REVIEW OF RESEARCH

REGULATORY CHALLENGES WITH CIVIL DRONES IN INDIA

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ABSTRACT:

"Drones technically called as Unmanned Aircraft System(hereafter referred as 'UAS') are a military technology now being developed for civilian and commercial use across the globe. Drone technology has grown exponentially and the law has to contend its growth. We have reached technological breakthroughs in the form of unmanned aviation as they have reached their fullest potential and ready to be implemented for civilian applications like surveillance, nuclear-biological-chemical (NBC) sensing/tracking, traffic monitoring, flood mapping, crime investigation, police, motion picture, news and media support, cargo transportation, monitoring of sensitive sites (like Fukushima nuclear catastrophe), forests fire monitoring, etc. The manned aircraft which are globally in-use may be replaced with the unmanned aircraft due to its eco-friendly nature based on less CO2 emissions, less noise pollution etc. It has been predicted by Association of Unmanned Vehicle Systems International (AUVSI) that the global market for civilian unmanned aircraft stood at US$11.3bn in 2013 and has the potential to grow to over US$140bn in the next ten years. It further stated that 80 percent of the commercial market for drones eventually will be for agricultural uses. Thus, the emerging civil drone sector across the globe has a wide application and will have a significant impact on jobs, the economy, how business is carried out and the aviation industry. Consequently, policy-makers should consider this in order to ensure that the market can develop appropriately vis-a-vis properly regulated too. But the lack of policies affecting adversely approximately 500 drones manufacturers across the world. And this is happening because of issues involved, majorly, safety, trespassing, & privacy implications, the threat to data protection etc., Lack of harmonization between the national & international regulations is another big issue because cross-border usage is very much probable with drones and Article 12 of Chicago convention gives jurisdiction to International Civil Aviation Organisation(ICAO) over high seas. Drones have been considered as 'aircraft' under amendment 43 of Annex 2 of the Chicago convention both, manned & unmanned, have distinctive features from each other." Hence, It requires a separate policy framework and becomes an urgent policy challenge for the world community to govern drones if cost & benefits are equal and in the public interest

India is at the edge of formulating policies to make civilian usage of unmanned a reality as Directorate General of Civil Aviation (DGCA) is formulating the policies for governing civil drones but the regulatory construct necessary to provide a safe implementation of drones is still unfinished. Hence, this article examines the necessary regulatory changes within India to allow for the implementation of the drones for civilian application. It further analyses the recently released draft guidelines by the DGCA for regulation civil drones in the light of international regulations. Finally, the author attempts to review the gaps and propose the recommendations to fill regulatory holes in hopes to provide a useful contribution to the eventual implementation of civil drones.

KEYWORDS*: "Unmanned"; "aircraft", ICAO, "DGCA".*

INTRODUCTION :

The idea of unmanned aviation is not new. Unmanned Aviation (UA) has been a part of aviation from the infancy of manned aviation. The first sophisticated use of unmanned aircraft happened to be for the military purpose in 1914 in the form 'kettering bug'. It was an aerial torpedo in the form of bi- plane named as, which drops its explosive load when the engine stops due to distance calculations made in beforehand.(Lawrence, 2004)

It was the second war only when the drones became more common. The introduction of 'Fieseler Fi 103 was the autonomous bomb used by the Germans. The United States used drones not only of destructive capability but also applied for reconnaissance in the Vietnam War. In the 1970's and 1980's Israel was the most eminent developer of unmanned aviation. In addition to this violent/military function of unmanned aircraft, there are innumerable non-violent/civilian functions of unmanned aircraft as well. And it is area only their usage and demand is increasing.

"Some of the civil applications of unmanned aircraft are surveillance, nuclear-biological-chemical (NBC) sensing/tracking, traffic monitoring, flood mapping, crime investigation, police, motion picture, news, and media support, cargo transportation, monitoring of sensitive sites (like Fukushima nuclear catastrophe), forests fire monitoring, etc. "It will have an economic boost in creating revenue, reducing operational costs to farmers providing precision agricultural spraying and data, and also providing first responders with lower cost solutions in rescue operations".

It has been predicted by Association of Unmanned Vehicle Systems International (AUVSI) that "70000 jobs will be created in the first three years of implementation of unmanned aircraft for civilian purposes in the United States only with an economic impact of $13.6 billion. This benefit will grow through 2025 when more than 100,000 jobs will be created with an economic impact of $82 billion. The global market for civilian unmanned aircraft stood at US$11.3bn in 2013 and has the potential to grow to over US$140bn in the next ten years." It further stated that 80 percent of the commercial market for drones eventually will be for agricultural uses. "The manned aircraft (drones) which are globally in-use may be replaced with the unmanned aircraft due to its eco-friendly nature based on less CO_2 emissions, less noise pollution etc". The introduction of highly equipped modern advanced technological UA has advantages too which benefits the people globally and can be used for various purposes.(AUVSI Report, 2013)

WHAT IS 'UNAMNNED AIRCRAFT?

We may hear people calling unmanned aircraft by different names. The most popular amongst all of them is the drone. Though the International Civil Aviation Organization (ICAO), which is international regulatory authority do not recognize this word. This organization based on the International Convention on civil aviation (Chicago convention), 1944 Chicago convent and its annexes and standards. The Chicago Convention 1944 defines "pilotless aircraft" under Article 8 as:

'No aircraft capable of being flown without a pilot shall be flown without a pilot over the territory of a contracting State without special authorization by that State and in accordance with the terms of such authorization. Each contracting State undertakes to ensure that the flight of such aircraft without a pilot in regions open to civil aircraft shall be so controlled as to obviate danger to civil aircraft.'

But it was way back in 1944 when the convention was enacted hence due to technological improvements, there is a change in the terminology of unmanned aircraft as well. The ICAO has adopted the Unmanned Aircraft System. Unmanned Aircraft is umbrella term and includes UAS, RPAS or UAS etc., but it certainly needs other components too, for their implementation into civilian airspace, namely, control station, data link, UA personnel etc. International civil aviation organization (ICAO), a regulatory authority for civil aviation, internationally, adopted & defines unmanned aircraft system (hereinafter referred as 'UAS') as "an aircraft and its associated elements which are operated with no pilot on board". Likewise, the ICAO has adopted the new terminology Remotely Piloted Aircraft System (RPAS) for the implementation into the civilian airspace in 2012 and hence, defines it as 'a remotely-piloted aircraft, its associated remote pilot stations, the required command and control links and any other components as specified in the type design'. The DGCA also adopted the similar definitions of these terms in its draft guidelines on Civil UAS.

WHY UNMANNED AIRCRAFT?

"Unmanned aircraft will only exist if they offer an advantage compared with manned aircraft. An aircraft system is designed from the outset to perform a particular role or roles. The designer must decide the type of aircraft most suited to perform the roles and in particular whether the roles may be better achieved with a manned or unmanned solution. In other words, it is impossible to conclude that UAS always have an advantage or disadvantage compared with manned aircraft systems. It depends vitally on what the task is. An old military adage (which also applies to civilian use) links the use of UAS to roles which are dull, dirty or dangerous (DDD). There is much truth in that but it does not go far enough. To DDD add covert, diplomatic, research and environmentally critical roles. In addition, the economics of operation are often to the advantage of the UAS.(Austin, 2010)

Dull Roles

Military and civilian applications such as extended surveillance can be a dulling experience for aircrew, with many hours spent on the watch without relief, and can lead to a loss of concentration and therefore loss of mission effectiveness. The UAS, with high-resolution color video, low light level TV, thermal imaging cameras or radar scanning, can be more effective as well as cheaper to operate in such roles. The ground-based operators can be readily relieved in a shift-work pattern.

Dirty Roles

Again, applicable to both civilian and military applications, monitoring the environment for nuclear or chemical contamination puts aircrew unnecessarily at risk. Subsequent detoxification of the aircraft is easier in the case of the UAS. Crop-spraying with toxic chemicals is another dirty role which now is conducted very successfully by UAS.

Dangerous Roles

For military roles, where the reconnaissance of heavily defended areas is necessary, the attrition rate of a manned aircraft is likely to exceed that of a UAS. Due to its smaller size and greater stealth, the UAS is more difficult for an enemy air defense system to detect and more difficult to strike with anti-aircraft fire or missiles. Also, in such operations, the concentration of aircrew upon the task may be compromised by the threat of attack. Loss of the asset is damaging, but equally damaging is the loss of trained aircrew and the political ramifications of capture and subsequent propaganda, as seen in the recent conflicts in the Gulf. The UAS operators are under no personal threat and can concentrate specifically, and therefore more effectively, on the task at hand.The UAS, therefore, offers a greater probability of mission success without the risk of loss of aircrew resource. Power-line inspection and forest fire control are an example so applications in the civili an field for which experience sadly has shown that manned aircraft crew can be in significant danger. UAS can carry out such tasks more readily and without risk to personnel. Operating in extreme weather conditions is often necessary for both military and civilian fields. Operators will be reluctant to risk personnel and the operation, though necessary, may not be carried out. Such reluctance is less likely to apply with a UAS.

Covert Roles

In both military and civilian policing operations, there are roles where it is imperative not to alert the 'enemy' (other armed forces or criminals) to the fact that they have been detected. Again, the lower detectable signatures of the UAS make this type of role more readily achievable. Also in this category is the covert surveillance which arguably infringes the airspace of foreign countries in an uneasy peacetime. It could be postulated that in examples such as the Gary Powers/U2 aircraft affair of 1960, loss of an aircraft over alien territory could generate less diplomatic embarrassment if no aircrew are involved.

Research Roles

UAS are being used in research and development work in the aeronautical field. For test purposes, the use of UAS as small-scale replicas of projected civil or military designs of manned aircraft enables airborne testing to be carried out, under realistic conditions, more cheaply and with less hazard. Testing subsequent modifications can also be affected more cheaply and more quickly than for a larger manned aircraft, and without any need for changes to aircrew accommodation or operation. Novel configurations may be used to advantage for the UAS. These configurations may not be suitable for containing an aircrew.

Environmentally Critical Roles

This aspect relates predominantly to civilian roles. A UAS will usually cause less environmental disturbance or pollution than a manned aircraft pursuing the same task. It will usually be smaller, of lower mass and consume less power, so producing lower levels of emission and noise. Typical of these are the regular inspection of power-lines where local inhabitants may object to the noise produced and where farm animals may suffer disturbance both from the noise and from sighting the low-flying aircraft.

Economic Reasons

Typically, the UAS is smaller than a manned aircraft used in the same role and is usually considerably cheaper in first cost. Operating costs are less since maintenance costs, fuel costs and hangarage costs are all less. The labor costs of operators are usually lower and insurance may be cheaper, though this is dependent upon individual circumstances. An undoubted economic case to be made for the UAS is in a local surveillance role where the tasks would otherwise be carried out by a light aircraft with one or two aircrews. Here the removal of the aircrew has a great simplifying effect on the design and reduction in the cost of the aircraft. Typically, for two aircrews, say a pilot and observer, the space required to accommodate them, their seats, controls and instruments,is of order1.2 mt. cube and frontal area of about1.5mt. Square. An UAS to carry out the same task would requires only 0.015 mt. cube, as a generous estimate, to house an automatic flight control system (AFCS) with sensors and computer, a stabilized high-resolution color TV camera and radio communication links. The frontal area would be merely 0.04 mt.square The masses required to be carried by the manned aircraft, together with the structure, windscreen, doors, frames,and glazing, would total at least 230 kg.The equivalent for the UAV would be about 10kg. If the control system and surveillance sensor (pilot and observer) and their support systems (seats, displays, controls, and air conditioning) are regarded as the ‘payload' of the light aircraft, it would carry a penalty of about 220 kg of ‘payload' mass compared with the small UAS and have about 35 times the frontal area with proportionately larger body drag. On the assumption that the disposable load fraction of alight aircraft is typically 40% and of this 10% is fuel, then its gross mass will be typical of order 750 kg. For the UAV, on the same basis, its gross mass will be of order 35 kg. This is borne out in practice. For missions requiring the carriage of heavier payloads such as freight or armament, then the mass saving, achieved by removing the aircrew, obviously becomes less and less significant.

(a) First Costs

The UAS equipped with surveillance sensors can be typically only 3–4% of the weight, require only 2.5% of the engine power (and 3% fuel consumption) and 25% of the size (wing/rotor span) of the light aircraft. The cost of the structures and engines within the range of manned aircraft tend to vary proportionally with their weight and power respectively. So one might think that the cost of buying the surveillance UAS would be, say, 3% of the cost of the manned aircraft. Unfortunately, this is not true for the following reasons:

Very small structures and engines have almost as many components as the larger equivalent, and although the material costs do reduce the weight, the cost of manufacture does not reduce to the same degree. The UAS must have a radio communications system which may not be necessary for the manned aircraft or, at least, would be simpler.

The UAS will probably have a more sophisticated electronic flight control system compared with the manned aircraft and, ofcourse, a day/night surveillance camera system rather than an observer with a pair of binoculars, night vision goggles, and digital SLR camera. In addition, the UAS must have a more sophisticated control station (CS) for interfacing between the operator(s) and the aircraft. The CS may be ground, sea or air based.

So the overall result is not obvious but, depending upon the surveillance requirements, may be of the order of:

UAV: 20–40% of manned aircraft cost
UAS control station: 20–40% of manned aircraft cost
UAS +UAS control station: 40–80% of manned aircraft cost

(b) Operating Costs

These figures are, to some degree, inevitably subjective. They include the following. Approximate UAS cost as % of manned aircraft cost:

i) Interest on capital employed 40–80% ii) Depreciation 30–60% iii) Hangarage [includes support vehicle and CS] 20% or less overall iv) Crew salaries and associated costs∗ 50% v) Fuel costs 5% vi) Maintenance 20% vii) Insurance∗∗ 30%
(Probably about 40% or less overall)
(∗ Aircrew is paid more than ground-based personnel, retire earlier and must pass regular, more rigorous professional and medical examinations.)
(∗∗This will include aircrew and third party cover and may be initially higher than that suggested here for the UAS System until insurers better understand the risk.)

At the other end of the scale, it could be argued that the cost savings of removing the aircrew (the cabin crew would still be required) from a large civil jet transport such as a Boeing 747 would be minimal (although it is understood that some airline circles are thinking along these lines!). The operation would have long-range navigation and control risks and probably would be psychologically unacceptable to passengers and insurers. In" "addition, the cost of operating a civilian passenger airline amounts to very much more than just the 'airside' cost. Airside costs include buying, crewing, flying, hangaraging and maintaining the aircraft. The 'ground' cost, which includes airline publicity, ticketing, check-in, baggage handling, security, policing, fire precautions, customs, air traffic control, facilities maintenance, etc. is the dominant cost which will not be reduced by UAS operation. Infact some of those costs might be increased.Therefore it is unlikely that UAS will ever operate as large passenger transports, though such observations are prone to be proven wrong! In between these two extreme applications, economic arguments for the use of UAS are possible but will depend upon particular circumstances. For example, it is possible that UAS may be considered for the long-range transport of goods in limited circumstances(Mathew, 2003)

UNMANNED AIRCRAFT AND THE ROLE OF DGCA

The Office of the Director General of Civil Aviation (DGCA) finally released the Civil Aviation Requirements (CARs) for the operation of civil Remotely Piloted Aircraft System (RPAS), 2018 which is also known as UAS or Drones. Various basic features of these guidelines have been identified and are relevant in bringing out the various policy gaps.

The drones technically referred to as Unmanned Aircraft Systems (UAS) or Remotely Piloted Aircraft (RPA) has been classified into various categories based on their weight. The classifications are as follows:

- Nano (less than or equal to 250 grams),
- Micro (greater than 250 grams and less than or equal to 2 kilograms),
- Mini (greater than 2 kilograms and less than or equal to 25 kilograms),
- Small (greater than 25 kilograms and less than or equal to 150 kilograms) and
- Large (greater than 150 kilograms).

The DGCA issues a unique identification number (UIN) for the purpose of accountability and management of UAS. The application for issuance of a UIN happens on a case to case basis. There are also various criteria to be eligible for obtaining a UIN. The Applicant must be a citizen of India or

The central government or any state government or any company or corporation owned or controlled by either of the said governments or,

A company or corporate body provided either it is registered and has its principal place of business within India, or its chairman and at least two-thirds of its directors are citizens of India, or its substantial ownership and effective control is vested in Indian nationals or

A company or corporation registered outside India, provided that it has leased the RPAS to any organization mentioned in points above. There are also various documents which need to be submitted regarding the same.

There have been no restrictions places for UAS that operate below 200ft above ground level in uncontrolled airspace. UAS operating at or above 200ft above ground level in uncontrolled airspace, or at any height in restricted or prohibited airspace, will require a Unmanned Aircraft Operator Permit (the "UAOP") that has an initial validity of five years. There also various exceptions for obtaining a UAOP i.e.

- a Nano RPA operating below 50 feet in uncontrolled airspace and indoor operations;
- Micro RPA operating below 200 feet in uncontrolled airspace and clear of prohibited areas, provided the local police authorities have been given prior intimation;

- RPA owned and operated by Government security agencies after giving prior intimation to the local police authorities and ATS units.

The pilot operating the RPAS or UAS is also required to fulfil training with respect to the provisions laid down in the draft guidelines. The aspect of speed has not been addressed in the guidelines. The UAOP issued by the DGCA may be suspended at any time if it is found that the performance or maintenance of the RPAS is no longer acceptable. Breach of compliance may also attract penal action and imposition of penalties. An important point to note is that the operations of autonomous aircrafts are strictly prohibited under the draft guidelines.

The 'Challenges' Ahead

The guidelines conceive an unmanned aircraft as "an aircraft which is intended to operate with no pilot on board". This requires certain components such as a remotely piloted aircraft (RPA), a command and control unit, and personnel for its operation, all of which form the unmanned aircraft system (UAS). A UAS may function either autonomously or be remotely piloted. However, the DGCA guidelines are focused almost entirely on remotely piloted drones, and hence require that they are operated within the visual line of sight (VLOS). This is a narrowness of focus the DGCA must address, to encourage the autonomy of the drones and bring more clarity into the regulations for autonomous drone-flights.

The Privacy Paradox

Although autonomous drones promise new possibilities, UAS are an intrusive technology with great privacy implications for individuals. However, the DGCA draft-guidelines clearly miss the issue, only stating that 'privacy must be given due importance' and do not lay out any procedure for how privacy rights of citizens can be identified and protected.

Solutions to this problem could take the form of amendment to the Information Technology Act, 2000 in case of data threats or the insertion of provisions regarding drone surveillance in the Privacy Bill, 2011 which is still tabled in the Parliament. But both these methods are cumbersome. Hence, the best way is for the DGCA to come up with privacy regulations for drone surveillance while sticking to the basic principle of 'reasonableness'. i.e., 'reasonableness' of drone surveillance must be tested and the expectation of the citizen's privacy must be reasonable too. The dichotomy between these two aspects requires careful consideration and clear addressing. Here, the 'reasonableness' of drones surveillance should be determined but the expectation of the citizens relating to privacy must be 'reasonable' too. And in the same corollary, an American case namely; ***California v. Ciraolo,*** is noteworthy, where the Court held 'the warrantless aerial surveillance of a backyard within the home was a reasonable search because even though the homeowner had a privacy fence, the 'marijuana' in his backyard was clearly visible'.

Frequency bandwidths versus satellite linkage

The DGCA also mentions that UAS require data-link for their proper functioning. This data-link could take the form of radio or satellite communication. As far as radio frequencies are concerned, bandwidth is already a scarce resource and with the potential proliferation of drones, this problem is likely to be exacerbated.

The International Telecommunications Union (ITU) is already considering specific regulatory provisions for UA frequencies. The DGCA must follow this lead and come up with a clear regulation on the mode of data-linking to be adopted because satellite communication lends greater accuracy of signals to the line of sight communication, but radio frequency communication is certainly cheaper. But for the latter, the DGCA must have comprehensive agreements with the Telecom Regulatory Authority of India (TRAI) if radio frequencies are likely to be shared for drones.

WHY HARMONISATION WITH INTERNATIONAL IS NEEDED?

The Chicago Convention, 1944 regulates international aviation, that is, the operation of services carried out by civil aircraft passing through the airspace of more than one contracting state.4 Domestic applications of civil aircraft do not fall under the regime set forth by the CC44 and its ICAO Annexes. Therefore, civil UAS may fall under the scope of the CC44 as long as they satisfy the international criterion. Within the military context, the international element is often satisfied, as for example, Reaper UAS can have a range of 5900 km, a maximum airspeed of 250 knots and can ascend to 15,300 m with missions capable of totaling 18 h, thus providing them with the capacity to conduct cross-border activities. However, within the civilian context, the satisfaction of the international criterion needed for the invocation of the CC44 is not so apparent as most operations will take place within the territory of one state. The majority of US activities in Europe involve small UAS used for civil purposes and these, where regulation is provided, often have to be flown with the visual line of sight (VLOS). Therefore, there is limited exposure to international borders for the majority of UAS activities because their range would be markedly limited. Nevertheless, the CC44 may still be applicable and should not be disregarded as states share land borders, and this may introduce an international element. This is even relevant within the context of small UAS in the EU, as most states share borders, and this could have significant legal implications for those that border with non-EU states, such as Russia, Belarus, Ukraine, and Turkey.

DGCA must also harmonize its regulations of International Civil Aviation Organization (ICAO). Being an international regulatory authority, the ICAO's mandatory guidelines on drones" would also clarify situations of cross-border usage of drones, and Article 12 of the Chicago convention gives Jurisdiction over the 'High Seas' to the ICAO.

Though the DGCA has prohibited the usage of drones across international borders, this is in a context of a lack of binding regulations by the ICAO. But with clarification of the international regulatory space, the effect on international trade could be great, and thus the DGCA must tackle this aspect as well in the coming future.(Filippo, 2010)

4.1. Definition and procedure

While the guidelines list some civil applications of drones like "damage assessment of property and life in areas affected by natural calamities, surveys; critical infrastructure monitoring including power facilities, ports, and pipelines; commercial photography, aerial mapping, etc", they do not clearly define the limits of the civil function of unmanned aircraft system and how this can be distinguished from 'other' purposes of drones. For instance, how should drone use by police authorities be classified under the DGCA guidelines? The ICAO excludes police services from civil applications. Hence, clarity is definitely required as to what shall be the civil uses of drones according to the DGCA guidelines.

There is no doubt that safety is a paramount concern in the use of drones for civil applications. However, the currently proposed 90-day time period for obtaining a drone permit is far too cumbersome. The application process must be made simpler and time-saving.

Once a clear regulatory space is established, drone manufacture and use are sure to grow. Hence, the exigent task for the DGCA is to create a sustainable space for this technology with massive potential.

CONCLUSIONS

For the effective implementation of UA, Policymakers and technology experts sit together. Lisa Ellen (US-based Public Policy lawyer) called this approach a *PoliVation.* It is a process where policy is being formulated for innovative technology. And When cost & benefits are equal, Policymakers must favor the innovation. This principle rests upon the principle the only government can provide that innovation that can thrive protecting the public interest"

As far as the DGCA approach of formulating the policy is concerned it can be said that the draft seemed to be designed more to suppress than encourage UA use, the issuance of these guidelines is indeed a welcome step from the DGCA. But multiple challenges still remain that must be addressed for a well-regulated but economically viable space to be created for domestic drone use. The Directorate General of Civil Aviation (DGCA) is contemplating strict regulation of the use of UA in the country.

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