Urban Air Mobility as the Environmental-Friendly Transport of the future in Indonesia? Some Legal Considerations

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Abstract. This paper investigates the legal framework required to develop a safe and sustainable Urban Air Mobility system in Indonesia. A coherent and comprehensive legal framework for UAM minimizes the risks posed by mass application of drones. Risk mitigation is essential, as public opinion, social resistance, and costs will determine how the public will receive such services. To ensure sustainability, drone services must be safe, comfortable, and not disturb local communities too much. Accidents are detrimental to trust and increase insurance costs. Areas that require special regulatory attention are requirements for aircraft, requirements for the ground station, requirements for operations, minimization of visual and sound pollution, and rights and responsibilities of operators vis-à-vis users and third parties. This paper explores the extent to which current Indonesia’s drone regulations provide a legal framework for future mass use of drones for transportation and provide recommendations for further regulation and risk mitigation.

1 Introduction

The Jakarta Metropolitan Area (Jakarta Bogor Depok Tangerang Bekasi; Jabodetabek) has an estimated population of 34 million and suffers from severe traffic congestion. In 2019 Jakarta was listed in the top ten of most congested cities of the world with resulting economic losses of approximately Rp100 trillion or four per cent of the Jakarta metropolitan area’s GDP [1]. As a result of all this traffic, Jakarta has a huge air pollution problem too, causing major health risks to its population. It has been estimated that each year air pollution in Jakarta is responsible for over 7000 children with pollution-related health problems, 5000 hospitalizations and 10,000 deaths, corresponding with an annual total cost of approximately USD 2943.42 million [2]. The Indonesian government has launched several infrastructure projects and policies to improve traffic congestion in Jakarta, but congestion in Jakarta remains problematic.

Urban Air Mobility (UAM) is an emerging concept of future air transportation, as it is envisioned that gradually the use of Unmanned Aircraft Systems (UAS) and Vertical Take Off and Landing (VTOL) aircrafts, ranging from small package delivery drones to passenger-carrying air taxis will replace, or at least compete with, road and railway transportation systems, especially in urban areas [3]. Access to immediate and flexible air travel has been coined “the third aviation revolution” as it is projected that it will make air travel available for the masses [4]. One of the requirements for this revolution to happen is that a regulatory framework is established that not only guarantees smooth and safe transportation but also addresses other public concerns such as liability, noise, and privacy of citizens [5]. In other words, UAM must comprise a comprehensive regulatory framework, including the establishment of air spaces where mass air traffic can safely take place, while minimizing the disruptive effects on the life of local communities.

The use of Unmanned Aircraft Systems for professional uses is already increasing – also in Indonesia. In Indonesia, drones are already used in the mining, construction, plantation, and electricity generation sectors [6]. Drones are readily available for recreational use. Current regulations in Indonesia still relate to UAS for specialized professional and recreational uses, even if the most recent regulation (Ministerial Regulation 37/2020) already anticipates a more large-scale use of drones in the professional realm than the previous regulation did (Ministerial Regulation 163/2015) [7].

UAM is generally considered to be an environment-friendly form of transportation, comparable with electric cars [8]. Technological developments relating to electric propulsion, autonomous flight technology and battery capacity will make a more large-scale application of UAS likely – among others in the transportation sector. Such large-scale use has the potential to reduce traffic congestion in the cities as, apart from landing and take-off hubs, UAM does neither require the use of existing transportation system nor the construction of new ones [9]. Since drones do not directly produce polluting emissions they can improve the air quality of cities – especially if they also manage to reduce road transport [10]. Potentially, drones may help reduce congestion in Jakarta, depending on whether Indonesia will manage to develop an affordable and safe UAM system in the long
run. The question central in this paper is: What areas of an UAM regulatory framework are covered by current drone regulations in Indonesia and what areas need further regulation?

2 Method

In this paper I will first will introduce UAS and VTOL as future transport means. Subsequently I will discuss the areas that according to the literature need to be regulated before a UAM system can be introduced in an urban area. As said, one of the requirements for creating a safe UAM system relates to its regulatory framework. There are issues of certification, safety, liability, privacy, and disruptions of spaces (noise and visual pollution). Subsequently, I analyse Indonesian drone regulations for each area that needs to be part of a future UAM regulatory framework. Thus, I will combine legal doctrinal analysis of Indonesian drone regulations with literature study about the requirements needed to develop a UAM legal framework that can ensure safe and sustainable large-scale drone and VTOL transportation in the future.

3 Results and Discussion

3.1 UAS and VTOL as future transport means

The use of drones for professional, security (including military), and recreational uses is skyrocketing. In 2022 the drone industry was worth an estimated USD 29.86 billion and predicted to grow 38.6% annually from 2023 to USD 583.51 billion in 2030 [11]. In 2020 the first drone delivery services started to operate in the health sector: UPS with CVS Health Corporation now delivers prescription medications to the 135,000 residents in a Florida retirement community, whereas in Ghana Zipline began delivering medical supplies and COVID-19 test samples in Accra and Kumasi [12]. Such medical deliveries are not large-scale, a full-fledged UAM system is not yet required and therefore they are apt to introduce drone delivery systems in this initial stage of UAM development. On demand package delivery by drones for the masses will need a more comprehensive and require a more sophisticated UAM system – including a comprehensive regulatory framework.

The same is true for passenger services. Investments in VTOL aircraft as the air taxis in the future are also high, reaching more than USD 6 billion in 2021. Worldwide more than 250 companies are involved in the development of eVTOL aircrafts, with the ten market leaders attracting investments from leading companies – including world leading tech-companies, aircraft builders and airlines [13]. The first VTOLS, apart from testing models, are expected to fly in 2025. It is expected that like the case with drone delivery services the introduction of passenger services will be relatively small-scale at first and despite the promise of developers to make UAM accessible for the masses, focused on limited areas where returns are sufficient profitable [14]. There are still barriers to a large-scale introduction of UAM – including legal barriers.

3.2 What needs to be regulated?

UAS and VTOL aircraft can only be used on a scale that allows for public transport and package delivery if a regulatory framework is in place that will guarantee safe and smooth travel that will not disturb the local population too much and for which one can insure themselves [15]. In case UAS and VTOL insufficiently can guarantee that passengers will arrive at the destination unscratched, the public will be reluctant to use UAM services. Moreover, it will be difficult or very expensive to find an insurance company willing to cover drone transportation services when there are issues with safety. Incidents with drones are rising, threatening the reputation of drones as a safe transport means [16]. A future use of UAS and VTOL as mass transportation systems, therefore requires the building of a comprehensive UAM safety framework, which includes a comprehensive regulatory framework.

An UAM regulatory framework must cover at least the following matters: requirements of the aircraft, requirements of the ground control, requirements for the vertiport, U-space management, noise and visual pollution management, and rights and responsibilities of users and service providers (Figure 1).

![Fig. 1. Risk areas to be regulated in an UAM regulatory framework](image-url)

From the legal perspective, safety starts with certification. Regarding regulation of requirements for aircraft, the aircraft, of course, must be airworthy. To ensure the drones and VTOLs built for transport are airworthy, governments must make sure that a thorough certification system is in place. This includes not only aircraft certification, to ensure that the UAS and VTOL aircraft will not lose control under changing circumstances (e.g., weather issues), but also certification of pilots, certification of autonomous control system, and certification of tracking systems that monitor the paths of all flying drones in a designated transport route. In a UAM system, drones must not only...
be individually safe to operate, but still be safe when used on a mass scale. Every autonomous controlled UAS needs to have a safe intelligent contingency management (ICM) system so that it is aware of its internal state and external environment at all times and can make decisions about mission completion or modification [17]. Moreover, when drones are used for mass transport, drones must be able to interact with and react to feedback from a drone operations control center that monitors the paths of all drones.

This brings us to the requirements of the ground station. A ground station must operate a certified drone flight control system to ensure that UAS and VTOL aircraft do not collide with other aircraft and will not collide with objects on the ground when diverted. Thus, in the future, individual certification of drones and VTOLs that will be used for large-scale transportation must be directly linked to the ability to work within the frameworks of the larger drone operation systems and flight control centers – much like is the case for airplanes. The people working in operation and control systems must be certified too – to minimize the occurrence of human errors and to be able to intervene when a system error occurs.

The drones and drone control systems are approved to be used for transport in a UAM system, safe transport hubs and UAM ports must be created, that must meet today’s safety and comfort standards. Regarding passenger transport, it is likely that in the initial small-scale experimental stage, the transport hubs will resemble vertiports, currently used by helicopters [18]. The advantage of VTOLs is that they can take off and land vertically meaning that relatively small spaces are needed for such transport hubs, for instance on rooftops of large buildings. However, in case of use of large vertiports for mass public transport, the issue arises how people can travel safely and comfortably from and to such vertiports, whether there are emergency paths in case of a calamity, and so on. In other words, the safety standards of vertiports need to be regulated to make sure passengers feel safe and comfortable.

Regulation of U-space management concerns the regulation of spaces where the drone services will operate. Such regulation must be based on a comprehensive risk assessment, not only pertaining to safety matters, but also potential visual and noise pollution issues that may lead to conflicts with local communities. Regulation of U-space management will not only concern the drone safety requirements and ground control requirements mentioned above, but also registration and authorization requirements, as well as a third-person liability insurance requirement. In case drones are used for large-scale transportation, it is very likely that governments will designate certain U-highways where such drone and VTOL transport services may operate. Like conventional highways these U-spaces will require special regulations to ensure safety. Use rights will probably be controlled by the government through issuance of permits.

One of the main risks for future UAM systems is social resistance, especially concerning the safety of drone transportation [19]. Even when people generally would consider drone transportation to be safe, it is likely that local communities who live near designated U-spaces will protest out of concerns for privacy and trespassing, as well as visual and sound pollution [20]. This not-in-my-backyard (nimby) mentality of communities must be taken seriously, as it may lead to litigation and consequent postponements or even cancellations of projects. Therefore, the risk assessment plan for the management of U-spaces aim at minimizing social resistance, for instance by designating U-spaces in zones already designated for transport, such as airports, railways, busways, and highways and require the use of the most silent drones.

This brings us to the last issue of the regulatory framework the rights and responsibilities of users and consumers vis-à-vis the drone service providers. It is very likely that for passenger travel by UAS and VTOL similar rules will apply as regular aviation regulations. A regulation that already applies in a number of countries, including the EU, is the requirement for operators of larger drones to have third person liability insurance. Hence, the operator must be insured against claims for damages when an accident happens that causes damage to third parties. If in the future similar rules apply pertaining to air taxi VTOLs as for air travel, it would also mean a regime of strict liability for the VTOL taxi service provider, meaning that the carrier is responsible for harm and damage that occurs as a result from accidents with the aircraft – even in the absence of fault. For consumers and third parties this means no legal hassle to prove fault. However, note that safety is related to insurance costs and that drone service providers must insure themselves for third party liability within a regime of strict liability. Consequently, in case accidents happen more frequently, insurance costs will rise, increasing the costs for drone transportation and potentially making drone transport less competitive compared to conventional transport means where insurance costs will be much lower. Hence, the importance to design, implement and execute a comprehensive UAM legal framework that minimizes accidents and harm to third parties.

3.3 Drone operation regulations in Indonesia

In Indonesia drone operations are regulated by Regulation of the Ministry of Transportation 37/2020 that replaced Regulation of the Ministry of Transportation 163/2015. The 2020 drone regulation has designated the Director General for Air Transport as the flight inspector, responsible for supervision over the implementation of drone operations. This supervision concerns the issuance of permits for drone operations and approval of drone operation plans, as well as security clearance pertaining to airworthiness of aircrafts, certification of drone operators, registration of aircrafts and certification of the remote pilot. The Directorate General will apply sanctions if drone operators do not abide by the drone regulations in the form of fines and withdrawal of operation permits. The changes in the 2020 regulation made possible a broader application of drones in Indonesia. In the 2015 regulation the use of drones was only possible in the
Visual Line of Sight (VLS). In the 2020 regulation the use of drones Beyond the Visual Line of Sight is allowed, under the condition that the drone is equipped with a certified detect and avoid (DAA) system and a tracking system. Moreover, whereas drones previously only were allowed to be operated during daytime and not allowed to be operated above people, now nighttime operations and operations above people are allowed, subject to permission and approval of the plan of operation. Finally, and the most relevant to this paper, whereas drone operation for cargo transport was not regulated in the 2015 regulation, in the 2020 regulation they are allowed, subject to aviation safety standards (standard keselamatan dan keamanan penerbangan). This indicates that Indonesia is anticipating the use of drones for cargo purposes and that aviation safety standards will apply to such future cargo operations.

Table 1. Changes in drone regulations [21]

<table>
<thead>
<tr>
<th>Regulation 163/2015</th>
<th>Regulation 37/2020</th>
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<tbody>
<tr>
<td>Drone operations may only take place in VLOS</td>
<td>Drone operations may take place BVLOS if equipped with DAA and tracking system</td>
</tr>
<tr>
<td>Drone operations may only take place during daytime</td>
<td>Drone operations may take place at nighttime; requirement of a special permit from the Director-General</td>
</tr>
<tr>
<td>Drone operations may not be conducted above populated areas</td>
<td>Drone operations may take place above populated areas; requirement of permission from the Director-General who must approve the plan of flight operation</td>
</tr>
<tr>
<td>The use of drones for cargo transport was not regulated</td>
<td>The use of cargo transport is allowed on the condition that relevant aviation safety standards are met</td>
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If we apply the five risks mentioned in Figure 1 to the 2020 regulation, we will find that regarding airworthiness, drones below must fulfill the Civil Aviation Safety Regulations (CASR). Different regulations apply to different types of drones, based on their weight [22].

As regards drone operations, the regulation states that use of drones that are operated within the visual line of sight are preferred by the Director (Art. 3.3.1). Drones that operate beyond the visual line of sight (BVLOS), always require permission by the Directorate General, and must have certified detect and avoid (DAA) and tracking systems. If drones are flown above populated areas, the flight path must be approved by the Directorate General, and additional requirements apply: the operation will take place at a safe height and does not form a risk for persons and objects in the operation area, the operator has mapped barriers in the flight path, there is available space to conduct an emergency landing, there is the ability to abort the drone flight for safety reasons according to established procedures, and the operator has agreed to take third-party liability. For large-scale transport use of drones and VTOL it is essential that drones have an intelligent contingency management system, and can automated interaction with.

Regarding U-spaces, the 2020 regulation differentiates between Controlled Airspace, Uncontrolled Airspace, Safe Flight Zones (Kawasan Keselamatan Operasi Penerbangan; KKOP), Restricted Areas and Prohibited Areas. Controlled Airspace are designated areas with air traffic control service, flight information service and alerting service. Uncontrolled Airspace are designated areas with flight information service, alerting service, and air traffic advisory service. Safe Flight Zone are land and airspace areas around an airport designated to create safe air traffic. The use of recreational drones can be done in designated uncontrolled airspace, all use of professional drones requires prior permission by the Directorate General.

The 2020 regulation does not concern sound and visual pollution. The drone operations mentioned in the regulation concern unique and small-scale activities, with the exception for the use of drones for spraying pesticides in agrarian areas. The use of drones for cargo transportation is anticipated and mentioned, but subject to further regulation by the Directorate General, however at the moment (May 2023) no regulations have been issued yet.

Finally, there is the issue of the responsibilities of drone operators towards users and third parties. There are several stipulations in the 2020 regulation that require drone operators to accept third-party liability and to present evidence of a third-party liability insurance in the permit application. Thus, the operator must agree to third-person liability and guarantee to bear responsibility for damage and injury caused by the drone operation. Cargo drone transport is anticipated, but not yet regulated. The issue of rights of passengers is also not mentioned in the 2020 regulation as it does not anticipate drone and VTOL operations for passenger transportation.

Table 2. Indonesian regulations vis-à-vis recommended UAM regulatory framework

<table>
<thead>
<tr>
<th>Risk Areas</th>
<th>Stipulations in Regulation 37/2020</th>
<th>Recommended for UAM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aircraft safety</td>
<td>CASR-standards</td>
<td>Drone with Intelligent Contingency Management system (ICM)</td>
</tr>
<tr>
<td>Operations safety</td>
<td>For drone operations BVLOS: DAA and tracking system required</td>
<td>ICM, automated interaction ability with drone operations control center</td>
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</tbody>
</table>
4 Conclusion

In this paper I have argued that large-scale drone and VTOL uses for cargo and passenger transportation require a coherent and integrated UAM system – including a coherent and comprehensive legal framework that minimizes the risk associated with mass application of drones and considers sustainability. Risk mitigation is essential, as public opinion, social resistance, and costs will determine how the public will receive such services. Drone services must be safe, comfortable, and not disturb local communities too much. Accidents are detrimental for trust and increase insurance costs. Risk areas that require regulation are requirements for aircraft, requirements for the ground station, requirements for operations, minimization of visual and sound pollution, and rights and responsibilities of operators vis-à-vis users and third parties.

Indonesia recently has replaced its drone regulation making its scope broader, now anticipating cargo transport. The regulation is a clear step in the direction of broader use of drones in Indonesia. However, if Indonesia intends to introduce large-scale use of cargo and passenger drone transport, it needs to create U-spaces in which even stricter safety measures apply. It is recommended that drones have an ICM system and interact and react to information of the drone flight control center that monitors U-spaces that are specially designated for large-scale UAS and VTOL transport. These U-spaces for mass transport must be created following a thorough and comprehensive risk assessment plan which aims at minimizing visual and sound pollution that might disturb communities and increase social resistance.

References


6. TerraDrone, Solve your Problems with Drones, www.terra-drone.co.id (2023)


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<table>
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<tr>
<th>U-space</th>
<th>Uncontrolled Airspace</th>
<th>Controlled Airspace</th>
<th>Safe Flight Zone</th>
<th>Special regulations for U-spaces used for (mass) cargo and passenger transportation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Noise and visual pollution</td>
<td>Not specifically regulated</td>
<td>Make noise and visual pollution part of risk assessment plans</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rights and responsibilities of drone operators</td>
<td>Third-person liability for drone operators</td>
<td>Special regulations concerning rights/responsibilities of all parties in cargo transportation and passenger transportation</td>
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