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Global Experience in the Use of Unmanned Aviation Technologies in Public Administration: a Review

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ABSTRACT

TUnmanned Aerial Systems (UAS), despite their relative novelty, are already an integral component of the general aviation structure, and, based on a number of complex and sophisticated solutions, including those related to artificial intelligence, are part of the spectrum of high technologies. UAS find application not only in the sphere of commerce, but also in the realisation of specific tasks of public administration, such as territory management, healthcare, emergency prevention and elimination, ensuring environmental safety and law and order, nature management. The purpose of the study, the results of which are presented in this publication, is to assess the current state and potential of the use of UAS in these areas based on a review of literature sources on the practice of their application in order to solve the tasks of public administration in different countries of the world. The main conclusion drawn from the analysis and characterising the general scientific novelty of the study is that, despite a significant number of specific examples, the breadth of UAS use range can be characterised as imaginary. The main and the only really significant application is various types of aerial survey in the interests of state control and supervision bodies. In the course of the work, a number of promising directions for the use of UAS have been identified. It is also noted that their wider implementation in the practice of public administration is hindered by the lack and/or imperfection of the relevant legal framework, typical for most legislative systems of the world, and postulates the need to actively address these issues in relation to the classification and certification of UAS, requirements for their operators and software, the procedure and rules of operation, the integration of unmanned aircraft (UAS) into the existing air traffic management system.

Keywords: unmanned aerial vehicles; UAVs; unmanned aerial systems; UAS; unmanned aircrafts; state administration; public administration

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INTRODUCTION

The current geopolitical and socio-economic environment is characterised by increasing systemic risks due to both crisis processes affecting the fundamental principles of socio-economic development, including models of sustainable development and globalisation, and local challenges, including the recent coronavirus pandemic or the current political situation in Europe. In such a context, the role of the state as a central regulator is increasing and the corresponding social expectations are formed, actualising the issues of improving public planning and management systems. The key direction of such improvement, in accordance with modern trends of social and economic development, is the integration of digital technologies (DT) into the public administration system. The latter naturally attract the attention of researchers, as evidenced by the impressive number of publications on this topic in both domestic and foreign periodicals. At the same time, some aspects of the application of digital and other "high" technologies in the implementation of the tasks and functions of public authorities have received, in comparison with others, much less coverage in the scientific literature. Such neglected issues may include the unmanned aerial systems.

The author's contribution to the development of the above-mentioned issues is his research into the current state, prospects, practice, and potential of unmanned aerial systems application in order to solve public administration tasks in different countries of the world. In the course of the work, the author analysed the place of digital technologies in the toolkit of public administration and considered the directions of specific application of unmanned aerial systems to perform certain functions of the latter. The methodological basis of the study was formed by modern general scientific research methods: dialectical method of cognition, target, and systemic approaches to the investigated set of problems, methods of comparative analysis, detailing and generalisation.

GOVTECH: DIGITAL TECHNOLOGIES IN SOLVING PUBLIC ADMINISTRATION TASKS

The expansion of digital technologies into various branches of human activity is uneven: the pioneers in this area are the financial and telecommunications spheres, while digital technologies are penetrating significantly into medicine and education. In this regard, terms such as "fintech", "biotech", "EdTech", etc., have become common, indicating the use of digital technologies in the relevant industries. Recently, the level of integration of digital technologies into various spheres of public administration (along with an assessment of the prospects for further development of a particular area) has led to the emergence of the concept of "government technologies" or "GovTech", considered as a platform of the "electronic state" ("smart state") and implying, first of all, the realisation of the potential of digital technologies for the development of communication and coordination mechanisms between the state, citizens and business [1], i.e., as a technology for the provision of state services.

However, the concept of "GovTech" is much broader than just the provision of public services in electronic form and covers a wide range of technologies that allow improving and optimising public administration processes. These include solutions in the field of paperless document management, technologies of "smart cities" and "digital regions" [2], monitoring and decision-making systems, electronic services in the transport, environmental and energy spheres, as well as in the field of public safety, etc. All these techni-

cal innovations are actively implemented in the world practice of public administration, which actualises the issues of accumulating and analysing the gained experience to determine the prospects and needs for further development of high technologies.

The experience of automation and digitalisation of public service delivery and document flow has been studied most fully [3]. There is a significant number of both individual publications in scientific periodicals and consolidated reports of international organisations — for example, the World Bank and the EU Joint Research Centre [4–6]. The completeness of the information published in them seems to be quite exhaustive, which is due to a rather long period of time that has passed since the beginning of the intensive introduction of digital technologies in the sphere of public service delivery.

Researchers' attention is naturally drawn to the application of artificial intelligence (AI) technologies in the processes of state planning and management, the development of which is characterised by an "explosive" nature in recent years. A number of researchers [7, 8], positively assessing the available experience of their application both for the purpose of proactive provision of some public services in specific life situations of citizens and in the sphere of assistance to civil servants in solving administrative tasks, advocate their active introduction into the practice of public administration and subsequent step-by-step solution of problematic issues arising in connection with the planning, development and deployment of AI systems. Other scientists, while paying tribute to the opportunities, prospects and advantages of AI technologies, are nevertheless inclined to caution the state and business about such potential consequences of their too hasty implementation as the displacement of many specialities in the corporate sector and in the civil service, which may lead to increased unemployment and social tension — according to the authors [9, 10], the issues concerning the limits of AI-technologies implementation at the current stage of socio-economic development and the degrees of freedom of artificial intelligence require a thorough public discussion involving the widest range of participants.

M. Ryan, recognising the solutions developed on the basis of AI in public administration as effective and diverse, emphasises the ethical side of the problem and the need for a high degree of openness and control over AI to ensure a proper level of legal responsibility for decisions made with its help [11]. T. Walsh and S. Mikhailov et al., analysing the prospects for the wide implementation of AI in public administration, compare it to a new stage of the industrial revolution, during which the key factor of scientific and technological leadership will be data, as well as algorithms and power of their processing [12, 13]. According to these scientists, AI will ensure the development and transformation of public policy under conditions of high uncertainty characteristic of the modern world, affecting all its spheres — from the provision of public services to the strategy of economic development.

As can be seen, the role of some governmental technologies has been studied quite well due to their widespread use; others have received increased attention due to the prospects offered by their extensive implementation, although their actual practical use is currently not so significant. At the same time, some digital technologies that have already been successfully implemented in the sphere of public administration do not arouse so much interest.

The latter include unmanned aircraft and unmanned aerial systems based on them, which, despite their comparative novelty, are in fact an integral component of the overall

aviation structure and undoubtedly part of the high-tech spectrum, based on a number of sophisticated solutions, including those related to AI. Unmanned aerial systems find a number of applications not only in the sphere of commerce, but also in the implementation of specific tasks of public administration. At the same time, such experience of their use remains practically ungeneralised and, even more so, unanalysed, and the majority of publications linking unmanned aerial systems and public administration are devoted to the issues of state regulation of this sphere.

APPLICATION OF UNMANNED AERIAL SYSTEMS TO SPECIFIC GOVERNMENT FUNCTIONS

At present, unmanned aerial systems are mainly used in the implementation of specific links in the functional chain of state monitoring, supervision, and control in various industries. The most widespread use of unmanned aerial systems today is in the sphere of prevention, detection, and elimination of emergency situations (ES).

Compared to manned aerial vehicles, unmanned aerial vehicles, as the world experience of their application in the sphere of monitoring, prevention and elimination of emergencies shows, are characterised by a number of advantages [14, 15]:

- high cost-effectiveness [unmanned aerial vehicles (UAVs) tend to be significantly cheaper than manned aircraft, both on their own and in operation];
- low-altitude (ability to perform tasks such as aerial photography or sampling at altitudes of 1 metre or above);
- pinpointing (the ability to obtain information on relatively small or hard-to-reach objects);
- mobility (unmanned aerial vehicles do not require specially equipped take-off sites and aerodromes, and the whole complex of unmanned aerial systems can be very compact and can be moved with the help of a passenger car, and in some cases manually);
- rapidity (the cycle of unmanned aerial vehicle application from travelling to the monitoring area to obtaining its results takes considerably less time than with the use of manned vehicles or satellite imagery and photography);
- environmental friendliness (unmanned aerial vehicles use low-power internal combustion engines or electric motors);
- no danger to the operator of the unmanned aerial vehicle, who controls it remotely.

The effectiveness of the application of unmanned aerial systems in this area is confirmed by significant accumulated practical experience.

One of the first cases of mass application of unmanned aerial systems for emergency response appears to be the 2014 flooding in the Balkans, when the displacement of large masses of soil together with minefields preserved from the war was recorded, with some mines being moved up to 20 kilometres away. Aerial photography from unmanned aerial vehicles provided images that were used to create a 3D map and geostatic modelling to determine the directions and distances of mine movement [16].

The area of emergency monitoring where unmanned aerial systems show significant effectiveness is the prevention and detection of natural fires. It is known that the effectiveness of firefighting depends directly on the speed of detecting fire centres, but it is very difficult to spot them in areas remote from human habitation. In this case, traditional monitoring methods are either very costly (aerial patrols by manned aircraft) or too slow (satellite imagery or ground patrols). The

experience of using unmanned aerial systems to detect wildfires in South Africa has shown that the average time to detect a fire, compared to ground patrols, has been reduced from several hours to tens of minutes at a much lower cost [17, 18]. Today, the use of unmanned aerial systems for these purposes is widespread in other countries of the world, including the USA and Canada [19], Australia, China, and Brazil [17], and in some regions of Russia [20]. In addition to monitoring the fire situation, drones can also be useful for extinguishing small fire areas [21].

An international team of researchers has developed a volcanic eruption prediction system based on a serial DJI Phantom quadrocopter retrofitted with spectrometers and gas sensors that determine the content of sulphur and carbon dioxide in the air near the volcano and directly in its vent. Analyses of the obtained data make it possible to predict with high accuracy the time of the next eruption [22]. For similar purposes NASA specialists have created and started using a complex based on a modified military unmanned aerial vehicle RQ-14 Dragon Eye [23]. Unmanned aerial systems are also used to collect other geophysical information, such as magnetometric data, in particular, for earthquake forecasting [24].

Hurricanes and tropical storms are another potential source of emergencies that require careful study and constant monitoring. This problem is most acute in the USA, and therefore it is there that NASA, NOAA and Northrop Grumman Corporation jointly developed and implemented a system of meteorological data collection and observation of hurricane development based on heavy unmanned aerial vehicles. This made it possible to significantly accelerate the detection of potentially dangerous atmospheric vortices compared to traditional methods of observation from manned aircraft and satellites [25].

An interesting example demonstrating the wide range of possible applications of unmanned aerial systems for monitoring and disaster prevention is their use to detect sharks near beaches in Australia and the USA. A joint project between Duke University and North Carolina State University in Chapel Hill (USA) has developed a fully automated drone-based system for the detection of dangerous hammerhead sharks.

A related area of application of unmanned aerial systems in the public sector in relation to emergency monitoring is environmental monitoring carried out within the framework of the relevant branches of state control (supervision). As a rule, in this area unmanned aerial vehicles and systems based on them are used to solve some specific tasks.

For example, since 2014, Mexican authorities have been using unmanned aerial systems to monitor beaches that are breeding grounds for sea turtles and to combat poachers. In Kenya, unmanned aerial systems patrolling nature reserves and national parks are also used to detect and prevent poaching, which has significantly (up to 96%) reduced the number of such crimes [26]. In the People's Republic of China, unmanned aerial systems are regularly used to monitor air pollution over industrial enterprises, power plants, and other potential sources of harmful emissions [27]; unmanned aerial vehicles are occasionally used for similar tasks in other countries (USA, Italy, France). In Denmark, unmanned aerial systems are used to monitor sulphur and other undesirable substances in the exhaust gases of ships travelling through the Great Belt Strait, which makes it possible to significantly reduce the time required for their passage through the strait, since the analysis is carried out without stopping the ships and having the measuring team board

them.[1] Unmanned aerial systems are used in India, Brazil, and a number of other countries, including Russia, to monitor forests, including detection of illegal logging sites [19].

Unmanned aerial vehicles are used in polar ice melt monitoring, where they provide more accurate data than satellites, as well as in assessing plastic pollution of the world's oceans, monitoring rare and endangered species of animals and other tasks related to the collection and analysis of data on the state of the environment, which are then used in making administrative decisions.

It is possible to note a number of other areas tested in practice, where unmanned aerial systems can be involved in solving the tasks of public administration: land monitoring, including assessment of the state of land resources, detection of illegally occupied and misused land plots, cadastral surveying of land [28]; monitoring of water bodies [29]; inspection of linear infrastructure facilities [30]; ensuring road safety [31], and others. However, the scope and objectives of this study do not allow us to consider each of them in detail.

CONCLUSIONS

In the course of the study, it was established that despite a significant number of specific applications of unmanned aerial systems in solving public administration tasks, the range of their use cannot be called wide. The main and, to date, the only really significant area of operation of unmanned aerial systems is various types of aerial surveys in the interests of state control and supervision bodies. In this regard, the possibilities of using unmanned systems in public administration seem far from being exhausted — on the contrary, the potential of drones is only beginning to be implemented. Based on the analysis of scientific and industry publications, it is possible to identify a number of promising areas of application of unmanned aerial systems for solving tasks and fulfilling functions of state administration:

1) cargo delivery (air logistics). It can be implemented wherever it is less expedient to solve transport tasks by traditional methods due to time and financial constraints. In the short term, the most relevant is the introduction of unmanned aerial systems in the implementation of health care and emergency response tasks (delivery of medical supplies, rescue packs, food, fuel, clothing, etc.). However, in the future, provided that unmanned technologies become more widespread and cheaper, unmanned aerial systems may be used, for example, in regular supply of remote settlements and special institutions (meteorological and polar stations, stationary forest guard posts, etc.), and later — in solving other transport tasks as well;

2) human transportation. It is often combined with the previous type of use of unmanned aerial systems into a general (logistic) direction, but due to the increased requirements in this case both to the unmanned aerial vehicles themselves and to the air traffic organisation, it seems reasonable to consider it separately. While cargo delivery is a fully operational (even if in experimental mode) technology, the transport of people using unmanned aerial vehicles is currently considered only as a potential use. Nevertheless, as in the previous case, the most likely development of this area is in the field of emergency medical care and disaster medicine, and only afterwards — in other areas of activity;

3) monitoring. As mentioned above, it is currently the main regular use of unmanned

[1] Danish Authorities Use Drones to Monitor Sulfur Emissions of Ships. The Maritime Executive. 2020. URL: https://www.maritime-executive.com/article/danes-use-drones-to-monitor-sulfur-emissions-of-ships. (accessed on 20.02.2023).

aerial systems in solving public administration tasks. At the same time, this direction is also characterised by the greatest potential for further development. In the near future, we can expect a wide introduction of unmanned technologies in the field of monitoring of fires and other emergency situations, as well as transport situation, inspection of linear objects (railway and energy infrastructure, gas and oil pipelines), etc., including aerial reconnaissance and protection of territories and objects;

4) distribution of substances, including firefighting, aerial chemical operations in agriculture and forestry, application of reagents for oil spill response and soil binding, etc.;

5) communication support. It implies the use of unmanned aerial vehicles as satellite and radio signal repeaters when deployment of fixed and land mobile communication systems is impossible or inexpedient — in emergency situations, in places of short-term stay of the users, in case of temporary increase of load on communication systems, etc.;

6) educational, sports and cultural and entertainment applications of unmanned aerial systems include their use for developing engineering and technical competences of schoolchildren and students, organising relevant sports competitions ("drone racing", sports navigation) and for creating visual effects (at entertainment events, in advertising, etc.);

7) physical interaction with objects. It potentially includes a wide range of applications of unmanned aerial systems in various fields of human activity — construction (high-altitude installation works), housing and communal services (sawing trees, cleaning windows and facades of buildings), emergency prevention and response (warning, rescue works), science and environmental protection (sampling), etc. The use of unmanned aerial systems in this area is also very promising. This area is, along with human transportation, the least developed and, at the same time, very promising one.

Progress and widespread adoption of unmanned aerial systems is hampered primarily by the fact that they are based on a number of complex technologies, many of which are still under development. Until significant progress is made in some areas, many of the most innovative applications of unmanned aerial systems will remain at the conceptual or experimental stage. These technologies include, but are not limited to: autonomous flight, battery performance, collision detection and avoidance, and integrated air traffic management systems — Unmanned traffic management (UTM).

In many respects, the lack or imperfection of a legal and regulatory framework also hinders the wider implementation of unmanned aerial systems in the practice of public administration. This problem is characteristic of legislative systems in most countries. In developed countries, the tasks of developing adequate regulatory support in the field of classification and certification of unmanned aerial systems, requirements for their operators and software products, defining the procedure and rules of operation, integration of unmanned aerial vehicles into the existing air traffic management system are being actively addressed.

Our country has also adopted a number of relevant regulatory documents, but Russian legislation in this area is invariably assessed by experts as "imperfect". However, on 30 December 2022 the President of Russia V.V. Putin approved the List of instructions on the development of unmanned aircraft systems,[2] according to which the solution of the tasks of

[2] List of instructions on the development of unmanned aerial systems. URL: http://kremlin.ru/acts/assignments/orders/70312 (accessed on 20.01.2024).

elaboration and implementation of the state policy in this area has been intensified to a great extent. It is expected that this will contribute to a wider integration of unmanned aerial systems into various fields of activity, including the sphere of public administration.

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