UPES
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THE SOCIETAL IMPACTS OF COMMERCIAL DRONES

By
Mayur Virendrakumar Panchal
SAP ID : 500063211

Guided By
G Ram Sarath Kumar
Project Manager,
Indian Institute of Drones.

A Dissertation Report Submitted in Partial Fulfillment of the Requirements for

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Signature

Name of the Student : **Mayur Virendrakumar Panchal**

Residential Address : B-23 Narayan Nagar -3, Near Narayan School, Shaktinath, Bharuch-392001, Gujarat.

Mobile : +91 9328855577

Email : mayurvipanchal@gmail.com

Date : 15/10/2019.

Place : Bharuch, Gujarat.

G RAM SARATH KUMAR
Project Manager - Aeronautics
Mo.: +91 8074611720
Email: ramsarath.12@gmail.com

INDIAN INSTITUTE OF DRONES
Nest Arpana Block-3, S1 Plot no.331A
Sri Alamelumangapuram Colony, Part-3
Sholinganallur, Chennai-600119, Tamil Nadu.

Subject : Willingness for Guiding Dissertation of ***Mr. Mayur Virendrakumar Panchal***

Registration No.: ***500063211.***

Dear Sir,

Mr. Mayur Virendrakumar Panchal is registered for ***BBA (Aviation Operations)***, with the University of Petroleum & Energy Studies, Dehradun in ***July 2017*** Batch.

I hereby give my acceptance to guide the above student through the Dissertation work named ***"THE SOCIETAL IMPACT OF COMMERCIAL DRONES"***, which is a mandatory requirement for the award of BBA (AO) degree.

Thanking You.

Yours Sincerely.

G. Ram Sarath Kumar

G RAM SARATH KUMAR.

Declaration by Guide

This is to certify that the ***Mr. Mayur Virendrakumar Panchal***, a student of ***BBA [Aviation Operation],*** SAP ID. - ***500063211*** of UPES has successfully completed this dissertation report on "***13/10/2019***" under my supervision.

Further, I certify that the work is based on the investigation made, data collected and analyzed by him and it has not been submitted in any other university of Institution for award of any degree. In my opinion it is fully adequate, in scope and utility, as a dissertation towards partial fulfillment for the award of degree of BBA [Aviation Operation].

Signature
Name: G Ram Sarath Kumar [Project Manager, IID]
Address: Nest Arpana Block-3, S1 Plot. No. 331A
Sri Alamelumangapuram Colony, Part-3,
Sholinganallur, Chennai-600119, Tamil Nadu.
Mobile No : +91 8074611720
Email: ramsarath.12@gmail.com

Data: 13/10/2019
Place: Chennai.

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Abstract

The use of drones or Unmanned Aerial Vehicle (UAVs) in Commercial application has the potential to dramatically alter several industries, and in the process, change our attitude and behaviors regarding their impact on our daily lives. The emergence of drones challenges traditional notions of safety, security, privacy, ownership, liability and regulation. With their ability to collect data and transport loads, drones are re-shaping the way we think and feel about our physical environment. However, they also burdened with the perception as being surveillance equipment, and their commercial use has been criticized by both individuals and activist organizations. In parallel, drones have been legitimized by regulation and licenses from federal agencies, are used by companies for surveying, inspecting, and imaging, and their technological development are driven by active communities of hobbyist and enthusiasts. This tension presents unique challenges to their integration in the currently existing public, governmental and private infrastructure.

In this Dissertation Report, we will take a look at a few of these issues to understand how drones influence society, and present recommendations for practitioners, policy makers, and researchers studying this phenomenon.

DRONE FACTS

The First "armed" Drones were built to get Osama Bin Laden.

Chapter -1
Introduction

In This Chapter
1.1 Overview
1.2 Background
1.3 Puupose of Study
1.4 Research Hypotheses

1.1 Overview

UAS or Unmanned Aircraft Systems are aircraft systems without a human pilot onboard. Though the technology has been present for some time now, there has been increasing awareness about UAS in the industry and the government alike. Even though the current regulation by DGCA are in the draft phase, it has not stopped organizations to grab on this opportunity to leverage this emerging technology to utilize in its operations and evaluate its potential. India has especially seen increasing UAS adoption, especially by government bodies.

The ability of UAS to reduce the cost of compliance and cost of technology, while also enhancing the value of the information gathered through these systems have the key drivers for increased adoption of UAS in India and the world. Traditional ways of working, which replied upon sometimes inaccurate and time consuming procedures can now be replaced by cost-effective, information rich UAS. Coupled with this applications from other synergetic technologies like 3D modeling, Internet of Things, Artificial Intelligence and augmented as well as virtual reality has opened up a world of possibilities for organizations.

Globally, countries like US and China have created a conducive environment for organization to benefit from the applications of UAS and its associated technologies and hence these market have seen a lot of capital invested in these systems and driving the innovation in this market. India should create an environment for various players in this ecosystem of companies and startups to collaborate and create value for each other. Regulations will have to pave the way for such n adoption and even though the regulations are still in the draft stage, that should not deter companies from investing in India because once regulation get formalized, the market will see a lot of industries and companies adopting UAS across their operations. To cater to the demand of the future, companies need to invest and the push has to come today from both the government and the private industry.

UAS and associated technologies have a wide number of use cases across industries which can benefits in terms of time, money and information for organizations. There are some Challenges like impact of drone on social environment which need to be resolved before

organizations can leverage the full potential of these technologies. Government should work with the ecosystem of startups, experts and companies to take the next steps forward in making this market a conducive area for growth, investment and innovation.

1.2 Background

The definition of UAVs, commonly know as drones, is rather broad, and it is understandable considering the wide range of configuration that exist. In practice, any aerial vehicle that does not rely on an on-board human operator for flight, either autonomously or remotely operated, is considered as UAV. UAVs range in size from large military drones with a wingspan of nearly 200 feet to commercially available inch-wide micro drones. There ranges of flight vary, with some commercial drones that can fly for over 17,000 miles without having to land. Likewise, there is a huge variation in their maximum flight altitude, which can be anything from a few feet to a maximum of 65,000 feet.

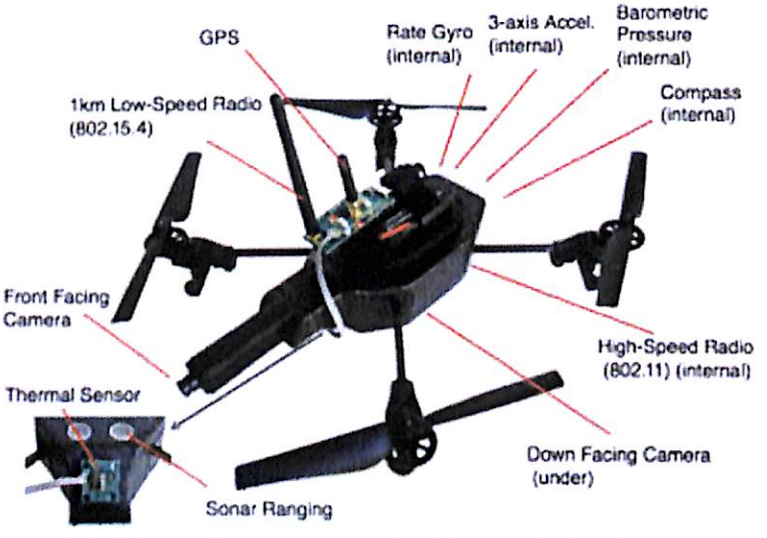


Figure-1 Structure of Commercial Drone

Most commercially available drones today follow a similar design [refer figure 1]. The basic design has a micro controller that acts as flight controller, usually with four but unto eight motor and propellers, a radio receiver, ESC, and a battery, built on a light plastic or metal frame. In addition, gyroscope and other sensors are added to increase the mid-air stability of the drone and a GPS device can be used for navigation. Most hobbyist drones also carry a camera for aerial imagery, and a gimbal for added image stability. Additionally, other sensors can be attached, though there is trade off with increased functionality and weight. DJI, 3D Robotics and Parrot are some of the leading hardware manufacturers, and their sales includes both assembled drones and drone components.

1.3 Purpose of Study

The advent of new and emerging technologies undeniably has broad economic, social and personal impacts. Most commonly, they influence practice, the way we do things, perform tasks, achieve goals, etc.; while creating new capabilities and possibilities for action. Take the Internet for instance; it did not just allow us to share information faster and cheaper; it completely changed the way we conceive of and use information. Usually, these changes are not just related to the features of the technology, but also how we interpret their usability. Rather than technology itself, it is our use of it that affects our perception, and thus our behavior. In this dissertation, we consider how an emerging technology, viz. commercial unmanned aerial vehicle, more commonly known as drones, affects us by challenging some of our societal values and beliefs. In particular, we argue that the way this technology is currently used has an impact on our conception of safety and security, privacy and ownership, individual and commercial liability, and the effectiveness and process of governmental regulation. Drones are thus becoming increasingly important in the field of science, technology and society.

Traditionally, these discussion have been created on their use in military surveillance and active combat. Since their emergence, the use of UAVs in combat zones has been heavily debated, and the conversation has been focused on their ethics, effectiveness, transparency and legality. Despite multiple criticisms from human rights organizations, their judicial use has been upheld by many of the world's governments. The official stance of governments is that drone prevent casualties by providing accurate surveillance information and precision strike capabilities, while their opponents emphasize their inability to discern between intended and unintended targets. There has also been increasing discussion around the use of drones over domestic airspace for the purpose of surveillance in the interest of national and local security. The dialogue closely mirrors that of combat drones, as it is the same issues of ethics and privacy that shape the conversation. This is particularly reflected in journals of law, ethics and technology policy as there been multiple articles that have described various issues regarding the use of drones over domestic skies.

In this Dissertation, we focus on a related but slightly different phenomenon: the emergence of commercial drones. These drones are designed, built and used by individuals, businesses, and organizations. Though commercial drones owe much of their development to their military counterparts, most designs do not resemble the larger and more expensive surveillance drones. Commercial drones typically are built on a small platform, use cheap and easily available components, and can lift only and average of 4 pounds. They emerge primarily from the work of UAV and quadcopter enthusiasts, and their creations have historically not been the subject of scrutiny, usually due to their small numbers and lack of public interest.

Drones have the ability to carry multiple sensors, transmitters, and imaging equipment. As the use of drones continues to proliferate, they will impact industries ranging from entertainment to agriculture, from construction to delivery markets. Their use in Hollywood and Bollywood film production has already been legitimized through the creation and use of

specialized high-definition imaging drones. Civilian UAVs have the potential of becoming a dominant infrastructural platform. Not only are they cheap and easily available, they can be deployed across many industries to perform complex, expensive and dangerous tasks. Currently, short battery life and the lack of proper regulation (and enforcement) remain the two major limitations for their rapid adoption.

Several organization and industrial standard associations have been created, to either design drones and or to support their integration with existing infrastructure. They have developed new and unique market-focused application and severe platform, and have thus influenced the social perception of this technology and its associated business models. Thus, this somewhat inevitable growth of drone based businesses seem destined to transform consumer behavior as well as reshape our nations freedom and responsibility. In the following section, we will look at how this technology was developed, how it was adopted, and how it is used in individual and commercial application. It will provide an overview of What drones are, how they come to be, and how they are perceived and used today. We will then use discourse analysis to explore the impact that drones have had on various societal aspects, and provide recommendations for practitioners, policy makers, and researchers studying this new phenomenon.

1.4 Research Hypothesis

Based on purpose of study, I believe that this study could have several potential outcomes, all of which would have further research implication. It is important to understand reason behind the Societal Impact of Commercial Drone for safe conduct of drone operation. From the purpose of Study, I have assembled two hypothesis which are mentioned as below:

1. I hypothesize that drones and unmanned aerial systems are not yet at the level of technology that they need be in order in order to sway both public opinion that they are safe, as well as prove to the FAA Federal Aviation Administration that they are capable of operating around commercial manned aircraft safely.

2. I hypothesize that increase in number of drone strikes due to the increase in technological capabilities. I expect to see the technological evolution of the latest generation of drone.

DRONE FACTS

Israel is the world's largest exporter of the defense drones and drone technology.

Chapter 2
Literature Review

In This Chapter
2.1 Getting a brief history of drones.
2.2 Knowing the various types of drones.
2.3 Understanding the different uses of drones.

2.1 Getting a Brief History of Drones

In this chapter, we take a close look at various types of drones and their applications. We will gain an understanding of the difference between drones, UAV's and RC devices. We will even see how drones are used in modern warfare, as well as how they were used in world wars.

Many different types of drones are available for the general public. In this chapter, We will see the differences between planes, helicopters, multi-copters, and tilt rotors. We get a glimpse of how average Joes are using drones for hobby flying, aerial video, and aerial photography. We even get a look at how drones are being used for commercial purpose by high-flying drone companies.

Before the chapter kicks off, please make sure that our seat backs and tray tables are in their upright and locked positions. Ensure our carryon is stowed under the seat in front of us, and our seatbelt is securely fastened low and across our waist. It's time for take-off!

What Are Drones?

When we hear the word drone, What is the first thing that comes to mind? If we're like most people, you have visions of military jet-powered aircraft taking out bad guys in a war zone. Or maybe we think of a helicopter hovering outside your home gathering surveillance footage of our mom's secret meatloaf recipe. A high-powered, very high-tech, unmanned aircraft is what probably comes to mind, as shown in figure-2.

The term drone is somewhat misleading when used to describe the high-flying marvels of modern technology. In reality, drones were not always so high-tech. Drone date back as far as the mid 1800s. The balloons were launched with a trajectory but there were no advanced piloting controls to guide them to their intended destinations. Drones also appeared in the 1900s when they were used by the American military for target practice as a mode of training troops.

It wasn't until the 1930s that remotely piloted vehicles, RPVs for short, were developed. RPVs were first rolled out to train anti-aircraft gunners going into World War II. They were later used

Figure-2 High Tech Drones.

to carry out attack runs on Nazi Germany. Remotely Piloted Vehicles are unmanned aircraft that are controlled by a pilot or piloting system located outside of the vehicle. Figure-3 shows a World War II era RPV.

Figure-3 World War II era RPV.

RPVs are high-tech versions of the hobbyist's remote controlled [RC] aircraft. Remote Controlled aircraft are aerial vehicles that are controlled by a ground operator using handheld piloting system that communicates using radio frequencies. Hobbyists around the world have been flying RC planes since the 40's and 50's.

Unmanned Aerial Vehicle, or UAV, is the term most commonly used today to described what the world has come to known as drones. UAVs can be controlled using milieu of high-tech communication protocols like GPS and other satellite communications. UAVs can be remotely piloted by a human, team of humans, or a computerized piloting system. UAVs can also be fully autonomous. How's that for artificial intelligence? Autonomous UAVs are given instruction and then they take-off, fly, carry out orders, and land. All without the assistance of humans.

Other terms used to describe drones include remotely piloted aircraft [RPA], remotely operated aircraft [ROA], unmanned aircraft system [UAS], and just recently the FAA [Federal Aviation Administration] adopted the term Unmanned Aircraft [UA] to describe aircraft without flight crew. For the sake of consistency throughout this book, and to be congruent with current trends and vernacular, we will use the drone to describe the high-tech consumer and commercial drones that we all know and love.

Drones and the Military

Drones have played a role in the theater of war for over a century. From the bomb-filled balloons of the 19th century to modern drones that resembles something from science fiction, drones have evolved as they have taken center stage in modern warfare and domestic security operations. Currently, the CIA uses drones primarily to carry out surveillance, although they have some authority to use drones to carry out strikes. The U.S. Armed Forces use drones to carry-out surveillance and combat missions and the department of homeland security uses drones to monitor the American borders.

The U.S. government currently uses and is testing several high-tech drones, called Unmanned aerial systems, or UAS, for short. The following sections offer a brief description and photo of each of the UAS.

General Atomics Predator

The Predator drone was first conceived in the early 1990s but didn't actually see use by the federal government until the mid to late 90's. It was originally used for surveillance and reconnaissance but later was fitted with a combat payload, primarily Hellfire missiles which are an air-to-surface, 100 lbs., rocket-powered missile. The predator's remote piloting system has

evolved greatly since the 90's. Advancements in satellite technology has made it possible to manage remote take-off, landing, and flight from thousands of miles away. There are several predators in use by the U.S. Air Force [USAF] and CIA but they will be slowly phased out and replaced by the newer version, the Reaper. Figure-4 shows the USAF's Predator drone.

Figure-4 The USAF's Predator Drone

General Atomics Reaper

The Reaper is the newest evolution of the famed predator drone. It is faster, more powerful, and more capable in surveillance and combat scenarios. The reaper can fly for 42 hours without a munitions payload and 12 hours with a full munitions payload. The reaper is also capable of carrying several different arms such as laser guided bombs, air-to-surface missiles like Hellfire, and it will soon be capable of carrying and using air-to-air attack missiles for aerial combat. The Reaper is staked with surveillance capabilities and is rumored to be able to read a license plate from a distance of 2 miles. The advancements in technologies have made the reaper a prime candidate for domestic surveillance, disaster assistance, border monitoring, and homeland security. Figure-5 shows the USAF's Reaper drone.

Figure-5 The USAF's Reaper Drone

Elbit Systems Herms 450

The Department of Homeland Security and he U.S. Armed Forces use the Herms 450 primarily for surveillance and reconnaissance. The Herms 450 can fly at high-altitudes for extended period of time, making it extremely useful for monitoring large stretches of open territory. The Hermes has yet to be fit with munitions payload to allow it to have attack capabilities in a combat scenario. Figure-6 shows the Department of Homeland Security's Hermes 450 drone.

Figure-6 Department of Homeland Security's Hermes 450.

Northrup Gruman Global Hawk

First developed in 1998, the Global Hawk went through several revisions before it made its debut in the U.S. Air Force's arsenal of surveillance tools. The Global Hawk set several world records, one of which been the first UAV to cross Pacific Ocean when it flew from Edwards Air Force Base to RAAF Base Edinburg in Australia. The flight totaled more than 8200 miles. The Global Hawk also set endurance records by flying for more than 33 hours at altitudes topping 60,000 feet. The Global Hawk is primarily used for global surveillance. Figure-7 shows the Global Hawk long range drone.

Figure-7 The Northrup Gruman Global Hawk.

Boeing X-37B

Originally developed by Boeing for NASA, the X-37B is classified as an Orbital Test Vehicle [OTV]. The USAF has conducted three missions with the X-37B and has thus far been very secretive on the test mission as well as the intended uses of the X-37B. The most recent flight of the X-37B saw it remain in low orbit for 674 days before being guided back to Vandenberg Air Force Base in California. The X-37B is nearly 30 feet in length and 10 feet in height. Its orbital cruising speed is slightly over 17,000 miles per hour. Figure-8 shows the Boeing X-37B.

Figure-8 The Classified Boeing X-37B Orbital Test Vehicle.

Growth in Consumer Drones

While the majority of the world's media pines over the plight of modern warfare with unmanned aerial war machines, a bigger story is brewing elsewhere in the world. The booming consumer industry is doing just that, booming! The consumer drone industry is a relatively new industry and growing at an estimate rate of 15-20% annually. Ironically enough, in the United States, arguably the largest consumer market in the world, the FAA has yet to release an updated set of laws to make commercial use of drones legal. They've also not outlined any sort of legislation necessary making it illegal. When a clear set of legal operating guide-lines are released, there is no telling where the drone market might go.

Part of the reason for the boom is that advances in technology have made it easier for high-end hardware and software to be developed and prototyped at a lower cost. These lower prices make it easier for a large amount of people to gain access to a product, but the real driver behind the surge in drone popularity is in the uses for drones. Drones have attracted more than just model airplane hobbyist and flight hobbyist. The technology advances in flight technology, flight modes, and controls along with the advancements in portable photography and video technology has caused an explosion with amateur and professional photographers and videographers. Who needs high-end video cranes when you can couple a small action camera, like a GoPro, with a drone, as shown in figure-9.

Figure-9 Drone with a GoPro action camera

The growth in drone popularity can also seen in the number of drone companies that launched in 2014 and secured funding by launching crowdfunding* campaigns that spread virally across the internet. *[Crowdfunding is the practice of funding a project or venture by raising many small amounts of money from a large number of people, typically via internet.]

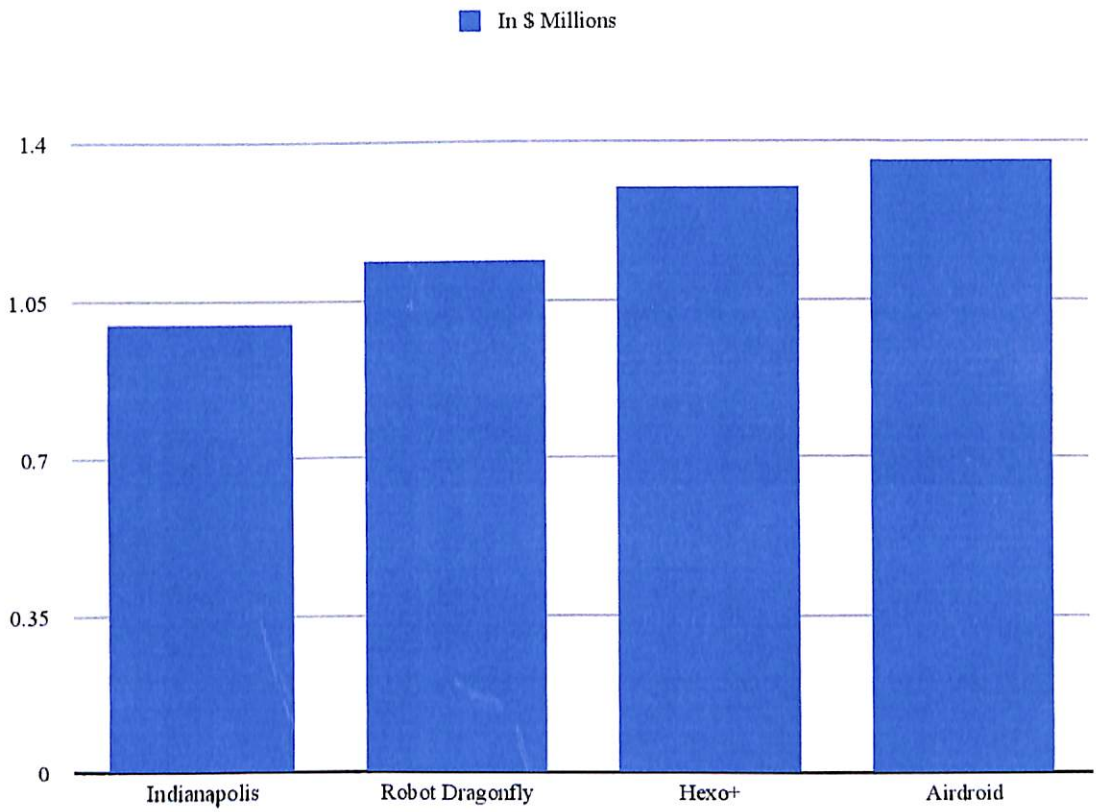


Table-1 Funding Raised by companies for drones.

Hexo+ raised $1.3 million, Airdroids raised $1.36 million, Robot Dragonfly raised $1.14 million, and Indianapolis-based Airdroids raised nearly $1 million for their compact drones.

2.2 Knowing Various types of Drone

The are several types of drones currently available for purchase by consumers. These types include planes or gliders, helicopters, multi-copters or multi-rotors, and tilt rotors. The following section discuss each type in detail.

Planes

Remote controlled airplanes have been around for quite some time in the model aircraft world. These devices achieve flight through horizontal takeoff, meaning they gain speed across the ground until enough air moves across the wings to force the plane off the ground and into the air.

Plane also land horizontally, and since their ability to remain airborne requires forward momentum, they do not have the capability to hover in place or move vertically. Planes and gliders can only, and always must, move forward. Figure-10 shows an airplane drone.

Figure-10 Airplane drone.

Helicopters

These aircraft have two sets of propellers, often referred to as rotors. The main rotor is used to create lift to get the aircraft airborne and thrust to move the aircraft forward. The second rotor is used for directional control and stability of the helicopter. Because helicopters do not require thrust to become airborne, they can move forward, backward, and strafe*.

Figure-11 Helicopter drone.

*Strafing means moving side to side without changing your directional orientation. For example, we are facing forward sidestep to the right or left. This movement is called strafing. Figure-11 shows a helicopter drone.

Multi-copters

If helicopters have two rotors then a multi-copter has more than two. One of the benefits of having a multi-copter, also referred to as a multi-rotor, is that the mechanics involved with flight controls are

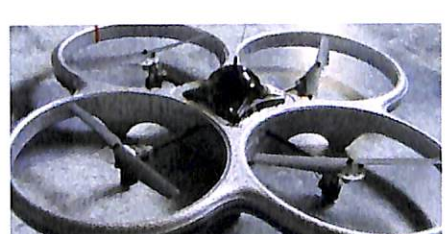


Figure-12 Multi-copter drone.

much simpler. The directional control of a multi-copter is handled by adjusting the speed of each rotor. Multi-copters are most common commercial drones because of their ease of construction and control. Figure-12 shows a multi-copter drone.

Tiltrotors

Tilt-rotors function in a manner that appears to be a cross between planes and helicopters. On these aircraft, the rotors are positioned above the aircraft to allow for vertical takeoff. The rotors slowly shift forward (toward the nose of the aircraft) as the aircraft gains momentum. This changes the roll of the rotors from creating the lift for vertical takeoff, to creating the thrust thus making the wings responsible for creating the lift. Currently, there are no commercially available tilt-rotor drones Figure-13 is a picture of a tilt-rotor aircraft.

Figure-13 Tilt-rotor drone.

2.3 Understanding different uses of Drones

Popular uses for Drones

In the United States, the organization that controls all air traffic (Private and commercial) is the FAA, Which stands for the Federal Aviation Administration. In 2012, the U.S.Congress passed a law requiring the FAA to issue rules for legalizing the commercial usage of drones in the United States by September of 2015. Currently, drone usage is protected under the FAA's regulations pertaining to recreational and hobby uses as long as the drone is under 55 lbs.

With no good way of monitoring or policing drone usage, however, there have been many private individuals, companies, farmers, small businesses, and so on that have begun using drones to help them get work done faster, smarter, and at lower risk and liabilities. The following sections describe the most common domestic uses for drones.

Remoter sensing

Drones can carry sensing equipment to assist with any number of functions. Geological surveying, agriculture, archeology, and several other industries can benefit greatly from the myriad of sensors that can be packed into a drone.

Commercial Aerial Surveillance

When we hear surveillance, chances are good that you think about security cameras designed to catch lawbreakers. Or possibly spying and monitoring of your personal movements and action.

Commercial and Motion Picture Filmmaking

In 2014, the Motion Picture Association, backed by seven computers, petitioned the FAA to allow the use of drones in video and filmmaking. Drones dramatically reduce the cost associated with gathering action or aerial footage that up until now would require expensive equipment like booms and dollies or even helicopters or other manned aircraft. In September of 2014, the FAA issued permits to six film studios for the use of drones in filmmaking. Drones are also being used to gather footage in sporting event because of their ability to maneuver into locations that cable-suspended cameras cannot reach. Most recently, drones were used to gather footage of the skiing and snowboarding events in the 2014 Sochi Winter Olympics.

Oil, Gas, and Mineral Exploration

With the help of specific electromagnetic sensors, drones can be used to gather geological information to help geophysicists identify and better approximate the location and presence of minerals, oil, and natural gas.

Disaster Relief

The milieu of sensors that can be packed into a drone can be used to help locate and save life in the midst of natural disasters. Drones can be used to gather and deliver medical samples, supplies, and medicine to remote or otherwise unreachable areas in a disaster zone. Drones can also use infrared sensors to detect humans by their heat signature which is helpful in search and rescue scenarios.

Real Estate and Construction

Drones have made it possible to survey land and gather information at job sites. Realtors, developers, and builders have also begun using drones to gather video and imagery for home and building inspections and marketing material to assist the selling process.

Recreational Use

Needless to say, drones can be extremely useful devices for plethora of applications ranging from agriculture to national security. However, we can't forget that drones are really fun to use, which is probably why you are reading this book in the first place! The miracle of flight is something that has fascinated man millennia, so it's no wonder that hobby flight enthusiasts have been tinkering with flying machines since the late 1800s.

The good news is that personal and hobby use of drones is perfectly legal in United States. Recreational flying can be done anywhere but is best if done in open locations so that you can always see your aircraft. This is called line-of-sight flying. Attaching to your drone is also a lot of fun for gathering beautiful imagery and video of the world around you.

Until the emergence of drones, to take aerial photos or videos, you needed a really tall ladder or a friend with a helicopter/plane to be able to capture the footage. A word of caution, be careful of who, who, and where you take photos and videos with your drone. Privacy is a major concern for many people.

Hobby groups and flying clubs exist all around the globe; plugging into a group is a great way to meet other people passionate about flying. It's also a great way to learn how to fly, learn new techniques, service and maintain your aircraft, and more.

High Flying Drone Companies

As the drone market continues to explode over the next several years and decades, there will be numerous companies getting into the fray. Currently there are several making a lot of noise in the world of unmanned aerial vehicles. We may find it worthwhile to check them out so that we can be in the know on what's going on in drone town.

Figure-14 High Flying Drone Companies and their Drone.

DRONE FACTS

India is the largest drone user for weddings as of 2015

Chapter 3
Research Design, Methodology and Plan

In This Chapter
3.1 Data Sources
3.2 Research Design.
3.3 Data Analysis Procedure.

3.1 Data Sources

In the field of commercial drones, we considered various stakeholders such as governmental regulatory organizations, judicial bodies, research institutes, training institutes, public organizations, drone manufacturers, technology developers, service providers, new organizations, insurance companies, non profit acting in public interest, activist for privacy, public and private establishment drone users, and individual users. We used an aggregate corpus of ninety-six articles published between 2001 and 2015, accessed through academic and non academic databases and search engines. We considered the text produced by these stakeholders as the object, and used content analysis to inferences. The text was then divided and coded based on origin, purpose, and content. Finally, the inferences were classified into three schemes represented the facts of society, and one that represented the governmental response. We have taken governmental response on the basis of draft issued by the governmental regulatory organizations.

The research process begins with exhaustive secondary research to source reliable qualitative and quantitative information related to the societal impact of Commercial drones. The secondary research sources that are typically referred to include, but are not limited to:

1. National Government Documents.

Directorate General of Civil Aviation

The Directorate General of Civil Aviation (**DGCA**) is the Indian governmental regulatory body for civil aviation under the Ministry of Civil Aviation. This directorate investigates aviation accidents and incidents. The operation of Civil Remotely Piloted Aircraft also comes under its authority. DGCA issues first draft for ban of drone on 7th October 2014, due one bad reason and one good reason. The reasons are as follows:

A. Bad Reason : Drone was being flown from Pakistan to Punjab border for delivering of drugs.
B. Good Reason : On the same day, drone was being flown from one pizza company based in Mumbai named 'Pizzeria' to deliver Pizza.

GOVERNMENT OF INDIA
OFFICE OF THE DIRECTOR GENERAL OF CIVIL AVIATION
OPPOSITE SAFDARJUNG AIRPORT, NEW DELHI – 110 003

PUBLIC NOTICE

File No. 05-13/2014-AED
Dated: 7th October, 2014

Subject: Use of Unmanned Aerial Vehicle (UAV)/ Unmanned Aircraft Systems (UAS) for Civil Applications

Of late, lots of interests are being shown for civil use (both commercial and recreational) of UAS in the country. International Civil Aviation Organization (ICAO) is yet to publish Standards And Recommended Practices (SARPs), as far as certification and operation of civil use of UAS is concerned.

UAS has potential for large number of civil applications. However, its use besides being a safety issue, also poses security threat. The Airspace over cities in India has high density of manned aircraft traffic. Due to lack of regulation, operating procedures/ standards and uncertainty of the technology, UAS poses threat for air collisions and accidents.

The civil operation of UAS will require approval from the Air Navigation Service provider, defence, Ministry of Home Affairs, and other concerned security agencies, besides the DGCA.

DGCA is in the process of formulating the regulations (and globally harmonize those) for certification & operation for use of UAS in the Indian Civil Airspace. Till such regulations are issued, no non government agency, organization, or an individual will launch a UAS in Indian Civil Airspace for any purpose whatsoever.

The above is for strict compliance.

Director General of Civil Aviation

Figure-15 DGCA issued first draft for ban of drone.

2. Statistical Database.

Statista is a German online portal for statistics, which makes data collected by market and opinion research institutes and data derived from the economic sector and official statistics available in English, French, German and Spanish.

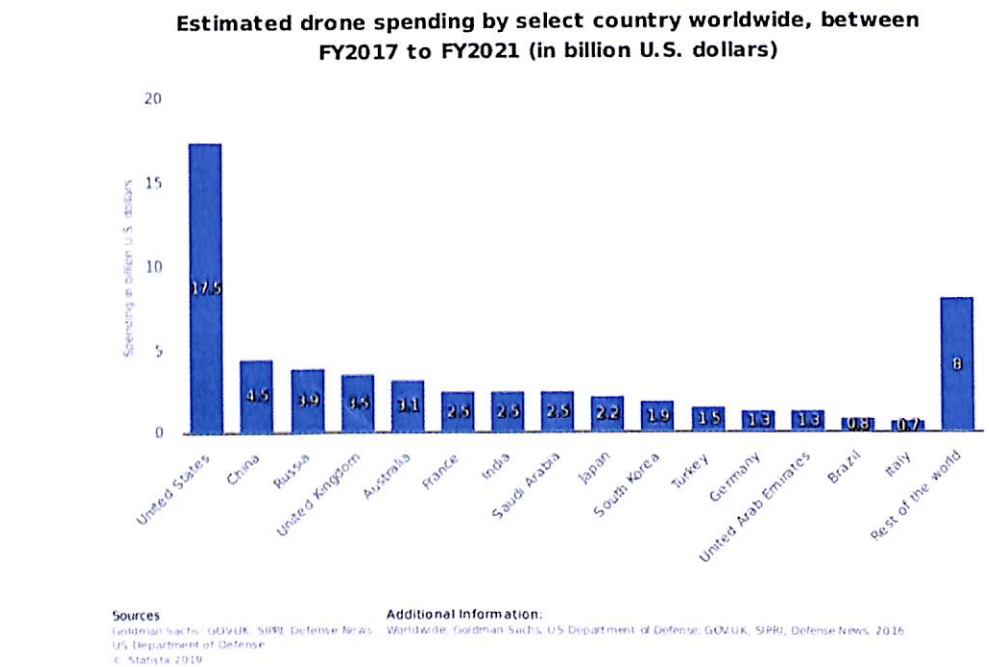


Table-2 Estimated Drone spending by country worldwide.

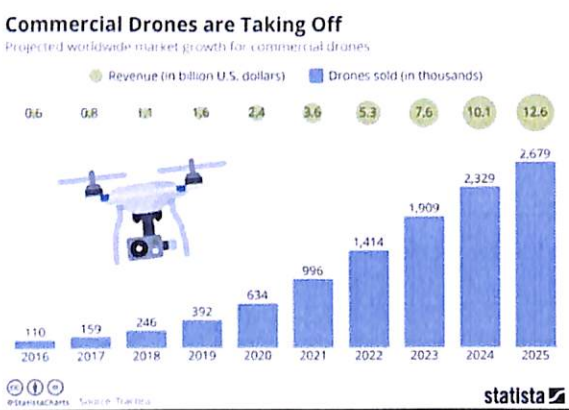


Table-3 Market growth of Commercial Drones.

3. Non-Profit Organisation.

Federation of Indian Chambers of Commerce and Industry [FICCI] was established in 1927, and is the largest and oldest apex business organization in India.

A non-government, not for profit organization, FICCI is the voice of India's business and industry. From influencing policy to encouraging debate, engaging with policy makers and civil society, FICCI articulates the views and concern of industry.

FICCI is recently working on ***"Make in India for Unmanned Aircraft Systems"***

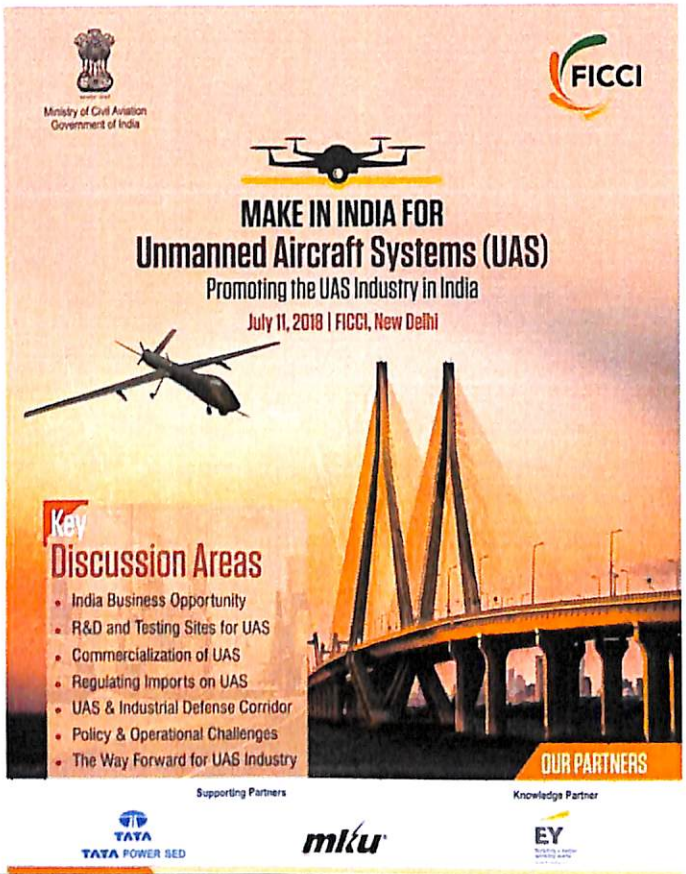


Figure-16 Make in India for Unmanned Aircraft Systems [UAS] workshop by FICCI

4. Training Institute.

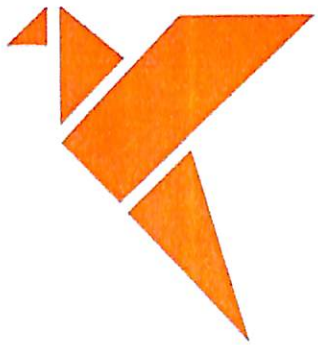
Indian Institute of Drones is the India's no. 1 Training institute for drone training. The intention and aims of IID is to offer the skill set requirements that tick the DGCA boxes as well as delivering courses that are insightful, fun and above all extend the *superior safety and security record that the Indian Aviation Industry enjoys.* ***Indian Institute of Drone is also a Panel member of DGCA and performed a great role in forming Indian regulation for drone.***

Figure-17 Drone Training by IID

5. Drone Manufacturer

Aarav Unmanned Systems

Throttle Aerospace Systems



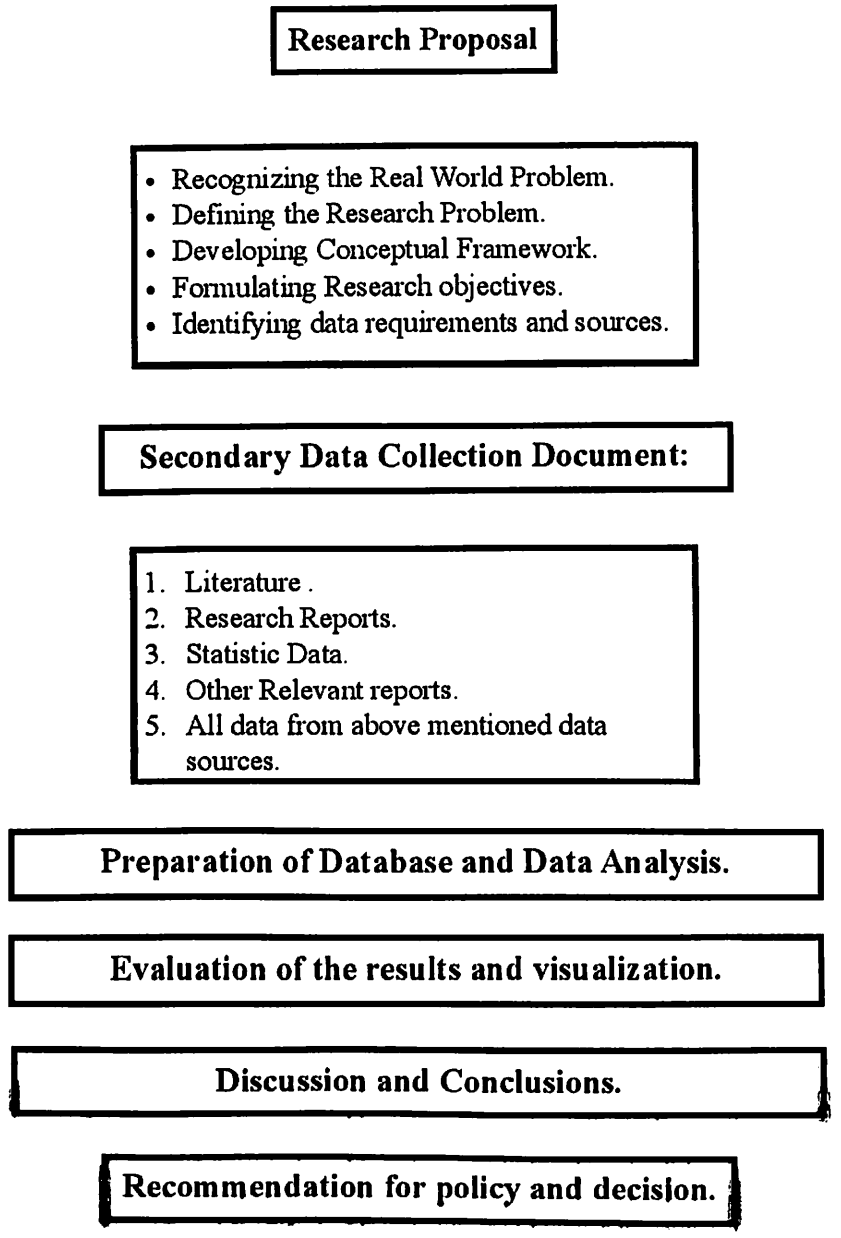
Skylark Drones

Figure-18 Drone manufacturers in India

These are three Indian Drone Manufacturing companies approved by DGCA for manufacturing of drones. Aarav Unmanned System is approved for manufacturing of Mini Category of Drone and Throttle Aerospace Systems and Skylark Drone are approved for manufacturing of Micro Category of Drone. These are only companies that are manufacturing NPNT* compliance drone. *NPNT is a brilliant feature for the safety of the nation which India has adopted for first time in the world.*

**NPNT : No Permission No Take-off*

3.2 Research Design



3.3 Data Analysis Procedure.

Understanding a subject as extensive as the relationship between technology and society requires a suitably broad approach. Thus, we performed a discourse analysis of various documents in order to investigate how various stakeholders perceived commercial UAVs. ***Discourse is a comprehensive concept that includes any practice by which individuals imbue reality with meaning.*** Though it is found in a wide range of forms (e.g. rituals, myths, customs), we are interested in verbal discourse in textual form. Particularly, we looked at spontaneous discourse, which subjects generate in their everyday lives. These take the form of articles, blogs, books, public records, announcements, reports, or indeed any text produced by an individual or organization. Since individual and group action is largely guided by socially produced and shared patterns, the knowledge of this inter subjectivity helps us understand the social order.

DRONE FACTS

From June 2004 through mid-September 2012, drone strikes killed 2,562-3, 325 people in Pakistan, of who 474-881 were civilians, including 176 children. Whereas, the total number of people killed during the 9/11 incident were less than 3000.

Chapter 4
Societal Impact of Commercial Drones

In This Chapter

4.1 Data Analysis

Based on our analysis of the discourse surrounding drones, we identify three broad classes of issues that need further attention.

- The first one is Safety and Security, and it relates to personal and property damage, as well as attacks on drones themselves.
- The Second one is Privacy and Ownership, and this is in regard to the data collected by the drones.
- Third is personal and commercial liability, which evokes questions about the responsibility undertaken by drone operators.

In the following sections, we will briefly examine each of these issues in more detail and delineate the broad concerns, as well as potential ways of addressing them. Finally, we will take a look at the attempts by governments to regulate this industry, and the challenges they have faced.

4.2 Safety and Security

Safety, the freedom from harm, and security, the freedom from fear of harm, are basic human rights that are guaranteed and protected by the constitutions of most nations.Currently, the use of drones in civilian airspace has triggered concerns about challenges to these basic rights. These concerns are directed towards both the technology and the user. Concerns regarding the technology center around the battery life, lift capacity, airworthiness, and reliability of the drones. The primary criticism with the flying of commercial drones over public space is that small mistakes could result in crashes that threaten the health, well-being and property of public. Furthermore, if they crash into public infrastructure such as electricity poles, or wanders into airport and other protected airspaces, they could result in dangerous scenarios that put lives into danger.

These fears are not unfounded as there have been cases of such incidents that have been reported. Currently, there are a few issues that challenge the security of drones in flight. Drone

navigation units are vulnerable to two different kinds of attacks on their GPS systems. 'Spoofing' entails the sending of strong [but fake] GPS signals towards a drone, so that it is essentially "hijacked" instead of following its programmed directions. The drone can then be manipulated to crash or be flown to the attacker's location. This would make it possible for a drone operator to be held responsible for the consequences of the "spoofed" drone since it is very difficult to prove the origin of the navigation signals.

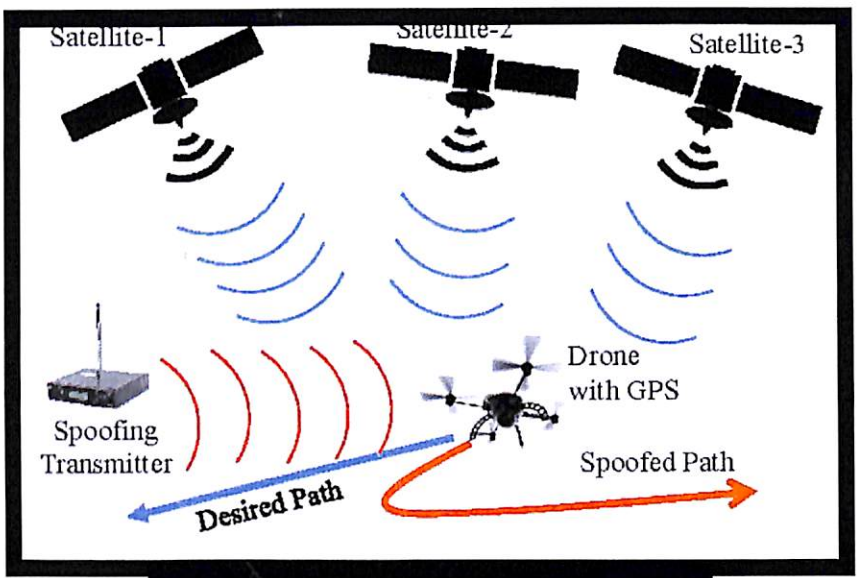


Figure-19 Drone "Spoofing"

It wasn't until 2014 that a successful spoofing attack was conducted against drone, by a researcher at a Department of Homeland Security facility. This controlled but sophisticated attack was achieved with $1000 worth of equipment. For now, military GPS uses encryption that renders it in invulnerable to any known spoofing attack, but still leaves it still susceptible to 'jamming'. In a jamming attack, the drone is overwhelmed with signals to GPS antenna. The encryption ensures that no fake signal is mistaken for the true one, but the true signal cannot get through either. Unintended collisions seems to be unavoidable in such scenarios, especially in an unregulated environment. There have been several incidents that have caused substantial losses without the owners of the devices being found.

Aside from attacks on the navigation of the drone itself, there is the security of the payload being carried: For example, one can imagine several logistical challenges faced by drone delivery services that are being envisioned [eg. Amazon]. Likewise, the intentions of drone operators have been called into questions, as currently, there is not regulation that controls the payload that is carried on the drones. Critics have speculated that drones could theoretically be

used to conduct attacks on a civilian population, though no cases have been reported thus far. In fact, currently available commercial drones lack the lift capacity to carry any equipment capable of creating damage, yet it is important to note that their lift capabilities have been improving over the last decade.

4.3 Privacy and Ownership

Outside of the military and commercial environment, the information carried by cameras and sensors on drones operating in the consumer space may be even more valuable to attackers and easier to target. If a private UAV is compromised, it is difficult for the owner to detect the leak of information, and ensure the security of the information as well as claims to detect ownership. These attacks aren't hypothetical either: an investigation prompted by a handful of documented cases of militants in Iraq who apparently captured videos on their laptops revealed that a piece of $26 off-the-shelf software was capable of intercepting feeds from US military drones. Currently, even the military isn't capable of securing its videos such attacks, and therefore foolproof security is not yet expected of police forces, private firms, or consumers using drones.

The problem only gets more complicated as device endurance improves and their costs decrease, giving the opportunity to any individual engaging in episodic or persistent surveillance at the expense of others "reasonable expectation privacy". As a matter of fact, the traditional notion of privacy itself is under threat: "the state in which one is not observed or disturbed by other people" will have to be defended not only from obvious and detectable threats such as

Figure-20 Stupid Things with Drones Harming Privacy.

people nearby or object on the ground, but also from quiet and distant flying object as well. This also raises the issue of airspace over private property and standards expectations for tis protection. In a public space such as a park or on a street, the reasonable expectation of privacy does not apply. Therefore, since a person is present in a public place, there is also not legal basis to make a claim of a breach of their privacy.

The same argument also extent up to an extent, to private property that is visible from public spaces. However, these laws assume that sight is confined to the eye-level. Drones disrupt the expectations of reasonable privacy since they are operated in a public place, yet can capture images and sound from that aren't traditionally available to public. This gap in the law allows for the possibility of unwarranted surveillance without fear of repercussion. Current privacy laws state that it is illegal to record the interior of a home or a privately owned building, even if the camera is placed outside. This creates uncertainty since even if the drone is being flown within eyesight and over the private property of the operator, there is the possibility of being in violations of privacy laws since it provides a monitoring capability that is not yet legitimated by the law.

4.4 Personal and Commercial Liability

Drones now face complex coverage and liability issues in regards to insuring their commercial use. These problems arise from the complexity of various factors such as the different types of accidents, procedures for air control, and uncertain privacy laws. Insurance companies are yet to develop insurance plans for UAVs, and there is very little guidelines or precedent to follow. Personal injury and the invasion of privacy are the most important issues, considering that many UAVs fly over habited regions. In order to judge a case of personal injury, insurance companies need to take into consideration the drone's ability to collect a massive quantity of data, which can either be stored on board or transmitted to a remote device. Moreover, it is very difficult to prove the intention behind the collection and use of data.

Currently existing DGCA guideline are not specific enough to dictate the coverage for personal and commercial liability, invasion of privacy, personal injury or property damage. Commercial liability should include financial loss since many drone companies are still in the startup phase. The property coverage also should include the processes of production, assembly and wholesaling. Likewise, rather than just focusing on the finished product, it is important to realize that most drones are modular and could be comprised of independently sourced components. Even more confusion arises from lack of a strict definition of a drone. Currently, due to the broad range of standards and applications, drones could be classified as quad-copters, model aircraft, or even light aircraft. This lack of categorization makes it challenging to properly assess the coverage policies since each class of aircraft has its own set of guidelines.

Chapter – 5

Interpretation of Result

When it comes to drones is it possible to divide the population in two main categories: those who can be defined as UAV's enthusiasts, looking forward to use them either for private or commercial use; and those who believe these are a threat - with the potential of endanger their freedoms as well as daily activities. Despite the huge improvements that drones can provide, the public is skeptical: a recent surveys on a sample of 2405 US citizen's shows that 42% disapprove private ownership[of drones, mostly because of privacy concerned. Many have questioned the recent. DGCA rules on commercial drones, suggesting that rules will adversely affect small drone based businesses, as well as questioning their clarity. The lag between meaningful and enforceable regulation compared to the pace of development of new devices, is creating more confusion. For example, in the aforementioned survey, most of the respondent are basically unaware of existing regulation [30% of them believe DGCA is not regulating class G airspace, which is below 1200 feet], are confused bout which certificate is needed to operate a drone [Certificate of Authorization vs. Exemption vs. Waiver vs. ...], and what those certificates imply, since the rules does not cover all potential situations. Forty seven percent of the companies surveyed in the report state they have been operating in Class G airspace even without the regulation in place, which means that potentially they are already exposing civilian to the threats they would like to avoid, and 62% are currently flying without commercial liability insurance for their UAVs. This also raises questions about the potential implications for the insurance industry. Currently, there are not policies available though they are in the process of being developed to cover such contingencies. Another 47% of respondents state that they are postponing the creation of jobs since they are not sure whether the regulation would make the industry favorable or not, and 61% would be willing not to start their operations, or to shut down the one that already exists if the regulations re perceived to be unfavorable.

In fact, there is some evidence that delays in developing a clear framework have prompted several private manned aircraft frequently operate without flight plans around working areas to capture images above sites without asking or approval prior to takeoff, even if those operations are currently in violation of DGCA policy. Thus, on one hand private users are not at all regulated and can create potential safety issues, while on the other hand commercial development is criminalized. The ability to enter private property undetected and to breaches. Generally speaking, the risk of UAV usage as every other technology for illegal activities is unavoidable. However, since existing guidelines and rules overlook the possibility of a hard-to-notice flying camera widely available to masses, they also increase the potential of misuse.

As mentioned above, many countries have already started the process to adapt their regulations to address safety and technical issues. Nevertheless those arrangements do not engage in fixing the most imperative problem created by drone technology: faulty privacy and surveillance regulations. Even Australia, which is one of the pioneers of the use of drones for

commercial activities, has recently pointed out the inappropriateness of tits Commonwealth Privacy Act that does not cover collection and use of personal information by private citizens and small businesses. Furthermore at this time, traditional enforcement appears weak and expensive and new infrastructure need to be established. It is paramount to first update the current definition of privacy and finds new ways to guarantee its protection balancing freedom of expression, open justice, public safety and national security. Given the current fuzziness of direction, business will face difficulties in lawfully developing hardware and software solutions to exploit the huge industry potential. Another critical aspect in integrating the UAS in the National Airspace System is law enforcement, which is currently ineffective and expensive.

Untrustworthiness creates huge resistance to new technologies: a way to sensitize masses to drone misuse consequences is to assign accountability and liability. As for now, in the US only broad general guidelines have been provided and basic tool such as evidence collection and operator/witness identification and interview have been performed in case of UAV related accidents. However, since UAV can cause physical damages as cars do, it seems legitimate to hypothesize the introduction of compulsory specific insurance plans, that would create a registry of devices to link each and every sold one to its owner and therefore help in assigning responsibilities for illegal activities. Furthermore, as for now each jurisdiction is empowered to determine its own rules they will eventually cause inconsistency across contiguous regions and countries. Also, in order to be valid to protect the interest of privacy as long as possible they should not be strictly related to protect the interest of privacy as long as possible they should not be strictly related to the single technology.

Issues	Major Challenges	Possible Solutions
Privacy	Detection/ Access to Justice.	Hardware and Software for device detection, and data retention / Registry of owner and devices.
Ownership	Accountability	Registry of owners and devices/ Assign liability for UAV owners.
Security	Control/Enforcement	Creation of new infrastructure and development of proper assets: UAV trackers devices/ automatic safe landing/ Establishment of insurance entities etc.
Regulatory	Lack of comprehensive rules and uniformity across jurisdictions.	Redefinition of "reasonable expectation of privacy"/ Definition of physical aerial boundaries/ Centralization of Powers.
Business Models	Lack of clear guidelines to operate in compliance with the law.	Promote regulations for the development UAV – related technologies.

Chapter – 6

Contribution and Conclusion

The rapid evolution of drones for civilian's applications has created several challenges: Regulatory, Safety, Privacy, Security, and the uncertain landscape for new business models. The paper shows that there are several bottlenecks that are hampering more rapid adoption of drones, including regulatory and enforcement clarity and lag, cultural perceptions or misconceptions of what drones are and what they can do, as well as significant challenges that can be thrown up by a more rapid proliferation of drones. As the population of civilian drones and their users expands globally, the risk of accidents both digital and physical are destined to multiply. The internet revolutionized personal computing thanks to a confluence of technical, social, regulatory and cultural trends and efforts. The future success of civilian depends on the ability of varied stakeholders to reconsider how this emerging technology platform can best harnessed to serve the broad interests of society.

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