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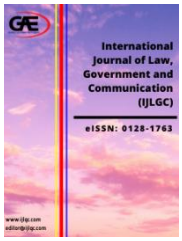

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THE LEGAL PERSPECTIVES OF THE DOCTRINE OF NAVIGABILITY OF AIRSPACE FOR COMMERCIAL UNMANNED AERIAL VEHICLES (UAVs) IN SHIPPING AND DELIVERY

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Abstract:

The emergence of the Covid-19 pandemic has had a massive social and economic impact all over the world. The conventional methods of logistics, shipping, and delivery of goods are crucial in the economic chains. The use of commercial unmanned aerial vehicles (UAVs) for shipping and delivery has been viewed as an innovative approach and business strategy for the logistics company. Commercial UAVs in shipping and delivery might be a novel and effective delivery technique in logistic services, especially for small parcels, and could be extended to medical supplies. However, due to the rigidity of laws and regulations in providing the right of way and other infrastructures to commercial UAVs, UAVs in shipping and delivery appear to be unwelcome in Malaysia. This article is based on doctrinal research and seeks to analyze the regulatory pattern of the doctrine of navigability of low-altitude airspace for the shipping and delivery of UAVs in Malaysia and other selected countries. Moreover, this article also further highlights the various secondary sources of laws from the various authors to view their standing on the navigability concept of UAVs in shipping and delivery. This article recommends the segregation of the low-altitude navigable airspace for UAVs to resolve the conflict of interest between the proprietor's airspace and the navigable airspace of manned aircraft and further suggests other infrastructures for the expansion of UAVs in the logistics sector.

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Introduction

The evolution of drones or unmanned aerial vehicles (UAVs) has expanded from military use to commercial use. Currently, UAVs are reshaping from the military and law enforcement use with extraordinary advantages and abilities of UAVs that could do surveillance, intelligence, and carrying weapons. UAVs have progressed from a primitive military weapon delivery system to a multipurpose platform used in the public, private, and commercial sectors. (Burzichelli, C., 2016). The nature of a UAV that is an aircraft without a pilot on board or could be pre-programmed flight gives advantages to the commercial arena to initiate it into business use. The expansion is indeed due to the high demand from commercial and business companies to utilize this technology in their business strategies. The usage of UAVs in the military that can carry weapons has given the business entities to spread their wings into the new method in the commercial arena of shipping and delivery services. The potential of UAVs in shipping and delivery service is due to the UAV itself which becomes accessible and affordable in all aspects.

Delivery and shipping *via* UAVs offer a fast delivery time limit as compared to the conventional method of delivering goods. Amazon, UPS, FedEx, DHL, postal services, and even Domino's Pizza anticipate using UAVs to serve their consumers. (Van de Wouwer, 2016, p.133). Consequently, UAVs are being utilized in many different ways, including in agriculture, delivery and logistics, surveying and mapping, filming, and journalism, and have extended to rescue missions and surveillance. The platform for UAVs in shipping and delivery in the United States of America (the USA) was initially projected by Amazon in the year of 2013. Amazon Air was announced in December 2013, which focuses on the service of delivery of goods through UAVs. The program's objective was to fulfil customers' satisfaction with the delivery time and length when they place an order from their e-commerce platform. Despite multiple denials by the Federal Aviation Administration (FAA) and multiple obstacles during Amazon Air's first trial (Burzichelli, C., 2016).), the integration of its e-commerce platform with Amazon Air has had a huge impact on the commercial arena since the Covid-19 era (Repko, M., 2020). With its aim of "almost immediate order fulfilment," Amazon plans to deploy its octocopter aerial UAVs to deliver products up to two kilograms to the customer within sixteen kilometres of the fulfilment centre (Matt Hickey,2013). Currently, the application of UAVs in logistic and delivery services in the USA is restricted in certain areas and states depending on the restriction and limitations imposed by the laws. Since the Covid-19 pandemic, an increasing number of companies have approached and viewed UAVs as a valuable technology for mitigating social contact with humans. During the first stage of the Covid-19 pandemic, for example, Walmart, Tesco, and Amazon launched UAVs in shipping and delivery to transport parcels and goods to their customers. Apart from that, UAVs have also been seen to carry medical supplies and even medical samples and tests, especially in remote areas in Rwanda. Rwanda was one of the first countries on the African continent to initiate and launch commercial UAVs, with a comprehensive set of regulations governing commercial UAV operations. The Covid specimen tests were also flown by UAV during the massive pandemic of Covid-19. On the other hand, the UAVs in Malaysia were seen during the first phase of the Movement Control Order (MCO) of Covid-19 in March 2020 by law enforcement especially the police for surveillance purposes (Bernama, April 27, 2020). In fact,

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during this phase, the Civil Aviation Authority Malaysia (CAAM) instructed that all other UAVs except law enforcement UAVs should not fly during the MCO (Bernama, May 27, 2020). Transferring airspace rights to the UAV delivery companies to facilitate a new infrastructure serves this policy without building new roads or reshaping the ones that exist. New modes of transportation will necessitate investment and are not without danger, but air travel avoids the costs of building physical roads and the resulting traffic congestion (Thompson, D, 2019-2020).

The airspace way is normally invisible to the naked eye and can only be discovered using specialized radar. The creation and expansion of the airspace way for UAVs do not demand the construction of physical infrastructures such as roads and highways, which entails significant expenditures and investments. The term navigability is always used in passage, waterway, and airspace to acknowledge the capabilities of a space or the degree to of an area is to be connected with others for a certain purpose. The navigability of low-altitude airspace for the UAVs is somehow in a grey area as it is placed in between the proprietors' ownership and the public airspace. The increased demand for commercial UAVs in shipping and delivery has had a significant impact on the mandate for the use of low-altitude airspace. CAAM only recognizes 400 feet above the ground as the maximum altitude at which all UAVs can fly, but they fail to specify the minimum altitude at which UAVs must fly. Currently, the navigable airspace of manned aircraft in Malaysia is shaped by customary international law, which stipulates a minimum of 500 feet from the land's surface. The navigability of low-altitude airspace, on the other hand, remains a point of contention.

Methodology

This paper adopts a mixture of legal and qualitative research where the method used in this paper is based on the analysis and evaluation from the various primary sources of law, particularly the legislation that influences the legal issue from the perspective of the commercial UAVs in shipping and delivery, especially in the doctrine of navigability of airspace. Besides, this paper also examines the laws available in other countries to view their standing and status on the potential regulatory frameworks available that best suit UAVs in shipping and delivery. Apart from that, the secondary sources of law are referred to in this paper from the various authors in various journals. The inductive analysis is inspired in this paper to highlight the doctrine of navigability from the available laws which reflect the new technology of UAVs in shipping and delivery to endure the economic chain of the nation.

The Evolution of the Doctrine of Navigable Water and Airspace

To compare and contrast the applicability of the concept of the unexplored lawless low-altitude airspace, it is appropriate to focus on the evolution of the doctrine of navigability of water and airspace during the early introduction of the laws. The idea and concept of navigability became popular in the 18th century as a result of the increasing demand for river waterways for economic transactions, which were considered as far more effective than regular roads. The claims of ownership over rivers by private individuals were another aspect that contributed to the development of river navigability. During that period, the theory of river navigability was crucial in determining Crown territorial ownership of rivers. (MacGrady, G. J. 1975). Both common law and civil law approaches to navigability highlighted different methodologies. The common law approach to river navigability was perceived as straightforward, concluding that the rivers were seen as public navigable, that the Crown held it as a public trust, and that it did not belong to private proprietors (MacGrady, G. J. 1975). The interesting fact to highlight in

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the test of navigability of rivers in common law, the Federal Supreme Court noted in a case laid down by, Justice Field in the case of Daniel Ball is as follows: firstly, it is sufficient for the rivers to be navigable; secondly, the navigation is used for commercial purpose, thirdly, the navigation of commercial purpose is in its natural and ordinary state; and lastly, any customary method of trade or travel can be used for the aforementioned commercial navigation (Daniel Ball v. United States, 1871). In the early evolution of water law, the notion of river navigability in common law had a commercial character and customary practice. In civil law, however, the idea of river navigability is significantly more complicated, as it is based on the geographical concept of tide and flow of rivers, as well as torrential rivers and perennial rivers (MacGrady, G. J. 1975). Rivers, perennial rivers, lakes, ponds, and canals that flow naturally were deemed public and hence navigable to all. Brooks, on the other hand, were not rivers and might be owned by private individuals (MacGrady, G. J. 1975). In the 19th century, the doctrine of navigability arose during the logging industry, when private parties who owned property with surface water were required to occasionally allow others to pass through on that water and created the waterway for the industry (Maureen Brady, 2015). At that time, most of the commercial shipping and delivery was through water and was considered the most effective method as compared to the railway. The owners of navigable waters no longer have the right to exclude parties who use the water for certain purposes. (Miller, B. M., 2020). The owner will be excluded from claiming ownership over the navigable water.

Airspace navigability, on the other hand, was historically designed for manned aircraft founded on the notion of state sovereignty and was fully recognized in the International Convention of the 13th of October 1919 in Paris. (Bouve, C. L. 1930). As of today, the navigation of airspace for manned aircraft is regarded as public airspace that is set at a minimum of 500 feet from the surface of the land, leaving the unanticipated low-altitude airspace in a grey zone and lawless. Therefore, can the concept of navigability, as introduced in navigable water, be adapted to low-altitude airspace with the ultimate goal of commercial use? The CAAM can use this idea of navigability to determine the proper low-altitude for commercial UAVs that will later be integrated and declared as navigable airspace. The potential for commercialization of low-altitude airspace will reflect the concept of river navigability as developed by common law.

Jurisdiction Integration: **Navigable Airspace Versus Proprietor's Airspace**

Laws and regulations should work in tandem with societal advancement and development by providing adequate infrastructure. In dealing with the UAVs in shipping and delivery, the first thing that the appropriate authorities should offer is the infrastructure of the right of way or airspace way for commercial UAVs. The ambiguity of the right of way laws will impede the development of commercial UAVs, rendering them unable to contribute significantly to society. Consequently, UAVs in shipping and delivery are impossible to be implemented due to the ambiguity and non-availability of law to provide a specific airspace route for commercial UAVs. Historically, the airspace is considered as the proprietor's ownership based on the legal maxim of *cujus est solum, ejus est usque ad coelom* universally interpreted as "anyone has the land owns all the space above to an unlimited extent". There was no clear statement on property rights in low-altitude airspace before Causby's case, at least in terms of unwelcome flights. (Miller, B. M., 2020). The *ad coelom* principle was highlighted in Causby's case whereby the proprietor owns exclusive right over the airspace so much beneath and the skies above the surface of the land. The Supreme Court ruled that the *ad coelom* principle does not have a place in the modern world where there is a need to have public airspace for separating it from the proprietor's airspace. The court further highlighted that the proprietor shall have "exclusive

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control of the immediate reaches of the enveloping atmosphere" (the United States v. Causby, 1946). The word “immediate reaches” was measured by the proximity and frequency of the flight to affect any direct interference of the enjoyment and rights of the proprietor over his or her airspace or land. The existence of unreasonable interference is a key element that needs to be proved in a nuisance suit. Causby's case emphasized the proprietors' rights over low-altitude airspace, as well as the interference by large military flights. The Court further determined that the altitude of 100 feet of low-altitude airspace was the exclusive right and ownership of Mr Causby. Thus, the proprietor may sue for trespass if any aircraft flies at an altitude of 100 feet from the surface of the land. Similarly, this rule could be extended to commercial UAVs by limiting the minimum altitude to fly UAVs.

In Rwanda, one of Rwanda's most notable achievements in integrating commercial UAVs in shipping and delivery to their national airspace is the integration of central government jurisdiction to provide adequate infrastructure and the right to airspace for commercial UAVs. Airspace is the major concern despite the safety issues in developing commercial UAVs in shipping and delivery as the routing for UAVs to fly shall be clear as the skies. Thus, airspace legally is divided into two: 1) navigable airspace, and 2) proprietor’s airspace. Navigable airspace is federal airspace set at a minimum altitude of 500 feet from the surface of the land and controllable by the Air Traffic Control (ATC) of the CAAM. Even though the CAAM has established general rules on UAVs, particularly in Regulations 140-144 of the Malaysian Civil Aviation Regulations 2016, there are still legal rules lacking to provide airspace infrastructure for the commercial use of UAVs. In Malaysia, the federal government has jurisdiction over navigable airspace, as specified in List 1 of the Ninth Schedule of the Federal Constitution under the heading of “aviation”. As of now, UAVs are still not included in the navigable airspace. However, the CAAM has stepped up its role in regulating a framework for UAVs in order to realize the International Civil Aviation Organization (ICAO) and CAAM's mission of integrating both manned and unmanned aircraft into navigable airspace controlled by ATC by the year 2035. The federal government may freely regulate this space because of an apparent carve-out of airspace rights. The ICAO regulates and standardizes the minimum height in navigable airspace for manned aircraft. In international aviation, it is a standard practice to set and fix navigable airspace for manned aircraft at a minimum of 500 feet above ground level. Nevertheless, according to Miller, B. M (2020), low-level airspace should probably be exempted from implied navigability because it has never been and never will be important for commerce or travel. As a result, the low-altitude airspace still recognizes the airspace's ownership, and prior consent from the proprietor or owner is required to avoid legal consequences such as trespass or nuisance. In contrast, as of today, there is no necessity to apply the doctrine of navigability to low-altitude airspace due to the availability of other alternative methods of delivery and shipping. Furthermore, the proprietor will lose their rights and enjoyments over low-altitude airspace under this doctrine. The reason for the exclusion of the doctrine of navigability is because land law has enshrined and established airspace as a part of the land, hence low-altitude airspace is currently under debate as to whether it is owned by a private individual or can be considered a public space. In other instances, the common law deems low-altitude airspace to be the property of the landowner (Miller, B. M., 2020).

Section 44(1) (a) of the National Land Code (NLC) 1965, provides that a proprietor shall own a bundle of enjoyments, rights, and ownership over the surface of the land, the sub-soil as well as the airspace. Thus, by virtue of this provision, it is prima facie that airspace is a part of the land. Furthermore, the airspace is regarded as part of the land, and the term “land” is listed

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within State jurisdiction by virtue of List 2 of the Ninth Schedule of the Federal Constitution, therefore it is under state authority. Nevertheless, the airspace as mentioned in the NLC does not specifically mention to what extent the proprietor owns the airspace. The proprietor is entitled to reasonable low-altitude airspace, but this does not extend to the legally defined navigable airspace. Apart from the state jurisdiction in dealing with low-altitude airspace, the municipal level may pass by-laws and rules for commercial UAVs, especially in mapping and zoning the free-fly zone area. Certainly, not every municipal road is suited for UAV delivery infrastructure, but this is something that both UAV delivery businesses and municipal governments may bargain in their airspace leases. The power of a municipal government to distribute public property does not end when that property exists in the air (Thompson, D, 2019-2020). Further, municipal councils may become law enforcers besides the Royal Police of Malaysia in administering the laws. Although currently preregistering or leasing from a municipality may appear irrational, this project would allow UAV in shipping and delivery companies to test a prototype of UAV infrastructure in preparation for UAV integration into the national airspace in the year 2035.

In Malaysia, the CAAM only limits the commercial UAVs to fly in the airspace maximum at the altitude of 400 feet from the surface of land only without encroaching the existing navigable airspace of manned aircraft of 500 feet from the surface of the land (Rule 140(4), Malaysian Civil Aviation Regulations 2016). The existing regulation does not set the minimum altitude for commercial UAVs to fly in the airspace and consequently may encroach on the low-altitude airspace that belongs to the proprietor. The UAVs in shipping and delivery may be successful in Malaysia if the legislator amends Rule 140(3) of the Civil Aviation Regulations The rule prohibits any unmanned aerial vehicle (UAV) from dropping or attaching any article or parachute to the aircraft system (Rule 140(3), Malaysian Civil Aviation Regulations 2016). This rule implies that shipping and delivery *via* UAV are not permitted in Malaysia unless the operator or pilot obtains prior approval and permission from the CAAM. In the midst to achieve the 2035's mission, the commercial UAVs in shipping and delivery shall be ready to initiate their program from now on as every state's laws and regulations have provided sufficient mechanisms as to the right of way and airspace for the commercial UAV to fly. The UAVs in shipping and delivery generally use low-altitude airspace which is currently in the vague and ambiguous area as to the ownership. Under the land law, the low-altitude airspace is treated similarly to the surface of the land to protect the proprietor from any trespass and encroachment of their land. The law and principle on trespass to land is extended to the low-altitude airspace where the severity of harm could be measured within this space (Section 44(1) (a) of the National Land Code, 1965). Furthermore, this could be applied to the flying UAV itself, particularly the shipping and delivery *via* UAV, which carries more weight than ordinary UAVs. Surface-level trespass laws give landowners the right to exclude others from entering their land (Miller, B. M., 2020). This can come in the form of an injunction against further invasion of the property or damages for past trespasses. The tree grows from the said land, building, or other structures and could become the yardstick to measure the low-altitude airspace and the ownership of the proprietor over the space.

In *Chen Yue Kiew (F) v Angkasamas Sdn Bhd*, the court decided that a landowner has the right to exclusive use of his land and the airspace above it and the court would not be reluctant to grant a perpetual injunction against those trespassing into another's land or the airspace above it *(Chen Yue Kiew (F) v Angkasamas Sdn Bhd, 2003)*. The court acknowledged that airspace is also part of the proprietor's ownership. Furthermore, in the case of *Karupannan Chellapan v*

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Balakrishnan Subban (Chong Lee Chun & Ors, third parties) the Federal Court decided that in the case of a serious trespass to land and airspace committed by the owner of an adjacent lot, the aggrieved owner of the land upon which the trespass is committed is entitled to an interlocutory mandatory injunction to have the source of the trespass removed, regardless of whether or not the source of the trespass existed before the new owner came to own the land and whether or not he knew or had notice of it. As the current registered owner, he is obligated to remove them *(Karupannan Chellapan v Balakrishnan Subban (Chong Lee Chun & Ors, third parties), 1994).* Moreover, in the case of *Gelumbang Jaya Sdn Bhd v Jaya Jeans Sdn Bhd,* the court held there was no trespass occurred because the defendant has the right to hang banners, buntings, flags, and balloons in the airspace above its property. As long as the defendant's actions do not infringe on the plaintiff's property or the airspace above the plaintiff's property *(Gelumbang Jaya Sdn Bhd v Jaya Jeans Sdn Bhd, 2011).* A trespass action would succeed only if the following essential elements were established: (a) There is an entrance and/or encroachment into the plaintiff's legal property by the defendant; and (b) The said entrance and/or encroachment must be illegal, inexcusable, unwarranted, and/or without any legal right for the defendant to do so. *(Spektra Segmen Sdn Bhd v TC Autoworld Sdn Bhd, 2018).*

As the commercial and economic sectors move faster, as does technology, existing regulations must keep up in order to provide adequate protections and rights based on a win-win principle. The rationale of the CAAM's mission in integrating UAVs into navigable airspace like manned aircraft is to provide sufficient control of navigable airspace and to synchronize accordingly air traffic control for both manned and unmanned aircraft. Until the realization of the CAAM's mission for the integration of UAVs into one navigable airspace in the year 2035, it is appropriate for the commercial UAVs in shipping and delivery to initiate and fly the commercial UAVs by observing the low-altitude airspace as provided under the existing land laws and regulations. As for now, the current state land laws and regulations provide numerous dealings that are harmonious and suitable for the utilization of low-altitude airspace. In addition, the dealings can be concluded with the proprietor like other land dealings as enumerated in the National Land Code.

Easement of The Airspace

The airspace easement or navigation easement is contingent on the proprietors' willingness to sacrifice their low-altitude airspace for the commercial UAVs to fly above the surface of the proprietors' land. The easement is a right of way or right to cross and use someone else's land for a certain purpose. Historically, the creation of easement developed under the land law when all people started to live in one society and thus had to concede and respect the right and ownership in immovable property with the necessity of having infrastructure of pathway and now easement constitutes one of the commercial dealings in land law. Both business owners and landowners make investments based on how they intend to use their assets Prospective landowners may be less eager to pay high prices for land if they know the sky above it will be buzzing with UAVs. Prospective landowners may be less prepared to pay high prices for land if they know the sky above it will be buzzing with unmanned aerial vehicles. If they expect to have to leave that airspace available for UAV flights, current landowners may be hindered in developing their land vertically. (Miller, B. M., 2020). The value of a UAV easement varies according to the location and geographical areas of one land, much like the market value of the landed property.

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In Malaysia, Section 282 of the NLC allows the proprietor to grant an easement of right of way to commercial UAVs to fly above the surface of his land. This grant of the easement shall be exercisable subject to any restrictions imposed by the Act. Thus, the shipping and delivery *via* UAVs company may start to initiate their program now without waiting for the year 2035 as the law on the easement that is available for land may be extended to the airspace as well. This effort by having easement of airspace could lower the risks or liabilities in case of trespass or nuisance affected by the delivery of UAVs. The customer also may give consent as to easement to the airspace if they opt to have a UAV as a mode for a delivery service for goods or products that they buy. However, the easement as provided under the NLC must be registered by filling up the required instrument of Form 17A to the Land Registry. If an easement is intended to be formed pursuant to the NLC, it must be registered in accordance with the provisions of section 286 of the NLC (American International Assurance Co Ltd, Third Party, 1997). Further section 282(2) of the NLC provides that easement may be either in perpetuity or for any term as agreed by the parties. There is no fixed payment imposed by the laws as to the creation of easement however, the payment for the easement is as per consideration agreed by the parties. Moreover, section 288 of the NLC mentions the special provision as to the easement of right of way to be specific right of footway or right of carriageway by authorizing any person to be entitled to the benefits to pass or re-pass the servient land all the time with or without animal or vehicles. The easement of airspace is suitable if the proprietor's land is adjacent to the servient land which may be described as the delivery UAVs company. However, this easement of airspace can offer a limited length of airspace depending on the extensive area of the proprietor or the dominant's land. The registered easement of the airspace is a justification for legal entry over the proprietor's land and could minimize the claim of trespass.

Alternatively, the State or Government may highlight the UAVs in shipping and delivery as a part of the national economic planning for the growth in the commercial logistic sectors. The policy from the government in providing airspace infrastructures for commercial UAVs is essential for the bulky and massive project of the UAVs in shipping and delivery. The route and mapping of low-altitude airspace require enormous as the normal road vehicles. If the conventional method of delivery by the road vehicles can deliver goods and parcels in big-scale areas so do the UAVs. Despite the commercial UAV companies' initiative by approaching one individual proprietor for the creation and the grant of easement, the government may invoke the provisions in the Land Acquisition Act to compulsorily acquire the necessary low-altitude airspace of the proprietors' land for the infrastructure of UAV's pathway for the commercial UAVs in shipping and delivery. Section 3(1)(b) of the Land Acquisition Act 1960 provides that the State Authority may acquire any land for the purpose that the State Authority thinks is beneficial to the economic development of Malaysia. Economic development connotes a well and long-term planning of the State. The definition of a commercial establishment determines whether commercial drone operators fall into this category (Thompson, D, 2019-2020). Further, in sub-clause (c) of section 3(1), the compulsory acquisition of the low-altitude airspace could be under the heading of commercial purpose. Section 2 of the Act interpreted 'land' as the alienated land within the meaning of the State land law, land occupied under customary right, and land occupied in expectation of title. As per section, 44 of the NLC the proprietor of alienated land shall have rights, enjoyments, and exclusive use over the surface of the land, beneath as well as the column of airspace. Thus by cross-referring both sections, the compulsory acquisition by the government may take effect in the low-altitude airspace as well. If the low-altitude airspace for commercial UAVs is listed as one of the Economy Planning Unit of the States for the public interest, the acquisition may be justifiable as

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mentioned under section 3A(1) of the Land Acquisition Act. The proprietor will be compensated adequately for the compulsory acquired low-altitude airspace (Section 6 of the Land Acquisition Act, 1960). In reality, following Causby, governments have made it common practice to compensate residents living near airports for the use of their low-altitude airspace. (Miller, B. M., 2020). A similar approach may be extended to commercial UAVs as well for national economic development.

Airspace UAV-highway

In the United States, shipping UAVs have yet to swarm from Amazon Hives, possibly due to property legal concerns. Amazon would have to fly through large areas of low-altitude airspace to ship by UAV, as the ownership of low-altitude airspace is still up in the air and undetermined. (Miller, B. M., 2020). Jonathan Kathrein (2017) proposes a UAV highway over railroads for the development of UAV infrastructure. Freight trains transport heavy cargo efficiently, whereas UAVs will primarily deliver lightweight objects. It is a profitable economic relationship for both parties. (Kathrein, J., 2017). Flying UAVs above trains could pose some safety problems, although it is controllable in terms of traffic control. Although railroads have limited coverage for the UAVs in shipping and delivery, the railroad could become a Drone-port or checkpoint for all UAVs and may stand as one added infrastructure for the commercial UAVs.

Alternatively, the area above and below a highway's specified grade line, known as "highway airspace," could be another effective method for developing UAV highways. It is considered a fast-forward development of infrastructure by utilizing the low-altitude airspace of the existing highway or expressway for the commercial UAV. The blueprint for routing, safety, and monitoring the traffic control for the UAV can be as similar as the existing highway. The difficulty is not simply finding space for UAVs in the airspace; rather, it is determining how to split up existing airspace to develop an infrastructure capable of integrating UAVs. (Thompson, D., 2019-2020). The hardest thing to realize is to integrate the existing highway with the UAV highway in terms of safety issues especially when it comes to the delivery and shipping of UAVs. The UAV highway could bring economic advantages to all especially to the commercial UAV as only routing properly could connect UAVs to the customers. Furthermore, after the UAV highway has been identified and determined, the issue of leasing and renting the low-altitude highway would give advantages to commercial UAV companies. The highway company, in this case, may lease the low-altitude airspace of an existing highway or expressway to a commercial UAV for a set period of time. Leasing as per the National Land Code should be in between 3 years to 99 years and registered under the Code. If the intended UAV airspace is only open for leasing below three years then it shall be concluded appropriately by agreement. Alternatively, the highway company may issue a permit to commercial UAVs to fly appropriately within the grade line of the existing highway in the low-altitude airspace above highways.

The concept of leasing could also be applied to the further infrastructure in commercial UAVs which is the Drone-port. When the commercial UAVs in shipping and delivery affect a large scale of logistic services with the utilization of busy low-altitude airspace, thus the creation of Drone-port functioning as if the airport is necessary for proper management of air traffic control for the commercial UAV together with the specifically designed take-off and landing area, loading bay and the charging port. As of now, the Rwanda government is very serious about funding this infrastructure for the development of the UAVs in shipping and delivery

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with the ideal network of Drone-ports to deliver medical supplies in the remote area of Rwanda due to the difficult access of the conventional method of delivering goods and lack of transport infrastructure *via* land. In reality, the Drone-port could generate job opportunities for the local population and would change the social and economic pattern of the countries.

Segregation of Airspace

Another method that commercial UAVs in shipping and delivery can fly in the airspace appropriately is by zoning the airspace vertically and horizontally. The vertical zoning is based on the altitude of airspace or layers of airspace, which is mapping accordingly for flying the UAV. What CAAM has organized currently in vertical zoning is by limiting and restricting the commercial UAV to fly a maximum of 400 feet from the surface of the land. Nevertheless, the CAAM is yet to determine the minimum safe flight altitude for the commercial UAV thus leaving a grey area as to who exactly owns the low-altitude airspace. If we were to apply Causby's case in relation to the proprietor's airspace, it is conclusive that the low-altitude airspace of 100 feet from the surface of the land belongs to the proprietor. Therefore, the reasonable flight altitude to fly UAVs for the shipping and delivery of UAVs in the low-altitude airspace should be between 200 feet and 400 feet from the surface of the land without encroaching neither the proprietor's airspace nor the navigable airspace of manned aircraft. According to Hazel, R.A. (2018), it was recommended that commercial UAVs fly in low-altitude airspace between a minimum of 200 feet and a maximum of 400 feet above the ground without invading either navigable airspace or the airspace of private landowners in order to maximize economic benefit without sacrificing societal welfare. The altitudes of 200 feet to 400 feet are believed to have commercialization potential for UAVs, especially in the logistics sector. These altitudes provide a lot of room for the successful deployment of commercial UAVs in the logistics industries. As a result, by the year 2035, the CAAM will be prepared to station specialised ATC for UAVs for low-altitude traffic control.

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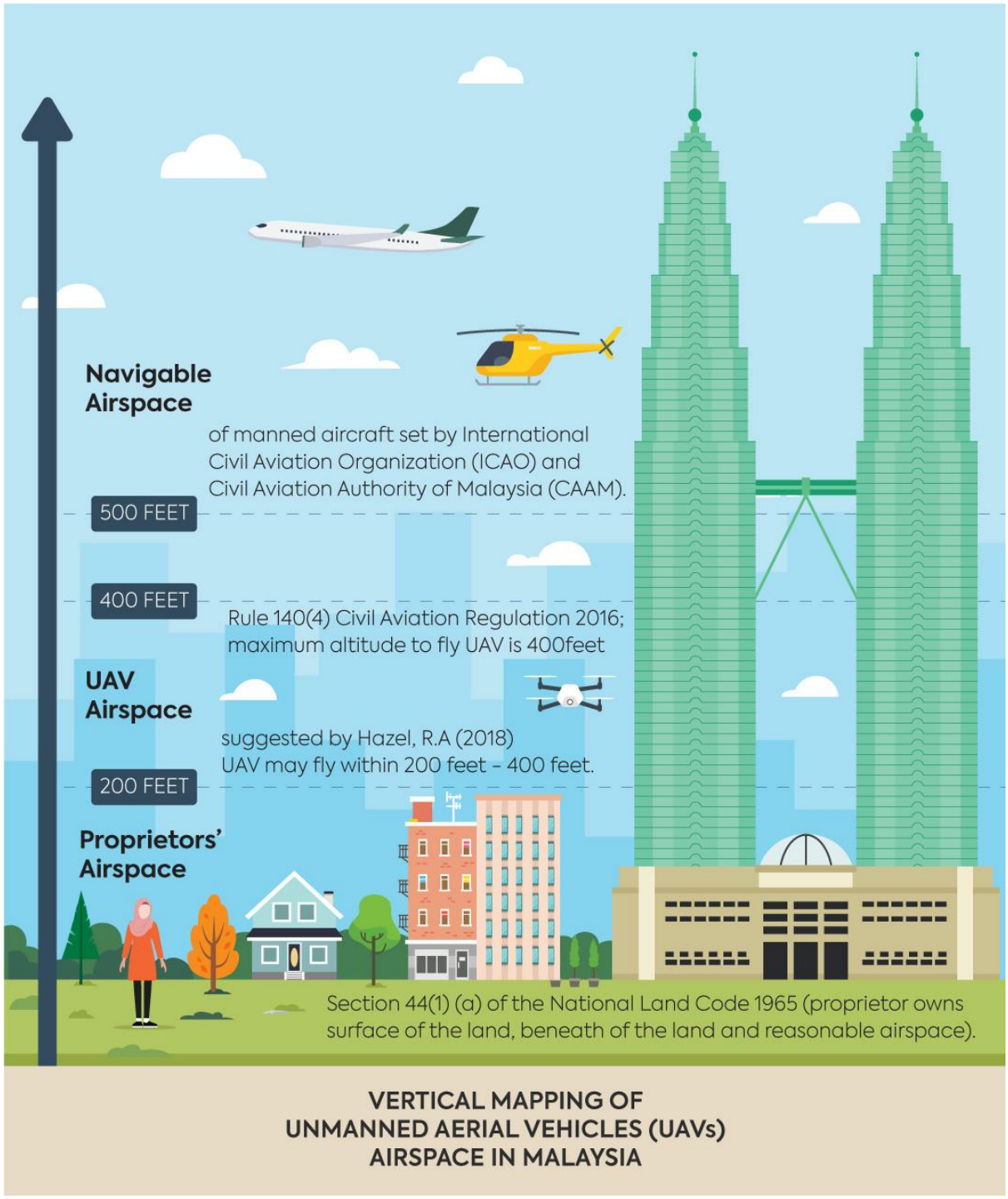

Figure 1. The Vertical Mapping of UAVs Airspace.

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On the other hand, horizontal zoning is based on the area where the CAAM can generate mapping for either the free fly zone area or the no-fly zone area. The CAAM has acknowledged several areas as a free fly zone for UAVs, for example, DRZ Iskandar in Johor and Area 57 in Pahang which was recently launched by the Minister of Science, Technology, and Innovation (MOSTI). Most of the horizontal zoning for the free fly zone is anticipated for the research and development of UAVs. Moreover, the free-fly zone is also stated in the regulation where all UAVs shall fly within the vicinity of sight, which involves the flight of visual line of sight (VLOS) and not extended to the UAV that flies extended the visual line of sight (EVLOS). All flights involving the EVLOS require prior approval from CAAM because the law currently only allows for VLOS flights (Rule 142(1), Malaysian Civil Aviation Regulations 2016). Currently, the EVLOS will stunt the development of commercial UAVs in shipping and delivery in Malaysia due to restrictive regulations. Generally, the method of commercial UAVs in shipping and delivery involves a flight that flies beyond the vicinity and sight of the operator or pilot. However, the operator or pilot can still control the movement of the UAV from the connection of the attached high-definition camera with the control system from the ground. In the non-fly zone region, the CAAM has designated several areas where flying UAVs is restricted, such as residential areas, airports, gathering areas, and other places. (Rule 143(1), Malaysian Civil Aviation Regulations 2016). Indeed, the CAAM approved a standard curriculum in relation to competency remote pilot to Air Asia Group Berhad as the sole institution to conduct the training course that includes Module 1 of EVLOS on January 10, 2022. Air Asia Group Berhad's training course focuses on commercial operations, particularly in shipping and delivery *via* UAVs, rather than private use of UAVs.

Public Safety: Pilot License and Airworthiness Certification

The rights and liabilities are symbioses when it comes *vis-à-vis* the commercial UAVs in shipping and delivery as the UAVs carry not only the burden of parcels and goods but also the burden of carrying the perception of public safety. Airworthiness refers to the process by which an aircraft, engine, propeller, or part complies with applicable airworthiness requirements and remains in a safe operating condition throughout its operational life. The term "airworthiness" refers to the conditions of the UAV itself, specifically whether it meets the safety requirements set for the specified purpose. Moreover, in the commercial arena, the component of the UAV usually differs according to the operation of the UAV. For example, the UAV for agriculture is different from the UAV for shipping and delivery in terms of its weight and capabilities. In Malaysia, UAV permits, licenses, and certificates of operation must be applied for through the CAAM in compliance with Rule 189 (Rule 143(2), Malaysian Civil Aviation Regulations 2016). The airworthiness certification currently is a compulsory requirement for all commercial UAVs depending on the types of UAVs as listed by the CAAM. Mostly, if the operation of the UAV is within the definition of commercial purpose then the UAV shall be fit to fly and shall have an airworthiness certificate. In, rule 6.10 of ICAO Circular 328-AN/190 provides all aircraft whether manned or unmanned shall meet the large degree of commonality with regard to airworthiness. Conversely, the UAV assessment in airworthiness is changing due to the growth of the technology, especially in commercial UAVs that require modification to fit the purpose of the operation. Article 33 of the Chicago Convention provides the requirement for the Certificates of Airworthiness of civil aircraft which applies mutatis mutandis to the UAVs based on the international compliance and standard established by Annex 8. The requirement of Annex 8 are the following: a) The State of Design must provide proof of an approved type design by issuing a Type Certificate; b) that an aircraft be manufactured in a controlled manner to ensure compliance to the approved type design; c) that the State of Registry issue a

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Certificate of Airworthiness relying on satisfactory evidence; d) that the aircraft meets the appropriate airworthiness requirements in terms of design; and that the State of Design, the State of Registry, and the type certificate holder work to ensure the aircraft's continued airworthiness (ICAO Circular 328-AN/190, rule 6.14, p27). The airworthiness certification under Annex 8 is based on a well-established airworthiness design standard for manned aircraft. Nevertheless, the performance standards currently in use for manned aviation may not apply or satisfactorily address UAV operations due to the difference in their functionality. The UAV itself is considered a vehicle. The requirement and quality control of the vehicles shall be approved by the specified agency as set by the government.

The commercial UAV in Malaysia shall be tested by the Standard and Industrial Research Institute of Malaysia (SIRIM), and the certification and accreditation by SIRIM are considered prima facie proof that the UAV has met and passed the standard and quality requirements as set by the CAAM. SIRIM is the third party that certifies the airworthiness of UAVs in Malaysia, which are generally made elsewhere. The UAVs shall meet the standard requirement set by CAAM in order to get airworthiness certification. UAVs, like other motor vehicles, must be registered and have a unique registration number to register the ownership of the particular UAVs. The CAAM has introduced the Standard Authorisation to Fly (ATF) specifically for the operation of UAVs that are categorized as Special UAV Project or Agricultural UAS Operations which fly in Class G Airspace within the VLOS. Prior approval from CAAM is needed for the ATF UAVs operation. UAVs categorized under Special UAV Project or Agricultural UAS Operations shall be less than 20kilogram. Since the operation of shipping and delivery *via* UAV is still in the initial stage and trial project, this UAV may fall under the category of Special UAV Project. Furthermore, the CAAM has recognized the functionality of UAVs in agriculture and has drafted special guidelines for the operation of UAVs in relation to agriculture in the Civil Aviation Directive Part 6011(II) Agriculture UAS Operations (CAD 6011 Part(II) – UAS AGR. This is considered flexibility and a new step taken by the CAAM in acknowledging the importance of commercial UAVs in the agricultural sector. Hopefully, by 2035, the CAAM can provide further guidelines specifically for the shipping and delivery of goods *via* commercial UAVs.

The pilot license also is a requirement for the CAAM permit, as it is proof that the operator is competent and has the required skills in handling the UAVs especially the modified UAVs in the commercial arena. Many national legislations such as in the US, UK, and France, provide for an obligation for commercial UAV pilots to obtain a license. In Malaysia, the Civil Aviation Directive Part (I) Remote Pilot Training Organization (CAD 6011 Part (I)-RPTO) applies to all Remote Pilot Training Organizations regardless of the types of UAV operation which set standard requirements, administrative processes, and guidelines for the issuance of Certificate of Approval (COA) to the RPTO. Various degrees of piloting an aircraft are contemplated, based on factors such as size, weight, speed, equipment, and operation. (Van de Wouwer, 2016, p.138). Apart from that, in Malaysia, the Drone Piloting training and certificate under the Technical and Vocational Education and Training (TVET) level 2 is recognized by the Malaysian Qualifications Agency (MQA), and also is certified under National Occupational Skills Standard (NOSS) for the remote pilot license as required by the CAAM. Thus, the operator who operates the UAVs owes a duty of care in operating and piloting the UAVs. Nonetheless, an operator's liabilities are subject to the types of commercial contracts that they enter into with other parties. The capacity of rights and liabilities of UAV operators and owners is determined by the type of commercial agreement. If the operator is under a contract of service

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hence placing him as an employee, vicarious liability may apply, thus rendering the owner of the UAVs to be liable for any injury or damage suffered by the third party. Further, if the commercial UAVs in shipping and delivery involve the contract of agency thus the doctrine of principal and agent shall be interpreted clearly in the agreement to illustrate the extent of liability of the agent or principal in tortious actions that may be accidental to the commercial UAVs in shipping and delivery.

Rwanda has succeeded in integrating commercial logistics and delivery UAVs as a part of the economic growth of the country. The use of UAVs in shipping and delivery has had a huge economic and social impact on Rwandan communities. Due to the geographical features of Rwanda, where most of the land is covered with hills and mountains made it is possible to succeed in the operation of the shipping and delivery UAV project especially in delivering medical supplies in the poor infrastructure area. Rwanda has begun delivering blood via UAVs to 25 hospitals and clinics across the country daily (Ackerman, E. & Koziol, M., 2019). UAVs in Rwanda have shaped society's acceptance of new logistical methods combined with technology for the benefit of society and the country's economy. Part 27.165 of Rwanda, Civil Aviation Regulation provides that the remote pilot license or certification can be obtained from the Rwanda Civil Aviation Authority (RCAA) if the operator or pilot has completed the specified training course for the specified operation namely the commercial operation. In order to apply for the remote pilot license, the operator or pilot of the UAV shall either have undergone the specific examinations which include; the aeronautical knowledge examination or aviation license theory examination, or the theory component of a remote pilot training course. In addition, the theory component of the remote pilot training course from other foreign countries is accepted for application for the said license. Moreover, Part 27.175 of Rwanda Civil Aviation Regulation mentions a list of conditions for the remote pilot license where the RCAA may allow the operator to operate a UAV of only a specified model, limitation on the area to fly UAV, and restriction to fly and operate UAV in Visual Meteorological Conditions (VCM). VCM is defined as meteorological conditions that are equivalent to or better than the prescribed minimum in terms of visibility, distance from cloud, and ceiling. Next Part 27.175 (b) of the Regulation provides a further condition for the holder of a remote pilot license or certificate shall not fly a UAV beyond 120 meters (400 feet) above ground level or within a 10-mile radius of an international aerodrome unless the operator or pilot of the UAV possesses at least one of the relevant qualifications; 1) an aeronautical radio operator certificate; 2) a flight crew license; 3) an air traffic control license; 4) a military qualification equivalent to a license mentioned in paragraph (b) or (c); 5) a flight service license. The Rwanda Civil Aviation Regulation imposed liability on the manufacturer to ensure the airworthiness of the UAV per Note 8 of the Regulation. *In lieu* of a more robust and dependable system certification, it is up to the operator to offer the required risk mitigations that enable higher-risk operations and to employ industry best practice standards when applicable to obtain Alternate Means of Compliance (AMOC). Note 8 of the Regulation highlights the current practice in commercial UAVs that have undergone a series of modifications of UAVs as compared to the original manufacturer set to suit the specific operation. Thus, it is considered as the leniency or flexibility of the Authority where the operator or pilot of a UAV must ensure the airworthiness of its UAV before launching the operation.

Conclusion

The Federal authorities, the States agencies as well as the municipal councils must be ready to provide the necessary infrastructures that ensure sufficient rights of way for the commercial

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UAV, especially in shipping and delivery, to fly in the low-altitude airspace with strictly observing the existing laws and regulations on trespass, nuisance, and privacy of individuals. The right of airspace is regarded as the first and major concern that shall be finalized by the relevant authorities in providing sufficient infrastructures to the commercial UAV. The mission of the CAAM to integrate UAVs into the navigable airspace controlled by the Air Traffic Control Service (ATS) by the year 2035 can be achieved if all agencies and private individuals are willing to cooperate in offering and compromising the right of way and airspace specifically for the UAVs. As a result, the river navigability test can be used to appropriately identify navigable and non-navigable low-altitude airspace based on its suitability for commercial navigation. If the creation of international customary law on the navigable airspace of manned aircraft was by sovereignty, the navigable low-altitude airspace shall be based on the test of commercialization as popularized by the doctrine of navigability of rivers to give a new spirit in approaching the said airspace without limiting the proprietors' airspace. Defining appropriately, the low-altitude airspace for commercial UAVs and the right of the proprietors over the airspace will generate the sustainability of commercial and economic growth in Malaysia. It will take time to transform and build commercial UAV infrastructure. Despite the fact that highways and expressways are more congested with cars and other road users, the airspace above the railway may be the best alternative for integrating commercial UAV routes. Because of the nature of the railway routes, which are secluded from the public, they may be the safest routes for UAV shipment and delivery. Furthermore, CAAM's approval of the EVLOS as part of a competency syllabus for commercial UAVs for Air Asia Group Berhad demonstrates the company's commitment to allowing UAVs to fly freely in Malaysian airspace for shipping and delivery. Following that, Malaysia's laws and regulations must enshrine the applicability of EVLOS operation to commercial UAVs, as Rwanda did in their legislation. The potential of shipping and delivery *via* UAVs in Malaysia will undoubtedly bear fruit as technology advances, as long as all government agencies and private individuals are willing to accept this new method of delivery service. The issuance of a remote pilot license and an airworthiness certificate for UAVs in shipping and delivery will give the public confidence in their safety, as the UAV will be handled by a competent pilot. Similarly, when it comes to motor vehicles, the vehicles must be safe and fit to be driven and ridden on the road. Further, the driver or rider also shall have a driving license to show that they are competent to drive on the road for the safety of other road users. Ideally, by 2035, the integration of navigable airspace for manned and unmanned aircraft should, in essence, increase and expand the demand for UAVs in various industries for the sustainability of the Malaysian economy.

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