Dissertation

Air Power Proliferation: How 'Commercial-off-the-shelf' Drones are being used by Violent Extremist Organisations to Influence The Future of Warfare in the Air

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Biography: Flight Lieutenant Peers Lyle is a trainee fast jet pilot, undergoing Advanced Flying Training at RAF Valley. He joined the RAF in July 2014, commissioning in March 2015. He completed Elementary Flying Training at RAF Wittering in April 2015, and Basic Fast Jet Training at RAF Linton-on-Ouse in May 2016. He graduated with a Master's degree in War Studies in 2018 from King's College, London, upon completion of a Chief of the Air Staff's 'Trenchard' Fellowship.

Abstract: Air power, long the privilege of affluent state powers, is no longer inaccessible for Violent Extremist Organisations. 'Commercial-off-the-shelf' drones have enabled these organisations to build capabilities within the aerial domain. This is challenging the traditional dominance of air power that state powers have enjoyed and has consequences for both the forces operating on the battlefield and the within the world of air power studies. This article is a shortened version of a 15,000-word dissertation written as part of a MA in War Studies at King's College, London. The longer version is available upon request.

Introduction

A hundred years on from the formation of the RAF, the technical capabilities of current air forces are truly remarkable. Modern fighter jets are immeasurably advanced beyond the early aerial capabilities used during World War One, offering political leaders global strike capabilities, from thousands of feet up in the air, almost immediately. However, close to the surface, the employment of aerial assets on the battlefield is changing, and at a rapid pace. The recent conflict in Syria and Iraq has brought attention to an increasingly insidious change, and a new threat in modern warfare - Violent Extremist Organisation (VEO) use of commercially bought drones.[1] Predicted in 2011, John Villasenor commented;

> *There will be imitators – crude at first – but better and better, and while reasonable people can disagree on how long it will take for terrorists, insurgents and other rogue groups to build or acquire weaponised drones that can be guided by video straight into a target, there is really no dispute that it is a question of when and not if. The day will come when such drones are available to almost anyone who wants them badly enough.*[2]

Following the proliferation of drone technology, air power, long the privilege of advance state powers, is now accessible for VEOs. 'Commercial-off-the-shelf' (COTS) drones have enabled these organisations to obtain and develop warfighting capabilities within the third dimension of the battlespace. Subsequently, nation states can no longer guarantee they own the airspace above the forces they are supporting, and this new VEO capability has already proven itself to be a deadly weapon.[3] As globalisation and the proliferation of ideas continues, it is likely that this capability becomes an increasingly potent threat. It is this developing situation that is the focus of this article.

This subject will be evaluated in three sections. First, the nature of COTS drones will be analysed, focusing on why and how VEOs are able to access COTS drone technology. Second, how VEOs are employing COTS drones on the battlespace will be evaluated, with regards to the four key roles of air power; Attack, ISR, Air Mobility and Control of the Air. Third, this article will offer insight in to what the employment of this new technology means for both military organisations, and within the wider discipline of air power studies.

As Dr Brian Jackson, a senior physical scientist at the Rand Corporation, identified, 'the relationship between the technology of terrorism and the technology of those fighting… [is] one of the more important modern arms races, not between superpowers in missile construction, but between small groups and states vying for the ability to either perpetrate or prevent low intensity conflict'.[4] Indeed, Western forces are well within an arms race in the use of COTS drone technology, and the commercial nature removes a significant element of control. H G Wells commented that 'once command of the air is obtained, the war becomes a conflict between a seeing host and one that is blind'.[5] However, it is the blinding of the enemy that is exactly what militaries are now struggling to do. To ignore this new capability would be a

serious error for Western forces in dealing with VEOs, and this assessment offers insight into the gravity of this new capability.

How and why VEOs access COTS drone technology

Warfare is a business of survival. Whether a survival of one idea over another, or one organisation's will over their enemy, the stakes involved cannot be underestimated. Indeed, to mobilise and legitimately use destructive force cannot be a decision taken lightly, and this is often cited as a limiting factor in counter-insurgency operations for Western nations.[6] The aerial domain offers key advantages within warfare. Subsequently, it is unsurprising VEOs have looked to pursue aerial capabilities and use innovation to develop the potential COTS drones offer. Therefore, it is important to look at what it is about COTS drones that make them such an attractive option for VEOs.

In warfare, new technologies can very quickly alter the battlespace. It is important to highlight that whilst this article does not argue that COTS drones will have an effect on a scale seen in the past, there are two facets of this type of technology worth noting. First, the examples and techniques evaluated here are in their infancy, and history implies they will only continue to develop greater potency. Second, the age of globalisation and the unprecedented access to information would imply the rate of change is going to be steeper than in the past. As noted by Paul Scharre, 'the history of revolutions in warfare has shown they are won by those who uncover the most effective ways of using new technologies, not necessarily those who invent the technology first'.[7]

This section will evaluate how and why VEOs access COTS drone technology in three parts. First, it will highlight the symbolism of drone technology for VEOs as they look to grow the legitimacy of their organisations. Second, the key characteristics of COTS drones that enable their proliferation will be assessed, drawing focus to their commercial characteristics. Third, an analysis will be carried out as to how VEOs are able to source COTS drones. This will be valuable preparation for the subsequent section on how VEOs are employing such assets.

Symbolism of drones

Drones hold a particular aura on the battlespace. This stems from their symbolism of the anti-terrorism campaign in the Middle East and North Africa (MENA) region, coupled to their method of air power delivery – invisible, permanent and perceptively uncontestable for the VEOs that they target. As such, to achieve even a moderate level of technical ability within this arena is a key aim of organisations looking to build their legitimacy. Western use of drones has engendered a symbolism surrounding such technology, and VEOs are exploiting this symbolism, both in the justification of their actions, and by pursuing similar capabilities.

VEOs operate in conflicts that are fought over the perception of a target audience. This applies both domestically, focusing on the support network VEOs require, and the international actors

that the organisations aim to undermine. In the fight for this perception, VEOs are using drones as more than just a physical weapon, but as a symbolic one. The heavy focus on drones in the rhetoric and propaganda realised by VEOs supports this conclusion, and by May 2017, Bellingcat had identified 121 'drone strike' propaganda videos released by ISIS.[8,9] The importance of credibility and legitimacy for VEOs cannot be underestimated. Indeed, 'allegiance is transferred from regime[s] to revolutionaries by shifts in the popular conception of relative credibility and legitimacy'.[10]

Interviews conducted by the Armament Research Services (ARES) with 'Syrian sources have indicated that there is a certain 'prestige factor' associated with operating [drones] – even small COTS models – in support of combat operations'.[11] Similarly, both Hamas and Hezbollah have been very vocal in their use of drones to build their legitimacy, though it should be noted, these have been both military and COTS assets. Hassan Nasrallah, the Secretary General of Hezbollah, claimed that the 'possession of such an aerial capacity [drones] is a first in the history of any resistance movement in Lebanon and the region'.[12] Similarly, Hamas has used drone technology to improve recruitment, with Izz al-Din al-Qassam dedicating Hamas' drone capabilities to the Palestinian Youth.[13] The symbolism of drone technology has not gone unnoticed by VEOs, and COTS drone technology has enabled them to engage with this characteristic.

The nature of COTS drones

This article focuses on commercially available drones, and in doing so, it highlights some important characteristics and nuances of this technology, notably; cost, simplicity of operation and ease of modification – all driven by the commercial sector. The combination of such characteristics leads to COTS drones being a very effective technology for VEOs.

The commercial nature of these technologies drives the cost of accessing such capabilities down. This is vital for VEOs who have a more limited access to financial resources than the state actors they compete with, and results in COTS drones being very attractive assets for such organisations. Pablo Chovil commented that 'the value of these devices, repurposed into weapons of war, far outweighs the price paid by the insurgent and extremist organisations that wage war against state governments'.[14]

Dà-Jiang Innovations (DJI) is one of the leading companies in commercial drone technology, accounting for roughly half of the drone market share in North America in 2016.[15] This dominance only exists in the market for drones costing over $500 USD, whereas below this value, 'there are hundreds of companies competing'.[16] As such, one is able to purchase HD-recording capable drones with remarkable capabilities for under $200 USD. ISIS showed itself to be adapt in using both quadcopter and fixed wing drones, both easily accessible on the open market.[17] A 2014 propaganda video by ISIS shows the use of a *DJI Phantom* quadcopter, with live video streaming.[18] With a range of just under 5 kilometres, and an endurance of 30 minutes, the capabilities offered by drones of this style are disproportionally

significant compared to its cost.[19] Likewise, analysis later in this article will show fixed wing drones costing approximately $200 USD (*Skyhunter FPV* and *X-8 Skywalkers*) have been used by ISIS in the ISR and Attack roles.[20] The minimal cost of COTS drones has enabled a wide range of actors to access of this technology, and is a key characteristic in their use by VEOs.

COTS drones are designed for the commercial user, and as such, cover a wide range of capabilities depending on the customer requirements. Furthermore, they are designed to be as simple to use as possible. Aided by miniaturised technology, the capabilities afforded to an untrained user by COTS drones is significant, and this ease of operation is a key benefit for VEOs using COTS drone technology. Driven by the highly competitive commercial market, there is a clear necessity for companies to continually improve their products. As such, the development of new technology and materials is resulting in them becoming easier to operate, and at a lower cost. Similarly, technologies that aren't designed specifically for COTS drone performance are influencing the capabilities of these assets. For 'each jump in camera technology has corresponded with a jump in COTS small [drone] capability',[21] from which VEOs can benefit.

There is a significant difference between procuring new technology and using such technology.[22] The knowledge to operate such capabilities comes in two forms; explicit and tacit, and 'it could be argued that it is tacit knowledge which makes it possible to effectively apply and use explicit knowledge'.[23] Whereas the employment of more complicated technology, like the incorrect use of a SA-11 system in the downing of Malaysia Airlines Flight MH17,[24] can have consequences far beyond those intended. The level of drone technology seen on the battlespace has resulted in capabilities that are both extremely easy to predict and employ. Modern 'plug-in-and-play' drones are simple enough that the expertise requirements for effective operation are becoming less important. Hobbyist users have demanded these requirements, and VEOs have benefitted as such. However, whilst the simple operation of drones is now easily achieved, causing the desired effects on the ground still takes a level of knowledge that offers Western forces an opportunity to negate some of the capabilities that VEOs currently enjoy.

COTS drones have shown themselves to be adapt to modification, in turn developing their capabilities significantly. Innovation and new designs have been seen worldwide, offering insights into concerning new methods that VEOs could use to employ COTS drones. The US has seen both the successful firing of a hand gun and the mounting of a flamethrower from a remotely-controlled COTS drone.[25] Open source information allows for other users to learn about these capabilities, including the software *OpenPilot*, that allows 'developers…[to] download the bill of materials, circuit diagram and software to build their own autopilots'.[26] Concerningly, ISIS documents showed evidence of over ten workshops in Mosul being used to develop drones into weaponised versions.[27] The ease with which these assets can be modified only adds to the attractiveness of COTS drones for VEOs.

Ultimately, COTS drones 'provide [VEOs] with advance capabilities which offer tactical flexibility without the requirement for a complex support network, making them ideal force enablers for asymmetric and 'hybrid' conflicts'.[28] As cheap, highly portable systems, COTS drones offer VEOs a 'distinct tactical advantage for modern asymmetric warfare'.[29] Such is the importance of these characteristics that Lt Gen Jack Shanahan, the US Director for Defence Intelligence, summarised 'the most important statement he could make surrounding the drone concern [was] that power, payload, endurance and autonomy of these devices are rapidly increasing while costs are rapidly decreasing'.[30]

How VEOs access COTS drones

As outlined, COTS drones have certain characteristics that make the technology attractive to VEOs. However, how VEOs access COTS is of vital importance in assessing the threat it poses. Jackson commented that it is often the effects of new technology that gets attention, but the procurement of such is key.[31] VEO access of COTS drones will be assessed in three parts; proliferation of the technology, the spread of ideas (both driven by globalisation), and the lack of coherent international response to these organisations. For Western forces aiming to deal with this capability, preventing VEOs accessing the technology offers a method to combating the threats observed. However, in the globalised market space, it is proposed this will be very challenging.

The globalised market is an ideal environment for the proliferation of COTS technology, as global logistical chains, mass movement and worldwide communications make, by design, obtaining these technologies relatively simple. Current VEOs operate in what Rupert Smith coined as 'wars amongst the people'.[32] As such, intervening forces try to build stability, security and a sense of 'normality'. In doing so, the use of embargos, sanctions and preventing the movement of goods, must be carefully considered. As noted by Jackson, 'because of the economic importance of technology diffusion in the economic realm, a great deal of effort has been devoted to designing strategies to remove roadblocks to effective technology use in commercial processes and product manufacture'.[33] It is within this ambiguous flow of goods that COTS drones and their associated systems can slip through unnoticed. The sheer mass of global markets, which is difficult to control, makes the proliferation of COTS drone technology relatively easy. This applies to both hardware and software – as online access for drone software is developed by companies, it can easily be exploited by VEOs in their pursuit of maximising the effectiveness of their assets.

It is important to note that the effects of the globalisation are not limited to the proliferation of drone technology to VEOs. The interconnectedness that comes from the internet has allowed VEOs to access not only the technology, but also the *ideas* surrounding both their procurement, and application. This provides a method that importantly, comes with minimal risk.[34] Worldwide communications and the internet has led to the proliferation of ideas at a rapid rate, which, in turn, influences the employment of COTS drone technology by VEOs. Indeed, this article is focused on what is likely to be the beginning of a capability VEOs may

enjoy for many years to come, and it is likely that VEOs will try to employ this capaility in future conflicts. The inspiration other actors may gain from the proliferation of ideas was highlighted by the presence of 'two drones among the material seized in the house of the militant who carried out the attack at the Reina night club in Istanbul'.[35] The idea that drones can provide new and effective capabilities is spreading.

Conflict Armament Research (CAR) carried out a three-year investigation into the weapons of ISIS, publishing a 200-page report in December 2017. Their 'findings are a stark reminder of the contradictions inherent in supplying weapons into armed conflicts in which multiple competing and overlapping non-state armed groups operate'.[36] Indeed, focusing on the complex geopolitical situation of the MENA, there is distinct lack of coherence in the response to VEOs from international actors. This confusion is ideal for the proliferation of technologies throughout the battlespace. The porous borders surrounding the region acts as routes not only for foreign fighters, but also for equipment required to sustain the conflict. Whilst not explicitly drone technology, results from the CAR report 'underscore[d] the predominant role of the Turkish domestic market as a source of [IED] precursors'[37] for the conflict in Syria and Iraq. It is within this chaotic battlespace that VEOs are able to exploit their access to a globalised market, from which access to COTS drone technology is possible.

Conclusion

Drones are symbolic of Western military dominance, and the employment of COTS drones by VEOs offers a way for these organisations to build legitimacy. ISIS, Hamas and Hezbollah have all paid specific attention to drone technology in their propaganda and when coupled to the innate advantages that the aerial domain offers, it is unsurprising that it has been a technology VEOs have looked to develop.

This development has been aided by some key characteristics of COTS drones. Their low cost, ease of operation and ease of modification, combine to make them an attractive new capability that VEOs are looking to exploit with minimal investment. Whilst there is a requirement for additional knowledge to maximise the effectiveness of such a capability, modern 'plug-in-and-play' designs allow for technology that is very simple to operate. This design is inherent in the commercially-driven sector, and the target audience of drone development.

The environment within which VEOs operate lends itself to the access of commercial technology. Globalisation has increased the proliferation of this technology, both on the international market and online, providing easy access to hardware, software and the inspiration required to use such technology. The technology found on the battlefield in Syria and Iraq emphasises this point, and the flow of commercial products from surrounding nations highlights the porous membrane that surrounds the current conflicts in the MENA. It is likely future VEOs will look to build on what the technology offers, and one would expect the presence of COTS drones in the battlespace to increase.

VEO use of COTS Drones

The first recorded combat death from an ISIS operated COTS drone occurred in October 2016. A Chinese built *X-8 Skywalker*, captured by Kurdish forces, was laden with explosives. The subsequent detonation caused the death of two Kurdish soldiers, injuring a further two French Special Forces Commandos.[38] A simple delayed fuse, on a cheap expendable drone, showed the world a worrying new capability ISIS were looking to develop. The effects of drone capabilities used in the conflict in Syria and Iraq have been significant. Indeed, 'an Iraqi general…stated that anti-drone technology [was] their top necessity'.[39] The employment of COTS drones by VEOs creates capabilities that can have strategic effects far beyond the relatively simplistic tactical employment, further exacerbated by the politically fragile environment of current conflicts. They can be considered as force multipliers, amplifying the efficacy of the weapon systems already in theatre.

The Centre for the Study of the Drone (CSD) identified 38 different models of drones being used in Syria and Iraq during 2016, of which 14 were commercially available or modified such that they were unidentifiable as to their source.[40] This section will analyse VEO employment of COTS drone technology by investigating their capabilities with regards to the four roles of air power; Attack, ISR, Air Mobility and Control of the Air.

Attack

VEO employment of COTS drone technology to directly attack ground targets is at a level of relative infancy compared to other capabilities. However, as drone technology develops, so too can the lethality of attacks that are carried out using them. The potential of this threat has not gone unnoticed, and previously, 'Britain's top commander in [Iraq], Major General Rupert Jones, said that ISIS were using off-the-shelf drones to drop grenades on civilian and security forces in Mosul in inhuman and indiscriminate attacks'.[41]

The reality of employing COTS drones to directly attack ground forces is the addition of a physical dimension to the battlespace. Whereas traditionally VEOs have been operating within a two-dimensional battlespace, employing drone technology has enabled a new route from which attack is possible. The Iraqi Security Force (ISF) led battle for Mosul against ISIS has shown some of the possibilities associated with using drones within the Attack domain. It has been assessed that 'the Mosul offensive has seen this kind of drone warfare [propaganda, ISR, Command and Control (C2)] step up a level, with ISIS employing drones armed with an assortment of different munitions, sometimes in conjunction with other assets, to deadly effect'.[42]

ISIS were not the first VEO to use UAS technology for direct attack within the current conflict in Syria.[43,44,45,46] However, ISIS have added scale to this method, and propaganda released by the group in January 2017 purports to show 20 drone strikes.[47] Whilst the destructive nature of drone delivered weaponry is incomparable to that delivered by Vehicle-born IEDs (VBIEDs), one of the most effective weapons used by ISIS, their employment has significant effects on

the battlespace. It is by using the combined capabilities of aerial attack and ground offensives that the attack capability of VEO COTS drones appears most effective,[48] and draws clear parallels with the coordinated use of Air to Ground fires and ground forces used by Western nations.

The majority of ordinance advertised in ISIS propaganda is small - modified hand grenades and 40mm shells. As such, the kinetic effects achieved by their use is fairly limited. However, there have been reports of ISIS adapting RPGs for use on drones. Evidence of this capability has been found in Deir ez-Zour, Syria,[49] along with reports of their use in Raqqa.[50] Using light munitions has the benefit that they are easily sourced in the current conflict zones, and whilst less effective than mortars, their accuracy can be greater.[51]

The psychological effects of aerial attack by drones is very important. Attack from an aerial threat is a new challenge from VEOs; one that has significant effect on the psyche of both personnel involved on the battlefield, and the perception of popular support required at home for Western forces to legitimise their intervention. COTS drones are quiet and can be inaudible as close as 40 metres depending on wind direction.[52] Once combined with the noise of combat operations, not only do VEOs have systems that may be very difficult to see, but are also effectively silent. To score kills through this method adds a significant propaganda win for VEOs, and the appreciation of such is displayed through VEO portrayal of drone capabilities in media operations.

It is worth re-iterating this technology is in its infancy and with only a small amount of imagination, further capabilities can be envisaged. Swarm attacks, with high numbers of small, weaponised drones, whilst yet to be observed being used by VEOs, could add a very potent new capability to the Attack domain for COTS drones. Indeed, in 2017, Lieutenant General Michael Lundy, Commander of the US Army Combined Arms Centre, commented that 'the use of small [drones] in Mosul right now by [ISIS]…[has] actually gone to almost swarm-level capability in a couple of cases. That is a big area [the US] are learning'.[53]

ISR

Alexandra Sander, Research Associate with the Technology and National Security Program at the Center for a New American Security, commented that 'the ability to conduct persistent, low-cost intelligence, surveillance, reconnaissance is a well-recognised and core advantage of uninhabited systems',[54] and this capability has not been overlooked by VEOs. ISIS are aware of this fact, employing drones for reconnaissance against the ISF in Ramadi during 2015.[55] Similarly, a Turkish military detachment, based in Bashika Camp, Northern Iraq, found themselves exposed to 'intensive harassment fire 15 minutes after identifying a drone'.[56] The aerial view VEOs now enjoy through their employment of drones has provided greater ISR capabilities.

In providing real-time ISR, COTS drones have provided VEOs with the capability to make Indirect Fire (IDF) capabilities more effective, as well as improve the reconnaissance capabilities of targets. A crude, unsophisticated weapon system, such as an unguided mortar, can become

a significantly greater threat if employed with effective ISR. The knowledge and application of ISR to obtain accurate targeting creates a weapon with increased efficacy. This technique has been observed both by Hamas and ISIS, as 'the [latter] group continue[s] to use drones mostly for surveillance, collecting intelligence and guiding mortar, cannonball and rocket fires against static targets'.[57,58] Indeed, ISIS have both an 'Aviation Surveillance Sector' and an 'Airborne Operations Centre' to maximise the effectiveness with which the organisation can employ its drone technology.[59]

The most significant employment of UAS technology within the ISR domain has been the development of an effective C2 network. ISIS have proved very capable in this respect, highlighted by their coordination of VBIEDs. The introduction of drones was a key link to making the threat of VBIEDs an incredibly dangerous capability during Operation Conquest.[60] The aerial view allowed for VBIEDs to be directed around road blocks,[61] and using the natural cover provided by urban warfare, positioned more effectively in order to increase their lethality. With an estimated one million civilians present in Mosul during the operation, the challenge to identify a VBIED from a normal civilian vehicle was already an issue for the ISF. When coupled to the C2 network developed by ISIS, they were able to effectively employ increasingly precise targeting of the ISF through aerial surveillance,[62] with the capability to not only effectively target columns of Iraqi troops, but also prioritise and target the most valuable vehicle within that target set.[63]

The employment of VBIEDs in Eastern Mosul caused significant casualties amongst the ISF. Over 900 attacks were recorded during the efforts to liberate the city, causing 40% of Iraqi Special Forces to be injured or killed.[64] The increased efficacy of these very crude weapon systems was a key capability that COTS drones enabled during the fight for Mosul. The employment of COTS drones by VEOs in the ISR role offers a key capability, at a minimal cost or risk to the organisation. ISR was previously a missing link for VEOs, which using COTS, has now been partially closed.

Air Mobility

The extent to which COTS drones have been used by VEOs in the Air Mobility role has thus far been fairly limited, but there have been instances within criminal organisations where their potential has been displayed. Therefore, it is important not to ignore this capability.

As the technology develops, the Air Mobility potential of COTS drones increases. The introduction of greater autonomy, allowing drones to transport equipment with pre-loaded GPS coordinates and minimal input from any ground operator, offers VEOs a new method of smuggling equipment, finances and other assets across a battlespace. This has been observed in the operations of Mexican cartels, with COTS drones used to deliver drugs across the US-Mexico border using pre-set GPS locations. US Security Services estimate that over 150 smuggling flights were carried out in 2014 by drones across the border.[65,66]

More importantly, COTS drones offer a method of smuggling with minimal risk – much less so than using human traffickers. The current payloads that can be delivered are very small

compared to manned smuggling, but so too are their 'footprints' making them more elusive to security services. Future developments to COTS drones may overcome the payload limiting factor. Amazon have shown themselves to be pioneering drone delivery systems that will drive the technology to having larger payloads, with greater endurance.[67]

As highlighted, the Air Mobility role is limited by the technology available. Nevertheless, the use of drones for Air Mobility is moving beyond its infancy. The Syrian Airlift Project has delivered aid to Aleppo using custom made drones,[68] and it is likely the minimal-risk method drones offer for transporting assets will increase their use in this role by VEOs. COIN operations aim to restrict the freedom of manoeuvre of VEOs, and COTS drones offer the potential for these organisations to overcome this issue.

Control of the Air

The introduction of COTS drones in to the battlespace draws focus on issues surrounding Control of the Air in warfare. In recent conflicts, Western forces have been the dominant presence among air assets present in theatre - this is no longer the case. COTS drones have challenged the assumed ownership of airspace by Western forces.

Giulio Douhet, an Italian General and air power theorist, identified the first aim in conflict was to obtain *Command* of the Air.[69] He defined this as the 'means to be in a position to prevent the enemy from flying, while retaining the ability to fly oneself'.[70] Absolute Control of the Air can, therefore, be interpreted as having complete freedom of manoeuvre of your own assets, and complete denial of manoeuvre for your enemy's air assets. With the proliferation of surface to air missiles, and the financial and political consequences of losing air assets on operations, it is rare for *complete* freedom of manoeuvre to be achieved. Indeed, during World War II, the RAF achieved *sufficient* Control of the Air to deter Hitler's desire of invading the mainland of Great Britain, but as shown by the Nazi Blitz offensive, the German Luftwaffe were still able to employ air assets over the UK. This example highlights some nuances of how Control of the Air is employed. The term has both a *geographical*, and a *temporal* dimension – localised air superiority.

The introduction of COTS drones on the battlespace has enabled VEOs to contest this idea of air superiority, as modern air forces are unable to fully control the airspace close to the ground. This article does not argue that VEO use of COTS drones will enable these organisations to contest Western air superiority in the upper airspace regions of a conflict.[71] However, as has been shown, COTS drones are enabling VEOs to have enjoy some of the privileges of air power in the air space close to the surface of a conflict. The ideas surrounding the traditionally assumed Western Control of the Air are being contested.

It has been commented that ISIS 'owned the sky under coalition air power'.[72] Indeed, 'US Central Command reported that in the last two months of 2016, ISIS drones were seen every day in Mosul. By February 2017, this had risen to 10-15 ISIS drones every day'.[73] Despite all the air

power in the upper airspace region, Western air forces were not able to exercise Control of the Air in the lower airspace of the conflict. This is likely to be a growing issue and as the proliferation of this technology continues, there will be greater employment of these assets in theatre by all sides involved in a conflict.

Whilst the counter-drone technologies being developed are not the focus of this article, certain issues brought about by the commercial development of these assets need to be noted. Increasing autonomy for COTS drones, having already been proven useful in the Air Mobility role, also have an effect when looking at contesting Control of the Air. Denying the use of these assets by interrupting data links only works when data links are available. With any increase in automation, the chances of interrupting the operation of COTS drones decreases – a concerning trend for the development of counter-drone technology. Similarly, increases in automation will allow for greater numbers of assets to be operated by a single user, aiding the effectiveness of the system, and offering a route to swarm-levels of capability.

Coordinated swarms of COTS drones offers a potential new method for VEOs to contest Control of the Air. A 2016 video released by the US Department of Defence shows 103 micro-drones being launched from F-18 fighters to test swam technology.[74] In this sense, swarming 'refers to a number of autonomous aircraft, networked together, and working towards a common goal'.[75] With a wingspan of 12 inches, the microdrones were 'seen flying through the air like a swarm of high-tech bees'.[76] Similarly, there are examples of major companies using swarms of coordinated drones for entertainment and marketing.[77] Whilst this example shows coordination of drones beyond the capabilities of VEOs to date, they highlight issues that may well be prevalent in the future.

An effective coordinated swarm of micro-drones offers the potential to damage both air and ground assets in theatre - whether used as weaponised platforms in the Air to Ground role, or by swarming an area that could inhibit flight of aircraft within that airspace. With the consideration applied to the highly asymmetric cost of a swarm of low-cost COTS drones against very expensive Western air assets, it is feasible a swarm of COTS drones could effectively deny an airspace region. Although VEOs achieving overall air superiority would be doubtful, the denial of airspace to Western forces would remove a huge advantage that VEOs would otherwise have to contend with.

Conclusion

VEOs have shown themselves to be adapt in using COTS drones to achieve a level of air power, without possessing an air force. Although the effectiveness of COTS drones in the Attack role is less when compared to ground fires, VEOs have used these assets to drop primitive munitions on enemy forces. In the ISR domain, COTS drones have already proven themselves as highly effective assets, providing aerial control for ground fires and a primitive C2 network for VEOs. ISIS has used the latter to improve the effectiveness of its VBIEDs, even more so when coordinated with the force dispersal effects of aerial attack. Currently, VEO use of COTS

drones in the Air Mobility role is fairly limited. However, as the technology develops, it is likely this minimal-risk method of transportation will become a useful option for VEOs. Indeed, the criminal world is using such methods frequently. The use of COTS drones by VEOs also adds complications to the assumed Control of the Air Western militaries have previously enjoyed. As technology improves, with developments in automation and swarm technology, it is possible that Western Control of the Air can be challenged further. Indeed, it is the future that will be the focal point for the last section of this analysis.

Future Considerations

The introduction of COTS drones on to the battlespace offers both new challenges and opportunities. These apply to military and non-military organisations, and considering the rate of development of these assets, proactivity is key if these situations are to be exploited effectively. Kelley Sayler has argued that 'hobbyist drones are often less discussed within a security context, thought they perhaps hold the greatest potential for achieving overmatch against the [US] in the near term'.[78]

Military Considerations

As outlined, VEOs are able to obtain elements of air power without the need for an air force. This in turn demands a reaction from military and government organisations if they are to maintain the upper hand in this domain of warfare. The Birmingham Policy Commission commented that 'as the nature of British air defence changes, the RAF and the MOD should consider, with civil authorities, the implication of the malign use of [drone] technology by state and non-state actors'.[79]

For Western governments and militaries, containing COTS drone technology is not an option. The proliferation of hardware, software, and more importantly, the idea that 'drones are a game changer in the wrong hands',[80] means that controlling the access to this technology is not viable. Sander has argued that 'limiting the spread of this technology is neither practical nor probable with the growth of commercial drones, international sales…and increases in indigenous production'.[81]

Anti-drone technology needs to be cost-effective, which is particularly challenging considering the low cost of COTS drones being a key characteristic. Tamir interceptor missiles in Israel's Iron Dome cost $100,000 USD, and it is challenging to justify their employment against a cheap drone, with unidentified intentions.[82] Whilst specific anti-drone techniques being developed are not the focus of this article, the release of $226.8 million USD for counter-drone solutions by the US Department of Defence in the 2017 Financial Year implies steps are being taken in the right direction.[83]

In addition to anti-drone technology, education is required. The employment of COTS drones by VEOs, in hindsight, is not remarkable. COTS drone technology needed to reach a sufficient level of capability before being useful to VEOs, and it begs the question as to

whether there are other new, commercially developed technologies that could subsequently be seen on the battlefield in decades to come. The threat of COTS drones was overlooked, to the extent that Lieutenant General Stephen Townsend, Commander of Operation Inherent Resolve,[84] said 'the number one force protection priority in the fight against [Daesh] was to defuse drones'.[85] Predicting such developments will be an expensive and challenging pursuit, but a necessary endeavour if states are to maintain their asymmetrical advantage over VEOs.

The use of COTS drones on the battlefield does offer opportunities to state militaries. In the conflict between the Ukrainian Government and the Donetsk People's Republic, the Ukrainian military have used COTS drones.[86] Similarly, their aforementioned use by the Syrian Airlift Project offers an insight in to aid and resupply operations that COTS drones could be used for by state forces in the future. Within the idea of a modern arms race, the ISF copied ISIS's tactics, by purchasing 'their own commercially available drone[s], offering the same low-cost, crystal-clear image and user interface, and used them offensively'.[87] In addition, the idea of weaponising a cheap COTS drone, paired with Virtual Reality goggles to improve handling characteristics,[88] to create a flying weapon that ground forces can use, offers the military personnel exciting new capabilities. Learning from VEO use of COTS drones can offer fresh insights into military requirements.

Theorist Considerations

As a developing technology, being employed on a scale unseen before, the use of COTS drones is a fast moving and challenging new characteristic on the battlefield. As such, the questions it poses in the realms of air power and international law need to be considered.

In recent unrest in the Gaza Strip, Israel were recorded using an armed COTS drone to drop tear gas on Palestinian protestors.[89] As highlighted by Faine Greenwood et al., 'the IDF's choice to use [an *ISPRA Cyclone* – an altered version of a *DJI Octocopter*] highlights the blurring of lines between consumer and military drones, and their uncertain status under international humanitarian law'.[90] Indeed, 'the growing number of operators, alongside the complex legal and ethical issues raised by the use of armed drones, highlights the urgent need for clear international controls'.[91] As governing bodies and international law struggles to keep pace, the commercial sector is driving capabilities at a fast rate. If any oversight of COTS drones in warfare is to be possible, these developments need to be tackled soon.

It is arguable that COTS drones will be used in all conflicts in the future, and therefore such a technology deserves attention within academic study. This includes the position it holds in both conventional war and sub-conventional threshold conflicts, the implications it brings in terms of commercially sourced assets on the battlefield, and the refocusing of the moral and ethical considerations of drone use. Such analysis is required to educate and inform the debates surrounding this new technology, in order that both militaries and international bodies can counter, and in turn employ, COTS drones on the battlefield.

Conclusion

In 2012, the Islamist Abu 'Ubayda al-Maki said;

> *'With the availability of these great inventions, there is only one thing left, which is the unmanned aerial vehicle. It is the sought hope and the unachieved dream....why don't the brothers build planes like these or buy them from the market, load them with explosives and target military bases, or even develop these planes; and make them fly for longer distances? These planes can be the best supporters for mujahidin and they can [be] easily found [in] toy stores.'*[92]

Unfortunately for Western forces, his claim has manifested itself into reality, and the introduction of COTS drones on the battlefield has enabled VEOs to access air power without the possession of an air force. As the weaker actor on the battlefield, accessing such a new domain offers higher marginal gains to VEOs, as provides a new route to challenge Western military dominance.[93]

The importance of the aerial dimension in warfare is evident by the priority Western governments place on it as a method of pursuing political aims. The introduction of unmanned systems into air power has further developed the capabilities offered by air forces, but in turn, has raised challenging moral and ethical considerations in their use. Ultimately, US-led drone use against VEOs has taken on a symbolic meaning beyond its kinetic effect and this type of technology has plagued VEOs since 9/11. However, developments in the commercial technology sector have allowed VEOs to fight back.

COTS drones offer a route for VEOs to contest in the aerial dimension, and by possessing such a symbolic capability, VEOs are able to build their own credibility. As commercial products, COTS drones offer VEOs a cheap, easily accessible and simple to use asset that has benefits that easily surpass their price tags. In complex conflicts, with access to global markets and the proliferation of ideas through the internet, VEOs are able to access this game-changing technology with relative ease.

Despite the relative infancy of the technology, VEOs, have shown themselves as being able to employ COTS drones effectively on the battlefield. In both the Attack and ISR roles of air power, COTS drones have shown themselves to be have serious potential, no more so than in the ISF operation to liberate Mosul from ISIS. The criminal world has displayed possibilities COTS drones offer within the Air Mobility role, and this is something that is likely to develop as the technology capabilities improve. COTS drones have also challenged Western Control of the Air. For all the technological dominance of Western militaries, VEOs are able to contest ownership of the lower airspace region in the MENA today.

As Western governments, under fiscal constraints, look towards the future, it is important to know the seriousness of likely threats. COTS drones have already proven themselves effective

on the battlefield, and the market for such assets is rapidly growing. It is vital therefore for militaries and security forces to plan appropriately, under the pretence that VEOs already have this capability – it is too late for prevention to be the answer. Similarly, the use of commercial products on the battlefield is another contribution to the ambiguity in conflicts being fought today. Legal frameworks appear thin when applied even to military drones, and the addition of state and non-state use of COTS drones is even a step further away from the rules based international system Western governments seek to defend.

Notes

[1] There are many terms used for these systems, including 'drones', 'remotely-piloted air systems' and 'unmanned aerial vehicles', with each term having its individual nuances and implications. For ease of reading, and as an acceptance of most academic as opposed to military authors, this thesis will use the term 'drone' throughout.

[2] Don Rassler, *Remotely Piloted Innovation: Terrorism, Drones and Supportive Technology* (West Point: US Military Academy, 2016), 63.

[3] Nick Waters, "Death From Above: The Drone Bombs of the Caliphate," *Bellingcat*, February 10, 2017. https://www.bellingcat.com/news/mena/2017/02/10/death-drone-bombs-caliphate/

[4] Brian Jackson, "Technology Acquisition by Terrorist Groups: Threat Assessment Informed by Lessons from Private Sector Technology Adoption," *Studies in Conflict & Terrorism* 24:3 (August 2010), 4.

[5] HMG, *Joint Doctrine Publication 0-30 – UK Air and Space Power 2nd Ed.* (HMSO: MOD Shrivenham, 2017), 24.

[6] M Smith and David Jones, *The Political Impossibility of Modern Counterinsurgency: Strategic Problems, Puzzles and Paradoxes* (New York: Columbia University Press, 2015), 169.

[7] Rassler, *Remotely Piloted Innovation: Terrorism, Drones and Supportive Technology*, 62.

[8] Larry Friese, N.R. Jenzen Jones and Michael Smallwood, "Emerging Unmanned Threats: The use of commercially available UAVs by armed non-state actors," *Armament Research Services* Special Report No.2 (February 2016), 51.

[9] Joanna Frew, "Drone Wars: The Next Generation – An overview of new armed drone operators," *Drone Wars UK* (May 2018), 24.

[10] Clive Blount and Charlie Sammut, "'A Gift to Our People': The Use of Drone Technology by Islamist Insurgents," *Air Power Review* Vol. 19 No. 1 (Spring 2016), 16.

[11] Friese, Jones and Smallwood, "Emerging Unmanned Threats: The use of commercially available UAVs by armed non-state actors," 43.

[12] Blount and Sammut, "'A Gift to Our People': The Use of Drone Technology by Islamist Insurgents," 14.

[13] ibid., 15.

[14] Pablo Chovil, "Air Superiority Under 2000 Feet: Lessons from Waging Drone Warfare against ISIL," *War on the Rocks*, May 11, 2018. https://warontherocks.com/2018/05/air-superiority-under-2000-feet-lessons-from-waging-drone-warfare-against-isil/.

[15] April Glaser, "DJI is running away with the drone market," *Recode*, April 14, 2017 https://www.recode.net/2017/4/14/14690576/drone-market-share-growth-charts-dji-forecast.

[16] ibid.
[17] A quadcopter is a 4-rotor drone, able to hover and maintain a stable geostationary position in flight.
[18] Dan Gettinger, "Drones Operating in Syria and Iraq," *Centre for the Study of the Drone* (December 2016), 4.
[19] The RRP for a *DJI Phantom 3* is under $700 USD http://www.argos.co.uk/product/6349772 Accessed 30 Apr 2018.
[20] Serkan Balkan, "Daesh's Drone Strategy – Technology and the rise of innovative terrorism," *Foundation for Political, Economic and Social Research (SETA)* (2017), 17.
[21] Friese, Jones and Smallwood, "Emerging Unmanned Threats: The use of commercially available UAVs by armed non-state actors," 31.
[22] Jackson, "Technology Acquisition by Terrorist Groups: Threat Assessment Informed by Lessons from Private Sector Technology Adoption," 22.
[23] ibid., 9.
[24] Dutch Safety Board, *Crash of Malaysia Airlines Flight MH17 – Hrabove, Ukraine 17 July 2014* (Netherlands: The Hague 2015), 9.
[25] Rassler, *Remotely Piloted Innovation: Terrorism, Drones and Supportive Technology*, 1.
[26] Friese, Jones and Smallwood, "Emerging Unmanned Threats: The use of commercially available UAVs by armed non-state actors," 32.
[27] Balkan, "Daesh's Drone Strategy – Technology and the rise of innovative terrorism," 18.
[28] Friese, Jones and Smallwood, "Emerging Unmanned Threats: The use of commercially available UAVs by armed non-state actors," 10.
[29] ibid., 10.
[30] Mark Pomerleau, "Counter-drone is the new counter-IED," *C4ISRNet*, March 21, 2017 https://www.c4isrnet.com/unmanned/uas/2017/03/21/counter-drone-is-the-new-counter-ied/.
[31] Jackson, "Technology Acquisition by Terrorist Groups: Threat Assessment Informed by Lessons from Private Sector Technology Adoption," 6.
[32] Rupert Smith, *The Utility of Force: The art of war in the modern world* (London: Penguin Books Ltd, 2005), 267.
[33] Jackson, "Technology Acquisition by Terrorist Groups: Threat Assessment Informed by Lessons from Private Sector Technology Adoption," 35.
[34] ibid., 15.
[35] Balkan, "Daesh's Drone Strategy – Technology and the rise of innovative terrorism," 50.
[36] Conflict Armament Research, *Weapons of the Islamic State* (London, Conflict Armament Research Ltd, 2017), 8.
[37] ibid., 110.
[38] Charles Clover and Emily Feng, "ISIS use of hobby drones as weapons test Chinese makers," *Financial Times*, December 11, 2017. https://www.ft.com/content/82a29f96-c9e7-11e7-ab18-7a9fb7d6163e.
[39] Balkan, "Daesh's Drone Strategy – Technology and the rise of innovative terrorism," 43.
[40] Gettinger, "Drones Operating in Syria and Iraq," 1.

[41] Balkan, "Daesh's Drone Strategy – Technology and the rise of innovative terrorism," 35.
[42] Waters, "Death From Above: The Drone Bombs of the Caliphate."
[43] Milton Hoenig, "Hezbollah and the Use of Drones as a Weapon of Terrorism," *Federation of American Scientists Public Interest Report* Spring 2014 Vol. 67 No. 2 (Spring 2014), 1.
[44] Waters, "Death From Above: The Drone Bombs of the Caliphate."
[45] Fars News Agency, "Hezbollah Drones Target Al-Nusra Front's Positions at Syrian Border," *Fars News Agency*, September 21, 2014. http://en.farsnews.com/newstext.aspx?nn=13930630001247.
[46] Waters, "Death From Above: The Drone Bombs of the Caliphate."– Evidence subsequently removed from YouTube for violation of the terms of service.
[47] ibid., https://www.bellingcat.com/news/mena/2017/02/10/death-drone-bombs-caliphate/.
[48] ibid., https://www.bellingcat.com/news/mena/2017/02/10/death-drone-bombs-caliphate/.
[49] ibid., https://www.bellingcat.com/news/mena/2017/02/10/death-drone-bombs-caliphate/.
[50] Balkan, "Daesh's Drone Strategy – Technology and the rise of innovative terrorism," 36
[51] ibid., 35.
[52] HMG, *Joint Doctrine Publication 0-30.2 – Unmanned Aircraft Systems* (HMSO: MOD Shrivenham, 2017), 33.
[53] Jed Judson, "Drone Warfare in Mosul Shapes US Army training to defeat airborne threats," *Defense News*, March 14, 2017. https://www.defensenews.com/digital-show-dailies/global-force-symposium/2017/03/14/drone-warfare-in-mosul-shapes-us-army-training-to-defeat-airborne-threats/.
[54] Alexandra Sander, Game of Drones – Proliferated Drones, (Washington DC: Center for a New American Security, 2016), 10 http://drones.cnas.org/reports/game-of-drones/.
[55] Balkan, "Daesh's Drone Strategy – Technology and the rise of innovative terrorism," 10.
[56] ibid., 10.
[57] ibid., 10.
[58] Friese, Jones and Smallwood, "Emerging Unmanned Threats: The use of commercially available UAVs by armed non-state actors," 45.
[59] Balkan, "Daesh's Drone Strategy – Technology and the rise of innovative terrorism," 13.
[60] Operation Conquest was the ISF led mission to liberate the city of Mosul from ISIS control.
[61] Balkan, "Daesh's Drone Strategy – Technology and the rise of innovative terrorism," 25.
[62] ibid., 30.
[63] ibid., 31.
[64] ibid., 33.
[65] Friese, Jones and Smallwood, "Emerging Unmanned Threats: The use of commercially available UAVs by armed non-state actors," 47.
[66] Robert Bunker, *Terrorist and Insurgent Unmanned Aerial Vehicles: Use, Potentials and Military Implications*, (Pennsylvania: US Army War College Press, 2015), 20.
[67] *Amazon Prime Delivery* is a new technology being developed by Amazon for rapid,

autonomous delivery of products to customers https://www.amazon.com/Amazon-Prime-Air/b?ie=UTF8&node=8037720011 Accessed 27 June 2018.
[68] Friese, Jones and Smallwood, "Emerging Unmanned Threats: The use of commercially available UAVs by armed non-state actors," 47.
[69] For the purpose of this analysis, it is argued Douhet's 'Command of the Air' is interchangeable with the more common term today of 'Control of the Air'.
[70] Giulio Douhet, *The Command of the Air*, trans. Richard Kohn and Joseph Harahan (New York: Coward-McCann, 1983), 24.
[71] Exact figures for the altitudes COTS can operate at vary with payload, power systems and the technology as it is developed. For the purposes of this analysis, 'lower' airspace is considered below 3000', whereas 'upper' airspace is seen as 10,000' and above.
[72] Chovil, "Air Superiority Under 2000 Feet: Lessons from Waging Drone Warfare against ISIL."
[73] Frew, "Drone Wars: The Next Generation – An overview of new armed drone operators," 24.
[74] Fox News, "Video shows fighter jets launch swarm of tiny drones," *Fox News*, Janurary 10, 2017. http://www.foxnews.com/tech/2017/01/10/video-shows-fighter-jets-launch-swarm-tiny-drones.html.
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[76] Fox News, "Video shows fighter jets launch swarm of tiny drones."
[77] Drone DJ, "2018 Winter Olympics and Intel's record drone show," *Drone DJ*, February 9, 2018.
[78] Kelly Sayler, *A World of Proliferated Drones: A Technology Primer*, (Washington DC, Centre for New American Security, 2015), 29.
[79] Birmingham Policy Commission, "The Security Impact of Drones: Challenges and Opportunities for the UK," *Birmingham Policy Commission* (Birmingham: University of Birmingham 2014), 78.
[80] Blount and Sammut, "'A Gift to Our People': The Use of Drone Technology by Islamist Insurgents," 2.
[81] Sander, "Game of Drones – Proliferated Drones," 2.
[82] Friese, Jones and Smallwood, "Emerging Unmanned Threats: The use of commercially available UAVs by armed non-state actors," 55.
[83] Jonathan Gillis, "In over their heads: US ground forces are dangerously unprepared for enemy drones," *War on the Rocks*, May 30, 2017. https://warontherocks.com/2017/05/in-over-their-heads-u-s-ground-forces-are-dangerously-unprepared-for-enemy-drones/.
[84] Operation Inherent Resolve is the US military name for operations against ISIS in both Iraq and Syria.
[85] Balkan, "Daesh's Drone Strategy – Technology and the rise of innovative terrorism," 11.
[86] Sayler, *A World of Proliferated Drones: A Technology Primer*, 12.
[87] Chovil, "Air Superiority Under 2000 Feet: Lessons from Waging Drone Warfare against ISIL."
[88] Bunker, *Terrorist and Insurgent Unmanned Aerial Vehicles: Use, Potentials and Military Implications*, 21.
[89] Faine Greenwood and Ossama Zaqqout, "Drones Don't Wear Uniforms. They Should," *Foreign Policy*, May 22, 2018.

[90] ibid., https://foreignpolicy.com/2018/05/22/drones-dont-wear-uniforms-they-should/.
[91] Frew, "Drone Wars: The Next Generation – An overview of new armed drone operators," 6.
[92] Rassler, *Remotely Piloted Innovation: Terrorism, Drones and Supportive Technology*, 9.
[93] Sander, "Game of Drones – Proliferated Drones," 17.