**Defence Research Paper**

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Abstract

Remotely Piloted Air Systems capture the imagination, with emotive ‘Drone Wars’ narratives and widespread speculation. This paper aims to deconstruct the narratives, separate incorrectly conflated issues and dispel popular myths in order to promote debate based on fact. Arguably, many of the issues attributed to drones have little to do with nature of the technology being employed, rather are generic political, ethical and legal debates concerning its use. Challenges to drone development are more perception based and political than technical. The paper concludes that an inexorable rise of the machines to become the future force is unlikely. Instead, across all air power roles, drones will be an adaptable force multiplier, with in-built flexibility through an open architecture systems vision rather than a platform-centric capability focus. Manned aviation is likely to remain for the foreseeable future, albeit as a smaller proportion of the manned-unmanned force balance.
Introduction

‘...commentators speak of a time when air power will be completely delivered by unmanned aircraft; it is not clear exactly when the transition will be complete’.1

Remotely Piloted Air Systems (RPAS) capture the imagination, playing on science fiction fears of human-killing robots, with a sensationalised narrative claiming the inexorable ‘Rise of the Drones’.2 Media ‘Drone Wars’ discourse constantly speculates on extra-judicial, opaque, CIA ‘targeted killing’.3

This paper will argue that such narratives conflate a plethora of subtly but critically separate debates, preventing academically mature discourse on the future of RPAS. Whilst technological progression will undoubtedly influence the composition of the future UK military inventory, the pace and extent of a transition from manned to unmanned air vehicles is neither determined nor inevitable. Once societal wisdom has managed to catch up with technology, most drone developments will arguably be accepted amongst the history of military evolution; lethal robots are a different matter.

More than academic tradition requires, it is essential to define the emotive lexicon of this topic. The paper will then outline a view of future warfare and some legal context. Aircraft design, fragility perceptions and autonomy will be examined, along with airspace integration challenges. Next, cost comparisons between manned and unmanned will be examined, before a broader look at capability debates. Then the paper will deconstruct the narratives on situational awareness, emotional detachment and 'Drone Wars,' before concluding whether RPAS are a future force construct for UK Defence, or whether they form a force multiplying element within a broader force balance.

The piece aims to avoid science fiction speculation, focusing on currently fielded equipment, demonstrated capabilities and mainstream evolution concepts. The analysis will consider those capabilities and roles traditionally associated with larger UK air power platforms; out of scope are the plethora of smaller, man-portable or patrol mounted remote systems inundating the modern battlespace.

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Definitions

Is it an Unmanned Air Vehicle (UAV), an RPAS, a drone, or a robot...should I care?

Defence academia, policy makers and military leadership must be comfortable with the distinctions as they will undoubtedly interact with drone debates. The semantics of language are essential to avoid misinterpretation and allow a mature, informed debate.

A UAV can be defined as a flying machine not containing a human. It is distinct from a guided weapon, such as a laser guided bomb or cruise missile because, although it could carry and launch weapons, the aircraft is not regarded as a single-use warhead delivery vehicle. A UAV could be remotely piloted or could be autonomous.

An RPAS comprises many elements, including the UAV, the Ground Control Station (GCS), the remote communications links, and the aircrew. Considering Reaper, the MQ-9 aircraft is a UAV, whilst aircrew in the GCS controlling an MQ-9 are operating an RPAS.

‘About that word “drone”:...I’ve been corrected...for failing to use terms like UAV or remotely piloted vehicle. Whilst literally accurate, those terms have a clumsy, euphemistic feel. Hence “drones”’. Grossman reflects the understandable trend: when drone will suffice, why should a journalist use more words than necessary, or use publically unfamiliar military acronyms? In academic circles, speakers regularly default to the convenience of drone. Though some may be comfortable with the terminology distinctions, many are not.

If ‘drone’ is transmitted and understood by its definition, ‘a remote-controlled pilotless aircraft,’ then it is appropriate for an RPAS. Unfortunately ‘drone’ can be interpreted simply as ‘pilotless’, allowing ambiguity during debate over the degree of autonomy. ‘Drone’ has become attached to ‘targeted killing’ and ‘Drone Wars in Pakistan’, invoking misplaced prejudice into debate. RPAS is not a euphemistic attempt to dilute lethality perceptions. The military prefers RPAS because it accurately represents the presence of a pilot in the system, hence removes the ambiguity associated with ‘unmanned’.

Military efforts to dissuade the use of drone are perhaps futile, as highlighted by Grossman. Perhaps the military should embrace the term drone, promote separation of the conflated narratives, and set a lexicon precedent between unmanned, remote and autonomous. ‘Manned’ is traditional for human occupied flight, ‘drone’ could denote a remotely piloted vehicle, and ‘robot’ could distinguish a fully autonomous vehicle. A UN Rapporteur uses ‘LARs’ for ‘lethal autonomous robots’, but again the acronym may not be adopted in public circles.

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The US Department of Defence (DoD) defines autonomy on four levels: one is human operated; two is human delegated; three is human supervised; and four is fully autonomous. In level one, all decisions and actions are made by the human. Level two covers vehicle functions, such as automatic pilot systems, that are activated and deactivated by the human. In level three, a system is empowered to make decisions on sensed data but only within the scope of its human directed task, such as a defensive counter-missile system. For fully autonomous activity in level four, a vehicle would be capable of performing tasks to satisfy broad goals outlined by the human, akin to the concept of military mission command. Singer, whose book remains an excellent foundation for remote and autonomous discussions, offers another level in ‘adaptive autonomy’. He describes where a vehicle would learn, update or change its behaviour. A further aspect is ‘collaborative autonomy’, often referred to as a ‘swarm’ concept, in which a number of fully autonomous vehicles coordinate to achieve common goals.

Air power is, ‘the ability to project power from the air...to influence the behaviour of people or the course of events’. This definition focuses on the important element of people: war is a human activity. Whilst technological developments might change the tactics and strategies applied, wars originate from human political discourse, or the failure of that discourse. The four fundamental roles of air power are: control of the air and space; air mobility; intelligence and situational awareness; and attack.

**Future Warfare**

The ‘Age of Uncertainty’ is emblazoned across the 2010 UK National Security Strategy (NSS) and the Strategic Defence and Security Review (SDSR). Will future conflicts be small-scale stability interventions, so called ‘war amongst the people’? Is State warfare against near peer or superior forces redundant? Or will future conflicts demand ‘agile, adaptable and scalable’ military capabilities across all scenarios from peace support to major combat operations?

The Development, Concepts and Doctrine Centre’s (DCDC) Global Strategic Trends provides analysis towards 2040, assessing divergent future outcomes on a scale of probability or plausibility, considering the implications of strategic shocks, and offering deductions on the broad defence and security implications. The document identifies that four dominant, pervasive issues,

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11 ibid., 37-60.
globalisation, global inequality, climate change and technological innovation will affect the lives of everyone on the planet”.13

DCDC concludes that the incidence of future conflict is likely to increase, fuelled by old and new state rivalries and increasingly important ideology, during an unstable transition towards a multi-polar global dynamic, containing an increasing and globalised population, of expanding inequality, with inter- and intra-ethnic tensions, competing for scarce resources.14 Colin Gray sums up the implications: ‘Many people... harbour the noble hope that somehow we will be able to order our security affairs in a much more peaceable manner in the future than we have in the past or present. I share that yearning, but must resist it as a belief’.15

Five ‘C’s pervade the narrative describing future operational environments: congested, cluttered, contested, connected and constrained. A congested, high population density environment leads to a cluttered environment, with adversaries operating amongst civilian actors and objects protected under international conflict norms, thus, ‘given the need for precision, time-critical decision-making, and for discrimination, it is likely that platforms that effectively combine find and attack functions, and which compress the sensor-to-shooter decision cycle, will be required’. Adversaries are likely to contest any and all environments, often using asymmetric or novel methods, due to the diffusion of technology. ‘In the complex battlespace of the future, Western legal and societal norms will place continued constraints on the conduct of operations... these are unlikely to restrict the actions of, or be reciprocated by, potential adversaries’.16

Another aspect of analysis predicts that Western technological superiority is likely to be challenged, perhaps weakening the paradigm that technology can replace mass.17 Notably, ‘there is likely to be significant lags between invention and the development of ethical norms governing their application,’18 as the debates surrounding unmanned aircraft confirm.

The NSS aims to ensure a secure and resilient UK, and shape a stable world, by applying instruments of power to shape the global environment and tackle risks at source.19 The strategy aims to meet these security objectives through five key principles: engaging upstream; maintaining a broad spectrum of military capability; strengthening alliances and partnerships; employing an integrated approach; and flexibility. The adaptable posture vision within the SDSR builds on this:...

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12 Greater than 90% chance.
13 UK, DCDC, Global Strategic Trends – Out to 2040 (Swindon:MOD, 2010), 10.
14 ibid., 15.
16 DCDC, Global Strategic Trends, 88-90.
17 ibid., 17.
18 ibid., 23.
‘No matter how clearly one thinks, it is impossible to anticipate precisely the character of future conflict. The key is to not be so far off the mark that it becomes impossible to adjust once that character is revealed’.21 This wise warning offers little comfort to policy and procurement personnel who must resolve military force structures for an unpredictable future. Many historical examples reinforce the hazard of military prediction: Napoleon dismissed suggestions that ships could sail against the wind by lighting a bonfire under their deck, and heavier-than-air flight was dismissed months before the Wright Brothers achieved their first flight.

Gray places a forward looking historical perspective on the next century and offers sagacious advice. First, he reminds us that technological change has long been the routine, that diffusion is normal, and that development is cyclic between innovation and counter, with no final move. Second, ‘it is likely that this new century will produce scientific surprises of the same order of awesomeness as heavier-than-air flight...nuclear weapons and the...development of the computer’. Yet he reflects that warfare continued through those developments hence he concludes it unlikely that any technological development will end warfare in the near future. Finally, he offers that the incidence and severity of warfare will be driven far more by politics and social development than weapon technology. ‘The future of warfare will be driven by Thucydides’ ‘fear, honor [sic] and interest’, not by the opportunities apparently on offer from exciting new ventures across the technological frontier’.22

Legal Context

Due to the emotive and conflated ‘Drone Wars’ narrative and the bearing it is likely to have on any manned versus unmanned discussions, it is worth examining the legal context of conflict before unpacking the ‘Drone Wars’ debate. This author is not a lawyer, and these offerings are simply to illustrate the complexity of the subject and the range of interpretations available.

Human rights law is deemed to always apply, whereas international humanitarian law (IHL) is triggered by the occurrence of armed conflict.23 There is a continuing friction in legal debates concerning the interaction of human rights law and IHL. Additionally, national interpretations of international treaty and customary law differ, as do nations’ domestic law.

A critical legal issue concerns whether lethal force is employed within an armed conflict or not. According to IHL, which could be considered largely synonymous with the Law of Armed Conflict (LOAC), States are central to the definition of an International Armed Conflict (IAC). Any difference between the States leading to the intervention of their armed forces is an IAC, even if

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21 Michael Howard quoted in DCDC, Future Character of Conflict (Swindon: MOD, 2010), 2.
22 Gray, Another Bloody Century, 103-105.
the other party denies a state of war; there are subtle exceptions such as small border skirmishes.24

A non-international armed conflict (NIAC) is distinct from an IAC in the status of the parties involved; whilst an IAC is between the armed forces of two or more states, a NIAC is between a state and an organised non-state armed group, or between such groups themselves. The parties involved must have a certain level of organisation and the violence involved must reach a certain level of intensity.25

The 31st International Conference of the Red Cross, in November 2011, examined an expanding typology of NIACs. Of interest for this paper, a Multinational NIAC was considered to be when, 'multinational armed forces are fighting alongside the armed forces of a “host state” – in its territory – against one or more organised armed groups...a current example is the situation in Afghanistan'.26

Another interesting type was a ‘cross-border’ NIAC, argued to exist ‘when the forces of a state are engaged in hostilities with a non-state party operating from the territory of a neighbouring host state without that state’s control or support’.27 The example given was of Israel versus Hezbollah, whilst Israel versus Lebanon was a parallel IAC.

The final very interesting paragraph offers a notion of an NIAC, ‘across multiple states between AQ...its “affiliates”...and the US’. ICRC contests this notion, offering that some elements of the ‘global war on terror’ have been deemed to be an IAC, whilst other elements have been considered to be NIACs, with other acts of terrorism occurring outside armed conflict.28

If an armed conflict is under way, and the attack furthers the aims of one party to the conflict, the use of lethal force will be considered legal if: distinction and discrimination are complied with; the precautionary rules are properly applied; and the target is a combatant or a civilian taking direct part in the hostilities.29

Distinction is the obligation to do everything feasible to attack only military objectives that are distinguished from civilians and civilian objects; feasible in this context is a measure of practicality rather than certainty. Discrimination is the obligation to limit the effects of an attack to those distinct military objectives. Other precautions include feasible care in the choice of attack in order to minimize collateral, the obligation to refrain from an attack when the collateral is expected to be excessive in relation to the military advantage gained.30

Members of a State’s armed forces are combatants. ‘Civilian directly participating in hostilities’ invokes extensive legal debate and is unlikely to be imminently resolved. A civilian

24 ibid., 7.
25 ibid., 8.
26 ibid., 10.
27 ibid.
28 ibid.
30 ibid., 64-65; 80; 121-127.
leader directing the conduct of the armed forces in conflict or planning military operations was
given as a lawful target example. During NIAC, non-state forces are technically not combatants
but are covered by the notion of ‘fighters’. ‘The notion of civilians is then defined...as all persons
who are not fighters’. During conflict, there is no obligation to capture rather than kill those whom it
is permissible to target.

Outside of an armed conflict, the legality of killing will depend on whether it complies with
applicable domestic and human rights law, including that of the deploying nation and agreements
between that nation and the host nation. Within a domestic law enforcement framework, ‘lethal
force may be used only if other means are “ineffective or without promise of achieving the intended
result”’ and that...any action... [is] pursuant to the human rights law principles of necessity and
proportionality’. Of relevance to the subsequent debates in this paper, extraterritorial application of
lethal force under a non-conflict scenario would be subject to questions of jurisdiction.

In summary, outside armed conflict, lethal force cannot be used unless reasonable,
absolutely necessary and proportionate. Cross border operations remain subject to the deploying
country’s domestic law and additionally to agreements with the host nation on the applicability of
host nation domestic law. Once an armed conflict exists, the use of lethal force is a recognised
element and is governed by IHL, which demands distinction, discrimination, proportionality and
necessity, but does not imply any obligation to capture rather than kill. Collateral damage is not
illegal, but must be minimised and proportionate to the military advantage gained.

The legal position on lethal force is a critical consideration, but moral, ethical and,
ultimately, political considerations will also have a significant influence. This is often referred to in
terms of could and should; just because one legally could use lethal force, political, moral and
ethical considerations may question whether one should. In an uncertain and incredibly complex
contemporary and future environment, the challenge for leaders is how to interpret the multiplicity
of regulations and values into meaningful, direction and delegation for fighters who are often
engaged in split-second decisions. The additional challenge is to offer guidance on strategy; whilst
legally permitted to use lethal force, a tactical victory, or of more impact, unintended yet legally
acceptable collateral consequences, may be strategically counter-productive. The concept of
‘courageous restraint’ associated with General McChrystal’s command of ISAF is linked to this
point.

The complexity outlined above is central to many narratives on technological development and
arguments against removing human interaction from decisions to use lethal force. Manned and

31 ibid., 141-164. For civilian involvement in UAV operations, see 287-288.
32 ibid., 434 and 526.
33 ICRC, “IHL and Conflicts”, 22.
34 ibid., 21.
remote operations retain a human in the decision process, whereas armed fully autonomous platforms will not.

**Design**

Examined through an aeronautical lens, the debate between manned and unmanned is relatively simple and concerns human physiological limits.

A variety of cost and weight penalties are associated with the presence of a human pilot, including constrained forebodies, large canopies, displays and environmental control systems. The aircraft's maneuver [sic] capabilities are limited by the pilot's physiological limits such as g tolerance. Removing the pilot from the vehicle eliminates man-rating requirements, pilot systems, and interfaces.\(^{35}\)

A cursory examination of aircraft shapes reveals that different designs optimise different characteristics. Cargo carrying aircraft are typified by the familiar shape of commercial airliners, optimised for volume, lift, and efficiency but limited in agility and speed. Fighters have sleek designs, similar to bullets or darts, in order to optimise their speed and agility but have limited endurance and payload capacity. Conversely, surveillance platforms tend to optimise endurance, thus often have the appearance of gliders, with sleek fuselages and long, high-profile wings, but sacrifice speed, agility and payload capacity. Endurance has traditionally required more fuel thus a larger aircraft, but novel concepts, such as solar power, and traditional ones, such as airships, measure endurance in weeks.\(^{36}\)

Fiscal imperatives to reduce the number of aircraft types in service, thus rationalise support and maintenance costs, as well as the logic to coalesce sensor and shooter functions into one platform, trend towards multi-role aircraft. However, aero engineering optimisation of one flight characteristic, such as persistence, is likely to compromise another, such as agility. The manned-unmanned debate is irrelevant in this context, except for the design benefits from omitting the human occupant. Manned fighters are limited to around 10g, whilst missile technology exceeds 35g. Unconstrained by human occupant g-tolerance, UAV agility is limited only by physics and component manufacture.

Human flight endurance is limited to around 5 hours, by hunger, fatigue or bladder capacity, or requires larger aircraft design, with facilities and an increased crew compliment. On extended

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\(^{36}\) DCDC, *JDN* 2/11, 4-9.
flights, human performance suffers as fatigue increases. Whilst possible to use stimulants\(^{37}\) to extend flight time over 30 hours\(^{38}\), the long term health risks continue to be debated. Should human occupant performance degrade during a mission, through illness, or fatigue, the options are to abort the mission or ‘press-on’.

RPAS operations do not suffer the same challenges. GCS operating time is managed with a series of breaks, both to mitigate console fatigue and to allow sustenance opportunities. Should an operator require a visit to the restroom, they simply invite a member of the operations room supervising crew to take command of the GCS for a few minutes. Of particular interest for risk holders, should the crew suffer fatigue, illness or psychological degradation during a mission, they can be replaced by a fresh crew member mid-mission; an impossible option for manned aircraft unless large enough to carry spare crew.\(^{39}\)

A common narrative is that RPAS cannot survive in a contested environment whereas manned platforms can; this discourse needs to be dissected further in order to be relevant. A contested environment will present two categories of threat: a physical threat to the air vehicle, and an electromagnetic threat of communication link disruption. Any threat to mission sensors would affect manned and unmanned alike.

Whilst current RPAS are vulnerable to weather, that is because their aerodynamic optimisation for persistence makes them susceptible to turbulence and icing. This aerodynamic issue is relevant to persistent aircraft designs and should not be misinterpreted as common to all RPAS.

Military requirements demand assured capability in contested environments. The options in a physically contested environment are to remain outside the threat envelope, thus perhaps suffering mission failure, or sneak around the threat using stealth technology, or use agility to out-manoeuvre the physical threat, or use countermeasure systems to defeat the enemy threat, or destroy the hazard before it threatens the air vehicle. Stealth technology, air-to-air missiles, countermeasure systems including electronic attack, and suppression or destruction of enemy air defence (SEAD or DEAD) weapons can be applied to any platform, manned or not. From an engineering perspective, the only difference between manned and unmanned in a physically contested environment is agility, with the design advantage belonging to UAVs.

Subject to platform sophistication and economics, a military commander might consider a sacrificial strategy; that is heresy in the current fiscally austere climate, but it is worth further consideration. Enemy surface and air threat systems have a finite capacity. It is a valid military

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\(^{39}\) Author’s experience.
option to employ masses of low-tech, cheap, disposable platforms in order to absorb, overwhelm or destroy that threat. Given the option to send a few, very expensive and treasured hi-tech systems into a strongly contested operating environment or sending a mass of disposable systems, the sensible military option may be the latter. If the enemy chooses not to engage, the low-tech systems may be able to accomplish their mission. If the enemy chooses to engage the low-tech systems, he is exposing the capabilities of his defensive systems whilst expending ammunition.

This is not a new concept. ‘Between the spring of 1967 and the middle of 1971, the USAF and US Navy launched a total of 138 Firebee [UAVs], of which 46 were lost to AAA or MiG-19s and 21s, and suspected mechanical failure (an estimated 7 of the 46)’.40 On the second day of the 1973 Yom Kippur War, the Israelis used Firebees to lead an attack on the Egyptian defences along the Suez. The Egyptians fired most of their SAMs and the Firebees successfully evaded 32 and destroyed 11 others with Shrike anti-radar missiles. In 1982, the Israelis again used UAVs to shape the Bekaa Valley battlespace. Using a fleet of Scout UAVs followed by manned aircraft, they located and destroyed most of the enemy SAMs before eventually gaining control of the air, losing only one Israeli aircraft for 86 Syrian Air Force losses. ‘In all these cases, the UAVs and UCAVs saved lives, which is the ultimate litmus test for the nations employing them’.41

The physical vulnerability of current RPAS does not prohibit their utility in a contested environment if one considers a wider military perspective, such as employing a sacrificial strategy or investing in modern countermeasure pods, just like the manned solutions of Harrier’s Terma pod or Tornado’s LAIRCM. Sacrifice or defensive systems are generally cited as economically prohibitive for fielded RPAS, but should not be dismissed. An often ignored perspective is the sacrifice of old airframes that have used most of their design flying hours. For example, the US fleet of Predators, eventually to be replaced by Reapers, will remain compatible with the Reaper GCS and could be stored at little cost, then dusted off and sacrificed. From a new capability perspective, a sacrificial strategy is viable if the platform cost versus planned attrition rate remains affordable, requiring procurement discipline.42 Finally, any current RPAS physical vulnerability must not be interpreted as typical of all future drones or robots, evident from the stealthy profiles of X-47 and Taranis.

If a currently fielded RPAS loses its communication link, the UAV will enter an auto-pilot mode and the attack capabilities are inhibited. The auto-pilot mode, very similar to that in a commercial airliner, flies the UAV along a pre-programmed route back to its base airfield. Thus, currently fielded RPAS are vulnerable to ‘soft’ mission failure through enemy denial of their communication links. Every military capability has vulnerabilities and it is for policy to decide if they

40 Grateful to Dr Goulter for emailed details.
42 DCDC, JDN 2/11, 3-5.
can be mitigated or accepted. Communication vulnerabilities can currently be mitigated by the use of encryption, and communication technology is no different to other military evolutions, such that innovation eventually becomes vulnerable which prompts innovation and so it continues. Concerns over finite bandwidth and communication vulnerability must be tempered by consideration of innovation trends.43

The presence of an empowered human in an air platform negates communications vulnerabilities. The human occupant can be given strategic commander’s intent prior to launch, and then employ military judgement to achieve that intent. A human occupant allows assured human processing of the tactical scenario, regardless of enemy denial of remote communications; that is a critical consideration in favour of manned platforms and can only be countered by an acceptance of UAV autonomy. Interestingly, the Taranis concept is for the platform to reach back with targeting imagery for human authority to use lethal force, either a conceptual flaw for a contested communication environment or design acceptance that full autonomy is a step too far.44

‘Optionally manned’ platforms may mitigate some of the unmanned challenges. An example would be for human occupant flight through global civilian airspace to an operational theatre, where the vehicle is operated as a UAV.45 Resolving UAV airspace integration issues would be better than compromising the aircraft design solely to support a human occupant for a rare transit. Whilst arguably increasing the adaptability of platforms to various scenarios, the optionally manned concept appears flawed as it fails to capitalise on unmanned design strengths, and requires all the support elements of manned operations plus remote piloted architecture, which may prove more expensive than selecting a manned or unmanned capability. If the concept, rather than optionally manned-remote was to be optionally manned-autonomous, that would negate any remote architecture costs but would still compromise the aircraft design and open the autonomy debate.

**Autonomy**

It is critical for mature debate on RPAS that the distinction between remote and autonomous is stressed. To be very clear, autonomous attack is not applicable to fielded RPAS. Whilst the section below examines the utility of robots across the various air power roles, the utility of drones can be inferred.

Commentators agree that societal wisdom needs to address the subject of autonomy before it is deployed.46 Most commentators rarely distinguish between air power tasks and

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45 ibid., 4-9.
generically condemn autonomy when their aversion actually concerns only autonomous attack. Others consider various air power applications of autonomy but conclude that they are a significant time away.\textsuperscript{47} If Moore’s Law continues to apply, then perhaps the future will arrive sooner than anticipated. ‘Advances in robotics, cognitive science coupled with powerful computing sensors, energy efficiency and nano-technology will combine to produce rapid improvements in the capabilities of combat systems’.\textsuperscript{48} Whether the technophobes or technophiles get the predictions correct will only be revealed in time.

Commentators forget how much autonomy is already present in manned military systems. One theory considers control of the air is too complicated for an autonomous system\textsuperscript{49}, yet forgets that most fourth and fifth generation combat is beyond visual range (BVR), with the human targeting decision based on BVR sensor data that has already been autonomously fused, and active weapons that autonomously home to their targets after release. The tactics and procedures used to mitigate BVR fratricide and cope with enemy jamming could easily be written into an algorithm. Thus, for a high end air control scenario, arguably it is mostly autonomous today. If we are not considering the high end air control scenarios, but congested and cluttered requiring visual identification, then autonomous control of the air may indeed be a long way in the future.

Other commentators doubt the distinction ability of autonomous attack vehicles, yet forget to discuss the current systems that are human-launched towards an area and then autonomously distinguish between target and collateral; anti-radiation missiles and Brimstone being examples. That point is tenuous if one considers that the examples would likely be constrained in cluttered, congested scenarios, however, highlights a deeper scrutiny requirement of what has been for manned autonomy before considering what maybe for unmanned autonomy.

Autonomous surveillance is a natural progression from remote surveillance and is likely to be accepted earlier than other developments, subject to airspace integration and privacy debates. Extreme persistence assets are likely to become more autonomous and remain unarmed, resisting the trend towards multi-role compressed ‘sensor-shooter’ platforms.

Autonomous mobility is an interesting concept. Consider air transport; contemporary commercial aircraft already operate at level 2 autonomy from before take-off, through a global transit, to auto-landing using a Category III system in weather conditions worse than a human is permitted to do. The ‘pilot’ in commercial situations has long been an autopilot monitor and the emergency backup. Cargo has no perception issues, but passengers may prefer a reassuring human aboard for some time. However, the automation of society may change passenger perception sooner than anticipated; Californian law already exists for driverless cars, once certified

\textsuperscript{48} DCDC, Global Strategic Trends, 17.
\textsuperscript{49} McMahon, Air Power – UAVs, 62.
safe, from 2015. Autonomous operations to tactical landing sites will be more challenging, though autonomous air dispatch appears to be a relatively simple technical problem.

Level 3 autonomous defences have been fielded for decades and are much more acceptable to society than autonomous attack, though not completely without controversy. Society is more acceptant of autonomous, time-critical defence systems to protect life, such as the US Counter Rocket, Artillery and Mortar system. However, it remains debatable whether missile defence systems are effective and whether the collateral damage they create is acceptable; even if the incoming missile is intercepted, the debris will fall somewhere. Human cynicism prevails and is reinforced by past errors in autonomous systems, such as the Patriot engagement of a coalition Tornado during the 2003 Iraq conflict. An interesting debate concerns UAV protection, as UK law does not permit the use of lethal force to defend property, could an autonomous aircraft defend itself against a manned threat? This is unlikely to be permitted, but an attack on the valid military objective presenting the threat would be permitted, but now we have entered the contentious realm of autonomous attack.

Autonomous attack quite rightly provokes the most intense societal debate. Could an autonomous platform interpret strategic intent and adhere to the principles of law without tactical human interaction? Who is accountable for any incorrect decisions the autonomous vehicle makes: the designer, the programmer, the commander, the dispatcher? With two opposing forces classically formed against each other, autonomous attack could be employed without fear of distinction errors. However, once the two forces advance to contact, distinction between friend and foe becomes an issue that continues to challenge contemporary military operations. Distinction during attack in cluttered, congested environments will continue to be extremely difficult and will likely remain unresolved by designers, lawyers and ethicists for some time to come.

Whilst computers can process data much quicker than humans, they lack the ability to interpret and form moral judgements on that data. A classic example is whether an automated system could distinguish between a legitimately armed host-national and an active enemy fighter. Those complex military judgement tasks are difficult enough for humans with years of military experience, but humans have the unquantifiable advantage of ‘gut instinct’.

Heyns agrees that warfare requires common sense, human appreciation of values and anticipation of unfolding events, applying intuition and compassion before taking life: ‘humans – while they are fallible – at least might possess these qualities, whereas robots definitely do not’. He goes on to argue that the Marten’s Clause in IHL, ‘demands the application of “the principle of humanity” in armed conflict’. Taking an argument from Peter Asaro, Heyns suggests that to remove a human from the application of lethal force removes humanity from the loop, therefore the

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51 DoD, Unmanned Roadmap FY2011-2036, 50.
Marten’s Clause demands a human decision that cannot be delegated to an automated system. On this logic, he concludes that non-human killing would be arbitrary deprivation of life, hence illegal.\textsuperscript{53} This UN report frames why autonomous attack is unlikely to be accepted soon:

The Human Rights Council should call on all States to declare and implement national moratoria on at least the testing, production, assembly, transfer, acquisition, deployment and use of [Lethal Autonomous Robots] LARs until such time as an internationally agreed upon framework on the future of LARs has been established.\textsuperscript{54}

**Fragility**

A recent report estimated 60 Predator and Reaper UAVs had been lost, that exact figures were hard to ascertain and that the ‘air of fragility’ would need addressing.\textsuperscript{55} Another cited drones as the most accident-prone USAF craft, with a concerned citizen wanting the 30000 pieces of robotic hardware over his head to be safe and have strict privacy laws. The article quotes a Global Hawk accident rate of 15.16 per 100000 flight hours as nearly three times that of the U-2 it is replacing. After conflating the 30000 small civilian craft with Global Hawk, the report includes balance from Singer, who offers that crash rates trend downwards after the kinks of any technology, manned or unmanned, are resolved and expertise builds.\textsuperscript{56} Academic commentators match the pattern of conflation, switching mid-paragraph between discussions of Predator to small UAV crash statistics before making generic conclusions on the fragility of all UAVs.\textsuperscript{57}

Small UAV safety and operator training standards are valid concerns, yet out of scope of this paper. However, it is invalid to conflate those concerns with medium to large UAVs designed and operated under air force standards.

The USAF Safety Center official public statistics were not hard to ascertain after a quick Google search.\textsuperscript{58} These figures do not include other US Services or international users. Class A mishaps are defined as those resulting ‘in fatality or total permanent disability, loss of an aircraft, or property damage of $2 million or more’.\textsuperscript{59} Class A does not equate to loss of the platform and statistics for destroyed aircraft are invariably lower.

\textsuperscript{53} ibid., 16-17.
\textsuperscript{54} ibid., 21.
By the end of financial year (FY) 12\textsuperscript{60}, there had been six Class A Global Hawks accidents in 66867 hours, giving a lifetime accident rate of 8.97 per 100000 flying hours, very different to the unreferenced claim of 15.16. Four of the six Class A accidents occurred in the first five years, before FY02. In the last five years, the accident rate is 3.98 supporting Singer’s hypothesis.

The U-2 lifetime accident rate is 5.51, which would have matched the reported times three comparison. However, in the first fifteen years of U-2 operations the rate was 14.8.\textsuperscript{61} Ignoring the anomalous first seven years, with several Class As but no flying statistics, the next fifteen years give an 8.4 rate. A more relevant comparison of accidents would be the first fifteen years flying for each type, where Global Hawk’s 8.97 versus U-2’s 8.4 is hardly sensational.

In sixteen years of Predator operations, there have been 98 Class A accidents in 1.26 million hours, a lifetime accident rate of 7.74.\textsuperscript{62} A vast one million of those flying hours were amassed in the last five years\textsuperscript{63}, with an accident rate of 5.14. In twelve years of Reaper use, 17 Class A accidents in 313068 flying hours, giving a lifetime accident rate of 5.43. These statistics again support Singer’s hypothesis, and that the lessons of the senior Predator model have been translated into the junior Reaper model.

Using some historical manned examples, there were 2449 Class A accidents for the F-86 in 5.5 million flying hours, a lifetime rate of 44.18.\textsuperscript{64} The F-16 had recorded just less than 10 million flying hours by the end of FY12 with a lifetime accident rate of 3.55 and a rate of 1.48 in the last 5 years.\textsuperscript{65}

Superficial comparison of F-16 lifetime rates with the drones would support the fragility claims. However, a deeper look at the first twelve years for each aircraft type reveals 73 accidents and a rate of 7.13 for F-16\textsuperscript{66} compared to 17 accidents and a rate of 5.43 for Reaper, arguably refuting the fragility reputation.

The F-22 figures are the most interesting, having amassed 136315 flying hours with 10 Class A accidents, giving a lifetime rate of 7.34.\textsuperscript{67} That is higher than Reaper in the same timeframe.

Regarding the reported concerns of the American public, it is worth noting that the general aviation\textsuperscript{68} accident figures for 2011 show 1466 accidents, within 22.5 million flight hours; that is an accident rate of 6.51\textsuperscript{69}, which is apparently higher than the last 5 years of drone operations.\textsuperscript{70} This may be empirically flawed, because the general aviation definition for accident has not been

\textsuperscript{60} US: ends on 30 September of the quoted FY.
\textsuperscript{61} FY83-FY77.
\textsuperscript{62} FY97-FY12.
\textsuperscript{63} FY08-FY12.
\textsuperscript{64} CY50-71.
\textsuperscript{65} CY75-FY12.
\textsuperscript{66} CY75-CY86.
\textsuperscript{67} FY02-12.
\textsuperscript{68} Assumed to exclude commercial and military.
\textsuperscript{69} Table 10 of http://www.ntsb.gov/data/aviation_stats.html (accessed May 13, 2013).
\textsuperscript{70} MQ-1 = 5.14; MQ-9 = 4.67; MQ-4 = 3.98.
confirmed as identical to the Class A one offered, highlighting the hazard of cursory statistical comparison when public perception may not include empirical nuances.

The above statistics are too simplistic because they lack context. For example, there is no mention of peacetime or wartime activity, safety culture of the day, commander’s risk appetite, or flight profiles. The figures for F-22 may be biased as any mishap on the expensive platform may trigger the $2 million Class A categorisation threshold.

Whilst ongoing rhetoric rightly highlights that drones must demonstrate airworthiness equivalence to achieve civilian airspace integration, the statistics banded around in popular discourse must be scrutinised at a much deeper level in order to draw appropriate comparisons and conclusions.

One argument offers that avoiding overflight of populated areas could mitigate airworthiness risks to third parties. This may be possible in certain scenarios. However, trend analysis suggests a congested and cluttered environment, thus avoiding overflight would render the air vehicles inflexible and impractical, hence is a flawed assumption. The MOD must retain its strict airworthiness standards in order to render UAVs relevant, agile, and adaptable across all future scenarios. Additionally, airworthiness risk management should begin with empirical data rather than overly risk-averse conjecture.

### Airspace Integration

International agreement requires pilots to ‘see and avoid’ other aircraft, translated to ‘sense and avoid’ for UAVs. UAV integration into civilian airspace will require transparency and equivalence: it must be transparent to an air traffic controller whether the aircraft is manned or unmanned; and the UAV must demonstrate at least the equivalent safety standards of a manned aircraft.

Drone narratives on airspace integration also become conflated, such as the previously identified privacy concern. Concern over the extent of State aerial surveillance outside conflict is also valid, though it should be irrelevant whether the sensors are fitted to a police manned helicopter or drone. The politics of privacy and civilian-operated small drone proliferation should be separated from debates on the safe integration of larger military UAVs into civilian airspace.

One theory offers that manned surveillance assets are more affordable in the short term because of slow airspace integration and required communication assurance, and that international law would preclude overflight permission to Reaper, hence larger platforms will be

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71 Benign medium altitude or air combat; low level; take-off or landing; etc.
72 Author’s experience.
74 CAA, CAP722, 1-1-1.
76 For more read Grossman, Time 181-5, 18-25.
needed for standoff surveillance.  This narrative is open to misinterpretation and requires deeper analysis.

Any State aircraft requires permission to enter another State’s national airspace; whether it is manned or unmanned is legally irrelevant as long as it meets safety equivalence. The size of a surveillance aircraft is irrelevant for political purposes; it is the nature of the platform that matters.

The implication in Quintana’s narrative is that larger surveillance assets are capable of more standoff. Size is irrelevant; sensor performance is the key. A smaller Harrier equipped with SNIPER had less endurance but more standoff than a larger Nimrod equipped with MX-15. Sensor capability, scenario-required standoff, and communication issues are the key, not the manned or unmanned nature or size of the platform.

Civilian airspace integration may occur quicker than commentators predict. The challenges are largely political or perception based rather than technical. Genuine will to resolve the politics exists, mainly driven by the US, but also by commercial companies wishing to exploit potential economic benefits of drone use across all sectors of aviation, worth $8bn annually to the UK before 2020. The US Congress tasked the FAA with integrating drones into national airspace no later than September 2015. UK CAA policy is maturing in CAP 722. The UK Autonomous Systems Technology Related Airborne Evaluation and Assessment (ASTRAEA) is backed by an impressive industrial and government consortium.

Aircraft separation in controlled airspace is mandated to be under non-visual separation regulations, relying largely on navigation system accuracy and procedural deconfliction. RPAS already use those principals in military segregated airspace and could arguably demonstrate manned equivalence in controlled airspace, especially those systems augmented with Link-16.

Uncontrolled airspace relies more on visual avoidance principles, hence is a more difficult but still relatively simple technical challenge for UAVs. Systems could be ground based sense and avoid (GBSAA) or airborne (ABSAA). The US Army and US Air National Guard are investigating scalable and transportable GBSAA that relies on ground-based radar to feed separation systems, with an initial capability planned for 2014. The challenge is to find a civilian agency willing to

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78 Boothby, Law of Targeting, 330.
79 CAA, CAP722, 1-2-1.
80 Author’s experience.
81 Gent, “Avoid System for UAVs”.
certify the system as manned-equivalent, and concerns over what happens during lost-link scenarios.\textsuperscript{86}

Cooperative technology, such as the Airborne Collision Avoidance System (ACAS or TCAS), has been fielded for decades as a commercial aircraft safety augmentation.\textsuperscript{88} Non-cooperative technology, which would use other sensors to replicate a human visual scan, has already been demonstrated. A\textsuperscript{T}R\textsuperscript{A}E\textsuperscript{A}E announced a technological solution for ABS\textsuperscript{A}A in March 2013,\textsuperscript{89} and in April demonstrated the concept through 500 miles of UK airspace.\textsuperscript{90}

Airspace integration is now largely a political and perception challenge. The solution will be driven by political and commercial factors beyond military concerns, and arguably will be resolved within two to five years.

Cost and Capability

There can be little doubt that air power is a force multiplier. A view suggests that, ‘air power offers alternative policy options to the large-scale commitment of land forces, with the heavy financial and human consequences…this…entails’.\textsuperscript{91} General Slim held that land campaigns were myths and that all successful modern operations were air-land campaigns.\textsuperscript{92} General Eikenberry, stated that without air power over a half million troops would be needed to achieve the same in Afghanistan as the 40000 deployed.\textsuperscript{93}

After Israeli success in 1973 and 1982, UAV interest was fuelled by the notion of cheap, low-tech, relatively easy to replace, platforms that would incur no human loss against a numerically superior adversary; technology versus mass.\textsuperscript{94} Whether unmanned systems are more cost effective than manned is still being debated. Cost comparisons between manned and unmanned options tend to be superficial at best, often inappropriately concerned with platform and people cost headlines rather than a focus on sustainable relative capabilities for the Defence budget. For example, rather than counting the platform purchase cost, the economics should consider the holistic cost per hour of available capability. Nuances of innovation, procurement, recruitment, sustainability, component recycling and capability employment must all be considered to inform a valid comparison; that list is not exhaustive. Often omitted or conveniently conflated, dependent on

\textsuperscript{86} When the UAV senses loss of communication with the GCS.
\textsuperscript{87} Email from a senior US military official, referenced anonymously with permission.
\textsuperscript{89} Gent, “Avoid System for UAVs”.
\textsuperscript{90} A\textsuperscript{T}R\textsuperscript{A}E\textsuperscript{A}E, “Pioneering First Remotely Piloted Flight Under NATS Control,” A\textsuperscript{T}R\textsuperscript{A}E\textsuperscript{A}E, \url{http://www.astraea.aero/downloads/ASTRAEA_end%20_FINAL.pdf} (accessed May 30, 2013).
\textsuperscript{91} Air Staff, AP3000, 18.
\textsuperscript{92} Robert Lyman, Slim, Master of War (London: Robinson, 2005), 129-130.
\textsuperscript{93} Tim Ripley, Air War Afghanistan: US and NATO Air Operations from 2001 (Barnsley: Pen & Sword Aviation, 2011), 204. More troops were deployed after this quote but the proportional point remains valid.
the proponent’s perspective, are associated capability costs, such as logistic footprint, air refuelling, or communication networks.

From a national perspective, the benefits to UK Defence industry must also be considered, and arguably the government must set industrial success conditions. ‘The lack of procurement agility is a major issue. Traditional procurement processes do not support the provision of rapidly changing technology in a timely manner’.\textsuperscript{95} It seems incomprehensible that future capability requirement contracts could follow the historic norm of being frozen over a decade in advance when, ‘industries must leverage test frameworks to take advantage of Moore’s Law advances that are exploitable every 18 months’.\textsuperscript{96} A much broader vision is required for the future.

Affordability is key to the NSS, and is also emphasised by the global superpower. The DoD vision for unmanned procurement involves an emphasis on open architecture and open interfaces to address proprietary obstacles to competition and spiral development.\textsuperscript{97} Commonality of data and power protocols, components, and sensors throughout the range of cross-Service platforms is part of the vision to reduce costs. The DoD Roadmap vision overarches individual Service roadmaps and provides interoperability standards and open architecture guidance across US military procurement and industry. Whilst JDN 2/11 is a good foundation, and FASOC acknowledges the concept\textsuperscript{98}, there appears to be no comparable overarching UK vision, which is desperately needed if UK Defence and industry aspire to reap UAV market benefits.

General Atomics (GA) demonstrated open architecture in May 2012 with their ‘Sovereign Payload’ concept, allowing third party software, loaded into GCS computers, to run third party sensors, placed in an aircraft generic pod, using common power and data protocols.\textsuperscript{99} The concept could feasibly employ novel attack payloads as well as surveillance sensors. Interestingly for UK Defence, the demonstration used a Selex-Galileo Sea Spray 7500E AESA radar fitted to Reaper; the same surface search radar used to upgrade the USCG HC130H Maritime Patrol Aircraft.\textsuperscript{100} Whilst not closing the full capability gap left by Nimrod, and perhaps interesting to investigate the overland capabilities for wide area surveillance, the concept highlights the built-in flexibility potential of an open architecture capability focus.

When considering the aspect of partnering\textsuperscript{101}, the challenge will be to balance military interoperability and affordability with national industrial competitiveness and particular international relationships. The UK will have to risk huge development costs to capitalise on a national military-industrial UAV export potential or continue with commercial-off-the-shelf purchasing. In the 1980s,
the US Army Aquila project suffered quintuple programme cost growth before being regarded as
one of the worst program management activities in US history and cancelled. The UK has its
own, recent examples of aviation programme cancellations. Conversely, GA’s story illustrates the
potential of getting it right. UK innovation is certainly present, with ASTRAEA’s ABSAA
demonstration, QinetiQ’s Zephyr holding the endurance record at over three weeks, and the similar
endurance LEMV airship that is made by UK company, Hybrid Air Vehicles.

In the absence of a national programme, the UK may face a choice between European and
US collaboration. The benefit of European collaboration and export potential is obvious, but
Europe is way behind the US. Predator derivatives continue to proliferate, as does the expensive
Global Hawk into the land-based Broad Area Maritime Surveillance (BAMS) derivative, Triton,
and the NATO Alliance Ground Surveillance System (AGS).

The decision is complicated by a cost comparison anomaly associated with RPAS. The air
vehicle is only one part of the RPAS and can be upgraded independent of the associated GCS and
communication architecture. The same GCS is common to all GA UAVs, including Predator,
Reaper and the next generation Avenger, capable of 400kts but retaining potentially 18 hours
endurance. Thus, the economics will be more challenging for a new capability option to warrant
switching from an existing, truly spirally developing system.

Perhaps to alleviate autonomy fears or just as a personnel counting exercise,
commentators often stress the number of personnel involved in an RPAS across the world.
Limited comparisons claim that RPAS do not save manpower, that a UAV lacks the air power
advantage of speed afforded to fast jets, and that a persistent armed UAV will persist only until its
weapons are exhausted.

The intensity and duration of operations increases the manning ratio regardless of deployed
manned operations or remote basing. To provide 17 hours per day of on-task time, a typical fast
jet unit would deploy 80-100 personnel, not including analysts, changing every four months.
Direct comparisons are difficult without getting embroiled in the detail of support contracts and
coalition burden sharing arrangements. 30 deployed personnel is an excessive estimate for the
UK LRE commitment, which provides 72 hours of RPAS on-task time per day. Overall squadron
personnel establishments might be similar, but a comparison of personnel per hour on-task would
significantly favour RPAS. More importantly is the decrease in forward footprint of at least 60%,
probably more. Every person less in theatre reaps significant logistical savings, in terms of transport, life support, and force protection. The above comparison graphically supports the advantage of an RPAS over a manned fast jet in providing persistent ISR and CAS in an uncontested environment; it does not support any claim that an RPAS has the advantage in other scenarios.

Commentators include in manning comparisons the number of image analysts required to process RPAS surveillance data. For any given volume of operational surveillance data from comparable sensors, the number of analysts required remains constant, regardless of the manned or unmanned nature of the collection platform. Changes in the processing of that surveillance data, such as sophisticated computer algorithms, will impact the number of analysts required, but collection platform nature will not. The reduction of forward-deployed analysts is dependent on the capacity of communications networks to move collected data from platform to a remote site or centralised distributed intelligence fusion centre. Those communication capacities are an inherent part of the RPAS but would be an additional requirement, and cost, for any manned platform.

Any platform, manned or unmanned, is limited by weapon capacity. The logic behind the assertion of manned fast jet advantage is that it could be relieved by an alert aircraft travelling quicker to the task than an RPAS. Current platform speed should not be conflated with future RPAS speeds; Avenger makes the point. Two persistent platforms in geographic proximity can always switch tasks, already seen in Helmand, with one Reaper having used its weapons assuming the nearby ISR task, and another fully-armed one switching from the ISR to the CAS. The debate depends on visions of future conflict and a more inventive consideration of capability mass and apportionment, be that manned or unmanned, fast and reactive, or persistent and proactively arrayed, and perhaps also fast.

RPAS have a unique advantage over manned platforms when it comes to The Whole Force concept. To employ a reservist operator or analyst in manned combat operations involves a mobilisation and deployment to theatre for several months. In an RPAS construct, once trained, a reservist could operate on a part-time basis and return home each day, alternating on a daily or weekly basis between civilian and reservist occupations.

This concept comes with a health warning. Use of reservists appears to have significant benefits for remote operations, however, the detailed practicalities will be far more complex. Any cost savings will be dependent on terms of service, the details of financial recompense for civilian employers and allowances for the reservist. The Air National Guard, whose units are individual state assets, have learned that complicated Federal activation laws and per-diem allowances have led to higher than expected personnel costs. The core forty percent full-time Guardsmen are sharing a higher burden of the task than their reservist counterparts, so manning establishments

must be carefully considered.\footnote{Email from a senior US military official, referenced anonymously with permission.} Any concept of non-deployment for reservist personnel would increase the harmony burden on others for LRE commitments. Operations require higher currency and competency levels than routine flying training, thus the reservist commitment will be higher or involve a nugatory continuation training burden; this lesson was learned by the few Harrier full time reserve personnel, who were invaluable for operational conversion instruction but unable to commit to operational status competency demands.\footnote{Author’s experience.}

Drones offer the best potential for fully synthetic training initiatives, manifesting a saving on continuation-training aircraft, allowing a procure-to-deploy concept.\footnote{JDN 2/11, 1-2.} For this concept to be feasible, affordability will have to be extremely hard headed not to constantly deploy the multi-role UAVs to build upstream capacity and understanding in a world of instability. Perhaps a truly open architecture system, with interoperable GCS, could have a range of UAVs in the boxes dependent on scenario, permissive persistent or contested high agility.

The recruitment and retention of RPAS crews is an interesting debate. Economics suggest the use of less expensive dedicated drone operators rather than traditional aircrew. Members of the ‘old guard’ rightly argue that pilots generally do not join the military with the image of sitting in a GCS. The debate continues to discuss the airmanship of non-traditional operators compared to their experienced counterparts, then moves to detachment and lack of warrior ethos. The economics seem plausible, but the debate should never be an either or equation, rather it should be a discussion about the appropriate balance between drone operators and traditional aircrew. All the narrative fears raised about drone operator airmanship, detachment, ethos, professionalism, etc., are all mitigated by the leadership of experienced aviators and a suitable training programme.

This raises another question worthy of research regards the ‘game playing detached teenager’ concern, whether that is a manifestation of youth, culture or inexperience. Testing a hypothesis that the relevant attribute for an emotionally and intellectually connected drone operator is maturity or previous experience on manned aircraft would be interesting. Generic results are likely to have statistical exceptions.

Aside from logistic practicalities, remote operations reduce the number of personnel at risk in an operational theatre. The logic regarding a duty of care to one’s own forces is compelling. Strawser and Whetham agree that ethically, ‘we should not order someone to take unnecessary risks when there are alternative methods available that can achieve the same results but are less risky for those taking part’.\footnote{David Whetham, “Remote Killing and Drive-By Wars”, in D Lovell & I Primoratz (Eds), Protecting Civilians During Armed Conflict: Theoretical and Practical Issues During Violent Conflict (Ashgate, May 2012), (pdf from author).}

The political costs of downed or captured military personnel are significant, and have associated risks and costs for combat rescue capabilities. There was a stark difference in the

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\begin{itemize}
  \item[111] Email from a senior US military official, referenced anonymously with permission.
  \item[112] Author’s experience.
  \item[113] JDN 2/11, 1-2.
  \item[114] David Whetham, “Remote Killing and Drive-By Wars”, in D Lovell & I Primoratz (Eds), Protecting Civilians During Armed Conflict: Theoretical and Practical Issues During Violent Conflict (Ashgate, May 2012), (pdf from author).
\end{itemize}
considerable political capital gained by the Soviet Union in the capture of downed U2 pilot, Gary Powers, in 1960 versus the little political gains by the Chinese display of downed ‘Firebee’ surveillance UAVs in 1964.

**Situational Awareness (SA)**

A common drone narrative claims operators possess low SA because their world is perceived through a narrow ‘drinking straw’. The field of view raises concerns about the operator’s ability to detect collateral issues outside the ‘straw’, as well as ethical detachment concerns. Other concerns relate to platform attrition through an inability to detect threats, and the potential for mid-air collisions. Additional speculation exists concerning operator capacity and sensory overload. Finally, concerns are raised about the narrowing of campaign perspective to the seductive, hypnotic full motion video feed.

Comparisons of manned and RPAS relative SA is generally speculative and made by individuals with operating experience of one or neither disciplines. A human in the manned platform is afforded the peripheral advantage provided by their eyeballs. However, an unmagnified view from the cockpit is of little use for cluttered target distinction. It can be difficult to ascertain the ground from medium altitude in the utter blackness of an un-moonlit remote desert landscape, even with NVGs. Both manned and unmanned crews can select wide, relatively unmagnified sensor fields of view to permit similar spatial orientation. Resolution is reduced in wider fields of view, hence narrow, zoomed views are used for target distinction and attack.

A fallacy exists that peripheral vision from the cockpit gives an advantage during precision weapon attacks. Both manned and RPAS crews use targeting sensors to acquire and distinguish the target, and both are fixated on the cockpit targeting screen during weapon time of flight. The target is likely to be under the aircraft fuselage, obscured from eyeball observation, through the attack flight profile. A last second collateral issue would be detected by both manned and unmanned crews in the same way; on the sensor targeting screen. The train on a targeted bridge during Allied Force is a manned collateral example. To clarify another misperception, RPAS satellite delay has only a second or so impact. It makes no statistically significant difference to the incidence of collateral for unmanned compared to manned platforms.

Manned crews cite the benefit of their wingman’s peripheral vision providing a collateral defence not available to RPAS. That presumes RPAS cannot have wingmen. RPAS have a

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115 Jordan and Wilkins, “UAVs Since 1980s,” 43.
117 Author’s experience.
119 Author’s experience.
technological advantage because any FMV feed on the network can be displayed on any GCS computer monitor.\textsuperscript{120}

The vast majority of visually detected aircraft threats are perceived by wingmen rather than manned occupants, a fact of perspective. The human eyeball detects movement laterally more easily than it perceives an object closing on a constant angle. The vast majority of contemporary threats are detected, and responded to, by automated defence systems, which would be no different for equipped manned platforms or RPAS.

The risk of mid-air collision is one shared by manned platforms and UAVs. RPAS operators and air traffic controllers have learned many lessons and developed robust procedures for deconfliction, much enhanced in the last five years.\textsuperscript{121} Key to this are airmanship, training and technological developments, including the addition of Link-16 into some RPAS.

The ICRC raised concerns of information overload, during which a plethora of information, sometimes contradictory, could saturate an RPAS operator.\textsuperscript{122} This situation, ironically, is much more likely in a manned aircraft than an RPAS. Though an RPAS has a networked mass of data available, more humans can easily be invited to assist with processing. For a manned platform, any increase in personnel incurs a design penalty in volume and weight. Fourth and fifth generation fighters use numerous automated sensor-fusion routines to identify beyond visual range targets before the data is ever presented to the human for a decision to use lethal force.\textsuperscript{123}

The criticism that RPAS hypnotise individuals from a strategic or operational perspective to tactical myopia is centred on the seductive nature of full motion video feeds. Jordan relates accounts of SACEUR tactically re-directing individual RPAS during Allied Force, presumably to the detriment of his strategic perspective.\textsuperscript{124} There are occasions when that ability is extremely useful and entirely appropriate for strategic targeting events; a real advantage for the networked RPAS compared to manned platforms. Routinely, the temptation to micro-manage must be resisted: ‘rarely will [feed viewers] have the full tactical situation and put bluntly, such activity is not their job’.\textsuperscript{125} The myopic criticism is more appropriate for those receiving the distributed video feed rather than for the RPAS operators themselves.

**Detachment**

Commentator speculation assumes that physical distance from the battlefield equals psychological and emotional detachment, and that such detachment morally erodes the essence of sacrifice that deters warfare initiation. The narrative then questions whether it is ethical to kill in the

\textsuperscript{120} ibid.
\textsuperscript{121} Jordan and Wilkins, “UAVs Since 1980s”, 38-39.
\textsuperscript{122} ICRC, “IHL and Conflicts”, 39.
\textsuperscript{123} Author’s experience.
\textsuperscript{124} Jordan and Wilkins, “UAVs Since 1980s,” 38-39.
\textsuperscript{125} MacMahon, “UAVs in RAF – 2047,” 58.
manner of sending an email. 126 That narrative assumes a link between personal risk to life and warrior values, used to justify the claims of inevitable psychological detachment. 127 ‘Throughout history, as each technology has pushed soldiers farther and farther away from their foes, many lamented the effect it would have for warriors and their values....using a gun was once seen as cowardly’.128

Coker draws on ancient Greek heritage, especially Homeric tradition, to argue that ‘war is the ultimate face to face encounter’ and that fidelity of resolution does not reveal moral character of the enemy129. His warnings are very appropriate for the debate on robots but less so for drones, indeed his study of mirror neurons can be turned to argue the advantage of drones over manned. ‘It’s like a video game. It can get a little bloodthirsty. But it’s fucking cool’.130 This comment was attributed to ‘a cubicle warrior’ during the Iraq war. Singer and Coker reflected on the worrying detachment indication, ‘[with] remote soldiers no longer having any “emotional connectivity with the battlespace”’. A less crass but similar quote was recently attributed to Prince Harry, soldier, forward air controller and Apache pilot, confusing the attribution as a drone issue.

Was the cubicle warrior attempting to relate a novel concept using a public analogy? Was he a seasoned veteran or a young man entering his first operation with bravado? Was it indicative of all RPAS operator attitudes, across all cultures, or the attempt of a young American to impress his listener? Whilst conjecture, the above questions merit more balanced appraisal, especially considering accounts of middle-aged UK crews, sober about their lethal duties.131

What a young military individual will say in public and in private are vastly different. Regardless of public banter and bravado, private squadron conversations concerning choices of when to and not to kill, despite tactical imperatives from other interested parties, are the same amongst manned and unmanned crews, being extremely sombre and human.132

The ICRC raised concerns that physical and emotional distance from the adversary ‘makes targeting easier and abuses more likely’.133 The military profession demands a degree of detachment so that humans can kill on orders; too much attachment either prevents completion of duty, or can lead to emotionally charged behaviour exceeding political and moral limitations. Whetham, citing Tripodi, argues that a good commander remains slightly detached. Whetham quotes a medical report stating, ‘members of [ground] units that had suffered casualties were more likely to treat civilians in negative ways’. Whetham, citing Strawser, concludes that an RPAS

128 Singer, Wired for War, 331.
129 Coker, Warrior Geeks, 122.
130 Singer, Wired for War, 332.
132 Author’s experience.
operator, with an absence of fear for their own safety, would be more capable, not less, of behaving justly.\(^{134}\)

Aircrew traditionally have been, and will remain, more detached than infantrymen. Historically, aircrew released weapons on a blurry target; consider the ground resolution when viewing from a commercial airliner at 20000 feet. In the 1990s, targeting pods allowed views of buildings and perhaps vehicles on their low resolution images. Contemporary sensors allow aircrew to distinguish between individuals wearing brown and black, one walking with a limp, carrying an AK74 rather than an AK47.\(^ {135}\)

Resolution, as Coker reflects, does not reveal the moral character of the enemy. What does is persistent observation coupled with the networked intelligence of the whole security community. An RPAS has the design advantage over manned platforms in its persistence. Surveillance is interrupted during manned air-to-air refuelling. Some manned platforms can receive in-flight data, but the scale of networked connectivity is insignificant to an RPAS. Mid-mission, an RPAS crew\(^ {136}\), can access their own optical, infra-red and radar sensors, rewind and review digital recording of the footage, manipulate current images and compare with a squadron archive of relevant imagery, peruse military mapping, satellite and radar data, access Google Earth, receive updated intelligence packs from the task force or distributed intelligence fusion centres via email, constantly talk to relevant members of the coalition community via chat rooms, talk to forward air controllers via UAV radio, and if necessary, talk to the task force commanders or forward air controllers via secure telephone from the GCS on the other side of the world.

Attachment to friendly infantry comes from that, plus a shared culture and empathy, personal relationships, either through training events, collocation or liaison visits, or through remote working relationships over a protracted period of time. Attachment is stronger when collocated, but remains relevant and tangible across dispersed sites.\(^ {137}\)

Conjecture that remoteness equals inappropriate behaviour does not appear to be supported by credible source material. RPAS crews are conscious that their actions are recorded and observed across the networked community, including by strategic leaders; that centres any human tendency for risk shift whilst facilitating an unprecedented degree of oversight and accountability.\(^ {138}\) Quintana, supports this theory and offers, ‘if anything, this is proving that it is more ethical to use remotely piloted aircraft than traditional combat aircraft’.\(^ {139}\) Whetham expands, claiming the nature of RPAS offers a higher degree of oversight than any other military activity. He does not restrict that to the crew, but includes the restraining effect of persistent surveillance on

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\(^{134}\) Whetham, “Drive By Wars”.

\(^{135}\) Author’s experience.

\(^{136}\) Including the Mission Coordinator, who is often an image analyst, always an intelligence professional.

\(^{137}\) Author’s experience.

\(^{138}\) Author’s experience.

\(^{139}\) Quintana, “Confusing Ethics”.

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emotional risk shift potential in any friendly land force.\textsuperscript{140} RPAS recordings have been used to rebut allegations of inappropriate friendly troop behaviour, also acting as a reputational defence.

Coker relates the story of a WWII sniper with a hated Austrian officer in his sights, when the combatant lights a cigarette and becomes a man rather than a demonised enemy; the sniper relaxes his trigger finger. Coker uses neuroscience to explain the sniper’s behaviour: mirror neurons, or empathy neurons, allow humans to grasp the minds of others not through conceptual reasoning but through direct simulation of feeling, that is to grasp the minds of others as if their thoughts and behaviours were their own.\textsuperscript{141} This makes sense to any layperson considering the impact of visual images in modern day media.

Aircrew with contemporary sensors get a view of their adversary just like that of Coker’s sniper. Over days of surveillance on the same target, RPAS crews will get to know the individual’s habits and shadow them through their daily business, all the time gathering the intelligence that is vital to targeting decisions. If a targeting decision is made, the crews might continue watching for hours or days, choosing not to shoot, even though they legally could, waiting for a low collateral opportunity. For judicial review, and to rebut any adversary claims of collateral, the crew will then be instructed to watch the aftermath, perhaps for minutes, probably for hours. Any engagement is thoroughly reviewed, dissected and debriefed by the operational accountability chain.\textsuperscript{142}

Often overlooked are the psychological and emotional implications of events not involving killing. Aircrew professionalism allows them to mentally compartmentalise killing as fulfilment of their military duty in accordance with the rule of law to remove the threat to friendly forces and civilians. Aircrew professionalism does not help mentally resolve witnessing a soldier walk towards a compound gate and explode in the blast of an Improvised Explosive Device; the RPAS crew will be ordered to keep watching the macabre scene, beaming their sensor feed to the networked community for recovery coordination. Watching over a friendly patrol, under sporadic fire, that chooses tactical patience but later loses a soldier to enemy fire, when less tactical patience would have previously offered the RPAS several firing opportunities, is not easy to resolve. Then the ‘detached’ RPAS aircrew return home from their ‘office job’, interact with their family, whilst still attempting to mentally resolve the soldier who just died. The ‘detached’ RPAS aircrew returns to do the same ‘office job’ again for the duration of their three year tour, and perhaps into their second or third tour.\textsuperscript{143} These accounts are not intended to garner sympathy; they are intended to provide an inside view to balance the outside speculation, and perhaps foster understanding of current RPAS operations to alleviate any concerns over detachment.

Coker’s concern for generational empathy changes is intriguing, and his aversion to autonomy chimes with Heyns. The accounts and empathy detailed above are those of a

\textsuperscript{140} Whetham, “Drive by Wars”.
\textsuperscript{141} Coker, \textit{Warrior Geeks}, 132-133.
\textsuperscript{142} Author’s experience. The review process after an engagement is identical for manned platforms.
\textsuperscript{143} ibid.
seasoned, ‘approaching middle-aged’ warfighter. Coker postulates, with some neuroscience backing, whether the current young generation, living an online existence of social media, will evolve with less mirror neurons and a lower ability to empathise.\textsuperscript{144} Perhaps that concern simply follows the generational tradition of doubting the succeeding one. Perhaps Coker’s worrying suggestion could only be countered by military tradition, ethos, and leadership. In addition to any legal reasons, perhaps Coker’s analysis reinforces the case for military employment, rather than civilian agency or contract use, of armed RPAS. Ironically, Coker’s criticism of the overused ‘warrior’ term and consequent devaluation arguably misses the point that the US military are intentionally emphasising the term to indoctrinate the very ethos that Coker fears is waning.\textsuperscript{145}

A continuation of the factors in this section favouring human involvement with the decision to kill, are very relevant when applied to an autonomous future. The logic of humanity, empathy and Homeric values warn of a dangerous threshold when considering autonomous attack, reinforced by the arguments on LARs and the IHL requirement for humanity.

\textbf{Drone Wars}

‘The greater the visibility...the fewer the opportunities...for perception to be clouded by corrosive lack of understanding and distortion’.\textsuperscript{146}

Arguably the headline technology in the ‘Drone Wars’ is barely relevant, whereas the politics of its use are. Typical reporting of drone strikes claims they kill innocents, they breach sovereignty, and are against international law and the UN charter.\textsuperscript{147} Numerous claims and denials consider Pakistani implicit or complicit consent. Other analysis questions CIA rather than military use, the scrutiny of intelligence behind certain strikes, questions their efficacy, claims a counter-productive increase in radicalisation, and claims drone technology lowers the political threshold for lethal force employment.

‘Targeted killing\textsuperscript{148b}’ is an incongruous phrase used to describe offensive lethal force against specific individuals. Surely all killing under the rule of law must be targeted otherwise it would not comply with the outlined legal context? The targeted killing debate is legal, ethical, and political; the nature of the weapon system employed is immaterial, be that a sniper, drone or manned air.

\textsuperscript{144} Coker, \textit{Warrior Geeks}, 122-139.
\textsuperscript{148b} See Boothby, \textit{Law of Targeting}, 530-532, and the references therein.
Emmerson condemned the use of force in another state’s territory without its consent as a sovereignty violation. He referenced a Pakistani parliamentary resolution, dated April 2012, which called for a cessation to drone attacks, and stated that:

...neither the Government nor any of its component entities may enter into verbal agreements with any other foreign Government or authority regarding national security; (d) provides that any such agreements previously entered into should forthwith cease to have effect; and (e) provides that any such agreements should, in the future, be subject to scrutiny by specified Ministries and Parliamentary bodies and then announced through a Ministerial statement in Parliament.\(^{149}\)

An inference from the resolution is that verbal agreements endorsing drone use were previously in place and were with individuals, or entities such as the security services, rather than the parliamentary assembly.

Ripley details a history of drone cooperation between the US and Pakistan. Prior to 2003 and relocation to Bagram, US Predator sorties into Afghanistan were flown from Jacobabad, Pakistan. Later operations focused on suspected Al Qaeda sanctuaries in the remote North West Frontier Province and the Federally Administered Tribal Area. The CIA was tasked, allegedly to allow President Musharraf - who reportedly sanctioned the strategy - plausible deniability of US troop presence in Pakistan. ‘The unmistakable shape of three ...Predators,’ was evident in Google Earth imagery of a UAV base inside Pakistan, published in a Pakistani newspaper. In April 2009, a surge to within 100 miles of Islamabad galvanised the government to launch an offensive to drive the Taliban out of Buner and the Swat Valley. US drone operations increased, described by Ripley as a coordinated move.\(^{150}\)

Ripley references a Wikileaks alleged communication from 2008, reported as PM Gilani not caring if drone attacks occurred as long as they targeted the right people; they would be protested in the National Assembly and then ignored.\(^{151}\) During an April 2013 interview, Musharraf admitted to a secret CIA drone arrangement.\(^{152}\)

There is sufficient evidence to conclude: an agreement existed between the US and Pakistan; public and private Pakistani political narratives differed; and the security services had deals outside parliamentary scrutiny. Pakistani political context blurred the transparency of events,


\(^{150}\) Ripley, *Air War Afghanistan*, 189-195.

\(^{151}\) ibid., 197.

and US administration transparency would have been challenged by potentially igniting Pakistani political scandal.

‘One of the main issues...is the lack of transparency with which the CIA is operating’.\(^{153}\) A senior US administration official emphasised the importance for the very effective use of drones to be more transparently seen as conducted by military personnel under the rule of law in a clear governance framework rather than any extraordinary measures.\(^{154}\) RUSI analysis agrees.\(^{155}\) Over the last few years, the Obama administration has made efforts to become more transparent.\(^{156}\) This influence campaign is definitely late, perhaps delayed by Bush administration perspectives, perhaps through an evolution of political sensitivities and a reassessed strategy.

It is clear that the US perspective is one of an armed conflict against Al Qaeda and its affiliates. Reinforced by President Obama’s recent speech\(^{157}\), the US position is coherent with the aforementioned context of a Multinational NIAC with host nation support, or a NIAC against AQ in areas where the host state is unwilling or unable to neutralise the threat. This position appears reasonable, though is likely to be legally, morally and politically contested for some time.

Aaronovitch offers analysis to support drone use as a lower collateral option compared to inaction or a ground campaign. Technically, Aaranovitch’s analysis applies to air power use rather than drones. He cites up to 3400 drone strikes deaths in Pakistan, including an estimated 400 to 900 civilians, meaning 2500 to 3000 were Al Qaeda, foreign jihadis or Taleban. He suggests that the Government of Pakistan allowed the Taleban to occupy Swat in 2007, which he describes as a failed appeasement theory resulting in many civilian deaths, public decapitations, destroyed schools, and a base for attacks on the Pakistan State. He offers that during the Pakistani ground campaign to retake Swat, thousands died and hundreds of thousands were displaced. He concludes that ‘to leave militants alone is to invite attacks [against civilians] in Pakistan and around the world; not conjecture. To root them out through a ground campaign would kill and displace far more civilians than drone use would’.\(^{158}\)

Successive leadership during recent campaigns has directed a change of strategic risk threshold from that in the immediate aftermath of 9/11, emphasising the wisdom of more subtle force use within counter-insurgency campaigns. General Petraeus directed escalatory responses were to be used, rather than a default to excessive air power for short tactical gains that risked strategic success. The phrase ‘courageous restraint’ was attributed to General McChrystal, who ordered ISAF troops to limit the use of force, ‘against residential compounds and other locations

\(^{153}\) Quintana, Confusing Ethics.

\(^{154}\) A serendipitous conversation in 2012, referenced anonymously with permission.


likely to produce civilian casualties'.\textsuperscript{159} These initiatives were evidence of a learning process for the missions, and also perhaps a product of the changed operational scenario. Both generals were directing more tactical patience after initiating troop surges, creating a less precarious situation for ground forces and giving them more manoeuvre options than their campaign predecessors. Those tactical directives applied across all forms of military force.

Drones do not cause collateral. Compared to manned platforms, the persistence of drones allows more tactical patience, actually lowering collateral risks.\textsuperscript{160} Collateral risks apply to all military operations, whether they are manned or unmanned.

It is too simplistic to attribute radicalisation to drones. Aaronovitch claims evidence suggests a reduction in terrorist incidents in Pakistan and elsewhere because of the US attacks.\textsuperscript{161} Fuchter offers the US view that, ‘in recent years, with the help of targeted strikes, we have turned al-Qaeda into a shadow of what it once was’.\textsuperscript{162} The potential for radicalisation is likely linked to the use of force rather than the nature of the platform used. The essential core of this debate is strategy, and the potential costs were reflected in the directions given by Petraeus and McChrystal. After following Aaronovitch’s analysis and favouring air power over doing nothing or a mass ground campaign, has the affect of air strikes on the Al-Qaeda network, weighed against the cost of potential radicalisation, given a strategic benefit to US, Pakistani and global security? That debate arguably may never be empirically resolved. It is also overly simplistic to assess a snapshot, and the strategic balance between using force or not must continually be reassessed.

The use of UAVs is often accused of being a ‘cowardly, Western’ approach to warfare, with an element of the ‘civilisation clash’ narrative between the West and Islam, rather than a perception of military practicality.\textsuperscript{163} It will be interesting to observe if the narrative is moderated as Islamic states follow Western investment in drone technology for domestic and regional security. The Iranians revealed a bomber drone in 2010 and Saudi Arabia is purchasing armed drones.\textsuperscript{164} Arguably the valid societal examination of drone employment is being amplified for political gain. Regardless of the security debate about their efficacy, various politicians have used the topic to mobilise political support and undermine opposition, as allegedly feared by Musharraf and Gilani. Imran Khan organised an anti-drone demonstration during his election campaign, which was widely reported and televised by the BBC.\textsuperscript{165}

\textsuperscript{159} Ripley, \textit{Air War Afghanistan}, 162-4.
\textsuperscript{160} Boothby, \textit{Law of Targeting}, 280.
\textsuperscript{161} Aaronovitch, “Drones or Jihadis?”.
\textsuperscript{162} Fuchter, “First Drone War”, 18.
\textsuperscript{163} Singer, \textit{Wired for War}, 309-314.
The final element of the drone wars debate, and arguably the one with most relevance, is whether the use of unmanned platforms lowers the political thresholds for military intervention. This is a very important point in societal consent, but must be examined from all perspectives and with consideration to multiple scenarios, both positive and negative.

Research suggests that casualty tolerance is inversely related to the perception of national interest; higher casualty figures are tolerated during a war of necessity than during a war of choice. One side of the political threshold argument implies that it is easier to deploy unmanned assets, without the risks of human casualties, perceptions of land invasions, or the media frenzy associated with captured personnel. The conclusion of this argument is that lower deployment costs, lower casualty potential, and a liberal democratic desire to export and enforce human rights and law, will increase the incidence of interventions and conflict rather than reduce it. Claims that drone technology lowered political thresholds for targeted killing against AQ are conjecture; in light of 9/11 US sentiment, political will arguably exceeded any threshold and manned airstrikes would have been authorized in the absence of drone technology.

Aaronovitch argues from a more positive perspective, that a move away from expensive, large troop interventions should not precipitate a total aversion to intervention and nation building. He argues from an opportunity perspective, that drones allow assistance to be provided when it would be politically unpalatable otherwise. This would certainly be the case when considering air power capabilities such as ISR for crisis clarity and mobility for humanitarian relief. Predictions are that the incidence of conflict is likely to increase regardless, thus the lowering of political intervention thresholds through technological developments might help alleviate global security problems. How humans decide to employ the technology remains critical.

Conclusion

This paper attempts to separate many issues within the conflated drone debate and deconstruct them to dispel popular misconceptions and enable debate based on fact. Terminology is crucial to unambiguous debate and military attempts to persuade public adoption of acronyms appear futile. Arguably, the military should embrace popular language and guide distinctions within the UAV lexicon. Drone should perhaps be embraced as a descriptor for RPAS, whilst robot could distinguish autonomous systems.

International law on the use of lethal force applies equally to manned air, drones and robots. Calls to codify the use of lethal robots are entirely appropriate but are arguably unnecessary for drone operations, which should be considered as any other human controlled activity.

167 Aaronovitch, “Drones or Jihadis”.
The Drone Wars narrative includes extraneous elements. Sovereignty, host State consent, ungoverned regions, legality of targeted killing, transparency, CIA versus military employment, radicalisation risks, and strategic efficacy of airstrikes, are all political, legal, ethical and generic air power debates, rather than drone specific debates.

Most drone narratives involve misperceptions. Drones do not cause, instead can reduce collateral risks compared to other military options. Superficial comparison of manned-unmanned accident totals is invalid and requires deeper analysis of accident rates per flying hour. Medium and large air power UAVs require appraisal distinct from small UAVs. Current drone designs and limitations should not be considered analogous with future systems. Airspace integration has technically been demonstrated and remains simply a political issue. Cost and manning comparisons between manned-unmanned operations require more complex analysis than common narrative claims. Remote operations may suit the Whole Force concept, however, the detail of terms, conditions and squadron establishments require deeper analysis.

Speculation about low SA and detachment for drone operators could not be further from the realities of networked capabilities and persistent, high resolution surveillance systems. The intellectual and emotional attachment of remote operators to the battlefield is facilitated by networked systems but most importantly by ethos, training, liaison, and leadership.

The benefits of drones, across all air power roles, will evolve and become more apparent. Unlimited by human physiology, UAVs can be optimised for persistence or agility. Fears concerning communication fragilities and finite bandwidth capacity should be tempered by the cyclic nature of technological progression between innovation and counter.

The alternatives are manned operations, or an acceptance of robots. Manned aviation is limited by human endurance and incurs aircraft design penalties, but the human occupant negates communication vulnerability. Complex military judgements, including human ‘gutt instinct,’ on the use of lethal force will likely remain beyond autonomous technology for some time; societal consent may never manifest. Drones and robots must be considered separately and the potentials harnessed across other air power roles, even if autonomous attack remains politically unacceptable.

An overarching government vision is necessary to set the conditions for affordable innovation to deliver adaptability and flexibility. Technology is moving faster than procurement or ethics. Capability design must not be limited to traditional platform-centric considerations. The US DoD Roadmaps, particularly the policy guidance on commonality and open architecture to exploit Moore’s Law opportunities within major capabilities, should be considered inspirational for a UK vision.
‘War and warfare will always be with us: war is a permanent feature of the human condition’.\textsuperscript{168} Whether drone use lowers political thresholds for military intervention is a valid debate, but should avoid misleading Drone Wars bias; positive and negative factors across all air power roles and political scenarios must be considered. ‘It is not what you use that counts, but the way that you use it’.\textsuperscript{169} Examining the concept of intervention thresholds from a discretionary use of force perspective will yield different results than examining the benefits of drones from a humanitarian crisis relief perspective.

The force multiplying potential of drones is evident. The current UK vision predicts a medium term balance of one-third unmanned to two-thirds manned. It is likely that balance will be reversed, but the pace of transition will be governed more by economics and commercial affairs than military intent. There is no inevitable transition to a total drone or robot force; many perception and political aversions remain, and certain military scenarios favour manned operations. Manned aviation has a role in the foreseeable future, as asserted by the leading world power’s Roadmap.

\textsuperscript{168} Gray, \textit{Another Bloody Century}, 378.
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TO: DAMIAN KILEEN  
SUBJECT: Approval of ethics application

Dear Damian,


I am pleased to inform you that full approval for your project has been granted by the WSG Research Ethics Panel. Any specific conditions of approval are laid out at the end of this email which should be followed in addition to the standard terms and conditions of approval, to be overseen by your Supervisor:

- Ethical approval is granted for a period of one year from 21/03/2013. You will not receive a reminder that your approval is about to lapse so it is your responsibility to apply for an extension prior to the project lapsing if you need one (see below for instructions).
- You should report any untoward events or unforeseen ethical problems arising from the project to the panel Chairman within a week of the occurrence. Information about the panel may be accessed at: http://www.kcl.ac.uk/innovation/research/support/ethics/committees/sshl/reps/index.aspx
- If you wish to change your project or request an extension of approval you will need to submit a new application with an attachment indicating the changes you want to make (a proforma document to help you with this is available at: http://www.kcl.ac.uk/innovation/research/support/ethics/applications/modifications.aspx
- All research should be conducted in accordance with the King’s College London Guidelines on Good Practice in Academic Research available at: http://www.kcl.ac.uk/iop/research/office/help/assets/good20practice20Sept200920FINAL.pdf

If you require signed confirmation of your approval please forward this email to crec-lowrisk@kcl.ac.uk indicating why it is required and the address you would like it to be sent to.

Please also note that we may, for the purposes of audit, contact you from time to time to ascertain the status of your research.

With best wishes,

Rosie Pearson – Research Support Assistant
On behalf of
WSG REP Reviewer