EARLY WARNING AND ENVIRONMENTAL MONITORING SYSTEMS IN THE CONTEXT OF ECONOMIC DIGITALIZATION

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Abstract

Digital technologies have completely changed the way of life of billions of people in just a couple of decades. Computers, smartphones, consumer electronics, information systems have become an integral part of work and life. The rapid development of digital technologies opens up a huge range of opportunities in various areas, including for solving environmental problems - from the creation of services for efficient waste management, monitoring and data collection systems, climate change observations, the search for charging stations for electric vehicles to the creation of systems that help prevent environmental disturbances and predict natural disasters. The development of society, the complication of its infrastructure require careful thoughtful resource management, mastering new means and methods of information processing, ways to quickly solve management problems, evaluate and control changing processes. In modern economic science, deep research is being carried out on smart city design methods: system dynamics, agent-based modeling, cluster analysis, and others. The conceptual models of the "smart city" are proposed to be based on the assessment of satisfaction with the conditions of the urban environment, taking into account the influence of multiple characteristics: the development of retail trade; food supply; housing construction; crowd behavior in emergency situations; distribution of harmful emissions into the city.

Keywords: Digital technologies, environmental problems, natural resources, environmental protection

I. Introduction

In various types of its activities, a person has long used a system of observations of objects or phenomena [1]. Already in ancient times, people could foresee the time of the flood, make an approximate weather forecast, etc. For example, the famous Greek philosopher Thales of Miletus (7th–6th centuries BC) became famous for predicting a solar eclipse (585 BC), and before him, Babylonian astronomers could quite successfully predict the eclipse of the moon. It is also reported that Thales once, foreseeing a rich harvest of olives on the basis of astronomical data, distributed a small amount of money as a deposit to the owners of all the oil mills in Miletus and Chios. When it was time to harvest olives, there was a sudden demand for oil mills. Then he began to give at the mercy of the oil mills contracted by him and, thus, greatly enriched himself. Or, for example, Anaximander, a student of Feles, predicted earthquakes, which is still a difficult task today [1].

Also, brilliant examples of the organization of observations of the natural environment are described in 37 volumes of "Historia naturalis" ("Natural History") by the Roman encyclopedist Pliny the Elder (1st century AD), which contained information on astronomy, physics, geography, zoology, botany , medicine, history, agriculture, and until the Middle Ages served as the most complete encyclopedia of knowledge [2]. As examples, one can also cite the well-known folk signs of the weather forecast, which have developed according to centuries-old observations, have been passed down from generation to generation and form part of the culture of most peoples [2].

By the end of the 60s. In the 20th century, as a result of observations and their analysis, almost all highly developed countries came to the conclusion that it is necessary to take urgent measures to prevent the deterioration and degradation of the natural environment. Later (in the 1970s) it became clear that a scientific approach to assessing the state of the natural environment and the development of models of interaction between society and nature were needed [3]. In connection with the powerful anthropogenic pressure on the natural environment and the rapid development of the technosphere, the main task of mankind at present is to find ways out of the current critical ecological situation. But in order to make the right decisions, it is necessary to have complete and reliable information about the state of the environment.

During the existence of mankind, especially in the 20th century, a large amount of factual material has been accumulated on changing nature, as well as natural-anthropogenic systems. However, in order to assess, predict and timely prevent possible adverse effects, special observations are needed, which would be carried out taking into account the links (direct and reverse) between human activities and the state of the environment. The term "monitoring" appeared before the Stockholm UN Conference on the Environment in 1972. Under the term monitoring (from the English monitoring - control, meaning - from the Latin monitor - the one who reminds, warns, overseer) it was decided to understand the system of continuous monitoring, measurement and assessment of the state of the environment [4].

At the same time (1972), the first proposals appeared on the need to create a Global Environmental Monitoring System, which has not yet been created due to disagreements in the volumes, forms and objects of monitoring, the distribution of responsibilities between existing observing systems and other problems. political nature. But in the future, such a system should take shape, becoming part of a single integrating process taking place in the world, called globalization. From the very beginning, two points of view appeared in the interpretation of the monitoring. Many foreign researchers proposed to carry out a system of continuous observations of one or more components of the environment with a given goal and according to a specially developed program. Another point of view (Yu.A. Izrael, 1977) proposed to understand by monitoring only such a system of observations that makes it possible to identify changes in the state of the biosphere under the influence of anthropogenic activity, i.e. monitoring only anthropogenic changes in the natural environment [4]. According to another Russian researcher I.P. Gerasimov (1975), it was proposed to consider a multicomponent set of natural phenomena subject to diverse natural dynamic changes and experiencing various impacts and human transformations as an object of general monitoring [5]. In recent decades, society has increasingly used information about the state of the natural environment in its activities. This information is needed in the daily life of people, in housekeeping, in construction, in emergency situations - to alert about impending natural hazards. But changes in the state of the environment also occur under the influence of biospheric processes associated with human activity. Determining the contribution of anthropogenic changes is a specific task.

By now, for more than a century, many developed countries of the world have been conducting regular meteorological, seismological, phenological and other observations that help to predict the future state of the environment with greater accuracy.

In 2015, the Department of Nature Management and Environmental Protection of Moscow and the state environmental budgetary institution Mosecomonitoring introduced an automated system for monitoring the environmental situation in the region, the main tasks of which are to collect, store, and analyze up-to-date data on the environmental situation in the region for government agencies. authorities and population.

II. Methods

The penetration of digitalization into all spheres of daily human activity on a global scale allows us to talk about the digital transformation of all sectors of production, the life of society and the formation of a digital society. It is noteworthy that the concept of "digitalization" is found in regulatory legal acts only from the point of view of reflecting its technical component and is understood as a transition from an analog form of information transmission to a digital one. Currently, the term "digitalization" is used in a narrow and broad sense. Digitization in the narrow sense refers to the transformation of information into digital form, which in most cases leads to lower costs, the emergence of new opportunities, etc. A large number of specific transformations of information into digital form leads to such significant positive consequences that determine the use of the term digitalization in broad sense. As a transition to digital information of all aspects of economic and social life, digitalization is turning from a simple method of improving various private aspects of life into a driver of global social development, ensuring an increase in the efficiency of the economy and an improvement in the quality of life. Therefore, digitalization in a broad sense is understood as a modern global trend in the development of the economy and society, which is based on the transformation of information into digital form and leads to an increase in the efficiency of the economy and an improvement in the quality of life [6].

In the broadest sense, the process of "digitalization" can be understood as a socio-economic transformation initiated by the massive introduction and assimilation of digital technologies, i.e. technologies for creating, processing, exchanging and transmitting information. The concept of digitalization for the social sciences is not unambiguous, does not have a generally accepted definition, a lot of work by various researchers does not contribute to the formation of a unified approach to the definition of digitalization [7]. Regulatory legal acts consider the process of digitalization mainly from the technical side, despite the widespread use of the concept. The uncertainty of the distinguished features of digitalization, the lack of consensus in the scientific community in its definition leads to the impossibility of using the concept to regulate the digitalization process. Digitalization in Russia is acquiring specific features, the main prerequisites for the formation of a digital economy in Russia are:

- development of physical infrastructure for Internet access,
- growth in the number of Internet users,
- development of e-commerce,
- development of the IT industry,
- development of the national e-government system.

Indeed, according to a report by the International Telecommunication Union, almost the entire population of the world now lives within the range of a mobile cellular network signal.

However, it seems that the use of neural networks as a control element, to improve environmental and economic efficiency or to predict pollutant concentrations in the atmosphere of industrial cities19 or for other purposes of implementing a smart city, does not introduce fundamental changes in its legal nature that would allow the formation and wide dissemination of a new term - neurocity. To scale the content of the Smart City Institute without its deep theoretical study and the formation of a consistent regulatory framework for implementation seems premature. Of the general questions regarding the development of the Smart City concept, it is

important to point out the existence of two main approaches to determining its features, characteristics and components [8]:

- technological (narrow), which takes into account only specific technical solutions, smart technologies and the degree of involvement of the information and telecommunications network "Internet" in the implementation of projects;

- comprehensive (broad), taking into account development indicators through the digitalization of all spheres of public relations, the presence of feedback and the degree of social activity in the electronic environment. The main indicators of project implementation from the point of view of a narrow approach are: involvement of residents in solving issues of local importance; digital traffic control systems; "intelligent" street lighting; public Wi-Fi network; the use of solar panels; SMS-alert of emergencies: refusal of cash payment for services and goods. According to representatives of this position, "Smart City" combines engineering, IT, business and social infrastructure to use the collective intelligence of the city [9].

Economic theory considers the city as a system of production and consumption of goods and services. The city is the center of economic activity, concentrating the functions of production of goods and services, their consumption, exchange, distribution. Thus, from the standpoint of the economy, the city is primarily the location of business and the totality of markets for factors of production. Summarizing, it can be noted that a city is a complex structure, including, on the one hand, an existing geographical object, on the other hand, an activity space (economic, social, cultural, etc.).17 Based on the foregoing, a city can be defined as a populated a point that is an industrial, economic and cultural center, has a developed infrastructure (social, industrial, engineering and transport), a certain number of inhabitants, most of whom are engaged in non-agricultural production and services, has an important (industrial, socio-economic, socio-cultural, historical) meaning.

The digitalization of the urban environment involves the creation of a modern city - a city open to the perception of everything new, with a developed infrastructure, which is managed using the most modern technologies (digital communications, computerization, automated control systems, in the future, the transition to the introduction of elements of artificial intelligence), a city with a developed structure of municipal government, involving a significant number of city residents in the process, a city with openness of city authorities to the needs of citizens, and the ability to respond flexibly to the needs of the population. Around the world, the urgency of numerous problems of cities has led to the search for ways to structure them and various models of solutions. Such cities are increasingly being labeled "smart". One way to conceptualize the concept of a smart city is to model it as a sustainable and livable city.

III. Results

The subject of regional monitoring, as follows from its very name, is the state of the environment within a given region [8].

Background monitoring, carried out within the framework of the international program "Man and the Biosphere", aims to fix the background state of the environment, which is necessary for further assessments of the levels of anthropogenic impact. Observation programs are formed according to the principle of choosing priority (subject to priority determination) pollutants and integral (reflecting a group of phenomena, processes or substances) characteristics. Pollutant priority classes established by experts and adopted in the GEMS system [9].

Determination of priorities in the organization of monitoring systems depends on the purpose and objectives of specific programs: for example, in regional monitoring, priority is given to cities, water bodies - sources of drinking water supply and spawning grounds for fish, therefore, in relation to observation environments, first of all, atmospheric air and fresh water are

studied. reservoirs. The priority of ingredients is determined taking into account criteria that reflect the toxic, radioactive or pathogenic properties of pollutants, the volume of their entry into the environment, the characteristics of transformation, the likelihood and magnitude of impact on humans and biota, and other factors. On the territory of the USSR in the 70s [5-6]. On the basis of hydrometeorological service stations, the National Service for Observation and Control of the State of the Environment (OGSNK) was organized, built on a hierarchical principle.

In a processed and systematized form, the information obtained is presented in cadastral publications, such as "Annual data on the composition and quality of surface waters on land" (according to hydrochemical and hydrobiological indicators), "Annual of the state of the atmosphere in cities and industrial centers", etc. To date, massive collections like "Annual data..." practically do not come to libraries. Some materials can be obtained (purchased) from the regional divisions of Roshydromet [10].

It must be said that the Unified System of Environmental Monitoring of Moscow began to be created in 1995. For 25 years, the system has undergone more than one modernization and today it works in accordance with the requirements of the World Health Organization (WHO) according to the directives of the European Union. At present, the Moscow Environmental Monitoring System is the largest and most modern in the Russian Federation and includes: 60 automatic air pollution control stations (18 million measurements per year); automatic systems for monitoring industrial emissions on chimneys (35 million measurements per year); 5 automatic noise control stations (276 thousand measurements per year); 1,300 sites for constant monitoring of soil conditions (7,000 measurements per year); 66 observation sites for the state of surface water bodies (32 thousand measurements per year); 1 automatic water pollution control station (259 thousand measurements per year); an observation system for dangerous geoecological processes (543,000 measurements per year); 130 sites for constant monitoring of the state of green spaces (200,000 measurements per year). The system is divided into 10 environmental monitoring subsystems by types of pollution. Air. Collection of data on the content of pollutants in the atmospheric air of the city. Analysis of the environmental situation of the city according to international standards (AQI). The soil. Collection of data on the state of soils in the city. Automation of reporting on the results of the study; Geological processes. Collection, analysis and storage of data on weather conditions. Cartographic link. Formation of analytical reporting. Weather conditions. Collection, analysis and storage of data on weather conditions. Formation of analytical reporting. Noise impact. Collection of data on the sound pollution of the city. Analysis of city noise pollution in conjunction with weather conditions. Ground water. Collection of data on the level, chemical composition and temperature of water in wells and wells of the city. Construction of statistical models based on the received data. The groundwater. Collection of data on the chemical composition of waters in open reservoirs of the city. Keeping statistics of excesses. Condition of green spaces. Maintenance of directories of green spaces of the city. Monitoring of the state of objects of observation. Automated reporting on research results. Industrial emissions. Monitoring the composition and volumes of industrial emissions from enterprises through automated data collection devices. Monitoring of environmental pollution. Automation of the process of obtaining results from mobile stations. Processing and storage of received data.

IV. Discussion

In terms of technology, the digital transformation of cities is based on several areas of information technology development - social communications, big data and predictive analytics, cloud technologies, artificial intelligence, mobility, "Internet of things", cybersecurity technologies,

digital platforms - these technologies are key to the whole range of technological solutions for smart cities. The digital transformation unfolding in the world affects key industries and areas that, on the one hand, are concentrated in cities, and, on the other hand, are integral parts of its life support: modern production, transport and mobility, energy, communications, housing and communal economy, trade and services, healthcare, education, municipal government systems. It is known that digital technologies provide the cheapest ways to solve many problems in the field of logistics, management, communications, allow regions to compensate for resource insufficiency, and increase the attractiveness of the living environment [8]. The Government's understanding of the need for widespread urban digitalization and concrete steps to introduce elements of a "smart" city are becoming important reasons that encourage the subjects of digitalization of urban spaces to work on projects in various cities of Russia. Challenges facing cities when carrying out the digitalization of their territory, they are complicated by territorial differences and digital inequality of territories. The digitalization of urban space will benefit not only large cities with developed infrastructure, whose residents have a large number of digital competencies, but also small towns, which are the majority in Russia. Large cities traditionally have not only great economic potential, but also experience large-scale projects in the field of digitalization, more opportunities to attract investors, and the absence of a staffing problem is also important [9]. At the same time, the administrations of small towns and rural settlements not only have less financial resources, but are also forced to solve infrastructure problems, independently train or attract personnel capable of servicing high-tech equipment, and also instill in local residents a set of necessary digital competencies. As one of the most important objects of management activity for the creation of a "smart city", one can single out the development of civil society and local government, the creation of a "smart society". The main objectives of this area will be: the creation of new mechanisms for interaction between government institutions and the local community, the formation (by analogy with electronic government) of a platform for interaction with citizens through information and telecommunication technologies, the inclusion of information resources of local governments in a single urban digital space.

"Electronic space" cannot function in isolation from the physical one, and the existing institutions of the public legal system, forms and mechanisms for solving state problems and issues of local importance are undergoing IT transformations, which are becoming the main trend of their further development. The digitalization of municipalities has a high potential for improving the quality of life on the ground, being also a necessary feedback mechanism and a means of involving the population in solving local issues. In addition, in the process of improving legal regulation and the implementation of certain digital technologies, local governments in the development of interaction with the population will move from information presence to interactive interaction. The development of practice-generated, conditionally spontaneous IT tools for solving local issues in the vast majority of large cities already contributes to an increase in the level of communication and information exchange, the formation of the possibility of electronically exercising public and municipal control, as well as solving local issues [10]. In many Russian municipalities, there are the necessary technological platforms and information resources for the parallel remote electronic implementation of direct democracy on places. Universal digital technologies have been tested that have a high potential for application regardless of the type of municipality, which in the most general form are referred to as "Smart City". The digitalization of municipalities has acquired particular importance in the fight against the coronavirus infection Covid-19 5: the work of state authorities and local governments for different periods, but in most cases was transferred to a remote mode. The legal regime of the pandemic mediated the mass acquisition of "digital skills" by the population, the use of IT forms of participation of residents in solving local issues (public hearings, discussions, polls, gatherings) and taking into account the

results of socially significant events online in the decisions of the authorities. It is generally accepted that the forced restrictions mediated the "digital leap" in every municipality [8]. Thus, despite the cross-border nature mediated by digitalization, with the help of new IT forms and methods, it is possible to resolve issues of local importance with real consideration of historical and local traditions, features and needs of each municipality, and to prevent a universal approach to the implementation of local self-government in Russian Federation. For the effectiveness of digitalization and maintaining the independence of local self-government, a certain basis of the constitutional system, the development of a unified concept and systematic legal regulation of the formation of innovative resources of municipalities of various types is of fundamental importance.

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