provisioned funds. In 2021, it reached 1.3 billion tg, accounting for 52.7% of the entire amount [167].

The matter of startup development at the Astana Hub technopark continues to be a pressing issue. There was a considerable number of potential participants in the country.

Meanwhile, legal entities were enrolled as hub participants, comprising established ICT entities with pre-existing goods that did not necessarily require the technopark site, like startups did. The audit findings indicated that while those entities still enjoyed tax advantages as hub participants, there might be instances when compliance with legal laws was not assured.

The ICRIAP order dated 11 April 2019 authorised the "List of priority activities in the sphere of information and communication technologies and criteria of own production". Specific enterprises that had business plans involving the acquisition (importation) of equipment for establishing data centers were counted among the participants of Astana Hub. As of 10 November 2021, there were 574 people enrolled in the technopark, with 112 participants engaged in the activity of providing comprehensive computer infrastructure for computing operations and data processing.

Hence, the operations of Astana Hub not only gave rise to numerous inquiries regarding effectiveness but also suffered from inadequate oversight by authorised entities, resulting in significant transgressions across various domains. That had a detrimental impact on the country's startup environment and the prudent utilisation of the RK budget, as well as the reputation of the Hub and the republic as a whole in the international sphere. The Digital Rebirth 2023 forum took place in Almaty [168].

The business forum was convened with delegates from prominent commercial enterprises and governmental entities. The participants engaged in a discussion regarding digital cloud technologies, essential instruments for generating revenue, and the advancements in innovation development in Kazakhstan. One of the main themes in digitalization that the speakers of the forum emphasised was the advancement of generative artificial intelligence. Those solutions were already capable of optimising a company's processes and generating value for it. Furthermore, their investment appeal was expected to increase even further in the future.

Furthermore, there was a conspicuous inclination towards adopting cloud-based solutions and platforms on a global scale. Nevertheless, the experts reached a consensus that the digital community in Kazakhstan must prioritise the establishment of a standardised strategy for utilising cloud platforms. Additionally, it was imperative to

guarantee the safeguarding of data stored in the cloud in compliance with the country's legislation.

During the initial forum discussion, delegates from prominent government and commercial entities deliberated on how to establish themselves as digital hubs. In a speech, President Kasym-Jomart Tokayev emphasised the need for Kazakhstan to become the primary digital hub in Eurasia. Enhancing our human resources was imperative to accomplishing this goal.

Problems of IT hubs

Spaces such as IT hubs were not merely comprised of chairs and technology; rather, they served as venues for individuals to connect, share perspectives, and foster innovation. However, only Astana Hub and Karaganda's Terricon Valley were being closely monitored [169]. According to inbusiness.kz, the regions faced obstacles that impede this process. Hubs served as the nexus where ideas and individuals converge.

Establishing IT hubs in the regions was crucial for fostering the advancement of cutting-edge technologies within the country. The Digital Development Minister stated that Kazakhstan produces approximately 20,000 skilled professionals every year. The demand for them had particularly increased in recent years. Regional hubs should serve as a platform for young and active individuals, fostering industry development and facilitating the retention of specialists in the subject.

The regions had a shortage of leaders.

Industry analysts asserted that a significant issue plaguing society was the limited scope of thought. The purpose of the hubs was to facilitate a broader perspective and consider events occurring in life beyond one's usual focus. In order to be competitive, a region must possess an innovation ecosystem. Each region had the potential to achieve progress, but that required a departure from conventional practices, the formulation of a growth strategy, and the nurturing of dynamic groups and innovative individuals, who definitely existed.

The primary advantages pertain to the exemption of Corporate Income Tax (CIT), Value Added Tax (VAT), and personal income tax for employees of enterprises involved in the Hub.

Huawei Technologies and KTZ had signed a letter of intent to collaborate on digitalizing Kazakhstan's railway network using new technologies like 4G and 5G. Those networks would enable real-time communications, data transfer, and monitoring, improving operational efficiency and passenger experience. Huawei would offer its latest technical solutions and innovations in 5G internet, with a presence in 170 countries, to make Kazakhstan a digital hub [170]. As an illustration, Huawei has set up its educational institutions in Kazakhstan, providing opportunities for young individuals to pursue studies in several IT fields such as networking, cloud computing, cybersecurity, artificial intelligence, and more. The program encompassed in-person instruction, hands-on laboratory exercises, and digital learning materials. Upon finishing the program, students were awarded certificates that were recognised by the industry, which enhanced their chances of finding employment and advancing in their careers. Huawei offered various programs for students to gain knowledge and share experiences, including Seeds for the Future, ICT Academy, and ICT Competition. Since this year, Huawei had been actively participating in offering jobs and helping

students with employment. They also offered students who show the best results to local partners who can involve them in various projects.

The Tech Orda initiative, located at Astana Hub, sought to enhance human resources in the IT industry. The program encompassed a comprehensive array of focus industries, encompassing web development, 3D design, software, and mobile application development, as well as emerging fields like Big Data and Blockchain. Instruction was provided in both the state language and the Russian language, with the length of the training program ranging from 6 months to 2 years. In 2023, the Tech Orda project got a total of 102 applications from IT schools inside the country. Out of these, 83 applications were chosen for participation. In 2022, a panel of experts evaluated 71 submissions and chose 49 schools to participate. These schools collectively submitted 146 courses [171].

The 3rd hypothesis: less than 50% of IT, management, and economics graduates plan ICT activities, and the methodology of the survey was conducted.

As can be seen from the results of the questionnaire, young specialists are interested in digitalization subjects and further activities in the field of ICT and digitalization. i.e., it is important to develop specialists' awareness of the existence of digital hubs. It is also important to develop the topic of digital technologies in universities with an IT profile and in digital economy subjects; it is important not only to familiarise them with their types but also to try to work with them in practical activities.

The next pie chart illustrates the number of specialists who see themselves working with ICT and digital technologies, who are interested in the sphere, and who are not planning or not interested in the area (Figure 34).

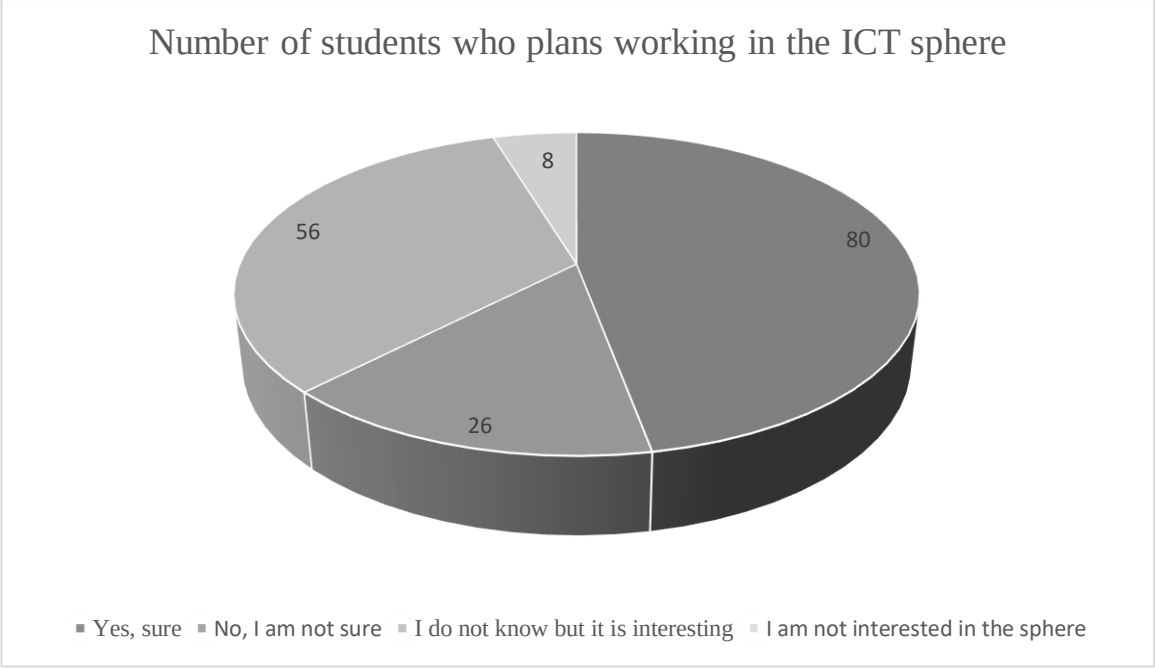


Figure 34 – The percentage of students, planning to work in ICT

According to the pie chart, 80 students are confident in planning to work in the sphere, while 56 are interested in the sphere. 26 respondents are not sure if to work there, while 8 of them are not interested at all.

Conclusions of the second chapter

The second chapter of the dissertation research analysed the activities of digital hubs, assessed the digital potential of the country's regions, and identified the problems of digital hubs in Kazakhstan.

There are five digital hubs in Kazakhstan: Parasat at Akhmet Baitursynov University, Caspian Digital Hub, Sifro hub, Most IT hub, and Astana-hub Digital Technopark. As of today, two digital hubs lack documentation and a website. Based on the financial report and balance sheet of Astana-hub, a calculation of the economic efficiency of the technopark for 2018-2021 was carried out (reporting on the website for this period). According to the results of the economic efficiency assessment, it was revealed that the hub in 2018 showed highly efficient indicators of return on assets, return on equity, current liquidity indicator, and return on sales. However, in subsequent years, the current liquidity ratios were downgraded but did not lose their efficiency.

The methodology of correlation and regression analysis of ICT costs on the level of innovation activity of participants and partners of digital hubs, such as enterprises, SMEs, universities, and R&D organizations, was applied to analyse the digital potential of the regions. For the study sample, the indicators of ICT costs by regions of the Republic of Kazakhstan, the number of enterprises by regions in the Republic of Kazakhstan, the number of active medium and small enterprises, the number of R&D organizations, and the level of innovation activity of organizations were selected. According to the results of the study, three hypotheses were proved and two hypotheses were disproved. ICT costs affect the number of enterprises in the Republic of Kazakhstan, the number of active medium and small enterprises, and the number of R&D organizations. However, ICT expenditure does not affect the number of universities and the level of innovation activity of organizations.

The method of integral index was applied in the study. To assess the digital potential of regions of Kazakhstan, the multiple technological and socio-economic indicators were consolidated into a single measure, based on an index approach. For the assessmen, the following indicatore were chosen: 1) the share of medium and large enterprises using digital technologies (Table 12); 2) digital literacy of the population aged 7 to 64 years (Table 13); 3) the share of Internet users aged 16-74 years (Table 14); 4) the structure of gross regional product: information and communication (Table 15); 5) Index of physical volume of gross regional product; 6) Labor productivity by regions: information and communication (table 16); 7) Number of employed population by types of economic activities and regions for 2010-2023: information and communication (table 17). In the long-term period, Astana and Almaty showed leading positions, and a gap was seen between those two cities and other regions.

According to the conducted survey, more than 80% of graduated students were planning to work in the ICT sphere, despite the shortage of ICT workers analyzed in the workforce market.

Digital hubs in Kazakhstan were a concept new to Kazakhstan. Since launching the program “Digital Kazakhstan” in 2017, new initiatives in the country had been organized. According to the analysis, the digital divide between regions was evident and needed improvement. Problems of digital hubs were identified. Mostly, the prob-

lems were identified in financial, social, and operational sectors. In Chapter 3, the recommendations and mechanisms to solve those problems will be provided.

3 RECOMMENDATIONS, MECHANISMS FOR IMPROVEMENT MANAGING THE ESTABLISHMENT OF DIGITAL HUBS

3.1 Recommendations and mechanisms for managing the establishment of digital hubs in Kazakhstan

The digital economy has profoundly influenced the function and structure of entrepreneurship in regional socio-economic systems. A knowledge- and skills-based economy has shifted strategies and goals in the traditional use of production factors and entrepreneurial initiative. This is because new economic conditions require innovative approaches to managing the key sectors of the regional economy, which were based on technological innovations. By adopting an integrated approach to the evolutionary processes of entrepreneurial activity, the clear priorities for modifying the structure of state regulation and support for economic entities in response to the impact of the digital economy were established.

The government regulated and promoted entrepreneurship in a digital economy to address disparities in regional socio-economic development indicators, considering the constraints of limited financial resources. When using digital technologies to regulate entrepreneurial activity in economically significant sectors that generate money for the regional budget, it was important to take into account the idea of the cyclic development of the global socio-economic system. The integration of digital technologies into global technology chains has necessitated the involvement of entrepreneurial initiatives in order to maintain a balance between supply and demand in marketplaces for products and services under transnational corporate regulatory frameworks. The digital economy revolutionised the amount of investment flows, considering the unique characteristics of each country's economic development model, regional natural resources, and the kinds and quantities of financial flows.

Conceptual strategies should be developed for executing entrepreneurial support programs. It was crucial to effectively manage local businesses in the age of digital commerce by carefully considering the interests of economic entities and promoting socio-economic progress in the area. That entailed making modifications to managerial decisions inside the institutional sector.

Understanding the complex dynamics of regulating regional entrepreneurship involved considering internal and external factors, such as organizational structure, management integrity, and the impact of digital technologies. The interplay between government, businesses, and consumers in the digital economy was influenced by changing circumstances and global trends, requiring management techniques to examine and promote entrepreneurship effectively. Regional management in the digital economy adopted standardized technological features, while international corporate structures drive innovative growth.

The advent of the digital age has significantly altered the organizational dynamics of interorganizational interactions among regulatory bodies overseeing corporate organizations. The state was increasingly becoming a specialised digital hub for corporate entities, particularly international corporations.

International alliances and unions were implementing structural modifications to the characteristics of their operations with the strategic aim of restructuring market segments for products and services.

Electronic technologies in the regional management system might effectively streamline and enhance the operations of administrative bodies.

The following recommendations are proposed:

- Strategic planning would play a crucial role in determining the future visibility of company results;
- Establishing roundtables consisting of local organizations as an operational infrastructure to create digital hub centers. The purpose was to facilitate interaction between the local infrastructure and the leaders of these organizations to pick one company as the primary hub;
- Dividing various functions of a digital hub into distinct organizations based on their available resources (such as human capital, investors, testing facilities, and training capabilities). The objective was to facilitate efficient collaboration among stakeholders to deliver services to these organizations;
- Evaluating the digital maturity of all organizations in the area, including those involved in digital hubs. The objective was to identify any deficiencies in digitalization and take steps to solve them;
- Improving digital services via the integration of websites, acquisition of funding for startupstartups, establishment of a network of Digital Innovation Hubs, and creation of an online platform for current hubs in Kazakhstan. The primary objective of that platform is to enhance awareness and promote transparency in the execution of various projects.

Huawei and IDC were working to establish Kazakhstan as a digital hub in the Eurasian region. They had opened a new Internet peering connection with AWS in Hong Kong, focusing on four components of the Digital Center: Communications Center, cloud hub, ICT talent center, and ecosystem hub. Huawei had aimed to become a global leader in this area.

International Data Corporation (IDC) was a prominent company that offered information, consulting services, and event organization to the information technology, telecommunications, and consumer technology sectors. IDC's team of 1,300 analysts spread across 110 countries analyzes technologies, trends, and industry prospects at the global, regional, and local levels. IDC assisted IT professionals, executives, and investors in making well-informed choices on information technology and business strategy. Established in 1964, IDC was a division of the International Data Group (IDG), a prominent firm in the field of IT publication, research, and specialist events.

Additionally, diverse services, including the e-Government Portal, E-License, Smart Data Ukimet, Digital Family Card, and e-Otinish digital projects, along with the e-Gov Mobile application, had been developed. Evaluations of e-government performance had identified deficiencies in its operation, especially in its interaction with service recipients.

Centralised monitoring was essential for government agencies to guarantee the effective provision of public services. Nevertheless, the procedure of submitting applications, tracking progress, and obtaining conclusions might differ across various channels of citizen participation. The digitalization of public organizations had the potential to automate tasks, but it might also have a negative impact on the customer experience. Although there had been improvement, the interactions between people,

corporations, and the state may still be difficult, necessitating individuals to get supplementary services or provide supporting documentation. In order to tackle those problems, there had been initiatives since 2020 to restructure the operational processes of government institutions. That involved transitioning from separate departments and agencies to a unified "e-government" architecture that was organised according to certain regions or sectors. There existed a significant degree of bureaucracy inside the G2G domain.

The assessment of the "e-government" communication and information infrastructure objects found that more than 400 information systems were created using different technologies. Nevertheless, the other and incompatible characteristics of these entities provide difficulties regarding their integration. An approved standard e-government design was implemented to simplify and eliminate duplicate information systems. That design facilitates the visualisation of connections among all components of identification, e-government, and organization of varied needs from various agencies.

Kazakhstan should build regional centers by partnering with private and regional technical institutes of higher and postgraduate education and with industry representatives. Implementing this concept will result in creating a unified "e-government" platform, facilitating the complete digitization of interagency processes and the establishment of a comprehensive organizational and technical infrastructure for service provision and public administration operations.

Given Kazakhstan's advantageous geographical position at the intersection of influential countries and data flows, the establishment of data centers would facilitate the movement of information and enable participation in the global market to enhance digital services. Establishing multilateral collaboration with telecom operators in neighbouring countries would develop a contemporary, effective, and scalable transport infrastructure that can facilitate telecommunication traffic between Russia, China, and Central Asia.

Advanced technical methods of information protection and stricter organizational measures should be implemented. Holding individuals accountable for breaches in personal data protection and cybersecurity will also contribute to this effort. The following methodologies are provided for the sustained creation and advancement of high-quality advancements in DIH: The three primary elements consist of 1) implementing the innovation management process; 2) formulating the inventive strategy; 3) overseeing and assessing the degree of invention. The primary component of these systems is to govern the cooperation processes among all the stakeholders in digital innovation centers.

Kazakhstan's legislative frameworks for the establishment and expansion of digital hubs were designed to synchronize the region with the modernization of industries and the transition towards Manufacturing sector 4.0. That entailed the establishment of a novel kind of structural-industrial specialisation and the augmentation of the region's industrial production via diversification. The program sought to provide conducive circumstances for investment spillovers, offer support for fundamental research and commercialization, and execute novel procedures. The explicit goal was to promote innovation and the development of novel industries using digital technology,

accelerating the invention process and providing assistance to sectors that significantly depend on information and knowledge. The objective was to facilitate the modernization of industrial sectors in Kazakhstan via the use of digitalization in manufacturing processes, which included the integration of intelligent technological breakthroughs such as Smart Solutions of compact urban areas known as "smart cities".

The arrangement of institutional mechanism: 1) Administrative regulations: Establishing and modifying legislation related to intellectual property, digital economy, data protection, and cybersecurity. This establishes the legal structure for the functioning and growth of digital hubs; 2) Governance bodies: Establishment of specialist entities or organizations tasked with the advancement of the digital economy, facilitation of collaboration among various stakeholders, and oversight of the execution of pertinent projects and initiatives.

The purpose of the social mechanism was to enhance and cultivate human capital while also promoting social acceptance and adjustment to the digital economy. It comprised: 1) Education and training: Designing and executing educational programs at all levels, ranging from primary education to advanced studies, with a specific emphasis on information technology and its associated fields. Additionally, it was crucial to provide retraining programs for experts whose occupations were susceptible to automation. 2) Social adaptation and inclusion: Initiatives focused on enhancing the digital literacy of individuals to guarantee the broad availability of digital services and technology. That would aid in diminishing digital disparity and fostering a wider embrace of digital advancements in society. 3) Fostering a Culture of Entrepreneurship: Encouraging entrepreneurial activities by supporting innovative startups and small to medium-sized enterprises (SMEs) through educational initiatives, mentorship, and the provision of financial resources.

Those methods together would provide a comprehensive strategy for managing and advancing hubs (digital ones) in the country. Their objectives include establishing essential infrastructure and legal structures, cultivating human resources, promoting innovation and investment, and cultivating a conducive social and entrepreneurial environment.

A comprehensive framework that incorporates the fundamental and pioneering findings was presented in Table 15.

Table 15 - Mechanisms of digital hub development in Kazakhstan

Type of mechanism	Implementation of mechanisms
Innovative mechanism	Expediting the invention process. Facilitating and focusing on knowledge-intensive sectors. Facilitating the modernization of the industries of region via the digitalization of manufacturing processes. Advancement of digital technologies.
Institutional mechanism	State and local support and development of socio-economic development programs. Establishment of initial circumstances and facilitation of digital hub advancement.
Investment mechanism	Inclusion of grants, conditionally repaid loans and equity financing in state grant programs as funding sources for projects.). Funds by employing unconventional methods to obtain external funding. Realign-

	ment of investment flows through effective redistribution. Encouraging the swift development of a digital hub through incentives.
Structural and technological mechanism	Facilitating the generation of favorable conditions for investment spillovers, backing basic research and R&D commercialization. The diversification of industrial output in the region. Development of a qualitatively different type of structural-industrial specialisation in the area.

The input and the output of mechanisms are presented in Table 16.

Table 16 – Implementation and output of mechanisms

Mechanism	Purpose of mechanisms	Implementation and output of mechanisms
Innovative	Expediting the invention process. Facilitating and focusing on knowledge-intensive sectors. Facilitating the modernization of the industries of region via the digitalization of manufacturing processes. Advancement of digital technologies.	Execution Strategies: -Bolster knowledge-driven sectors and expedite innovation timelines; -Encourage the evolution of "intelligent" technologies (Smart Solutions) and compact "intelligent cities." Input: -Regulations advocating for research-heavy industries like IT, fintech, and biotech; -Monetary and logistical aid for innovation-focused startups; -Incorporation of digital advancements such as blockchain, AI, and IoT in conventional industries. Output: -Revamped industrial foundation with diminished inefficiencies; -Emergence of innovation centers and clusters of startups promoting economic diversification; -Adoption of intelligent technologies in urban environments, resulting in more efficient and sustainable cities. Application in Kazakhstan: 1.Intelligent city initiatives: Launch pilot intelligent city programs in Almaty and Astana, prioritizing public services, transportation, and energy frameworks; 2.Incubators and accelerators: Enhance initiatives like the Astana Hub to nurture startups, with a focus on cutting-edge technologies; -Sector-specific digitization: For instance, implement IoT in agriculture to maximize productivity in rural regions, which is vital for Kazakhstan’s agrarian sector.

Continuation of the table

1	2	3
Institutional	State and local support and development of socio-economic development programs. Establishment of initial circumstances and facilitation of digital hub advancement.	The implementation strategies: -It is recommended that extensive governmental support programs and socio-economic initiatives be established, with a specific focus on digital transformation; -It is essential to establish a regulatory framework that encourages innovation while ensuring compliance with global standards. Input: -The implementation of policies and regulations that espouse the tenets of digital entrepreneurship, including the establishment of regulatory sandboxes for fintech and blockchain technologies, is recommended; -The implementation of educational initiatives is essential for the cultivation of a proficient workforce that can support digital endeavors; -The establishment and management of digital businesses should be conducted in an efficient manner. The resulting output will be: -An institutional ecosystem that has been developed in such a way as to foster innovation and entrepreneurship; -The fostering of robust collaboration between the public and private sectors, with the objective of promoting sustainable economic development; -Kazakhstan will gain an elevated international standing as a center for digital innovation. Implemented in Kazakhstan: 1.The establishment of regulatory sandboxes is a key component of this strategy. It is recommended that trial regulatory frameworks be implemented in Astana for the purpose of evaluating and expanding fintech solutions; 2.In the realm of education, reforms are being implemented with the aim of enhancing the quality of the educational system. It would be beneficial to collaborate with universities in order to create programs that are centered on digital competencies and entrepreneurship; -Synchronization of policy initiatives: It is essential to align the development strategies of digital hubs with national initiatives such as "Digital Kazakhstan."

Continuation of the table

1	2	3
Investment mechanism	Inclusion of grants, conditionally repaid loans and equity financing in state grant programs as funding sources for projects.). Funds by employing unconventional methods to obtain external funding. Realignment of investment flows through effective redistribution. Encouraging the swift development of a digital hub through incentives.	It is essential to develop effective mechanisms for the redistribution of investment flows. It is essential to establish incentives that will facilitate the rapid development of digital hubs. It would be beneficial to investigate alternative financing schemes, such as venture funds, crowdfunding, and conditionally repaid state loans. Input: -It is recommended that legislative reforms be implemented to enhance investor protections and facilitate the streamlining of bureaucratic processes; -The promotion of Kazakhstan as a regional leader in digital innovation is intended to attract international investment; -Formulation of collaborative agreements with international financial institutions for the purpose of establishing joint financing arrangements for digital infrastructure projects; The anticipated outcome is as follows: -There has been an increase in the inflow of foreign direct investment (FDI) into the digital industries. This will serve to reinforce Kazakhstan's position as a regional leader in the field of digital transformation; -The accelerated development of startup ecosystems and digital innovation hubs is a key objective. The aforementioned strategies may be applied in Kazakhstan as follows: 1.Incentives for investors: It would be beneficial to provide tax incentives and grants for venture capitalists who invest in Kazakhstan's digital sector; 2.Public-private partnerships (PPPs) It would be beneficial to facilitate PPP models for infrastructure projects, such as data centers or broadband expansion; 3.State-Backed Venture Funds It would be prudent to establish a national digital fund with the objective of co-investing in promising startups alongside private investors.

Continuation of the table

1	2	3
Structural and technological mechanism	Facilitating the generation of favorable conditions for investment spillovers, backing basic research and R&D commercialization. The diversification of industrial output in the region. Development of a qualitatively different type of structural-industrial specialisation in the area.	-The joint efforts of private enterprises, universities, and research institutions to stimulate innovation. -The government offers incentives to attract industry leaders and foreign direct investment (FDI). **The anticipated outcome is as follows:** -The diversification of regional economies, accompanied by a reduction in reliance on traditional sectors (e.g., oil and gas), is a key outcome; -The increased industrial productivity and technological competitiveness that result from these developments will also lead to the establishment of high-value supply chains utilizing advanced technologies. In order to facilitate the application of Industry 4.0 in Kazakhstan, it is recommended that the following steps be taken: 1. The development of regional specializations should be encouraged, with a particular focus on the transformation of industrial zones such as Kostanay or Atyrau into advanced manufacturing clusters; 2. Investment in Industry 4.0 infrastructure should be facilitated, with the goal of establishing industrial parks and technology hubs equipped with smart systems and robotics; 3. Research commercialization should be promoted, with an emphasis on fostering partnerships between local universities (such as Nazarbayev University) and businesses for the purpose of conducting applied research projects.

Orientation of the digital hub space towards Industry 4.0 is the goal of structural and technological mechanisms that aim to renew the structure of industries. The goal of the innovative mechanism is to enable innovation and create new industries through digital technologies. The primary objective of the investment framework is to draw in various funding sources and establish a conducive environment for prospective investors. The purpose of institutional frameworks is to establish circumstances conducive to fostering a robust institutional climate.

For Kazakhstan to achieve success in the digital transformation process, these mechanisms must function synergistically with each addressing a distinct set of requirements. The structural and technological mechanism can serve as the foundation for industrial modernization, while the innovative mechanism can facilitate the development of new industries. The investment mechanism ensures the provision of sustained financial support, while the institutional mechanism provides the necessary regulatory and educational frameworks.

Hubs are considered from the aspect of innovation management:

1) Number of startups and residents:

- Total number of startups registered and supported in the hub.
- Number of resident startups that have successfully completed incubation and accelerator programs.
- Startup survival rate (percentage of startups still operating 1, 3, and 5 years after incubation).

2. Number of patents and intellectual property:

- Number of registered patents created by startups and companies in the hub.
- Number of patent and trademark applications filed by hub members.
- Number of licenses to use intellectual property developed in the hub.

3. Attracted investments:

- Amount of venture capital investment and private equity raised by startups and hub residents.
- Number of successful investment raising deals (funding rounds).
- Average amount of investment per startup.

4. Economic indicators and revenues:

- Total income of hub residents (revenue of startups and companies).
- Number of jobs created as a result of startups' activities.
- Return on investment (ROI) for projects supported by the hub.

5. Number of innovative projects and products:

- Number of innovative products (new technologies, services, and solutions) developed and implemented.
- Number of completed research and development (R&D) activities.
- Share of commercialized projects among all completed developments.

6. Educational and training programs:

- Number of educational programs and trainings conducted for hub participants and employees.
- Number of trained specialists, including students, developers, and entrepreneurs.

- Percentage of participants who received certification after completing training programs.

7. International cooperation and partnerships:

- Number of international partnership agreements entered into with foreign hubs and organizations.
- Number of international startups and companies working in the hub.
- Participation in international conferences and exhibitions (number of projects presented abroad).

8. Innovation activity and publications:

- Number of scientific publications and articles published by hub residents.
- Number of scientific and practical conferences and seminars held.
- Innovation activity index (number of innovative proposals and solutions per year).

By adapting these strategies to align with regional strengths and global trends, Kazakhstan can establish itself as a leading force in digital innovation within Central Asia.

Establishing a Digital Hub: Key Attributes and Research Methods

• Relevant research on existing deficiencies or resolving issues.
• Systematic evaluation of preparedness for a digital hub.
• Consistent expansion of stakeholders across various industries.
• Partnerships with local academics and international professionals.
• Research on successful strategies of digital hubs.
• Use examples from two categories of cities for comparison.
• Identification and search for suitable digital hub locations.
• Assistance provided to digital startupstartups and advanced ICT firms.

To summarise, the mechanisms for managing the establishment of digital hubs have been highlighted above, and recommendations have been given to the state administration and companies.

3.2 D-BEST model, scale, and criteria for managing the establishment of digital hubs in Kazakhstan

There were diverse models of digitalization and digital transformation. The model of Capability Maturity Integration assesses the maturity of processes of digital transformation to evaluate the readiness of an organization [172]. The Digital Maturity model was based on five levels of digital transformation and assesses the digital maturity of enterprises [173].

The comparative analysis of digital transformation models was presented below in Table 17.

Table 17 - The comparative analysis of digital transformation models

Title of the model	Key Features	Advantages	Disadvantages
Capability Maturity Model Integration	1. Defines five levels of maturity, from "Initial" (ad hoc processes)	provided a structured approach to process improvement of an or-	High costs of implementation of hubs, complicated and bu-

	to "Optimizing" (continuous improvement). Diverse methods were applied to gradate the organization (survey, interview, evaluating products, documentation and so on)	ganizations (digital hubs might count as an organization). Assessment of maturity of hubs, adaptation, improvement of service portfolio of hubs	reaucratic processes, limited applicability for small organizations (if a digital hub was just set-up) long payback period of investments
Digital Maturity models	Diverse models of digital maturity assess capabilities such as: -strategy; -leadership; -skills of workers; -operations. Key features were organizational culture, business transformation, and technological adoption.	considered the gradual process of digitalization and permitted comparison of companies and regions	frequently, involve complex analysis and data collection, and might lack the specificity of digital hubs
EDIHs Maturity Model	Assess: -service portfolio of hubs; -business model; -network engagement; -digital expertise.	oriented towards digital hubs, complies with European standards	EU specific, may be difficult to adapt to other regions
Global Smart Industry Readiness Index Initiative	Evaluate: -process; -technology; -organization. Focused on industrial and manufacturing sectors.	considered global trends of digitalization	was geared toward industrial enterprises, not hubs.
Note - compiled by the author using sources [58, 172, 173, 174]			

In comparison with the models in the table, the D-Best model was oriented specifically to the assessment of digital hubs, while the following models were oriented toward digital maturity evaluation of organizations in general. Traditional models often considered a gradation (high level, medium, low), which was not always applicable to dynamically developing hubs. Using key features of the D-Best model, the scale and criteria were compiled and validated in “Sifro hub”.

Sassanelli & Terzi (2022) developed the D-Best Reference model [175]. The acronym D-Best, transcribed as Data-Business-Ecosystem-Skills-Technology, refers to the five macro-domains. Those domains are divided into classes of services and types, being defined through a three-phase methodology (1) literature review for model conceptualization; 2) expert feedback; 3) twofold survey and comparative benchmarking.

The theoretical foundation of the model stems from the evolution of ETBSD and ETB models, European digital initiatives.

This research adapts the D-BEST framework specifically for the Kazakhstani regional context. Key model dimensions (technology support, ecosystem development, and skills improvement) have been localised through expert input and case studies. Unlike its original application to pan-European networks of DIHs, this version emphasizes readiness of local innovation ecosystems, governance, and digital infrastructure, providing a tool not only for strategic planning and resource allocation.

The adaptation of the model includes:

- Adjusting terminology and indicators to reflect the institutional realities of Kazakhstani hubs;
- Testing the model through case studies of local hubs;
- Incorporating local factors such as governance models, startup support infrastructure, and public-private coordination.

The model's validity was supported by its successful application in European countries.

The development of a model for managing innovation in Kazakhstan to create digital hubs involves strategic planning, building capabilities, and establishing a resilient technological infrastructure. To be more explicit, the tasks that need to be completed rely on the pillars:

1) Strategic planning and analysis, which involves careful and systematic thinking and evaluation;

2) Creation of a comprehensive plan for digital centers around the country, considering the unique characteristics of each area;

3) Analysing the market, industry requirements, and technological trends to pinpoint areas of specialised focus;

4) Evaluating regional economic indicators, infrastructure, scientific and educational potential to determine suitable locations;

5) Identifying key industry and technology clusters in each region;

6) Developing infrastructure and services to support the chosen specialisation.

Establishing or modifying infrastructure to accommodate the requirements of digital hubs, such as technology parks, research centers, and educational institutions. Creation of assistance initiatives for startups, creative enterprises, and scientific investigation. The financing and investment side involves the attraction of both public and private funding as incentives and advantages for investors and participants in the hub. It also entails the administration and coordination of these funds, as well as the construction of highly competent management teams with expertise in innovation and technology.

Suggestions for regional specialization

The choice of areas for digital hubs should be determined by a thorough examination of their economic, scientific, technical, and educational assets, as well as their sector specialism.

Astana and Almaty, the most populous cities with well-established infrastructure and a significant degree of commercial engagement, have the potential to serve as hubs for IT startups, fintech, and digital advancements in management and education.

Shymkent and Karaganda, due to their significant industrial capabilities, can specialise in the growth of technologies, the digital ones, in the areas of engineering, metallurgy, and production logistics.

The areas of Aktobe and Atyrau, which have a well-established oil and gas industry, may prioritise the digitalization of the energy sector. This involves creating solutions to enhance the efficiency of production and refining processes.

East Kazakhstan has the potential to become a hub for the advancement of high technologies, such as materials science, pharmaceuticals, and biotechnology.

The approach to managing the establishment of hubs in the country must be characterised by flexibility and adaptability, considering the dynamic technical advances and market demands. A crucial factor is the establishment of favourable circumstances for collaboration among the government, businesses, scientific institutions, and educational organizations to guarantee the long-term growth of digital hubs and optimise their influence on the national economy.

Implementing The Optimal D-Best Model For The Management Of Kazakhstan.

The D-Best model, while not explicitly outlined in generally acknowledged academic or commercial management literature, seems to provide a framework or a collection of optimal methods for efficiently managing digital hubs. This approach could be applicable and very advantageous in the context of Kazakhstan.

Kazakhstan, with its fast-expanding digital infrastructure and government programs focused on digital transformation, provides an ideal environment for implementing a model of exemplary methods in administering digital hubs. The D-Best model may be conceptualised and applied to Kazakhstan in the following manner:

Achieving the implementation of the D-Best model in Kazakhstan requires a meticulous and all-encompassing plan that engages several stakeholders. The government plays a pivotal role in establishing a regulatory framework and providing early financial support. The private sector can make valuable contributions via financial investments, specialised knowledge, and collaborative relationships. Academic institutions must modernise their curriculum and engage in partnerships with digital centers to guarantee the presence of a competent workforce. Community participation is crucial in customising digital technologies to meet local requirements, resulting in increased adoption and impact.

The analysis of innovation management in the planning and implementation of Kazakhstan's digital hub can be carried out using multiple parameters, with a focus on the significance of systematic evaluation for efficient establishment management.

1. Development of Local Infrastructure considers ensuring the presence of state-of-the-art technical infrastructure for digital hubs, including fast internet connections, cloud computing, data centers, and contemporary software. This will guarantee that digital platforms and services can function optimally.

2. The hub's approach should be by the strategy of a nation, with a specific emphasis on adopting emerging technologies, promoting digital literacy, and facilitating transformation. To accelerate the expansion of the digital economy and improve competitiveness, it is necessary to establish strategic objectives and a vision for digital hubs, taking into account the market requirements. Novel methods are crucial for achieving this alignment.

3. Highlighting the importance of talent recruitment and growth is essential for recruiting, nurturing, and retaining exceptionally qualified individuals in the technology sector.

4. Funding: A robust financial framework is essential to attract private and public funding and ensure effective operations and growth.

5. Establishing strong collaborative relationships with academic institutions, entrepreneurs, and worldwide organizations is crucial.

6. Supportive policies for innovation, including robust safeguards for rights to intellectual property, guidelines encouraging the adoption of digital technologies, and tax incentives for technology firms, ought to be given precedence in the regulatory environment.

7. Entrepreneurship: Financial support, mentorship, market entry opportunities, and the establishment of a conducive environment for new enterprises are essential to ignite entrepreneurial endeavours.

8. Innovation leadership: Establishing a culture within the management team of digital hubs that encourages a continuous pursuit of novel solutions and technical advancements. To attain high performance, leaders of digital hubs must demonstrate a willingness to experiment and take risks.

9. Innovation ecosystem: Establishing inclusive and adaptable ecosystems that enable collaboration among startups, entrepreneurs, investors, educational institutions, and government agencies. This will aid in promoting the transfer of knowledge, technology, and resources, hence boosting innovation.

10. Risk and Security Management: Formulate methods to mitigate risks and ensure information security in digital hubs. In light of the risks posed to digital security, it is crucial to establish and enforce policies aimed at safeguarding data, upholding privacy, and thwarting cyber-attacks.

11. Performance Metrics and Outcome Assessment: Establish and articulate essential performance indicators (KPIs) and metrics for outcome assessment to evaluate the effectiveness of digital hubs. This entails evaluating cost-effectiveness, degree of innovation, customer happiness, and other indicators of success.

12. Stakeholder engagement: Proactively involve stakeholders such as the business sector, academia, government agencies, and society in the establishment and growth of digital hubs. This will establish enduring collaborations and optimise adaptability to the requirements of various industries.

The scale was presented in chapter 1, subchapter 1.4. The established evaluation scale enables a thorough examination of the management level of digital hub creation in Kazakhstan, including crucial factors such as strategic planning, investment attractiveness, infrastructure, and people resources. Efficient administration in all of these domains is crucial for establishing a conducive atmosphere for the expansion and advancement of digital hubs that contribute to the creative progress of the nation's economy.

Creating the platform – digitalhubs.kz

The primary phases of constructing an online platform encompass requirements research, development and design, installation and evaluation, support and launch, and marketing and monetization (Figure 35).

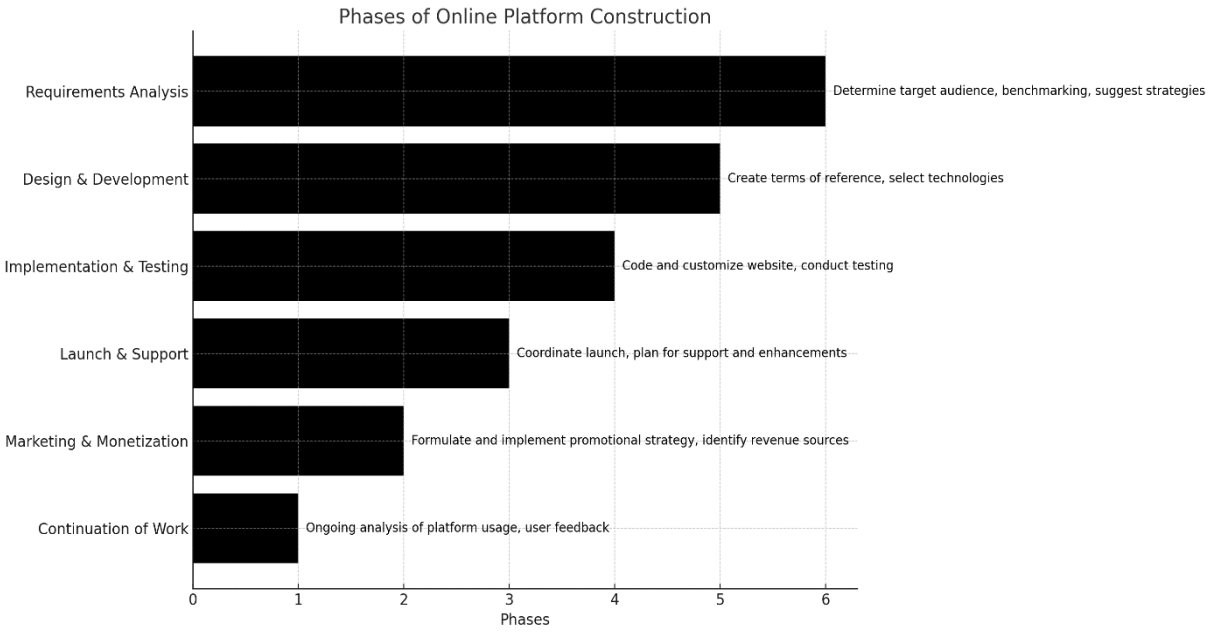


Figure 35 – Phases of Online Platform Construction

During the requirements analysis phase, the target audience is determined, and benchmarking is performed to examine existing platforms and suggest optimal strategies.

The design and development stage entails creating comprehensive terms of reference and selecting suitable technologies for the site's development.

During the implementation and testing phase, the website is coded and customised based on the specifications provided. Testing is then carried out to ensure that the website functions well, performs well, is user-friendly, and is secure.

The launch and support stage encompasses coordinating the website's launch and formulating a comprehensive plan for technical assistance and platform enhancements.

During the marketing and monetization phase, a promotional strategy is formulated and implemented, while potential sources of money are determined.

The continuation of work entails the ongoing analysis of platform usage and user input in order to enhance the functionality and usability of the site.

Conclusions of the third chapter

The third chapter provides recommendations for improving the management of digital hubs' creation and management mechanisms. It also developed and applied the scale of evaluation of digital hubs' formation management, criteria, and the D-Best model.

Management mechanisms for the establishment of digital hubs were proposed: innovation, institutional, structural, technological, and investment mechanisms.

The thesis proposed a methodology for evaluating the management of digital hubs, which was a system in which the activities are evaluated by items: 1) Strategic planning and adaptability, 2) Capital allocation and funding, 3) Infrastructure development, 4) Human resource potential and education on a five-point scale, where 1 indicates ‘low level’ and 5 ‘high level’. Scale and criteria for assessing the maturity of

digital hubs in Kazakhstan is proposed. The methodology was validated in “Sifro hub”.

It was recommended to build regional strategies for the establishment of digital hubs. When strategizing, it was important to consider regional characteristics, location, infrastructure, available resources, and problematic aspects of the region. In the third chapter, directions for the establishment of digital hubs in diverse regions of the country were proposed.

It was proposed to create a portal for digital hubs, where information on each digital hub in Kazakhstan was uploaded, with a website, documentation, and a proposed portfolio of services for organizations in the regions. This site will allow local organizations to get acquainted with hub activities and create open reporting for transparency of hub activities.

CONCLUSION

Summary conclusions on the results of the thesis research.

1. The study of theoretical and conceptual foundations of the management of the establishment of digital hubs allows us to draw the following conclusions: digital hubs are one-stop-shops in the regional context and provide a portfolio of services for local government, businesses, scientific organizations, to solve the presented problem; in the management of the establishment of digital hubs it is necessary to take into account the processes of digitalization, in particular the development of ICT in the regions, digital literacy of the population, the development of computer literacy, the number of Internet users, the use of digital technologies, the use of digital technologies, the number of Internet users, the number of Internet users and the number of digital hubs. These highlighted aspects allow us to develop a definition of digital hubs. Digital hubs are centers at a university, at a scientific institute, at a technopark, etc., which implies activities aimed at the triple helix action in the form of uniting the state, science and business to create innovations and startups using digital technologies, whose participants and partners are universities, R&D organizations, research institutes, laboratories, technoparks, incubators, accelerators, public administration and others to provide an innovative output product or service as a component of innovation management and digitalization of business. Effective management of the establishment of digital hubs depends on considering the peculiarities, mechanisms, and level of digitalization of a particular region. The management of the establishment of digital hubs should be oriented to the conditions, reserves, and digital potential of the area.

2. According to the analysis of international experience, a tangible prospect of digitalization development and digital transformation of organizations, which significantly affects the country's GDP and competitiveness at the international level, has been identified. Digital hubs are an excellent tool for the digital transformation of organizations at regional, national, and global levels. According to the results of the dispersion analysis, an uneven ratio of digitalization indicators was revealed, which suggests that a separate strategy for developing digital hubs is needed for each region. Establishing digital hubs in each area of the state will allow for a relatively high increase in digitalization indicators, such as computer literacy, digital literacy, the number of Internet users, the number of organizations using digital technologies, and others. Creating new digital hubs should be oriented to regional needs, specifics, and strengths of the regional economy.

3. Foreign experience of advanced countries shows that ICT is directly related to digitalization. According to the results of the correlation and regression analysis of the impact of ICT costs on hub stakeholders, it was found that ICT costs affect the number of enterprises by region, the number of operating medium and small enterprises, and the number of scientific organizations. However, ICT costs do not affect the number of universities and enterprises' innovation activity levels. This indicates that ICT expenditure and business organizations and medium and small enterprises have a direct relationship, and a moderate relationship with scientific organizations.

4. The digital hub governance assessment should consider the following criteria: strategic planning and adaptability, capital allocation and funding, infrastructure development, human resource capacity, and education. Performance is measured on a five-point scale for each criterion. The D-best model and the main criteria for managing the establishment of digital hubs in Kazakhstan were identified. According to this scale and criteria, the activities of the Sifro hub were evaluated by the hub management.

5. The analysis of the digital potential of the regions shows that the regions with high digital potential are Astana and Almaty. As a result of the integral index method, other regions showed significant statistical differences in the digitalization indicators of the regions. To improve digitalization indicators by region, measures should be taken such as: providing access to broadband internet in the areas; creating digital support centers; introducing digitalization programs in higher education institutions; conducting digital literacy training for the population; providing preferential terms for enterprises and medium and small enterprises; and holding forums to discuss best practices between regions.

6. The case study results show that digital hubs have emerged relatively recently, since 2018, in Kazakhstan. However, only the Astana hub has a website and documentation until 2021. Digital hubs should develop websites with transparent reporting, quarterly and annually. This will be convenient for enterprises in the region to familiarise themselves with the hub's activities and to improve the living standards of the population by raising competitiveness and GDP. According to the calculation of the economic efficiency of the Astana hub, it has been shown that the hub's activity is relatively sustainable and favours the development of businesses and startups.

7. The introduction of digitalization and ICT programs in higher education institutions and the allocation of a relatively large number of grants will help fill the state's IT workforce. Thus, according to the results of a survey of undergraduate students, more than 50% of graduates are interested in digitalization activities, and more than 80% of undergraduate students are planning ICT and digitalization activities.

Evaluation of the completeness of the solutions to the tasks set. The tasks set in the dissertation research are fully solved using the methods of systematic literature review, comparative analysis, correlation-regression analysis, dispersion analysis method of integral index, case study of digital hubs, calculating the economic efficiency of Astana hub, analysing the digital potential of regions by indicators, identifying the problems of digital hubs and ways to solve them in the form of recommendations and mechanisms of management of the establishment of digital hubs, methodology for assessing the management of digital hubs, D-best management of digital hubs, and other methods—theoretical and practical approaches to the management of the establishment of digital hubs, conceptual foundations and evolution.

Recommendations and baseline data on the specific use of the results. The developed methodology for assessing the management of digital hubs can become a comprehensive tool for optimising and analysing hubs' activities. This methodology can serve as a basis for making managerial decisions in a reasonable way, stimulating innovative development in the region, and increasing the efficiency of hubs' activities.

The completed work's scientific level is assessed and compared with the best achievements in this field. The author's vision of the essence of digital hubs developed a methodology for assessing the management of hub activity, justified recommendations, and mechanisms for managing the establishment of digital hubs. The analysis of scientific literature on the thesis research topic has revealed the absence of domestic works on digital hubs. This dissertation fills this gap at a sufficient scientific and methodological level.

The scientific level of the research in comparison with other works in this area is determined by the fact that it includes a comprehensive approach, which covers theoretical and practical aspects of the problem under study. The approach used in the dissertation work is theoretically substantiated, statistically and logically tested, and adapted for application in the Republic of Kazakhstan. In the study, new scientific results were obtained, which contribute to the improvement of the management of the establishment of digital hubs in Kazakhstan.

REFERENCES

1 State Program “Digital Kazakhstan”. Resolution of the Government of the Republic of Kazakhstan dated 12 December 2017 No.827. – URL: https://primeminister.kz/ru/news/tsifrovoi-kazahstan-transformatsiya-posredstvom-sovremennih-tehnologii-16093. (Date of access 21.09.2021)

2 Message of the Head of State Kassym-Jomart Tokayev to the nation of Kazakhstan “UNITY OF THE NATION AND SYSTEMIC REFORMS - A STRONG BASIS FOR THE PROSPERITY OF THE COUNTRY”, September 1, 2021 // https://www.akorda.kz/ru/poslanie-glavy-gosudarstva-kasym-zhomarta-tokaeva-narodu-kazahstana-183048. 22.09.2021

3 On approval of the Concept of digital transformation, development of information and communication technologies industry and cyber security for 2023 - 2029 years. Resolution of the Government of the Republic of Kazakhstan dated 28 March 2023 No. 269 // https://adilet.zan.kz/rus/docs/P2300000269. 30.06.2023

4 Киреева А.А., Әбілқайыр Н.Ә. Цифровизация экономики регионов Казахстана: понятия, перспективы и механизмы реализации / Под ред. академика НАН РК, профессора, д.э.н. Сатыбалдина А.А. – Алматы: Институт экономики КН МОН РК. – 2021. – 292 с. ISBN 978-601-215-197-8

5 Price, L., Deville, J., Ashmore, F. A guide to developing a rural digital hub // Local Economy. – 2021. - №36(7-8). – P. 683-694. https://doi.org/10.1177/02690942221077575

6 Atiase V.Y., Kolade O., Liedong T.A. The emergence and strategy of tech hubs in Africa: Implications for knowledge production and value creation // Technological Forecasting and Social Change. – 2020. - №161. – P. 120307-120320.

7 Casorati, A., Verbeek, A., Liu, P. W., Lundqvist, M., Borg, L., Gigler, B.-S., Paindaveine, Y. In Financing the digitalization of small and medium-sized enterprises: The enabling role of digital innovation hubs: European Investment Bank // Front Matter. – 2020. – P. 1-2. https://doi.org/10.2867/210258

8 Littlewood, D.C., Kiyumbu, W. “Hub” Organizations in Kenya: What are they? What do they do? And what is their potential? // Technological Forecasting and Social Change. – 2018. - №131. - P. 276-285. https://doi.org/10.1016/j.techfore.2017.09.031

9 Rundel, C.T., Salemink, K., Strijker, D. Exploring rural digital hubs and their possible contribution to communities in Europe // The Journal of Rural and Community Development. – 2020. - №15(3). – P. 21–44.

10 Sassanelli, C., Panetto, H., Guédria, W., Terzi, S., Doumeingts, G. Towards a Reference Model for Configuring Services Portfolio of Digital Innovation Hubs: The ETBSD Model // Working Conference on Virtual Enterprises. – 2020. – P. 597 – 607. https://doi.org/10.1007/978-3-030-62412-5_49

11 Ujwary-Gil, A., Florek-Paszkowska, A.K. A Network Approach to the Digital Innovation Hub as an Ecosystem Supporting the Digital Transformation of Enterprises in a Region // European Conference on Innovation and Entrepreneurship. – 2022. – №17(1). – P. 557-566. http://dx.doi.org/10.34190/ecie.17.1.334

12 Virkkunen, R., Rosso, L., Still, K. Digital Innovation Hubs in Finland // Ministry of Economic Affairs and Employment. Publications of the Ministry of Employment and the Economy No. – 2019. - №27. http://urn.fi/URN:ISBN:978-952-327-423-5

13 Lanz, M., Latokartano, J., Pieters, R. Digital Innovation Hubs for Enhancing the Technology Transfer and Digital Transformation of the European Manufacturing // Industry In S. Ratchev (Ed.), Smart Technologies for Precision Assembly - 9th IFIP WG 5.5 International Precision Assembly Seminar, IPAS 2020, Revised Selected Papers. – 2021. – №620. – P. 210-219. https://doi.org/10.1007/978-3-030-72632-4_15

14 Dyba M., Gernego I., Dyba O., Oliynyk A. Financial support and development of digital rural hubs in Europe // Management theory and studies for rural business and infrastructure development. – 2020. - №42 (1). – P. 51-59.

15 Georgescu A., Tudose M.B., Avasilcăi S. Digital Innovation Hubs: SMEs' Facilitators for Digital Innovation Projects, Marketing Communication Strategies and Business Internationalization / In: Reis, J.L., Peter, M.K., Varela González, J.A., Bogdanović, Z. (eds) Marketing and Smart Technologies. – Singapore: Springer. – 2023. – №337. – P. 307-330.

16 Hervas-Oliver J., González-Alcaide G., Rojas-Alvarado R., Monto-Mompo S. Emerging regional innovation policies for industry 4.0: analyzing the digital innovation hub program in European regions // Competitiveness Review: An International Business Journal Incorporating Journal of Global Competitiveness. – 2021. – №31 (1). – P. 106-129.

17 Kalpaka A., Sörvik J., Tasigiorgou A. Digital Innovation Hubs as policy instruments to boost digitalization of SMEs // https://op.europa.eu/en/publication-detail/-/publication/1a956fc3-0f60-11eb-bc07-01aa75ed71a1/language-en/format-PDF/source-239781123. 12.05.2023

18 Rissola G., Sörvik J. Digital Innovation Hubs in Smart Specialisation Strategies. Luxembourg: Publications Office of the European Union, 2018. – P. 50.

19 Gavkalova, N., Gładysz, B., Quadrini, W., Sassanelli, C., Asplund, F., Ramli, M.R., Detzner, P., Deville, J., Dragic, M., Van Erp, T., Georgescu, A., Price, L., Robertsone, G., Terzi, S. Digital Innovation Hubs and portfolio of their services across European economies // Oeconomia Copernicana. – 2024. - 15(1). – P. 59-94. https://doi.org/10.24136/oc.2757

20 Michael E. P. The Economic Performance of Regions // Regional Studies. – 2003. – 37(6&7). - PP. 549–578.

21 Блинников Е. Б., Леонидова А. И. Свободные экономические зоны: сущность, возможности // Актуальные проблемы авиации и космонавтики. – 2010. - №6. – С. 138-139.

22 Aggarwal A. SEZs and economic transformation: towards a development approach // Transnational Corporations Journal. – 2019. - № 26(2). - P. 27-48.

23 Kechichian E., Jeong M.H. Mainstreaming eco-industrial parks. - Washington, D.C.: The World Bank, 2016. – 35 p.

24 Yean Th.S. The Digital Free Trade Zone (DFTZ): Putting Malaysia's SMEs onto the Digital Silk Road. Hong Kong: HKTDC, 2018. – 9 p.

25 Zeng Z.D. The Past, Present, and Future of Special Economic Zones and Their Impact // Journal of International Economic Law. – 2021. – №24(2), - P. 259-275.

26 Туарменский В.В., Кострова Ю.Б., Шибаршина О. Ю. Университеты и технопарковые структуры: межстрановый анализ опыта взаимодействия // Экономические и социально-гуманитарные исследования. – 2019. - №2(22). – С. 117-124.

27 Akaydın A. The Role of Technoparks in the Innovation Ecosystem and A Model Proposal for Its Development: Technology Transfer and Development Center // Uluslararası İşletme Bilimi Ve Uygulamaları Dergisi. – 2023. - №3(1). – P. 80-103.

28 Туарменский В.В. Технополисы и технопарки в структуре современного образования: дисс. … канд. пед. наук: 13.00.01. – Рязань: Рязанский государственный педагогический университет имени С.А. Есенина, 2003. – 196 с.

29 Трибушная В.Х. Инновационная инфраструктура как необходимость поддержки наукоемкого предпринимательства: технопарки и стратегическое управление: Монография. – Ижевск: Ижевский государственный технический университет, 2011. – 243 с.

30 Чечеткин С.А. Субъекты инновационной инфраструктуры технологические (технопарки) и научные (инновационные) парки // Цифровизация: экономика и управление производством: материалы 88-й научно-технической конференции профессорско-преподавательского состава, научных сотрудников и аспирантов. – Минск: БГТУ, 2024. – С. 71-76.

31 Ходжагельдыев Б.Д., Шурупова О.С. Русский с английским привкусом (развитие русского языка в эпоху глобализации). – Москва: Флинта: Наука, 2017. – 348 с.

32 Березовский К.Г. Глобальный город в трансграничных отношениях: политологический анализ на материалах города Москвы: автореф. дис. ... канд. полит. наук: 23.00.04 – Москва: Российская академия государственной службы при Президенте Российской Федерации, 2009. – 185 с.

33 Толмачев А.Ю. Бизнес-модели в Индустрии 4.0 и их влияние на клиентские коммуникации // Экономика: вчера, сегодня, завтра. – 2023. - №13(6). – С. 695-703.

34 Katz, B., Julie W. The Rise of Innovation Districts: A New Geography of Innovation in America // Geography, Business. – 2014. - P. 1-34.

35 Королева А.Н. Правовые аспекты трансформации стратегического планирования в условиях нового технологического уклада и формирования рынков национальной технологической инициативы // Вестник института права Башкирского государственного университета. – 2022. – № 3. – С. 42–49.

36 Peters J. How a 1950s Egg Farm Hatched the Modern Startup Incubator // https://www.wired.com/story/how-a-1950s-egg-farm-hatched-the-modern-startup-incubator/. 23.10.2021

37 Sharma S.K., Meyer K.E. Industrializing Innovation-the Next Revolution. Luxembourg: Springer, Cham, 2019. – 216 p.

38 Prüfer J. Business Associations and Private Ordering // Journal of Law

Economics & Organization. – 2012. – № 32. – P. 306-358.

39 Bennett R.J., Mark R. The Contribution of Business Associations to SMEs // International Small Business Journal. – 2007. – № 25. P. 49 - 76.

40 Öztemel E., Gursev S. Literature review of Industry 4.0 and related technologies // Journal of Intelligent Manufacturing. – 2020. – № 31. – P. 127-182.

41 Digital Innovation Hubs (DIHs) in Europe // https://ec.europa.eu/digital-single-market/en/digital-innovation-hubs-dihs-europe. 20.10.2021

42 Alberto C., Arnold V., Financing the digitalization of small and medium-sized enterprises: The enabling role of digital innovation hubs. – Innovation Finance Advisory, European Investment Bank, 2020. – 126 p.

43 Peter M.K., Kraft C., Lindeque, J. Strategic action fields of digital transformation. An exploration of the strategic action fields of Swiss SMEs and large enterprises // Journal of Strategic Management. – 2020. – №13(1). - P. 160–180.

44 European Commission: Digital Innovation Hubs. Working Group Report from the Working Group Meeting on Digital Skills DG Connect. – Brussels: European Union, 2018. – 59 p.

45 Daniel N. Top 10 Digital Transformation Trends for 2020, FOW Future at work website // https://fowmedia.com/top-10-digital-transformation-trends-for-2020/. 25.10.2021

46 European commission: Shaping Europe's Digital Future Policy // https://ec.europa.eu/info/strategy/priorities-2019-2024/europe-fit-digital-age/shaping-europe-digital-future_en. 26.10.2021

47 Genennig S.M. Digital technology integration in service systems: identification of drivers and challenges in SMEs // In: Realizing Digitization-Enabled Innovation Markt- und Unternehmensentwicklung Markets and Organizations. – Wiesbaden: Springer Gabler, 2020. – P. 79–113.

48 Rangone A. What is the future for the Digital Enterprise? Managing Corporate Innovation, Contributions to Management Science. – Switzerland: Springer Nature, 2020. – P. 69–82.

49 European Commission: The need for digitalization technology // https://ec.europa.eu/digital-single-market/en/news/digital-innovation-hubs-helping-companies-across-economy-make-most-digital-opportunities. 29.10.2021

50 Collister P. How to: Use innovation & Creativity in the Workplace. – London: Bluebird Pan Macmillan Publishing, 2017. – 208 p.

51 European Commission: Digitising European Industry Policy. Shaping Europe's Digital Future // https://ec.europa.eu/digital-single-market/en/policies/digitising-european-industry. 30.10.2021

52 Posirca O. Digitalization at core OD economic recovery in age of social distancing // Business Review. – 2020. – №24(4). – P. 16–17.

53 DEI (2017). Digital Innovation Hubs: Mainstreaming Digital Innovation Across All Sectors // https://nem-initiative.org/wp-content/uploads/2018/03/nem-dei_dih-wg-december-2017.pdf. 03.11.2021

54 Camarinha-Matos L.M., Afsarmanesh H., Galeano N., Molina A. Collaborative networked organizations - Concepts and practice in manufacturing enterprises // Computers and Industrial Engineering. – 2009. – №57. – P. 46-60.

55 DIH Digital Innovation Hubs Catalogue // https://s3platform.jrc.ec.europa.eu/digitalinnovation-hubs-catalogue. 05.11.2021

56 Antonopoulos C.P., Keramidas G., Tsakanikas V., Faliagka E., Panagiotou C., Voros N.S. Capacity Building Among European Stakeholders In the Areas of Cyber-Physical Systems, IoT& Embedded Systems: The SMART4ALL Digital Innovation Hub Perspective // 2020 IEEE Computer Society Annual Symposium on VLSI (ISVLSI). – 2020. – P. 464-469.

57 Miörner J., Kalpaka A., Sörvik J., Wernberg J. Exploring heterogeneous Digital Innovation Hubs in their context - a comparative case study of six (6) DIHs with links to S3, innovation systems and digitalization on a regional scale. – Luxembourg: Publications Office of the European Union. – 2019. – 60 p.

58 Roundtable on digitising European industry: mainstreaming digital innovation across all sectors. - Brussels: European Commission, 2017. – 36 p.

59 Butter M., Gijsbers G., Goetheer A., Karanikolova K. Digital Innovation Hubs and Their Position in the European, National and Regional Innovation Ecosystems / In: Feldner, D. (eds) Redesigning Organizations: Business. – Berlin, 2019. – P. 45-60.

60 Digital.hub Logistics Dortmund // https://ec.europa.eu/futurium/en/system/files/ged/dih_digital_hub_dortmund.pdf. 23.11.2021

61 Digital Innovation Hubs: helping companies with digital opportunities // https://www.zabala.eu/news/digital-innovation-hubs-helping-companies-with-digital-opportunities/. 25.12.2021

62 Our common future. World Commission on Environment and Development. – New York: Oxford University Press, 1990. - 421 p.

63 Digital Economy and Society Index (DESI) // https://ec.europa.eu/digital-single-market/en/european-digital-progress-report. 25.11.2021

64 COSME Work Program 2017. Action GRO/SME/17/C/06 - Action 3 - Access for SMEs to advanced manufacturing support and follow-up action under Horizon 2020 // http://ec.europa.eu/DocsRoom/documents/21624. 26.11.2021

65 Stanisławski R., Lisowsk R. The Relations between Innovation Openness (Open Innovation) and the Innovation Potential of SMEs // Procedia Eco-nomics and Finance. – 2015. – №23. – P.1521- 1526.

66 Kowalkowski C., Witell L., Gustafsson A. Any way goes: Identifying value constellations for service infusion in SMEs // Industrial Marketing Management. – 2013. – №42(1). – P.18-30.

67 Sörvik J. Digital Innovation Hubs as enablers of Smart Specialisation in Sparsely Populated Areas / in Kristensen I., Dubois A., and Teräs J. (Eds.) Strategic approaches to regional development-smart experimentation in less-favoured regions. – Abingdon: Routledge, 2019. – 16 p.

68 2014-2020 European structural and investment funds // https://commission.europa.eu/funding-tenders/find-funding/funding-management-mode/2014-2020-european-structural-and-investment-funds_en. 27.11.2021

69 Gianelle C., Kyriakou D., Cohen C., Przeor M. (Eds.) Implementing Smart Specialisation Strategies: A Handbook. – Luxembourg: Publications Office of the Eu-

ropean Union, 2016. – P. 213-218.

70 European Digital Innovation Hubs in Digital Europe Program, 2020. Draft working document // https://europa.eu/!bG73XB.29. 30.11.2021

71 Затерянный кластер // https://academcity.org/content/zateryannyy-klaster?ysclid=lsvrnyvqty304903834. 31.11.2023

72 Кувшинов Н.Е., Галяутдинов А.А. РАЗВИТИЕ СВОБОДНЫХ ЭКОНОМИЧЕСКИХ ЗОН // Форум молодых ученых. – 2017. -№9 (13). – Р. 437-440.

73 Bell Labs // https://en.wikipedia.org/wiki/Bell_Labs. 31.11.2023

74 Бунин М.А. История возникновения технопарков в США и Японии // Горный информационно-аналитический бюллетень. – 2013. - №5. – С. 323-325.

75 Семенова И.В., Лачининский С.С. Научно-технологические парки в системе регионального развития США // Вестник ЧГУ. - 2010. - №2. – С. 1-7.

76 Как технологические хабы сместили опенспейсы и стали мировым трендом // https://www.pravilamag.ru/articles/263933-kak-tehnologicheskie-haby-smestili-openspeysy-i-stali-mirovym-trendom/. 02.12.2023

77 Сычев И. Национальная инновационная система США // https://habr.com/ru/articles/405577/. 02.12.2023

78 Семенова Е.А. Новая индустриализация: Тенденции и перспективы // РИСИ. – 2015. - №5(32). - С. 185-203.

79 Etzkowitz H., Leydesdorff L. The dynamics of innovation: from National Systems and “Mode 2” to a Triple Helix of university–industry–government relations //Research policy. – 2000. – №.2(29). – P. 109-123.

80 Global Digitalization Index (GDI) 2024 // https://www.huawei.com/en/gdi. 04.04.2025

81 Седов К. Хиллари Клинтон пообещала избавить США от цифрового неравенства к 2020 году // https://www.vedomosti.ru/technology/articles/2016/08/30/654924-klinton-tsifrovogo-neravenstva. 12.12.2023

82 Кутовая Я. Проводники технологий: как Китай и Америка воюют за рынок микросхем // https://www.forbes.ru/kompanii/342361-provodniki-tehnologiy-kak-kitay-i-amerika-voyuyut-za-rynok-mikroshem. 12.12.2023

83 Anagnostopoulou D. The Digital Agenda of the European Union and the Digital Policies of the USA / In: Zacher, L. (eds) Technology, Society and Sustainability. – Luxembourg: Springer, Cham. – 2017. – P. 49–80.

84 Куприяновский В.П., Синягов С.А., Намиот Д.Е., Уткин Н.А., Николаев Д.Е., Добрынин А.П. Трансформация промышленности в цифровой экономике - экосистема и жизненный цикл // International Journal of Open Information Technologies. - 2017. - №5(1). – P. 34-46.

85 Ревадзе Д. 8 фактов об IT Великобритании // https://hightech.fm/2016/09/27/britain-9things. 13.12.2023

86 Crossrail — самый крупный инфраструктурный проект в Европе // https://www.cadmaster.ru/magazin/articles/cm_80_09.html#hcq=6h9ZmJq. 13.12.2023

87 Orlowski A. Three useless UK.gov 'catapults' put in Last Chance Saloon // The Register. Business. Policy. – 2017.

https://www.theregister.com/2017/11/28/useless_catapults_put_in_last_chance_saloon/. 14.12.2023

88 Шульцева В. Цифровая экономика Китая // Первая миля. - Смоленск-М.: Техносфера, 2015. - №4(5). - С. 90-94, 66-76.

89 Чжан Д. Современное состояние цифровой экономики в Китае и перспективы сотрудничества между Китаем и Россией в области цифровой экономики // Власть. – 2017. №9. - С. 37-43.

90 Иванченко В. Единый цифровой рынок ЕС: Глобализация и регионализация в одном пакете // РИАЦ. Сообщество. Блог. - 2016. https://russiancouncil.ru/blogs/viktoriia-ivanchenko/_2280/. 14.12.2023

91 OECD (2017), OECD Digital Economy Outlook 2017, OECD Publishing, Paris // https://doi.org/10.1787/9789264276284-en. 15.12.2023

92 Голофаст А. Матрица единого цифрового рынка ЕС // Европейский союз: факты и комментарии. - 2017. - № 86.- С. 15–20.

93 Cooke P., Uranga M.G., Etxebarria G. Regional innovation systems: institutional and organizational dimensions // Research Policy. – 1997. - №26. - P. 475-491.

94 Noni I.D., Orsi L., Belussi F. The role of collaborative networks in supporting the innovation performances of lagging-behind European regions // Research Policy. – 2018. – №47. – P. 1-13.

95 Fitzgerald M., Kruschwitz N., Bonnet D., Welch M. Embracing digital technology: a new strategic imperative // MIT Sloan Management Review. – 2014. - №55(2). - P. 1-12.

96 Hassink R., Isaksen A., Trippl M. Towards a comprehensive understanding of new regional industrial path development // Regional Studies. – 2019. - №53 (11). - P. 1636-1645.

97 Eurostat Explained, Manufacturing statistics - NACE Rev. 2 (2019). https://ec.europa.eu/eurostat/statistics-explained/index.php/Manufacturingstatistics-NACERev.2. 01.12.2021

98 Zillner, S., Bisset, D., Milano, M., Curry, E., García Robles, A., Hahn, T., Irgens, M., Lafrenz, R., Liepert, B., O'Sullivan, B. and Smeulders, A. (eds). Strategic Research, Innovation and Deployment Agenda – AI, Data and Robotics Partnership. Third Release. – Brussels: BDVA, euRobotics, ELLIS, EurAI and CLAIRE, - 2020.

99 ManuFUTURE Vision 2030 A Competitive, Sustainable and Resilient European Manufacturing Report of the ManuFUTURE // https://www.manufuture.org/wp-content/uploads/2022/04/Manufuture-Vision-2030_DIGITAL.pdf. 15.11.2022

100 The network of European Digital Innovation Hubs (EDIHs) in full action // https://regions-and-cities.europa.eu/program/2023/program/4098. 03.01.2024

101 European Commission Statistics // https://cordis.europa.eu. 03.12.2021

102 Reconcell - A Reconfigurable robot workCell for fast set-up of automated assembly processes in SMEs, GA 680431 // http://www.reconcell.eu/index.html. 04.12.2021

103 Horse - Smart integrated Robotics system for SMEs controlled by Internet of Things based on dynamic manufacturing processes, GA 680734 //

http://www.horseproject.eu/. 04.12.2021

104 COVR - Being safe around collaborative and versatile robots in shared spaces, GA 779966 // https://safearoundrobots.com/. 05.12.2021

105 Esmera - European SMEs Robotics Applications, GA 780265 // http://www.esmeraproject.eu/welcome/. 05.12.2021

106 RobotUnion - Stimulate ScaleUps to develop novel and challenging Technology and systems applicable to new Markets for ROBOticsoLUTIONs, GA 779967 // https://robotunion.eu. 05.12.2021

107 DIH^2 ACCELERATING PRODUCTION // https://dih-squared.fundingbox.com/. 06.12.2021

108 DIH Rima - Robotics for Infrastructure Inspection and MAintenance, GA 824990 // https://rimanetwork.eu/. 06.12.2021

109 TRINITY - Digital Technologies, Advanced Robotics and increased Cybersecurity for Agile Production in Future European Manufacturing Ecosystems, GA 825196 // https://www.trinityrobotics.eu. 06.12.2021

110 DIH agROBOfood - Business-Oriented Support to the European Robotics and Agri-food Sector, towards a network of Digital Innovation Hubs in Robotics, GA825395 // https://agrobofood.eu/. 07.12.2021

111 DIH Hero - Digital Innovation Hubs in Healthcare Robotics, GA 825003 // https://dih-hero.eu. 07.12.2021

112 Federica A., Désirée R., Christoph W. Who is prepared for the new digital age? Evidence from the EIB Investment Survey. – Luxembourg: European Investment Bank. – 2019. – 134 p.

113 European Court of Auditors, Digitising European Industry – An ambitious initiative whose success depends on the continued commitment of the EU, governments and businesses - Special report No 19, 2020 // https://data.europa.eu/doi/10.2865/246035 24.04.2025

114 Italy: Industria 4.0 – Report // https://monitor-industrial-ecosystems.ec.europa.eu/reports/other-reports/italy-industria-40 24.04.2025

115 What is Mittelstand-Digital? – Report // https://www.mittelstand-digital.de/MD/Navigation/DE/Service/EnglischeSeite/englische-seite.html 24.04.2025

116 How Agtech accelerates solutions from food companies based the Netherlands – Report // https://investinholland.com/news/agtech-ecosystem-thrives-netherlands/ 24.04.2025

117 Call for tenders: Smart factories in new EU Member States – Article // https://digital-strategy.ec.europa.eu/en/funding/call-tenders-smart-factories-new-eu-member-states 24.04.2025

118 The Digital Europe Program // https://digital-strategy.ec.europa.eu/en/activities/digital-program 24.04.2025

119 Digital Innovation Hubs, Helping companies across the economy make the most of digital opportunities – Brochure // https://docs.yandex.kz/docs/view?tm=1745517615&tld=kz&lang=en&name=DEIBrochureSeptember2019pdf.pdf&text=inycom%20encore%20lab&url=https%3A%2F%2Fwww.ffg.at

%2Fsites%2Fdefault%2Ffiles%2Fdownloads%2FDEIBrochureSeptember2019pdf.pdf&lr=163&mime=pdf&l10n=ru&sign=6fd5bfa7569a46d9b9052747fa81a688&keyno=0&nosw=1&serpParams=tm%3D1745517615%26tld%3Dkz%26lang%3Den%26name%3DDEIBrochureSeptember2019pdf.pdf%26text%3Dinycom%2Bencore%2Blab%26url%3Dhttps%253A%2F%2Fwww.ffg.at%2Fsites%2Fdefault%2Ffiles%2Fdownloads%2FDEIBrochureSeptember2019pdf.pdf%26lr%3D163%26mime%3Dpdf%26l10n%3Dru%26sign%3D6fd5bfa7569a46d9b9052747fa81a688%26keyno%3D0%26nosw%3D1 24.04.2025

120 Digital Innovation Hubs: helping companies across the economy make the most of digital opportunities – Brochure // https://ec.europa.eu/digital-single-market/en/news/digital-innovation-hubs-helping-companies-across-economy-make-most-digital-opportunities. 13.11.2021

121 Draft Document on DIHs in the Digital Europe Program – Call for Feedback // https://ec.europa.eu/digital-single-market/en/news/draft-document-dihs-digital-europeprogram-call-feedback. 13.11. 2021

122 Samúdio M.J., Azevedo M.M., Parra-Domínguez J., Pérez-Pons E., Abril E.J. How Digital Innovation Hubs Can Help The SMEs Digitalization, Portuguese And Spanish Examples // Ediciones Universidad de Salamanca – Proceedings Of The Iii Work-Shop On Disruptive Information And Communication Technologies For Innovation And Digital TransforMation. – Salamanca: Ediciones Universidad de Salamanca. - 2020. - P. 145-155.

123 Claudio F., Youngsun K., Johannes M.B., Erik B., Bronwyn H., Rekha J., Petrus P., Khuong V., Jason W., Jun X. Harnessing artificial intelligence (AI) to increase wellbeing for all: The case for a new technology diplomacy // Telecommunications Policy. – 2020. - №44(6). – P. 1-14.

124 Мельянцев В.А. Современный экономический рост в развивающихся странах: важнейшие тенденции, пропорции, факторы и социальные последствия // Восток. - 2021. - № 6. - С. 203–212.

125 Measuring Digital Development // https://itu.foleon.com/itu/measuring-digital-development/home/. 16.07.2022.

126 Friedrich R. Measuring industry digitization: Leaders and laggards in the digital economy // https://www.the-digital-insurer.com/wp-content/uploads/2014/06/204-BoozCoMeasuring-Industry-Digitization-Leaders-Laggards-Digital-Economy.pdf. 05.04.2024

127 Куприянова М.В. Методические подходы к оценке уровня цифровизации промышленного производства / М. В. Куприянова, И. П. Симикова // Право, экономика и управление: актуальные вопросы: материалы Всероссийской научно-практической конференции с международным участием (Чебоксары, 13 декабря 2019 г.) / главный редактор Л. П. Кураков. - Чебоксары: ИД «Среда», 2019. – С. 28-34.

128 Мельянцев В.А. Современный экономический рост в развивающихся странах: важнейшие тенденции, пропорции, факторы и социальные последствия // Восток. - 2021. - № 6. - С. 203–212.

129 Ezekiel M., Fox K.A. Methods of correlation and regression analysis: Linear and curvilinear (3rd ed.). – New York: Wiley, 1959. – P.548

130 Kredina A., Seitkan G., Nurlanova N., Kireyeva A. The Impact of ICT Costs on Innovation Activity of Digital hubs in Regions of Kazakhstan: Universities, SMEs and R&D // Journal of Distribution Science. – 2023. - №21(12). - 1-13.

131 Seitkan G., Nurgaliyeva K., Akparova A. Exploring the Management Perspective in the Formation of Digital Hub // Eurasian Journal of Economic and Business Studies. – 2024. - №68(1). - P. 5-18.

132 Kireyeva A., Jussibaliyeva A., Seitkan G. Formation and Development of Digital hubs in Kazakhstan: Risks, Drivers and Mechanisms // Eurasian Journal Of Economic And Business Studies. – 2022. - №2(64). – P. 45-65.

133 Seitkan, G. G., Karacsony, P., Zaitenova, N. K., Konysbay, A. R&D Expenditures and Their Impact on Innovation in the Digital Era: A Kazakhstan Perspective // Economy: strategy and practice. – 2024. - №19(3). – P. 19-31.

134 Киреева, А. А., Кенжегулова, Г. К., Сейткан, Г. Г. Оценка уровня влияния ИКТ на уровень участия женщин на онлайн рынке Казахстана // «Вестник КазНУ. Серия экономическая. – 2022. - №1(139). – С. 3-15.

135 Brimbetova, N. Z., Chulanova, Z. K., Bekturganova, M. S., Seitkan, G. G. Settlement of the population in Kazakhstan: principles, features and prospective development // Economics: the strategy and practice. – 2022. - №17(2). – P. 82-97.

136 Moldabekova, A. T., Seitkan, G. G., Mussayeva, D. M., Yessentay, A. Socio-Economic Problems of Depressed Settlements of Kazakhstan: an Empirical Analysis // Economics: the strategy and practice. – 2022. - №17(3). – P. 124-137.

137 Киреева, А. А., Сейткан, Г. Г. Концептуальные основы проблем неравенства стран, регионов и городов // Международная научно-практическая онлайн-конференция «Региональная экономика и векторы демографического и социально-экономического развития». – Алматы: Институт экономики КН МНВО РК, 2022. – С. 236 – 245.

138 Киреева, А. А., Сейткан, Г. Г. Аспекты и проблемы развития управления цифровизацией на территории РК // Международная молодежная научно-практическая конференция «Экономика и Менеджмент инновационного пространства развивающихся рынков», сборник статей Международной молодежной научно-практической конференции. – Москва: РУДН, 2021. Том II. – 201 с.: ил. ISBN 978-5-209-11208-2.- раздел «Бросая вызов традициям менеджмента: 21-й год 21-го века». – С. 182 – 187.

139 Satpayeva Z., Seitkan, G., Yessentay A. Models of Social Research in the Development of Digital Infrastructure // Международная научно-практическая конференция «Парадигма устойчивого экономического развития в условиях глобальных перемен: вызовы, последствия, возможности». – Алматы: КазНУ имени аль-Фараби, 2023. – С. 129 – 140.

140 Сейткан Г. Г. Проблемы управления развитием ИКТ в Казахстане // Международная научно-практическая конференция «Наука: теория и практика» 20-21 февраль. Алматы: «Bilim Innovations Group», 2023. – С. 105 – 109.

141 Яшин С.Н., Коробова Ю.С. Метод расчета интегрального индекса инновационного развития региона // Финансовая аналитика: проблемы и решения. – 2017. - №10 (4 (334)). – С. 360-374.

142 Bureau of National Statistics Agency for Strategic Planning and Reforms

of the Republic of Kazakhstan. Share of large and medium-sized enterprises using digital technologies. – URL: https://stat.gov.kz/ru/industries/business-statistics/stat-it/dynamic-tables/.
https://view.officeapps.live.com/op/view.aspx?src=https%3A%2F%2Fstat.gov.kz%2Fupload%2Fiblock%2Fa47%2Fjyf7avga5ncdnbeq1gqk8eahezv0cqt8%2F%25D0%2594%25D0%25BE%25D0%25BB%25D1%258F%2520%25D0%25BA%25D1%2580%25D1%2583%25D0%25BF%25D0%25BD%25D1%258B%25D1%2585%2520%25D0%25B8%2520%25D1%2581%25D1%2580%25D0%25B5%25D0%25B4%25D0%25BD%25D0%25B8%25D1%2585%2520%25D0%25BF%25D1%2580%25D0%25B5%25D0%25B4%25D0%25BF%25D1%2580%25D0%25B8%25D1%258F%25D1%2582%25D0%25B8%25D0%25B9%2C%2520%25D0%25B8%25D1%2581%25D0%25BF%25D0%25BE%25D0%25BB%25D1%258C%25D0%25B7%25D1%2583%25D1%258E%25D1%2589%25D0%25B8%25D1%2585%2520%25D1%2586%25D0%25B8%25D1%2584%25D1%2580%25D0%25BE%25D0%25B2%25D1%258B%25D0%25B5%2520%25D1%2582%25D0%25B5%25D1%2585%25D0%25BD%25D0%25BE%25D0%25BB%25D0%25BE%25D0%25B3%25D0%25B8%25D0%25B8.xls&wdOrigin=BROWSELINK. Date of access (25.12.2024)

143 Bureau of National Statistics Agency for Strategic Planning and Reforms of the Republic of Kazakhstan. – URL: https://view.officeapps.live.com/op/view.aspx?src=https%3A%2F%2Fstat.gov.kz%2Fupload%2Fiblock%2F586%2Fi6n2hvmeu9kqq2x5qf1irjcgue184aly%2F%25D0%25A3%25D1%2580%25D0%25BE%25D0%25B2%25D0%25B5%25D0%25BD%25D1%258C%2520%25D1%2586%25D0%25B8%25D1%2584%25D1%2580%25D0%25BE%25D0%25B2%25D0%25BE%25D0%25B9%2520%25D0%25B3%25D1%2580%25D0%25B0%25D0%25BC%25D0%25BE%25D1%2582%25D0%25BD%25D0%25BE%25D1%2581%25D1%2582%25D0%25B8%2520%25D0%25BD%25D0%25B0%25D1%2581%25D0%25B5%25D0%25BB%25D0%25B5%25D0%25BD%25D0%25B8%25D1%258F.xlsx&wdOrigin=BROWSELINK Date of access (25.12.2024)

144 Bureau of National Statistics Agency for Strategic Planning and Reforms of the Republic of Kazakhstan. – URL: https://view.officeapps.live.com/op/view.aspx?src=https%3A%2F%2Fstat.gov.kz%2Fupload%2Fiblock%2Faa0%2Fzlqxy3sujkbowi04q7xbx4mv1k1cvogo%2F%25D0%2594%25D0%25BE%25D0%25BB%25D1%258F%2520%25D0%25BF%25D0%25BE%25D0%25BB%25D1%258C%25D0%25B7%25D0%25BE%25D0%25B2%25D0%25B0%25D1%2582%25D0%25B5%25D0%25BB%25D0%25B5%25D0%25B9%2520%25D1%2581%25D0%25B5%25D1%2582%25D0%25B8%2520%25D0%2598%25D0%25BD%25D1%2582%25D0%25B5%25D1%2580%25D0%25BD%25D0%25B5%25D1%2582%2520%25D0%25B8%2520%25D0%25BA%25D0%25BE%25D0%25BC%25D0%25BF%25D1%258C%25D1%258E%25D1%2582%25D0%25B5%25D1%2580%25D0%25BE%25D0%25BC.xls&wdOrigin=BROWSELINK Date of access (25.12.2024)

145 Bureau of National Statistics Agency for Strategic Planning and Reforms of the Republic of Kazakhstan. – URL: https://view.officeapps.live.com/op/view.aspx?src=https%3A%2F%2Fstat.gov.kz%2

Fupload%2Fiblock%2Ff8f%2Fmgaelq48pggmwu6u4hawraq5gxrxgntn%2F4.%2520%25D0%25A3%25D0%25B4%25D0%25B5%25D0%25BB%25D1%258C%25D0%25BD%25D1%258B%25D0%25B9%2520%25D0%25B2%25D0%25B5%25D1%2581%2520%25D1%2580%25D0%25B5%25D0%25B3%25D0%25B8%25D0%25BE%25D0%25BD%25D0%25BE%25D0%25B2%2520%25D0%25B2%2520%25D0%2592%25D0%2592%25D0%259F%2C%2520%25D1%2581%25D1%2582%25D1%2580%25D1%2583%25D0%25BA%25D1%2582%25D1%2583%25D1%2580%25D0%25B0%2520%25D0%2592%25D0%25A0%25D0%259F.xlsx&wdOrigin=BROWSELINK Date of access (25.12.2024)

146 Bureau of National Statistics Agency for Strategic Planning and Reforms of the Republic of Kazakhstan. – URL: https://view.officeapps.live.com/op/view.aspx?src=https%3A%2F%2Fstat.gov.kz%2Fupload%2Fiblock%2Fbe9%2Ffcfnl72cv7mx80wai4nxrw8i7e6cl9it%2F2.%2520%25D0%2598%25D0%25A4%25D0%259E%2520%25D0%2592%25D0%25A0%25D0%259F.xls&wdOrigin=BROWSELINK Date of access (25.12.2024)

147 Bureau of National Statistics Agency for Strategic Planning and Reforms of the Republic of Kazakhstan. – URL: https://view.officeapps.live.com/op/view.aspx?src=https%3A%2F%2Fstat.gov.kz%2Fupload%2Fiblock%2Fe29%2Fdmriz0d3ft6puyimpo8ta6vrd41bijub%2F11.%25D0%25A0%25D0%259A%2520%25D0%259F%25D1%2580%25D0%25BE%25D0%25B8%25D0%25B7%25D0%25B2%25D0%25BE%25D0%25B4%25D0%25B8%25D1%2582%25D0%25B5%25D0%25BB%25D1%258C%25D0%25BD%25D0%25BE%25D1%2581%25D1%2582%25D1%258C%2520%25D1%2582%25D1%2580%25D1%2583%25D0%25B4%25D0%25B0%2520%25D0%2592%25D0%25B0%25D0%25BB%25D0%25BE%25D0%25B2%25D0%25BE%25D0%25B9%2520%25D0%25B4%25D0%25BE%25D0%25B1%25D0%25B0%25D0%25B2%25D0%25BB%25D0%25B5%25D0%25BD%25D0%25BD%25D0%25BE%25D0%25B9%2520%25D1%2581%25D1%2582%25D0%25BE%25D0%25B8%25D0%25BC%25D0%25BE%25D1%2581%25D1%2582%25D0%25B8(1).xls&wdOrigin=BROWSELINK Date of access (25.12.2024)

148 Bureau of National Statistics Agency for Strategic Planning and Reforms of the Republic of Kazakhstan. – URL: https://view.officeapps.live.com/op/view.aspx?src=https%3A%2F%2Fstat.gov.kz%2Fupload%2Fiblock%2Ffa5%2Fjc78hxhhafgxj1i2zn4cbdzn0fyamcsh%2F%25D0%2597%25D0%25B0%25D0%25BD%25D1%258F%25D1%2582%25D0%25BE%25D0%25B5%2520%25D0%25BD%25D0%25B0%25D1%2581%25D0%25B5%25D0%25BB%25D0%25B5%25D0%25BD%25D0%25B8%25D0%25B5.xlsx.xlsx&wdOrigin=BROWSELINK Date of access (25.12.2024)

149 Bureau of National Statistics Agency for Strategic Planning and Reforms of the Republic of Kazakhstan. – URL: https://view.officeapps.live.com/op/view.aspx?src=https%3A%2F%2Fstat.gov.kz%2Fupload%2Fiblock%2F0b0%2F5hdbn3wyelh3nxlvycuqyjtrl7l98mqw%2F%25D0%25AD%25D0%25BA%25D1%2581%25D0%25BF%25D0%25BE%25D1%2580%25D1%2582%2520%25D0%25B8%2520%25D0%25B8%25D0%25BC%25D0%25BF%25D0%25BE%25D1%2580%25D1%2582%2520%25D1%2583%25D1%2581%25

D0%25BB%25D1%2583%25D0%25B3%2520%25D0%25B2%2520%25D0%25A0%25D0%25B5%25D1%2581%25D0%25BF%25D1%2583%25D0%25B1%25D0%25BB%25D0%25B8%25D0%25BA%25D0%25B5%2520%25D0%259A%25D0%25B0%25D0%25B7%25D0%25B0%25D1%2585%25D1%2581%25D1%2582%25D0%25B0%25D0%25BD.xls&wdOrigin=BROWSELINK Date of access (25.12.2024)

150 Wang Q., Zhang Q. Measuring Regional Innovation Efficiency in China using a Dynamic Network DEA Model // The Economics and Finance Letters. – 2022. – № 9(2). - pp. 244-256. https://10.18488/29.v9i2.3179

151 The official webcite of Astana Hub // https://astanahub.com/ru/ 25.04.2025

152 The official webcite of MOST IT hub // https://mosthub.space/ 25.04.2025

153 The webcite of Kostanai state university named after Akhmet Baitursynov // http://test.ksu.edu.kz/about/progress/ 25.04.2025

154 Public Registry of Legal Entities of the Republic of Kazakhstan // https://publicreg.myafsa.com/details/230840900210/ 28.06.2025

155 Development Program Kostanay Regional University named after A. Baitursynov for 2020-2025 // https://www.ksu.edu.kz/files/docs/ksu/o_kru/mission/strategicheskij_plan_kgu_na_2020-2025.pdf 25.05.2025

156 Mangistau region will become a digital hub. Investors from the UK are interested in developing projects in the region // https://invest.gov.kz/ru/media-center/press-releases/mangistauskaya-oblast-stanet-tsifrovym-khabom-investory-iz-velikobritanii-zainteresovany-v-razvitii-/ 25.04.2025

157 Public Registry of Legal Entities of the Republic of Kazakhstan // https://publicreg.myafsa.com/details/240540900965/ 28.06.2025

158 INTERNATIONAL TECHNOPARK OF IT-STARTUPS ASTANA HUB // https://help.kazpatent.kz/sites/default/files//astana_hub_general_info_rus_0.pdf 25.04.2025

159 The President receives Minister of Digital Development, Innovation and Aerospace Industry Bagdat Mussin // https://www.akorda.kz/en/events/akorda_news/meetings_and_receptions/the-president-receives-minister-of-digital-development-innovation-and-aerospace-industry-bagdat-mussin 25.04.2025

160 National Information and Analytical Center, Sifro // https://niac.kz/220740039055 29.07.2025

161 Public Registry of Legal Entities of the Republic of Kazakhstan // https://publicreg.myafsa.com/roc/?form=&name=hub&bin_number=&reg_status= 28.06.2025

162 MOST IT CITY // https://mosthub.space/city 21.05.2025

163 Establishment of cross-border transport and logistics hubs to increase exports of non-resource goods by 30% // https://primeminister.kz/en/news/establishment-of-cross-border-transport-and-logistics-hubs-to-increase-exports-of-non-resource-goods-by-30-29451 25.04.2025

164 Over 50 startups and tech companies from Kazakhstan were showcased at the UNESCAP conference // https://astanahub.com/en/article/bolee-50-startapov-i-it-kompanii-kazakhstana-prezentovany-na-ploshchadke-konferentsii-eskato-oon

25.04.2025

165 Startup Ecosystem Awards 2024: Kazakhstan Once Again Leads Central Asia's Startup Ecosystem // https://astanahub.com/en/article/startup-ecosystem-awards-2024-kazakhstan-vnov-stal-liderom-startap-ekosistemy-tsentralnoi-azii#:~:text=The%20international%20StartupBlink%20ranking%2C%20which%20evaluates%20startup%20ecosystems,the%20top%2075%20startup%20ecosystems%20in%20the%20world 25.04.2025

166 Astana Hub summed up the results of the year // https://astanahub.com/en/article/astana-hub-podvel-itogi-2021-goda 25.04.2025

167 Almaty to host anniversary digital forum Digital Almaty 2023 // https://el.kz/en/almaty-to-host-anniversary-digital-forum-digital-almaty-2023_60839/#:~:text=On%20February%2023%2C%202023%2C%20the%20V%20International%20Digital,and%20Aerospace%20Industry%20of%20the%20Republic%20of%20Kazakhstan. 25.04.2025

168 The accelerator of the Terricon Valley: 11 startups have made sales abroad The results of a joint project with ICRIAP and Astana Hub have been summed up // https://astanahub.com/en/article/akselerator-terrikonovoi-doliny-11-startapov-sdelali-prodazhi-za-rubezhom-podvedeny-itogi-sovmestnogo 25.04.2025

169 Huawei Launches AI-Centric 5.5G Solutions to Ignite the Mobile AI Era // https://www.huawei.com/en/news/2025/3/ai-centric-mobile 25.04.2025

170 Learn more about the private IT schools participating in Tech Orda 2022. // https://astanahub.com/en/article/opredeleny-chastnye-it-shkoly-uchastniki-programmy-tech-orda-2022-dlia-podgotovki-spetsialistov-v-sfere 25.04.2025

171 Геокчакян А. Г. Обзор методологических аспектов оценки уровня проектной зрелости организаций // Вестник ЧелГУ. - 2024. - №10 (492). URL: https://cyberleninka.ru/article/n/obzor-metodologicheskih-aspektov-otsenki-urovnya-proektnoy-zrelosti-organizatsiy. Дата обращения: (02.04.2025)

172 Aslanova I.V., Kulichkina A.I. Digital Maturity: Definition and Model // Proceedings of the 2nd International Scientific and Practical Conference "Modern Management Trends and the Digital Economy: from Regional Development to Global Economic Growth" (MTDE 2020). Amsterdam: Atlantis Press. – P. 443-449.

173 Jurgens J., Swan Gin B. The Global Smart Industry Readiness Index Initiative: Manufacturing Transformation Insights Report 2022 // Singapore International Center for Industrial Transformation (INCIT): Singapore. – 2022.

174 Sassanelli C., Terzi S. The D-BEST Reference Model: A Flexible and Sustainable Support for the Digital Transformation of Small and Medium Enterprises // Global Journal of Flexible Systems Management. – 2022. – №23. – P. 345 - 370.

ANNEX A

КазНУ им. аль-Фараби
В диссертационный совет группы специальностей 6D050600, 8D04102 – Экономика, 6D051000, 8D04103 – Государственное и местное управление, 6D051700, 8D04105 – Инновационный менеджмент, 6D051800, 8D04107 – Управление проектами, 6D050800, 8D04108 – Учет и аудит, 6D050900, 8D04110 – Финансы, 6D051100, 8D0411 – Маркетинг, 6D051300, 8D04101 – Мировая экономика, 6D090900, 8D11301 – Логистика

Акт о внедрении результатов диссертационного исследования

Настоящим подтверждаем, что результаты диссертационного исследования Сейткан Г. на тему "Features and Mechanisms of Managing The Formation of Digital Hubs in Kazakhstan" представляют ценность в практическом применении и были использованы в деятельности ТОО "Sifro" hub.

В рамках проведенного исследования разработанная методика оценки цифровых хабов была апробирована на примере деятельности Sifro Hub. Директором хаба было принято участие в экспертной оценке, в ходе которой деятельность хаба была проанализирована и оценена по предложенной автором шкале критериев (стратегическое планирование, финансирование, инфраструктура, кадровый потенциал и инновационная активность). Полученные результаты позволили выявить сильные и слабые стороны в развитии хаба, а также обозначить приоритетные направления совершенствования его работы. Наша компания занимается разработкой цифровых проектов. Sifro — это IT-компания с более чем 10-летним опытом в разработке и продвижении цифровых продуктов. Мы создаём решения для бизнеса, государственных структур и образовательных проектов. Наша команда — это эксперты в вебразработке, мобильных приложениях, CRM системах, WebAR, VR 360 и образовательных платформах.

Выводы и результаты, полученные в рамках диссертационного исследования, способствуют углублению понимания механизмов управления цифровыми хабами, а также могут быть использованы при формировании региональной политики цифровизации и повышении эффективности инструментов инновационного менеджмента. Внедрение предложенных подходов создает практическую основу для оптимизации деятельности цифровых хабов и способствует развитию цифровой экономики Казахстана.

Директор _____ У. Куандыков

ANNEX B

В Диссертационный совет по
группе специальностей «6D050600 – Экономика»,
«6D051300 - Мировая экономика»,
«6D051700 - Инновационный менеджмент,
«6D090900 – Логистика (по отраслям)»,
«6D051800-Управление проектами»,
«6D051000-Государственное и местное управление (ГиМУ)»

050040, г. Алматы, пр. аль-Фараби, 71

Справка
о практической актуальности результатов
диссертационного исследования

Настоящим подтверждаем, что материалы докторской диссертации «Особенности и механизмы управления формированием цифровых хабов в Казахстане», в частности, шкала и критерии управления формированием цифровых хабов были применены нами для оценки деятельности хаба “Sifro”.

Генеральный директор

ТОО “Sifro” **Куандыков У. Е.**

Scanned by TapScanner

ANNEX C

Справка

Результаты диссертационного исследования Сейткан Галии Газизкызы на тему «Особенности и механизмы управления формированием цифровых хабов в Казахстане» были апробированы при разработке научно-исследовательских проектов Института экономики КН МНВО РК, в частности, грантового проекта фундаментальных исследований по теме: «Приоритеты и механизмы инклюзивного регионального развития Казахстана в условиях преодоления спада экономики» (AP09259004-OT-23, 2023 - 2025). Научный руководитель проекта: д.э.н., профессор Нурланова Н. К.

Генеральный директор
Института экономики КН МНВО РК
д.э.н., ассоц. профессор **Тургинбаева А.Н.**

ANNEX D

Table 7 - Value meanings of hypothesis 1

Y	X1	X2	X3	X4	X5
53485,8	268564	643376	167	438	4,8
78159,4	283744	707821	143	421	4
126597,2	298028	663374	148	414	4
147538,3	287068	661598	149	424	4,3
214179,7	301372	846111	146	412	5,7
309821,2	317926	809750	139	345	5,7
220847,7	338981	888233	128	341	8
237079,4	353833	926844	126	392	8,1
375600,4	360287	1242579	127	390	8,1
269526,7	383850	1106353	125	383	9,3
349943,6	412677	1145994	122	386	9,6
305217,4	433774	1241328	124	384	10,6
337712,7	446687	1330244	125	386	11,3
388928,5	461983	1357311	125	396	11,5
443121,3	481732	1431647	122	438	10,5
589 852,5	507 238	1 641 815	116	414	11,0
918 349,9	526 290	2 035 147	112	425	11,7

ANNEX E

Количество зарегистрированных юридических лиц РК по регионам и размерности

	1999	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**
Республика Казахстан	**120 862**	**138 530**	**156 404**	**173 684**	**190 042**	**208 396**	**226 908**	**247 930**	**268 564**	**283 744**	**298 028**	**287 068**	**301 372**	**317 926**
малые	113 730	132 052	149 993	167 543	183 840	202 158	220 413	241 117	261 347	275 898	290 112	278 981	293 080	309 499
средние	4 656	4 352	4 341	4 118	4 190	4 213	4 441	4 659	4 937	5 474	5 544	5 658	5 942	6 095
крупные	2 476	2 126	2 070	2 023	2 012	2 025	2 054	2 154	2 280	2 372	2 372	2 429	2 350	2 332
Абай	**3 949**	**4 361**	**4 696**	**4 987**	**5 171**	**5 377**	**5 631**	**5 871**	**6 115**	**6 234**	**6 380**	**6 246**	**6 305**	**6 510**
малые	3 672	4 110	4 454	4 762	4 952	5 171	5 415	5 651	5 881	5 998	6 139	6 016	6 064	6 269
средние	179	172	171	158	152	150	156	161	175	175	180	175	188	185
крупные	98	79	71	67	67	56	60	59	59	61	61	55	53	56
Акмолинская	**5 150**	**6 040**	**6 651**	**7 344**	**8 102**	**8 757**	**9 211**	**9 958**	**10 421**	**10 805**	**11 048**	**10 625**	**10 989**	**11 241**
малые	4 569	5 494	6 129	6 911	7 676	8 349	8 781	9 510	9 961	10 311	10 597	10 178	10 580	10 864
средние	329	334	338	282	280	270	287	302	311	344	325	315	315	284
крупные	252	212	184	151	146	138	143	146	149	150	126	132	94	93
Актюбинская	**5 592**	**6 086**	**6 644**	**7 137**	**7 729**	**8 378**	**9 293**	**10 323**	**11 115**	**11 798**	**12 418**	**11 813**	**12 243**	**12 722**
малые	5 276	5 825	6 395	6 910	7 487	8 120	9 016	10 038	10 800	11 453	12 071	11 467	11 900	12 384
средние	187	172	172	160	171	177	188	193	219	250	256	262	252	239
крупные	129	89	77	67	71	81	89	92	96	95	91	84	91	99
Алматинская	**5 026**	**5 965**	**5 610**	**5 675**	**6 100**	**6 607**	**7 167**	**8 075**	**9 104**	**9 712**	**10 161**	**10 386**	**10 922**	**11 493**
малые	4 611	5 530	5 276	5 375	5 822	6 320	6 842	7 745	8 799	9 377	9 823	10 040	10 580	11 132
средние	268	293	235	205	210	213	255	260	222	245	250	260	262	287

крупные	147	142	99	95	68	74	70	70	83	90	88	86	80	74
Атырауская	**2 628**	**3 155**	**3 802**	**4 535**	**5 194**	**5 710**	**6 361**	**6 953**	**7 512**	**8 134**	**8 659**	**8 900**	**9 446**	**9 862**
малые	2 430	2 964	3 603	4 330	4 987	5 498	6 139	6 713	7 272	7 850	8 370	8 592	9 131	9 546
средние	130	134	140	144	148	152	162	179	180	218	209	226	239	240
крупные	68	57	59	61	59	60	60	61	60	66	80	82	76	76
Западно-Казахстанская	**3 105**	**3 440**	**3 986**	**4 357**	**4 737**	**5 054**	**5 581**	**5 996**	**6 390**	**6 723**	**7 101**	**6 948**	**7 236**	**8 293**
малые	2 780	3 208	3 766	4 136	4 514	4 811	5 339	5 741	6 131	6 440	6 811	6 645	6 930	7 984
средние	206	163	156	150	159	173	172	185	190	208	223	227	226	228
крупные	119	69	64	71	64	70	70	70	69	75	67	76	80	81
Жамбылская	**5 313**	**5 826**	**6 271**	**6 650**	**7 028**	**7 328**	**7 723**	**8 133**	**8 444**	**8 835**	**9 239**	**8 587**	**8 978**	**9 375**
малые	4 803	5 475	5 932	6 311	6 697	7 031	7 410	7 830	8 146	8 485	8 885	8 231	8 638	9 010
средние	399	261	248	244	246	203	218	208	220	263	263	266	255	287
крупные	111	90	91	95	85	94	95	95	78	87	91	90	85	78
Жетісу	**1 613**	**1 834**	**2 991**	**3 575**	**3 711**	**3 838**	**4 122**	**4 535**	**4 914**	**5 126**	**5 322**	**5 342**	**5 419**	**5 641**
малые	1 386	1 612	2 720	3 335	3 500	3 628	3 912	4 315	4 703	4 902	5 100	5 130	5 214	5 447
средние	122	128	189	165	150	147	146	157	147	154	155	145	142	148
крупные	105	94	82	75	61	63	64	63	64	70	67	67	63	46
Карагандинская	**8 815**	**9 578**	**10 061**	**10 900**	**11 574**	**12 404**	**13 371**	**14 444**	**15 711**	**16 699**	**17 602**	**17 874**	**18 876**	**20 003**
малые	8 210	9 077	9 596	10 460	11 128	11 966	12 905	13 981	15 218	16 213	17 096	17 342	18 339	19 459
средние	409	334	318	291	289	291	306	309	332	326	348	375	382	387
крупные	196	167	147	149	157	147	160	154	161	160	158	157	155	157
Костанайская	**7 016**	**7 750**	**8 302**	**8 967**	**9 234**	**9 540**	**10 151**	**10 709**	**11 291**	**11 702**	**12 163**	**11 622**	**12 051**	**12 491**
малые	6 501	7 265	7 804	8 496	8 793	9 121	9 734	10 288	10 864	11 269	11 747	11 192	11 639	12 082
средние	298	313	319	304	288	275	287	288	285	297	294	304	279	284
крупные	217	172	179	167	153	144	130	133	142	136	122	126	133	125
Кызылординская	**3 296**	**3 641**	**3 943**	**4 246**	**4 496**	**4 818**	**5 412**	**5 840**	**6 081**	**6 345**	**6 691**	**6 827**	**7 172**	**7 484**
малые	3 060	3 411	3 719	4 013	4 252	4 563	5 103	5 530	5 781	5 990	6 326	6 471	6 793	7 123
средние	179	175	165	175	184	186	223	229	217	281	289	273	297	279
крупные	57	55	59	58	60	69	86	81	83	74	76	83	82	82
Мангистауская	**2 802**	**3 306**	**3 910**	**4 440**	**5 010**	**5 468**	**6 004**	**6 747**	**7 650**	**8 349**	**8 942**	**9 333**	**9 992**	**10 415**

малые	2 634	3 151	3 748	4 283	4 852	5 294	5 835	6 554	7 406	8 084	8 661	9 035	9 703	10 132
средние	120	107	109	101	103	121	113	121	162	185	189	204	205	199
крупные	48	48	53	56	55	53	56	72	82	80	92	94	84	84
Павлодарская	**7 049**	**7 557**	**8 399**	**9 075**	**9 549**	**10 179**	**10 756**	**11 459**	**12 234**	**12 679**	**13 134**	**11 762**	**12 264**	**12 821**
малые	6 670	7 267	8 132	8 816	9 301	9 910	10 478	11 164	11 915	12 330	12 787	11 423	11 920	12 483
средние	228	192	180	176	163	176	181	191	204	242	245	240	236	236
крупные	151	98	87	83	85	93	97	104	115	107	102	99	108	102
Северо-Казахстанская	**4 522**	**4 962**	**5 448**	**5 852**	**6 094**	**6 713**	**7 151**	**7 492**	**7 898**	**8 235**	**8 806**	**8 599**	**8 885**	**9 148**
малые	4 072	4 592	5 108	5 566	5 815	6 429	6 861	7 194	7 581	7 907	8 473	8 274	8 564	8 833
средние	283	251	236	190	192	202	212	226	246	252	249	241	249	246
крупные	167	119	104	96	87	82	78	72	71	76	84	84	72	69
Туркестанская область	**6 937**	**7 237**	**7 895**	**8 362**	**8 954**	**9 825**	**10 132**	**10 636**	**10 967**	**11 315**	**11 788**	**11 671**	**12 030**	**12 456**
малые	6 477	6 890	7 572	8 072	8 655	9 522	9 827	10 302	10 621	10 856	11 288	11 157	11 502	11 897
средние	355	258	245	221	236	234	240	258	276	386	401	400	426	456
крупные	105	89	78	69	63	69	65	76	70	73	99	114	102	103
Ұлытау	**1 392**	**1 518**	**1 537**	**1 571**	**1 550**	**1 582**	**1 631**	**1 698**	**1 805**	**1 881**	**1 974**	**2 084**	**2 176**	**2 258**
малые	1 325	1 448	1 468	1 500	1 483	1 518	1 562	1 631	1 728	1 807	1 895	2 001	2 094	2 179
средние	42	51	50	54	49	47	52	48	58	57	64	68	67	64
крупные	25	19	19	17	18	17	17	19	19	17	15	15	15	15
Восточно-Казахстанская	**6 182**	**6 878**	**7 775**	**8 487**	**8 972**	**9 721**	**10 380**	**10 920**	**11 434**	**11 810**	**12 119**	**12 084**	**12 430**	**12 869**
малые	5 875	6 609	7 499	8 200	8 677	9 422	10 059	10 575	11 072	11 454	11 762	11 730	12 060	12 500
средние	188	179	178	184	186	182	209	221	229	226	225	226	244	252
крупные	119	90	98	103	109	117	112	124	133	130	132	128	126	117
г.Астана	**5 738**	**7 177**	**8 775**	**10 418**	**12 349**	**14 797**	**17 695**	**21 118**	**25 110**	**27 575**	**29 752**	**30 492**	**33 334**	**36 702**
малые	5 511	6 914	8 483	10 110	12 004	14 447	17 303	20 664	24 607	27 041	29 225	29 939	32 767	36 093
средние	150	159	169	175	192	203	224	274	292	320	302	328	349	372
крупные	77	104	123	133	153	147	168	180	211	214	225	225	218	237
г.Алматы	**30 353**	**36 463**	**43 312**	**49 950**	**56 505**	**63 361**	**69 225**	**76 007**	**82 268**	**86 772**	**90 889**	**81 269**	**85 321**	**89 903**
малые	29 650	35 663	42 409	49 030	55 503	62 344	68 230	74 929	81 029	85 418	89 524	79 846	83 693	88 185

средние	472	525	575	568	618	629	622	669	776	830	860	892	1 089	1 175
крупные	231	275	328	352	384	388	373	409	463	524	505	531	539	543
г.Шымкент	**4 384**	**5 756**	**6 396**	**7 156**	**7 983**	**8 939**	**9 911**	**11 016**	**12 100**	**13 015**	**13 840**	**14 604**	**15 303**	**16 239**
малые	4 218	5 547	6 180	6 927	7 742	8 694	9 662	10 762	11 832	12 713	13 532	14 272	14 969	15 897
средние	112	151	148	171	174	182	188	180	196	215	217	231	240	247
крупные	54	58	68	58	67	63	61	74	72	87	91	101	94	95

ANNEX F

Количество зарегистрированных юридических лиц РК по отраслям экономики

	1999	2000	2001	2002	2003	2004	2005	2006	2007
Всего	120 862	138 530	156 404	173 684	190 042	208 396	226 908	247 930	268 564
Сельское, лесное и рыбное хозяйство	9 972	10 076	10 290	10 665	10 933	12 229	12 471	12 523	12 848
Горнодобывающая промышленность и разработка карьеров	731	830	904	991	1 102	1 240	1 435	1 609	1 723
Обрабатывающая промышленность	9 860	11 013	11 910	12 903	13 756	14 701	15 568	16 435	17 289
Снабжение электроэнергией, газом, паром, горячей водой и кондиционированным воздухом	983	1 080	1 134	1 086	1 041	1 090	1 114	1 138	1 104
Водоснабжение; сбор, обработка и удаление отходов, деятельность по ликвидации загрязнений	974	1 116	1 228	1 307	1 330	1 385	1 450	1 519	1 582
Строительство	8 693	10 116	11 936	14 095	16 605	19 896	23 945	28 338	33 490
Оптовая и розничная торговля; ремонт автомобилей и мотоциклов	34 253	42 744	51 098	58 679	65 177	71 287	76 431	83 086	89 616
Транспорт и складирование	3 589	4 297	4 758	5 252	5 708	6 333	6 914	7 738	8 655
Предоставление услуг по проживанию и питанию	1 683	1 858	2 065	2 248	2 458	2 598	2 726	2 821	2 991
Информация и связь	2 301	2 806	3 228	3 657	4 074	4 536	4 907	5 297	5 698
Финансовая и страховая деятельность	3 142	2 775	2 881	3 011	3 237	3 550	3 938	4 626	5 418
Операции с недвижимым имуществом	6 833	7 372	7 880	8 329	8 892	9 561	10 729	11 983	12 891

Профессиональная, научная и техническая деятельность	6 624	7 709	8 941	10 015	11 317	12 805	14 559	16 381	18 331
Деятельность в области административного и вспомогательного обслуживания	2 227	2 935	3 580	4 128	4 660	5 276	6 109	7 109	8 327
Государственное управление и оборона; обязательное социальное обеспечение	6 064	6 211	6 731	7 189	7 681	7 951	8 826	9 816	9 724
Образование	9 363	10 137	10 771	11 772	12 543	12 956	13 477	13 909	14 337
Здравоохранение и социальное обслуживание населения	4 923	5 375	5 439	5 443	5 460	5 653	5 839	5 869	5 784
Искусство, развлечения и отдых	2 190	2 515	2 746	3 021	3 233	3 507	3 763	3 984	4 120
Предоставление прочих видов услуг	6 457	7 565	8 884	9 893	10 835	11 842	12 707	13 749	14 636
Деятельность домашних хозяйств, нанимающих домашнюю прислугу; деятельность домашних хозяйств по производству товаров и услуг для собственного потребления	-	-	-	-	-	-	-	-	-
Деятельность экстерриториальных организаций и органов	-	-	-	-	-	-	-	-	-

ANNEX G

Количество предприятий осуществлявших НИОКР

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	201
Республика Казахстан	**257**	**259**	**267**	**273**	**295**	**390**	**437**	**438**	**421**	**414**	**424**	**412**	**345**
Область Абай													
Акмолинская	8	7	7	8	7	8	8	8	8	7	7	8	9
Актюбинская	10	13	11	11	11	15	17	17	16	15	16	18	16
Алматинская	8	7	8	5	6	8	9	14	12	7	10	8	7
Атырауская	12	9	10	9	8	8	10	10	11	12	12	9	9
Западно-Казахстанская	4	5	5	6	8	11	13	16	10	10	10	9	15
Жамбылская	5	5	5	5	7	9	13	12	11	12	10	7	8
Область Жетiсу													
Карагандинская	29	31	35	33	43	51	51	46	40	29	28	29	26
Костанайская	7	7	7	7	7	10	15	16	13	14	15	13	14
Кызылординская	3	3	4	6	5	7	6	6	7	7	14	23	7
Мангыстауская	5	5	6	5	3	4	6	7	7	6	8	8	7
Павлодарская	7	7	5	5	5	10	12	12	11	10	9	11	11
Северо-Казахстанская	7	7	9	9	9	5	4	5	5	5	5	3	3
Туркестанская	4	4	4	3	3	6	3	4	3	3	3	3	3
Область Ұлытау													
Восточно-Казахстанская	26	28	26	29	30	36	35	35	35	34	33	36	34
г. Астана	9	7	5	5	10	23	30	35	41	43	42	41	49
г. Алматы	110	111	117	121	127	170	194	184	183	193	196	180	119
г. Шымкент	3	3	3	6	6	9	11	11	8	7	6	6	8

ANNEX H

Количество действующих субъектов малого и среднего предпринимательства

единиц

	Всего	в том числе			
		юридические лица малого предпринимательства	юридические лица среднего предпринимательства	индивидуальные предприниматели	крестьянские или фермерские хозяйства
2005					
Республика Казахстан	**507 365**	**50 612**	**2 541**	**297 234**	**156 978**
Акмолинская	22 746	1 821	232	17 236	3 457
Актюбинская	15 467	1 891	120	9 456	4 000
Алматинская	61 101	2 555	224	21 323	36 999
Атырауская	20 930	1 880	50	17 692	1 308
Западно-Казахстанская	16 377	1 176	94	12 116	2 991
Жамбылская	27 290	1 120	105	13 416	12 649
Карагандинская	31 877	3 171	226	23 100	5 380
Костанайская	30 138	2 111	177	22 348	5 502
Кызылординская	13 816	1 214	84	11 368	1 150
Мангистауская	14 249	1 489	79	12 213	468
Южно-Казахстанская	98 339	4 624	162	31 146	62 407
Павлодарская	21 614	2 394	120	16 426	2 674
Северо-Казахстанская	21 921	1 514	166	16 341	3 900
Восточно-Казахстанская	45 834	3 852	235	27 670	14 077
г.Астана	21 214	5 836	115	15 260	3
г.Алматы	44 452	13 964	352	30 123	13
2006					
Республика Казахстан	**572 738**	**47 756**	**2 678**	**358 583**	**163 721**
Акмолинская	29 074	1 739	254	23 370	3 711
Актюбинская	23 901	2 078	122	17 990	3 711
Алматинская	69 089	2 128	206	26 336	40 419
Атырауская	25 372	1 811	95	21 966	1 500
Западно-Казахстанская	18 895	1 165	100	14 400	3 230

Жамбылская	34 181	1 483	111	19 486	13 101
Карагандинская	33 763	3 348	226	24 875	5 314
Костанайская	34 495	2 217	210	26 914	5 154
Кызылординская	15 952	1 398	88	13 447	1 019
Мангистауская	18 369	2 150	73	15 663	483
Южно-Казахстанская	104 423	4 574	172	35 385	64 292
Павлодарская	23 427	2 051	124	18 522	2 730
Северо-Казахстанская	21 210	1 489	172	15 812	3 737
Восточно-Казахстанская	49 967	3 772	251	30 648	15 296
г.Астана	22 964	4 120	105	18 730	9
г.Алматы	47 656	12 233	369	35 039	15
2007					
Республика Казахстан	**643 376**	**55 865**	**2 476**	**415 709**	**169 326**
Акмолинская	31 576	1 853	220	25 964	3 539
Актюбинская	27 093	2 215	137	20 931	3 810
Алматинская	82 391	2 679	153	33 571	45 988
Атырауская	29 349	1 892	77	25 791	1 589
Западно-Казахстанская	22 258	1 413	94	17 414	3 337
Жамбылская	33 822	1 637	106	17 803	14 276
Карагандинская	38 463	4 135	228	28 334	5 766
Костанайская	41 838	2 255	185	34 191	5 207
Кызылординская	15 647	1 565	84	12 801	1 197
Мангистауская	21 928	2 347	69	18 940	572
Южно-Казахстанская	105 109	5 142	159	38 548	61 260
Павлодарская	26 213	2 182	118	21 115	2 798
Северо-Казахстанская	18 858	1 513	170	13 749	3 426
Восточно-Казахстанская	59 287	5 178	239	37 322	16 548
г.Астана	28 826	5 826	97	22 900	3
г.Алматы	60 718	14 033	340	46 335	10
2008					
Республика Казахстан	**707 821**	**58 480**	**4 019**	**475 841**	**169 481**
Акмолинская	33 319	1 977	307	27 426	3 609
Актюбинская	27 897	2 716	182	21 298	3 701
Алматинская	90 884	3 121	247	40 172	47 344

Атырауская	33 431	2 214	158	29 429	1 630
Западно-Казахстанская	24 186	1 639	110	18 960	3 477
Жамбылская	36 181	1 717	131	19 431	14 902
Карагандинская	40 983	4 173	292	30 700	5 818
Костанайская	43 651	2 168	306	36 216	4 961
Кызылординская	19 832	1 677	110	16 856	1 189
Мангистауская	24 894	3 223	128	20 902	641
Южно-Казахстанская	111 725	3 465	255	47 886	60 119
Павлодарская	28 750	2 239	150	23 528	2 833
Северо-Казахстанская	23 030	1 547	238	18 020	3 225
Восточно-Казахстанская	68 742	4 748	356	47 619	16 019
г.Астана	32 278	5 748	244	26 283	3
г.Алматы	68 038	16 108	805	51 115	10
2009					
Республика Казахстан	**663 374**	**60 601**	**4 160**	**428 420**	**170 193**
Акмолинская	26 755	2 050	300	20 654	3 751
Актюбинская	22 848	2 659	221	16 307	3 661
Алматинская	107 788	3 912	241	55 174	48 461
Атырауская	18 220	2 146	176	14 377	1 521
Западно-Казахстанская	18 986	1 893	145	13 398	3 550
Жамбылская	36 688	1 552	110	19 682	15 344
Карагандинская	43 688	4 563	306	32 950	5 869
Костанайская	36 187	2 366	302	28 494	5 025
Кызылординская	14 557	1 631	136	11 613	1 177
Мангистауская	16 480	3 864	159	11 711	746
Южно-Казахстанская	122 898	3 423	228	59 978	59 269
Павлодарская	24 150	2 418	153	18 723	2 856
Северо-Казахстанская	20 911	1 609	252	15 898	3 152
Восточно-Казахстанская	68 879	4 882	319	47 876	15 802
г.Астана	25 758	5 645	301	19 810	2
г.Алматы	58 581	15 988	811	41 775	7
2010					
Республика Казахстан	**661 598**	**66 492**	**8 712**	**416 085**	**170 309**
Акмолинская	26 704	1 930	416	20 066	4 292

Актюбинская	24 091	2 998	463	16 479	4 151
Алматинская	92 705	4 667	546	39 530	47 962
Атырауская	24 861	2 237	373	20 625	1 626
Западно-Казахстанская	20 302	1 955	224	14 517	3 606
Жамбылская	31 938	1 441	169	14 936	15 392
Карагандинская	44 748	4 915	725	33 104	6 004
Костанайская	33 850	2 613	493	25 454	5 290
Кызылординская	16 227	1 831	205	13 048	1 143
Мангистауская	21 967	3 641	342	17 333	651
Южно-Казахстанская	113 770	4 521	462	49 193	59 594
Павлодарская	25 041	2 505	332	19 127	3 077
Северо-Казахстанская	19 797	1 786	393	14 334	3 284
Восточно-Казахстанская	59 405	4 919	494	39 763	14 229
г.Астана	35 081	5 845	805	28 429	2
г.Алматы	71 111	18 688	2 270	50 147	6
2011					
Республика Казахстан	**846 111**	**64 457**	**9 028**	**589 640**	**182 986**
Акмолинская	33 050	2 019	452	26 719	3 860
Актюбинская	36 052	3 541	482	27 885	4 144
Алматинская	113 859	4 628	491	56 288	52 452
Атырауская	31 366	2 281	354	27 231	1 500
Западно-Казахстанская	27 805	1 707	222	22 178	3 698
Жамбылская	39 916	1 496	189	22 704	15 527
Карагандинская	56 552	4 567	697	45 097	6 191
Костанайская	42 801	2 681	503	34 176	5 441
Кызылординская	21 803	1 822	229	18 512	1 240
Мангистауская	27 923	3 014	330	23 634	945
Южно-Казахстанская	135 793	5 232	531	63 076	66 954
Павлодарская	31 675	2 497	354	25 649	3 175
Северо-Казахстанская	25 125	1 750	420	20 178	2 777
Восточно-Казахстанская	75 740	5 004	544	55 122	15 070
г.Астана	49 870	6 041	869	42 959	1
г.Алматы	96 781	16 177	2 361	78 232	11
2012					

Республика Казахстан	**809 750**	**62 888**	**8 388**	**573 618**	**164 856**
Акмолинская	32 046	2 156	379	26 142	3 369
Актюбинская	36 168	3 514	466	27 949	4 239
Алматинская	100 362	3 233	447	47 243	49 439
Атырауская	31 472	2 313	266	27 181	1 712
Западно-Казахстанская	28 141	1 809	192	22 509	3 631
Жамбылская	38 582	1 508	201	21 655	15 218
Карагандинская	56 987	4 604	693	46 596	5 094
Костанайская	41 464	2 896	439	33 131	4 998
Кызылординская	22 924	2 050	209	19 304	1 361
Мангистауская	28 678	2 748	280	24 743	907
Южно-Казахстанская	111 810	6 568	539	49 144	55 559
Павлодарская	30 539	2 731	383	24 711	2 714
Северо-Казахстанская	23 771	1 821	353	18 948	2 649
Восточно-Казахстанская	72 762	5 060	461	53 286	13 955
г.Астана	51 871	5 890	795	45 181	5
г.Алматы	102 173	13 987	2 285	85 895	6
2013					
Республика Казахстан	**888 233**	**61 076**	**8 312**	**660 262**	**158 583**
Акмолинская	35 097	2 231	374	29 074	3 418
Актюбинская	39 328	3 527	457	31 047	4 297
Алматинская	95 863	2 544	433	48 110	44 776
Атырауская	33 495	2 171	288	29 504	1 532
Западно-Казахстанская	30 337	1 836	187	24 674	3 640
Жамбылская	43 658	1 456	189	26 653	15 360
Карагандинская	63 791	4 665	784	53 368	4 974
Костанайская	45 097	3 020	445	36 733	4 899
Кызылординская	27 269	2 106	198	23 531	1 434
Мангистауская	32 835	2 341	282	29 379	833
Южно-Казахстанская	125 682	4 773	522	65 042	55 345
Павлодарская	33 783	2 837	349	27 653	2 944
Северо-Казахстанская	25 775	1 814	316	20 764	2 881
Восточно-Казахстанская	77 951	5 330	526	59 861	12 234
г.Астана	58 810	6 008	815	51 982	5

г.Алматы	119 462	14 417	2 147	102 887	11
2014					
Республика Казахстан	**926 844**	**74 829**	**4 559**	**694 759**	**152 697**
Акмолинская	36 271	2 732	229	29 757	3 553
Актюбинская	41 237	3 995	238	32 806	4 198
Алматинская	96 424	3 123	287	49 357	43 657
Атырауская	35 560	2 728	161	31 085	1 586
Западно-Казахстанская	31 437	2 035	138	25 627	3 637
Жамбылская	45 713	1 697	114	28 493	15 409
Карагандинская	67 557	6 019	355	55 419	5 764
Костанайская	46 067	3 378	285	37 600	4 804
Кызылординская	30 377	2 216	141	26 399	1 621
Мангистауская	35 620	2 638	149	32 055	778
Южно-Казахстанская	126 819	6 071	274	70 179	50 295
Павлодарская	35 348	3 398	186	28 553	3 211
Северо-Казахстанская	25 888	2 250	234	20 930	2 474
Восточно-Казахстанская	79 915	5 857	306	62 068	11 684
г.Астана	64 504	7 553	393	56 549	9
г.Алматы	128 107	19 139	1 069	107 882	17
2015*					
Республика Казахстан	**1 242 579**	**175 679**	**2 897**	**882 849**	**181 154**
Акмолинская	46 256	4 828	125	37 770	3 533
Актюбинская	50 212	7 070	94	38 828	4 220
Алматинская	117 332	6 423	138	65 508	45 263
Атырауская	46 687	5 959	85	38 715	1 928
Западно-Казахстанская	39 588	4 277	83	30 884	4 344
Жамбылская	63 511	3 891	61	43 771	15 788
Карагандинская	85 906	13 889	196	65 266	6 555
Костанайская	60 252	5 887	155	49 569	4 641
Кызылординская	41 474	4 437	73	34 173	2 791
Мангистауская	46 488	5 925	92	39 253	1 218
Южно-Казахстанская	183 367	12 635	151	102 174	68 407
Павлодарская	44 264	6 743	102	34 064	3 355
Северо-Казахстанская	34 306	3 772	140	27 571	2 823

Восточно-Казахстанская	98 617	8 070	167	74 467	15 913
г.Астана	99 186	26 758	292	72 132	4
г.Алматы	185 133	55 115	943	128 704	371
2016*					
Республика Казахстан	**1 106 353**	**189 637**	**2 711**	**736 121**	**177 884**
Акмолинская	40 531	5 726	117	31 171	3 517
Актюбинская	47 868	8 279	101	34 906	4 582
Алматинская	107 980	6 862	139	58 861	42 118
Атырауская	40 735	5 335	99	33 238	2 063
Западно-Казахстанская	36 157	4 762	91	26 662	4 642
Жамбылская	53 852	4 268	53	33 953	15 578
Карагандинская	79 424	14 872	192	57 675	6 685
Костанайская	47 729	5 928	147	37 032	4 622
Кызылординская	35 614	4 563	66	27 521	3 464
Мангистауская	44 138	6 454	95	36 234	1 355
Южно-Казахстанская	168 889	13 922	159	86 876	67 932
Павлодарская	40 628	7 566	94	29 814	3 154
Северо-Казахстанская	27 652	4 218	135	20 511	2 788
Восточно-Казахстанская	87 041	8 542	158	63 168	15 173
г.Астана	92 921	30 900	295	61 694	32
г.Алматы	155 194	57 440	770	96 805	179
2017*					
Республика Казахстан	**1 145 994**	**208 742**	**2 618**	**747 107**	**187 527**
Акмолинская	41 719	6 437	114	31 034	4 134
Актюбинская	50 209	9 032	101	35 935	5 141
Алматинская	109 877	8 627	152	56 297	44 801
Атырауская	42 897	6 016	103	34 529	2 249
Западно-Казахстанская	37 111	5 505	92	26 064	5 450
Жамбылская	58 692	5 231	51	37 346	16 064
Карагандинская	79 276	16 100	188	55 287	7 701
Костанайская	48 237	6 614	147	36 368	5 108
Кызылординская	37 450	4 827	60	27 500	5 063
Мангистауская	47 015	7 414	84	37 840	1 677
Южно-Казахстанская	177 411	16 523	163	92 092	68 633

Павлодарская	41 311	8 480	103	29 517	3 211
Северо-Казахстанская	27 587	4 704	125	19 595	3 163
Восточно-Казахстанская	79 966	9 895	163	55 407	14 501
г.Астана	97 251	35 329	261	61 553	108
г.Алматы	169 985	58 008	711	110 743	523
2018*					
Республика Казахстан	**1 241 328**	**231 325**	**2 620**	**809 115**	**198 268**
Акмолинская	44 106	7 072	116	32 173	4 745
Актюбинская	54 430	9 856	105	38 687	5 782
Алматинская	115 630	10 246	162	60 103	45 119
Атырауская	46 756	7 037	114	37 139	2 466
Западно-Казахстанская	40 062	5 825	91	27 895	6 251
Жамбылская	63 262	5 916	54	40 677	16 615
Карагандинская	84 032	17 122	181	58 040	8 689
Костанайская	51 093	7 278	149	37 970	5 696
Кызылординская	42 342	5 194	59	30 642	6 447
Мангистауская	51 096	8 322	92	40 576	2 106
Павлодарская	43 820	9 199	110	31 263	3 248
Северо-Казахстанская	28 969	4 967	134	20 179	3 689
Туркестанская	130 804	7 084	50	54 685	68 985
Восточно-Казахстанская	87 678	10 818	171	61 149	15 540
г.Астана	124 685	40 887	251	83 339	208
г.Алматы	174 509	62 324	661	110 931	593
г.Шымкент	58 054	12 178	120	43 667	2 089
2019*					
Республика Казахстан	**1 330 244**	**258 365**	**2 502**	**855 920**	**213 457**
Акмолинская	45 453	7 703	114	32 017	5 619
Актюбинская	59 116	10 819	90	41 451	6 756
Алматинская	122 368	11 739	163	64 934	45 532
Атырауская	49 917	7 776	121	39 223	2 797
Западно-Казахстанская	42 785	6 277	71	29 041	7 396
Жамбылская	69 961	6 520	47	45 290	18 104
Карагандинская	88 299	18 024	160	59 591	10 524
Костанайская	52 516	7 951	144	38 298	6 123

Кызылординская	46 297	5 533	63	32 266	8 435
Мангистауская	52 949	8 958	84	41 448	2 459
Павлодарская	45 482	9 994	109	31 996	3 383
Северо-Казахстанская	30 071	5 347	124	19 990	4 610
Туркестанская	141 992	8 314	56	62 471	71 151
Восточно-Казахстанская	88 938	11 676	154	60 863	16 245
г.Астана	134 475	47 395	227	86 559	294
г.Алматы	190 190	70 117	650	118 591	832
г.Шымкент	69 435	14 222	125	51 891	3 197
2020*					
Республика Казахстан	**1 357 311**	**280 200**	**2 486**	**857 910**	**216 715**
Акмолинская	46 564	8 152	116	32 228	6 068
Актюбинская	61 797	11 413	95	42 655	7 634
Алматинская	123 181	12 748	150	64 617	45 666
Атырауская	50 239	8 063	114	39 001	3 061
Западно-Казахстанская	43 035	6 312	87	28 994	7 642
Жамбылская	69 338	7 304	44	44 062	17 928
Карагандинская	90 196	18 988	170	59 731	11 307
Костанайская	52 495	8 394	134	37 701	6 266
Кызылординская	48 657	5 738	57	31 922	10 940
Мангистауская	52 900	9 652	70	40 537	2 641
Павлодарская	45 809	10 740	113	31 549	3 407
Северо-Казахстанская	30 331	5 723	121	20 043	4 444
Туркестанская	140 605	9 080	74	62 859	68 592
Восточно-Казахстанская	90 453	12 296	155	61 410	16 592
г.Астана	144 769	52 121	234	92 057	357
г.Алматы	197 066	77 616	617	117 910	923
г.Шымкент	69 876	15 860	135	50 634	3 247
2021*					
Республика Казахстан	**1 431 647**	**299 737**	**2 754**	**907 722**	**221 434**
Акмолинская	48 544	8 499	114	33 793	6 138
Актюбинская	65 992	11 848	99	45 501	8 544
Алматинская	129 716	14 008	169	70 734	44 805
Атырауская	52 031	8 302	121	40 401	3 207

Западно-Казахстанская	44 260	6 701	85	29 625	7 849
Жамбылская	71 298	8 277	52	44 984	17 985
Карагандинская	95 296	19 656	189	63 469	11 982
Костанайская	54 870	8 737	151	39 616	6 366
Кызылординская	51 063	5 972	62	32 828	12 201
Мангистауская	56 521	10 386	121	43 186	2 828
Павлодарская	46 694	11 122	113	31 687	3 772
Северо-Казахстанская	30 228	6 142	119	19 548	4 419
Туркестанская	144 778	10 384	59	64 838	69 497
Восточно-Казахстанская	95 916	13 002	160	65 500	17 254
г.Астана	163 017	57 496	264	104 750	507
г.Алматы	206 109	80 865	744	123 468	1 032
г.Шымкент	75 314	18 340	132	53 794	3 048
2022*					
Республика Казахстан	**1 818 764**	**340 584**	**2 924**	**1 234 536**	**240 720**
Абай	49 693	4 663	53	35 328	9 649
Акмолинская	54 838	9 206	124	39 021	6 487
Актюбинская	82 580	13 217	98	60 451	8 814
Алматинская	116 585	12 391	151	77 468	26 575
Атырауская	63 115	8 914	131	50 560	3 510
Западно-Казахстанская	53 008	7 496	93	37 195	8 224
Жамбылская	92 572	9 107	54	60 764	22 647
Жетiсу	53 600	4 341	52	30 293	18 914
Карагандинская	93 086	19 288	178	64 717	8 903
Костанайская	61 133	9 677	159	44 802	6 495
Кызылординская	67 145	6 544	65	47 159	13 377
Мангистауская	75 341	11 220	118	60 587	3 416
Павлодарская	52 084	11 587	110	35 566	4 821
Северо-Казахстанская	33 066	6 779	120	21 481	4 686
Туркестанская	184 579	11 719	62	98 639	74 159
Ұлытау	17 413	1 716	17	12 282	3 398
Восточно-Казахстанская	61 475	9 175	125	43 658	8 517
г.Астана	204 308	67 087	264	135 891	1 066
г.Алматы	292 734	96 852	795	192 978	2 109

г.Шымкент	110 409	19 605	155	85 696	4 953
2023*					
Республика Казахстан	**2 002 199**	**360 268**	**2 940**	**1 369 043**	**269 948**
Абай	53 269	4 874	53	37 821	10 521
Акмолинская	57 919	9 203	121	41 645	6 950
Актюбинская	83 819	12 742	122	61 850	9 105
Алматинская	134 628	13 878	148	91 789	28 813
Атырауская	65 045	9 242	127	51 607	4 069
Западно-Казахстанская	57 653	7 831	97	40 156	9 569
Жамбылская	106 779	9 312	60	67 167	30 240
Жетiсу	58 914	4 690	50	33 630	20 544
Карагандинская	99 190	19 162	181	69 770	10 077
Костанайская	64 286	9 755	159	47 168	7 204
Кызылординская	67 180	6 245	71	48 383	12 481
Мангистауская	79 742	11 805	121	63 829	3 987
Павлодарская	54 578	11 983	117	36 936	5 542
Северо-Казахстанская	34 891	6 873	119	22 933	4 966
Туркестанская	206 855	12 416	84	113 084	81 271
Ұлытау	18 791	1 766	15	13 145	3 865
Восточно-Казахстанская	62 616	9 131	129	44 339	9 017
г.Астана	227 386	71 559	253	153 765	1 809
г.Алматы	340 132	106 543	755	229 685	3 149
г.Шымкент	128 526	21 258	158	100 341	6 769

** В соответствии с международной практикой, в целях применения единых подходов к формированию показателей о количестве субъектов МСП и для исключения расхождений с данными Комитета государственных доходов Министерства финансов Республики Казахстан, начиная с 1 февраля 2015 года, публикуется показатель количество «действующих» субъектов, вместо «активных».*

ANNEX I

Число организаций высшего образования

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	20
Республика Казахстан	170	185	177	180	181	181	176	167	143	148	149	146	139	128	126	12
Абай	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Акмолинская	7	7	7	8	8	8	7	7	6	6	6	6	6	6	6	6
Актюбинская	5	6	6	6	7	7	7	6	6	7	8	8	7	6	6	6
Алматинская	3	3	3	4	4	4	4	4	2	2	2	2	3	3	3	3
Атырауская	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Западно-Казахстанская	5	5	5	6	6	7	7	7	4	4	4	4	4	3	3	3
Жамбылская	4	4	4	4	5	5	5	6	5	5	5	5	5	5	5	4
Жетису	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Карагандинская	17	17	14	15	15	15	15	13	14	13	13	13	10	10	9	9
Костанайская	8	8	8	8	9	9	8	7	7	7	7	7	7	7	7	7
Кызылординская	7	8	7	6	6	6	6	6	5	5	5	4	4	4	4	4
Мангистауская	4	4	4	5	4	3	4	4	3	3	3	3	3	2	2	2
Павлодарская	4	4	4	4	5	4	4	4	4	4	4	4	4	4	4	4
Северо-Казахстанская	2	4	4	4	4	4	4	4	3	3	2	2	2	2	2	2
Туркестанская*	5	5	4	2	2	2	3	2	2	2	2	2	2	2	2	2
Улытау	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Восточно-Казахстанская	11	13	12	9	11	10	10	9	9	10	10	10	10	7	7	7

г.Астана	6	7	7	10	10	11	13	13	12	12	13	14	14	14	14	14
г.Алматы	68	73	69	69	66	66	62	63	48	52	52	47	45	41	40	42
г.Шымкент	11	14	16	17	16	17	14	9	10	10	10	12	10	9	9	9

ANNEX J

Основные показатели инновационной активности предприятий и организаций по технологическим инновациям

	Количество респондентов всего, единиц										из них: имеющие инновации										Уровен
	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2003
Республика Казахстан	**7 212**	**8 022**	**10 392**	**10 591**	**10 889**	**11 172**	**10 096**	**10 937**	**10 723**	**21 452**	**148**	**184**	**352**	**505**	**526**	**447**	**399**	**467**	**614**	**1215**	**2,1**
Акмолинская	468	466	542	555	575	579	589	764	728	1 180	3	1	8	12	12	7	7	5	7	54	0,6
Актюбинская	54	308	368	384	430	442	397	440	436	1 023	4	10	17	23	24	18	16	27	37	41	7,4
Алматинская	82	578	673	699	763	752	695	750	610	1 221	4	10	15	20	16	14	10	7	28	67	4,9
Атырауская	247	204	300	282	296	328	276	245	212	599	-	1	3	22	11	9	8	9	14	27	-
Западно-Казахстанская	208	248	312	329	246	265	267	195	205	553	6	5	7	7	12	13	12	9	26	42	2,9
Жамбылская	92	328	332	351	363	385	320	400	401	657	5	9	19	23	32	23	14	31	41	52	5,4
Карагандинская	980	715	934	894	981	986	908	963	982	2 046	16	30	42	57	60	64	56	67	71	78	1,6
Костанайская	223	429	552	574	652	643	600	653	645	1 342	14	5	8	11	16	13	9	17	31	95	6,3
Кызылординская	76	225	245	255	252	270	275	278	274	532	-	3	3	6	6	8	4	17	22	28	-
Мангистауская	227	179	402	402	517	515	440	466	457	1 021	5	8	10	13	12	10	6	5	5	11	2,2
Павлодарская	428	675	581	541	542	530	500	514	515	1 085	10	23	16	39	44	19	19	26	28	45	2,3
Северо-Казахстанская	238	351	430	389	410	404	378	449	460	947	4	5	8	8	9	10	10	11	11	98	1,7
Туркестанская	868	321	363	362	349	349	333	343	354	798	1	2	5	6	7	7	8	11	27	49	0,1
Восточно-Казахстанская	1083	714	892	920	989	954	800	932	868	1730	16	20	37	63	55	41	47	60	70	108	1,5
г.Астана	196	264	725	717	732	833	705	695	707	1796	-	1	11	20	22	15	15	18	29	122	-
г.Алматы	1361	1746	2420	2611	2451	2592	2259	2466	2490	3639	52	45	132	164	176	166	151	133	143	243	3,8
г. Шымкент	381	271	321	326	341	345	354	384	379	1283	8	6	11	11	12	10	7	14	24	55	2,1

Основные показатели инновационной активности предприятий по всем типам инноваций*

	Количество предприятий всего, единиц											из них: имеющие инновации									
	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Республика Казахстан	**22 070**	**24 068**	**31 784**	**31 077**	**30 854**	**30 501**	**28 411**	**28 087**	28 203	30 750	30 610	**1774**	**1 940**	**2 585**	**2 879**	**2 974**	**3 230**	**3 206**	**3 236**	2 960	3 390
Абай	-	-	-	-	-	-	-	-	-	593	601										48
Акмолинская	1 173	1 270	1 325	1 301	1 299	1 207	1 148	1 160	1 155	1 173	1 165	83	92	90	91	98	93	88	86	67	70
Актюбинская	1 044	1 114	1 236	1 234	1 149	1 174	1 144	1 118	1 114	1 176	1 127	68	85	86	115	116	125	121	124	139	159

Алматинская	1 318	1 473	1 643	1 648	1 797	1 830	1 715	1 666	1 699	1 259	1 326	126	139	114	129	146	151	160	163	137	67
Атырауская	798	977	1 276	1 193	1 145	1 161	1 081	1 074	1 046	1 119	1 031	41	79	102	101	92	96	97	108	106	75
Западно-Казахстанская	646	768	857	917	932	952	834	786	795	828	837	34	51	35	33	49	50	44	46	55	39
Жамбылская	734	808	852	834	846	841	739	732	732	774	758	75	98	90	90	96	96	97	100	67	42
Жетiсу	-	-	-	-	-	-	-	-	-	564	567										61
Карагандинская	1 957	1 902	2 340	2 235	2 309	2 289	2 175	2 196	2 199	1 993	1 890	148	159	216	238	257	336	293	281	285	300
Костанайская	1 393	1 500	1 502	1 438	1 475	1 342	1 357	1 337	1 366	1 353	1 314	164	204	218	161	167	163	174	191	163	125
Кызылординская	709	725	846	812	784	756	653	635	645	651	625	85	73	99	91	89	92	80	79	72	86
Мангистауская	838	922	1 027	1 060	1 131	1 128	988	1 035	1 070	1 062	1 055	20	32	41	43	40	45	34	82	67	53
Павлодарская	1 118	1 142	1 354	1 286	1 292	1 272	1 148	1 128	1 092	1 127	1 122	95	79	65	83	112	116	104	101	57	149
Северо-Казахстанская	1 047	1 001	1 047	1 049	1 023	1 013	964	965	992	1 054	1 042	114	116	111	119	115	119	92	136	112	160
Туркестанская	997	837	884	905	939	927	795	832	814	899	910	42	47	52	60	50	60	72	93	85	81
Ұлытау	-	-	-	-	-	-	-	-	-	179	192										15
Восточно-Казахстанская	1 767	2 055	2 091	1 985	2 010	2 050	1 836	1 831	1 854	1 292	1 277	99	157	240	296	303	317	273	236	207	114
г.Астана	1 617	1 997	4 103	4 003	4 039	3 975	3 821	3 605	3 668	4 264	4 117	179	214	541	543	582	583	567	453	494	633
г.Алматы	3 902	4 389	7 970	7 716	7 124	6 997	6 646	6 561	6 527	7 826	8 122	314	219	377	590	550	670	810	856	747	1 031
г. Шымкент	1 012	1 188	1 431	1 461	1 560	1 587	1 367	1 426	1 435	1 564	1 532	87	96	108	96	112	118	100	101	100	82

ANNEX K

Questionnaire survey on "Digitalization through the eyes of future professionals"

Hello, dear undergraduate, graduate or postgraduate student! Please answer the questions in the questionnaire. The survey is anonymous, the results will be used in a generalised form. Thank you in advance!

1) What university are you studying at?

2) Mark the level of your educational program?

- Bachelor's program;
- Master's program;
- PhD program.

3) What is your field of study?

4) Do you study the subjects on "digitalization, information and communication technology, IT"?

-Yes, I do;

-No, I do not;

-Not yet;

-I do not know.

5) Are you interested in digitalization, IT, ICT (information and communication technology) subjects?

- Yes, I am;
- No, I am not;
- Rather yes than no;
- Rather no than yes.

6) What do you consider as "digitalization?"

-Digitalization is the introduction of modern digital technology into various areas of life and production;

-Digitalization is the use of digital technology in education;

-Digitalization is the process of collecting, processing and storing information;

-Digitalization is the automation of operations;

All of the above.

7) What is your level of personal computer skills?

-Basic level;

-Average level of computer skills;

-Advanced user.

8) How proficient do you think you are in digital skills?

-Easy to use online applications, conduct online transactions;

-I can create applications and other things;

-Can use digital technology (3D printing, artificial intelligence, robotics and others);

-All of the above;

-I can not do online transactions;

-I do not use technologies, including digital.

9) Is there a stable internet connection in your area?

-Yes, it works perfectly;

-Yes, it works a bit weak;

-No, not available;

-I prefer using mobile internet.

10) What types of digital technology are you familiar with?

-Robotics;

-Artificial Intelligence;

-The Internet of Things;

-Big Data;

-The blockchain;

-3D printing, additive technologies;

-All of the above.

11) What types of digital technology have you used in real life?

1) 3D printing, additive technologies;

2) The blockchain;

3) Big Data;

4) The Internet of Things;

5) Robotics;

6) Artificial Intelligence;

7) I have not used any digital technology.

12) Do you know about the "Digital Kazakhstan" program?

1) Yes, I do;

2) No, I do not.

13) What factors do you think will be the main drivers for the development of digitalization in Kazakhstan?

1) Market factor (competitors' strategies, quality and quantity requirements);

2) Management factor (availability of digital experience, organizational culture, etc.);

3) Personnel factor (specialist training system, staff qualifications);

4) Technological factor (state of the art of fixed assets, digital data handling system, offering comprehensive solutions, etc.);

5) Financial factor (state support, cost of implementing digital technologies, cost of using the implemented digital technologies).

14) Have you heard of or are you familiar with the term "digital hub"?

1) Yes, I have;

2) No, I have not.

15) Digital hubs are centers providing digital services to local companies and organizations on the use of digital technologies (robotics, artificial intelligence, blockchain, Big Data). What steps and measures do you think should be taken to establish digital hubs in Kazakhstan?

16) Do you plan to work in digital activities using digital technologies in the future?

1) Yes, sure;

2) No, I am not sure;

3) I do not know, but it is interesting;

4) I am not interested in digital activities and technologies.

ANNEX L

Table 13 – Data of share of large and medium-sized enterprises using digital technologies in %, for 2019-2023

Region title	2019	2020	2021	2022	2023
Republic of Kazakhstan	4,8	6,1	7,8	12,9	16,4
Abay region	5,6	6,9	6,5	9,7	12,5
Akmola region	5,9	5,4	7,3	13,6	18,2
Aktobe region	5,1	5,3	5,1	7,0	25,6
Almaty region	3,1	4,9	6,8	11,3	11,7
Atyrau region	11,1	7,7	14,3	13,3	33,3
West Kazakhstan region	3,7	8,3	13,0	15,4	19,2
Zhambyl region	4,2	4,2	3,8	11,1	15,4
Zhetisu region	5,6	5,9	6,3	5,3	4,5
Karaganda region	7,2	9,1	8,1	15,5	21,5
Kostanay region	7,3	7,0	12,2	17,8	23,9
Kyzylorda region	-	-	-	14,3	21,4
Mangystau region	5,3	5,6	4,8	4,5	13,0
Pavlodar region	7,4	11,1	10,9	21,6	23,4
North Kazakhstan region	6,7	7,1	10,0	13,8	9,1
Turkestan region	0,0	0,0	0,0	3,4	5,6
Ulytau region	9,1	10,0	14,3	25,0	18,8
East Kazakhstan	7,4	12,8	12,0	10,4	11,8
Astana	3,3	8,1	14,3	19,1	29,5
Almaty	0,0	0,0	1,0	11,2	11,1
Shymkent	7,4	6,5	11,5	10,3	11,1
Note – Collected by the author from the source [138]					

ANNEX M

Table 14 – Data of digital literacy of the population of ages 7-64 in %, for 2019-2023

Region title	2019	2020	2021	2022	2023
Republic of Kazakhstan	82,1	84,1	87,3	88,3	90,2
Abay region				79,9	85,5
Akmola region	74,7	74,9	81,5	83,1	85,8
Aktobe region	80,0	81,0	86,8	89,6	90,0
Almaty region				91,9	92,4
Atyrau region	82,6	83,1	85,2	85,4	86,6
West Kazakhstan region	78,4	78,8	79,2	82,0	84,6
Zhambyl region	79,8	80,9	85,8	85,8	87,0
Zhetisu region				85,3	87,1
Karaganda region				86,2	88,8
Kostanay region	82,9	85,8	90,8	90,9	91,7
Kyzylorda region	80,1	83,0	89,3	89,4	90,6
Mangystau region	78,7	79,6	84,9	86,0	84,9
Pavlodar region	82,4	83,5	85,1	85,1	86,7
North Kazakhstan region	77,1	78,8	80,2	82,1	82,6
Turkestan region	77,7	82,1	87,2	89,9	93,9
Ulytau region				91,8	94,1
East Kazakhstan region				84,8	87,0
Astana	88,7	91,3	94,7	95,2	97,0
Almaty	89,0	91,4	91,5	93,8	95,5
Shymkent	81,5	82,3	87,5	87,5	89,9
Note – Collected by the author from the source [139]					

ANNEX N

Table 15 - the percentage of Internet users aged 16-74 years old, for 2019-2023

Region title	2019	2020	2021	2022	2023
Republic of Kazakhstan	86,6	89,0	93,3	94,5	95,8
Abay region				89,6	91,6
Akmola region	80,0	85,6	90,6	91,2	94,7
Aktobe region	88,2	89,4	93,6	96,2	97,0
Almaty region				95,6	96,7
Atyrau region	83,3	78,6	89,7	90,0	90,8
West Kazakhstan region	81,3	84,2	89,2	91,8	92,9
Zhambyl region	84,9	86,2	90,6	95,8	96,1
Zhetisu region				92,7	92,9
Karaganda region				97,2	98,0
Kostanay region	88,6	87,2	93,1	93,4	94,3
Kyzylorda region	81,9	82,7	90,5	91,9	93,0
Mangistau region	86,0	86,5	97,6	98,5	96,4
Pavlodar region	86,6	94,6	93,2	92,9	96,8
North Kazakhstan region	82,3	88,6	90,3	90,7	93,9
Turkestan region	91,7	94,6	96,3	95,2	97,6
Ulytau region				89,6	90,4
East Kazakhstan region				96,5	97,9
Astana	92,3	95,3	96,5	96,8	98,1
Almaty	89,5	92,9	94,3	94,7	95,9
Shymkent	84,4	84,0	94,0	95,8	97,1
Note – Collected by the author from the source [140]					

ANNEX O

Table 16 – Data on indicator - Structure of gross regional product: information and communication in %, for 2010-2023

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Republic of Kazakhstan	100	100	100	100	100	100	100	100	100	100	100	100	100	100
Abai													2,30	2,34
Akmola region	2,70	2,80	2,60	2,70	2,60	2,70	2,90	2,86	2,75	2,78	3,23	3,19	3,36	3,22
Aktobe region	5,40	5,50	5,70	5,10	4,90	4,30	4,40	4,31	4,38	4,28	4,19	4,27	4,30	3,55
Almaty region	4,60	4,40	4,70	4,80	4,80	4,80	4,70	4,55	4,52	4,67	5,28	5,49	4,11	4,36
Atyrau region	13,00	13,40	11,70	11,00	11,00	10,30	11,10	10,94	12,65	13,41	10,95	12,66	13,23	11,96
West Kazakhstan region	4,80	4,80	5,70	4,90	5,00	4,20	4,30	4,30	4,51	4,24	3,87	4,21	4,27	4,44
Zhambyl region	2,00	2,20	2,50	2,40	2,50	2,50	2,50	2,48	2,48	2,46	2,69	2,70	2,59	2,55
Zhetisu													1,38	1,43
Karaganda region	8,60	8,50	7,90	7,30	7,30	7,60	7,90	7,88	7,66	7,75	8,63	8,87	7,01	6,78
Kostanay	3,90	4,00	3,70	3,70	3,50	3,40	3,20	3,40	3,35	3,53	4,07	4,19	4,03	3,89

region														
Kyzylorda region	3,90	4,00	4,10	4,00	3,50	2,90	2,80	2,63	2,66	2,63	2,33	2,29	2,33	2,16
Mangystau region	6,80	6,60	5,70	5,80	6,10	5,20	5,20	6,06	6,15	5,30	4,35	4,32	4,24	3,73
Pavlodar region	4,70	5,40	4,90	4,90	4,40	4,20	4,20	4,36	4,44	4,36	4,42	4,63	4,14	3,65
North Kazakhstan	2,20	2,40	2,20	2,10	2,00	2,00	2,00	2,05	1,96	1,99	2,23	2,13	2,12	2,03
Turkestan region									2,69	2,90	3,37	3,34	3,39	3,38
Ulytau													1,55	1,73
East Kazakhstan	5,70	5,70	5,80	5,70	5,80	5,70	5,90	5,84	5,81	5,79	6,52	6,03	3,77	3,87
Astana	8,10	7,60	8,50	9,70	10,10	11,80	10,40	10,62	10,85	11,27	11,29	10,63	10,29	10,78
Almaty	18,10	17,30	18,30	20,00	20,50	22,30	22,60	21,87	19,63	19,48	19,05	17,87	18,46	20,78
Shymkent									3,52	3,17	3,53	3,18	3,17	3,36
South Kazakhstan region	5,50	5,40	6,00	5,90	6,00	6,10	5,90	5,86						
Note - Collected by the author from the source [141]														

ANNEX P

Table 17 - Data on the indicator - Index of physical volume of gross regional product (in % to the previous period of the previous year), for 2010-2023

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Abai	0	0	0	0	0	0	0	0	0	0	0	107	102	105,6
Akmola region	96,3	116,2	94,3	105	104,7	101,9	102,9	102,4	103,8	102,9	102,7	103,3	107,7	99,9
Aktobe region	109,2	106,5	107,6	104,7	104,5	96,9	101	105	105,3	104,9	99,9	103,1	100,1	99,2
Almaty region	107,6	109	107,4	110,7	105,2	104,2	101,8	104	103,1	105,1	98,5	111,2	105,5	103,1
Atyrau region	112,7	103,2	97,7	104	102,5	102,8	103,7	116	113,3	107,4	93,5	105,8	101,6	107,4
West Kazakhstan region	102,6	104,3	104,4	103,3	105,1	99,4	102,6	103,1	99,3	98,5	99,3	98,1	100,7	107,2
Zhambyl region	107,6	113,2	109,8	103,3	100,4	100,2	102,6	103,7	103,7	103,8	101,1	106,6	103,4	102,6
Zhetisu	0	0	0	0	0	0	0	0	0	0	0	101,4	102	112,6
Karaganda region	106,4	106	101,2	107,5	103,2	102,7	102,4	103,7	103	105,8	100,1	103,1	100,3	102,6

Kostanay region	101,7	115,6	93,5	110,2	102,2	96,4	98	104,6	105,9	104,6	103	104,3	104,5	102,8
Kyzylorda region	103,8	105,9	103,2	104,4	98,7	95,9	95,2	100,4	99,9	101,5	89,2	102,2	102,4	104,7
Mangystau region	107,8	99,9	100,9	105,5	104	100,1	99,9	99,6	101,1	101,2	94,5	101,2	101,1	102,7
Pavlodar region	104,5	105,7	104	103	102,3	101,4	101,9	103,4	0	0	0	0	0	0
North Kazakhstan	106,4	110,8	108,1	100,1	100,9	100,3	99,4	104	106,2	105,3	96,9	103,9	101,3	102,2
Turkestan region	100,8	116,4	94,6	107,7	105,8	101	100,8	103,1	103,2	102,1	99,8	101	105,6	99,3
Ulytau	0	106,6	106,7	104,6	100,5	103,4	101,4	102,2	107,7	107,8	104,9	104,3	100,3	102,3
East Kazakhstan	0	0	0	0	0	0	0	0	0	0	0	102,1	102,5	99,9
Astana	107,2	107,6	112,6	107,3	102,8	100	102,2	102	104,9	105,4	100,6	103,1	103,5	104,1
Almaty	107,3	108,9	114,7	110,6	109,4	106,4	102,4	104	100,2	107,8	101	105,4	105,5	106,3
Shymkent	110,4	109,4	109,6	114,8	107	104,2	102,6	102,8	103	104,5	95,3	106	105	109,7
South Kazakhstan region	0	104,4	100,9	101,4	104,6	99,9	102,8	104,8	114,1	103,8	100,9	105,4	106,8	105,7
Note - Collected by the author from the source [142]														

ANNEX Q

Table 18 - Labor productivity by regions: information and communication (GVA per employed person, ths tg).

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Abai													7 287,8	5 786,3
Akmola region	1 932,2	1 508,3	2 118,8	2 272,8	2 458,3	2 992,0	3 010,2	3 843,9	3 370,1	3 589,7	3 570,9	3 625,2	3 603,2	3 702,1
Aktobe region	2 804,6	1 978,2	1 826,2	2 395,6	2 623,2	2 478,5	2 823,4	2 677,4	2 452,9	3 150,1	4 092,4	4 328,6	5 425,5	4 492,2
Almaty region	2 468,9	2 063,9	1 034,5	1 339,2	1 027,6	1 436,0	1 470,2	1 530,6	1 750,6	1 678,9	1 806,2	2 537,6	1 933,6	3 308,6
Atyrau region	3 365,9	2 504,8	4 376,6	2 507,2	3 098,8	4 184,8	5 156,0	4 926,3	4 902,4	6 299,5	4 103,8	4 988,9	5 719,2	7 322,0
West Kazakhstan region	2 449,6	1 724,8	1 940,9	2 052,5	1 941,4	2 548,6	2 853,7	2 664,2	2 836,5	3 386,5	4 119,5	4 172,4	3 902,1	12 627,1
Zhambyl region	1 818,3	1 397,3	1 531,0	1 739,0	1 891,2	2 749,0	1 883,3	2 942,3	3 060,0	2 758,3	3 068,9	4 370,6	4 807,9	4 447,4
Zhetisu													3 877,6	4 455,9
Karaganda region	2 508,9	2 172,9	1 858,7	1 849,9	2 272,5	2 585,5	2 418,3	3 010,1	4 007,2	4 478,4	4 987,7	5 113,1	7 643,4	7 816,7

Kostanay region	2 021,6	1 588,1	1 925,3	2 455,0	2 726,1	2 918,5	3 069,9	3 626,4	3 179,0	3 318,3	3 595,6	4 549,8	4 248,6	7 638,0
Kyzylorda region	1 795,6	1 020,1	1 193,3	1 141,0	1 888,6	2 048,0	1 780,9	2 717,8	3 003,1	2 570,3	3 231,3	3 983,8	4 232,3	4 987,9
Mangystau region	4 224,4	2 858,2	2 530,7	3 419,2	3 429,7	3 109,2	2 946,4	2 700,0	2 749,3	3 025,8	2 527,8	2 725,9	2 737,1	2 242,7
Pavlodar region	2 589,7	1 800,7	2 287,3	2 807,5	3 223,0	3 481,8	3 578,4	4 132,1	4 274,3	6 421,9	6 519,7	9 802,5	16 869,6	9 058,8
North Kazakhstan	2 503,4	1 840,9	2 184,0	2 741,8	2 455,7	3 613,7	2 710,6	3 399,0	4 087,8	3 968,8	4 448,4	5 383,4	7 821,4	11 160,3
Turkestan region									376,9	470,6	696,3	1 251,8	1 402,7	950,2
Ulytau													4 032,1	4 868,2
East Kazakhstan	2 600,2	2 024,5	2 392,4	2 998,8	2 476,7	2 397,4	1 570,5	1 531,0	1 713,0	2 758,4	3 293,3	4 017,3	4 816,1	5 395,7
Astana	5 128,1	4 548,8	7 179,9	15 756,7	15 545,9	12 345,5	12 478,6	14 699,9	15 848,4	16 633,3	20 262,2	21 029,2	20 381,1	20 919,0
Almaty	14 933,4	15 937,1	14 956,1	16 357,5	13 206,7	16 739,5	13 984,5	16 710,2	16 484,7	17 449,7	21 950,0	23 965,7	22 651,9	26 898,5
Shymkent									944,9	1 087,1	1 325,7	1 586,5	1 449,7	1 458,6
South Kazakhstan	1 305,2	819,8	1 747,3	1 854,1	891,7	1 084,2	729,4	791,7						

region														
Note - Collected by the author from the source [143]														

ANNEX R

Table 19 - Employed population by economic activity and region for 2010-2023: information and communication (thousands of people).

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Abai													1,4	2,1
Akmola region	4,5	4,9	4,3	4,6	4,7	4,2	4,0	3,6	3,7	3,8	4,3	4,6	4,8	5,2
Aktobe region	4,1	5,0	5,9	5,8	6,1	6,7	5,3	6,1	6,9	5,6	5,0	5,3	5,2	7,2
Almaty region	5,2	5,8	11,8	11,2	15,3	11,8	11,5	12,5	12,1	11,7	11,5	11,5	9,2	9,0
Atyrau region	3,8	4,3	4,1	5,2	4,7	4,7	4,5	4,0	4,0	4,1	3,9	3,7	3,6	3,4
West Kazakhstan region	3,7	4,0	4,3	4,1	4,5	3,6	3,2	3,7	3,6	3,6	3,2	3,3	3,9	4,1
Zhambyl region	3,5	3,9	4,3	4,1	4,3	3,1	4,1	2,9	2,8	3,8	3,3	3,0	3,0	3,4
Zhetisu													2,7	3,5
Karaganda region	8,3	8,1	10,3	13,4	11,5	11,6	10,9	9,7	8,0	7,7	7,8	9,3	8,0	8,1
Kostanay	6,1	6,3	6,4	6,1	5,9	5,8	5,6	5,3	6,2	6,3	6,2	5,5	5,1	4,4

region														
Kyzylorda region	2,8	4,4	4,0	5,2	3,8	3,7	3,9	2,8	2,7	3,2	2,9	2,8	2,9	2,5
Mangystau region	2,4	3,0	4,5	3,6	4,5	5,9	6,4	5,5	5,7	4,4	5,9	5,9	6,9	9,0
Pavlodar region	4,7	6,1	5,9	5,2	4,9	5,1	5,1	5,0	4,8	3,5	3,4	3,5	3,2	3,2
North Kazakhstan	2,9	3,3	3,5	3,1	3,7	2,8	3,8	3,4	2,9	3,1	3,2	2,8	2,6	2,9
Turkestan region	5,4	6,4	2,3	2,5	13,3	11,0	16,1	16,9	16,6	14,8	12,0	9,1	7,1	12,1
Ulytau													0,8	0,8
East Kazakhstan	6,4	6,8	7,0	6,5	9,0	9,8	13,4	15,2	14,3	9,5	8,4	7,9	4,3	5,5
Astana	11,2	15,7	13,6	15,6	16,8	21,4	21,3	19,9	22,3	25,6	27,6	31,4	39,0	41,8
Almaty	30,9	30,9	36,8	31,6	40,9	34,8	35,4	33,8	35,7	38,2	38,3	40,3	41,5	47,1
Shymkent	3,5	6,6	5,1	5,0	6,0	5,7	5,8	5,8	14,1	12,9	12,6	11,9	11,2	12,6
Note - Collected by the author from the source [144]														

ANNEX S

Table 20 - Export and import of services in the Republic of Kazakhstan: Telecommunication, computer and information services (mln USD).

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Export	4 119,0	4 337,7	5 430,9	5 970,6	7 002,5	6 177,4	6 084,5	6 504,9	7 319,9	7 754,3	5 208,3	5 935,0	7 967,9	10 288,0
Telecommunication, computer and information services	93,6	103,7	124,4	140,6	146,6	142,8	124,4	116,1	122,5	131,6	145,0	191,9	473,5	732,4
Import	11 368,5	10 972,9	14 344,5	14 083,5	13 845,9	10 954,4	9 897,1	10 158,1	12 081,6	11 541,0	8 445,7	8 034,6	9 518,1	12 100,4
Telecommunication, computer and information services	223,7	222,9	240,2	307,5	337,9	347,2	285,9	302,2	408,7	413,0	443,8	429,5	592,7	815,7
Note - Collected by the author from the source [145]														

For the time period 2010-2023

Region	Year	Structure of Gross Regional Product	Index of physical volume of Gross Regional Product	Labor productivity by regions: information and communication	Employed population by economic activity and region for 2010-2023: information and communication
Abai	2010,00	4,89	89,27	3812,05	7,26
Abai	2011,00	4,89	89,27	3812,05	7,26
Abai	2012,00	4,89	89,27	3812,05	7,26
Abai	2013,00	4,89	89,27	3812,05	7,26
Abai	2014,00	4,89	89,27	3812,05	7,26
Abai	2015,00	4,89	89,27	3812,05	7,26
Abai	2016,00	4,89	89,27	3812,05	7,26
Abai	2017,00	4,89	89,27	3812,05	7,26
Abai	2018,00	4,89	89,27	3812,05	7,26
Abai	2019,00	4,89	89,27	3812,05	7,26
Abai	2020,00	4,89	89,27	3812,05	7,26
Abai	2021,00	4,89	107,00	3812,05	7,26
Abai	2022,00	0,47	102,00	7287,80	1,36
Abai	2023,00	0,48	105,60	5786,30	2,14
Akmola region	2010,00	1,30	96,30	1932,20	4,45
Akmola region	2011,00	1,10	116,20	1508,30	4,91
Akmola region	2012,00	1,10	94,30	2118,80	4,28
Akmola region	2013,00	1,10	105,00	2272,80	4,61
Akmola region	2014,00	1,10	104,70	2458,30	4,70
Akmola region	2015,00	1,20	101,90	2992,00	4,24
Akmola region	2016,00	1,20	102,90	3010,20	4,05

Akmola region	2017,00	1,26	102,40	3843,90	3,58
Akmola region	2018,00	1,06	103,80	3370,10	3,72
Akmola region	2019,00	1,02	102,90	3589,70	3,85
Akmola region	2020,00	0,91	102,70	3570,90	4,27
Akmola region	2021,00	3,29	103,30	3625,20	4,61
Akmola region	2022,00	0,83	107,70	3603,20	4,84
Akmola region	2023,00	0,74	99,90	3702,10	5,17
Aktobe region	2010,00	1,70	109,20	2804,60	4,07
Aktobe region	2011,00	1,40	106,50	1978,20	4,96
Aktobe region	2012,00	1,30	107,60	1826,20	5,93
Aktobe region	2013,00	1,50	104,70	2395,60	5,76
Aktobe region	2014,00	1,60	104,50	2623,20	6,07
Aktobe region	2015,00	1,50	96,90	2478,50	6,69
Aktobe region	2016,00	1,50	101,00	2823,40	5,30
Aktobe region	2017,00	1,50	105,00	2677,40	6,10
Aktobe region	2018,00	1,42	105,30	2452,90	6,87
Aktobe region	2019,00	1,30	104,90	3150,10	5,59
Aktobe region	2020,00	1,23	99,90	4092,40	5,01
Aktobe region	2021,00	3,94	103,10	4328,60	5,29
Aktobe region	2022,00	1,30	100,10	5425,50	5,18
Aktobe region	2023,00	1,24	99,20	4492,20	7,17
Almaty region	2010,00	1,90	107,60	2468,90	5,21
Almaty region	2011,00	1,70	109,00	2063,90	5,78
Almaty region	2012,00	1,50	107,40	1034,50	11,83
Almaty region	2013,00	1,60	110,70	1339,20	11,22
Almaty region	2014,00	1,60	105,20	1027,60	15,33
Almaty region	2015,00	1,60	104,20	1436,00	11,84

Almaty region	2016,00	1,70	101,80	1470,20	11,53
Almaty region	2017,00	1,76	104,00	1530,60	12,52
Almaty region	2018,00	1,79	103,10	1750,60	12,10
Almaty region	2019,00	1,46	105,10	1678,90	11,73
Almaty region	2020,00	1,25	98,50	1806,20	11,54
Almaty region	2021,00	3,20	111,20	2537,60	11,47
Almaty region	2022,00	0,84	105,50	1933,60	9,19
Almaty region	2023,00	1,14	103,10	3308,60	8,97
Atyrau region	2010,00	1,90	112,70	3365,90	3,81
Atyrau region	2011,00	1,60	103,20	2504,80	4,33
Atyrau region	2012,00	2,20	97,70	4376,60	4,11
Atyrau region	2013,00	1,40	104,00	2507,20	5,23
Atyrau region	2014,00	1,50	102,50	3098,80	4,72
Atyrau region	2015,00	1,80	102,80	4184,80	4,72
Atyrau region	2016,00	2,40	103,70	5156,00	4,53
Atyrau region	2017,00	1,81	116,00	4926,30	3,99
Atyrau region	2018,00	1,66	113,30	4902,40	4,00
Atyrau region	2019,00	1,90	107,40	6299,50	4,06
Atyrau region	2020,00	0,97	93,50	4103,80	3,95
Atyrau region	2021,00	13,73	105,80	4988,90	3,69
Atyrau region	2022,00	0,98	101,60	5719,20	3,60
Atyrau region	2023,00	0,96	107,40	7322,00	3,39
West Kazakhstan region	2010,00	1,30	102,60	2449,60	3,71
West Kazakhstan region	2011,00	1,00	104,30	1724,80	4,03
West Kazakhstan	2012,00	1,00	104,40	1940,90	4,30

region					
West Kazakhstan region	2013,00	0,9	103,30	2052,50	4,08
West Kazakhstan region	2014,00	0,9	105,10	1941,40	4,54
West Kazakhstan region	2015,00	0,8	99,40	2548,60	3,55
West Kazakhstan region	2016,00	0,9	102,60	2853,70	3,18
West Kazakhstan region	2017,00	0,91	103,10	2664,20	3,72
West Kazakhstan region	2018,00	0,87	99,30	2836,50	3,65
West Kazakhstan region	2019,00	0,91	98,50	3386,50	3,62
West Kazakhstan region	2020,00	0,79	99,30	4119,50	3,22
West Kazakhstan region	2021,00	3,68	98,10	4172,40	3,28
West Kazakhstan region	2022,00	0,72	100,70	3902,10	3,92
West Kazakhstan region	2023,00	1,98	107,20	12627,10	4,07
Zhambyl region	2010,00	0,9	107,60	1818,30	3,52
Zhambyl region	2011,00	0,8	113,20	1397,30	3,90
Zhambyl region	2012,00	0,8	109,80	1531,00	4,29
Zhambyl region	2013,00	0,7	103,30	1739,00	4,14

Zhambyl region	2014,00	0,8	100,40	1891,20	4,35
Zhambyl region	2015,00	0,8	100,20	2749,00	3,13
Zhambyl region	2016,00	0,8	102,60	1883,30	4,11
Zhambyl region	2017,00	0,78	103,70	2942,30	2,90
Zhambyl region	2018,00	0,73	103,70	3060,00	2,81
Zhambyl region	2019,00	0,78	103,80	2758,30	3,80
Zhambyl region	2020,00	0,61	101,10	3068,90	3,34
Zhambyl region	2021,00	2,09	106,60	4370,60	3,00
Zhambyl region	2022,00	0,69	103,40	4807,90	3,05
Zhambyl region	2023,00	0,58	102,60	4447,40	3,36
Zhetisu	2010,00	4,89	89,27	3812,05	7,26
Zhetisu	2011,00	4,89	89,27	3812,05	7,26
Zhetisu	2012,00	4,89	89,27	3812,05	7,26
Zhetisu	2013,00	4,89	89,27	3812,05	7,26
Zhetisu	2014,00	4,89	89,27	3812,05	7,26
Zhetisu	2015,00	4,89	89,27	3812,05	7,26
Zhetisu	2016,00	4,89	89,27	3812,05	7,26
Zhetisu	2017,00	4,89	89,27	3812,05	7,26
Zhetisu	2018,00	4,89	89,27	3812,05	7,26
Zhetisu	2019,00	4,89	89,27	3812,05	7,26
Zhetisu	2020,00	4,89	89,27	3812,05	7,26
Zhetisu	2021,00	4,89	101,40	3812,05	7,26
Zhetisu	2022,00	0,49	102,00	3877,60	2,69
Zhetisu	2023,00	0,61	112,60	4455,90	3,55
Karaganda region	2010,00	3,10	106,40	2508,90	8,31
Karaganda region	2011,00	2,50	106,00	2172,90	8,13
Karaganda region	2012,00	2,40	101,20	1858,70	10,31

Karaganda region	2013,00	2,60	107,50	1849,90	13,37
Karaganda region	2014,00	2,60	103,20	2272,50	11,49
Karaganda region	2015,00	2,80	102,70	2585,50	11,63
Karaganda region	2016,00	2,70	102,40	2418,30	10,86
Karaganda region	2017,00	2,68	103,70	3010,10	9,71
Karaganda region	2018,00	2,72	103,00	4007,20	8,03
Karaganda region	2019,00	2,56	105,80	4478,40	7,72
Karaganda region	2020,00	2,33	100,10	4987,70	7,81
Karaganda region	2021,00	4,63	103,10	5113,10	9,28
Karaganda region	2022,00	2,89	100,30	7643,40	7,97
Karaganda region	2023,00	2,43	102,60	7816,70	8,06
Kostanay region	2010,00	1,80	101,70	2021,60	6,07
Kostanay region	2011,00	1,40	115,60	1588,10	6,31
Kostanay region	2012,00	1,50	93,50	1925,30	6,40
Kostanay region	2013,00	1,60	110,20	2455,00	6,09
Kostanay region	2014,00	1,60	102,20	2726,10	5,89
Kostanay region	2015,00	1,60	96,40	2918,50	5,83
Kostanay region	2016,00	1,80	98,00	3069,90	5,60
Kostanay region	2017,00	1,76	104,60	3626,40	5,29
Kostanay region	2018,00	1,66	105,90	3179,00	6,19
Kostanay region	2019,00	1,54	104,60	3318,30	6,25
Kostanay region	2020,00	1,34	103,00	3595,60	6,21
Kostanay region	2021,00	2,44	104,30	4549,80	5,47
Kostanay region	2022,00	1,03	104,50	4248,60	5,12
Kostanay region	2023,00	1,30	102,80	7638,00	4,43
Kyzylorda region	2010,00	0,80	103,80	1795,60	2,85
Kyzylorda region	2011,00	0,60	105,90	1020,10	4,36

Kyzylorda region	2012,00	0,60	103,20	1193,30	4,05
Kyzylorda region	2013,00	0,60	104,40	1141,00	5,19
Kyzylorda region	2014,00	0,70	98,70	1888,60	3,82
Kyzylorda region	2015,00	0,70	95,90	2048,00	3,65
Kyzylorda region	2016,00	0,70	95,20	1780,90	3,88
Kyzylorda region	2017,00	0,70	100,40	2717,80	2,80
Kyzylorda region	2018,00	0,68	99,90	3003,10	2,69
Kyzylorda region	2019,00	0,61	101,50	2570,30	3,19
Kyzylorda region	2020,00	0,57	89,20	3231,30	2,92
Kyzylorda region	2021,00	2,13	102,20	3983,80	2,78
Kyzylorda region	2022,00	0,58	102,40	4232,30	2,90
Kyzylorda region	2023,00	0,48	104,70	4987,90	2,49
Mangystau region	2010,00	1,50	107,80	4224,40	2,38
Mangystau region	2011,00	1,20	99,90	2858,20	3,04
Mangystau region	2012,00	1,40	100,90	2530,70	4,52
Mangystau region	2013,00	1,30	105,50	3419,20	3,62
Mangystau region	2014,00	1,50	104,00	3429,70	4,49
Mangystau region	2015,00	1,70	100,10	3109,20	5,90
Mangystau region	2016,00	1,90	99,90	2946,40	6,37
Mangystau region	2017,00	1,37	99,60	2700,00	5,55
Mangystau region	2018,00	1,32	101,10	2749,30	5,67
Mangystau region	2019,00	0,99	101,20	3025,80	4,42
Mangystau region	2020,00	0,89	94,50	2527,80	5,89
Mangystau region	2021,00	5,42	101,20	2725,90	5,87
Mangystau region	2022,00	0,90	101,10	2737,10	6,93
Mangystau region	2023,00	0,78	102,70	2242,70	9,04
Pavlodar region	2010,00	1,80	106,40	2589,70	4,72

Pavlodar region	2011,00	1,60	110,80	1800,70	6,11
Pavlodar region	2012,00	1,70	108,10	2287,30	5,88
Pavlodar region	2013,00	1,50	100,10	2807,50	5,23
Pavlodar region	2014,00	1,60	100,90	3223,00	4,94
Pavlodar region	2015,00	1,60	100,30	3481,80	5,06
Pavlodar region	2016,00	1,90	99,40	3578,40	5,11
Pavlodar region	2017,00	1,89	104,00	4132,10	4,97
Pavlodar region	2018,00	1,75	106,20	4274,30	4,84
Pavlodar region	2019,00	1,68	105,30	6421,90	3,54
Pavlodar region	2020,00	1,32	96,90	6519,70	3,38
Pavlodar region	2021,00	2,83	103,90	9802,50	3,47
Pavlodar region	2022,00	2,59	101,30	16869,60	3,24
Pavlodar region	2023,00	1,11	102,20	9058,80	3,17
North Kazakhstan	2010,00	1,10	100,80	2503,40	2,86
North Kazakhstan	2011,00	0,90	116,40	1840,90	3,33
North Kazakhstan	2012,00	0,90	94,60	2184,00	3,50
North Kazakhstan	2013,00	0,90	107,70	2741,80	3,05
North Kazakhstan	2014,00	0,90	105,80	2455,70	3,74
North Kazakhstan	2015,00	0,90	101,00	3613,70	2,79
North Kazakhstan	2016,00	1,00	100,80	2710,60	3,75
North Kazakhstan	2017,00	1,05	103,10	3399,00	3,35
North Kazakhstan	2018,00	1,02	103,20	4087,80	2,94
North Kazakhstan	2019,00	0,92	102,10	3968,80	3,12
North Kazakhstan	2020,00	0,85	99,80	4448,40	3,19
North Kazakhstan	2021,00	1,30	101,00	5383,40	2,82
North Kazakhstan	2022,00	0,95	105,60	7821,40	2,56
North Kazakhstan	2023,00	1,23	99,30	11160,30	2,86

Turkestan region	2010,00	4,89	89,27	3812,05	5,38
Turkestan region	2011,00	4,89	106,60	3812,05	6,39
Turkestan region	2012,00	4,89	106,70	3812,05	2,30
Turkestan region	2013,00	4,89	104,60	3812,05	2,52
Turkestan region	2014,00	4,89	100,50	3812,05	13,32
Turkestan region	2015,00	4,89	103,40	3812,05	11,02
Turkestan region	2016,00	4,89	101,40	3812,05	16,05
Turkestan region	2017,00	4,89	102,20	3812,05	16,91
Turkestan region	2018,00	0,53	107,70	376,90	16,65
Turkestan region	2019,00	0,52	107,80	470,60	14,79
Turkestan region	2020,00	0,50	104,90	696,30	12,04
Turkestan region	2021,00	5,29	104,30	1251,80	9,11
Turkestan region	2022,00	0,47	100,30	1402,70	7,06
Turkestan region	2023,00	0,44	102,30	950,20	12,07
Ulytau	2010,00	4,89	89,27	3812,05	7,26
Ulytau	2011,00	4,89	89,27	3812,05	7,26
Ulytau	2012,00	4,89	89,27	3812,05	7,26
Ulytau	2013,00	4,89	89,27	3812,05	7,26
Ulytau	2014,00	4,89	89,27	3812,05	7,26
Ulytau	2015,00	4,89	89,27	3812,05	7,26
Ulytau	2016,00	4,89	89,27	3812,05	7,26
Ulytau	2017,00	4,89	89,27	3812,05	7,26
Ulytau	2018,00	4,89	89,27	3812,05	7,26
Ulytau	2019,00	4,89	89,27	3812,05	7,26
Ulytau	2020,00	4,89	89,27	3812,05	7,26
Ulytau	2021,00	4,89	102,10	3812,05	7,26
Ulytau	2022,00	0,15	102,50	4032,10	0,78

Ulytau	2023,00	0,16	99,90	4868,20	0,84
East Kazakhstan	2010,00	2,50	107,20	2600,20	6,44
East Kazakhstan	2011,00	2,00	107,60	2024,50	6,81
East Kazakhstan	2012,00	2,10	112,60	2392,40	7,04
East Kazakhstan	2013,00	2,10	107,30	2998,80	6,54
East Kazakhstan	2014,00	2,20	102,80	2476,70	9,02
East Kazakhstan	2015,00	2,30	100,00	2397,40	9,79
East Kazakhstan	2016,00	2,10	102,20	1570,50	13,36
East Kazakhstan	2017,00	2,13	102,00	1531,00	15,17
East Kazakhstan	2018,00	2,07	104,90	1713,00	14,27
East Kazakhstan	2019,00	1,93	105,40	2758,40	9,45
East Kazakhstan	2020,00	1,65	100,60	3293,30	8,39
East Kazakhstan	2021,00	3,85	103,10	4017,30	7,91
East Kazakhstan	2022,00	0,99	103,50	4816,10	4,35
East Kazakhstan	2023,00	1,14	104,10	5395,70	5,48
Astana	2010,00	8,50	107,30	5128,10	11,18
Astana	2011,00	10,20	108,90	4548,80	15,72
Astana	2012,00	12,10	114,70	7179,90	13,63
Astana	2013,00	26,00	110,60	15756,70	15,63
Astana	2014,00	25,90	109,40	15545,90	16,75
Astana	2015,00	24,70	106,40	12345,50	21,38
Astana	2016,00	27,20	102,40	12478,60	21,26
Astana	2017,00	26,89	104,00	14699,90	19,92
Astana	2018,00	29,89	100,20	15848,40	22,31
Astana	2019,00	31,52	107,80	16633,30	25,57
Astana	2020,00	33,52	101,00	20262,20	27,63
Astana	2021,00	17,62	105,40	21029,20	31,43

Astana	2022,00	37,72	105,50	20381,10	39,04
Astana	2023,00	33,72	106,30	20919,00	41,84
Almaty	2010,00	68,20	110,40	14933,40	30,85
Almaty	2011,00	70,50	109,40	15937,10	30,91
Almaty	2012,00	67,80	109,60	14956,10	36,77
Almaty	2013,00	54,70	114,80	16357,50	31,63
Almaty	2014,00	53,80	107,00	13206,70	40,93
Almaty	2015,00	54,30	104,20	16739,50	34,77
Almaty	2016,00	50,60	102,60	13984,50	35,35
Almaty	2017,00	51,86	102,80	16710,20	33,81
Almaty	2018,00	49,70	103,00	16484,70	35,66
Almaty	2019,00	49,33	104,50	17449,70	38,15
Almaty	2020,00	50,27	95,30	21950,00	38,26
Almaty	2021,00	21,74	106,00	23965,70	40,34
Almaty	2022,00	44,60	105,00	22651,90	41,53
Almaty	2023,00	48,78	109,70	26898,50	47,06
Shymkent	2010,00	4,89	89,27	3812,05	3,47
Shymkent	2011,00	4,89	104,40	3812,05	6,64
Shymkent	2012,00	4,89	100,90	3812,05	5,08
Shymkent	2013,00	4,89	101,40	3812,05	5,01
Shymkent	2014,00	4,89	104,60	3812,05	5,97
Shymkent	2015,00	4,89	99,90	3812,05	5,69
Shymkent	2016,00	4,89	102,80	3812,05	5,79
Shymkent	2017,00	4,89	104,80	3812,05	5,81
Shymkent	2018,00	1,13	114,10	944,90	14,11
Shymkent	2019,00	1,04	103,80	1087,10	12,90
Shymkent	2020,00	1,00	100,90	1325,70	12,62

Shymkent	2021,00	2,82	105,40	1586,50	11,86
Shymkent	2022,00	0,77	106,80	1449,70	11,19
Shymkent	2023,00	0,71	105,70	1458,60	12,61
South Kazakhstan	2010,00	5,50	104,50	1305,20	7,26
South Kazakhstan	2011,00	5,40	105,70	819,80	7,26
South Kazakhstan	2012,00	6,00	104,00	1747,30	7,26
South Kazakhstan	2013,00	5,90	103,00	1854,10	7,26
South Kazakhstan	2014,00	6,00	102,30	891,70	7,26
South Kazakhstan	2015,00	6,10	101,40	1084,20	7,26
South Kazakhstan	2016,00	5,90	101,90	729,40	7,26
South Kazakhstan	2017,00	5,86	103,40	791,70	7,26
South Kazakhstan	2018,00	4,89	89,27	3812,05	7,26
South Kazakhstan	2019,00	4,89	89,27	3812,05	7,26
South Kazakhstan	2020,00	4,89	89,27	3812,05	7,26
South Kazakhstan	2021,00	4,89	89,27	3812,05	7,26
South Kazakhstan	2022,00	4,89	89,27	3812,05	7,26
South Kazakhstan	2023,00	4,89	89,27	3812,05	7,26
	срзнач	5,84	101,72	4564,09	8,49
	сроткл	6,30	4,68	2696,58	5,08

For the time period 2019-2023

Region	Year	Share of large and medium-sized enterprises in the manufacturing industry using digital technologies	Level of digital literacy of the population	The percentage of Internet users aged 16-74 years old
Abai	2019	5,56	70,27	77,90
Abai	2020	6,90	70,27	77,90

Abai	2021	6,45	70,27	77,90
Abai	2022	9,68	79,90	89,60
Abai	2023	12,50	85,50	91,60
Akmola	2019	5,88	74,70	80,00
	2020	5,41	74,90	85,60
	2021	7,32	81,50	90,60
	2022	13,64	83,10	91,20
	2023	18,20	85,80	94,70
Aktobe	2019	5,13	80,00	88,20
	2020	5,26	81,00	89,40
	2021	5,13	86,80	93,60
	2022	6,98	89,60	96,20
	2023	25,60	90,00	97,00
Almaty region	2019	3,13	70,27	77,90
	2020	4,92	70,27	77,90
	2021	6,78	70,27	77,90
	2022	11,29	91,90	95,60
	2023	11,70	92,40	96,70
Atyrau	2019	11,11	82,60	83,30
	2020	7,69	83,10	78,60
	2021	14,29	85,20	89,70
	2022	13,33	85,40	90,00
	2023	33,30	86,60	90,80
West Kazakhstan	2019	3,70	78,40	81,30
	2020	8,33	78,80	84,20

	2021	13,04	79,20	89,20
	2022	15,38	82,00	91,80
	2023	19,20	84,60	92,90
Zhambyl	2019	4,17	79,80	84,90
	2020	4,17	80,90	86,20
	2021	3,85	85,80	90,60
	2022	11,11	85,80	95,80
	2023	15,40	87,00	96,10
Zhetisu	2019	5,56	70,27	77,90
	2020	5,88	70,27	77,90
	2021	6,25	70,27	77,90
	2022	5,26	85,30	92,70
	2023	4,50	87,10	92,90
Karaganda	2019	7,25	70,27	77,90
	2020	9,09	70,27	77,90
	2021	8,06	70,27	77,90
	2022	15,49	86,20	97,20
	2023	21,50	88,80	98,00
Kostanay	2019	7,32	82,90	88,60
	2020	6,98	85,80	87,20
	2021	12,20	90,80	93,10
	2022	17,78	90,90	93,40
	2023	23,90	91,70	94,30
Kyzylorda	2019	9,88	80,10	81,90
	2020	9,88	83,00	82,70
	2021	9,88	89,30	90,50
	2022	14,29	89,40	91,90

	2023	21,40	90,60	93,00
Mangystau	2019	5,26	78,70	86,00
	2020	5,56	79,60	86,50
	2021	4,76	84,90	97,60
	2022	4,55	86,00	98,50
	2023	13,00	84,90	96,40
Pavlodar	2019	7,41	82,40	86,60
	2020	11,11	83,50	94,60
	2021	10,91	85,10	93,20
	2022	21,57	85,10	92,90
	2023	23,40	86,70	96,80
North Kazakhstan	2019	6,67	77,10	82,30
	2020	7,14	78,80	88,60
	2021	10,00	80,20	90,30
	2022	13,79	82,10	90,70
	2023	9,10	82,60	93,90
Turkestan	2019	9,88	77,70	91,70
	2020	9,88	82,10	94,60
	2021	9,88	87,20	96,30
	2022	3,45	89,90	95,20
	2023	5,60	93,90	97,60
Ulytau	2019	9,09	70,27	77,90
	2020	10,00	70,27	77,90
	2021	14,29	70,27	77,90
	2022	25,00	91,80	89,60
	2023	18,80	94,10	90,40

East-Kazakhstan	2019	7,41	70,27	91,70
	2020	12,77	70,27	94,60
	2021	12,00	70,27	96,30
	2022	10,42	84,80	95,20
	2023	11,80	87,00	97,60
Astana	2019	3,33	88,70	92,30
	2020	8,11	91,30	95,30
	2021	14,29	94,70	96,50
	2022	19,15	95,20	96,80
	2023	29,50	97,00	98,10
Almaty	2019	9,88	89,00	89,50
	2020	9,88	91,40	92,90
	2021	0,98	91,50	94,30
	2022	11,22	93,80	94,70
	2023	11,10	95,50	95,90
Shymkent	2019	7,41	81,50	84,40
	2020	6,45	82,30	84,00
	2021	11,48	87,50	94,00
	2022	10,34	87,50	95,80
	2023	11,10	89,90	97,10
	срзнач	10,67	82,92	89,59
	сроткл	4,448139	6,03499	5,476594

ANNEX T

Standartization calculated in Microsoft Excel

For the time period 2010-2023

Structure of Gross Regional Product	**Index of physical volume of Gross Regional Product**	**Labor productivity by regions: information and communication**	**Employed population by economic activity and region for 2010-2023: information and communication**
0,15	2,66	0,28	0,24
0,15	2,66	0,28	0,24
0,15	2,66	0,28	0,24
0,15	2,66	0,28	0,24
0,15	2,66	0,28	0,24
0,15	2,66	0,28	0,24
0,15	2,66	0,28	0,24
0,15	2,66	0,28	0,24
0,15	2,66	0,28	0,24
0,15	2,66	0,28	0,24
0,15	2,66	0,28	0,24
0,15	2,66	0,28	0,24
0,15	1,13	0,28	0,24
0,85	0,06	1,01	1,40
0,85	0,83	0,45	1,25
0,72	1,16	0,98	0,80
0,75	3,10	1,13	0,71
0,75	1,59	0,91	0,83
0,75	0,70	0,85	0,77
0,75	0,64	0,78	0,75

0,74	0,04	0,58	0,84
0,74	0,25	0,58	0,88
0,73	0,15	0,27	0,97
0,76	0,44	0,44	0,94
0,76	0,25	0,36	0,91
0,78	0,21	0,37	0,83
0,40	0,34	0,35	0,76
0,79	1,28	0,36	0,72
0,81	0,39	0,32	0,65
0,66	1,60	0,65	0,87
0,70	1,02	0,96	0,70
0,72	1,26	1,02	0,50
0,69	0,64	0,80	0,54
0,67	0,59	0,72	0,48
0,69	1,03	0,77	0,35
0,69	0,15	0,65	0,63
0,69	0,70	0,70	0,47
0,70	0,77	0,78	0,32
0,72	0,68	0,52	0,57
0,73	0,39	0,17	0,69
0,30	0,29	0,09	0,63
0,72	0,35	0,32	0,65
0,73	0,54	0,03	0,26
0,63	1,26	0,78	0,65
0,66	1,56	0,93	0,53
0,69	1,21	1,31	0,66
0,67	1,92	1,20	0,54

0,67	0,74	1,31	1,35
0,67	0,53	1,16	0,66
0,66	0,02	1,15	0,60
0,65	0,49	1,12	0,79
0,64	0,29	1,04	0,71
0,69	0,72	1,07	0,64
0,73	0,69	1,02	0,60
0,42	2,03	0,75	0,59
0,79	0,81	0,98	0,14
0,75	0,29	0,47	0,09
0,63	2,35	0,44	0,92
0,67	0,32	0,76	0,82
0,58	0,86	0,07	0,86
0,70	0,49	0,76	0,64
0,69	0,17	0,54	0,74
0,64	0,23	0,14	0,74
0,55	0,42	0,22	0,78
0,64	3,05	0,13	0,89
0,66	2,48	0,13	0,89
0,63	1,21	0,64	0,87
0,77	1,76	0,17	0,90
1,25	0,87	0,16	0,95
0,77	0,03	0,43	0,96
0,77	1,21	1,02	1,01
0,72	0,19	0,78	0,94
0,77	0,55	1,05	0,88
0,77	0,57	0,97	0,83

0,78	0,34	0,93	0,87
0,78	0,72	0,97	0,78
0,80	0,50	0,75	0,97
0,78	0,19	0,63	1,05
0,78	0,29	0,70	0,94
0,79	0,52	0,64	0,95
0,78	0,69	0,44	0,96
0,80	0,52	0,16	1,04
0,34	0,77	0,15	1,03
0,81	0,22	0,25	0,90
0,61	1,17	2,99	0,87
0,78	1,26	1,02	0,98
0,80	2,45	1,17	0,91
0,80	1,73	1,12	0,83
0,82	0,34	1,05	0,86
0,80	0,28	0,82	0,82
0,80	0,33	0,67	1,06
0,80	0,19	0,99	0,86
0,80	0,42	0,60	1,10
0,81	0,42	0,56	1,12
0,80	0,44	0,67	0,92
0,83	0,13	0,55	1,01
0,60	1,04	0,07	1,08
0,82	0,36	0,09	1,07
0,83	0,19	0,04	1,01
0,15	2,66	0,28	0,24
0,15	2,66	0,28	0,24

0,15	2,66	0,28	0,24
0,15	2,66	0,28	0,24
0,15	2,66	0,28	0,24
0,15	2,66	0,28	0,24
0,15	2,66	0,28	0,24
0,15	2,66	0,28	0,24
0,15	2,66	0,28	0,24
0,15	2,66	0,28	0,24
0,15	2,66	0,28	0,24
0,15	0,07	0,28	0,24
0,85	0,06	0,25	1,14
0,83	2,33	0,04	0,97
0,43	1,00	0,76	0,04
0,53	0,91	0,89	0,07
0,55	0,11	1,00	0,36
0,51	1,24	1,01	0,96
0,51	0,32	0,85	0,59
0,48	0,21	0,62	0,62
0,50	0,15	0,80	0,47
0,50	0,42	0,58	0,24
0,50	0,27	0,21	0,09
0,52	0,87	0,03	0,15
0,56	0,35	0,16	0,13
0,19	0,29	0,20	0,16
0,47	0,30	1,14	0,10
0,54	0,19	1,21	0,09
0,64	0,00	0,94	0,48

0,70	2,97	1,10	0,43
0,69	1,76	0,98	0,41
0,67	1,81	0,47	0,47
0,67	0,10	0,68	0,51
0,67	1,14	0,61	0,52
0,64	0,80	0,55	0,57
0,65	0,62	0,35	0,63
0,66	0,89	0,51	0,45
0,68	0,62	0,46	0,44
0,71	0,27	0,36	0,45
0,54	0,55	0,01	0,59
0,76	0,59	0,12	0,66
0,72	0,23	1,14	0,80
0,80	0,44	1,03	1,11
0,83	0,89	1,31	0,81
0,83	0,32	1,25	0,88
0,83	0,57	1,27	0,65
0,82	0,65	0,99	0,92
0,82	1,24	0,93	0,95
0,82	1,39	1,03	0,91
0,82	0,28	0,68	1,12
0,82	0,39	0,58	1,14
0,83	0,05	0,74	1,04
0,84	2,68	0,49	1,10
0,59	0,10	0,22	1,13
0,83	0,15	0,12	1,10
0,85	0,64	0,16	1,18

0,69	1,30	0,13	1,20
0,74	0,39	0,63	1,07
0,70	0,18	0,75	0,78
0,72	0,81	0,42	0,96
0,69	0,49	0,42	0,79
0,66	0,35	0,54	0,51
0,63	0,39	0,60	0,42
0,71	0,45	0,69	0,58
0,72	0,13	0,67	0,56
0,77	0,11	0,57	0,80
0,79	1,54	0,76	0,51
0,07	0,11	0,68	0,52
0,78	0,13	0,68	0,31
0,80	0,21	0,86	0,11
0,64	1,00	0,73	0,74
0,67	1,94	1,02	0,47
0,66	1,36	0,84	0,51
0,69	0,35	0,65	0,64
0,67	0,18	0,50	0,70
0,67	0,30	0,40	0,68
0,63	0,50	0,37	0,67
0,63	0,49	0,16	0,69
0,65	0,96	0,11	0,72
0,66	0,77	0,69	0,98
0,72	1,03	0,73	1,01
0,48	0,47	1,94	0,99
0,52	0,09	4,56	1,03

0,75	0,10	1,67	1,05
0,75	0,20	0,76	1,11
0,78	3,14	1,01	1,02
0,78	1,52	0,88	0,98
0,78	1,28	0,68	1,07
0,78	0,87	0,78	0,94
0,78	0,15	0,35	1,12
0,77	0,20	0,69	0,93
0,76	0,29	0,43	1,01
0,76	0,32	0,18	1,09
0,78	0,08	0,22	1,06
0,79	0,41	0,04	1,04
0,72	0,15	0,30	1,12
0,78	0,83	1,21	1,17
0,73	0,52	2,45	1,11
0,15	2,66	0,28	0,61
0,15	1,04	0,28	0,41
0,15	1,06	0,28	1,22
0,15	0,62	0,28	1,18
0,15	0,26	0,28	0,95
0,15	0,36	0,28	0,50
0,15	0,07	0,28	1,49
0,15	0,10	0,28	1,66
0,84	1,28	1,55	1,61
0,84	1,30	1,52	1,24
0,85	0,68	1,43	0,70
0,09	0,55	1,23	0,12

0,85	0,30	1,17	0,28
0,86	0,12	1,34	0,70
0,15	2,66	0,28	0,24
0,15	2,66	0,28	0,24
0,15	2,66	0,28	0,24
0,15	2,66	0,28	0,24
0,15	2,66	0,28	0,24
0,15	2,66	0,28	0,24
0,15	2,66	0,28	0,24
0,15	2,66	0,28	0,24
0,15	2,66	0,28	0,24
0,15	2,66	0,28	0,24
0,15	2,66	0,28	0,24
0,15	0,08	0,28	0,24
0,90	0,17	0,20	1,52
0,90	0,39	0,11	1,51
0,53	1,17	0,73	0,40
0,61	1,26	0,94	0,33
0,59	2,33	0,81	0,29
0,59	1,19	0,58	0,38
0,58	0,23	0,77	0,10
0,56	0,37	0,80	0,26
0,59	0,10	1,11	0,96
0,59	0,06	1,12	1,31
0,60	0,68	1,06	1,14
0,62	0,79	0,67	0,19
0,66	0,24	0,47	0,02

0,32	0,29	0,20	0,11
0,77	0,38	0,09	0,82
0,75	0,51	0,31	0,59
0,42	1,19	0,21	0,53
0,69	1,54	-0,01	1,42
0,99	2,78	0,97	1,01
3,20	1,90	4,15	1,40
3,18	1,64	4,07	1,63
2,99	1,00	2,89	2,54
3,39	0,15	2,94	2,51
3,34	0,49	3,76	2,25
3,81	0,33	4,18	2,72
4,07	1,30	4,48	3,36
4,39	0,15	5,82	3,77
0,93	0,79	6,11	4,52
5,06	0,81	5,87	6,01
4,42	0,98	6,07	6,57
9,89	1,86	3,85	4,40
10,26	1,64	4,22	4,41
9,83	1,68	3,85	5,57
7,75	2,80	4,37	4,56
7,61	1,13	3,21	6,39
7,69	0,53	4,52	5,17
7,10	0,19	3,49	5,29
7,30	0,23	4,50	4,98
6,96	0,27	4,42	5,35
6,90	0,59	4,78	5,84

7,05	1,37	6,45	5,86
2,52	0,91	7,19	6,27
6,15	0,70	6,71	6,50
6,81	1,71	8,28	7,59
0,15	2,66	0,28	0,99
0,15	0,57	0,28	0,37
0,15	0,18	0,28	0,67
0,15	0,07	0,28	0,69
0,15	0,62	0,28	0,50
0,15	0,39	0,28	0,55
0,15	0,23	0,28	0,53
0,15	0,66	0,28	0,53
0,75	2,65	1,34	1,11
0,76	0,44	1,29	0,87
0,77	0,18	1,20	0,81
0,48	0,79	1,10	0,66
0,80	1,09	1,15	0,53
0,81	0,85	1,15	0,81
0,05	0,59	1,21	0,24
0,07	0,85	1,39	0,24
0,03	0,49	1,04	0,24
0,01	0,27	1,00	0,24
0,03	0,12	1,36	0,24
0,04	0,07	1,29	0,24
0,01	0,04	1,42	0,24
0,00	0,36	1,40	0,24
0,15	2,66	0,28	0,24

0,15	2,66	0,28	0,24
0,15	2,66	0,28	0,24
0,15	2,66	0,28	0,24
0,15	2,66	0,28	0,24
0,15	2,66	0,28	0,24

For the time period 2019-2023

Share of large and medium-sized enterprises in the manufacturing industry using digital technologies	Level of digital literacy of the population	The percentage of Internet users aged 16-74 years old
1,15	2,10	2,13
0,85	2,10	2,13
0,95	2,10	2,13
0,22	0,50	0,00
0,41	0,43	0,37
1,08	1,36	1,75
1,18	1,33	0,73
0,75	0,24	0,19
0,67	0,03	0,29
1,69	0,48	0,93
1,24	0,48	0,25
1,21	0,32	0,03
1,24	0,64	0,73
0,83	1,11	1,21
3,36	1,17	1,35
1,70	2,10	2,13
1,29	2,10	2,13

0,87	2,10	2,13
0,14	1,49	1,10
0,23	1,57	1,30
0,10	0,05	1,15
0,67	0,03	2,01
0,81	0,38	0,02
0,60	0,41	0,08
5,09	0,61	0,22
1,57	0,75	1,51
0,52	0,68	0,98
0,53	0,62	0,07
1,06	0,15	0,40
1,92	0,28	0,61
1,46	0,52	0,86
1,46	0,33	0,62
1,53	0,48	0,19
0,10	0,48	1,13
1,06	0,68	1,19
1,15	2,10	2,13
1,08	2,10	2,13
0,99	2,10	2,13
1,21	0,39	0,57
1,39	0,69	0,61
0,77	2,10	2,13
0,35	2,10	2,13
0,58	2,10	2,13
1,09	0,54	1,39

2,44	0,97	1,54
0,75	0,00	0,18
0,83	0,48	0,44
0,34	1,31	0,64
1,60	1,32	0,70
2,98	1,45	0,86
0,18	0,47	1,40
0,18	0,01	1,26
0,18	1,06	0,17
0,81	1,07	0,42
2,41	1,27	0,62
1,21	0,70	0,65
1,15	0,55	0,56
1,33	0,33	1,46
1,38	0,51	1,63
0,52	0,33	1,24
0,73	0,09	0,55
0,10	0,10	0,92
0,05	0,36	0,66
2,45	0,36	0,61
2,86	0,63	1,32
0,90	0,96	1,33
0,79	0,68	0,18
0,15	0,45	0,13
0,70	0,14	0,20
0,35	0,05	0,79
0,18	0,87	0,39

0,18	0,14	0,92
0,18	0,71	1,23
1,62	1,16	1,03
1,14	1,82	1,46
0,35	2,10	2,13
0,15	2,10	2,13
0,81	2,10	2,13
3,22	1,47	0,00
1,83	1,85	0,15
0,73	2,10	0,39
0,47	2,10	0,92
0,30	2,10	1,23
0,06	0,31	1,03
0,26	0,68	1,46
1,65	0,96	0,50
0,57	1,39	1,04
0,81	1,95	1,26
1,91	2,03	1,32
4,23	2,33	1,55
0,18	1,01	0,02
0,18	1,41	0,61
2,18	1,42	0,86
0,13	1,80	0,93
0,10	2,08	1,15
0,73	0,24	0,95
0,95	0,10	1,02
0,18	0,76	0,81

0,07	0,76	1,13
0,10	1,16	1,37

ANNEX U

Integral index of digital potential of regions

For the time period 2010-2023

Regions	Year	Integral Index
Abai	2010	3,33
Abai	2011	3,33
Abai	2012	3,33
Abai	2013	3,33
Abai	2014	3,33
Abai	2015	3,33
Abai	2016	3,33
Abai	2017	3,33
Abai	2018	3,33
Abai	2019	3,33
Abai	2020	3,33
Abai	2021	1,80
Abai	2022	3,33
Abai	2023	3,38
Akmola region	2010	3,65
Akmola region	2011	5,69
Akmola region	2012	4,08
Akmola region	2013	3,07
Akmola region	2014	2,92
Akmola region	2015	2,20
Akmola region	2016	2,44
Akmola region	2017	2,11
Akmola region	2018	2,59
Akmola region	2019	2,29
Akmola region	2020	2,19
Akmola region	2021	1,86
Akmola region	2022	3,15
Akmola region	2023	2,17
Aktobe region	2010	3,78
Aktobe region	2011	3,38
Aktobe region	2012	3,50
Aktobe region	2013	2,67
Aktobe region	2014	2,46
Aktobe region	2015	2,85
Aktobe region	2016	2,12
Aktobe region	2017	2,56

Aktobe region	2018	2,57
Aktobe region	2019	2,50
Aktobe region	2020	1,98
Aktobe region	2021	1,31
Aktobe region	2022	2,04
Aktobe region	2023	1,56
Almaty region	2010	3,30
Almaty region	2011	3,67
Almaty region	2012	3,87
Almaty region	2013	4,33
Almaty region	2014	4,07
Almaty region	2015	3,02
Almaty region	2016	2,42
Almaty region	2017	3,05
Almaty region	2018	2,69
Almaty region	2019	3,13
Almaty region	2020	3,04
Almaty region	2021	3,78
Almaty region	2022	2,71
Almaty region	2023	1,60
Atyrau region	2010	4,34
Atyrau region	2011	2,57
Atyrau region	2012	2,37
Atyrau region	2013	2,60
Atyrau region	2014	2,14
Atyrau region	2015	1,76
Atyrau region	2016	1,97
Atyrau region	2017	4,71
Atyrau region	2018	4,15
Atyrau region	2019	3,36
Atyrau region	2020	3,60
Atyrau region	2021	3,23
Atyrau region	2022	2,19
Atyrau region	2023	4,02
West Kazakhstan region	2010	2,63
West Kazakhstan region	2011	3,25
West Kazakhstan region	2012	3,14
West Kazakhstan region	2013	2,92
West Kazakhstan region	2014	3,26
West Kazakhstan region	2015	3,02
West Kazakhstan region	2016	2,65
West Kazakhstan region	2017	2,72
West Kazakhstan region	2018	2,90

West Kazakhstan region	2019	2,87
West Kazakhstan region	2020	2,52
West Kazakhstan region	2021	2,29
West Kazakhstan region	2022	2,18
West Kazakhstan region	2023	5,64
Zhambyl region	2010	4,04
Zhambyl region	2011	5,33
Zhambyl region	2012	4,48
Zhambyl region	2013	3,06
Zhambyl region	2014	2,71
Zhambyl region	2015	2,85
Zhambyl region	2016	2,84
Zhambyl region	2017	2,93
Zhambyl region	2018	2,91
Zhambyl region	2019	2,84
Zhambyl region	2020	2,53
Zhambyl region	2021	2,79
Zhambyl region	2022	2,34
Zhambyl region	2023	2,08
Zhetisu	2010	3,33
Zhetisu	2011	3,33
Zhetisu	2012	3,33
Zhetisu	2013	3,33
Zhetisu	2014	3,33
Zhetisu	2015	3,33
Zhetisu	2016	3,33
Zhetisu	2017	3,33
Zhetisu	2018	3,33
Zhetisu	2019	3,33
Zhetisu	2020	3,33
Zhetisu	2021	0,74
Zhetisu	2022	2,31
Zhetisu	2023	4,17
Karaganda region	2010	2,23
Karaganda region	2011	2,40
Karaganda region	2012	2,02
Karaganda region	2013	3,72
Karaganda region	2014	2,27
Karaganda region	2015	1,93
Karaganda region	2016	1,90
Karaganda region	2017	1,74
Karaganda region	2018	1,07
Karaganda region	2019	1,58

Karaganda region	2020	1,19
Karaganda region	2021	0,85
Karaganda region	2022	2,02
Karaganda region	2023	2,02
Kostanay region	2010	2,06
Kostanay region	2011	5,21
Kostanay region	2012	3,84
Kostanay region	2013	3,43
Kostanay region	2014	1,97
Kostanay region	2015	2,94
Kostanay region	2016	2,56
Kostanay region	2017	2,24
Kostanay region	2018	2,52
Kostanay region	2019	2,20
Kostanay region	2020	1,80
Kostanay region	2021	1,69
Kostanay region	2022	2,14
Kostanay region	2023	2,89
Kyzylorda region	2010	3,38
Kyzylorda region	2011	3,85
Kyzylorda region	2012	3,27
Kyzylorda region	2013	3,32
Kyzylorda region	2014	3,37
Kyzylorda region	2015	3,95
Kyzylorda region	2016	4,15
Kyzylorda region	2017	2,90
Kyzylorda region	2018	2,93
Kyzylorda region	2019	2,66
Kyzylorda region	2020	5,11
Kyzylorda region	2021	2,03
Kyzylorda region	2022	2,20
Kyzylorda region	2023	2,83
Mangystau region	2010	3,32
Mangystau region	2011	2,83
Mangystau region	2012	2,42
Mangystau region	2013	2,91
Mangystau region	2014	2,38
Mangystau region	2015	2,05
Mangystau region	2016	2,03
Mangystau region	2017	2,43
Mangystau region	2018	2,08
Mangystau region	2019	2,25
Mangystau region	2020	3,60

Mangystau region	2021	1,38
Mangystau region	2022	1,90
Mangystau region	2023	1,98
Pavlodar region	2010	3,12
Pavlodar region	2011	4,11
Pavlodar region	2012	3,38
Pavlodar region	2013	2,33
Pavlodar region	2014	2,05
Pavlodar region	2015	2,05
Pavlodar region	2016	2,15
Pavlodar region	2017	1,97
Pavlodar region	2018	2,43
Pavlodar region	2019	3,09
Pavlodar region	2020	3,48
Pavlodar region	2021	3,88
Pavlodar region	2022	6,20
Pavlodar region	2023	3,57
North Kazakhstan	2010	2,82
North Kazakhstan	2011	5,95
North Kazakhstan	2012	4,17
North Kazakhstan	2013	3,81
North Kazakhstan	2014	3,37
North Kazakhstan	2015	2,41
North Kazakhstan	2016	2,59
North Kazakhstan	2017	2,50
North Kazakhstan	2018	2,35
North Kazakhstan	2019	2,14
North Kazakhstan	2020	2,29
North Kazakhstan	2021	2,30
North Kazakhstan	2022	3,98
North Kazakhstan	2023	4,80
Turkestan region	2010	3,70
Turkestan region	2011	1,89
Turkestan region	2012	2,71
Turkestan region	2013	2,22
Turkestan region	2014	1,64
Turkestan region	2015	1,29
Turkestan region	2016	1,99
Turkestan region	2017	2,19
Turkestan region	2018	5,28
Turkestan region	2019	4,90
Turkestan region	2020	3,66
Turkestan region	2021	1,99

Turkestan region	2022	2,61
Turkestan region	2023	3,03
Ulytau	2010	3,33
Ulytau	2011	3,33
Ulytau	2012	3,33
Ulytau	2013	3,33
Ulytau	2014	3,33
Ulytau	2015	3,33
Ulytau	2016	3,33
Ulytau	2017	3,33
Ulytau	2018	3,33
Ulytau	2019	3,33
Ulytau	2020	3,33
Ulytau	2021	0,75
Ulytau	2022	2,79
Ulytau	2023	2,91
East Kazakhstan	2010	2,83
East Kazakhstan	2011	3,14
East Kazakhstan	2012	4,01
East Kazakhstan	2013	2,75
East Kazakhstan	2014	1,69
East Kazakhstan	2015	1,99
East Kazakhstan	2016	2,76
East Kazakhstan	2017	3,09
East Kazakhstan	2018	3,47
East Kazakhstan	2019	2,27
East Kazakhstan	2020	1,40
East Kazakhstan	2021	0,93
East Kazakhstan	2022	2,06
East Kazakhstan	2023	2,16
Astana	2010	2,35
Astana	2011	3,64
Astana	2012	5,75
Astana	2013	10,65
Astana	2014	10,52
Astana	2015	9,41
Astana	2016	8,98
Astana	2017	9,84
Astana	2018	11,04
Astana	2019	13,21
Astana	2020	14,14
Astana	2021	12,34
Astana	2022	17,74

Astana	2023	18,03
Almaty	2010	20,00
Almaty	2011	20,53
Almaty	2012	20,93
Almaty	2013	19,48
Almaty	2014	18,33
Almaty	2015	17,91
Almaty	2016	16,07
Almaty	2017	17,02
Almaty	2018	17,00
Almaty	2019	18,11
Almaty	2020	20,73
Almaty	2021	16,90
Almaty	2022	20,06
Almaty	2023	24,39
Shymkent	2010	4,08
Shymkent	2011	1,37
Shymkent	2012	1,28
Shymkent	2013	1,18
Shymkent	2014	1,54
Shymkent	2015	1,37
Shymkent	2016	1,19
Shymkent	2017	1,62
Shymkent	2018	5,84
Shymkent	2019	3,36
Shymkent	2020	2,96
Shymkent	2021	3,03
Shymkent	2022	3,58
Shymkent	2023	3,63
South Kazakhstan	2010	2,10
South Kazakhstan	2011	2,55
South Kazakhstan	2012	1,80
South Kazakhstan	2013	1,53
South Kazakhstan	2014	1,75
South Kazakhstan	2015	1,64
South Kazakhstan	2016	1,71
South Kazakhstan	2017	2,00
South Kazakhstan	2018	3,33
South Kazakhstan	2019	3,33
South Kazakhstan	2020	3,33
South Kazakhstan	2021	3,33
South Kazakhstan	2022	3,33
South Kazakhstan	2023	3,33

For the time period 2019-2023

Region	Year	Integral Index
Abai	2019	5,38
Abai	2020	5,08
Abai	2021	5,18
Abai	2022	0,72
Abai	2023	1,21
Akmola	2019	4,19
	2020	3,24
	2021	1,17
	2022	0,99
	2023	3,10
Aktobe	2019	1,98
	2020	1,57
	2021	2,62
	2022	3,14
	2023	5,88
Almaty region	2019	5,93
	2020	5,52
	2021	5,10
	2022	2,73
	2023	3,10
Atyrau	2019	1,30
	2020	2,70
	2021	1,21
	2022	1,09
	2023	5,92
West Kazakhstan	2019	3,83
	2020	2,19
	2021	1,22
	2022	1,62
	2023	2,80
Zhambyl	2019	2,83
	2020	2,41
	2021	2,20
	2022	1,71
	2023	2,93
Zhetisu	2019	5,38
	2020	5,31
	2021	5,22
	2022	2,18
	2023	2,68
Karaganda	2019	5,00

	2020	4,58
	2021	4,81
	2022	3,02
	2023	4,95
Kostanay	2019	0,93
	2020	1,74
	2021	2,29
	2022	3,62
	2023	5,29
Kyzylorda	2019	2,05
	2020	1,45
	2021	1,40
	2022	2,31
	2023	4,31
Mangystau	2019	2,57
	2020	2,26
	2021	3,12
	2022	3,51
	2023	2,10
Pavlodar	2019	1,36
	2020	1,11
	2021	1,08
	2022	3,42
	2023	4,81
North Kazakhstan	2019	3,19
	2020	1,65
	2021	0,73
	2022	1,04
	2023	1,19
Turkestan	2019	1,43
	2020	1,23
	2021	2,11
	2022	3,80
	2023	4,42
Ulytau	2019	4,58
	2020	4,38
	2021	5,04
	2022	4,70
	2023	3,83
East-Kazakhstan	2019	3,21
	2020	3,48
	2021	3,62
	2022	1,39

	2023	2,39
Astana	2019	3,10
	2020	3,01
	2021	4,03
	2022	5,26
	2023	8,12
Almaty	2019	1,20
	2020	2,19
	2021	4,46
	2022	2,86
	2023	3,34
Shymkent	2019	1,91
	2020	2,07
	2021	1,75
	2022	1,97
	2023	2,63

ANNEX V

Average integral index of digital potential of regions

For the time period 2010-2023

Regions	**Average index 2010-2023**
Abai	3,26
Akmola region	2,88
Aktobe region	2,52
Almaty region	3,19
Atyrau region	3,07
West Kazakhstan region	3,00
Zhambyl region	3,12
Zhetisu	3,14
Karaganda region	1,92
Kostanay region	2,68
Kyzylorda region	3,28
Mangystau region	2,40
Pavlodar region	3,13
North Kazakhstan	3,25
Turkestan region	2,79
Ulytau	3,08
East Kazakhstan	2,47
Astana	10,55
Almaty	19,10
Shymkent	2,57
South Kazakhstan	2,51

For the time period 2019-2023

Region	**Average index 2019-2023**
Abai	3,51
Akmola	2,54
Aktobe	3,04
Almaty region	4,48
Atyrau	2,44
West Kazakhstan	2,33
Zhambyl	2,42
Zhetisu	4,15
Karaganda	4,47
Kostanay	2,77
Kyzylorda	2,30
Mangystau	2,71

Pavlodar	2,36
North Kazakhstan	1,56
Turkestan	2,60
Ulytau	4,51
East-Kazakhstan	2,82
Astana	4,70
Almaty	2,81
Shymkent	2,06

«ӘЛ-ФАРАБИ АТЫНДАҒЫ
ҚАЗАҚ ҰЛТТЫҚ УНИВЕРСИТЕТІ»
КОММЕРЦИЯЛЫҚ ЕМЕС АКЦИОНЕРЛІК ҚОҒАМЫ
ҒЫЛЫМ ЖӘНЕ ИННОВАЦИЯЛЫҚ
ҚЫЗМЕТ ДЕПАРТАМЕНТІ
ЖЕРГІЛІКТІ ЭТИКАЛЫҚ КОМИТЕТ

ЖЭК
ЛЭК

НЕКОММЕРЧЕСКОЕ АКЦИОНЕРНОЕ ОБЩЕСТВО
«КАЗАХСКИЙ НАЦИОНАЛЬНЫЙ
УНИВЕРСИТЕТ ИМЕНИ АЛЬ-ФАРАБИ»
ДЕПАРТАМЕНТ ПО НАУКЕ
И ИННОВАЦИОННОЙ ДЕЯТЕЛЬНОСТИ
ЛОКАЛЬНЫЙ ЭТИЧЕСКИЙ КОМИТЕТ

№ 512
Алматы қаласы

№ _____
город Алматы

Ethical approval

1.	Full name of PhD student	Seitkan Galiya Gazizkyzy
2.	Specialty of PhD Program	8D04105 – Innovation management
3.	Time period of study at PhD Program	2021-2024
4.	Theme of the thesis, date of approval	"Features and Mechanisms of Managing The Formation of Digital Hubs in Kazakhstan", The order № "4932-б/а" from 04.12.2023
5.	Information about scientific supervisor (-s) (Name, title, degree, work position and citizenship)	Domestic scientific advisor: Bekturganova Makpal Sattikulovna, PhD, senior researcher (Institute of Economics of the Committee of Sciences of the Ministry of Scientific Higher Education), Kazakhstan. Foreign scientific advisor: Lee Jung Wan, PhD, Professor (Anhui University of Finance and Economics), Republic of South Korea
6.	Objects of study	Digital hubs
7.	Planning, sampling and conducting of study	Violations are not revealed
8.	Dissemination of results or practical implementation	Violations are not revealed
9.	Protection of rights, safety and welfare of research objects	No violations detected
10	Code of approval	IRB- A1553
11	Date of study approval	11.03.2025

Chair of LEC _____ G. Ussatayeva

Secretary of LEC _____ M. Shaukharova