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Possibilities and Restrictions on the Use of Unmanned Aircraft Systems in Security Work in Latvia

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Vilnis Veinbergs
Turība University

Ivita Kisnica
Turība University

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Abstract

Unmanned aircraft systems (UAS) have become available not only in the military environment, but to every member of society. They can be effectively used in security work, although, if used unprofessionally, UA can pose a threat to the public or the protected object. The aim of the article is to find evidence that the use of UA for the protection of a security object can be of a technical nature. With the introduction of UA as a part of technical equipment for security work, it would be possible to immediately inspect the guarded object and track and/or detain persons with criminal intent, or transfer the data obtained by the video camera recording system to the State Police. The primary data of the research was collected using the survey method, where the general set of research was compiled by security companies that have received the required license for the provision of Technical Security by the State Police. The experience of using UAV in Latvia and in the international environment has been analysed using the case study method; secondary data has been obtained from statistical databases and scientific literature, as well as from publicly available sources. The results of the research theoretically reflect the effectiveness of the use of UA and UAS in security work, which will provide an opportunity to reasonably conduct practical research in the security industry environment.

KEYWORDS: security work, technical support, unmanned aerial vehicles (UA), unmanned aerial systems (UAS), drones.

Introduction

It is human nature to constantly look for easier ways to survive and to live, to develop values, to gain wealth and to protect it. Such a "drive" encourages the diverse development of different technologies and technical solutions.

In order to use recognizable and regulatory abbreviations in this study, the authors of the study use the terms and concepts defined in the EU Commission Delegated Regulation (EU) 2019/945 on the service of unmanned aircraft systems and third country unmanned aircraft systems' operators. An unmanned aerial vehicle (hereinafter - UA), is any aircraft operated or designed for autonomous operation or piloting from a distance without a pilot in the aircraft, but unmanned aircraft systems (hereinafter - UAS), are unmanned aerial vehicles and the equipment used to control it remotely.

Influenced by the rapid development of technology, opportunities for the use of UA have been discovered in agriculture (Muraru, Cardei, Muraru, Sfîru, Condruz, 2019); forestry; construction; in conducting fire detection and its localization as well as in search and rescue work, to name

a few (Brohi, Jhanjhi, 2020; Schulzke, 2018). For example, in agriculture one of the uses is the honeybee fertilization, where UA has great potential to improve the health of the honeybee queen and the whole colony (Brutscher, Baer, Niño, 2019, 18). With the use of a non-traditional type of counting, the UA has shown that, with the digital video and camera capabilities, the system is able to accurately count waterbird populations in previously inaccessible locations (Dundas, Vardanega, O'Brien, McLeod, 2021, 11). The use of UA promotes research on a variety of animals, such as formerly unavailable shark behaviour research (Butcher et al., 2021, 22), as well as UA's successful disaster assessment and human rescue efforts (Eames et al., 2021, 14).

Considering the diversity of the UA models and the variety of their size dimensions, as well as the diversification of UA technical structure solutions and the development and use of data storage and transfer technologies, UA as a base carrier or as a transport, can be practically used in the economic sector or in a number of the security industry sectors.

This article seeks evidence that the use of UA is recognized as practical in a wide range of economic sectors, as well as whether the use of UA, as shown in several studies noted in the work, is effective and usable in safety work. In addition, taking into account the specifics of security work, the article discusses the rules of UA flights and the use of UAS.

In order to find out the attitude of Latvian security industry companies in relation to the use of UA and UAS in security work, the authors of the article have conducted an empirical study to find evidence that the use of UA in security protection is important technical support to improve the work. The authors of the article, when started the research, put forward a hypothesis - a Latvian security company uses UA and UAS in security work.

The empirical study was based on the survey method using both semi-closed questionnaires in electronic format and using the telequest method (phone-phone).

The results of the empirical research are maintained and reflected in the Research results and the Discussion section of the article.

The historical experience and diversity of unmanned aerial vehicles

In order to learn the experience of using UA in different industries, the authors of the article study the research available in scientific databases. Despite the fact that not all research is directly aimed at investigating UA-specific flights, UA equipment, that has been deployed on a flying device, can be valuable for security work.

UAS historical experience

The vast majority of society do not think about the ways how various practical things became obvious to use in everyday life. That is, preserved food in metal cans, high-strength glue, also knows as "super glue", high-strength adhesive tape used in plumbing and elsewhere, night vision devices, the Internet, which today is an integral part of everyday life for the society, and a few dozen more goods which were initially classified and used solely for military needs, but now is a part of our daily lives. One of the latest innovations in the civil society is the digital camera, which initially was used as a military equipment deployed on spy satellites in the 1970s to obtain high-definition data.

It is believed that the first purpose-driven unmanned aerial vehicle was built in 1849, when Austrian Empire's air balloons with explosive bags attached to them were sent off over Venice to blow the besieged and starved place from a height, in order for it to surrender. However, the origin of this UA is quite primitive and was influenced by the wind flow, but the detonation of explosives was controlled by thin copper wires (RPAV, 2003). Similarly, using wind power in 1898, during the Spanish-American War, the U.S. military equipped the so called “dragons” with cameras to obtain

data on enemy fortification positions (Nguyen, 2019). During the Second World War, the German side invented the anti-tank guided missile (ATGM); in Russian *Противотанковая управляемая ракета* (ПТУР), and from 1944 to 1945, the Germans were able to fire more than 100 test shots. This UA/rocket was further developed by both Swiss and French designers. As technology developed, so did the above-mentioned equipment, and since the 1990s, when the United States used Predator and Hellfire to launch missiles (Tristam, 2019) in order to destroy ground targets during various conflicts, UA has been controlled at a higher level and the ideological direction and the tasks entrusted are comprehensively usable. This is confirmed by Koslowski and Schulzke: "UA shows how military technology interferes in non-military security strengthening operations" (Koslowski, Schulzke, 2018, 320).

Application of UA in a multidisciplinary environment

Today, there are a considerable amount of researchers who spend time researching the advantages, technical solutions and disadvantages of UA and UAS, or even their negative consequences.

According to Romanian researchers, the use of UA to obtain surveillance data for public protection and security is highly beneficial, "The breakthrough in the development of artificial intelligence and deep neural networks opens up a new perspective for providing such solutions with human accuracy". A study on new solutions was carried out at the Polytechnic University of Bucharest, which, by automating the processing of identification data of persons and objects, made it possible to take immediate action without wasting time on manual data processing (Ionescu, Ghenescu, Răstoceanu, Roman, Buric, 2020, 2; 6).

The UAs used to fertilize the honey bee queen have proven to be a valuable partner. The queen bee mates with several male bee type UAs. Therefore, at the very beginning of her life, the queen obtains sperm to fertilize the egg for the rest of her reproductive life (Brutscher, Baer, Niño, 2019).

UA was used in topographic works to obtain microtopographic data, which allowed to obtain high spatial resolution images from a sensor height of 100 m and a swath width of 171 × 128 m, from which were calculated the height differences in the study area (Lou, et al., 2021).

To find new insights into the behaviour of sharks and to change the society's dogma that sharks are "death machines," a team of researchers used UA to track sharks from the air, which allowed data to be obtained quickly and over long distances with a high degree of efficiency. Researchers note that documenting the behaviour of sharks in other ways is difficult due to their aggressive and sporadic nature, but UA offers an opportunistic method of data collection that greatly facilitates the work (Butcher, et al., 2021).

A special program using UAs was set up to identify and neutralize rebels in Pakistan. Intelligence analysts, using data from long-term air surveillance and interception of communications, identified the insurgents, which made it quick to target them (Mir, Moore, 2019; Restrepo, 2019).

Within the framework of a joint project of European and African scientists, the fire safety of African savannas was studied, or more precisely - the material of burning savannas. Using UA in South Africa and Mozambique, the researchers explained the effects of different fractions of combustible materials (shrubs, bark, broken trees, grass) on ignition. UAVs, equipped with multispectral cameras, along with meteorological data from ERA-5 obtained the necessary data to model the degree of fire hazard (Eames, et al., 2021).

A valuable assessment of UA usage was given in the human searching work in a post-disaster environment using signals received by the phone. UA communicates with mobile devices that help with human search as it travels through the rubble of the disaster. "Extensive simulations

have been performed and the results have shown the benefits of the proposed scheme from both a drone and a survivor perspective" (Mezghani, Mitton, 2020, 16).

Researchers in Australia used quadrocopter-type UA in their research to survey koalas. Digital thermal imagers were installed on the UA, as well as using the DJI Pilot (Android) UA motion, programmed in parallel with linear motion - the lawnmower principle, with 10% coverage. In addition, stationary surveillance cameras were placed on the ground, as well as cameras with a 4K colour camera technology (Witt, Beranek, Howell, Ryan, Clulow, 2020). In the survey area searching for a living / warm object with thermal cameras is a promising and effective method that can be an alternative to high-energy floodlights.

Belgian and others researchers are proposing a new approach to detecting oil spills in port areas. The researchers have come to the conclusion that by using UA and thermal infrared cameras, it is possible to detect the fact of oil spills quicker, thus reducing natural pollution and the cost of oil product collection works. Researchers suggest using UAs equipped with cameras with other capture spectra, such as shortwave infrared or hyperspectral imaging cameras (De Kerf, Gladines, Sels, Vanlanduit, 2020; Duan et al., 2020).

An important support for ornithologists are the UAS, that are able to quantify the number of birds more accurately compared to the traditional method of human walking and counting from the ground. This is especially important in larger bodies of water and larger groups of birds. For work, UAs were equipped with a 20 MP camera at 60 frames per second (Dundas, Vardanega, O'Brien, McLeod, 2021). Ibid., Researchers observed that UAS can be valuable in open areas, in the countryside, and in water bodies, but are considered problematic for accurate quantification of birds or animals in all habitat types. This can be hampered by shrubs and grasses, where birds often nest and are virtually impossible to observe from above.

Thanks to small-scale UA and UAS technologies as well as reasonably located UAS battery charging stations, border control costs can be reduced, both by reducing the cost of using live force to patrol the surveyed area and by installing fencing and other specialized control and protection equipment. Small UAs consume little energy, which allows them to survey larger and more remote areas, as well as places that are inaccessible to humans. In addition, the UA is able to replace the batteries in the base charging station by itself in offline mode. UAS, detecting a significant loss of battery capacity, goes to the base charging station, where, by disconnecting the spent batteries, is able to insert the charged batteries by itself (Mirzaeinia, Hassanalian, Lee, 2020).

Avoiding border guards from visually heavy and grand walls, barbed wire and other types of wire, UAS fencing is virtual, which pays little attention to the public and the media (Koslowski, Schulzke, 2018).

The information obtained above shows that the experience of nationally important and confidentially developed equipment and evolving technologies is being taken over in the multidisciplinary non-military / civilian life.

In the first chapter, the authors of the article have found evidence that UA and UAS are used comprehensively and in most industries. Different variations in UA sizes, specifications, and equipment are applicable for security operations. Quadcopter-type UA is a successful solution for inspecting a guarded object, both obtaining data statically and at a certain height as well as when moving vertically and horizontally. It should be noted that the effectiveness of the UAS for the protection of a specified object is also observed in the fact that it can be used in places that are difficult for people or equipment to access, such as bushes, swampy environment, water, etc. When providing security services, three types of UA can be used: in the air - UA, in water - unmanned

underwater vehicle, on land - unmanned surface vehicle. These three types of devices or groups of devices can be controlled in one system, or each group can have a separate, autonomous control system (Dghaym, et al., 2021).

UAS is recognized as a successful solution when applied in automatic mode in cases when the guarded object is located in remote areas and the security staff patrol is not able to inspect it in time. Accordingly, by equipping UA with video or photo techniques emphasizing different spectra, it would be possible to trace the subject of a criminal offense and gaining an evidence base for proving a crime. UA minimizes the human factor, saves capital on the salaries of patrol staff and technical means of transportation, and makes it possible to carry out surveillance in areas where the access is difficult or completely denied, etc.

In this chapter, the authors have found evidence that the use of UA and UAS is a good support in many sectors of the economy, as well as successful in scientific research, however, is the use of such a technical solution so safe and complete, or does it have negative consequences? The answers to this question are sought in the next section.

Introduction to UAS application problems

When using UAS, the data acquisition and processing issues should be taken into account (Lemaire, Crispim-Junior, Robinault, Tougne, 2021). Since the flying objects with cameras are noticeable in Latvia, we all feel worried whether our privacy will not be violated. UAS provides unprecedented opportunities not only to monitor the protected area, but also anyone living in their movement route and data acquisition sector. Regarding the amount of delicate data, US researchers point to the situation where the use of UAS improves certain aspects of border security while creating data leakage risks that should be avoided (Koslowski, Schulzke, 2018). Leakage of acquired data and loss of control of the UAS may cause interruption of service, leakage of information or, if the control is taken over by a third party, endanger the protected object or another person. The solution to this problem is found in smart contracts based on blockchain technology, which helps to manage the security of sensors and devices, creates UAS smart contracts with different ledgers and platforms, and offers a high-level approach with a conceptual framework (Chinnaiyan, Balachandar, 2020). In addition, the use of UAS requires a well-trained technical support and control panel staff, an invulnerable control system algorithm and the security of its protection against unauthorized technological intrusion (Radu, Remzi, 2017; Yañez-Badillo, et al., 2020). UAS technological advances and the improvement of information processing technology are only part of the success. The key to success is considered to be the competence of the UA pilot and the degree of pilot's professional training, especially in driving the UA out of sight and in various meteorological conditions (Butcher, et al., 2021). Studies on the use of UA in beach rescue operations (Del-Real, Díaz-Fernández, 2021) indicate that about half of the beach holidaymakers would be satisfied or they would not be uncomfortable in situations where UA would be used to inspect or rescue beaches. In addition, in a 100% urban environment such as Singapore, people have more trusting attitude towards UA and its presence is less negative in comparison to people's from rural areas. However, small UAs can cause the drivers to pay extra attention, distracting them for a few seconds, which can increase traffic or number of accidents (Tan, Lim, Park, Low, Yeo, 2021).

Some studies point to the negative effects of the noise caused by UA. Part of the public may experience discomfort, unpleasant associations with life experiences such as the effects of humps and bee bites, or discomfort while being in their own private area where they should feel safe and protected from data leakage. However, "someone" may obtain personal data without author-

ization. Also, at the subconscious level, the perceived noise makes humans nervous and raises anxiety levels. A study carried out by the European Commission on aircraft, road and rail noise shows that there are slight differences in the impact thresholds for a given transport, but it is the aircraft noise that is more harmful than noise from other types of transport. (European Commission, 2002). There are also discussions of a similar nature about power plants - the shaft rotor blades of generators installed in wind farms generate similar air splitting noise as UA. Moreover, UA propeller noise is complemented by engine noise. For these and other reasons, studies have recognized that UA-induced noise is a factor that can put public pressure on the use of UAS (Tory, Clark, 2021). However, the noise generated by UA during the provision of security services can be positive, as this noise or psychoacoustic approach can serve as an initiator of discomfort to a person guided by a criminal intent to deter or partially restrict criminal activity.

The comprehensive experience and consequences of the use of UA and UAS have prompted the public to pay close attention to the conditions of use of UAS. Therefore, in March 2019, the EU Commission delegated Regulation no. 2019/945 which lays down requirements for the operation of unmanned aircraft systems and the design, manufacture and maintenance of remote identification devices as well as their marketing in the EU environment and for the operation of third country UAS in the single European sky. In May 2019, the EU Commission issued Regulation no. 2019/947 which specifies the UAS operating standards and the regulation of the activities of the persons involved in this process, including remote pilots and organizations.

Legal framework for the use of UA and UAS

In the interests of the citizens of the Republic of Latvia, the use of all types of state airspace is regulated by the Law on Aviation. Within the competence of this Law, an additional regulatory framework is issued, which clarifies, explains and indicates the conditions for the safe use of state airspace for civil and military aviation. At present, UA flights in Latvia are regulated by Cabinet Regulation No. 368 of 13 August 2019 "Procedures for Unmanned Aircraft and Other Aircraft Flights", but they will be in force no later than the 1st of July, 2021. In accordance with the Law on Aviation, the Cabinet of Ministers of the Republic of Latvia plans to issue unmanned aircraft flight regulations, which should enter into force no later than the 1st of July, 2021. In this regulatory enactment it is planned to determine the criteria for the use of UA in the airspace of the Republic of Latvia, the procedure for facilitation, restriction and prohibition of their flights, as well as to determine the procedure for the circulation of information required for unmanned aircraft flights. The full deadline for the implementation of the relevant regulations is set for the 1st of January, 2023.

Starting from the 31st of December, 2020, security companies that use UAS to provide a service must register as operators. An operator in accordance with EU Regulation No. 2019/945 means any legal or natural person who operates or intends to operate one or more UAS. The operator is the owner of the UAS, but the remote pilot is the person responsible for the safety of the UA flight, both manually controlling the UA and monitoring the UA flights in automatic mode with the possibility to intervene and take control of the UA at any time.

Implementing Regulation No 2019/947 provides that Member States have the possibility to create their own specific airspace structure - UAS geographical areas, where the flight conditions must be complied with by all UAS operators and remote pilots. These restrictions mainly concern the distance from the defined area, meaning, not exceeding 50 m in the horizontal plane, except up to 500 m from prisons and military facilities, including static warships in the port area and at sea, and to be used not closer than 5000 m in the horizontal plane from a certified aerodrome runway threshold or a helicopter aerodrome control point.

In instances where the density of crowds restricts the free movement of people and the avoidance of a crashed UA, such as public events, shopping malls and marketplaces, the UAS operator

must provide instruction and make sure that people are aware of the risks and know how to act in an emergency. Choosing the fastest, shortest and safest flight path outside human dense areas and for a flight at a height of no less than 30 m above the ground or water surface and no less than 10 m above the obstacle, avoiding overflights of people, animals, buildings and structures as far as possible, but no higher than 120 m from the ground or water surface, it is planned in the regulations of the Cabinet of Ministers to allow UA to fly over the properties owned by third parties without the consent of their owners, possessors or users. Such a condition is considered positive for a security service provider using UA.

An assessment of the main legislation on UA flights and the use of UAS shows that they are comprehensible and specifically point to prohibitions or restrictions on the use of UA and UAS. According to the authors, the legal references reflect the public concern for the protection of both natural persons and objects important to the state and the EU, which does not preclude the use of UA in security work outside the restrictions and prohibitions.

In the following section, the authors of the article summarize and reflect the results obtained in an empirical study on the attitude of Latvian security industry companies in relation to the use of UA and UAS in security work using the survey method.

Research methodology

In order to achieve the aim of the study to find evidence that the use of UA in the protection of the security object is an important technical support to improve the quality of security work as well as to learn the security industry's opinion on the use of UAS in security activities, the authors of the article based the study on primary data obtained in the period from the 15th of January to the 20th of February, 2021. The sample of research respondents consists of security companies, which in accordance to the provisions of Sections 3 and 6 of the Security Activities Law are entitled to provide technical security services. According to the State Police database (State Police security industry licenses, 2020), by the end of 2020, the number of 41 security industry companies have received licenses for the provision of technical security in Latvia. In order to learn whether the difference of opinions between the respondents is based on the duration of the service, we divided the sample of respondents into 5 groups.

Table 1

Numerical division of Latvian security companies according to their experience in the duration of security service provision

Source: Authors'

Up to 5 years	From 6 to 10 years	From 11 to 15 years	From 16 to 20 years	Over 21 years	The whole sample of respondents
2	4	7	6	14	33

The sample of respondents received partially closed questionnaires in electronic form, to which 7 respondents replied. The remaining 34 respondents were identified by the authors of the article using the telesquest method (phone - phone). 26 respondents responded to the telesurvey. Therefore, a total of 33 respondents participated in the study, which is 80.5% of the possible. The respondent companies employ from 30 to 1200 employees, but the number of guarded objects of the companies involved in the survey ranges from 1 to 1600.

Research results and the discussion

The results of the survey indicate that none of the surveyed companies used UA or UAS during the provision of security services. However, 9% of respondents have taken the UA for a test. This shows the interest of the security industry in the use of modern technologies for the provision of the service, as well as to invest in the acquisition of new technologies and integrate them into the support group for the technical means of providing the service.

Different perceptions are formed about the reasons for using or not using UA or UAS. Slightly more than half (52%) of respondents admit that they have not used UA because it was not needed yet, but 18% of them have thought about it. 12% of respondents indicate that the reason for non-use is to be found in the failure of technical parameters, more precisely, in batteries. They acknowledge that this is a significant obstacle to the usefulness of involving UAS in technical support. Respondents admit that they do not use UA, because there is uncertainty with the regulatory framework and such a step requires significant financial investments, as well as expenses and inconveniences in staff training. About 15% of respondents point to the potential inconvenience of using UAS in an urban environment, as it can be difficult to pilot between buildings. Some respondents provide services in the vicinity of the aerodrome, but flights with UA in the vicinity of the aerodrome (not closer than 5000 m) are prohibited.

The economic factor of human resources and the permanent location of UA in the protected object are the main reasons for using UAS. In addition, surveying a protected object with UA would take a significantly shorter time, which would take considerably longer or even impossible with traditional methods.

The answers provided by the respondents to the question "What are the main disadvantages of using or not using UAS" reveal that 39% of respondents conclude that the main obstacle to using UAS is the regulatory framework that significantly restricts the use of UAS in security work, but 21% do not know or do not know because they know little about such devices. It is stated that, to successfully apply UAS in security work, it would be necessary to significantly improve the performance of the UAS management program and the sustainability of battery operation. About 21% point to the difficult use of UAS due to various meteorological conditions, and some respondents have no opinion at all. One respondent accurately indicated that the inconvenience or the inefficient use of UAS is in the survey of objects with limited visibility, such as canopies, horizontal architectural niches, gaps. An argument for such a statement is found in ornithological scientific studies on bird counting, when UAS is ineffective in situations where birds hide under shrubs and grasses.

The absolute majority of respondents, except for 9%, indicate that it would be worthwhile to integrate US and UAS into the security system of the common facility, however, 12% of respondents do not know whether this is a good solution. Of the total, 27% acknowledged that UAS has future and the UAS solution will improve the overall quality of the security service provision. One respondent stated that UAS can provide area / perimeter alarm video verification, which can reduce the involvement of statically placed cameras.

Taking into consideration the many scientific studies where UA with different types of equipment have been used, the authors of the article explained the opinion of respondents about the possible equipment or what equipment should be attached to UA to make the security service more complete and customers more satisfied with the quality of service. All of the respondents provided answers. The whole sample agrees that the UA can be equipped with a camcorder. The video camera should be multispectral with a high resolution, one respondent indicated that it would be desirable to equip the UA with a camera with biometric facial recognition software. The camcorder also should have a photo function. 45% of the respondents indicated that it is desirable to use UA also as a carrier of sound equipment, because in times when an accidentally strayed or a criminal subject should be warned, it is desirable to send a message or even an alarm signal to this person. One respondent indicated that it is desirable to equip the UA with a gas spraying device in order to prevent and, therefore, more easily capture the subject of the crime. Some respondents indicated that the UA could be equipped with an additional light carrier; walkie-talkie

signalling station; motion detectors as well as a fire detection system. One respondent indicated that it would be desirable to equip the UA with a TASER (dart-type electric shock weapon) with the aim of temporarily impairing the physical ability of a living object (neuromuscular disability), thus, it would be possible for the security guards to detain or deter a person in a safer way with a lower risk to public safety and health.

One of the most important proposals is the instruction of one of the respondents on the implementation of a high-quality operating software that could perform UAS management in an effective and safe manner. It should be noted that such a current of the message was perceived by 81% of the respondents at the time of the telesurvey. Such findings have also been indicated in other scientific studies, when the quality of the system maintenance software for the peculiarities of the required tasks is considered to be an important factor for the success of the use of UAS.

However, no clear correlation was found between the values of the answers provided between the groups of respondents in terms of their experience in the field of security.

Conclusions

The hypothesis of the empirical research put forward by the authors of the article - a Latvian security company uses UA and UAS in security work, has been completely overturned. Empirical research proves that a Latvian security company does not use UA and UAS security services at all, although an insignificant part of respondents admitted that they have tried or thought about using such technical support to protect objects and maintain security of public events. The main reasons or obstacles for a Latvian security company to make full use of UA and UAS security work are the significant costs of UAS and its equipment and the burden imposed by legal acts.

The theoretical section reveals that taking into account the experience of using UA in various sectors of the economy - such as agriculture, fire safety, protection of state borders, maintaining internal security, rescue operations, obtaining microtopographic data, even in such a delicate work as fertilization of the queen bee, likewise in the security work UA and UAS are fully usable and can operate as a significant technical support in order to improve the quality of the protection. The following statements serve as evidence:

1. Accuracy of tasks, saving money on the salaries of patrol service personnel by excluding the human factor, carrying out surveillance in an area where the access of a person is difficult or completely denied, etc.;
2. Deploying various types of equipment on a UA, such as a multi-spectrum high definition video camera; light sensor; a sounding device or even an audible alarm; gas spray equipment; walkie-talkie signalling station; fire detection system; TASER, etc.;
3. Small UA consumes little power;
4. UAS can be valuable on open ground in both fields and water bodies;
5. By automating the processing of identification data of persons and objects obtained, immediate action can be taken without loss of manual data processing time;
6. Visually heavy walls, barbed wire and other types of wire can be replaced by UAS;
7. A psychoacoustic approach can serve as an initiator of a feeling of discomfort in a person driven by criminal intent in order to deter or partially restrict a criminal activity.

The study found data that point to the downside of using UAS, such as the high cost of purchasing the original equipment; possible data leakage; the troublesome ability of the UAS to navigate with the conditions of the geographical environment interacting with the objects of the urban environment; green mass stands in the territory of the protected object; canopies, places which

are closed or invisible when viewed from above; meteorological diversity and sometimes unpredictability; battery failure and more. In order for UAS to be successfully used in security work, UAS management software would have to be significantly improved.

Types of UAS deployment solutions, as well as UAS deployment automation and equipment technologies, have improved significantly in the recent decades. However, a further research is necessary to improve the data collection and processing technologies as well as UAS data security in order to understand the impact of UAS on public attitudes, the perception of the criminal environment, the sustainability and lifting capacity of the UAS batteries themselves as well as the development of methods for limiting the area of operation of the UAS.

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About the authors

VEINBERGS VILNIS

Mg.soc.
Turiba University

Fields of interests
Security, personnel psychology, business management, public relation.

Address
68 Graudu Street, Riga, LV-1058, Latvia,
+37129464463,
vilnis.veinbergs@turiba.lv

KĪSNICA IVITA

MPA.
Turiba University

Fields of interests
Business ethics, security, public relation.

Address
68 Graudu Street, Riga, LV-1058, Latvia,
+37127881884,
ivita.kisnica@turiba.lv