Environmental safety monitoring management of territories using modern technologies

M.V. Masaleva[1*] and *A.N.* Minkin[2]

[1] Moscow Timiryazev Agricultural Academy, 127434 Moscow, Russia
[2] Financial University under the Government of the Russian Federation, 125167 Moscow, Russia

Abstract. Modern scientific and technological development is connected with the development and integration of modern monitoring technologies and computer integrated manufacturing systems (CIM) into management processes. Computer Integrated Manufacturing (CIM) is an approach to management in various areas of production and activity, where computers and automated systems play a central role in all aspects of safety monitoring, including environmental safety of territories. Considered modern technologies and CIM provide an opportunity to integrate the management of all stages of environmental monitoring into one process, ensuring their rational functioning in one system. Importance and prospects of integration of modern monitoring technologies into automated systems of environmental safety management through the use of computer integrated manufacturing systems (CIM) contribute to creation of sustainability of development of territories in accordance with modern requirements of environmental safety. Transition to management of monitoring of environmental safety of territories with the help of modern observation means and computer integrated manufacturing systems (CIM) reduces the terms of realization of monitoring stages, automation of control that provides positive economic effect. A promising direction in the field of informatization of processes of observation of environmental safety and monitoring of its changes is the creation of new opportunities of modern observation technologies and computer integrated manufacturing systems (CIM) allowing to increase the functionality and their automation, including with the change and expansion of tools, observation, their spatial configuration in the real mode of modeling changes in the environmental situation.

1 Introduction

The study of Arctic security issues has recently been the subject of many studies [2], which address general issues related to the economic development of its territories, as well as the geopolitical interests of China, Western states, and the need to build defense infrastructure [1]. Also, much attention in scientific works is paid to the issues of climate change in the Arctic territories and ensuring their environmental safety [3-5]. However, in the author's

* Corresponding author: marissenka@mail.ru

opinion, there are not enough studies devoted to the issues of hazards and threats of emergencies of natural and man-made nature [4].

In recent decades, the relationship between society and the environment has become increasingly aggravated, becoming a real threat of global environmental catastrophe, so research is being conducted to create ecological innovations in order to find new more efficient and better models of balanced development of society, which will make it possible to reduce the pressure on the natural environment and contribute to improving the performance of both the economic well-being of enterprises and sustainable development as a whole.

The introduction of environmental innovations is associated with scientific and technological progress, which leads to qualitative improvements in the organization of production in society and provides an increase in economic, social or environmental effect.

Based on global trends, the following promising areas of environmental security can be identified:

– energy production and storage;
– energy saving;
– economical use of raw materials;
– environmentally friendly transportation;
– water management;
– bioplastics and polymers;
– application of waste-free and low-waste technologies;
– solar cooling
– environmental monitoring.

2 Materials and methods

Studying the basic patterns of information technology creation and operation is a modern need for disruptive risk management to achieve efficiency and effectiveness in security assurance.

As conclusions, it is suggested that:

1. to develop and improve in the territories of the zone monitoring and forecasting systems for changes in climatic and anthropogenic factors that create prerequisites for emergencies;
2. conduct research of information support in terms of development of models, algorithms and methods of management of forces and means of environmental emergencies prevention and elimination.

One of the methods of ensuring a balanced ecological state of safety environment is the introduction of innovations in the form of modern observation technologies and computer-integrated manufacturing systems.

The realization of this task is also associated with the development of information support aimed at improving, developing and implementing surveillance and monitoring systems, which results in the possibility of forecasting environmental emergencies. In addition, as studies [5] show, the use of information technologies can contribute to solving the problems of determining the need for resources for the prevention and elimination of environmental emergencies, their optimization of their use in conditions of limited capacity and the need for effective expenditure of financial resources.

Automation of environmental monitoring and surveillance processes makes the security of the environment more flexible and sustainable, processes for analyzing the information obtained helps to make informed decisions in managing the environment, and cloud services allow information to be stored safely and efficiently.

In today's system, environmental safety issues are faced with the challenge of managing various aspects of environmental project design. There is a need to continuously monitor the condition of habitats: areas, plants, irrigation systems, lighting, and the use of resources such as water, energy, and fertilizer without proper control and optimization.

Automated habitat ecology management systems play an important role in ensuring the effective functioning of landscape facilities, providing amenity, safety and environmental sustainability.

Such systems integrate various technologies and innovations to automate environmental management, maintenance and monitoring processes. The relevance of the problem stems from overcoming the complexities of plant and environmental care in a timely manner, ensuring improved quality and sustainability of green spaces. Automated environmental management systems for habitat ecology contribute to the creation of a comfortable and attractive environment that combines modern technology and natural beauty.

Efficient resource management is the goal of automated control systems by reducing the cost of optimizing the use of water, energy and other resources. Accurate and reliable operation ensures the maintenance of green spaces, which leads to reduced probability of errors and problems in plant care, provides optimal conditions for plant growth and health, leads to beautiful and well-maintained landscapes.

3 Results

Integration of innovative technologies into the system of environmental safety management is the result of analyzing and improving the systems of functioning of infrastructural objects as a prerequisite for the sustainability of development and functioning of the territories under consideration.

Creating smart systems that can adapt to environmental changes and save resources is important for sustainable and ecological urban development.

Technologies used in automated control systems:

- weather sensitive irrigation systems: automatic activation and deactivation of the irrigation system depending on rainfall, soil moisture and weather forecasts. Automatic irrigation system (AIS) — is a system that includes a network of pipelines, a pump station, a storage tank, a set of fittings for connecting the pipelines, a control panel, a weather sensor, a set of solenoid valves and a set of sprinklers, for uniform irrigation of the entire area of the plot without direct human involvement in the process [5]. "According to projections by the Organization for Economic Cooperation and Development, water use could increase by 55% by 2050" [3]. Therefore, every year the task of finding the most effective methods that would allow to use water resources most rationally becomes more and more urgent. Automatic irrigation provides an opportunity to insure against drought or, conversely, from excessive flooding of plants, and also avoids waterlogging of the site.
- fogging system - a method of watering plants allows to ensure optimal humidity and full irrigation of the soil at the right time. Fogging systems are able to reduce the air temperature in the garden or vegetable garden, in the flower bed, thus they stimulate normal development, growth of green plants, high yields. Fogger works almost like an irrigation system: the pump draws running water, it is cleaned and sprayed through pipes with nozzles. Many water droplets end up in the air. They immediately evaporate and fog is produced. This system helps to save from insects. Firstly, mosquitoes and gnats find it difficult to move in a dense cloud of water droplets. Secondly, if necessary, the system can be used to spray reagents to protect plants from pests [1].
- automatic mowers effectively care for lawns, providing regular mowing and maintenance of green spaces without human intervention. Lawn mower robot program precise runs

and the ability to work at night, allowing you to keep your lawns in perfect condition. The device requires the connection of an AC adapter, or the use of a specially installed base to recharge. The robotic lawnmower has compact overall dimensions and is quite quiet when working. There are models with different features and functionality available for different working areas, continuous operation times and travel paths [4].

– Motion-sensor lighting: automatic switching on and off of the lights depending on the presence of people or lighting conditions.

The main design feature of motion sensors is the presence in them of a special device that detects the appearance of a person in the radius of action, which provides automatic switching on of the light in the street lamp. But the action of the smart sensor does not end there: after a person passes a certain area after a set period of time, the light will automatically go out.

The operation of motion sensors in street lamps is based on the detection of infrared radiation zones, which always appear when a person moves. The device, with the help of an infrared indicator, detects the thermal radiation and signals a short circuit in the power circuit. As a result, the lantern, LED street lamp or floodlight on which the motion sensor is installed lights up [2].

The use of motion sensors in street lamps is an economical modern solution for organizing the illumination of a house, garden or park.

The use of unmanned aerial vehicle (UAV) in monitoring and visualization of landscape objects is expedient for clarification of site characteristics and planned cartographic materials. With the help of a drone, the operator can more fully and quickly assess the entire vegetation assortment present on the site and its condition. Compilation of a volumetric topographic model of the terrain with existing height differences and objects located on the territory, which will allow to more accurately form a topoplan of the territory and determine the scope of future work, significantly accelerate the pre-project analysis.

The following UAVs are the most popular for accomplishing the set tasks:

-VTOL –UAV is designed for surveying large areas;

- DJI Matrice 210 is a topodron with a professional set of tools, the payload of which enables to equip it for the task at hand (Figure 1);

Fig. 1. DJI Matrice 210 surveying quadcopter

- DJI Inspire 2 Topodrone – a fully ready-to-use and relatively cheap Quadro copter (Figure 2) [3].

Fig. 2. DJI Inspire 2 Topodrone surveying quadcopter

4 Discussion

Management of environmental safety of territories and habitats, its resource support is connected with formation of information support on the principle of system approach. The current state of information support of environmental safety, as well as the state of implementation of digital technologies, as the analysis shows, is insufficient. There are various reasons for this situation, and one of them is the lack of systematic use of information and digital technologies, as they function separately from each other, which leads to a situation of inconsistency in the implementation of preventive and operational measures to manage environmental risks.

The following should be identified as the main information support tasks

- Timely detection of incidents that pose an environmental threat to territories and habitats, as well as shortening of response times;
- Organizing the interaction of response forces and means for taking measures to prevent and eliminate environmental hazards that may provoke an emergency situation;
- Determining the level of resource adequacy to ensure environmental safety of infrastructure facilities;
- Forecasting the current and planned expenditure of resources;
- forecasting situations related to the possibility of hazards and their threats to life support facilities, territories and population living in the Arctic zone, as well as possible global security threats.

5 Conclusions

Automated systems for environmental safety management of territories provide effective management of natural resources, ease of operation and safety of facilities. Their implementation makes it possible to create innovative and environmentally sustainable solutions that meet modern safety requirements.

The development of new technologies such as artificial intelligence, the Internet of Things, blockchain and quantum computing promises even greater changes in infocommunications. These technologies can automate processes, improve forecasting, provide transparency and security of transactions, and create new opportunities for innovation and development.

Modern technology is not only changing our daily lives and interactions. It is important to follow the latest trends in the field, adapt to changes and use technology to achieve your goals and improve your quality of life.

References

1. T. Kosulnikova, et.al, E3S Web of Conferences **175,** 10017 (2020)
2. O.A. Melyakova, G.V. Kuchumova, E3S Web of Conferences **395,** 05006 (2023) https://doi.org/10.1051/e3sconf/202339505006.
3. S.S. Chebotarev, [et al.], *Regional aspects of monitoring in managing the development of national economic security* in Proceedings of 2019 12th International Conference "Management of Large-Scale System Development", MLSD 2019, 8911005 (2019) https://doi.org/10.1109/MLSD.2019.8911005
4. E.I. Cherdymova, K.I. Vorobyeva, O.V. Romashkova, [et al.], Ekoloji **27(106),** 1271-1278 (2018)
5. Yu. Kosenok, M. Danilina, V. Grigorenko [et al.], // XV International Scientific Conference “INTERAGROMASH 2022”, Rostov-on-Don, **574**, 1328-1334 (2023)