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Research Article

A Solution Package for Rules and Regulations of Unmanned Aerial Vehicles

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Abstract

Since the Paris Agreement of 1919, the world witnessed a lot of changes in terms of airspace utilization. Today, airspace utilization is problematic for practitioners and theoreticians with new developments and innovations such as VTOL (Vertical Take-Off and Landing) aircraft and sudden changes in the international context because of wars and conflicts. In this paper, it is aimed in essence the development of airspace utilization one more step forward in parallel with the technological pace. To reach this purpose, the most controversial vehicles, UAVs (Unmanned Aerial Vehicles), are examined depending on their utilization in civil aviation and airspace. The concept of governmentality and its roots are also used for the development of a legal basis for UAVs. Comparative law methodology is selected as a research model. According to the findings, there is still room for legal development of UAVs, especially regarding security and international politics because of the different utilization of different nations. At the end of the article, it reached a frank conclusion that civil aviation needs rules and regulations in a wide and international sense for these vehicles. New policy offers and titles are organized for these vehicles like the Annex of ICAO (International Civil Aviation Organization).

Keywords

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1. Introduction

It is a sound, strict and comprehensively accepted reality that the First World War was such a destructive event that millions of people died, thousands of households were scattered, and national borders and, maybe, nations were re-defined. On the other side, it is another reality that wars, especially big ones, had dramatic impacts on concrete and abstract technologies. For example, developing technologies and army designs such as in the Thermopylae War, the Conquering of Constantinople, the Battle of Kadesh, and the Invasions of Chengiz Khan and Alexander the Great. Similarly, the First World War was the main cause of the distinction between the two realities in terms of civil and military aviation with the Paris Agreement of 1919. With this agreement, it became an important step that the absolute utilization rights of airspaces over national borders, territories and territorial waters were given to the states by international order. Since then, the aviation economy and politics have been in the hands of the states and they are sustained with different mechanisms under the names of civil aviation and military aviation due to the politics of states.

Unmanned Aerial Vehicles (UAVs) are one of the fruits of technological development with the understanding of hybrid sciences. They can be utilized in almost every economic and instinctual activity of humankind. Although they have special advantages for their versatile nature, De Garmo (2004) insists on their negativeness in terms of arrangements in the safety and security laws, rules and regulations depending on their dependence on

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a highly technological development nature. This nature has grown up with newer and specific techniques and concepts such as path length, optimality, completeness, cost-efficiency, time efficiency, energy efficiency, robustness and collision avoidance (Aggarwal and Kumar, 2019). This impact can easily be observed in the paper of Urbahs and Jonaite (2013) on agriculture applications and it can be concluded that UAVs can be re-arrangeable due to utilization purposes. For example, Eisenbeiss (2004) discusses their dimensions in a technological language in the field of photography but this can also an intelligence matter on a wide and state spectrum. According to Elmeseiry et al. (2021), UAVs have still challenges with flying smoothly and other fields including collision avoidance, battery life and intruders such as burglars. With their economic and political explanations, Fuhrmann and Horowitz (2017) maintained that states can create their autocracies and democracies over UAVs technologies that have great importance on supply-side factors. In light of this argument, shortly, it will try to answer in the paper the question of "How can we develop a new way of UAVs' governance in terms of security and safety depending on laws, rules and regulations under the assumptions of no environmental and noise risk?"

While we analyze this question, we will benefit from law and social sciences methods such as comparative law methodology with the help of the Annex of ICAO (International Civil Aviation Organization), because of their legislative power in civil aviation. One of the purposes of the research is to examine the philosophical roots of Annex or current rules and regulations and the law systems of aviation benefiting from the "Governmentality" concept of Foucault. Secondly, it is aimed to develop a detailed legal framework for UAEs in terms of security and safety benefiting from law and social sciences methodologies.

For Foucault (1977, 1981, 1985, 1988, 1997, 2000), the power of governance' exercises take their roots from the definition, identification and classification of society and individuals one by one. When it realizes this first step, it utilizes surveillance mechanisms such as prison, formal education and training etc. If a deviation occurs both in society and individuals; specific, known and rational tools, habits, mechanisms and reflexes such as punishment and discipline and in some situations, semi-medical mechanisms such as psychoanalysis are utilized. In specific considerations and context, also some deviations are created by the hands of governance in person. Bröckling (2001) describes this mechanism as military obedience which is the utmost form of discipline and it includes sexual, social, and psychological motives, patterns and designs, besides these, it does not aim only to change behaviours, but also change daily and even momentary reflexes. If it is concentrated on aviation activities, it shall be sure that some activities such as communication, leadership or occupational health and safety are ensured with a great amount of attention that needs extra effort and can consume the emotions and cognitive powers of aviators. Therefore, individuals need to gain extra capabilities and abilities for before-after awareness and readiness through aviation governmentality. So discipline, punishments and other factors are so important like the creation of military obedience. It's the essence of modern working and business activities.

But, in the UAV context, the situation is so different depending on the relatively lesser number of human resources. Security has priority, therefore, the protection of private and state property rights can be very important. In this work, this subject is the main focal point of our research. By doing so, research completes a legal gap between practice and theory on UAV technologies philosophically and scientifically.

In light of the arguments above, in the first stage of the research, a wide literature review of the research will be realized and then a comprehensive methodology takes its place in the second section. Findings and discussions, conclusions and policy implications will be the subjects of our next step and finalization of this research.

2. Literature Review

As it is stated in the methodology and theory development section, law and legal studies and social sciences can be utilized under one umbrella. As it is stated in UAV literature, these technologies suffer from legislative power in terms of security and safety. It will be developed a framework in light of the methodology and theory development in this section. Out of their utilization as air vehicles and engineering designs, this literature review mainly contributes to our theory of aviation security and safety.

UAVS are highly technological vehicles that mainly have greater maneuverability, low risk to human operators, significant weight savings, lower costs, the potential for superior coordination, and opportunities for new operational paradigms, for these reasons, they can be utilized for intelligence, surveillance, and reconnaissance; communication relay or gateway; radar jamming and decoying; suppression of enemy air defence (SEAD) missions; theatre and cruise missile defence; fixed and moving target attack; and air-to-air combat in military aviation (McLain et al., 2000). Tahir et al. (2019) classify their purposes in civil aviation as monitoring, surveillance, marketing, mapping, business and management, security, hobby, research and delivery logistics, and photography. Doherty et al. (2000) underline problems in fully autonomous UAV utilization such as negative weather conditions and cold regions

(also in Gaffey and Bjardwaj, 2020) limited energy, capacity and hardware and software problems (Chao, 2010). Otto et al. (2018) maintain that UAVs or drone technology are utilizable for innovations in operational optimization opportunities. Besides these developments, they are open to new technologies such as the Internet of Things, machine-type communication, data processing Motlagh et al. (2016) and upper-class remote sensing (Pajares, 2015) of which negative impacts are unknown or unpredicted in terms of aviation safety and security.

Coifman et al. (2006 a,b), Puri (2005) and Wang et al. (2016) describe their features as monitoring tools of air traffic for surveillance purposes in city developers' programs. Anderson and Gaston (2013) examine the importance of UAV utilization for ecological purposes and small ecological lands. Jones et al. (2006) determine their same impacts on wildlife research and life. For Klemas (2015), UAVs are utilizable for coastal and environmental remote sensing. Herwitz et al. (2004) describe the utilization of UAVs for agricultural surveillance and decision support. Kim et al. (2019) also maintain that the impacts of the UAVs on the facilitation of business in the agriculture sector continue especially in specific processes such as pesticide and fertilizer spraying, seed sowing, and evaluation of plant growth.

He et al. (2017) underline UAV's deficits in communication security. According to Coutinho et al. (2018) depending on their complex electronic infrastructure, UAVs are problematic for airspace utilization, although they have wide and comprehensive utilization fields. Also, Cai et al. (2014) state that airspace utilization is a big problem for civil aviation, for them, although states such as the USA (United States of America) and Australia try to develop specific regional and national arrangements for the utilization of airspace, an international arrangement is not possible. For Hardin and Jensen (2011), the main purpose of the USA is to regulate UAVs is to order commercial and private air travel depending on UAV dense use within the border of the USA. Fuhrmann and Horowitz (2017) also state that UAVs are one of the great security threads for countries.

Like many other utilization purposes, it is still a big debate over whether these technologies are humanitarian, especially in military activities. For example, Kreps (2014) states that UAVs' efficient and effective utilization in interventions by the USA in Pakistan, Somalia and Yemen in taking military actions, but they are criticized in terms of legal and ethical sides by authorities. Kreps and Kaag (2012) also maintain their negativities in military utilization. These problems are directly related to military and international law and politics. If it is returned to civil aviation problems, Shresta (2021) draws attention to civil UAV utilization purposes and states that the aviation world will be witnesses some problems with UAV-related traffic management in the next years, in terms of surveillance, navigation and communication. For Zuo (2022), controlling these vehicles in the airspace is arguable and open to development depending on their sophisticated design, despite the intensive economic demand of the public. Lin (2018) and Zeng et al. (2016) underline communication deficits and technologies that can be used against them in the complex structure of UAVs. Shakhatreh et al. (2019) argue the negative impacts of UAV's civil infrastructure and architecture structure on the ground services and operations, they count the challenges as charging challenges, collision avoidance and swarming challenges, and networking and security-related challenges.

Governmentality, on the other side, is a degree of management or government practices. However, it is a specific state, which includes psychological, sociological and economic motives, awareness and readiness to govern or to be governed. According to Skalen's (2006) contribution, it also examines some ethical investigations on governed-governing relationships in terms of know-what, know-how and know-who sides, therefore it focuses on a productive knowledge-force mutualism. Ferguson and Gupta (2002) examine some extra and important mechanisms in the development stages of governmentality such as discourses, norms, identities; self-regulation and techniques for the disciplining and care of the self and political economy. However, Clegg (2019) underlines the impacts of culture and cultural designs on government practices and mechanisms, because of their definitive impacts on governing and governed relationships. Besides, according to Collier (2009), it can be maintained that governmentality is to make thinkable and practicable of an activity for governed and governing. Li (2007) avoids the concept of governmentality and utilizes governmental interventions in some considerations such as natural disasters (floods, droughts, accidents and diseases), excessive economic price movements of commodities in international markets and media relations. Larner and Walters (2004) emphasize that governmentality is important for global wealth, justice and welfare, therefore it is a global matter.

3. Method

Before the ICAO decides on a specific event, incident or accident on the decision-making side or joins a legislative action in terms of civil aviation, generally moves depending on its standards which are accepted by member countries. Therefore, these standards are legally binding and known as ICAO Annexes. Depending on the legislative force of ICAO, a comparative law methodology will be utilized in this research. This research method develops under the impacts of social

sciences and law and legal studies. Besides these, the law includes different reasonings such as the a priori or metaphysical method, the analytical method, the historical method and the comparative method and the comparative method serves to a better understanding between the influential and active spirits of different nations as well as for the unification of the commercial laws of the world (Scmitthoff, 1939). Feeley (1976) investigates the importance of law in social sciences. According to his findings, the rationality between legal studies and social studies or a separate theory of law and society will be abolished. Besides these, Garth (1998) pays attention to some examples such as racial discrimination, poverty and crime, and underlines the forces of competition and cooperation of law legal sciences and social sciences. Nevertheless, Twining (2005) maintains that comparative legal and law studies suffer from necessary attention in social sciences like sociology under the conditions of state-based legal arrangement, modernization, technological development and attitude changes in the developing world. For Samuel (2009) this situation is also correct and interdisciplinary research is a need. Interdisciplinary research, for example. According to Villegas (2006), is nothing more than restructuring Bourdieu's structuralism, which accepts human behaviours in the mental structures or schemes, to make comparisons between American and French legal fields. Nonetheless, Ratner and Slaughter (1999) investigate the variants and objectivity of international law and prescribe its decision-making process depending on their reasonings and logic, especially in event studies like "dirty wars and events" such as the Bosnia War of 1992. For Samuel (2008), with all of its dimensions and legal constructs such as economic, political, social (and cultural) and psychological, comparative law should be accepted as a different branch of social sciences. On the other side, Faigman (1989) states that social sciences with all of their deep explanations of human behaviour can be accepted as only modest assistance to legal studies and this modesty can change depending on the quality of social science research. Under this specific literature review on legal studies and social sciences, a comparative law methodology is selected as a research methodology in this research, if it is concentrated on the details.

Before this work, there were also some other studies in transportation literature with different methodologies, for example, Ojo (2019) developed a classification methodology, and Mokhtarian (2009) underlined the importance of transportation schemas and tables. Auld and Mohammadian (2009) developed a simulation model after an intensive and dense literature review. According to Reitz (1998), i) Explicit comparisons diminish ambiguity in the law and legal studies, ii) They depend on similarities and differences among the legal systems and consider functional equivalence, iii) They are aware of distinctive characteristics of the individual legal system and commonalities concerning how the law deals with the particular subject under study, iv) The main aim of comparative analysis is to make more wide levels of abstraction through its investigation of functional equivalence, v) The comparative method invests cultures, similarities and differences among legal systems into the analysis, vi) It fills the gap between practice and theory, and also different systems. Meares (2014) offers a new framework that includes social sciences and law to increase the power of law against crime. Cook (1927) describes and emphasizes the concept of "syllogism" in the law study-making process. Besides these, Hill (1989) underlines that three important legal systems in the world law conjuncture are Germanic, Romanistic and Anglo-American legal systems. Therefore, different legal applications gain different insights with explicit comparisons (Schlesinger, 1995). And for this cause, comparative law is a sociology of law (Kamba, 1974).

4. Results and Discussion

According to our main findings, if it is realized a comparison between UAVs and other aircraft, it is natural to find important differences beginning from their utilization purpose, economic and business organizations, and safety and security understandings in terms of civil aviation and aviation and international law and legal dimensions. This research, it will try to develop a framework focusing on these clear and net differences benefiting from governmentality and technological abilities, capabilities and deficits of UAVs. Also, Stöcker et al. (2017) underline the importance of a clearer legal system and framework with market forces such as industry design standards and reliable information about UAVs.

It is clear that the structure of UAVs is relatively more micro dimensions, are suitable without human or crew transportation but ground operations and services, require innovative infrastructures and aerodromes, clearly more open to high technologic activities and arrangements. These features carry it directly to the focus points of governmentality subjects with great rationality. For example, if it is concentrated on Weidner (2009) who describes these subjects or problems as the European Union, the integrated region, globalization, global civil society, development economics, security, the failed stated, peacebuilding and peacekeeping, immigration, refugees, AIDS (Acquired Immune Deficiency Syndrome), humanitarian need, the environment, global health. The main features of these problems that are directly related to global order, are new or relatively new, change their position depending on time, space and extension and are subject to different

scientifical branches like UAVs. According to Elden (2007), the main efforts of the governmentality mechanisms are purposed to optimal efficiency and effectiveness in the fields of society, economy, population, security and liberty, and geographical-territory dependence gain importance in all these issues. Essentially, the importance of geographical territory is the main problem of air transportation since the Paris Agreement of 1919 on which the sovereignty of the state over airspace was accepted. Neu and Heincke (2004) investigate whether governmentality mechanisms and applications have some borders, according to them financial anxieties have negative impacts on governmentality aims.

As it is understood, humankind needs governmentality in deviations from normal, it has borders and it needs law and legal power greatly. It is directly related to psychological and bio-readiness and awareness of people. Especially, in this technological and innovative age, it is one of the first steps to gain consciousness toward new or relatively newer. Therefore, a comparison between UAVs and normal civil aircraft with all their dimensions is suitable. For example, in accidents, damage and injury caused by UAVs (Cracknell, 2017), in excessive utilization of airspace with drones or UAVs as in India (Srivastava et al., 2020) or anywhere (Kubas, 2023).

5. Conclusions

After the COVID-19 disease, civil aviation began to change its core, sustainability, unmanned systems and technological development in every section of civil aviation. It has witnessed many different inventions and innovations with all of their negative impacts. On the other side, unmanned aerial vehicles are financially accessible to people. There are no strict aerodrome rules and regulations about them, navigation, surveillance and communication can be realized easily with them within the airspace. Standardization levels in terms of certification and licensing are lower than other air vehicles. However, as it is stated in the literature review, they can easily be utilized for military purposes with specific technological arrangements. They are open to malevolent activities such as terrorism, ultra-excessive nationalism, burglars, smuggling, and contravention of state and private rights. Civil aviation management overcomes all of the other negativities through its special governmentality, especially after the Chicago Convention of 1944. In clearer words, Civil Aviators and stakeholders from all of the civil branches have consciousness, awareness and readiness towards negativities in their occupation through the forces of intensive training and education activities and licensing and certification processes, so governmentality according to the literature review of this research. But, unmanned aerial vehicles even devices are open to discussion.

6. Policy Implications

Especially, more strict rules, and regulations should be developed in a set of standards like Annex understanding of ICAO for UAVs on an international basis by stakeholder and civil aviators. Because of licensing and certification processes, education and training need extra care and details. Besides psychological awareness and readiness, literacy of law and legal side, technical details, aerodrome, air traffic and airspace utilization, the consciousness toward accidents incidents and risks is still ambiguous. In this paper, governmentality with all its dimensions and mechanisms can be considered the first step, with all of its power on destructive, definitive and re-definitive roots on the act of governed and governing. Standardization and legislation should be the second stage of these efforts in the field of Unmanned Aerial Vehicles with definitions and descriptions, numerical details, warnings and cautions such as IFR (Instrument Flight Rules) and VFR (Visual Flight Rules) rules, and extraordinary events such as wars, international conflicts between states and volcanic eruptions. These standards should be comprehensive, flexible and organic in light of comparative law.

Nomenclature

AIDS	: Acquired Immune Deficiency Syndrome
ICAO	: International Civil Aviation Organization
IFR	: Instrument Flight Rules
SEAD	: Suppression of Enemy Air Defence
UAV	: Unmanned Aerial Vehicle
USA	: United States of America
VFR	: Visual Flight Rules
VTOL	: Vertical Take-Off and Landing

CRediT Author Statement

Olcay Ölçen: All dimensions of the research are conducted by Olcay Ölçen.

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