

Unmanned Aerial Systems:

Future Military and Commercial Outgrowth in the
Canadian Context.

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Abstract

Unmanned aerial systems (UAS) have been a source of controversy over the last decade for their role in killing suspected militants in the Middle East and Northern Africa. However, they are also making headlines for their commercial applications in various civilian industries. Regardless of how they have been utilized, UAS technology is proliferating rapidly across the globe and it is being extensively developed by democratic and non-democratic nations alike. This paper provides a comprehensive overview of the outgrowth of military and commercial UAS in Canada, their ideal use for its democratic military as well as its commercial industry growth. The first half of the paper will illustrate the history of unmanned vehicles and their evolution into the systems we know today. Adding to this, the author will illustrate what military UAS entail as well as their current uses in the Canadian armed forces. Further, it will be explained how UAS are well-suited to western militaries for use in their asymmetric democratic wars of choice. The second half of the article will focus on UAS in the commercial industry with a specific focus on the Canadian context. Current federal regulations that govern the use of UAS as well as the regulatory challenges surrounding them will be highlighted in order to emphasize how clear federal regulations can facilitate the industry's growth. Further, this paper will detail the various key commercial sectors of the Canadian economy where UAS can be beneficial.

By summarizing the military uses of UAS in Canada, this author will attempt to argue that in line with current democratic trends and global usage, the utilization of UAS by the Canadian military will expand in accordance with the current government's political commitments as outlined in the Canada First Defense Strategy. Further, by detailing the commercial UAS industry and the ways it can benefit key Canadian commercial sectors, this author will demonstrate that maintaining regulatory pace with UAS industry growth satisfies Canada's economic priorities as outlined in 'Canada's Economic Action Plan.'

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1. Unmanned Aerial Systems

The proliferation of unmanned aerial systems (UAS) is proceeding globally at a blistering pace. Having found its genesis in military technology, UAS are quickly becoming less expensive to acquire, operate and maintain and have thus become a valuable tool for many commercial industries. There is a wide variety of terminology used to describe these systems, but the common names for the airborne element include drones, robots and decoys, as well as various acronyms: Remotely Piloted Vehicles (RPVs), Remotely Operated Aircraft (ROA), Unmanned (or Uninhabited) Aerial Vehicles (UAVs), and Unmanned Combat Aerial Vehicles (UCAVs) being the most popular.¹ What they all share in common is they are autonomous or remotely piloted aircraft capable of flight without an onboard operator.

Formerly a sole fixture of defense technology, UAS are now growing globally in both military and commercial capacities. In 2012, world governments spent more than 6.6 billion on military unmanned aerial vehicles.² The industry for civilian UAS is also beginning to expand as the market demand for them takes hold in key national commercial sectors like mining and agriculture. With the amount of commercial UAS applications available, growth in this industry will be inevitable and it will result in tangible economic benefits such as creating quality jobs and attracting investment.

Canada's position in this industry is advantageous in comparison to the U.S for reasons of regulation. While the use of commercial UAS is completely banned in the U.S without special approval, in Canada they are allowed with an easily attainable Special Flight Operations Certificate. (SFOC) However, if the use of this technology surpasses the existing legislation governing it, there is the risk of regulatory uncertainty which could dampen any financial investment in the industry and ultimately threaten its future. In this paper, the author argues that due to current trends resulting in widespread military and commercial UAS proliferation, both in democratic and non-democratic nations alike, it is in the Canadian government's best interests to facilitate national outgrowth in order to satisfy both the military requirements of the Canada First Defense Strategy as well as economic priorities outlined in Canada's Economic Action Plan.

¹ Holman, Fraser. *The Future of Drones in Canada: Perspectives from a Former RCAF Fighter Pilot*. Working paper. Ottawa: Canadian International Council, 2013. Print. Pg. 04

² Hall, Abigail R., and Christopher J. Coyne. "The Political Economy of Drones." *Defense and Peace Economics* (2013): 1-16. Web. Pg. 445

This paper is split into two parts. To begin, the author will outline the historical evolution of unmanned systems technology beginning with the first model aircraft in ancient Greece to today's Predator designs. Adding to this, the author will detail the unprecedented expansion of military UAS and how they became what they are defined as today.

Following that, the first half of the article will illustrate what military UAS entail as well as their current uses in the Canadian military. Continuing, the author will demonstrate how UAS are well-suited to western militaries for use in their asymmetric democratic wars of choice. Further, the article will highlight the development, production and use of UAS by those nation states and organizations, democratic and non-democratic alike, in order to demonstrate the proliferation of the technology worldwide. Based on this information, the author predicts that the utilization UAS by the Canadian military will expand in accordance with its commitments to the Canada First Defense Strategy.

The second half of the article will focus on the myriad uses for UAS in the commercial industry with a specific lens on the Canadian context. These include agriculture, resource exploitation, weather monitoring and scientific research, freight delivery, film and photography, journalism, law enforcement, search and rescue as well as firefighting. To begin, the author will explain how maintaining regulatory pace with the UAS industry is in line with Canada's economic priorities as outlined in 'Canada's Economic Action Plan.' Building on this, the author will summarize the government regulations that govern the use of commercial UAS in both the United States and Canada to demonstrate that the latter are considerably more relaxed. Next, the author will showcase the myriad of areas in the Canadian economy where UAS are being successfully employed as well as how future legislation can ensure their continued effectiveness. By illustrating the commercial development, production and use of UAS in Canada, the author will argue that UAS use will continue to expand due to the current level regulatory recognition and significance to key sectors of the economy.

History of Unmanned Flight

Unmanned flight has existed for centuries. According to the writings of Roman Aulus Gellis, ancient Greek philosopher and mathematician Archytas of Tarentum flew a wooden pigeon powered by steam enclosed in its stomach.³ Somewhere around 400BC, Archytas's

³ Benson, Tom. "Brief History of Rockets." *Brief History of Rockets*. NASA.gov, n.d. Web. 07 July 2014.

unmanned aircraft would ‘fly’ along suspended wires while mystifying and entertaining the city where he resided.⁴ During the same period on the other side of the world, the Chinese were discovering kites, hot air balloons and spinning tops that could fly vertically.⁵

Jumping ahead to the first half of the 20th century, the OQ-Radioplane was the first mass produced unmanned aircraft in the world and was used for realistic anti-aircraft gunnery practice. The aircraft was built by Reginald Denny, a former World War One RAF pilot who became a Hollywood movie star.⁶ Between acting jobs, he pursued his passion in radio controlled model aircraft by opening a hobby shop dedicated to exactly that. The shop evolved into the “Radioplane Company” where the world’s first anti-aircraft shooting target was designed and created.⁷ Thousands were produced for training purposes during the Second World War while today, Mr. Denny’s company is owned by U.S defense giant Northrop Grumman.⁸

For two decades after the Second World War ended, advancements in guidance systems and imaging technology led only to small developments in unmanned aircraft used for reconnaissance purposes. During American involvement in the Vietnam War, upgraded target drones were retrofitted with film cameras and transformed into long range unmanned surveillance systems capable of an autonomous predetermined flight path.⁹ Known as the AQM-34 ‘Lightning Bug’ the small and highly maneuverable UAS flew over enemy territory collecting intelligence while confounding enemy MiG fighters.¹⁰ According to John Dale, a retired U.S Air Force (USAF) Colonel and former director of U.S Special Air Command’s 15th Air Force HQ, “at one time, they had nineteen enemy MiGs chasing one drone.”¹¹ Between 1965 and 1975, Lightning Bugs flew thousands of sorties over North Vietnam, China and North Korea.¹² Despite its resounding success, the program was cancelled after the war.

⁴ *Ibid*

⁵ Gibb, Alexandra S. *Droning the Story*. Thesis. Simon Fraser University, 2011. Vancouver: U of British Columbia, 2013. Print. Pg. 07

⁶ Katz, Kenneth P. "Before Predator: The History of USAF Remotely Piloted Aircraft." *Katz AeroSystems* (2013): 1-18. *The Society of Flight Test Engineers*. Katz AeroSystems. Web

⁷ Gibb, Alexandra S. Pg. 10

⁸ *Ibid*

⁹ Orr, Scott. "Drones Declassified: UAVs Date Back to '60s over China, N. Korea, Vietnam - The Prescott Daily Courier - Prescott, Arizona." *The Daily Courier*. N.p., 17 Jan. 2014. Web. 09 July 2014.

¹⁰ *Ibid*

¹¹ *Ibid*

¹² Ehrhard, Thomas P. *Air Force UAVs: The Secret History*. Publication. Mitchell Institute, July 2010. Web. 3 June 2014.

During the 1967 Six Day War, the Israelis significantly ramped up their use of UAS. Egyptian anti-aircraft missiles had downed a large number Israeli Air Force (IAF) planes and a more effective method of intelligence gathering with less casualties was required.¹³ During the 1973 Yom Kippur War, the IAF used UAS designs they had purchased from the Americans. The Israeli-deployed UAS fooled enemy radar operations and ground systems into thinking that a mass strike had begun against their anti-aircraft positions. This deception caused the Arab defenses to expend their surface-to-air missiles (SAMs) against the perceived onslaught.¹⁴ The Israeli UAS were followed by manned IAF aircraft which could then attack the enemy SAMs sites which were in the process of reloading. In recognition of their value, Israel Aerospace Industries (IAI) the official state arms industry, started to manufacture UAS in 1974.¹⁵

It was Abraham Karem, an Israeli-born engineer who designed and built drones for the IAF during the Yom Kippur war and would go on to be the creator of the U.S military's most infamous and recognized UAS today. When Mr. Karem moved to the U.S in 1977, he founded a company called 'Leading Systems' in the garage of his Los Angeles home and from there he built and designed a drone codenamed 'Albatross.'¹⁶ After showcasing the Albatross which remained aloft for fifty-six hours, the U.S Defense Advanced Research Projects Agency (DARPA) took notice and funded Mr. Karem to scale it up into a more capable drone called 'Amber,' which over time evolved into today's modern Predator design.¹⁷ It was in 1994 that a U.S defense company by the name of General Atomics began to develop the Predator further by incorporating satellite links which gave "the drone a gently rounded nose that belied its pugnacious new name."¹⁸ First deployed during the 1990's conflict in the former Yugoslavia, American forces now had a platform that could loiter over a target area for days, provide infra-red and optical surveillance in all weather and launch devastating anti-tank missiles.

2. The Rise of Military UAS

¹³ Dobbing, Mary, and Chris Cole. *Israel and the Drone Wars: Examining Israel's Production, Use and Proliferation of UAVs*. Rep. Oxford: Drone Wars UK, 2014. Print. Pg. 08

¹⁴ *Ibid*

¹⁵ *Ibid*

¹⁶ "The Dronefather." *The Economist Newspaper*. The Economist, 1 Dec. 2012. Web. 1 June 2014. Pg. 01

¹⁷ *Ibid*

¹⁸ *Ibid*

Following the September 11th, 2001 terrorist attacks, the US-led wars in Iraq and Afghanistan led to the unprecedented expansion of unmanned aerial vehicle (UAV) use for military purposes and now the market for them is a serious business around the world. The Teal Group, an aerospace and defense-industry market analyst, estimates that worldwide spending on military UAVs will grow considerably from 5.24 billion this year to almost 11.2 billion by 2020.¹⁹ In May 2014, Forecast International, a private market researcher, published a forecast of the global UAV market over the next decade. The report predicts that the value of UAV production will more than double in the next ten years, rising from \$942 million in 2014 to an annual \$2.3 billion in 2023 with both China and the US accounting for the lion's share of the overall market value.²⁰ Both analyses point to the fact that UAS development, production and use is expanding with no end in sight.

The driving force behind UAS development by Western militaries has been to minimize the number of human lives placed at risk in order to collect real-time intelligence as well as to deliver small amounts of ordinance with a degree of precision. UAS are also relatively less-expensive than their manned counterparts, with more basic UAS costing "less than 1/20th" as much as the latest combat aircraft and even more advanced UAS that feature jet propulsion and employ stealth technology are less than 1/10th the cost.²¹ UAS also possess unique capabilities that give them certain advantages and make them invaluable in certain types of modern armed conflicts. These capabilities include a high airborne endurance for surveillance purposes as well as their imaging payloads which allow their combat use to be discriminate and proportional. This combination of desirable capabilities, force protection and low cost has made UAS attractive to democratic militaries, including Canada. Conversely, for these same reasons, non-democratic militaries have also taken notice and are investing in their own national UAS industries.

Whatever the reason for their need, it is near certain that military UAS use will expand globally over the next decade by democratic and non-democratic militaries alike. As worldwide production and use increases, Canada, a Group of Seven (G7) and North Atlantic Treaty Organization (NATO) country, must follow suit or risk lagging behind. In this section, the author

¹⁹ Mackin, Rob. "Drones Poised to Fill Canadian Skies." *News Features*. Straight.com, 4 June 2014. Web. 5 June 2014

²⁰ Keck, Zachary. "China to Lead World in Drone Production." *The Diplomat*. The Diplomat, 2 Mar. 2014. Web. 10 June 2014.

²¹ Lewis, Michael W. "Drones and the Boundaries of the Battlefield." *Texas International Law Journal* 293rd ser. 47.2 (2011): 293-314. Print. P. 296

will begin by illustrating what exactly military UAS are as well as their past use and current status as defined by the Canadian Department of National Defense (DND). Continuing forward, the author will demonstrate how UAS are well-suited to democratic militaries such as Canada's.

Based on Canada's current and declared future use of UAS, and how well suited it is for asymmetric conflicts fought by its democratic military as well the present trend of worldwide proliferation by nation states and non-state actors alike, this author predicts that the use of UAS by the Canadian military will expand in line with its defense policy commitments.

What are Military UAS?

The 'vehicle' in unmanned aerial vehicle (UAV) is only one element of a complex system known as an Unmanned Aircraft System (UAS). The vehicles themselves are useless "without communications and a control station with human controllers, without properly configured payload elements and without systems to launch and recover the vehicle."²² While there may not be a human inside the cockpit of a UAV, a pilot (or a team of pilots) is always at the controls and sometimes at a distance of up to twelve thousand kilometers away.²³ Military UAVs have had an interesting evolution since their genesis. A majority of the earliest designs are based off the 'Predator' RQ-1 design (R for reconnaissance) manufactured by General Atomics, a defense contractor headquartered in San Diego, California. When these systems first emerged, it was accepted that they would be useful for performing "difficult, dangerous and different" tasks such as surveillance missions that required a longer period of time and a greater degree of persistence. Further, without the need for a pilot inside, UAV's could be given 'radar-cheating' stealthy shapes to aid in their surveillance duties.²⁴

As military unmanned systems use became more widespread, demands in regards to their capabilities evolved as well. In 2002, the Predator RQ-1 became the MQ-1 (M for multipurpose) a 'hunter-killer' design equipped with two AGM-114 Hellfire tactical air-to-surface missiles able to hit targets from a range of eight kilometers.²⁵ A seamless system of surveillance and strike capability was introduced by General Atomics in 2007 with the newer, faster 'Reaper' MQ-9 design. This 'hunter-killer' system is laden with a series of sophisticated sensors as well as a

²² Holman, Fraser. Pg. 04

²³ "Flight of the Drones; Unmanned Aerial Warfare." *Economist (US)* 8 Oct. 2011: n. pag. Web. 5 June 2014. Pg. 02

²⁴ *Ibid*

²⁵ "Drones: What Are They and How Do They Work?" *News South Asia*. BBC News, 31 Jan. 2013. Web. 4 June 2014.

greater number of Hellfire missiles and can even carry up to two, five-hundred pound JDAM laser-guided munitions.²⁶ This system requires an even larger human contingent for its operation as more than a hundred and eighty people are required to keep it airborne.²⁷ Although Predators and Reapers receive the most scrutiny, they are only a part of a large, diverse fleet of worldwide UAS. UAV's can include model airplane-style hand-launched aircraft like the Shadow RQ-7B which has surveyed more territory and spotted more combat targets for the United States military than any other drone type.²⁸ Other systems can also include massive aircraft like the Global Hawk RQ-4A, an all-weather spy-plane propelled by jet engines which can survey daily an area of a hundred and thirty-seven square kilometers and fly from the United States to Australia without refueling.²⁹ Some systems are even based on micro designs which can be as small as a bird or even an insect.

What these systems have in common is they offer a new dimension in intelligence, reconnaissance and surveillance (ISR) and in an uncontested airspace like Afghanistan they can provide an eye in the sky around the clock providing the enemy's location as well as his activities.³⁰ Since 2005, there has been a 1,200% increase in combat air patrols by UAV's indicating they have become the counter-terrorism weapon of choice.³¹ Today, the United States Department of Defense has over 10 thousand UAV systems including hundreds based on the Predator design.³² They have been used in every United States conflict since the Balkans, including Somalia, Iraq, Yemen, and Afghanistan and have even been used by NATO forces against Qaddafi in Libya. According to The Economist magazine, America's armed forces plan to spend \$37 billion on UAV's in the next decade.³³ As it stand now, UAV's have collectively logged millions of flight hours and currently more hours are flown by UAS than by manned strike aircraft as well as more pilots are being trained to fly them.³⁴

²⁶ *Ibid*

²⁷ *Ibid*

²⁸ "Flight of the Drones; Unmanned Aerial Warfare." Pg. 03

²⁹ *Ibid*

³⁰ Gregory, Derek. "From a View to a Kill: Drones and Late Modern War." *Theory, Culture & Society* 28.7-8 (2012): 188-215. Web. P. 190

³¹ "Flight of the Drones; Unmanned Aerial Warfare." Pg. 03

³² Whitlock, Craig. "When Drones Fall from the Sky." *Part One: War Zones*. The Washington Post, 20 June 2014. Web. 21 June 2014.

³³ "The Dronefather." Pg. 02

³⁴ "Drones and the Man." *The Economist*. The Economist Newspaper, 30 July 2011. Web. 10 July 2014.

UAS and Canada's Military

The Canadian military has so far only used unmanned aerial systems in a limited capacity. In 2008, the Canadian Department of National Defense (DND) let \$109 million worth of contracts to lease ScanEagle drones from Insitu, a subsidiary of Boeing as well as Israel Aerospace Industries- built Heron UAS from Richmond, British Columbia-based military contractor MacDonald Dettwiler and Associates. (MDA)³⁵ In October 2013, the Department of National Defense announced an \$11.3 million contract for MDA to deliver hand-launched AeroVironment Raven B drones.³⁶ In April 2014, a further 5 million dollar contract was awarded to MDA by DND to “support (the) UAV solution it agreed to supply in 2013.”³⁷

The use of the ScanEagle with the Canadian Navy represented the first step towards their introduction into the national military. The ScanEagle, a surveillance-only aircraft with a three-meter wing-span, is capable of staying airborne for more than 24 hours and can carry a variety of sensors.³⁸ There were used extensively in Mediterranean missions as well as the Arabian Sea.

Alternatively the Israeli-built Heron UAS were used for surveillance and force protection during Canada's ongoing operations in Afghanistan. According to General Tom Lawson the Canadian chief of defense staff, the UAS were used ‘to great effect’ and that Canada was “in the game along with many NATO allies and delighted by the capabilities it gives us to use the high ground in recognizance and surveillance.”³⁹ At the time of this writing, the Raven B UAS to be delivered by MDA has not yet been introduced into service. All of Canada's UAS are not weaponized and are not able to be converted for such use.

During his 2006 election campaign, Prime Minister Stephen Harper promised that under his leadership “Goose Bay in Newfoundland and Labrador would become home to a new 650-member military rapid reaction unit, as well as a new squadron operating long-range UAVs.”⁴⁰ However, this promise has yet to be fulfilled. According to the Ottawa Citizen, Canada's military hopes to have a fleet of UAS fully operational by 2023, but this date is tentative as the federal

³⁵ Mackin, Rob. "Drones Poised to Fill Canadian Skies."

³⁶ *Ibid*

³⁷ "MDA to Support Canadian DND UAV Solution." *UV Online*. Shephard Media, 22 Apr. 2014. Web. 5 June 2014.

³⁸ "ScanEagle System." *ScanEagle System*. Insitu, 2013. Web. 10 July 2014.

³⁹ Marsden, William. "Canada Contemplating Buying Fleet of Armed Drones, Top General says." *News. Canada.com*, 26 Nov. 2013. Web. 10 July 2014.

⁴⁰ Pugliese, David. "RCAF Hopes to Have Drones Flying by 2023." *RCAF Drone Program Might Get Airborne in 2023*. Ottawa Citizen, 23 May 2014. Web. 5 June 2014.

government has yet to approve the purchase.⁴¹ The project, known as the Joint Unmanned Surveillance Targeting and Acquisition System (JUSTAS), “is the Department of National Defense’s long term solution for Medium Altitude Long Endurance (MALE) UAVs” and is an integral part of meeting the priorities of the Canada First Defense Strategy.⁴² The delay has so far been attributed to a lack of money as well as personnel to staff the new UAV squadron.

UAS and Democratic Militaries

The use of unmanned aerial systems by democratic military's has been expanding quickly. They represent the most contemporary development in conventional armaments and have become the tool of choice for democracies in their latest counter-terrorism efforts. In current counter-insurgencies where the local population is at the center of military operations being conducted, the continued outgrowth of UAS represents a shift towards the importance of data-collecting surveillance and precision-strike capabilities.

The recent expansion of unmanned military systems is the result of democracies spearheading the charge of their development. According to a recent edition of *Military Balance*, published annually by the International Institute for Strategic Studies, "thirty-four countries, with two-thirds of them being democratic states, are listed as possessing either medium or heavy-sized UAV's."⁴³ Democratic militaries are developing unmanned systems for a myriad of purposes, but the underlying reason is that the types of wars fought by democracies have changed over the past few decades and as a result they have become largely asymmetrical and more adherent to the tenets of the laws of armed conflict.

According to the democratic peace theory, democracies tend to keep the peace among themselves but towards non-democracies, very different behavior can often be expressed. This behavior can be described as 'democratic aggressiveness' and focusing on this phenomenon, scholars have coined the term of "democratic wars" which are wars that are "typical for democracies and consistent with specific norms such as humanitarian intervention in a non-democracy to prevent abuses."⁴⁴ Democracies engaging in 'democratic wars' of aggression are

⁴¹ *Ibid*

⁴² "JUSTAS (Joint Uninhabited Surveillance and Target Acquisition System)." *Industrial and Regional Benefits*. Industry Canada, 09 Dec. 2013. Web. 5 June 2014

⁴³ Sauer, Frank and Niklas Schornig. "Killer Drones: The 'silver Bullet' of Democratic Warfare?" *Security Dialogue* 43.4 (2012): 363-80. Web. 5 June 2014. Pg. 364

⁴⁴ Geijs, A., and W. Wagner. "How Far Is It from Konigsberg to Kandahar?" *Review of International Studies* 37.4

possible as long as the costs are considered acceptable by the domestic population. The concept of "acceptable costs" differs according to the type of conflict and "is inversely related to the national interest understood to be at stake."⁴⁵ For example, in "wars of necessity" defined as waged in self-defense and national survival, any democratic population is willing to accept high casualties among its own armed forces.⁴⁶ However in contemporary asymmetric 'democratic wars' which have been dubbed "wars of choice," tolerances for casualties are considerably lower.⁴⁷ Compounding this fact is that in 'wars of choice' clear criteria for progress or 'victory' are harder to establish and mission objectives may change suddenly and significantly.⁴⁸ Decision makers face the real possibility of a shift in the public's mood when different costs dramatically rise without tangible progress. The subsequent diminished approval for the conflict in terms of human, monetary and political costs will lead it to being regarded as unnecessary. Unmanned systems provide a broad solution to mitigating the costs of these three criteria which are often brought to the forefront whenever a democracy engages in a democratic war of choice.

According to the Geneva Conventions, democracies must subscribe to three crucial tenets regarding the laws of armed conflict. These laws state "that before any attack, any weapon's system must be able to verify that targets are legitimate ones, all reasonable precautions to minimize civilian harm have to be taken and disproportionate collateral damage must be taken into consideration."

Before UAS, operational missions with these same boundaries were carried out by manned strike aircraft or cruise missiles fired from hundreds of kilometers away. While advanced cruise missiles with conventional warheads can accomplish the same task as an unmanned aerial system, its disproportionate use contrasts with the laws of armed conflict. In democratic wars of choice that are often fought among the local population, this excessive firepower is a disservice where in order minimize civilian casualties, less and more precise

(2011): 1555-577. Web. 20 Apr. 2014.

⁴⁵ Sauer, Frank and Niklas Schornig. p.366

⁴⁶ *Ibid*

⁴⁷ *Ibid*

⁴⁸ Freedman, Lawrence. "Iraq, Liberal Wars and Illiberal Containment." *Survival* 48.4 (2006): 51-66. Web.

firepower must be deployed.⁴⁹ Also, a 1.4 million dollar airframe is wasted every time a cruise missile reaches its target, implying an even greater monetary loss.⁵⁰

Manned aircraft have their drawbacks as well. For example in the United States led bombing campaign over Serbia, pilots "had to fly above 15,000 feet to avoid anti-aircraft fire" which led to a significant reduction in their accuracy.⁵¹ Targets had to be spotted and approved before the manned flight mission took place. By the time the strike aircraft reached its target, due to the fluid nature of counter-insurgency warfare, the target could have moved, changed or the area was occupied by the local population. UAS can take bigger risks through their freedom of movement thereby improving accuracy. By replacing overwhelming firepower with a precision UAS and its ability to wait hours for the best moment to engage, this allows for the use of the "least force necessary in accordance with the law of armed conflict regarding discrimination and proportionality."⁵² In regards to discrimination, a UAV's ability to relay real time intelligence, surveillance and reconnaissance (ISR) allows for striking targets with an even greater degree of "precision to minimize or even avoid civilian casualties and unnecessary damage."⁵³

UAS allow decision makers more time to assess the situation more effectively. The manned pilot observing the situation from a cockpit will be exhausted by the physical toll of flying a jet, or affected by the adrenalin rush of combat.⁵⁴ The UAV pilots removal of tangible risk as well as emotions like anger and frustration, allows for decisions to be made in a more deliberate manner. For example, a Predator series UAS has the ability to hover over a target for up to eighteen hours and can be easily relieved by another when it runs low on fuel.⁵⁵ The UAV operators are able to loiter over targets and monitor patterns of activity on the ground for longer periods of time allowing them to choose the best moment to release their ordinance. This further allows unmanned systems a greater degree of discrimination than manned fast-jets or helicopter-borne special forces.

Counter-insurgency and counter-terrorism efforts are often the type of operations that democratic countries wage in their asymmetrical democratic wars of choice. According to the

⁴⁹ Sauer, Frank, and Niklas Schornig. Pg. 369

⁵⁰ Enemark, Christian. "Drones over Pakistan: Secrecy, Ethics, and Counterinsurgency." *Asian Security* 7.3 (2011): 218-37. Web. Pg. 220

⁵¹ "Flight of the Drones." Pg. 02

⁵² Gregory, Derek. Pg. 139

⁵³ *Ibid*

⁵⁴ Enemark, Christian. Pg. 228

⁵⁵ Gregory, Derek. Pg. 206

United States Air Force, "counter-insurgency requires three to four times as much ISR as major combat operations."⁵⁶ This is due to the fact that counter-insurgency operations involve a fluid set of targets which require longer periods of airborne surveillance that only UAV's can provide. Gathering intelligence on fast, hidden and unpredictable adversaries requires knowledge of what is happening everywhere, all the time. Individuals and their movements can also be tracked through a series of networks to establish a 'pattern of life' consistent with an emerging counter-insurgency paradigm named "activity-based intelligence which is indispensable to counter-insurgency operations."⁵⁷

The legality of killing with unmanned aerial systems must be integral to a democracy's concern towards the political costs of democratic wars of choice. The use of unmanned systems enables the existence of judicial oversight throughout the entire mission of any UAV. All conduct by military UAS are governed by the Laws of Armed Conflict, the Uniform Code of Military Justice and the Rules of Engagement. As mentioned earlier, there are currently 185 personnel required for supporting a US Reaper combat system. 83 of those personnel in the operation are charged with processing and disseminating the imagery while 34 are analyzing the video and 18 are monitoring signals intelligence.⁵⁸ About 25 personnel are involved in the complex task of takeoff and landing, while the rest are actively flying the aircraft.⁵⁹ The longer consideration times and enhanced video streams from UAS have also considerably enlarged the role of judge advocates who since the late 1980s have provided expert counsel to commanders about the prosecution of targets.⁶⁰ As it stands now, legal advisers are stationed at the combat operations floor to scrutinize image streams, live communications and collateral damage estimates and inform the commander of the legal parameters of any attack.

As any military engagement progresses over an extended period of time where soldiers are placed in harm's way, human costs have to be taken into account. Democracies exhibit a particularly low tolerance for casualties in democratic 'wars of choice' for utilitarian and normative reasons. On the utilitarian side, "decision makers in democracies fear losses among their own more than authoritarian leaders because rising numbers of casualties will have adverse

⁵⁶ Gregory, Derek. Pg. 193

⁵⁷ Gregory, Derek. Pg. 199

⁵⁸ Gregory, Derek. p. 194

⁵⁹ *Ibid*

⁶⁰ Gregory, Derek. p. 199

effects on public support for the military mission."⁶¹ Domestic democratic populations are "casualty phobic" insofar as they express disapproval if the conflict is perceived as unnecessary or in of losses have been in vain. On the normative side, democracies are adverse to human casualties because they are in direct conflict with the liberal ideal that "every life is valued and that every individual human being is the bearer of innate indefensible rights."⁶² In most modern western democracies, "the concept of casualty avoidance has become a mission goal in itself."⁶³ In order to counter this, unmanned systems allow for the successful application of 'risk transfer' and represent the ideal 'risk transfer path' for avoiding casualties. UAS thus adhere to the democratic tenet of casualty and risk-aversion through the minimization of casualties "by the replacement of labor (soldiers) by capital (technology)."⁶⁴ Unmanned systems allow for friendly forces to be safely hundreds if not thousands of kilometers away, removing themselves from the hostile environment of the battlefield.

In terms of monetary costs, unmanned systems are relatively less expensive than their inhabited counterparts. This concept caters to the democratic interest of limiting military expenditures during peacetime as well as mitigating the overall monetary costs of a 'democratic war.'⁶⁵ To begin, UAV pilots salaries are lower and their training costs less than a tenth as much as a fast-jet pilot.⁶⁶ No complex life-support system is required to fly a UAV, as well as UAS are less expensive to maintain and do not have to be rotated in and out of a combat theater like their manned counterparts.⁶⁷ This translates into future cost savings over the continued lifespan of the UAV.⁶⁸ For the systems themselves, a technologically advanced Reaper-class drone purchased from the US firm General Atomics costs over 10 million dollars per UAS when purchased in a group of ten.⁶⁹ According to *The Economist*, cheaper observer drones can be bought commercially for as low as fifty thousand US dollars.⁷⁰ These costs are in stark contrast to Canadian government reports that the F-35 Lightning II will cost seventy-five million US dollars

⁶¹ Sauer, Frank, and Niklas Schornig. Pg. 368

⁶² *Ibid*

⁶³ Strawser, Bradley J. "Moral Predators: The Duty to Employ Uninhabited Aerial Vehicles." *Journal of Military Ethics* 9.4 (2010): 342-68. Web. Pg. 343

⁶⁴ Sauer, Frank, and Niklas Schornig. Pg. 370

⁶⁵ *Ibid*

⁶⁶ "Flight of the Drones." Pg. 02

⁶⁷ "Flight of the Drones." Pg. 03

⁶⁸ "Flight of the Drones." Pg. 02

⁶⁹ "How Much Does the MQ-9 Reaper Drone Cost?" *Drones*. Time Magazine, 6 Nov. 2012. Web. 09 Apr. 2014.

⁷⁰ "Watching from above." *The Economist*. The Economist Newspaper, 15 Jan. 2013. Web. 10 July 2014.

for each combat aircraft while the Canadian Auditor General believes that the final price for each aircraft purchased is closer to ninety-million US dollars due to maintenance expenses and other costly variables over its operational period.⁷¹ The lowered costs of unmanned systems allow a conflict with a more complex and therefore slower progression to be extended until 'victory' is achieved. Further, this is conducive to the concept that military spending in peacetime is politically 'less useful' when those domestic resources could be spent helping the domestic population through the growth of public goods and services.

Military UAS also have other advantages regarding their unique capabilities, which have encouraged even more innovative development. Originally designed for "dull, dirty and dangerous" tasks, UAV's now fulfill these roles spectacularly. Task included in the "dull" category are surveillance missions requiring extended time periods and a high degree of persistence. According to the General Atomics website, a Reaper-class drone can stay airborne for up to twenty-seven hours; something their manned equivalents cannot provide.⁷² Missions designated as "too dangerous" such as where a captured pilot could be exploited are better accomplished with a UAS due to the UAV's capability of maximum force protection for its human operator. "Dirty" tasks are those that require surveillance of areas that are not conducive to human observation such as areas contaminated with chemical, biological or nuclear materials.

The development of different types of military UAS with various capabilities has accelerated considerably in little more than a decade of their use. For example, five-pound backpack UAS are now used by infantry soldiers for tactical reconnaissance while special operations forces have developed a warhead fired from a Predator UAS that can knock down doors.⁷³ Inexpensive balloons have become platforms which unleash Tempest drones, which then send out smaller surveillance drones – called Cicadas – that glide to the ground to collect data.⁷⁴ K-Max unmanned helicopter drones have even transported supplies to troops at forward operating bases in Afghanistan.

The continued development of UAS capabilities allow for the laws of armed conflict to be realized like never before. The staff judge advocate in the Combat Air Operations Center at

⁷¹ Byers, Michael, and Stewart Webb. "Canada's F-35 Purchase Is a Costly Mistake." *Canadian Foreign Policy Journal* 17.3 (2011): 217-27. Web. P. 220

⁷² "Predator B UAS." *Aircraft Platforms*. General Atomics Aeronautical, 2014. Web.

⁷³ Zenko, Micah. "10 Things You Didn't Know about Drones." *Obama's Secret Wars*. Foreign Policy, Mar. 2012. Web. Pg. 03

⁷⁴ *Ibid*

the United States Department of Defense claims that it is airborne ISR that gives them the ability to apply the laws of armed conflict principles with amazing precision.⁷⁵ UAS possess qualities which enable this: Its full-motion video camera feeds, its ability to remain airborne for long periods of time as well as allowing for even greater judicial oversight and its specialized characteristics that allow it to wage counter-insurgency against a determined enemy who is difficult to positively identify.

The multi-spectral targeting system capabilities in military UAS provide for real-time full-motion video. This basic platform has been further developed into a completely unique system known as the "Gorgon Stare."⁷⁶ This is a system that "streams sixty-five full-motion video (FMV) feeds, quilting the images inflight into a tiled mosaic sending them to networked users through a dedicated ground station in theater that will control the sensors and coordination operations with the flight crew in North America."⁷⁷ This system provides detailed information about targets being surveyed allowing for strikes to be considerably more accurate and discriminate. Discrimination is crucial in a contemporary counter-insurgency which is described as a "war amongst the people where the distinction between combatants and civilians is very unclear."⁷⁸ If this technologically advanced imagery enables a more discriminate use of force, the use of armed UAS technology is therefore a superior mode of warfare for democracies waging democratic wars of choice.

Due to the continually shifting nature of modern warfare, UAS are essential for democratic nations to maintain discrimination among civilians while at the same time completing mission-specific objectives in the future generation of asymmetrical democratic wars of choice. The use of UAS is significantly more proportional and discriminate method for exercising the use of force due to their superior imaging and 'loitering' capabilities. These same abilities allow UAS to be more conducive to greater judicial oversight providing the democratic nation the proof it needs to declare it is operating within the boundaries of domestic and international law, including the laws of armed conflict. Further, UAS allow for the maximum force protection by keeping their human operators away from the theatre of combat as well as providing a low-cost alternative to their manned equivalents. Based on these facts, UAS and their myriad of

⁷⁵ *Strawser, Bradley. p. 349*

⁷⁶ *Gregory, Derek. p. 205*

⁷⁷ *Gregory, Derek. p. 205*

⁷⁸ *Gregory, Derek. p. 200*

capabilities seem certain to remain the centerpiece of a democratic military's counter-insurgency and counter-terrorism efforts in the new generation of asymmetric democratic wars of choice.

3. Global Usage of UAS

In this section, the author will highlight the current trend of development production and use of UAS by Canada's closest military allies: The US, Israel, Britain and France. Further, the recent use of UAS by United Nations peacekeeping missions will also be outlined. The author will then outline the development, production and use of UAS by non-democratic nations as well as non-state actors in order to demonstrate that the trend of global growth in this field is not restricted to friendly powers, but could be used by possible future adversaries. By illustrating the rapid pace by which democracies and non-democracies alike are developing, producing and using UAS, this author will argue that the military expansion of UAS in the Canadian context is practically inevitable.

United States

The Canadian military's present utilization of UAS completely pales in comparison to our strongest ally; The United States. As mentioned previously, the United States Department of Defense has over ten thousand UAS based on the Predator design combined with hundreds of Reaper-class UAS boasting specific capabilities designed for a myriad of different tasks.⁷⁹ UAS have been used in every United States conflict since the Balkans, including Somalia, Iraq, Yemen, Afghanistan and Libya. At the time of this writing, America's armed forces plan to spend \$37 billion on UAV's in the next decade.⁸⁰ American UAS have collectively logged millions of flight hours and currently more hours are flown by UAS than by manned strike aircraft. U.S defense giants like General Atomics, Raytheon, Boeing, and Northrop Grumman all work in UAS development. The United States, Canada's strongest ally, is without a doubt a global power in the development, production and use of UAS.

Israel

⁷⁹ Whitlock, Craig. "When Drones Fall from the Sky." *Washington Post*. The Washington Post, 20 June 2014. Web. 21 June 2014.

⁸⁰ "Flight of the Drones." Pg. 03

Israel, a pioneer of unmanned technology, spends more across the board on UAS than almost any other country and has become the largest exporter of unmanned aircraft in the world. Israel competes with the U.S as a top global supplier of UAS which are manufactured by Elbit Systems, Israel Aerospace Industries, and Aeronautics Defense Systems Ltd.⁸¹ Frost & Sullivan, a U.S consultancy firm, “estimates that Israel sold more than \$4.6 billion worth of drones and support systems to foreign governments between 2005 and 2012 nearly double the amount exported by the United States.”⁸² Israeli defense officials say drones account for roughly half of the military’s total flight time and have proved essential in Israel’s last two wars fought in the Gaza Strip, providing real-time ISR over congested urban areas in the Palestinian territory.⁸³ An Israeli infantry officer was quoted as saying that troops fighting Palestinian guerrillas in Gaza now routinely call in drones, rather than helicopters, for support.⁸⁴ Israel is also phasing out its US-supplied Cobra attack helicopters in favor of using more UAS. According to Reuters, UAS are a lighter and less expensive air power when countering sneak attacks by guerrilla rocket crews or riflemen on its borders.⁸⁵ Israeli companies which benefit from close ties with the military are in a position to develop more specialized UAS technology that function in a tactical environment.

United Kingdom

The United Kingdom’s UAS capabilities have also been established and are growing. Several systems, including the armed U.S-made Reaper, have been used by UK forces during their operations in Afghanistan.⁸⁶ The Royal Air Force (RAF) possesses ten Reapers and all are based in Afghanistan to support UK as well coalition forces stationed in that country. Previously flown from U.S Creech Air Force Base in Nevada, the Reapers are now flown from UK soil at

⁸¹ Goldberg, Tia. "Israel Becomes World's Largest Exporter of Drones." *Canadian Manufacturing*. Company Wire, 6 June 2014. Web. 10 June 2014.

⁸² Kreps, Sarah, and Micah Zenko. "Preparing for Proliferation." *The Next Drone Wars*. Foreign Affairs, Mar.-Apr. 2014. Web. Pg. 06

⁸³ "Drones Gain Ground in Israel after Cobra Helicopters Cut." *Reuters*. Thomson Reuters, 28 May 2014. Web. 10 June 2014.

⁸⁴ *Ibid*

⁸⁵ *Ibid*

⁸⁶ "UK Use of Armed Drones Increases." *News UK*. BBC News, 6 Sept. 2013. Web. 10 July 2014.

RAF Waddington and are mainly used for surveillance purposes. However, UK UAS have also been weaponized and have the ability to carry offensive systems.⁸⁷

The UK is one of three countries, alongside the U.S and Israel that is known to have carried out bombings with unmanned aircraft. Since 2007, British-piloted Reaper UAS have carried out over three hundred strikes in Afghanistan, where they have been used alongside more conventional aerial and ground-based weapons.⁸⁸ While the UK's UAS fleet is a fraction the size of the U.S's armed UAS fleet, it was discovered that British-piloted drones have carried out a significant proportion of all strikes.⁸⁹ According to the BBC, during 2012, 10% of drone missions released weapons, compared to 5% in 2008.⁹⁰ According to a UK Ministry of Defense spokesperson, the British Reapers have flown more than 50,000 hours in the Afghan theater.⁹¹

The British Firm BAE Systems is one of Europe's biggest defense companies based in the UK. As well as working on a range of technology aimed at enabling drones to fly, BAE Systems has been working over the past few years on two specific unmanned aircraft; the 'Mantis' and the more advanced unmanned combat UAS 'Taranis.'⁹² An experimental concept, Taranis is not flown by pilots on the ground but operates completely autonomously when taking off, flying a mission and returning to land. The UK Ministry of Defense (MoD) signed a 127 million pound contract to design and build Taranis, which is being regarded as another expansion in the use of armed unmanned systems.⁹³

BAE Systems is hoping to persuade the MoD to buy its UAS to fulfill 'Scavenger'; a program which the MoD's policy document on unmanned aerial vehicles states is aimed at providing UK forces with "a theatre-wide, persistent intelligence, surveillance and reconnaissance capability and able to attack land and maritime time-sensitive targets."⁹⁴ Another UK-built UAS known as 'The Watchkeeper' is also in the process of being developed under a

⁸⁷ "Armed Drones Operated from RAF Base in UK, Says MoD." *News Lincolnshire*. BBC N, 27 Apr. 2013. Web.

⁸⁸ Ross, Alice K. "UK's New Reaper Drones Remain Grounded, Months before Afghan Withdrawal." *Drone Warfare*. The Bureau of Investigative Journalism, 22 May 2014. Web. 14 June 2014.

⁸⁹ *Ibid*

⁹⁰ "UK Use of Armed Drones Increases in Afghanistan." *News UK*. BBC News, 6 Sept. 2013. Web. 14 June 2014.

⁹¹ "Remotely Piloted Air Systems." *www.parliament.uk*. Parliamentary Business - Publications and Records, 25 Mar. 2014. Web.

⁹² Cole, Chris. "BAE Systems Joins the Drones PR Push with Media Briefing on Taranis." *Drone Wars UK*. Dronewars.net, 5 Feb. 2014. Web.

⁹³ *Ibid*

⁹⁴ *Ibid*

900 million pound MoD contract by UAV Tactical Systems Ltd; a joint venture company owned by Thales UK and Elbit Systems, an Israeli company.⁹⁵

At the start of 2014, both the British and French governments signed an agreement to cooperate on developing and building UAS similar to that of the Reaper design with the objective of reducing their dependence on purchasing foreign-manufactured UAS.⁹⁶ This comes after a December 2013 European Union announcement that all twenty-eight member countries would cooperate on developing and building surveillance drones for service after 2020.⁹⁷ BAE Systems is already working with France's Dassault Aviation, the maker of French Rafale fighter jets, on UAS development. With Britain and France leading the development of combat-ready UAS and the EU spearheading investment into their surveillance roles, development, production and use of the unmanned systems can only expand across the European continent.

France

France's January 2013 military intervention in Mali highlighted the importance of surveillance UAS suitable for modern conflicts. At the start of their deployment, the French military was forced to rely on the U.S to provide their commanders with key ISR intelligence from UAS which were based in neighboring Niger.⁹⁸ To remedy this, the French government stated in June 2013 it would buy twelve MQ-9 Reaper reconnaissance drones from General Atomics to replace its four aging Harfang-class IAI-built surveillance drones it has used since 1995.⁹⁹

Since the start of 2014, two French MQ-9 Reaper-class UAS have been deployed in the Sahel Region for operations over Mali.¹⁰⁰ Both UAS being operated are currently for surveillance purposes only and have not carried out lethal strikes. As of March 31st, 2014 the French Reaper detachment has passed the 500 hour flight milestone.¹⁰¹ The French are also still

⁹⁵ Cole, Chris. "Watch Out! Watchkeepers over Wiltshire." *Drone Wars UK*. Dronewars.net, 22 Feb. 2014. Web. 14 May 2014.

⁹⁶ Viscusi, Gregory, and Thomas Penny. "U.K., France up Armed Cooperation With Drones, Missiles." *Bloomberg News*. Bloomberg.com, 31 Jan. 2014. Web.

⁹⁷ *Ibid*

⁹⁸ "France to Use Unarmed U.S.-made Drones to Hunt Al Qaeda in Mali." *Reuters*. Thomson Reuters, 19 Dec. 2013. Web.

⁹⁹ *Ibid*

¹⁰⁰ "Après Harfang: France's Next High-End UAVs." *France's Next MALE UAV: Contenders*. Defense Industry Daily, 22 May 2014. Web.

¹⁰¹ "French Reaper Reaches 500 Mali Flight Hours." *UV Online*. Shephard Media, 24 Apr. 2014. Web.

using their Harfang UAS in Mali and have recently reported that the aging UAS have reached 2000 flight hours since their January 2013 deployment which had underscored the importance of utilizing UAS capabilities in that country.¹⁰²

France has an established national industry when it comes to developing new UAS technologies. Dassault Aviation is France's foremost military aircraft manufacturer and is currently the program lead on the 'nEUROn,' a next generation experimental stealth UCAV, similar to BAE System's Taranis project. A pan-European collaborative effort, bringing in expertise from France, Italy, Sweden, Spain, Greece and Switzerland, the nEUROn was part of the world's first operation in which a combat UAV flew in formation with other aircraft.¹⁰³

As mentioned previously, British firm BAE Systems is working with France's Dassault Aviation on the next generation of medium altitude, long endurance UAS systems under the 'Future Air Combat System' program. During a summit in January 2014, both countries have agreed to launch a two year, one-hundred and twenty million pound 'feasibility phase' which will "develop the concepts and technologies to provide an Unmanned Combat Air Vehicle for (our) Armed Forces."¹⁰⁴ As a result of this phase, both countries will be ideally placed to decide by 2016 whether to collaborate on the demonstration and manufacturing phases.

United Nations

While the United Nations (UN) does not produce UAS it has recently been acquiring and deploying them in its African peacekeeping operations. UN forces in Democratic Republic of Congo (DRC) launched unmanned aircraft in December, 2013 to monitor the volatile border in the country's mineral rich east with Rwanda and Uganda, the first time U.N. peacekeepers have deployed surveillance drones.¹⁰⁵ Recently, this is the region in which Congolese and UN experts have accused neighboring Rwanda and Uganda of supplying arms and soldiers in order to back the recently defeated March 23rd (M23) rebel group.¹⁰⁶ In addition to monitoring the positions and movements of armed groups, export routes for illicit conflict materials and refugees, "these

¹⁰² *Ibid*

¹⁰³ Baker, Berenice. "Taranis vs. NEUROn - Europe's Combat Drone Revolution." *Taranis vs. NEUROn*. Airforce Technology, 6 May 2014. Web.

¹⁰⁴ Cole, Chris. "'Future Combat Air Systems': UK-France Military Declaration Reveals Development of 'Combat Drones'." *Global Research*. Centre for Research on Globalization, 6 Feb. 2014. Web.

¹⁰⁵ Katombe, Kenny. "U.N. Forces Use Drones for First Time, in Eastern Congo." *Reuters*. Thomson Reuters, 3 Dec. 2013. Web

¹⁰⁶ *Ibid*

new unmanned surveillance assets will operate as a situational awareness tool to inform and protect ground-based UN combat brigades operating in dangerous terrain.”¹⁰⁷

Herve Ladsous, UN under-secretary-general for peacekeeping operations, has stated publicly that UAS have “already helped in the Democratic Republic of Congo and could be vital for improving humanitarian access.”¹⁰⁸ He also declared that “UN peacekeeping missions should deploy more surveillance drones to become more effective and keep aid workers safer.”¹⁰⁹ Continuing this trend, Mr. Ladsous also said he was considering possible UAS use in order to monitor sectarian violence in the Central African Republic ahead of the September deployment of 12,000 peacekeepers to the nation.¹¹⁰ The Central African Republic, a country with few paved roads and large swathes of territory with limited government authority, is similar to that of the Democratic Republic of Congo where UAS have proved invaluable. This author sees the present deployment of UAS in the DRC as setting a precedent for other African theaters. Judging by their recent effectiveness, this author predicts the proliferation of UAS to other peacekeeping operations, including Mali, Darfur, South Sudan and even Côte d’Ivoire.¹¹¹

The People’s Republic of China

When it comes to UAS, The People’s Republic of China has at least twenty-five types of systems in development.¹¹² China joins an elite club of nations which include the US, France, UK and Israel that is pushing the bounds of unmanned aircraft and developing UAS that are matching the United States’ capabilities in every way. One of these systems in development is China’s first stealth UAS known as ‘Sharp Sword’ which was successfully tested in November 2013.¹¹³ Analysts say that although China is still trailing the industry leaders, like the U.S. and Israel, “its technology is maturing rapidly and is on the cusp of widespread use for surveillance and combat strikes.”¹¹⁴

¹⁰⁷ Calfas, Amy. "Unmanned Peacekeeping: Are Drones the New Blue Helmets?" *Publications*. Atlantic Council, 14 Jan. 2014. Web

¹⁰⁸ "UN Peacekeeping Chief Wants More Drones." *Africa*. Al Jazeera News, 30 May 2014. Web.

¹⁰⁹ *Ibid*

¹¹⁰ "UN Mulls Drone Use to Monitor C. Africa Conflict." *Agence France-Presse*. GlobalPost, 4 May 2014. Web.

¹¹¹ Calfas, Amy. "Unmanned Peacekeeping: Are Drones the New Blue Helmets?"

¹¹² Zenko, Micah. Pg. 04

¹¹³ "China 'Flies First Stealth Drone'" *News China*. BBC News, 22 Nov. 2013. Web. 14 June 2014.

¹¹⁴ "China Emerges as New Force in Drone Warfare." *CBS News*. CBS Interactive, 16 May 2013. Web. 14 June 2014.

Forecast International, a private market researcher, published a report which forecasts that over the next decade, the Aviation Industry Corporation of China (AVIC), a state-owned Chinese defense company, will lead the world in UAV production. According to the report, “AVIC will produce about \$5.76 billion worth of UAVs through 2023.”¹¹⁵ This is more than half of the UAVs by value that will be produced during this time period and nearly all these will be sold to Chinese consumers.¹¹⁶

China has been developing UAS since 1960 and is believed to have used them in their invasion of Vietnam in 1979. Chinese development was aided by the purchase of Harpy drones from Israel, but after US opposition to Israeli upgrades to the existing systems, China was forced to develop its own industry.¹¹⁷ Today, “AVIC manufactures a wide range of UAVs, including its electrically powered micro air vehicle (MAV), the jet-powered LIEOE, which appears almost identical to the Northrop Grumman RQ-4 Global Hawk, the AVIC Sky Eye, an electrically unmanned helicopter designed for reconnaissance and targeting, and the TL-8 Sky Dragon used for simulating cruise missiles for the Chinese military.”¹¹⁸ China has also developed and showcased the popular UAS ‘Wing Loong’ or ‘Pterodactyl,’ which is very similar to the US Reaper design. While believed to be less capable by military analysts, this Chinese UAS has a price tag of only a million dollars, versus the American-made Reaper, which is worth considerably more.¹¹⁹

According to a report released by the Pentagon, China’s investment in military spending “exceeded \$145 billion last year as it advanced a program modernizing an arsenal of drones, warships, jets, missiles and cyber weapons.”¹²⁰ In the same report, advances in Chinese drone technologies were specifically cited. It cautioned that Beijing's push into UAS “combines unlimited resources with technological awareness that might allow China to match or even outpace U.S. spending on unmanned systems in the future.”¹²¹ This spending will also inevitably have to see some sort of cost-recovery. As a global arms producer, China has fewer technology

¹¹⁵ Keck, Zachary. "China to Lead World in Drone Production." *Flashpoints*. The Diplomat, 2 May 2014. Web. 10 June 2014.

¹¹⁶ *Ibid*

¹¹⁷ "China Emerges as New Force in Drone Warfare"

¹¹⁸ Keck, Zachary. "China to Lead World in Drone Production."

¹¹⁹ "China Emerges as New Force in Drone Warfare."

¹²⁰ Stewart, Phil. "Chinese Military Spending Exceeds \$145 Billion, Drones Advanced: U.S." *Reuters*. Thomson Reuters, 06 June 2014. Web. 11 June 2014.

¹²¹ *Ibid*

export controls that allow it to freely export this technology around the world. The BBC reported that China has plans to sell UAS to the Asian and African markets and some could have already been exported to the United Arab Emirates.¹²² There are already some indications China may be exporting know-how to Pakistan, given design similarities between Chinese UAS and Pakistan's Shahpar UAV according to Jane's Defense Weekly.¹²³ There have also been further reports that Russia is looking to make use of Chinese military resources and acquire their UAS technology. While generally speaking Russia is ahead of China in terms of military development, China outshines Russia in its development of UAS.¹²⁴ "So far Russian UAS are intended for reconnaissance missions and Russia has to rely on imports. UAS may serve as a new bridge for Sino-Russia cooperation, especially with the Ukraine crisis greatly decreasing the chance of purchasing UAS from Western countries."¹²⁵ With the current geopolitical climate in the East today, coupled with the state's technological awareness and unprecedented military spending on unmanned systems over the last year, the proliferation of Chinese UAS cannot be in doubt.

North Korea

The reclusive hermit kingdom of North Korea is allegedly actively employing its own basic versions of UAS. In South Korea, there have been three separate reports of wreckage found in three separate areas each consisting of small UAVs of unknown origin on March 24th, March 31st and April 3rd of 2014.¹²⁶ Besides their sky-blue camouflage paintwork which is identical to that of larger drones paraded recently in the North's capital of Pyongyang, there are North Korean inscriptions on the plane's batteries and the sequence of 193 photographs "found stored in one of the plane's cameras suggest the drones were sent from North Korea."¹²⁷

However, North Korea's UAS are primitive at best. They are roughly one-meter-long and two-meters-wide, made of polycarbonate and appear to be something a radio-controlled airplane enthusiast might design in their basement. However, because of their small size, speed, altitude and weight, all three have entered South Korean airspace undetected and have been able to take

¹²² "China 'flies First Stealth Drone'"

¹²³ "China Emerges as New Force in Drone Warfare."

¹²⁴ "Russia May Look to China to Acquire Drone Technology." *Politics*. *Want China Times*, 6 Mar. 2014. Web. 4 June 2014.

¹²⁵ *Ibid*

¹²⁶ "Out of the Blue." *The Economist*. *The Economist Newspaper*, 10 Apr. 2014. Web.

¹²⁷ *Ibid*

pictures from a fitted camera of sensitive sites such as maritime facilities and even the presidential residence.¹²⁸ Other UAS reported to be in the possession of the pariah state includes one model based on the MQM-107 Streaker; a jet-powered aircraft used by the US to tow missile targets in the 1980s and is considered ‘antique’ when in comparison to today’s designs.¹²⁹

While North Korea’s outdated military has no hope of matching the technological prowess of its closest neighbors, the recent discoveries of UAS wreckage indicates that the North Korean regime is attempting to narrow their intelligence gap. The North does not possess satellite capabilities and these aerial systems, while minimal in value, signal the North’s need for more accurate information on the South’s activities. North Korea’s deployment of UAS, while basic, shows that they recognize their value in being able to breach their technologically superior neighbor’s airspace while bringing back minimal amounts of valuable intelligence.

Islamic Republic of Iran

The Iranians have had their UAS program operational since the 1980s. During the first years of the Iran-Iraq war, Iranians soldiers were being killed by the thousands. The government of Ayatollah Ruhollah Khomeini ordered his top military commanders to reduce those numbers and unmanned aircraft were the solution they came up with.¹³⁰ Iran's first drone, the ‘Mohajer,’ spied on Iraqi infantry positions yielding intelligence that helped Iranian units avoid walking into slaughters.¹³¹ An updated version of the Mohajer, called the ‘Mirsad’ was flown by Iran’s proxy in Lebanon, Hezbollah in 2004. While Hezbollah claims it was the sole manufacturer, U.S and Israeli intelligence sources reported that the UAS was obtained from Iran and flown with Iranian support and managed to penetrate Israeli airspace for around thirty minutes before returning to its owners safely.¹³² During the 2006 war, Hezbollah deployed three UAV’s bearing warheads of roughly sixty pounds each; all three were shot down by the Israeli F-16s and the media reported at the time that each of the aircraft were ‘Ababil’ models made by Iran.¹³³

¹²⁸ *Ibid*

¹²⁹ Smith, Alexander. "Suspected North Korea Drone Is 'Model Airplane' or 'Antique'" *World*. NBC News, 1 Apr. 2014. Web.

¹³⁰ Dreazen, Yochi. "The Next Arab-Israeli War Will Be Fought with Drones." *The New Republic* [Washington] 7 Apr. 2014: 28-33. Print. Pg. 02

¹³¹ *Ibid*

¹³² Meyers, Lisa. "Hezbollah Drone Threatens Israel." *NBC Nightly News with Brian Williams*. NBC News, 4 Dec. 2005. Web. 3 Mar. 2014.

¹³³ Dreazen, Yochi. Pg. 03

Much about Iran's current UAV fleet remains unknown; much of what the country has revealed about the program could be just be an exaggeration. However, evidence suggests that Iran spent the years after the 2006 Hezbollah-raid markedly increasing the damage its UAS can do. In the summer of 2010, then-Iranian President Mahmoud Ahmadinejad unveiled a gold-colored UAS that he dubbed the "ambassador of death" to Iran's enemies which could carry four cruise missiles or two large bombs.¹³⁴ Last November 2013, Iranian Defense Minister announced that engineers from the Iranian Aircraft Manufacturing Industries had produced a missile-bearing UAS called the 'Fotros,' which he said could fly more than 2,000 kilometers and could stay aloft for up to 30 hours.¹³⁵

As recently as last month, the Iranian military stated that it has fully reverse engineered a U.S RQ-170 sentinel drone built by Lockheed Martin which was downed on their territory back in 2011. In May 2014, Iran unveiled a copy of their version of the captured stealth drone with added bombing capabilities alongside the captured American surveillance aircraft.¹³⁶ However, it is not known if the Iranian stealth copy has yet taken a test flight, or even if it has been successfully reverse engineered. In the past Iran has been eager to showcase its defense capabilities for propaganda reasons but so far there has been no indication it has the sophisticated intelligence capabilities to direct UAV's to their targets.

The numerous Iranian aircraft unveiled in the past five years underscores the fact that Iran's UAS program is maturing and that UAS technology is proliferating rapidly in the region. At the end of 2013, Aljazeera reported that Jabhat Al-Nusra, an Al-Qaeda affiliate fighting against the Syrian regime of Bashar Al-Assad, had shot down a drone while it was flying over the embattled city of Aleppo.¹³⁷ The group claims that the government of Al-Assad is deploying drones in its war against the opposition. The type of UAS that was shot down was a 'Yasir' drone, which is believed to be an Iranian copy of a U.S ScanEagle, which Iranian media reported

¹³⁴ "Iran Unveils 'Ambassador of Death' Bomber." *Iran on NBC News.com*. NBC News, 23 Aug. 2010. Web. 2 May 2014.

¹³⁵ Michel, Arthur H. "Iran's Many Drones." *Center for the Study of the Drone*. Bard College, 25 Nov. 2013. Web. 10 May 2014.

¹³⁶ Cenciotti, David. "Iran Unveils Reverse-engineered Version of Captured U.S. RQ-170 Stealth Drone." *Captured Stealth Drone*. The Aviationist, 11 May 2014. Web. 8 June 2014.

¹³⁷ Atassi, Basma. "Al-Qaeda Says It Shot down Syria Drone." *Middle East*. Al Jazeera News, 7 Dec. 2013. Web. 5 May 2014.

they had acquired in 2012.¹³⁸ Syrian opposition commanders have confirmed a sharp increase in the number of surveillance drones they have seen and citing the Farsi script found on them have described the drones they have shot down as Iranian made.¹³⁹ Iran's proxy in Lebanon, Hezbollah has also publicly stated they are fighting on the side of the Syrian government. As mentioned previously, it is no secret that Iran has previously provided UAS to its Shiite ally. This could be an early indication that Iran, a significant UAS manufacturer in the region, is not shy about freely sharing its available technology to its allies when it suits their interests.

Hezbollah

Over the past 20 months, UAS piloted by the terrorist organization Hezbollah, but almost certainly built and supplied by its patron, Iran, have penetrated Israeli airspace, coming very close to key infrastructure sites and major population centers. The relative unsophistication of the militia's slow low-flying drones is what makes them so elusive to Israeli detection systems and have resulted in the Israeli Defense Forces releasing a statement in April 2013 which declared UAV's to be a serious threat to the country.¹⁴⁰

Hezbollah UAS represent the next evolution of warfare-by-remote-control, when weaponized robotic planes give terrorist groups de facto air forces.¹⁴¹ Each flight by the Shiite group into Israel airspace is at minimum a significant propaganda victory for the militia over its Zionist enemy. However, it is believed that the drones might be used in the future to increase the deadliness of Hezbollah's rockets. During the 2006 war with Israel, the militia fired about four thousand missiles from Lebanon to rain down on the Jewish state.¹⁴² Militarily the missiles had a horrendous accuracy rate and were primarily used as a way to spread terror. Today, Hezbollah is believed to have systematically re-stockpiled its arsenal with tens of thousands of rockets, with some of them capable of reaching Tel Aviv.¹⁴³ UAS would give the terrorist organization a way to see where its rockets land and therefore calibrate further strikes for greater precision.

¹³⁸ "Iranian TV Shows off 'Captured US ScanEagle Drone'" *News Middle East*. BBC News, 4 Dec. 2012. Web. 2 June 2014.

¹³⁹ Warrick, Joby. "Russian, Iranian Technology Is Boosting Assad's Assault on Syrian Rebels." *National Security*. The Washington Post, 1 June 2013. Web. 1 Apr. 2014.

¹⁴⁰ Dreazen, Yochi. Pg. 01

¹⁴¹ *Ibid*

¹⁴² Dreazen, Yochi. Pg. 02

¹⁴³ *Ibid*

Senior military officials are increasingly concerned with Hezbollah's capabilities, especially their use of UAS. "A Hezbollah with modern surface-to-air systems, with modern U.A.V.'s, with modern cyber capabilities, well, this is a different Hezbollah," a senior IDF official said, one that could have "much more appetite to taste another conflict with Israel."¹⁴⁴ Hezbollah is seen as actively developing its drone program as the organization recognizes their value. "Today, we are uncovering a small part of our capabilities," Hezbollah leader Nasrallah said in a speech carried on Hezbollah's TV station, Al Manar when referring to their available drones. "This is not the first time, and it will not be the last. We can reach any place we want."¹⁴⁵

Concluding Remarks

A considerable number of armed nation-states and organizations across the globe, whether they are democratic, authoritarian or terrorist, have actively been developing their respective UAS programs. Sometimes they are simple designs which have been constrained by the technological wherewithal of those trying to develop them and other times, they are extremely complicated machines that require elaborate communications with highly specialized targeting systems.

Regardless of their origin or level of sophistication, the reality is that proverbial Pandora's Box has been opened and UAS technology is now spreading around the world at breakneck speeds. Based on the fact that UAS are well suited for asymmetric conflicts fought by democratic militaries coupled with the present trend of worldwide UAS proliferation by nation states and non-state actors alike, Canada must fulfill its priorities as stipulated by the Canada First Defense Strategy by satisfying the obligations required by the Joint Unmanned Surveillance Targeting and Acquisition System (JUSTAS) project.

4. UAS and Commercial Growth

The market for commercial unmanned aerial systems is booming. When the Libyan opposition marched on the city's capital of Tripoli to oust Gaddafi in 2011, a Canadian-made UAS provided the reconnaissance. Created by Aeryon Labs, whose main office is in Waterloo

¹⁴⁴ Kershner, Isabel. "Israel Watches Warily as Hezbollah Gains Battle Skills in Syria." *Middle East*. The New York Times, 10 Mar. 2014. Web. 5 May 2014.

¹⁴⁵ Levy, Elior. "Hezbollah Confirms It Sent Drone Downed over Israel." *Middle East*. Ynetnews.com, 10 Nov. 2012. Web. 2 June 2014.

Ontario, the high-tech device was used for continuous surveillance, mapping terrain and sending back valuable tactical information to the opposition.¹⁴⁶ Today, Aeryon is moving away from its military beginnings and designing UAS for other tasks like investigating automobile accident scenes as well as inspecting tall electrical towers in a less dangerous and expensive way.

In the first section we observed how UAS were being utilized by numerous nation-states and non-state actors around the world for predominately military purposes. However, this world-wide proliferation has also translated into their development, production and use by commercial industries. Canadian businesses are already using UAS in various sectors of the economy and the potential for their growth is staggering. Assisting this growth is the fact that the federal regulations governing their use are much more relaxed than those of the U.S Federal Aviation Agency (FAA) which oversees the airspace of our southern neighbor. However, that will not last long as the FAA predicts that “there could be 10,000 drones buzzing around America’s skies by 2017.”¹⁴⁷ Real estate agents have used them for aerial photography and energy firms are employing them to monitor vital infrastructure, such as pipelines. Amazon recently created a stir by introducing Amazon Prime Air, a new service that will be delivering packages with drones.¹⁴⁸ The uses for commercial UAS are limitless and Canada is “among the best placed countries in the world to profit from the commercial boom.”¹⁴⁹

UAS and Canadian Economic Growth

After the Conservative party led by Stephen Harper came to power in 2011 and formed a majority government, their focus was on one key priority: the economy. The main document that encompasses the government’s economic policies can be found in ‘Canada’s Economic Action Plan’ which outlines a series of priorities and initiatives to improve the nation’s overall economic performance.

One of the top priorities listed in the Economic Action Plan is defined as ‘jobs, growth, prosperity’ and encompasses fields like jobs and job creation, growth through innovation and

¹⁴⁶ Akkad, Omar E., and Kelly Cryderman. "Canadian Technology and the Flight of the Drones." *Technology*. The Globe and Mail, 6 Apr. 2014. Web. 10 June 2014

¹⁴⁷ "Game of Drones." *The Economist*. The Economist Newspaper, 21 Dec. 2013. Web. 14 Apr. 2014.

¹⁴⁸ "Day of the Drone." *The Economist*. The Economist Newspaper, 02 Dec. 2013. Web. 5 June 2014.

¹⁴⁹ Common, David. "Drones Go Commercial, Take on Tasks from Industry to Farming." *Technology and Science*. CBC News, 30 May 2014. Web. 2 June 2014.

investing in individuals as well as communities to increase prosperity across Canada.¹⁵⁰ The current government has reiterated that job creation and helping workers get more quality jobs remains paramount. However with one in ten Canadian jobs linked to foreign investment, attracting that investment has also been integral to the government's boosting of the national economy which has resulted in a very favorable business environment.¹⁵¹ According to Bloomberg Ease of Business Ranking, Canada is second only to Hong Kong as the best place to do business in the world.¹⁵²

For Canada to maintain its economic priorities of long-term growth and competitiveness it must foster as well as attract globally competitive businesses that innovate and create high-quality jobs. Innovation is so critical to the Canadian economy that the Economic Action Plan specifically lists a myriad of initiatives and incentives that are offered to help innovative businesses remain competitive and create high-paying jobs in Canada.¹⁵³ In short, Canada's economic policies aim to create and grow innovative businesses as well as attract foreign investment in order to provide quality jobs which will provide a solid foundation for long-term economic growth and a greater national prosperity.

UAS are a massive industry that is constantly innovating new products and has the potential to create jobs that are unknown to most people. In 2012 alone, world governments spent more than 6.6 billion on military unmanned aerial vehicles.¹⁵⁴ Established U.S defense industry giants like Lockheed Martin, Northrop Grumman, Boeing, General Dynamics and General Atomics all took advantage of this period for military UAV demand to create significant profits not only from manufacturing, but also in maintenance and modification.¹⁵⁵ However, as the both the military engagements in Afghanistan and Iraq wound down and defense spending began to drop globally, these companies started to see the potential of UAS in the commercial market and were eager to make up for lost revenues.

¹⁵⁰ "Priorities." *Canada's Economic Action Plan*. Government of Canada, 2014. Web.

¹⁵¹ "Harper Government Leads by Example at World Economic Forum." *Foreign Affairs, Trade and Development Canada*. Government of Canada, 25 Jan. 2014. Web. 12 July 2014.

¹⁵² *Ibid*

¹⁵³ "Investing in World-Class Research and Innovation." *Canada's Economic Action Plan*. Government of Canada, n.d. Web.

¹⁵⁴ Hall, Abigail R., and Christopher J. Coyne. "The Political Economy of Drones." *Defense and Peace Economics* (2013): 1-16. Web. Pg. 445

¹⁵⁵ Hall, Abigail R., and Christopher J. Coyne. Pg. 454

According to Michael Toscano, President of the Association for Unmanned Vehicle Systems International, “the commercial market will outstrip military demand within in the next decade.”¹⁵⁶ Northrop Grumman which makes a variety of high-end military UAS recently partnered with Yamaha to manufacture crop dusting UAVs while Lockheed Martin, the world’s largest defense company is currently developing a range of small UAVs to sell directly to civilian customers.¹⁵⁷ Companies that made their fortunes through military contracts are returning to their civilian roots and designing systems for applications most people have not even thought about. According to Terry Parisher, a manager of Northrop Grumman, his company and the others believe that the civilian interest in unmanned systems will soon surpass that of the U.S Department of Defense.¹⁵⁸

Canada has a small but nascent UAS industry. Companies currently operating include Aeromao, Draganfly Innovations, Aeryon Labs, Brican Flight Systems and Stratus Aeronautics. Despite the fact they are nowhere near as big as the U.S defense companies, they are fast-growing, providing quality jobs and their innovative products are reaching international markets. Recently, Unmanned Systems Canada, the association representing the national UAS industry received \$20,000 in federal funding to grow new markets abroad for Canadian-made UAS.¹⁵⁹ Aeryon Labs, whose workforce grew by 75% in the last months, sells 90% of its products to foreign markets.¹⁶⁰

If the Canadian government is serious about tackling its top economic priorities as laid out in the Economic Action Plan, investment in the commercial UAS sector now will reap large dividends in the future. Canada’s UAS industry has proven viable but has only received minimal recognition and little support. Alternatively, U.S defense companies have recognized the commercial UAS industry’s potential and are actively aiming to corner the market, much like they did with military UAS. With UAS having so many applications in key economic sectors like mining, oil and gas and agriculture, it is in the best interests of the Canadian government to

¹⁵⁶ Michel, Arthur H. "The Future of the Drone: From War Machine to Crop Duster." *Technology*. Al Jazeera America, 16 May 2014. Web. 2 July 2014.

¹⁵⁷ *Ibid*

¹⁵⁸ *Ibid*

¹⁵⁹ Pender, Terry. "Government Lends Support to Soaring Industry." *TheRecord.com*. The Waterloo Record, 14 July 2014. Web. 15 July 2014.

¹⁶⁰ *Ibid*

foster a national UAS industry which creates quality jobs, innovative economic growth and attracts foreign business investment.

One way the federal government can facilitate the domestic growth of UAS in key economic sectors is with clear and favorable regulations. Regulation can be defined as “instruments used to influence or control the way people and businesses behave in order to achieve economic, social or environmental policy objectives”¹⁶¹ The application of UAS in civilian contexts creates new sources of harm through possible interference, accidents or violent action and therefore requires some form of constraint. However, UAS technology is subject to a range of measures that were created without UAS specifically in mind leading to a lack of ‘regulatory connection.’ Regulatory approaches which were designed for the technological landscape of the past require therefore constant ‘reconnection.’¹⁶² If the pace of government reconnection does not match the UAS industry’s growth, this will breed regulatory uncertainty. For something as tightly controlled as country’s national airspace, associated regulatory uncertainty will be a major impediment to any form of investment or financial participation and could even jeopardize the industry altogether.

In the next section the author will summarize the federal regulations that govern the use of commercial UAS in both United States and Canada in order to highlight that the latter are currently much more favorable. Next, the author will summarize the diverse variety of sectors in the Canadian economy where UAS are being successfully utilized as well as how future legislation can ensure their continued efficiency and growth. Overall, the author will illustrate that the development, production and use of commercial UAS in the Canadian context will flourish based on their current level of regulation and significance to the nation’s vital economic sectors.

North American UAS Regulations

Transport Canada

UAS are presenting Transport Canada regulators with their biggest challenge in generations and one aviation lawyer was quoted as saying that the “technology is surpassing the

¹⁶¹ Clarke, Roger, and Lyria B. Moses. "The Regulation of Civilian Drones' Impacts on Public Safety." *Computer Law and Security Review* 30 (2014): 263-85. Print. Pg. 267

¹⁶² *Ibid*

legislation.”¹⁶³ The Canadian Aviation Regulations (CARs), authorized under the Aeronautics Act, dictate that anyone can fly a UAV for recreational purposes if it does not weigh more than 35 kilos, stays under 400ft and is within the line of the sight of the operator.¹⁶⁴ This list of rules is the same as those imposed on hobbyists. However, for anything larger and/or for commercial purposes the rules are; Section 602.41 of the CAR states, “No person shall operate an unmanned air vehicle in flight except in accordance with a Special Flight Operation Certificate (SFOC).”¹⁶⁵

The SFOC requirement is stated as “intended to ensure the safety of the public and protection of other users of the airspace during the operation of the unmanned air vehicle. Transport Canada has to be convinced that an individual can conduct their planned operation safely and is familiar enough with aviation regulations before an SFOC will be granted.”¹⁶⁶ The SFOC process ensures that the operator has evaluated the risks associated with its operation as well as put into place satisfactory risk mitigation measures. According to the CBC, 945 SFOC’s were issued by Transport Canada last year.¹⁶⁷ The SFOC also guarantees that they have proper liability insurance coverage in case of an accident which is a very real threat. Recently According to CBC News “Transport Canada Safety is investigating a case where an Air Canada pilot spotted one in Vancouver a few dozen meters from his jet. A 35 kilo carbon-fiber drone in an engine or windscreen could be catastrophic.”¹⁶⁸

In 2007, a federal government working group produced a report stressing the future importance of UAS to the Canadian economy and the need for stronger regulations. It stated: “Canadian industry is currently capable of becoming a world leader in unmanned aircraft system technology and services. The working group is unanimous in the view that the rapid development by Transport Canada of regulations and standards is critical to exploit this

¹⁶³ Brown, Chris. "Drones Have Regulators, Hobbyists on Collision Course." *Technology and Science*. CBC News, 19 May 2014. Web. 2 June 2014.

¹⁶⁴ "Unmanned Air Vehicle (UAV)." *Transport Canada; Safety and Security Group, Civil Aviation*. Government of Canada, 3 May 2010. Web. 1 June 2014

¹⁶⁵ *Ibid*

¹⁶⁶ *Ibid*

¹⁶⁷ Brown, Chris. "Drones Have Regulators, Hobbyists on Collision Course." *Technology and Science*. CBC News, 19 May 2014. Web. 2 June 2014

¹⁶⁸ *Ibid*

technological advantage for domestic and export opportunities.”¹⁶⁹ However, progress has been slow. A new working group was established in 2010 and its final report is not due until 2017.

Federal Aviation Administration

The regulations in Canada are still much less stringent than our neighbors to the south. The US has considerably tighter laws when it comes to operations of UAS. Presently, UAS are not currently legal to fly in the US whatsoever without special approval.

U.S President Barack Obama signed the Federal Aviation Administration (FAA) Air Transportation Modernization and Safety Improvement Act of 2012 which includes a mandate to loosen the restrictions on drones and integrate them into the national air space.¹⁷⁰ The first steps of that regulatory process are expected on September 30th, 2015. However, the FAA has realized that crafting these has presented significant challenges and has stated that commercial UAS, "rule-making efforts may be more complex, receive greater scrutiny, and require longer development timeframes than the average regulatory effort."¹⁷¹

The FAA estimates 7,500 commercial UAS will be in use within five years of a regulatory framework being set.¹⁷² However, not everyone is particularly happy about it. Lawmakers in at least 43 states of the union have also introduced 118 UAS-related bills and resolutions in 2013 alone with a majority of them placing an emphasis on their prohibition.¹⁷³

At the end of 2013, the FAA announced six ‘test states’ to trial the use of UAS for commercial and industrial purposes. These test sites are intended to help the FAA identify gaps in the regulations that prohibit drone aircraft from flying in national airspace. Alaska, Nevada, New York, North Dakota, Texas and Virginia were all selected as states that will host research sites.¹⁷⁴ While selecting the sites, the FAA considered geography, climate, ground infrastructure, research needs, airspace use, aviation experience and risk. Tests will determine whether UAS can detect and avoid obstacles including other aircraft and whether they can operate safely when they lose contact with their operators.

¹⁶⁹ Santry, Charlotte. "Droning On." *Canadian Lawyer*. Canadian Lawyer Magazine, 3 Feb. 2014. Web. 12 Mar. 2014.

¹⁷⁰ Snyder, Chris, and Eddie Schneckloth. "A Drone Pilot Speaks." *PC Magazine*. ZDNet, Sept. 2013. Web

¹⁷¹ United States of America. US Department of Transportation. Federal Aviation Administration. *Integration of Civil Unmanned Aircraft Systems (UAS) in the National Airspace System (NAS) Roadmap*. 1st ed. Washington: FAA Communications, 2013. Print

¹⁷² Santry, Charlotte. "Droning On." *Canadian Lawyer*. Canadian Lawyer Magazine, 3 Feb. 2014. Web. 12 Mar. 2014.

¹⁷³ *Integration of Civil Unmanned Aircraft Systems (UAS) in the National Airspace System (NAS) Roadmap*. Pg.

¹⁷⁴ *Ibid* Pg.

Currently, the FAA has roughly about a year to reach its congressional mandated deadline. As of August 2013, the FAA had issued 114 special airworthiness certificates to 22 different models of civil aircraft, more than half of which were unmanned.¹⁷⁵ The rules for UAV pilots are the same as those as certified manned-aircraft pilots. However, Nevada officials said a statement, that the state's selection as a test site would create thousands of jobs "with an average annual salary of 62 thousand. This would create 2.5 billion in economic activity with an estimated 125 million in annual state and local tax revenue."¹⁷⁶ This kind of economic activity cannot be ignored and as a result the U.S Congress is being lobbied by groups like the Association for Unmanned Systems International (AUVSI) to further accelerate the process. The FAA still expects to have a certification process in place by next year, but has until 2017 to include certifications for large and high-altitude aircraft and has until 2020 for full integration.¹⁷⁷

When comparing both sets of regulations, it is much easier to see why Canada is currently placed advantageously in regards to the commercial drone sector. If Transport Canada can maintain its pace of crafting legislation that fairly governs the use of UAS, its national industry would have an edge over that of the United States. However, if loopholes in the regulations are dangerously exploited there is the risk of a catastrophic event occurring, which could result in the complete prohibition of UAS until proper regulations are enacted.

Commercial UAS and Canadian Economic Sectors

Agriculture

In their continuous efforts to improve yields, farmers crave data as much as advertising firms. One of the foremost civilian uses for UAS will be in the agricultural industry which accounts for a significant amount of economic activity in Canada. In 2012 the Canadian agriculture and agri-food system generated \$103.5 billion, accounting for 6.7% of Canada's gross domestic product.¹⁷⁸ In order to increase efficiency and productivity in their yields, farmers have been employing 'precision agriculture' (PA) techniques which have recently garnered a

¹⁷⁵ Parsons, Dan. "Drones Over U.S. Soil Still Years Away, Despite Congressional Mandate." *National Defense* Feb. 2014: n. pag. Print.

¹⁷⁶ *Ibid*

¹⁷⁷ Parsons, Dan. "Drones Over U.S. Soil Still Years Away, Despite Congressional Mandate." *National Defense* Feb. 2014: n. pag. Print.

¹⁷⁸ "An Overview of the Canadian Agriculture and Agri-Food System 2014." *Agriculture and Agri-Food Canada*. Government of Canada, 15 Apr. 2014. Web. 20 May 2014.

great deal of attention. With UAS, farmers now have an easily accessible remote sensing platform that allows them to employ PA techniques which involves monitoring their land in “detail, pinpointing outbreaks of disease and infestation, where to spray nutrients and chemicals and even checking soil humidity.”¹⁷⁹

PA is a type of field management strategy that works in tandem with new technologies, machinery and available equipment using GPS technology that allows the farmer to “identify, analyze and react quickly to the qualitative characteristics of a cultivated land area and apply the most appropriate farming system.”¹⁸⁰ The emergence of PA is related to a growing trend in processing and analyzing the necessary data in order to make the most informed decisions as well as to develop and implement solutions. The Association for Unmanned Vehicle Systems International, the US lobbyist group which represents producers and users of drones and other robotic equipment, predicts that 80% of the commercial market for UAS will be for agricultural uses.¹⁸¹

Satellite imagery, manned aircraft and simply walking the field are currently the main ways farmers monitor their crops. However, these methods can often be incomplete or time consuming and when data is finally collected it can be arduous to process and analyze. UAS that monitor agricultural land can enable precise crop management which saves farmers time and resources. Today, many crop species are being monitored using remote sensing techniques including; canola, corn, cotton, sorghum and wheat.¹⁸²

In the past, remote sensing platforms like medium resolution satellite imagery have traditionally been the most readily available source of data for farmers employing PA techniques. However, this platform is only useful for large scale studies and “cannot provide high frequency data for an emergent situation (e.g., nutrient stress monitoring, disease) with a limited 1–2 day revisit period.”¹⁸³ Satellites also have to take into account weather conditions as well their associated costs and availability of use.

¹⁷⁹ Zhang, Chunhua, and John Kovacs. "The Application of Small Unmanned Aerial Systems for Precision Agriculture: A Review." *Precision Agriculture* 6th ser. 13 (2012): 693-712. Print Pg.

¹⁸⁰ Urbahs, Aleksandrs, and Ieva Jonaite. "Features of the Use of Unmanned Aerial Vehicles for Agriculture Applications." *Aviation* 17.4 (2013): 170-75. Web. Pg. 171

¹⁸¹ Doering, Christopher. "Growing Use of Drones Poised to Transform Agriculture." *USA Today*. Gannett Co., 23 Mar. 2014. Web. 14 Apr. 2014.

¹⁸² Zhang, Chunhua, and John Kovacs. Pg. 695

¹⁸³ Zhang, Chunhua, and John Kovacs. Pg. 696

UAS can provide PA strategists an inexpensive and immediately accessible alternative to satellite imagery. For example, an agricultural services company based in Chatham is currently using a bat-winged drone to take photographs and other images of farm fields in Southwestern Ontario. Last year, the battery-powered drone snapped images over 8,000 acres of farm fields in five counties.¹⁸⁴ To date, UAS acquired images have been successfully employed for mapping grass species, to measure shrub biomass, for aiding in vineyard management, documenting water stress in crops and for examining the results of various nitrogen treatments.¹⁸⁵

UAS used for agriculture has been a fixture in Japan since the 1990s. The RMax built by Yamaha sprays nearly half that country's rice crops and its capabilities were recently demonstrated in Californian Vineyards.¹⁸⁶ Ontario vineyards which have 16,000 acres of grapes could utilize the same technology to increase yields and profits.¹⁸⁷ The ASETA project, a robotic weed killer being tested over fields in Denmark, aims to reduce herbicide use by concentrating weed killer only in places where it is needed most.¹⁸⁸ This project is designed for saving the grower money from unnecessarily overusing resources while at the same time reducing the amount of chemical runoff that could flow into nearby rivers and streams. Harvard scientists have even created tiny winged "Robobee" UAS for the function of pollinating flowers. Called the Micro Air Vehicles Project, it first sought to replicate bee behavior but "designers now envision using them for high-altitude weather monitoring and traffic management."¹⁸⁹

As potential industry-changing innovations are being developed, the uses for UAS in agriculture are seemingly limitless. The "robotics revolution" will take off, says the Brookings Institution's Peter Singer, "When you have innovation crossing with profit-seeking, people will be coming up with new ideas and new ways to make money off it."¹⁹⁰ With the agri-foods industry being a considerable part of the Canadian economy, advances in the development, production and use of agriculture specific UAS will subsequently flourish. Farmers utilizing the

¹⁸⁴ Epp, Peter. "Bat-winged Drone Is Chatham Company's Eye in the Sky." *Farm Show*. Chatham Daily News, 29 Jan. 2014. Web

¹⁸⁵ Zhang, Chunhua, and John Kovacs. Pg. 695

¹⁸⁶ Sorcher, Sara. "What Drones Can Do for You." *National Journal* (2013): n. pag. *Academic OneFile*. Web.

¹⁸⁷ "Grape and Wine Production in Ontario." *Grape & Wine Production*. VQA Ontario, 2015. Web. 15 June 2014.

¹⁸⁸ Hodson, Hal. "Precision Herbicide Drones Launch Strikes on Weeds." *New Scientist* 6 July 2013: n. pag. Print.

¹⁸⁹ Common, David. "Drones Go Commercial, Take on Tasks from Industry to Farming." *CBC News*. CBC/Radio Canada, 30 May 2014. Web. 3 June 2014.

¹⁹⁰ Sorcher, Sara. "What Drones Can Do for You." *National Journal* (2013): n. pag. *Academic OneFile*. Web.

technology will be able to better control their inputs subsequently while reducing costs and maximizing yields.

Resource Exploitation

Canada's resource extraction industries are also extensively using UAS. The Canadian Energy Pipeline Association has stated that some member companies have done limited tests with unmanned systems. Royal Dutch Shell PLC has tested unmanned aircraft for land surveying at its Jackpine and Muskeg River oil sands mines.¹⁹¹ Syncrude Canada Ltd. has been using them for the past few years to map reclaimed areas, looking at details such as shoreline vegetation growth.¹⁹² Canadian oil sands giant Cenovus Energy Inc. is working to build a fleet of UAVs. Transport Canada has just approved a flight and mapping program at three of its project sites and the company expects to conduct UAS flights at least once a week.¹⁹³ Energy giant BP has even been given the all clear by the restrictive FAA to utilize UAS over Alaskan oilfields, the first such commercial flights permitted in the U.S.¹⁹⁴

In the mining industry, UAS are being pitched as a cheaper and safer way to map deposit sites and explore for minerals rather than employing traditional methods. Gold prospectors in Yukon Territory are using UAS to survey huge stretches of land for mineral deposits while greatly reducing the cost of doing business in the initial stages of mineral exploration and leaving less of an environmental footprint in the process. Geophysical surveys of large areas which took a year and a half to get done can now take only two to three weeks to do, with the costs of initial exploration reduced to about one fifth of what it was before.¹⁹⁵

UAS are gaining further appeal as mining companies are forced to write down assets they bought during boom times and are now committed to getting control of their costs.¹⁹⁶ According to the U.S. Geological Survey project office, it would cost roughly cost \$2,000 an hour to rent a helicopter, but the cost of sending out a couple of UAS operators out with a system is under \$200

¹⁹¹ Akkad, Omar E., and Kelly Cryderman. "Canadian Technology and the Flight of the Drones." *Technology*. The Globe and Mail, 6 Apr. 2014. Web. 10 June 2014.

¹⁹² *Ibid*

¹⁹³ *Ibid*

¹⁹⁴ "FAA Approves BP Drone, Ushering in Unmanned Commercial Flights." *U.S. Al Jazeera America*, 10 June 2014. Web. 11 June 2014.

¹⁹⁵ "Drones Help Yukon Prospectors Find New Gold Deposits." *CBC News North*. CBC News, 4 Sept. 2013. Web. 10 Mar. 2014.

¹⁹⁶ Martell, Allison. "Drone Start-ups Woo Stretched Miners for Survey Work." *Mining*. The Globe and Mail, 7 Mar. 2013. Web. 4 June 2014.

an hour.¹⁹⁷ UAS are also being touted a safer alternative to taking measurements from the ground. UAS create precise maps of open pits which can help in planning mines and monitoring the angle of slopes, a key safety concern because of the risk of rock slides. Further, workers on the ground are not being exposed to heavy equipment on an active mine site.¹⁹⁸

UAS are powerful tools for monitoring, assessing risk, and ensuring safety measures are intact. UAS provide an attractive alternative to more conventional monitoring operations. Visual and infrared cameras are being used to detect hydrocarbon gas leaks from flare stacks, pipelines, rail cars and marine vessels.¹⁹⁹ Canada is also home to several hundred thousand kilometers of oil and gas pipelines, many of them spanning inhospitable terrain. Ensuring that right-of-ways are clear and that environmental protection requirements are met means a great deal of repetitive flight time is logged each year inspecting the length of each line.²⁰⁰ UAS are well suited to pipeline monitoring because they eliminate the requirement for owned or leased aerial surveys and as well as the traditional visual analysis of image data. UAS help pipeline operators meet their survey needs while better protecting the environment by performing more recent inspections and immediately spotting flaws such as leaks. The use of UAS that helps reduce environmental and social impacts is essential if the Canadian North's rich oil and gas and mineral deposits are to be properly developed.

Existing Transport Canada regulations however, are not exactly facilitating the use of UAS in this industry. Current regulations include conditions like UAS only being flown during daylight hours, within the remote operator's line of sight and at least five miles away from any airports nearby. None of those are very conducive toward drone usage for monitoring a nationwide pipeline network.²⁰¹ Federal regulators must be aware of the economic benefits that can be obtained through the utilization of UAS in this vital Canada sector. Only with more advantageous regulatory conditions implemented in the future will UAS be able to reach their maximum potential.

¹⁹⁷ *Ibid*

¹⁹⁸ *Ibid*

¹⁹⁹ Ligaya, Armina. "From Toy Shelves to the Oil Sands, Drones Are Taking off in Canada." *FP Tech Desk*. Financial Post, 14 June 2014. Web. 15 June 2014.

²⁰⁰ MacDonald Dettwiler and Associates. *MDA UAV Service*. Richmond: MacDonald Dettwiler and Associates, 2008. Print

²⁰¹ Chakravorty, Swagato. "Monitoring Oil Pipelines with Drones." *Oil Field Drones*. Energy & Capital, 11 June 2013. Web. 12 May 2014.

Weather Monitoring and Scientific Research

UAS are being used to monitor future weather conditions and scientific researchers are increasingly recognizing their unique capabilities. The FAA has authorized 25 universities to fly UAS in U.S. airspace and tens of thousands of dollars are being granted by U.S government departments like the Federal Highway Administration to evaluate the potential uses of UAVs for surveying and bridge inspections.²⁰² In Antarctica a team from the Australian universities of Tasmania and Wollongong in New South Wales, have been using two types of UAS which are helping the team create 3D maps of moss beds, whose health may be an indicator of climate change.²⁰³ In the middle of the Pacific Ocean, archaeologists are using a fixed-wing UAV to take aerial photographs of Easter Island to produce the highest resolution survey of the World Heritage Site ever made.²⁰⁴ This indispensable and revolutionary technology is being used an efficient way to gather data and perform better experiments therefore leading to significant advances in the scientific community and ultimately a better way of life for all.

UAS technology is increasingly being used to monitor weather conditions, including hurricanes. UAS are being used to spend hours spiraling in a hurricane's dark places, transmitting data that could help forecasters understand what makes some storms peter out while others strengthen into monsters.²⁰⁵ The point where the roiling ocean meets the fury of a hurricane's winds may hold the key to improving storm intensity forecasts, but it's nearly impossible for scientists to see. Knowing that information while a storm is still far offshore could help emergency managers' better plan for evacuations or storm surge risks.²⁰⁶ For example, this kind of information could have saved lives when Hurricane Charley suddenly strengthened to into a Category 4 as it sped into southwest Florida in 2004, leaving nine dead in its wake.²⁰⁷

It is not the technical issues that are the greatest challenge to researchers using UAS, but the case-by-case permitting process currently required by Transport Canada. This stifles the tools' utility for scientific applications, making ad-hoc, time-sensitive flights difficult to

²⁰² Joyce, Erin. "Research Ramping Up for More Drones on Jobsites." *Construction, Building & Engineering News*. Engineering News Record, 07 Feb. 2013. Web. 1 June 2014

²⁰³ Marks, Paul. "Drones for All Take to the Skies." *New Scientist* 2 Apr. 2012: n. pag. Web.

²⁰⁴ *Ibid*

²⁰⁵ Kay, Jennifer. "Drones Are the Newest Tool in Hurricane Research." *Nation and World*. The Denver Post, 28 May 2014. Web. 2 June 2014.

²⁰⁶ *Ibid*

²⁰⁷ *Ibid*

arrange.²⁰⁸ In any future legislation governing the use of UAS, federal regulators must recognize that important contributions that the technology can make towards the scientific community and inclement weather monitoring.

Freight Delivery

The first thing that springs to your mind when you hear the word ‘drone’ is not likely ‘expedited parcel delivery.’ However, Jeff Bezos, the CEO of e-commerce giant Amazon Inc. revealed in December 2013 that the company was experimenting with a service called ‘Amazon Prime Air’ “which involves using small drones to ship goods from an Amazon fulfillment center directly to customers.”²⁰⁹ The drones are designed to operate within a radius of ten miles from a distribution center, which in urban areas would mean they could autonomously deliver small packages to programmed GPS co-ordinates under 2.3 kilograms to a large number of customers within a half hour timeframe. 86% of the packages that Amazon delivers everyday are under the 2.3kg weight.²¹⁰

Delivery through UAS might seem far-fetched and something out of a science fiction film, but it is actually quite possible and already being performed around the world. The “OppiKoppi Beer Drone,” developed by Capetown’s Darkwing Aerials, served as a fully functioning beer delivery system during the Oppikoppi outdoor music festival in South Africa last year.²¹¹ After clients placed an order using a smartphone app, a UAS zoomed 50 feet above the heads of the festival-goers to make the delivery. The smartphone app registers the position of users using the GPS satellite chips on their phones and drops the beverage with a parachute.²¹² To avoid striking festival-goers with an errant delivery, one nearby campsite was designated as the beer drop zone.

Luxury hotels are also experimenting in the U.S with UAS deliveries on their property. The Mansion at Casa Madrona in California, recently introduced a champagne bottle service, where a custom-built UAS can deliver up to three bottles at a time for guests staying in the

²⁰⁸ Ogden, Lesley E. "Drone Ecology." *BioScience* Sept. 2013: n. pag. Print.

²⁰⁹ "Day of the Drone."

²¹⁰ News, CBC. "Amazon PrimeAir Drone Deliveries Coming Soon, CEO Jeff Bezos Says." *CBC News*. CBC/Radio Canada, 02 Dec. 2013. Web. 2 June 2014.

²¹¹ "Drone Delivers Beers — Not Bombs — at South Africa Music Festival." *NY Daily News*. AFP RelaxNews, 9 Aug. 2013. Web. 15 June 2014

²¹² *Ibid*

hotel's most luxurious suite where nights start at \$10,000 dollars.²¹³ The hotel is also customizing mini-drones to deliver cookies as well as other amenities, all in an effort to create memorable experiences for luxury travellers coming through.

What these UAS delivery mechanisms have in common is they all transport small, mostly consumable items where time and speed are a factor. However, for even more important small items such as emergency medical supplies, why not use UAS to deliver them? Some entrepreneurs have envisioned a 'matternet' which is similar to that of the internet, but would instead be a "drone-powered internet for objects."²¹⁴ The plan is to build a network of autonomously controlled, multi-rotor UAS to carry small packages of a standardized size. Rather than having UAS carry each package directly from sender to recipient, which could involve a long journey beyond the aircraft's flying range, the idea is to build a network of base stations, each no more than 10km from the next, with drones carrying packages between them.²¹⁵ While the internet delivers data, the 'matternet' would deliver important items such as urgent medicines to remote clinics and blood samples that could be sent and returned in hours.²¹⁶ Successful field tests of this prototype system were carried out in the Dominican Republic and Haiti.

The 'matternet' while a complex, immature technology at present, could become extremely useful in a country the size of Canada. For example, a stranded farmer in the middle of a field in Saskatchewan could place an order for a new tractor part by text message and pay with it via mobile money transfer. A supplier many miles away would then take the part to the local matternet station for airborne dispatch via drone directly to the farmer in the field.²¹⁷ Supply UAS are also not affected by certain transportation-specific issues such as Hours of Service regulations, automobile accidents, inclement weather and highway construction.²¹⁸

Film and Photography

The U.S Federal Aviation Administration (FAA) said recently they are considering allowing the film and television industries to utilize UAS because there could be 'tangible

²¹³ "Hotel Delivers Champagne to Guests by Drones." *Travel News*. AOL Travel UK, 23 May 2014. Web. 2 June 2014.

²¹⁴ "An Internet of Airborne Things." *The Economist*. The Economist Newspaper, 01 Dec. 2012. Web. 4 May 2014.

²¹⁵ *Ibid*

²¹⁶ *Ibid*

²¹⁷ *Ibid*

²¹⁸ Stillman, Enan. "Supply Chain Drones on the Horizon." *Material Handling and Logistics* July 2013: 26-30. Web.

economic benefits.²¹⁹ UAS are currently being used extensively in the film industry around the world, including in high-profile movies such as ‘The Hobbit: The Desolation of Smaug’ which was filmed in New Zealand.²²⁰ Seven aerial video and photography firms based in the U.S recently petitioned the FAA for exemptions to the agency's current ban on commercial UAS use. As mentioned previously, the U.S restrictions on the use of commercial UAS is much stricter than that of Canada.

Kaspi Films, a Canadian film company, “has been using drone technology to shoot everything from Toyota car commercials to aerial videos for real estate companies.”²²¹ The versatility compared to filming with more traditional jib-arm cranes or with helicopters is one of the main draws of UAS for the film industry. More importantly, film UAS save on the production costs associated with a pilot, rental equipment, travel and the labor wages of the staff that has to ensemble such equipment.²²² UAS are also less intrusive than helicopters which can be noisy and disruptive for nearby residents and allow the camera angle to be much lower without have to be concerned about the back-draft caused by whirling rotor-blades.

Aerial photography is another UAS use that is popular with Canadian businesses and entrepreneurs. Aerial imagery gives potential homebuyers a bird’s eye view of properties and provides a unique home shopping experience giving real-estate brokers an edge over the competition in what is a very competitive market.²²³ Presently, airborne photography is mostly being used for high-end properties, where acres of land and outdoor amenities such as tennis/basketball courts or a pool can be accentuated. UAS could capture the exact view from a unit in a condo building that has not yet been constructed. It could also allow condo buyers in other cities to get a close-up view of their building in various phases of construction, or see to what is going on behind the hoarding that fences in construction sites.²²⁴

The Vancouver film industry is one that has been actively using UAS for many years. Many U.S companies that are unable to acquire exemptions from the FAA turn to their northern

²¹⁹ "US to Consider Drone Licenses for Film and TV." *Business*. BBC News, 2 June 2014. Web. 4 June 2014.

²²⁰ *Ibid*

²²¹ "Canadian Businesses Harness Drone Technology." *CBC News*. CBC/Radio Canada, 06 May 2014. Web. 2 June 2014

²²² "What Is a Film Drone?" *Drone-Film-Camera*. Cineweb, 2014. Web.

²²³ Roche, Kelly. "Ottawa Real Estate Agent Takes to the High Skies to Try and Sell Homes." *News Ottawa and Region*. Ottawa Sun, 15 May 2014. Web. 10 June 2014.

²²⁴ "Canadian Businesses Harness Drone Technology." *CBC News*. CBC/Radio Canada, 06 May 2014. Web. 2 June 2014

neighbor to complete the task. If Transport Canada can maintain a robust level of regulation that is up-to-date, streamlined, and timely as well as maintains the desired quality of safety for the public, the film industry in British Columbia as well as the rest of Canada will flourish while the U.S will have to find alternative avenues to achieve the same result.

Journalism

When skiers and snowboarders flew down the mountains at the Sochi 2014 Winter Olympics, the dramatic action was captured by cameras mounted on UAS which had never been done before.²²⁵ UAS are starting to become more widely used in film and TV, but they are also being used for purposes of journalism. News networks are increasingly recognizing the value that UAS can bring to their signature broadcasts, thereby increasing viewership and overall revenues.

During the past few months, UAS shot the most revealing footage of the violent protests that toppled Viktor Yanukovich, Ukraine's president. UAS let journalists capture scenes that previously would have put their lives in danger, thereby making it harder for governments to cover up the truth.²²⁶ Journalists also used UAS to cover protests in Bangkok in December 2013, "filming clashes without having to dodge police tear gas and water-cannons, or lumps of concrete hurled by protesters."²²⁷ UAS journalism has officially made its mark on disaster reporting and has become a powerful tool for the news industry.

There is absolutely no limit to the type of news events that can be covered using UAS: Riots, fires, floods, landslides, pipeline spills, ship-grounding, accident scenes and even sporting events. UAS provide a unique, airborne perspective that cannot be acquired any other way while simultaneously helping journalists overcome logistical hurdles. They have recently been used to cover fires raging in the Australian bush and floods in southern England.²²⁸

The College of the North Atlantic in Stephenville, Newfoundland's and Vancouver's Langara College offer Canada's only drone journalism courses which started in 2014.²²⁹ Major-market radio and TV stations can afford traffic helicopters, but UAS like Langara's off-the-shelf DJI Phantom 2 Vision, could fit the tight budgets of newspapers which must innovate to stay in

²²⁵ "Drone Journalism: Is Canada Ready?" *CBC News*. CBC/Radio Canada, 20 May 2014. Web. 4 June 2014.

²²⁶ "Eyes in the Skies." *The Economist*. The Economist Newspaper, 29 Mar. 2014. Web. 2 June 2014.

²²⁷ *Ibid*

²²⁸ *Ibid*

²²⁹ Mackin, Rob. "Drones Poised to Fill Canadian Skies."

business. Langara instructor Ethan Baron, who spent some six months reporting under UAS in Afghanistan and Africa, hopes Transport Canada eventually allows daily newsgathering by UAS.²³⁰ Since journalists are in the commercial use category, they must apply for a SFOC, which as mentioned earlier is granted on a case-by-case basis. After the application is filed it's a minimum 20-day waiting period which is far too long for most journalists covering breaking news. The use of UAS for journalism in Canada is still in its infancy, but is expected to surge ahead as the technology becomes even more accessible and the current restrictions are loosened.²³¹

Jeff Ducharme, an instructor at the College of the North Atlantic, asserts that the future of UAS in journalism will depend on how it is regulated.²³² If Transport Canada can maintain a certain level of public safety while allowing journalists to utilize another tool in their reporting arsenal, Canada will be in an advantageous position when it comes to maintaining a robust and independent media with up-to-date reporting. As policymakers iron out the rules around UAS use, the two journalism schools will continue to teach students about this exciting new technology which will hopefully become a fixture of Canadian news in the near future.

Law Enforcement

Canadian law enforcement agencies have been using UAS before most people even knew what they were. As far back as 2002, the Royal Canadian Mounted Police (RCMP) and the Canadian Forces teamed up in 'Operation Grizzly' to monitor crowds for terrorist threats at the G8 Summit in Kananaskis, Alberta.²³³ The joint surveillance operation employed the 'I-Gnat' UAS which was acquired at the time from General Atomics.²³⁴ The UAS currently used by Canadian law enforcement are small and have limited range but can assist in collision reconstruction by helping investigators see what they may have overlooked; they can identify potential threats to tactical officers responding to a critical incident; and they can help locate

²³⁰ "Langara's Journalism Program Launches Drone Training." *News and Events*. Langara College, 25 Feb. 2014. Web. 2 June 2014.

²³¹ Reichel, Justina. "Drone Journalism Moving Ahead in Canada." *World, Canada, Canadian Content*. Epoch Times, 9 Apr. 2014. Web. 2 June 2014.

²³² *Ibid*

²³³ Gersher, Shayna. "Drone Surveillance Is Increasing in Canada." *News*. The Ottawa Citizen, 04 Sept. 2014. Web. 5 June 2014.

²³⁴ *Ibid*

missing people over difficult terrain.²³⁵ For example, an UAS flew over the wreckage of the Algo Centre Mall in Elliot Lake after a roof collapsed killing two people, in order to judge what remained of its structural integrity.²³⁶

UAS are being purchased regularly and deployed more often by national police forces. Overall, RCMP in British Columbia, Alberta, Saskatchewan, Manitoba, the Northwest Territories and Newfoundland and Labrador all use the devices. There are currently ten UAS used in the province of Alberta alone, one for each traffic investigation unit.²³⁷ At the start of 2014, the Nova Scotia RCMP announced that they were buying five UAS for use by their officers.²³⁸ The Halton Ontario Regional Police have been using UAS since 2009 and in 2012 an investigation using UAS located 744 marijuana plants in a field at the north end of Milton.²³⁹

However, police UAS use is beginning to ignite controversies across the country. In early March, the OPP “deployed an Aeryon Scout drone above a Mohawk roadblock protesting police inaction on missing and murdered women investigations. On Twitter, the OPP spun it as “an economical way to take pictures. It is a tool used in investigations.”²⁴⁰ Some human rights groups saw this as a form of escalation and political intimidation; while others simply questioned the ethics behind their use in that context.

Others believe that the use of the technology could erode Canadians’ rights and freedoms when it comes to their privacy. The potential expansion of UAS in domestic skies has spurred debates about their potential impact on diminishing expectations of privacy in public spaces.²⁴¹ The prospect that UAS could eventually be deployed for a myriad of surveillance activities is often the most controversial. Assessments about the “reasonableness” of UAS surveillance, including reasonable expectations of privacy in public spaces, are at the crux of the debate. Those concerns became reality when the Seattle police department was forced to scrap its UAS

²³⁵ Quan, Douglas. "Not Just for Modern Warfare: RCMP to Expand Use of Drone Mini-helicopters." *Canada*. The National Post, 27 Jan. 2014. Web. 4 June 2014.

²³⁶ Quinn, Jennifer. "Police Drones Sparks Debate over Personal Privacy." *News/World*. The Toronto Star, 5 Feb. 2013. Web. 4 May 2014.

²³⁷ Salz, Allison. "Edmonton Police Launching a Drone Pilot-project." *News Edmonton*. Edmonton Sun, 15 May 2014. Web. 2 June 2014

²³⁸ Mcleod, Paul. "Nova Scotia RCMP to Get Drones." *Herald News*. The Chronicle Herald, 2 Jan. 2014. Web. 4 June 2014.

²³⁹ McNaughton, Graeme. "Halton Police Find \$744K worth of Drugs Using High-tech Pot-spotting Drones." *Posted Toronto*. The National Post, 13 Sept. 2012. Web. 1 June 2014.

²⁴⁰ Mackin, Rob. "Drones Poised to Fill Canadian Skies."

²⁴¹ "Drones in Canada." *Privacy Research Papers*. Office of the Privacy Commissioner of Canada, Mar. 2013. Web. 2 June 2014.

program after a disastrous public hearing “on a proposed ordinance outlining restrictions for the department’s drone program, which drew vocal opposition from numerous citizens concerned with intrusions into their privacy.”²⁴²

At present, there are very few controls in place governing the use of UAS by Canadian policing bodies, according to a November 2013 report by Block G Privacy and Security Consulting. In the report it states that “until national policies are established or court challenges arise . . . the use of UAVs by Canadian policing bodies will likely continue to be somewhat ad hoc and primarily constrained by the SFOC process and [law enforcement agencies’] interests in avoiding public pushback of UAV-based practices.”²⁴³ In order to limit the social harm of police UAS operations, there needs to be clear and precise formal controls by way of regulations. Both civil liberties organizations and privacy agencies need to play a part in drafting the information collection components of any future legislation. Transport Canada needs to heed the concerns and expertise of these organizations, otherwise future litigation may lead to the use of UAS not meeting the privacy expectations of the nation’s citizenry.

Search and Rescue

One of UAS of the many uses that should be promoted and used more regularly by Canada’s police forces is for search and rescue operation assistance. In May 2013, the Saskatchewan RCMP reported the first life saved by a drone, a new milestone for UAS technology.²⁴⁴ The police used a small Draganflyer X4-ES helicopter UAS to locate an injured man whose car had flipped off the road into a remote, wooded area. The man inside managed to call 911, but he did not know where he was and he was only wearing a t-shirt while outside it had plunged to near-freezing temperatures. The police had originally deployed a “regular, manned helicopter equipped with night vision to try and find him, but they weren't able to in an initial sweep of the area.”²⁴⁵ The RCMP eventually deployed their UAS which was equipped with an infrared camera and flew it towards the last recorded location from the man’s cell phone GPS. The infrared camera picked up three heat signatures 200 meters from the last known GPS

²⁴² Clarridge, Christine. "Seattle Grounds Police Drone Program." *Local News*. The Seattle Times, 7 Feb. 2013. Web. 3 June 2014.

²⁴³ Santry, Charlotte. "Droning On." *Canadian Lawyer*. Canadian Lawyer Magazine, 3 Feb. 2014. Web. 12 Mar. 2014.

²⁴⁴ Franzen, Carl. "Canadian Mounties Claim First Person's Life Saved by a Police Drone." *Policy and Law*. The Verge, 10 May 2013. Web. 2 June 2014.

²⁴⁵ *Ibid*

location, where fire department members found the driver “curled up in a ball at the base of a tree next to snow bank.”²⁴⁶ According to the RCMP’s website, without the UAS and its infrared camera, “searchers would not have been able to locate the driver until daylight.” Without UAS, this man would have frozen to death before he could have been reached.

The use of UAS for search and rescue operations is slowly gaining momentum. Most recently, a photographer from New Brunswick who used UAS to capture popular tourist attractions volunteered his aircraft to search along a river for a missing canoeist.²⁴⁷ He also belongs to an international organization called SAR Drones, which consists of UAS operators who donate their time and equipment to local search and rescue organizations. The organization is also dedicated to increasing awareness about the benefits of UAS technologies.

In the U.S, the search and rescue non-profit, Texas EquuSearch has “coordinated over 1400 searches in 42 states and eight foreign countries, and has found over 300 missing people alive.”²⁴⁸ However, despite the success of this organization, the FAA has ordered it to stop using UAS in its search and rescue missions. Texas EquuSearch has recently filed an appeal before the federal Court of Appeals in Washington D.C, which claims that they have been using model aircraft to conduct searches since 2005 and that they do not charge for its rescue missions and its operators are unpaid volunteers.²⁴⁹

In a country the size of Canada, UAS would be an ideal technology for search and rescue operations. Not only can UAS stay airborne for longer, at about \$500 an hour, UAS are also cheaper to operate than helicopters, which can cost as much as \$1,700 to rent for an hour and they must periodically refuel.²⁵⁰ UAS could also cover a wider area in searches and reduce volunteer’s exposure to hazardous terrain. However, search and rescue operators currently still must follow Transport Canada guidelines and file for a SFOC the same as any other commercial operator. Since approval of the SFOC can take weeks, this would be unfeasible for a search and rescue operation where time is of the essence. If Transport Canada can implement regulations

²⁴⁶ "Single Vehicle Rollover – Saskatoon RCMP Search for Injured Driver with Unmanned Aerial Vehicle." *RCMP in Saskatchewan*. Royal Canadian Mounted Police, 9 May 2013. Web. 2 June 2014.

²⁴⁷ "Drone Aids in Maritime Search and Rescue." *CTV Atlantic*. CTV News, 23 May 2014. Web. 2 June 2014.

²⁴⁸ Goglia, John. "Search and Rescue Drone Operator Challenges FAA Authority In Federal Appeals Court." *Forbes*. Forbes Magazine, 21 Apr. 2014. Web. 2 June 2014.

²⁴⁹ *Ibid*

²⁵⁰ Ferreras, Jesse. "Drones Could Help Search and Rescue In B.C." *Huffpost British Columbia*. The Huffington Post, 23 Mar. 2014. Web. 2 June 2014.

that recognize the benefit of UAS in search and rescue, more time, resources and ultimately lives will be saved.

Firefighting

Wildfires can destroy thousands of hectares each year and incur very high environmental and economic costs. Forest-fire fighting is an extremely dangerous activity that requires significant resources and leads to many casualties every year. In many cases, it is the lack of information on the state and evolution of the front which is the cause of many accidents.²⁵¹ Common fires in urban areas which first responders face every day can be equally as dangerous. When a fire rages inside a building, the structural integrity is compromised, causing roofs to collapse and walls to push out which can kill firefighters.²⁵² When an industrial location experiences a fire emergency, first responders need information quickly to avoid a dangerous situation, such as what sort of materials are on the site and could they pose a serious threat. A DJI Phantom off-the-shelf UAS was deployed recently in Connecticut to monitor a blaze at a local quarry and a potential disaster was averted.²⁵³

Currently, wildfires on Alaska's Kenai Peninsula are being monitored by a ScanEagle UAS, which can fly up to 22,000 feet and remain airborne for 20 hours.²⁵⁴ Having recently received permission from the FAA to fly, the ScanEagle's infrared camera shows the contrast of cold and hot areas and is being used to map boundaries and hotspots.²⁵⁵ This recorded video is given to fire officials who can then plan the best way to extinguish the fire. Similarly, when wildfires raged in the Sierra Nevada in California, a national guard Predator UAS was used to give firefighters battling the blaze almost immediate views of any portion of the flames as they chewed through rugged forest.²⁵⁶ Fire ground commanders were immediately alerted to any new

²⁵¹ Dios, José Ramiro Martínez-De, Luis Merino, Fernando Caballero, and Anibal Ollero. "Automatic Forest-Fire Measuring Using Ground Stations and Unmanned Aerial Systems." *Sensors* 11.6 (2011): 6328-353. Web.

²⁵² Arnold, Tiffany. "Unmanned Aircraft Are Latest Tool for Montgomery County Firefighters." *Gazette.net*, 2 June 2014. Web. 4 June 2014.

²⁵³ Atherton, Kelsey D. "Connecticut Fire Department Gets Help from a Drone." *Popular Science*. Popsci.com, 2 Apr. 2014. Web. 5 June 2014.

²⁵⁴ Balen, Beth. "Alaska Fire Still Raging Now Monitored by Drone Aircraft." *Alaska*. Liberty Voice, 2 June 2014. Web. 15 June 2014.

²⁵⁵ *Ibid*

²⁵⁶ Skoloff, Brian, and Tracie Cone. "Calif. Launches Drone to Aid Wildfire Battle." *The Big Story*. The Associated Press, 28 Aug. 2013. Web. 2 June 2014.

flare-up they otherwise would not have seen as previously as they has previously relied on helicopters that had to refuel every two hours.²⁵⁷

According to Natural Resources Canada, “over the last 25 years, “wildland fires” across Canada have consumed an average of 2.3 million hectares a year.”²⁵⁸ Canada has about 10% of the world’s forests and the costs of suppressing these fires over the last decade have ranged from about half a billion to a billion dollars a year.²⁵⁹ Only 3% of fires grow to more than 200 hectares burned, but they account for 97% of the total area burned across the country.²⁶⁰ These numbers reflect the significant economic resources that firefighting demands as well as the amount of damage that could potentially be caused. Transport Canada needs to be aware that firefighting in Canada could be drastically improved and lives could be saved with the advent of UAS technology. In any future regulations that the department releases, the importance of UAS in the nations firefighting forces needs to be acknowledged.

Conclusion

The development, production and use of military and commercial unmanned aerial systems (UAS) are expanding rapidly in the Canadian context. Borne from the rise in asymmetric battlefields in democratic wars of choice, military UAS have quickly become less expensive to operate, maintain and ultimately acquire. These same qualities have made UAS an indispensable innovation in many established commercial industries. In Canada, these sectors include agriculture, resource exploitation, weather monitoring and scientific research, freight delivery, film and photography, journalism, law enforcement, search and rescue as well as firefighting.

In the first half of the article, the author outlined the historical evolution of unmanned systems technology as well as detailed their unprecedented expansion in the military realm. The author then explained how the utilization of UAS is well-suited for Western democratic militaries who favor lower costs while offering their personnel maximum force protection. Adding to this, democratic militaries see UAS strike capabilities as proportional, precise and scrupulous so as to allow for the greatest adherence to the laws of armed conflict. UAS

²⁵⁷ *Ibid*

²⁵⁸ "Fire." *Natural Resources Canada*. Government of Canada, 2 Apr. 2014. Web. 15 June 2014.

²⁵⁹ *Ibid*

²⁶⁰ *Ibid*

development, production and use are also proliferating around the world exponentially was highlighted with descriptions of how Canadian allies are leading the pack. However, non-democratic nations and terrorist organizations alike have also recognized the value of UAS technology and are developing their own aerial systems in order to pursue their individual agendas. Based on these facts, the author predicted that UAS in the Canadian military will increase in accordance with its Canada First Defense policy.

In the second half of the article, the focus was on the seemingly endless uses that UAS have in the commercial sector with a specific mention of the Canadian context. To start, the author summarized the government regulations in both the United States and Canada in order to demonstrate that that differ wildly and that the latter has the more relaxed rules. With this in mind, the sectors in which the Canadian economy has benefited were showcased with an added reminder that with further favorable federal regulations that recognize each sector's importance, the effectiveness and efficiency of each sector would grow. By illustrating the commercial development, production and use of UAS in Canada, the author argued that the use of commercial UAS in the Canadian context will flourish based on their current level of regulation and significance to the nation's vital economic sectors.

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