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Formation and Development of Digital Hubs in Kazakhstan: Risks, Drivers, and Mechanisms

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Abstract

The purpose of this study is to analyze the best foreign experience in the formation and development of digital hubs, as well as to identify the principal risks, drivers, and mechanisms of their formation in the regions of Kazakhstan. Based on the conducted literary review, the author's vision of the digital hub is given, and its main features are identified. The methodological basis of the research was the scientific works of domestic and foreign scientists, analytical reports, the results of scientific and practical publications. The authors revealed that various programs for the formation and development of digital hubs are being implemented in European countries, thereby demonstrating the experience of introducing and applying digital technologies in manufacturing, industry, and business. The analysis showed that various digital technology development programs are being implemented in Kazakhstan. Still, the possibilities of forming a digital hub and its development depend on the quality of the ICT infrastructure. In particular, the authors identified possible risks and presented their classification, which may arise during the implementation of the activities of the digital hub. The drivers of forming a digital hub are proposed, creating the foundation for sustainable development through the adaptation of existing knowledge. The main mechanisms for forming digital

hubs that can create conditions for their expansion have been developed: structural, technological, innovative, investment, institutional and social. The proposed mechanisms, if applied systematically, will contribute to the effective formation and development of digital hubs in Kazakhstan.

Keywords: Digitalization, Digital Platform, Digital Hub, Digital Technologies

Introduction

Today, both society and business are changing, influenced by an important technological trend such as digitalization (Leviäkangas, 2016; Parviainen et al., 2017). Digitalization has affected aspects such as innovation, industry, economic growth, technology, organizational efficiency, and the civilization of society (Alekseeva, 2021). Rapidly developing countries are using advanced digital strategies and digital technologies in almost all areas of their lives. However, many companies still find it difficult to implement innovation through digital technology under pressure from already developed countries, as these countries are already making great strides in this area while developing countries have only adopted programs to implement and embed digitalization in all areas of society (Kohli & Melville, 2019). The specifics of innovation in the context of digitalization are a driving force of economic processes (Gorfinkel', 2021). In order to implement and implement these programs of activities, investment and investment are essentially required, without which it is difficult to start certain activities (Ahmad & Murray, 2019).

Through the introduction of new digital technologies in organizations, digitalization has given impetus to the consolidation and facilitation of organizations such as universities, companies, technology centers, research institutes, and others. Digitalization is carried out in companies through the introduction of technologies that include processes: 1) creating digital business models; 2) value chain integration processes and digitalization of processes; 3) digitalization processes of services and products (Oztemel & Gursev, 2018).

There is an urgent need to create a digital space that will be conducive to fruitful work, the development of digital technologies, and create opportunities for

learning digital skills. Digital hubs can be used to solve such issues. In addition, according to the Message of the President of the country Kassym-Jomart Tokayev dated September 1, 2021, the head of state set an important task Kazakhstan should become a central digital hub in a significant part of the Eurasian region.

One of the main trends of the last decades is the increasing role of digital transformations in the economy created on the interaction standard. In this case, we are talking about the so-called "digital hub" or "technology hub". The term "digital hub" is close to the concept of "cluster" in the sense that both concepts represent a set of interacting entities to exchange ideas and knowledge. The difference between them is that the digital hub has quarrying teams, ICT centers, data centers, etc. While a cluster is a place for interconnection of relatively equal participants, interconnected by location on the same territory.

The European Commission has launched the EDIH program, whose main task is to support industry, and businesses in the regions to implement the digital transformation (Maurer, 2021).

There are different models for configuring a portfolio of services provided by digital hubs, one of the reference models is Data-driven Business-Ecosystem-Skills-Technology (Sassanelli, C. et al 2021).

The main objective of this study is to identify possible risks, drivers, and mechanisms for the formation of digital hubs in the regions of Kazakhstan based on the study of foreign experience.

Literature Review

Now the term "digital hub" is usually used mainly for digital platforms based on which feedback is constantly active and public events are held (for example, workshops, lectures, seminars, conferences, and other events). In the USA, such digital spaces are becoming a substitute for universities, being a powerful tool for learning and knowledge exchange. Successful examples of such digital hubs are companies and organizations formed around such digital platforms as Alibaba,

Amazon, and Wildberries, e-commerce services. However, it is not necessary to attribute to the participants of the hub all entities whose activities are based on such services. Accordingly, various types of actors can join the digital hub: banks, telecom operators, technology companies, developers, etc.

The notion of "virtual cluster" is used in the scientific environment (Kostrykin, 2009). The author applies it to the association in the virtual space of organizations involved in the innovation process and development of digital technology. The term "virtual cluster" is also used to characterize one of the stages of formation of a "real" cluster, ensuring the transition from the venture project to the production of goods and services (Lapygin et al., 2020). Nevertheless, it is advisable to use the term "digital hub" that combines the concepts of the virtual and conventional clusters, due to the fact that the understanding of the cluster as an economic structure tied to a certain geographical space has gradually lost its relevance.

Digital hubs represent the coordinating space of a region with partners at the center of the digitalization and innovation ecosystem. The ecosystem implies the involvement of organizations in hub activities, such as chambers of commerce, universities, incubators, technology organizations, research centers, regional development agencies, and national digitalization programs, for example, the Digital Kazakhstan program in our country, the government, and others. The ecosystem organizational model has considered the range of services that digital hubs offer in the process of digitalization and digital transformation to support companies in obtaining efficiency from certain activities (Antonopoulos, 2020). As defined by the European Commission: digital hubs are one-stop centers that provide services in the development of competitive business processes, products, or services using digital technologies. Through digital hubs, companies can gain access to new technologies, new knowledge, prior experience to support the projects of a particular company that has requested assistance from a digital hub, where in turn experimentation, testing of this knowledge, experience, and technology with digital innovations take place. In some cases, it is also possible to support funding certain innovations for the business. One of the objectives of digital hubs is to strengthen the local innovation ecosystem as well as to act as the

first point of contact in the region. In the interaction between businesses and financial actors, factors such as type of organization, financial and business models, origin, scope, and readiness of digital technologies are considered.

The study of technology hubs shows that users have a very high appreciation of such hubs, which provide access to experts in the field and technology as well as the use of ICT in business. The formation of technology hubs has shown its value, where new ideas and new technologies are offered.

Managing the formation of digital hubs implies a set of management functions, such as planning, organizing, 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 (DEI, 2017). The virtual selection environment, which is an association of different organizations that complement each other with resources and certain skills, can be called digital hubs (DEI, 2017). 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 (Digital Innovation Hubs Catalogue, 2021). As bringing agents, technologies, and research centers together is a complex and lengthy process due to location, there are certain ways of doing this. The main purpose of digital hubs is to identify and select a specific business model to solve the problems encountered. A business model is a logically structured schematic description of the business processes running in a particular company, the purpose of which is to create value for all stakeholders (Kiel et al., 2017). A business model includes such areas of the organization as value proposition, customers, financial viability, and infrastructure (Erik, 2010). The business model canvas is a visual representation in the form of a structure, through which it is possible to identify the elements that are critical for the further functioning of a particular business (Pigneur & Fritscher, 2014). However, it is not easy to assess the performance of digital hubs, as digital hubs are complex organizations with their own technological specializations that are regionally based, taking into account the needs of a given region, with digital hubs being a space for

a set of different actors with different interests and different business strategies (Hervas-Oliver et al., 2020).

As part of a European, national, and regional digitization policy initiative with access to a variety of resources, facilities, services, and expertise, benefiting significantly, digital hubs work to organize, provide and develop a set of services for organizations and companies that are experiencing digitization difficulties and challenges (INEDIT, 2021). It is important to note that it is the collaboration that the digital hubs benefit from. The essence of digital hubs is to create synergies whereby organizations are created and supported to compete effectively in the digital environment. One of the critical factors of which is the continuous improvement of a service, program, or product. Managing the formation and development of digital hubs is a complex activity that consists of providing services to improve certain activities, increase competitiveness, growth, innovation, application of digital technology and innovation in the production value chain, as well as access to innovation, new knowledge, experience, networking opportunities, testing of digital technologies (Butter et al., 2020).

Thus, the term "digital hub" is close to the concept of "digital platform" because both concepts represent a set of interacting entities to exchange ideas and knowledge. These stakeholders are interlinked and strengthen supportive relationships, collaborate, substitute, and complement each other. Essentially, they are equipped with human resources, technological resources, and intellectual resources. Based on the above information, a digital hub is a hub that ensures the exchange of strong links with service providers not only in its region, but also beyond, and serves customers, mainly companies in the spectrum of digital transformation (Fischer et al., 2020). Hence, it is possible to give the author's vision that a digital hub is a set of economic entities whose interaction is based on the ubiquitous spread of ICT and digital technologies operating in the digital space and having a relatively stable character.

The services provided by digital hubs should be considered as work on the business plan of the organization, work on the formation of the vision, mission, and strategy. In addition, based on the review, it follows that special attention is paid to

marketing activities, research in the field of economics, financing opportunities, work on the coordination of certain plans, coaching-coaching, work on finding investments; the ability to access infrastructure, the ability to access the network, awareness development, assessment, experiments, certain digital needs of the organization, access to both online laboratories and physical laboratories (Digital Innovation Hubs (DIHs) in Europe, 2021; Zabala, 2019; Rissola & Sörvik, 2018).

According to recent studies in the formation and development of digital hubs, conclusions have been made on the application of robotics in improving product quality, predictability of production; in the application of artificial intelligence and the Internet of Things in improving the transparency of the supply chain (Lanz, M. Et al 2021).

In the studies previously studied the stages of management of the formation of digital hubs, the importance of the business model in the formation of digital hubs, the formation of sustainable digital hubs, digital technologies but not clearly shown the possible risks of formation of digital hubs, drivers of digital hubs and mechanisms for the formation of digital hubs.

Research Methods

The methodological basis of the study are the achievements of world economic science, related industries, the results of scientific and practical research. Various programs for the formation and development of digital hubs are being implemented in European countries, thereby showing the experience of implementation and application of digital technologies in manufacturing, industry and business. In Kazakhstan, the program "Digital Kazakhstan" is being implemented, according to which Kazakhstan also opened digital hubs "Parasat" in Kostanai, "Caspian Digital Hub", technoparks "Astana Hub" and "Almaty Hub".

In this article, we decided to analyse the formation and development of digital hubs in countries such as Germany, France, Spain, the Czech Republic, Lithuania. These digital hubs were chosen according to the studies of scientists who considered them more developed.

The proposed methodology contains possible risks, drivers, and mechanisms for the formation of digital hubs in the regions of Kazakhstan. In developing the methodology, more than 26 studies were studied. This methodology allowed us to develop a model for the formation of digital hubs.

The model of a digital hub based on the works of Antonopoulos, Keramidas & Tsakanikas (2020) can be represented in figure 1.

Figure 1. The model of a digital hub

The activities of digital hubs can be represented as this model in which a company approaches a digital hub with its problem that it cannot find a solution for or wants to find the most effective solution, which is carried out by analyzing experience in a particular industry, conducting technological expertise, analyzing experience with a business model, whereupon the digital hub selects a particular business model or a particular solution to the problem.

There is the following classification of categories of digital hubs (Table 1).

Table 1. Classification of categories of digital hubs

Category	Definition
Scope - specific sectors or technologies (expert hubs)	A particular region or area and more; Digital technology and digital adapters
Business model and funding model	A mixed model that combines tangible and intangible services; Tangible services (private finance)
Technology readiness of companies	All 9 levels of technological readiness; Some levels only

Origins of sponsors/founders	Higher education institutions; Research institutes; Associations by industry; Private organisations and others.
Type of company - public or private partnership	Private companies; Public organisations; Informal associations and others.

Compiled by the author from the source (Alberto & Arnold, 2020)

The study of technology hubs shows that users have a very high appreciation of such hubs, which provide access to experts in the field and technology as well as the use of ICT in business. The formation of technology hubs has shown its value, where new ideas and new technologies are offered.

Findings and Discussions

In Kazakhstan, there is a technopark of IT startups Astana Hub, which in 2020 presented its own digital hub astanahub.com. In the digital version of the Astana hub, all processes have been automated: from accepting applications for participation in programs to filling out online reports for residents receiving tax and visa preferences. The main idea of the project is to provide users with all the necessary digital resources. Thus, Astana Hub is developing its export potential of technological products and is also trying to achieve in this direction an indicator of 500 million US dollars by 2025. By 2021, Astana Hub's IT startups have already attracted 34.5 billion tenge. In 2019-2021, the participants of the technopark saved 7.7 billion tenge. In addition, the digital park is changing the approach to the formation of a critical mass of ICT entrepreneurs, and the development of human capital, and digital skills.

It is important to note that these services can be carried out using digital technologies, artificial intelligence, advanced automation, modeling, cyber-

physical system, machine learning, text analysis using artificial intelligence, network analytics, information retrieval, Internet of things, user experience, robotics, and others. Examples of industry digital hubs are represented in table 2.

Table 2. Experience of foreign digital hubs

Location and name of the digital hub	Management	Specialization, Offer	Services
France, Paris DIGIHALL	An industry cluster together with a research and technology organization.	Artificial intelligence, cyber-physical systems, cybersecurity	Assessment of digital maturity, testing, and analysis of equipment, training in digitalization skills, and access to finance.
Germany, Dortmund, Digital Hub Logistics	Fraunhofer Institute, Technical University of Dortmund, Duisburger Hafen AG, Efishnz cluster	Extensive ecosystem, for contact with players, testing collaboration in a special space,	Contract and applied research, product development methodologies, and idea development.
Spain, Bilbao, BDIH	Vocational training Center, regional state institutions, research organizations	Robotics, cybersecurity, 3D printing	Testing, technological evaluation, project scaling, testing infrastructure,

			and startup development.
Lithuania, Vilnius Lithuanian Hub of Digital Innovations in the field of Robotics	Lithuanian Robotics Association, Startup Department.	Internationalization, robots	Search for possible financing, technological audit, access to researchers and suppliers of technologies in the field of robotics.
Czech Republic, Ostrava IT4Innovations	Universities of Ostrava	Computer technology	Access to computer infrastructure, research activities.

Compiled by the author from the source (Alberto & Verbeek, 2020)

As can be seen from this table, five digital foreign hubs are presented here. In their practical activities, they use advanced digital technologies such as artificial intelligence, robotics, computer programs, computer technology, cybersecurity, cyber-physical systems, additive technologies, and others. The practical experience of these digital hubs shows successful application and results. The experience of the formation and development of foreign digital hubs can be applied taking into account the region of the country where it is necessary to form a digital hub. It is necessary to develop a business model that will fit exactly the characteristics and needs of the region. To begin with, let's consider the digital literacy of the country since the services provided by digital hubs will take place in a digital format, and accounting for the digital literacy of the population is an important indicator of the country's readiness for digitalization.

Table 3 shows the possible risks that any digital hub can face.

Table 3. Possible risks that can occur in a digital hub

No.	Risk	Characteristics
1	Phishing attack	This is a scam tactic through sending emails and trying to trick users into clicking on a malicious link to steal their personal data and information. *Measures to counteract this:* the defenses can include tracking various key phishing indicators, looking for unregistered domains, detecting changes in MX records, and checking DNS reputation.
2	Prioritization of vulnerabilities	Manually correlating error and vulnerability data in real time becomes very difficult. *Measures to combat* vulnerability management controls (monitoring), aimed at detecting and classifying vulnerabilities and at eliminating or mitigating their exploitation, can be used as a defense.
3	*DarkNet*	A segment of the darknet internet is hidden from public view, with the controlling DDoS attack servers hidden away to make them harder to find. Darknet tricks can hide user data and spoof IP addresses. *Measures to combat this*: automated DRP vulnerability harvesting, which constantly monitors darknet activity, can be used as a defense.
4	Potential for leaks of confidential data	This is a fraudulent attack tactic aimed at deliberately collecting personal customer data, intellectual property, sensitive credentials, and sensitive documents. *Measures to combat this:* DLP (Data Loss/Leak Prevention) technology can be used as a defense to prevent confidential data leaks.

5	Cyberfraud	This is a cyber-attack tactic aimed at causing material or other damage by stealing a user's personal information using new technologies (e.g. stealing bank accounts, passport data, codes, passwords, etc.). *Measures to counteract this*: anti-virus protection (installation of anti-virus software and anti-virus hardware), firewalls, gateways, IDS/IPS and malware detection systems, etc. can be used as defences.

Note – compiled by authors

In order to implement a policy of shaping and developing a digital hub based on best practice research, we propose to put forward the necessary attributes "drivers" that adapt general knowledge to sustainable development.

1) Research problems should be relevant, address existing gaps or solve problems, take into account different perspectives, data, and evidence to form conclusions.

2) Develop a methodology to assess readiness to form a digital hub, supported by a multidisciplinary team of skilled professionals including government, academia, industry, and civil society.

3) Continuously increase the number of stakeholders in terms of numbers and sectors.

4) Collaboration with local academics or research institutes, supported by international experts.

5) Research on successful best practices of digital hubs to be used for benchmarking purposes. Best practices should include examples from two types of cities. The first type is hubs with similar conditions in the local context. The second type is hubs that have excelled in a particular area of interest to the local constituency.

6) Identifying and seeking locations for a digital hub at regional, national and international levels.

7) Support for digital start-ups and advanced ICT companies.

A comprehensive model covering the main and innovative findings:

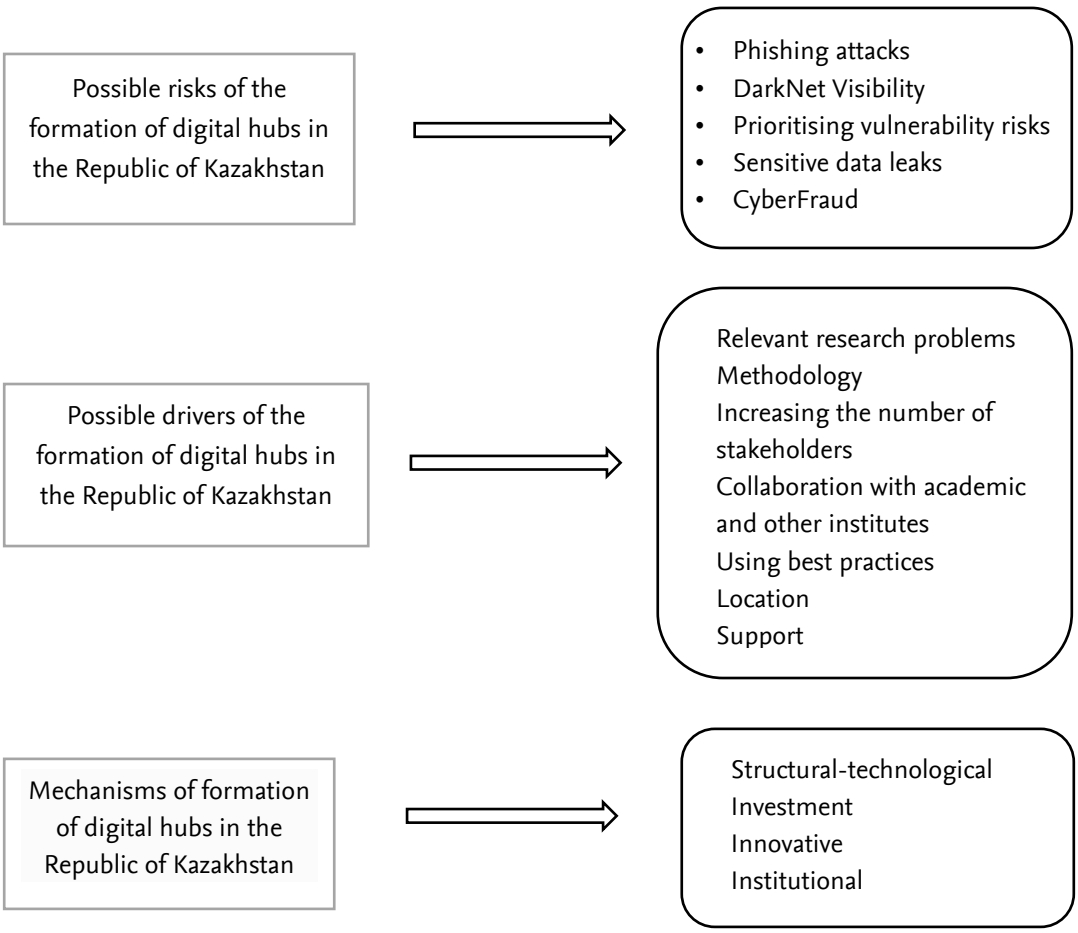

Figure 2. The comprehensive model covering the main and innovative findings

Note compiled by authors

Next, it is useful to consider in more detail the main mechanisms for regulating the formation and development of digital hubs in Kazakhstan. In particular, we identified structural-technological, innovative, investment, institutional and social mechanisms. The above list of implementation mechanisms is not exhaustive, but shows a certain system, within which in the future, the policy of Kazakhstan for the development of a central digital hub can be conducted. Table 4 details the regulatory mechanisms for the formation and development of digital hubs in Kazakhstan.

Table 4. Regulatory mechanisms for the formation and development of digital hubs in Kazakhstan

Mechanism	Purpose	Implementation mechanisms
Structural and technological mechanism	Orienting the digital hub space towards the renewal of the structure of industries and the transition to a new industrial revolution, Industry 4.0.	Creation of a qualitatively new type of structural-industrial specialization of the region. Diversification of the region's industrial production. Development of favorable conditions for investment spillovers, support for fundamental research and commercialization of R&D.
Innovative mechanism	Enabling innovation and new industries through digital technologies.	Accelerating the innovation process. Supporting and targeting knowledge-intensive industries. Creating conditions for modernization of the region's industrial sectors through the digitalization of production processes. Development of "smart" technologies (Smart Solution), the emergence of compact "smart cities".
Investment mechanism	Attracting different sources of financing and creating a favorable climate for potential investors.	Effective redistribution of investment flows. Creation of incentives oriented towards accelerated development of the digital hub. Search for non-standard schemes to attract external financing. Support of projects through state grant programs (grants,

		conditionally repaid loans, equity financing, etc.).
Institutional mechanism	Creating conditions for the development of institutional environment.	Creation of starting conditions and stimulation of digital hub development. Development of state support and socio-economic development programs.

Note – compiled by authors

As can be seen from the table, structural-technological, innovative, investment and institutional mechanisms for regulating the formation and development of digital hubs in Kazakhstan should be highlighted. The application of the above mechanisms in the management of the formation of digital hubs in Kazakhstan will accelerate the innovation process in Kazakhstan.

Conclusions

To summarize the above, smart infrastructure is a robust and secure digital and technological framework that can withstand information-related disruptions. It can include digital and ICT infrastructure, including the latest innovations, sensors, and control systems, data centers, data bases that will help accumulate, store and transmit any data and provide equitable access to digital hub consumers. Today, digital hubs bring together people working in the ICT sector. As digital technology has evolved, hubs have become centers of attraction for entrepreneurs and creatives. Many organizations from Google, Apple, Uber, Facebook, and Slack can rightly be considered successful digital hubs. However, in order to work for such companies, many skilled professionals are forced to give up half of their salary for housing close to their work.

Possible risks that can arise in a digital hub are phishing attacks, prioritizing vulnerability risks, darknet visibility, the possibility of sensitive data leaks, and cyber

fraud. Highlighting risks is an important factor in the management of digital hubs, they reflect solutions to all kinds of problems as well as prevent them.

Structural-technological, innovative, investment, and institutional mechanisms for regulating the formation and development of digital hubs in Kazakhstan are highlighted. The proposed mechanisms, if applied systematically, will contribute to the effective formation and development of digital hubs in Kazakhstan.

The drivers' attributes are a set of components that will give impetus and enable the implementation of the digital hub initiative. The proposed drivers are part of the context of the digital hub and are likely to change with the context. A number of research papers provide additional characteristics, describe possible approaches, and, in some cases, provide specific values for the attributes of smart hub infrastructure development.

Management issues of the formation and development of digital hubs remain actual and require further research. Features of management of the formation of digital hubs and mechanisms for the development of digital hubs in the regions of Kazakhstan are relevant today.

The information in the article will be useful to researchers in the field of digitalization, teachers, students, graduate students, doctoral students of universities of the economic profile, as well as anyone interested in this topic.

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