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Abstract. Modern technologies are constantly evolving, almost continuously various innovations aimed at improving life appear in various branches. In addition to the rapidly growing number of inventions, the amount of information in public access is also growing. To store and process large volumes of information, BIG DATA technologies are used, which help improve the quality of urban planning studies. The article discusses the possibilities of using BIG DATA in urban planning, lists possible areas for using geographic information systems in economics, medicine, transport, environmental management, construction, municipal and state administration, science, and investment activities. There is identified possible users of GIS at various levels of management. The authors define the role of the federal universities in the creation, management of GIS, and training in this area.

1. Introduction

Every moment a person comes across information, it comes from a variety of sources and is easily acceptable – today there is no need to travel long distances and spend time to gain access to various interesting data.

Information is a resource that will never be depleted. Many people can use one and the same information for infinite number of times. Information was important at all times, however nowadays its value has increased even more.

By now the data bank, accumulated by humanity, is very large. For example, DigitalGlobe, which operate satellites performing remote ultra high resolution sensing of the Earth, have collected about 100 petabytes of data for over 17 years of operation [1]. That is why not only systematization, structuring and storing information, but also the rapid retrieval of the necessary data became an important aspect. And here is where BIG DATA come in handy, allowing automating the whole process.

For those who do not know, the largest BIG DATA is geographic information systems (further referred to as GIS). It is here where large amounts of data are organized layerwise and where the associated task of accessing it via WEB publishing mechanism is being solved.

2. GIS technologies in the modern society

The modern society cannot do without GIS technologies. It is impossible to build economy or perform modern management without them. The worldwide trends are such, that it is necessary to manage a large base of spatial data in time, and doing this requires GIS. Until recently, this task was difficult to

solve because the data bank was small and the access to spatial data on the Earth (satellite photographs) was limited. However, during the last few years the situation changed for the better, and with the advent of new technologies the GIS rise to a new level. This allows GIS to be introduced into new areas of social activity.

GIS technologies have been in place in the world for over 50 years. During that time these technologies became widely distributed and appeared not only in fields were people professionally deal with geography, but in many other fields - business, emergency response services, municipal services, etc. This is partially due to the fact that this discipline covers a very wide range of issues, from purely theoretical to purely practical, from geography to programming, from business presentations to database design.

The purpose of GIS is to provide a decision-making process for optimal resource management, arranging transport and retail operations, utilization of real estate assets, water, forest and spatial resources. [2].

V I Laykin highlights several types of GIS industry applications:

a) administrative and territorial management:
- urban planning and objects design;
- maintaining of engineering communications inventory, land inventory, urban planning inventory, plantation inventory;
- predicting emergencies of technogenic and environmental nature;
- managing traffic flows and public transport routes;
- building environmental monitoring networks;
- engineering and geological zoning of the city.

b) telecommunications:
- trunked radio and cellular communications, traditional networks;
- strategic planning of telecommunication networks;
- optimal positioning of antenna, repeaters etc.;
- determining cable routes;
- monitoring the status of networks;
- operational dispatch control.

c) engineering communications:
- assessment of needs for water and sewage networks;
- modeling of natural disasters effects on engineering communication systems;
- designing engineering networks;
- monitoring of engineering networks condition and preventing emergencies.

d) transport:
- road, railroad, water, pipeline and air transport;
- management of transport infrastructure and its development;
- vehicle fleet management and logistics;
- traffic control, route optimization and freight traffic analysis.

e) oil and gas complex:
- geologic exploration and field survey works;
- monitoring of oil and gas pipelines technological operation modes;
- designing of trunk pipelines;
- modeling and analysis of consequences of emergency situations.

f) defense and law enforcement agencies:
- fast response services, armed forces, police, fire services;
- rescue operations and protective measures planning;
- simulation of emergency situations;
- strategic and tactical planning of military operations;

- navigation of fast response services and other defense and law enforcement agencies.

g) ecology:

- assessment and monitoring of natural environment condition;
- modeling environmental disasters and analyzing their effects;
- planning environmental protection activities.

h) forestry:

- strategic forestry management;
- lumbering management, forestry approach planning and road design;
- maintaining forest inventories.

i) agriculture

- planning agricultural land processing;
- accounting of farmers and crop lands;
- optimization of agricultural products and mineral fertilizers transporting.

This list is constantly being complemented, because the GIS are increasingly integrated into our life, activities and business. [3]

GIS have many features that should be considered. One of the features is that geographic information systems are elements of social informatization. This feature takes into account the integration of the GIS into education, science, production and applying the obtained information in practice.

Previously the information obtained from research scattered and its application was localized within the boundaries of the project, where it was generated and obtained. It was difficult and almost impossible to find the existing facts, check their availability. No data exchange was established. The lack of information on spatial data, in return, led to multiple repetitive works, inappropriate waste of time and money, creating obstacles to free utilization of data.

In 2006, in accordance with the Concept of creation and development of spatial data infrastructure in the Russian Federation (hereinafter - the Concept), formation of spatial data infrastructure (SDI) was started at the discretion of the Russian Federation Government decree no. 1157-r dated August 21, 2006. [4]

As stated by Sergey Menyaylo, RF Presidental Envoy in Siberian Federal District, at the XIII Interexpo GEO-Siberia 2017 international exhibition and research congress, held in April 2017 in Novosibirsk: "Without modern geographic simulation systems and reliable spatial information it is impossible to plan territorial development, perform effective traffic flow management, predict and prevent emergencies and deal with other important issues. [5]

During 13 years of operation of the Urban Development Code of the Russian Federation and of the Concept, new GIS and geographic portals have emerged, which significantly increased the quality and efficiency of management decisions at various level, due to SDI implementation. Transparency in making such decisions and increased investment in territorial development were reached through an accessible procedure of spatial data analysis.

However, due to the following facts:

- less then 50% of federal subjects of the Russian Federation and less than 10% of municipal entities of the country have developed and are maintaining the information systems for urban planning and geographic portals;
- each federal subject of the Russian Federation or municipal entity maintain it in a form, convenient for themselves (sometimes only by keeping the electronic copies of the documents, but not the graphic version of the information contained in them), using their own classifiers, static two-dimensional maps instead of multi-dimensional information maps etc.
- it is necessary to provide privacy of some spatial data,

further development of SDI is difficult and almost impossible without significant investments, because the burden on the budget of many, small, medium and large municipal entities referring to creating and maintaining the information systems for urban planning is infinitely high.

According to the Russian TASS information agency, at the Krasnoyarsk economic forum, held on April 20-22, 2017, Kirill Kuzmenko, Secretary to Council of the National Prospectors Union association, voiced an opinion concerning creation of a unified information portal, which would become the center of geographic data infrastructure and unite numerous bases under single standard, format and quality, leading to adoption of certain state standards.

In many developed countries, about 70% of managerial decisions in business and government are based on spatial data, i.e. the digital economy is based on the Earth data. Nowadays a considerable geographic data market has established in Russia. Its monetary value is expected to increase to about five times by 2020. However, these data are not compiled and analyzed in a proper way, and this leads to low quality and ineffective decisions being made. An operator is needed to collect this information into a single data bank, because the creation of a unified structure, especially in construction, will save millions of rubles, because it would take twice less time to accumulate the initial data etc.

It is especially urgent to create a unified database for urban planning and territorial management, because these are the fields where it is important to analyze a fairly large amount of information in order to make the right decision. Most of the information that is owned by the executive authorities, refers to territories, objects and particular addresses, that is why it becomes clear that GIS technologies, as tools for the most powerful and effective information assurance in the field of urban planning, are applicable to works with such data. Users of the geodata include federal ministries and departments, commercial customers and local self-governing authorities.

Regardless of whether the issue of developing the urban planning documentation of any level is solved, or any management decision is made, it is necessary to analyze a considerable volume of information that is relevant and presented in a certain way. However, the reality is that every structural unit and every administrative department "protect" their information and do not share it eagerly with other agencies. That is why the information is usually duplicated in every department, and sometimes is distorted due to different approaches to obtaining, updating and analyzing information, i.e. it is difficult, if not impossible, to see the real state of things in the municipal entity or the entire region.

Basically data are stored in Excel spreadsheets or in databases, however, even in such form it can sometimes be quite difficult to analyze the whole volume of the information and present it in a user-friendly manner upon request of specialists or residents. It is even more difficult to speak about making a certain management decision on its basis, which will have a strategic focus. Thus, to present complete and reliable information on one and the same object, it is often necessary for multiple agencies to interact, and analyzing this information takes much time and financial resources. This is why errors and inaccuracies may appear in urban planning documentation; inflated operating costs of various infrastructures (improvements, transport support etc.); risks and additional costs for the investor both at the stage of land plot allocation and at the stage of architectural and engineering design, leading to overall increase of the investment project cost; errors of municipalities, leading to legal expenses and additional costs of error correction etc. Since there is no agreed scheme of interdepartmental interaction, there is a need to establish a common base containing all the information from all departments.

As an example, let us consider the development of a project of partly-urbanized territory planning: in order to determine the number of places needed in the newly designed pre-school institutions it was necessary to know the number of children of pre-school age, living in houses already built. The information was requested from the Department of education, Department of Federal Migration Service Directorate of the Russian Federation and Department of Health. Letters of reply were received. What is interesting, the number of pre-school age children in two of these documents was two times different. However, the number of children living in a certain territory is a definite value, which means there already was a certain amount of inaccuracy at the level of design project preparation. This inaccuracy clearly affects the comfort of living in this area, while the administration of the municipal entity does not actually have any reliable information.

It is therefore appropriate to conclude that every municipal entity is simply obliged, according to cl. 56 of the Urban Development Code of the Russian Federation [6], to maintain information systems for

urban planning (hereinafter ISUP) based on GIS technologies. However, in view of limited financial and human resources of required qualification, and requirements for provision of information security of such systems, the vast majority of municipal entities either maintains such systems nominally (for reporting only) or does not maintain them at all. In other words, the federal authorities granted these powers to municipal entities without considering, how these powers would be exercised.

The goal of information assurance of urban planning is to increase the efficiency of urban planning solutions in municipal entities, provide publicity, create conditions for growth of investment potential of the territories.

Here it is very important to be able to analyze a huge array of data from related industries. That is why the information contained in information systems for urban planning, as well as the basis of this system itself, can be used in various fields (see table 1).

Table 1. GIS application fields.

Field of application	Possible users
The information system for urban planning ensures compliance with the requirements of cl. 4 Ch. 7 of the Civil Code of the Russian Federation. [6]	Relevant departments of municipal entities and the Government of the subject of the Russian Federation. Private individuals and legal entities - in particular, - documents of unlimited use.
Maintaining a standby topographic plan of territory of inhabited localities and subject of the Russian Federation of various dimensions (initially – in electronic version, further – in digital version). In the future – creating a 3D engineering model of inhabited localities.	Relevant departments of municipal entities and the Government of the subject of the Russian Federation. Service recipients: design organizations, asset management companies, resource-supplying companies, private individuals etc.
Maintaining a standby address plan for inhabited localities of the subject of the Russian Federation.	Relevant departments of municipal entities and the Government of the subject of the Russian Federation. Separate units of special, municipal and emergency services (Emercom, Ministry of Internal Affairs, emergency medical service, gas emergency service, migration control service etc.)
Maintaining a standby plan of engineering communications (tracing, engineering network specifications, ownership, hydraulic models of pressure networks)	Relevant departments of municipal entities and the Government of the subject of the Russian Federation. Resource-supplying companies. Service recipients: developers, design companies, asset management companies, private individuals etc.
Maintaining a standby register of buildings and facilities (data on year of construction, designers and developers, technical specifications of objects and facilities, relevant drawings of buildings (in the future – 3D models), data on conducted repairs, data on resource consumption meters (water, gas, heat, electricity consumption) etc.).	Relevant departments of municipal entities and the Government of the subject of the Russian Federation. Asset management companies. Technical inventory bureaus. Service recipients: developers, design companies, private individuals, etc.

Field of application	Possible users
Maintaining a standby register of plantation in inhabited localities (location, species, planting year, measures taken etc.)	Relevant units of municipal entities. Asset management companies. Service recipients: developers, design companies, private individuals, etc.
Maintaining a standby register of geological and hydrogeological surveys (location and survey data by holes with indication of survey year and attachment of report)	Relevant departments of municipal entities and the Government of the subject of the Russian Federation. Various scientific and technical organizations (Lower Ob Basin Water Management Board, Institute of Geology of the Ural Department of Russian Academy of Sciences., Uralgidroekspeditsiya, etc.). Service recipients: developers, design companies, private individuals, etc.
Maintaining a standby plan of mineral deposits (developed deposits, survey data etc.).	Relevant departments of municipal entities, Government of the subject of the Russian Federation, Government of the Russian Federation. Various scientific and economic organizations (Institute of Economics of the Ural Department of Russian Academy of Sciences). Service recipients: investment companies, financial and industrial groups.
A system for monitoring and predicting traffic flows (location and operation of traffic lights, location of road signs (with reasons for their installation), collection of data from CCTV systems, data processing, information on the intensity of traffic flows at various time intervals and directions, determination of the parameters of gas contamination and noise levels in residential areas).	Relevant departments of municipal entities, Government of the subject of the Russian Federation, Government of the Russian Federation (especially State Traffic Safety Inspectorate). Service recipients: developers, design companies, private individuals and legal entities etc.
Maintaining a standby register on population (divided into age groups and location-specific, in the future – with data on places of employment, -education).	Relevant departments of municipal entities and the Government of the subject of the Russian Federation. Office for National Statistics. Service recipients: developers, design companies, legal entities etc.
Maintaining a standby register on motor vehicle registration (with reference to graphic map materials).	Relevant departments of municipal entities and the Government of the subject of the Russian Federation.

Field of application	Possible users
Inhabitant morbidity monitoring and prediction system (broken down by illness, age, place of residence and employment).	Relevant departments of municipal entities and the Government of the subject of the Russian Federation (especially the Ministry of Health).
The Natural Resource Potential system (assessment of the natural resource potential of the territory in terms of administrative and municipal division).	Relevant units of the Government of the subject of the Russian Federation (especially the Ministry of Natural Resources, Ministry of Economic Affairs and Ministry of Investment).
Telecom Operators Coverage Zones system	Relevant units of the Government of the subject of the Russian Federation. Telecom companies. Communication operators.
Specially Protected Nature Conservation Areas system (apart from map materials it includes the information from the State Inventory of Specially Protected Nature Conservation Areas, accounting information and regulatory framework).	Relevant units of the Government of the subject of the Russian Federation (especially the Ministry of Natural Resources). Ecological and environmental protection organizations.
Historical and Cultural Property Sites system (location, description, specifications of the protected sites, description of the protected site, - documents on renovation, protective legislation, historical references).	Relevant departments of municipal entities and the - Government of the subject of the Russian Federation (especially the Ministry of Culture). Monument protection departments. Non-governmental organizations. Service recipients: developers, design companies, legal entities etc.
Cataclysms and Emergencies of Natural Origin system (location, description, flood, forest fires, earthquake, landslide, karst hole prevention measures etc.).	Relevant departments of municipal entities and the Government of the subject of the Russian Federation.
Cataclysms and Emergencies of Technogenic Origin system (location and description of possible sources, possible consequence coverage areas of technogenic accidents, measures for prevention, localization and neutralization of such events).	Relevant departments of municipal entities and the Government of the subject of the Russian Federation.
Accounting and Management of State and Municipal Property in the Territory of the Subject of the Russian Federation system	Relevant departments of municipal entities and the Government of the subject of the Russian Federation.

Field of application	Possible users
Forest Administration of the Subject of the Russian Federation system (location, boundaries, quantitative and qualitative characteristics of forests, information on allocated plots, lumbering permits, lumbering and processing enterprises etc.).	Relevant departments of municipal entities and the Government of the subject of the Russian Federation.
Ecology of the Subject of the Russian Federation system (information on sources of water, air - basins and soils pollution, monitoring data (including comparative time analysis), pollution abatement and elimination activities).	Relevant departments of municipal entities and the Government of the subject of the Russian Federation. Ecological and environmental protection organizations.
Agriculture of the Subject of the Russian Federation system (data on location, boundaries, characteristics of the allocated agricultural land plots, zoning of the specific territory by preferred agricultural crops, crop data, etc.)	Relevant units of municipal entities and Government of the Subject of the Russian Federation (especially Ministry of Agriculture, Ministry of Investments, Ministry of Economic Affairs). Research institutions in agricultural sector. Service recipients: Business community.
Investment Sites of the Subject of the Russian Federation system (data on deployment, boundaries, characteristics of natural and engineering resources, human potential, examples of projects with calculated economic indicators).	Relevant departments of municipal entities and the Government of the subject of the Russian Federation (especially the Ministry of Investments, Ministry of Natural Resources, Ministry of Social development). Service recipients: Business community.
Science and Education system (location of scientific and educational facilities, description of activities (staff training), spatial and statistical analysis of data on the activities of organizations in the field of science and education, etc.)	Relevant departments of municipal entities and the - Government of the subject of the Russian Federation (especially the Ministry of Education and Science). The Russian Academy of Sciences and its branches. Service recipients: private individuals and legal entities, investment companies, business community.
Public Passenger Transport system (data on urban, suburban, long-distance routes of the transport system indicating the rolling stock, the timetable, the actual location of the rolling stock at a particular point in time, the number of passengers transported (in the future, information on the distribution of passenger flows).	Relevant departments of municipal entities and the Government of the subject of the Russian Federation (especially the Ministry of Transport). Service recipients: private individuals and legal entities, transport companies, business community.

Field of application	Possible users
Housing and Public Utilities system (data on buildings, engineering communications, transport facilities, technical condition, ongoing and scheduled repairs, analysis of efficiency of energy conservation measures, etc.)	Relevant departments of municipal entities and the Government of the subject of the Russian Federation (especially the Ministry of Construction, Ministry of Housing and Public Utilities, Ministry of Economic Affairs). Service recipients: private individuals and legal entities, asset management companies and homeowners associations, business community.

As K Norts noted, GIS are a powerful tool for business analytics and interaction with other enterprise systems.

Here, location data can be a versatile tool for advanced modeling, analysis, and processing of information. The ability of GIS to perform analysis and to interpret different information is what is relevant nowadays for most professionals in every company, because there is no need in searching and analyzing hundreds of analytic articles. They simply need to use the analytical capabilities of GIS to help benefit from the amount of the data available to them. And to achieve this, it is important to be able to find patterns in information, to eliminate redundancy and to make the right decisions. This can be done with modern GIS analysis capabilities based on BIG DATA technologies [7].

3. Conclusion

In these circumstances, Federal Universities have gained particular importance, serving as the only host to interdisciplinary staff able to quickly understand the complexities of subject-specific GIS and their construction, and to train a sufficient number of people for completely new professions. That is why it is important to involve the federal universities in the process of informatization and building of the country's digital economy. Federal universities should become centers for accumulation, storage, processing and use of spatial data in the territory of the respective federal districts, and state authorities (federal and regional) and local self-governing authorities should obtain regulated access to these data to enable analysis and the adoption of sound management decisions.

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