Aviation Regulations for Drone Operations in the Slovak Republic and the EU

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***Abstract*—Drone technology provides a plenty of benefits and opportunities in a vast range of daily tasks. It is evident that we have a very exciting period for Slovak and EU´s drone operations sector. Nowadays, drones are used for recreational purposes, emergency services, police patrolling, media coverages, agricultural and environmental monitoring, security setups, and others. The popularity of drones indicates that the future of aviation will be inseparably confronted with Unmanned Aerial Vehicles (UAV). We witness an extensive application of drones that is opening new concerns regarding safety of their operations as well as ethics and morality of people. A protection of individual people rights, and orderly operated airspace, surely require to set a clear and effective legal framework in a respective country. This study deals with legal aspects of drone operations. The aim of this study is focus on how drones are legally bound in the legislation of the European Union and the Slovak Republic. This study presents a few overall objectives which will particularly contribute to secure safe drone operations. Also, the study suggests to use the risk-based concept as an appropriate decision making tool of law-making bodies. The applied method in this study was valid legal acts analysis. The study proves that governments must put enough attention to set out the framework for the safe operations of drones in the European skies.**

Keywords—drone, legislation, risk-based method, UAS, UAV, Unmanned Aircraft Systems, Slovak Law, EU Law

I. INTRODUCTION

Across the entire world, drone operations entered into all levels of airspace at an exponential rate. The size and the technical sophistication of these aircraft and operations used to vary from small consumer toys to large aircraft. Drones can fly far from a remote pilot, mostly in airspace which is traditionally reserved for manned aircraft. Unfortunately, legal regulations in many countries have been very "slow" to accommodate these new airspace entrants, and control possible threats of their operations. The size, performance, purpose, and complexity of drones can vary significantly, as well as the variety and complexity of related operations. Some drones conduct similar roles to manned aviation, but the obvious divergence from the manned aircraft is that there is no pilot on board. There are many definitions what term drone means. Essentially, drone is a flying robot that can be remotely controlled or fly autonomously using software-controlled flight plans in its embedded systems, that work in conjunction with onboard sensors and a global positioning system (GPS) [1]. Originally developed for the military and aerospace industries, drones have found their way into the mainstream because of the enhanced levels of safety and efficiency they bring [2]. But these days, drones are used in tech manufacturing, agriculture, health, civil engineering, environmental protection, local administrations, security and guarding, transport, etc. Every aircraft that has a propulsion system (e.g., battery, fuel… just no gliders) and does not carry humans is considered a drone, though the FAA often uses the terminology "UAS" which means an unmanned aerial system, and refers to the flying object, the pilot on the ground, and the means of communication between the two [3]. There are a several UAV drones on the market, all available in a variety of sizes. The largest drone is often used for military purposes. This type of drone technology has wings and needs a short runway to operate successfully. These types are commonly used to cover large sections of land [4]. Drones are used in agriculture, too. The use of drones in agriculture has advantages for farmers. Image processing programmes provided by drones are increasingly complex and at the hand of farmers [5]. The current level of drones´ technical development and public expatiations split drone market into three categories: infrastructure inspection and maintenance; environment inspection and maintenance; and transportation and leisure [6].

The safety is ensured provided the civil drone operator complies with the relevant requirements for its intended operations. A drone operator is required to prove operational authorization from a national civil aviation authority where they are registered, unless a Standard Scenario covers the operations. To obtain the operational authorisation, the drone operator is required to conduct a risk assessment. The risk assessment determines the requirements necessary for the safe operation of the civil drone. Standard Scenario (STS) is a predefined operation. More on this is published in an appendix to EU regulation 2019/947. To date two STSs have been published, STS 1 and STS 2, for use of drone with class identification label C5 or C6. If the operation falls under the STS and the drone bears this class identification label, a drone operator may send a declaration to the national civil aviation authority, and just wait for the confirmation of completeness and receipt. If operations are not covered by STS and does not fall in the Open category, then an operator must have an operational authorisation before starting the operation. In general, today´s drone operators are corporate entities, governmental entities, universities, and non-governmental entities. Corporate entities are represented by drone manufacturers, drone operators, flight schools, research organisations, test and demonstration site management, and finally U-Space service provider. According European Commission´ Rolling Plan for ICT Standardisation U-space is defined as a set of new services relying on a high level of digitalisation and automation of functions and specific procedures, designed to provide safe, efficient and secure access to airspace for large numbers of unmanned aircraft. The structure of this paper consists of selected legislation which laying down rules of drone operations, methods applicable as rulemaking bases, and recommendations for future legislation

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changes. The paper should answer the question whether valid regulations can ensure safe drone operations.

II. International Organizations

A collaboration and communication platform for national civil aviation authorities – ICAO, provides a fundamental regulatory structure for ICAO member states across the world. Remotely piloted aircraft are only one type of unmanned aircraft. All unmanned aircraft, whether remotely piloted, fully autonomous, or combination thereof, are subject to the provisions of Article 8 titled Pilotless Aircraft of the Convention on International Civil Aviation [7]. According ICAO´s reports for development of drone regulations, the rapid growth of the drone industry has resulted in significant and multiple challenges for ICAO member states to meet the needs and expectations of the industry. ICAO attempts to issue the regulations for safe integration of drones into controlled airspace.

Joint Authorities for Rulemaking on Unmanned Systems (JARUS) is another international organization which recommends technical, safety, and operational requirements to safely integrate Unmanned Aircraft Systems (UAS) into aviation. JARUS is a group of 65 National Aviation Authorities (NAAs) and regional aviation safety organizations, as well as EASA and EUROCONTROL. JARUS´s main objective is a contribution to the development of the safe operation of drones. JARUS provides guidance material to facilitate each authority to write their own requirements and avoid duplicated efforts. Since 2007 JARUS has published many recommendations, guidance materials, and methodologies regarding drone operations.

Riga Declaration on Remotely Piloted Aircrafts, 2015, put principles for future regulatory frameworks of drones. The Declaration established five important principles which are supposed to guide the regulatory framework in Europe: (1) drones need to be treated as new types of aircraft with proportionate rules based on the risk of each operation; (2) EU rules for the safe provision of drone services need to be developed now; (3) technologies and standards need to be developed for the full integration of drones in the European airspace; (4) public acceptance is key to the growth of drone service; (5) the operator of a drone is responsible for its use [8].

EASA released a draft of common rules for drone operations. The document is called “Concept of Operations for Drones, A risk based approach to regulation of unmanned aircraft”. Here, EASA proposes a regulatory framework which should set a level of safety and of environmental protection acceptable to the society. Considering the broad range of operations and types of drones, EASA proposed to establish three categories of operations and their associated regulatory regimes: “Open”, “Specific” and “Certified”. The “Open” operation category of drones, should not require an authorisation by an Aviation Authority for the flight but stay within defined boundaries for the operation (e.g. distance from aerodromes, from people, etc).

III. Drones in EU Legislation

The EU Member States based their civil aviation law on a number of different legal acts. Since the Slovak Republic is the EU Member State, the Slovak Government is obliged to incorporate the EU Law into the national legislation. EU Secondary Legislation is published by the EU institutions. The five EU legal instruments specifically provided for in the Treaties are: Regulations, Directives, Decisions, Recommendations and Opinions. The legal instruments binding upon each Member State are Regulations, Directives and Decisions. Article 288 of the Treaty on the Functioning of the European Union also provides in for non-binding legal instruments. These are Recommendations and Opinions. The three other main forms of actions that shape the EU legal order without having legally binding effect are Resolutions, Declarations and Action programmes.

Recently, EU drone market has proved a considerable growth. It is no easy effort to outline regulations that would empower safe operations and progress at the market of unmanned aviation. The EU is trying to encourage its Member States to become drone powerful countries, while applying unified, clear and strict EU legislation. Naturally, EU drone legislation suffering from a few issues. The main concern is to assure such legislation that provides the necessary level of safety. EU Law making institutions publish regulations that provide solutions regarding technical and operational sides of drones application. EU law proposals include: airworthiness standards for UAV and UAS elements, data transmission standards for remote pilot stations, including protection against unauthorized interference, collision avoidance systems, including motion and obstacle detection, emergency systems, unmanned traffic management systems, operator competences and training [9]. The current situation does not demonstrate that the EU has a uniform drone legal system valid in each Member State. There are some smaller or bigger deviations identified from how EU Member States control their drone operations. It is justified that the existence of deviations in law can retard the development of drones use across the EU. Fragmented legislation does not give any stable bases for safe drones application. EASA committees and EU institutions used to put much effort into developing an adequate legislation for safe drone operations across European counries. The European Commission has been recognizing a challenging drone legislation as an opportunity to form Member States more unified and stronger in protecting citizens, property and airspace.

In 2008, the European Parliament and the Council adopted Regulation (EC) No 216/2008 on common rules in the field of civil aviation and establishing a European Aviation Safety Agency. The principal objective of this Regulation is to establish and maintain a high uniform level of civil aviation safety in Europe [10]. Regarding drones, this Regulation considers only unmanned aircraft with an operating mass of no more than 150 kg. The Official Journal of the European Union enforced two interlinked regulations: Commission Delegated Regulation (EU) 2019/945 on unmanned aircraft and on third country operators of unmanned aircraft systems, and Commission Implementing Regulation (EU) 2019/947 on the procedures and rules for the operation of unmanned aircraft. These two regulations set out the framework for the safe operation of civil drones in the European skies. They represent risk-based approach, and do not differentiate between leisure or commercial civil drone activities. The main purpose of these regulations is building safe drone operations, orderly operated airspace, privacy protection, property protection and personal data protection. Commission Implementing Regulation (EU) 2019/947 of 24 May 2019 on

the rules and procedures for the operation of unmanned aircraft drafts the three categories drones classification – "Open", "Specific", and "Certified", based on the risks involved, their mass, and their application [11]. Regulation 2019/947 represents a positive step towards the harmonization of drone rules across Europe. But still, there is room for new challenges arising from drone operations. According to the recent EU rules, drone flights classified in "Open" category are only allowed under conditions of Visual Line of Sight (VLOS). Extended Visual Line of Sight operations (EVLOS) allows flight Beyond Visual Line of Sight of the Remote Pilot. EVLOS operations require special permission from respective country's Aviation Authority. BVLOS means 'Beyond Visual Line of Sight' operations. This is where the flying of a drone is without a pilot maintaining visual line of sight on the aircraft at all times. As under European laws, BVLOS operations and operation above assemblies of people generally require prior authorisation [12]. Nevertheless, one of the biggest challenges lying ahead for every Member States is making the transition and replacing their current national rules – those that have been widely accepted by UAV operators in them – with an "unknown" set of regulations put forward by a supranational body. Adapting these to the specificity of each Member State's legal framework will certainly be a difficult task [13].

IV. DRONE LAW IN THE SLOVAK REPUBLIC

National governments of the EU Member States are faced with tasks of synchronizing their national regulations with the EU aviation legislation. According to the Civil Aviation Division of the Transport Office of the Slovak Republic, flying drones in Slovakia is legal, and must be complaint with existing specific drone regulations. Pursuant to drone law, drone flights shall be performed in such way to compromise safety of other aircraft, persons, property on the ground, and to ensure environment protection from noise level and pollutants emissions of an unmanned aircraft. The Slovak Republic is the EU Member State (total 27 countries in July 2022), and therefore must abide by the drone regulations published by the European Union, and the EASA.

Drones in the Slovak Law are coordinated under Decision No 2/2019 of 14 November 2019, On determination of conditions for unmanned aircraft flight operations and restriction of specific categories aircrafts flight operations in the airspace of the Slovak Republic. The Decision lays down conditions of drone operations which are regulated through a number of regulation´s articles, namely Definitions, Remote Pilot Certificate, Category A, B, C flight operations, Operation of unmanned aircraft with maximum take-off mass more than 25kg, Conditions for an unmanned aircraft system flight operation, and Restriction of specific categories aircrafts flight operations in the airspace. In Slovakia drones shall not be used for commercial air transport operations. Following European Regulation (EU) 2019/947, registration is mandatory for drone operators in Slovakia. Drones related legislation in Slovakia in not unified. There are many legal acts which indirectly lay down conditions of drone ownership and operations. The Chicago Convention on International Civil Aviation was undersigned to govern certain principles and arrangements in order that international civil aviation may be developed in a safe and orderly manner. Therefore, the Convention represents the basis of civil aviation legislation in the Slovak Republic. The Convention was implemented in Slovakia as Act 196/1995 and lays down principles and arrangements for international civil aviation and international air transport services. The Constitution of the Slovak Republic, Act 460/1992, is the most important and powerful norm in the Slovak Republic. The norm is ranked as the highest one in the legal acts hierarchy, and all other legal acts are subordinated to the Constitution. The Constitution regulates a variety of relations including human rights. As human rights are often exposed to unlawful drones´ misuse, it assumes that the Constitution belongs to a group of drone related law, but with indirect impact only. Civil Aviation Act 143/1998, lays down all conditions and processes for performing legal civil aviation operations, including drones. Unfortunately, this regulation does not cover drones application exhaustively, and must be interpreted in connection with other legislation which contents drone operations! Other national regulations are Critical Infrastructure Protection Act 45/2011, Armed Forces Act 321/2002, Police Act 717/1993, Armed Forces Intelligence Act 198/1994, Personal Data Protection Act 18/2018, Criminal Codex 300/2005, and Environmental Protection Act 543/2002. Following current regulations in the Slovak Republic, drones must be flown within pilot visual line of sight. Controlled airspace, including areas sensitive to aircraft noise are prohibited for drone flying in the Slovak Republic.

Tsiamis *et al* in their study [14] specified 14 criteria in national legal frameworks of different countries across Europe. Their study aims to show a degree of drone legislation implementation in a respective country. In TABLE I, there are 14 criteria Tsiamis *et al* consider as important indicators while assessing national legislation of the Slovak Republic.

TABLE I. CRITERIA FOR DRONE LEGISLATION IN THE SLOVAK REPUBLIC [14]

Criteria	***Regulated***
Flying Distance Restrictions	+
Weight Classification	+
Over Crowded Areas Restrictions	+
Flight Permissions	+
Area´s Distance Restrictions	+
Drone Regulations	+
Buildings' Distance Restrictions	+
Safety Insurance	+
Piloting Certificate	+
Purpose of Flights	+
Operators' Age Limitations	-
Operation Plan	-
Air Flight Zones	+
Weather Conditions	-

"+" means "criteria are direct drone law regulated in Slovakia"

"-" means "criteria are indirect drone law regulated in Slovakia"

V. METHODS

A method applicable to provide the source-full bases for regulators´ rulemaking processes is a risk-based concept. This concept is designed to give rulemaking bodies information about future legal arrangements regarding drones. Nevertheless, this concept shows a baseline regulatory structure for technical and operational work efforts. The risk-based concept allows to define and standardize individual components of drone operations.

This paper deals with the risk-based concept theoretically only. The purpose of this paper´s chapter is to explain risk-based concept´s principals and strategies, which allow appropriate authorities to set properly risks-based proportionate drone regulations. Risk analysis has become a routine procedure in assessing, evaluating, and managing harm to humans and the environment [15].

The process of reducing the risks to a level deemed acceptable by society and to assure control, monitoring, and public communication is covered under the term "risk management" [16]. The risk-based approach identifies the highest compliance risks to considered areas, giving them a priority, compliance control; and adapting policies and procedures. The risk-based approach consists of two inseparable parts: risks identification and priority giving. Fig. 1 details risk areas to be considered in the drone law making process. Safety risks associated with drone operations can be compiled by levels of impacts on human health and life. The statistics say that dominant safety risk caused by drone operations is harm to people on the ground. The risk of damage or destruction of critical infrastructure means a significant safety risk, too. Although critical infrastructure is similar across all nations due to basic living needs, the infrastructure considered critical can vary according to a nation's unique needs, resources and level of development [17]. Other important risks associated with drone operations are property, privacy, security, and environmental hazards. These risks must be necessarily considered by legislators.

There were surveys on European UAS Operations (UAS OPS) and Operation Risk (OPS RISK) assessment methods, conducted in The Context Of The Horizon 2020 Programme. The objectives of the UAS OPS and OPS RISK surveys were defined as follows: consult only European drone operators (ECAC countries) conducting flight missions in order to increase the validity and pertinence of the results, identify the European drone operator community to the regulatory and standards communities, as well as to itself, apply an operation centric approach (not make a distinction between on the drones used based on airframe type, size, mass, or propulsion), identify the drone operators [18]. The survey considered commercial and non-commercial categories of operations. The operational parameters as VLOS, EVLOS, BVLOS, flight altitude: < 500 ft, over densely and/or sparsely populated areas. The survey in [18] conducted risk-based survey applicable on current situation and near future situations. Current situation activities were defined as: identify the market sectors where drone flight operations are currently taking place, and identify the mission purposes of the flight operations currently taking place. Near future activities were defined as: identify the market sectors where drone flight operations that are anticipated to take place (new EU drone regulation), and identify the mission purposes of the drone flight operations that are anticipated take (new EU Drone regulation). There were 247 respondents from 22 countries involved in the survey. Achieved results demonstrate current situations and near future situations. The answers demonstrated a wide recognition of the perceived potential benefits of drone use by corporate and governmental operators. The study [18] selected 25 market sectors [see Fig.2]. Only 8 of them [see TABLE II.] were proposed as Principal Market Sectors with major impact on the research. Collected data for other 17 market sectors were not important for the research and were neglected. The results in Fig. 2 show that Current Market Sector´s "Construction and Real Estate" represented the highest drone activity. According the research, the same market sector cannot be expected as sustainable, and remaining on the highest level, as in Near-future Market Sector this is not proved and shows about -26 % decline. On the other hand, "Agriculture, Fishery, Forestry" market sector reports 26% growth here. As to data mentioned in [18], the drone activity volume is prognosticated to change, and here detailed in TABLE II.

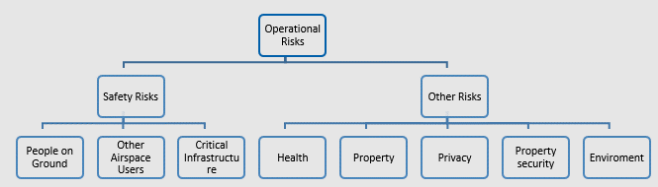

Fig. 1. Risk areas [16]

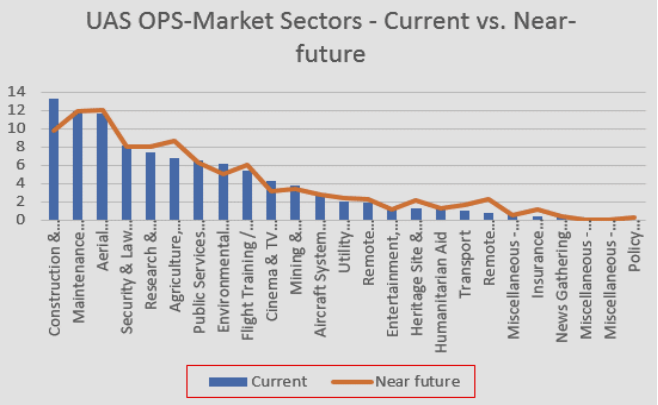

Fig. 2. Graph UAS OPS market sectors; Current vs. Future development [18]

TABLE II. PRINCIPAL MARKET SECTORS´ CHANGES OF ACTIVITY VOLUME [18]

Principal market sector	*Indicated change (in %)*
Maintenance	stable
Construction & Real Estate	-26
Agriculture, Fishery, Fish Farming, Forestry	+26
Research & Science	+9
Flight Training & Instruction	+12
Security & Law Enforcement	stable
Public Services & Safety	stable
Environmental Protection & Wildlife Conservation	-17

VI. DISSCUSION

The diversification of domestic drone regulations reflects different approaches based on the demands from various interest groups. Nevertheless, there are a couple of unifying approaches which predict where drones´ future development will lead. The biggest concerns are over legislators´ abilities to establish the balance between operators´ demands on the one hand, and governments´ protection of people rights and safety, on the other.

The future trends in drone innovations will adapt interests of various groups of operators and drone pilots, who would require priority for their needs and plans. Governments will be searching for legal approaches to satisfy these requirements, and balance them with human rights, drone manufacturers, recreational and professional drone users, as well as a safe use of airspace. Government institutions, not strictly those active in civil aviation, received their political mandates to ensure not only citizens´ security and welfare, but also support drone technical development, and application in various spheres of daily life. Drone production has already achieved a stable position at commercial markets. The demands from end users seem big. Governments must also consider these commercial matters, while preparing law which will be effectively protecting intended interests. Governments in Europe already used to invest their potential in research of drone operation risks inside of a respective country. They also record possible threats to air space capacity.

Upon analysing collected inputs, they are able to predict long term and immediate needs for law making actions. Shown in this risk-based approach, detailed safety requirements for various scenarios can be inbuilt into the regulatory framework [19]. The risk-based approach is one of methods how to investigate an appropriate regulatory tool for accurate and understandable legal acts. EU Regulations 2019/947 and 2019/945 set out the framework for the safe operation of civil drones in the European skies. They adopt the risk-based approach, and as such, do not distinguish between leisure or commercial civil drone activities. What they consider is the weight and the specifications of the civil drone and the operation it is intended to conduct [20]. This approach is capable to identify needs which must be law regulated either in priority or postponed. The risk-based approach excludes complicated demands from drone users for various special exemptions. It is suggested, if a drone flight can be considered as riskless (i.e. lightweight, in uninhabited areas), or extremely low risk, no bureaucratic barriers should impede it simply for the sake of bureaucracy [21].

The more threats are colliding with drone flights, the more legal requirements must be in place. But that signals an issue of overwhelming bureaucracies which could put more costs on administration. If the trend goes the way of every single flight registration and approval, then there will be not enough capacity left for technological innovations and development. Regarding registrations and approval practices governments must find a right balance between their capacity and increasing demands from drone users. Online application process, including an automatic system of checking and approving, could be another tool for flexible responds to accommodate each request, and make drone flying safe. Future trends of drone flying must meet such legal regulations able to eliminate all kinds of threats. International drone law has not been unified yet. The most effort is left on an individual country or on larger geopolitical structures as the European Union or the USA and Canada.

There are individual specifications among countries regarding drone operating permissions as well as drone flying conditions. It is suggested to develop easily accessible information services and support awareness campaigns beside quality educational programmes. Shared experiences and best practices could contribute to safe drone flying. But the future trend shows that every drone should be registered. This will bring more evidence to what types of drones there are operating in a country, and purpose they are used for. New regulations and amendments must respect main principles of law development across the EU and in a respective Member State. There are four key areas for drone law development: justice systems, anti-corruption framework, media pluralism and freedom, and other institutional issues linked to checks and balances [22].

Upon assessment of available sources, it is suggested that the national legal framework of the Slovak Republic should focus on following objectives: a high and uniform level of safety of drone operations, define conditions for drone safe operations in the U-space airspace, harmonise the regulatory framework across the EU member states by enhancing clarity, and removing the inconsistencies, and foster an operation-centric, and risk-based and performance-based regulatory framework.

CONCLUSION

Commercial activities across the Slovak Republic and the EU are constantly developing and demonstrating new uses for drones. Recently, there have been a plenty of bad examples of drones´ misuse like state security threats, harm to human, property damage, etc. Nevertheless, drones have their attractive side, and there were reported a number of lives saving situations, and troubles solving actions, where drones were involved. A drone industry has continued to grow in recent years in both the commercial and consumer markets. In [23], subtitle *Torts of the Future Report* is argued that as drone lawsuits arise, courts should be able to adapt existing doctrines of law rather than create new legal doctrines specific to one type of technology. The above mentioned *Report* continues with stating that using existing laws will be far more efficient than trying to “create a patchwork of new, drone-specific law that could be inconsistent from jurisdiction to jurisdiction and create conflict with general tort and privacy doctrines.”

As with the legal requirements for any new technology, drone legislation needs time to grow as the EU and the Member States wrestle with how to fit the new possibilities offered by drones into existing legal doctrines [24, 25]. Countries will want to make key policy, technical, regulatory and programming decisions for drone operations. An assurance will need to be made as to what extent drone regulatory proposals will need to adapt to conventional aviation rules, parameters, procedures and practices. Attention should be given to whether existing standards and

regulations, which control the operation of manned aircraft can be balanced, while also approaching the specific and unique needs and characteristics of drones. When creating a regulatory framework for drones, it is imperative to assure that the new regulations do not contradict actual aviation regulations. The risk-based approach for regulating drone operations could present the regulatory requirements based on the size of the aircraft, the location, and the complexity of the operations. In order to initially allow operations of drones to fly in the aviation system, governments should limit the type of permissible operations to definite lower risk operations, while controlling flexibility of future technologies. Consideration will also need to be given to an issue whether all airspace users should be subject to the same set of regulations, or will exemptions or exceptions be provided. Those ones excluded from regulations could be recognized as public benefits and services providers such as police agencies, border surveillance, fire fighters, paramedic services and search and rescue unites. According EASA [17], one of the factors to be taken into account during current law making process is transfer of drones from one control station to another. This action is necessary as some drones have a significant flying range and the transfer from one control station to another needs to be envisaged. Considering operational control of drones by a single control centre could lead to a real possibility to format drones flights with other flights. The development of drone law must reflect real needs of drone users, state security, privacy protection and commercial activities. Existing airports could find drones as an alternative for traditional business activities [26]. Future drone legislation must include a further integration of aviation law, commercial law, state law, criminal law, as well as other drone-related international regulations. Governments must be able to identify the barriers to comprehend possible opportunities, and to define the actions to overcome them. In the above chapters this paper examined how to improve quality of aviation regulations of drones. The paper describes valid drone regulations, both international (EU Law included) and Slovak, explains how risk-based method can provide valuable data for law-making bodies, as well as suggesting the future trends in drone law. The study shows that drones interconnect numerous industries, including construction, real estate, maintenance, aerial photography, audio-visual, production, advertising, security and law enforcement, research and science, etc. Governments should assess advantages and disadvantages of drones in specific situation, and transfer their experience, best practice and risk-based analyses to drone regulations.

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