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ANALYSIS OF THE CURRENT STATE OF THE ISSUE OF CREATING A SPATIAL DATA INFRASTRUCTURE IN THE REPUBLIC OF KAZAKHSTAN

ҚАЗАҚСТАН РЕСПУБЛИКАСЫНДА КЕҢІСТІК ДЕРЕКТЕР ИНФРАҚҰРЫЛЫМЫН ҚҰРУ МӘСЕЛЕСІНІҢ ҚАЗІРГІ ЖАҒДАЙЫН ТАЛДАУ

АНАЛИЗ ТЕКУЩЕГО СОСТОЯНИЯ ВОПРОСА СОЗДАНИЯ ИНФРАСТРУКТУРЫ ПРОСТРАНСТВЕННЫХ ДАННЫХ В РЕСПУБЛИКЕ КАЗАХСТАН

Abstract. This article is devoted to the analysis of currently existing domestic geoportals with open / free access. The analysis allows to identify the problems and prospects for the development of spatial data infrastructure in the Republic of Kazakhstan, to note the features of geoportals, to show the possibilities of geoportals technologies for solving a variety of management tasks in various fields of activity. The results of the study will be used to implement the integration of a geographic information system and elements of 3D visualization of geological objects.

Keywords: Geoportals; geoportals technologies; spatial data; spatial data infrastructure.

Аңдатпа. Бұл мақала қазіргі уақытта ашық/еркін қолжетімділігі бар отандық геопорталдарды талдауға арналған. Талдау Қазақстан Республикасындағы кеңістіктік деректер инфрақұрылымын дамытудың проблемалары мен перспективаларын анықтауға, геопорталдардың ерекшеліктерін атап өтуге, қызметтің әртүрлі салаларындағы сан алуан басқару міндеттерін шешуге арналған геопорталдық технологиялардың мүмкіндіктерін көрсетуге мүмкіндік береді. Зерттеу нәтижелері географиялық ақпараттық жүйені және геологиялық объектілерді 3D визуализациялау элементтерін біріктіруді жүзеге асыру үшін пайдаланылады.

Түйін сөздер: Геопортал; геопортал технологиялары; кеңістіктік деректер; кеңістіктік деректер инфрақұрылымы.

Аннотация. Данная статья посвящена анализу существующих на данный момент отечественных геопорталов с открытым/ свободным доступом. Анализ позволяет выявить проблемы и перспективы развития инфраструктуры пространственных данных в Республике Казахстан, отметить особенности геопорталов, показать возможности геопортальных технологий для решения множества управленческих задач в различных сферах деятельности. Результаты исследования будут использованы для реализации интеграции геоинформационной системы и элементов 3D-визуализации геологических объектов.

Ключевые слова. Геопортал; геопортальные технологии; пространственные данные; инфраструктура пространственных данных.

Introduction. In the information age, for the development of tourism in a particular area, a special tourist information resource is needed with the provision of specialized maps. Such a universal web-cartographic resource is a geoportal. Geoportals are gateways to the World Wide Web that organize content and services, directories, search tools, community information, support resources, data, and applications. It can serve for several purposes: research, commercial, information and educational. A geoportal is a website where geospatial resources can be found, geoportals facilitate the transfer of geospatial information from providers who own or control it to consumers who need it. Geoportal technology is a new area of computer technology related to the delivery of spatial data to the end user. Any network can be used as a medium, not just the Internet. The presentation of data and applications in the form of a web service (software as a service - SaaS, data as a service - DaaS) has been a promising direction in the development of information technology over the past few years. This trend has also penetrated into the field of geoinformation technologies (GIT), i.e. technologies for processing spatial data. Moreover, the field of GIT is one of the most applicable areas of this concept due to the fact that the processing of spatial data requires significant resources for processing big data and it is advisable to perform this processing in distributed and cloud systems [1].

This article analyzes geoportals for various purposes with open access to identify the features of the advantages and disadvantages of existing geoportals. The results of the study show the possibilities of geoportal technologies for solving a variety of management tasks in various fields of activity and will be used to develop a geoportal that allows the integrating data on tourist geographical objects into a geographic information system.

Literature review. The expediency of using geoinformation systems in various fields of science is beyond doubt. Many works of foreign and domestic scientists are devoted to the application of GIS in various branches of agriculture. For example, M. Sigala [2] draws attention to the practical application of geoportals as a tool for creating your own tourist routes. In addition, the works of M. Sigala [3] consider the issues of geovisualization and its application in the field of education. S.V. Shaitura [4], E.O. Ushakova [5], B.V. Robinson [6] note the importance of geoportals in tourism in terms of their economic efficiency and stages of implementation; the great importance of such a resource for the development of tourism on the scale of individual regions. Geoportals are compared by such scientists as Yu.N. Mironova [7], A.V. Koshkarev [8]. Koshkarev A. also clarifies the meaning of the term "geoportal" and the correspondence to it of various currently existing resources called geoportals. The problems of creating and forming the National Spatial Data Infrastructure (SDI) of the Republic of Kazakhstan were considered in the works of O. Alipbeki [9,10], B. Bekmurzaev [11]. The works [12,13] of Z. Zhantayev are devoted to the issues of monitoring natural and man-made emergency situations on the territory of the Republic of Kazakhstan using satellite data and the development of a corresponding unified geoportal. The work [14] of Kyrgyzbay K. and Erkin K. is devoted to the creation of a geodatabase of the Almaty region for the unification and collection of spatial information. Their work examined the methods, data, and tools used in defining the architecture and structure of a spatial database. The legal side of the issue of developing geoportals in the Republic of Kazakhstan is given attention in the works of K. Slabodich [15].

Through the system of national, regional and local geoportals of the Internet, the spatial data infrastructure should connect and unite geographically dispersed producers and consumers of spatial data, including government agencies, businesses, the scientific and educational community and citizens. The number of information products available is enormous: there are many tens or even hundreds of thousands of pieces of information in each national SDI. Many countries of the world are already working on the creation of state SDIs, which include geoportals; a legal framework is being formed to regulate this activity (ISO international standards, Russian GOSTs, etc.). Regional and departmental SDIs are also being formed, providing for the creation of specialized,

sectoral, thematic geoportals. The creation of SDI and geoportals in the Republic of Kazakhstan has been given attention in the last 10 years. Thus, within the framework of the ongoing projects “Creation of a space remote sensing system” and “Creation of a ground-based infrastructure for high-precision satellite navigation of the Republic of Kazakhstan”, unique opportunities for the development of a national SDI in the republic appeared [16]. Since 2016, Kazakhstan has been actively participating in the development of the Eurasian technological platform “Space geoinformation technologies - products of global competitiveness” [17]. In connection with the development of the space industry in Kazakhstan, the development of a space system for remote sensing of the earth (ERS) on the basis of a national operator, there were some difficulties with thematic processing of remote sensing data in relation to the tasks of the relevant industry, there is a need to create industry geoportals and subsystems of space monitoring and control [18]. Remote sensing methods are becoming increasingly important, including space and digital aerial photography, and laser scanning. The need to develop urban planning documentation stimulates the practical application of space sounding and aerial photography data for updating topographic and geodetic foundations. In 2018, the Eurasian Economic Union (EAEU) prepared and approved the draft Interstate Program “Integrated system of the EAEU Member States for the production and provision of space and geoinformation services based on national sources of Earth remote sensing data (ERS)”. The second stage of this program provides for the creation of a single information portal - a databank based on satellite imagery materials of the combined satellite resources of the EAEU countries, the modernization of national ground-based complexes for receiving and processing remote sensing data in order to combine into a single network for receiving information from any satellites of the Union countries and the creation of a single software coordination complex shooting planning. The implementation of the second stage of the program contributes to a significant improvement in the quality of geoinformation services provided to users of various sectors of the economy of the Member States. [19]

The creation of regional geoportals has become one of the priority tasks of the regions of Kazakhstan, and state funding is allocated for these purposes. In 2022, two laws were adopted “On geodesy, cartography and spatial data” and “On amendments and additions to some legislative acts of the Republic of Kazakhstan on geodesy, cartography and spatial data” [20]. The main objectives of the laws are to provide Kazakhstan with a high-precision geodetic coordinate system and create a single digital cartographic basis for the country.

In March 2023, the Order of the Minister of Digital Development, Innovation and Aerospace Industry of the Republic of Kazakhstan “On approval of the instructions for creating and updating the National Spatial Data Infrastructure” was published [21]. Instructions for the creation and updating of the National Spatial Data Infrastructure details the implementation of activities for the creation and updating of the National Spatial Data Infrastructure. The instruction provides clear definitions of basic concepts such as: basic spatial data, spatial data; spatial data geoservices, metadata, etc. The instruction regulates the requirements for the creation of the state geoportal of the National Spatial Data Infrastructure. The NSDI geoportal provides access to distributed geoinformation resources and acts as an information and communication platform on the Internet. Functionally, the geoportal provides: cartographic visualization, access to the catalog of spatial data (via metadata); search for spatial data and data providers; a set of services that provide standard queries; access to metadata that provides a description and assessment of the applicability of the presented spatial data; availability of applications corresponding to the main stated objectives of the NSDI. A prerequisite for ensuring the search for the necessary data is a preview of spatial data by means of visualization in the search process. Visualization of spatial data provides their representation in raster and/or vector format in the form of cartographic images, as well as in the

form of aerial or space orthoimages (orthomosaics) of various resolutions in a matrix (grid) representation. Additional visualization tools provide for the derivative generation of cartographic images based on spatial data, their presentation in three-dimensional form, in real time. [21].

The development of digital technologies and their implementation in all spheres of life is carried out in accordance with the Strategic Development Plan of the Republic of Kazakhstan until 2025 [22], the national project "Technological breakthrough through digitalization, science and innovation" [23]. In particular, several of the tasks [22,23] are:

– Reforming the agro-industrial sector to adapt to new conditions. Geoinformation systems will be widely used for effective management of water and land resources and combating desertification;

– Development of domestic tourism. Particular emphasis will be placed on improving the availability and quality of tourism services and products through the development of tourist destinations and the massive involvement of labor resources in the industry, creating a favorable tourism climate, and popularizing the tourism potential of Kazakhstan. For the development of cultural tourism, the rich heritage of the people and the cultural and geographical map of the sacred objects of the country "Sacred Geography of Kazakhstan" will be widely used;

– Development of infrastructure and digitalization of basic sectors of the economy.

Materials and methods of research. The research material was the works of domestic and foreign scientists, devoted to the development of spatial data infrastructure and geoportal technologies; modern solutions in the state legislative base on spatial data infrastructure; directly domestic geoportals of free (open or partial) access for various purposes, including regional portals, as well as special purpose portals.

The article uses analytical and abstract-logical research methods, as well as a generalization method. These methods allow us to consider a geoportal as a complex structure and analyze the components of its information support.

Results and discussions. In the process of surfing and analyzing the Kazakhstan segment of the open access spatial data array, several regional geoportals of free access were selected. They provide users with the spatial information they need at the request of the user. Features, peculiarities and purposes of these geoportals are presented in Table 1 and Table 2.

Table 1. Brief overview of domestic special-purpose geoportals of the Republic of Kazakhstan

Site name and URL	Purpose	Peculiarities
Central Asian Geoportal http://www.cac-geoportal.org Geoportal of Kazakhstan http://www.geoportal-kz.org	The portal provides geo-information of the region for multiple stakeholders at the international level, and its development is ongoing.	Static site. Maps are unscaled copies of printed maps.
Geoportal of space monitoring of droughts. http://zasuhi.gzi.kz/	The main goal of creating a geoportal is to provide interested Kazakhstani users with data on drought in a form that is convenient for visual perception.	No download or print options
Space monitoring geoportal http://old.gharysh.kz/	Joint Stock Company "NC Kazakhstan Gharysh Sapary" geoportal of the Center for geoinformation data and services	The portal provides remote sensing data of DES regions

For the analysis of information support, the following geoportals were selected, from which the development of SDI and the creation of geoportals in the Republic of Kazakhstan began: Central Asian Geoportal, Geoportal of Kazakhstan, Geoportal of space monitoring of droughts, Space monitoring geoportal. As well as a number of regional geoportals (geoportals of the regions of the Republic of Kazakhstan). Work on these geoportals continues. The functionality of

geoportals, as well as the territorial coverage, is constantly expanding. Many of the listed portals have a similar interface and functionality, but also have a number of unique differences. For example, the Akmola region was the first to introduce the "Tourism" module into the geoportal and used augmented reality technology: There are about ten of them at each object, there are animated videos using AR technology.

Table 2. Brief overview of regional geoportals of the Republic of Kazakhstan

Site name and URL	Purpose	Peculiarities
Geoportal of Ust-Kamenogorsk and Semey cities http://openmap.kz/	General plans, urban planning projects, information on water protection areas, data on the road network have been introduced into the geoportal. Educational and healthcare facilities, as well as engineering networks, are displayed in separate layers.	Geoportal of Ust-Kamenogorsk and Semey cities was renamed into the Geoportal of East Kazakhstan region
Geoportal of the East Kazakhstan region http://vkomap.kz		
geoportal of Kyzylorda region https://map.e-kyzylorda.gov.kz/map/ru/	The interface of the portal is similar to the interface of the geoportal of Aktobe region. The functionality is not fully implemented.	Has problems with the security certificate.
geoportal of Akmola region https://aqmola.gov.kz/page/read/Smart_Aqmola.html	It has a user-friendly interface, a virtual map, a guide to sacred places with detailed information about the object and its exact location. Also included here are attractions, museums, routes, hotels and restaurants, public maps of the area with refinement down to small objects and plantings. The audio guide informs in Kazakh, Russian, English and German.	The geoportal is available through the "SmartAqmola" mobile application. 10 objects have been implemented here in augmented reality.
geoportal of Aktobe region http://geoportal.akt.kz/	The portal provides geo-information of the region for multiple stakeholders at the international level, and its development is ongoing.	Geoportal launched. Its open part has been operating since mid-2018.
geoportal of Atyrau region https://geo.eatyrau.kz/	A detailed electronic map of the city and region with data on each object of the social, transport, engineering infrastructure of the region, covering various areas of the region's activities.	Provided with a mobile application "Smart Atyrau".

Kazakhstan geoportals, discussed in Table 3, meet the basic technical requirements for geoportals. However, their information support has some differences [24]. The table highlighted the main characteristics inherent in most of the analyzed geoportals: the presence of a user-friendly interface, scalable maps, geoanalysis tools, feedback, etc.

Table 3. Analysis of information support of domestic geoportals

Geoportal	Scalable Maps	Thematic layers	Search	Tags, legend	Data upload	Tools	Languages	metadata	Instruction	Feedback
1	2	3	4	5	6	7	8	9	10	11

Central Asian Geoport- tal Geoportal of Kazakh- stan	-	-	Name	-	-	-	Russian English	-	-	e-mail, phone
Space monitoring geo- portal	space pictures	-	+	+	+	-	Kazakh Russian English	+	+	+

Continuation of Table 3

1	2	3	4	5	6	7	8	9	10	11
Geoportal of space monitor- ing of droughts.	OSM, Bing, MapBox Outdoors, Map- Box Streets Sat- ellite	+	-	+	-	Distance, area, coordi-nates, visuali-zation and graphs	Russian	-	+	-
Geoportal of Ust-Kameno- gorsk and Semey cities	Topographic Bing Google	+	Name	+	-	Length, area, printing	Russian Kazakh	-	-	-

Summing up, we can conclude that the studied domestic geoportals have certain functional services. It should be noted that some geoportals have implemented them partially. Let's group and display them in Figure 1.

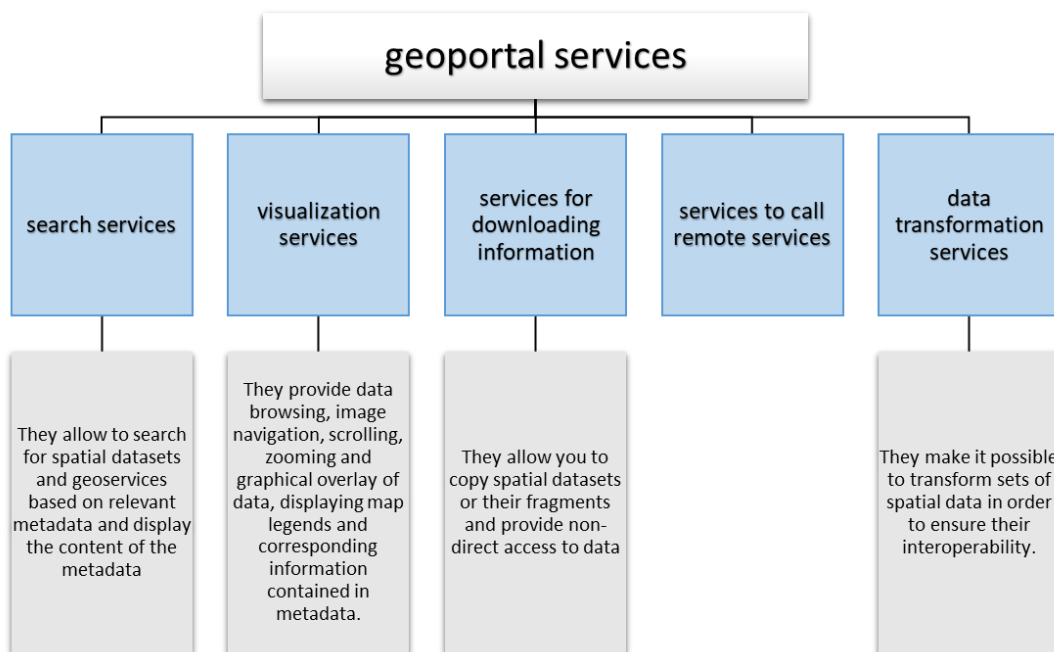


Figure 1. Geoportal functional services

Based on the review and analysis of the information support of the above portals, the following conclusions can be drawn. All geoportals can be divided into several groups that differ in spatial coverage, purpose and target audience. At the same time, geoportals differ not only in coverage

of the territory and subject matter, but also in technical characteristics. For example, some provide only maps of different routes and different places, others provide maps and other textual and multimedia information about the region, and still others provide an interactive map with metadata (information associated with objects on the map). Each of them has its own advantages, but in tourism practice, geoportals with an interactive map and metadata are more popular today.

The minimum set of geoportal visualization functions includes data visualization, image navigation, scrolling, zooming, graphic overlay of image layers, displaying legends, and viewing the metadata content of the visualized data set is also provided. In addition, geoportals should have a subsystem for interactive visualization of thematic maps and layers of geospatial data of a geoportal, that is, provide for the ability to control scale and positioning, display attribute data for objects on a map, select various cartographic substrates, address and spatial search, measure distances, and so on. Geoportals can also act as a tool for integrating the visualization of geological objects, including three-dimensional ones, and geoinformation systems [25, 26]. Thus, the standardization of the graphical interface and the search for the optimal number of functions can improve the ergonomics of visualization tools on geoportals. The geoportal can become a tool for the development of geotourism in the East Kazakhstan region of the Republic of Kazakhstan.

Conclusion. In conclusion, it should be noted that the informatization of society has been increasing in Kazakhstan in recent years. Many electronic services and portals covering various spheres of economy and economic activity are being created. Information systems and the means of their construction are also constantly and rapidly developing. The main trends and directions for the development of building modern information systems are clearly distinguished, among the main ones are:

1) The transition from information to geographic information systems (GIS), which have the advantages of conventional information systems and additionally contain specialized functions for working with the spatial components of data sets.

2) Portal technologies that allow providing wide access to online resources and services from any device and place.

Geoportal technologies have gone through several stages of standardization of data and geoservices, and the world community has developed clear principles for building geoportals. Compliance with these principles will allow not only to correctly build and develop a geoportal, but also to integrate it into the global geoinformation space. In addition, it will allow the use of ready-made components and data. Libraries of ready-made geocomponents, including Open Source (for open use), have now been developed and are actively developing. There are also large volumes of geospatial data built according to these standards, covering the whole world and Kazakhstan in particular. These are geospatial databases (OSM, etc.), satellite images (landsat, etc.), and geoservices - Google TMS, Google Geocoding, etc.

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