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A NEW DIRECTION FOR AUSTRALIAN AIR POWER: ARMED UNMANNED AIRCRAFT

Dr Peter Layton

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Preamble

This, the fifth CAF Occasional Paper, *A New Direction for Australian Air Power: Armed Unmanned Aircraft*, examines the key issues associated with contemporary armed unmanned aircraft. These aircraft are programmed for acquisition in the *2016 Defence White Paper* and will bring important new capabilities to Air Force. The introduction into service of armed unmanned aircraft will ensure our force structure balance remains appropriate to evolving strategic circumstances. An Air Force that is capable across the full spectrum of conflict best ensures Australia continues to make meaningful contributions to the maintenance of the contemporary rules-based global order.

My intent for the CAF Occasional Papers is to make interested decision-makers, policy-makers, strategists and members of the public aware of air power issues of importance. These papers, focussed at the strategic level, are produced as needed rather than to a fixed schedule.

A New Direction for Australian Air Power: Armed Unmanned Aircraft was written at my direction. It discusses the utility of contemporary armed unmanned aircraft and dispels some myths that have developed over time. It focuses its discussion on the systems currently deployed on operations by Australia's allies, as these provide the reader a familiar point of reference. While future technical developments may improve unmanned aircraft capabilities, particularly in terms of their survivability in a contested environment, this paper views matters from a practical perspective and deliberately focuses on current technology and circumstances. Although written from the viewpoint of the Royal Australian Air Force, the paper may have broader application for other air forces.

I endorse the views expressed in this paper and commend it to you.

Air Marshal Leo Davies, AO, CSC
Chief of Air Force
September 2016

A New Direction for Australian Air Power

Armed unmanned aircraft have come of age. In today's fight in Iraq and Syria against the armed non-state group known as Daesh, more than a third of the US Air Force's land strike missions are being flown by armed unmanned aircraft. They have earned this prominence by bringing unique capabilities to this conflict that manned land strike aircraft cannot match. The most important is persistence; armed unmanned aircraft can loiter overhead undertaking tasks for more than a day. The long-recognised Achilles heel of air power—its transitory nature—has been significantly mitigated. Not surprisingly, armed unmanned aircraft are quickly becoming an important part of many modern air forces, including of the Royal Australian Air Force (RAAF).

The *2016 Defence White Paper* sets out an intention to introduce an armed unmanned aircraft capability into RAAF service in the next decade. Such a capability will build on the expertise first developed flying Israel Aerospace Industries' (IAI) Heron unmanned aircraft in Afghan skies and now being extended by embedding RAAF personnel in US Air Force armed unmanned aircraft squadrons.

The introduction of armed unmanned aircraft will bring a wholly new capability to the RAAF. The unmanned aircraft themselves are simple, some may even think primitive, by comparison with modern fast jet strike aircraft. The real advance is the deep adoption of network-centric warfare concepts where the aircraft is a part of a system of systems. Manned aircraft and their employment concepts draw their lineage from World War I, some one hundred years ago. In sharp contrast, armed unmanned aircraft are products of the internet age.

The introduction of armed unmanned aircraft will bring a wholly new capability to the RAAF.

This thought will worry some. Fears over the 'rise of the machine' are long held, dating back to the early phases of the industrial revolution. This paper has been written in part to address this concern. A better understanding of the technology, the operational concepts and the ethical and legal issues associated with armed unmanned aircraft can help allay fears. Equally, however, now is an appropriate time to reflect on how the acquisition of armed unmanned aircraft will change ideas about what air power can bring to the nation's defence. Policy-makers, military planners and operators all need to think hard both about getting the best out of this new capability and about how this capability may evolve.

This paper discusses ten propositions that encompass particularly important aspects of armed unmanned aircraft. The propositions concentrate on technology and employment considerations with legal and ethical aspects included to a limited degree. Discussion of these considerations can quickly become complex as they can be influenced to a large degree by context. In so focusing on practical

issues however, these propositions help focus thinking about what are in some respects revolutionary aircraft, while helping to avoid confusion and misunderstanding.

Ten Propositions Concerning Armed Unmanned Aircraft

1. Armed unmanned aircraft have brought greater persistence to the application of air power.
2. Armed unmanned aircraft are one part of a much larger system.
3. Armed unmanned aircraft are remotely controlled by a large distributed crew with diverse skills.
4. Armed unmanned aircraft offer new ways to provide close air support to ground forces.
5. Armed unmanned aircraft offer new ways to conduct interdiction operations and meet overall theatre strategy demands.
6. Armed unmanned aircraft can be employed ethically.
7. Armed unmanned aircraft have been developed to meet the laws of armed conflict.
8. Armed unmanned aircraft offer unsurpassed deployment options.
9. Armed unmanned aircraft are best suited for operations in areas where the air defences are limited or suppressed.
10. Armed unmanned aircraft complement manned aircraft.

Proposition 1

Armed unmanned aircraft have brought greater persistence to the application of air power

Armed unmanned aircraft now bring the attribute of persistence to the application of air power for the first time. This achievement reflects not only new technology but also changes in operational imperatives. During the Cold War, the main requirement was to operate in a very hostile air defence environment in the presence of extensive electronic warfare and data link jamming. The unmanned aircraft technology of the time was fundamentally incapable of meeting this demand.

In the 1990s this changed because of the long-running Yugoslavian civil war. In this slow paced conflict, the Western peacekeeping forces involved needed prolonged surveillance of the opposing ground forces. The legacy Cold War surveillance systems were highly survivable but had been designed for episodic reconnaissance. Manned aircraft lacked persistence while satellites

had predictable orbits and overhead times, could not easily be repositioned to cover new areas and were adversely impacted by bad weather. However, meeting this new requirement for extended surveillance was eased somewhat by the reduced threat from anti-air defences. A quick reaction program for a long-endurance unmanned aircraft was initiated by the US Department of Defense, and by 1995 the General Atomics Predator unmanned aircraft was in operations in the Balkans.

The aircraft's design was optimised for its particular mission. While maximum speed was only some 220 km/h, the early piston-engined Predators could loiter for almost a day, flying at 130 km/h at an altitude of 3000–5000 metres. This performance was adequate—if not sparkling—for the new long-persistence requirement, albeit of limited use for the earlier Cold War-type missions where survivability was critical.

Armed unmanned aircraft now bring the attribute of persistence to the application of air power.

In its long-duration surveillance missions, the Predator unmanned aircraft cued manned aircraft to attack time-critical targets. This worked well but sometimes manned aircraft were not readily available and hours passed before they were overhead. This delay meant hostile forces could group and attack civilians or peacekeeping forces before defensive measures could be taken. To overcome this, lightweight, small-warhead missiles were fitted to the Predators that could be fired by remote aircrew controllers against time-critical targets.

Proposition 2

Armed unmanned aircraft are one part of a much larger system

Armed unmanned aircraft systems consist of several elements including the aircraft, a range of sensors and weapons, a communication network, command-and-control facilities, an analysis suite and a support system. When operating as an integrated whole—as a system of systems—these elements provide a capability considerably greater than the sum of their parts. This system of systems approach is progressively becoming a characteristic of advanced manned aircraft as well.

The most commonly used armed unmanned aircraft, the turbo-prop engined General Atomics MQ-9 Reaper, is optimised to fly long-endurance sorties—some 27 hours or more—although with longer winged variants endurance can be further increased to around 42 hours. The sensors used vary with the type of mission being flown and include imaging sensors, high-resolution radars and electronic signal intelligence collection equipment. Together

with a synthetic aperture radar, the sensor most commonly used to find, identify and precisely locate objects is the multi-spectral targeting sensor that incorporates colour, black and white and low-light TV cameras, an infra-red imaging sensor and a laser range finder and illuminator. Importantly, this multi-spectral sensor provides full-motion video that can be transmitted in real-time to a wide range of users.

The mix of weapons also varies depending on the mission and may include GPS-guided bombs, laser-guided bombs, and short-range missiles. A common weapon load in recent conflicts has been four AGM-114 Hellfire missiles, as their light weight and low drag have minimised impact on aircraft endurance. These small warhead weapons, when used in conjunction with the multi-spectral targeting sensor, allow very accurate attacks with low collateral damage and, when necessary, little warning.

The communications network into which the armed unmanned aircraft connects has two main functions: firstly, to allow remote operators to control the aircraft, its sensors and weapons; and secondly to provide access to everyone authorised to receive the information the aircraft's sensors collect. A constant stream of encrypted data is exchanged between the unmanned aircraft and its associated ground command-and-control facilities using line-of-sight radios and beyond-line-of-sight satellite communication links. The unmanned aircraft can also broadcast its sensor information directly to multiple nearby land, sea and air commanders and units, including to in-flight manned aircraft.

Armed unmanned aircraft systems consist of several elements including the aircraft, a range of sensors and weapons, a complex communication network, command-and-control facilities, an analysis suite and a support system.

Proposition 3

Armed unmanned aircraft are remotely controlled by a large distributed crew with diverse skills

Armed unmanned aircraft are not self-driving autonomous vehicles. People are at their core, with the aircraft controlled remotely from distant ground stations, sometimes on the other side of the world. These remote pilots can, through internet connectivity, draw on the skills, expertise and insights of many others at a moment's notice. The aircraft may be 'uninhabited' but that is in a purely physical rather than capability sense. In some respects, an armed unmanned aircraft's 'cockpit' is a rather crowded one.

Armed unmanned aircraft are part of a network that directly connects into the wider military command-and-control system. This means the aircraft controllers can access and work with a wide diversity of external expert sources when flying their assigned missions. These external sources can provide real-time supplementary information, on-going analysis and situation-

specific insights based on their extensive, specialist knowledge. Each mission effectively acts as a focal point for a complex social network that, independent of geography, forms and closely cooperates as the tactical situation requires.

> Armed unmanned aircraft are part of a network that directly connects into the wider military command-and-control system.

A key external source is the national intelligence network with its global perspectives and worldwide access to information. As part of this, intelligence coordinators are generally collocated with the unmanned aircraft's aircrew and are often in the ground control station as the mission is being flown. This approach allows the intelligence community as a whole to directly provide support and deeper analysis as the mission develops and tactical circumstances change. This works both ways in that the intelligence coordinators can also feed information collected during the mission back into the national intelligence network to improve the overall intelligence picture. An armed unmanned aircraft mission represents an operations-intelligence fusion that manned aircraft cannot easily match.

The foundation of this is the extensive and complex communications architecture that provides global connectivity. The sophistication of this architecture makes it a major cost driver of armed unmanned aircraft systems but also brings significant benefits.


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Proposition 4

Armed unmanned aircraft offer new ways to provide close air support to friendly ground forces

Close air support involves attacking hostile targets very close to friendly ground forces when and as required. With manned aircraft, meeting this time imperative requires a constant shuttle of aircraft arriving on station for one or two hours—their typical on-station endurance before returning to base or moving back to conduct aerial refuelling—and then departing, to be continually replaced by others. The great advantage of the armed unmanned aircraft is that it can remain available overhead for up to a day awaiting the call to attack.

Unlike the constant shuffle with manned aircraft, the unmanned aircraft's persistence means its aircrew controllers can build up a very detailed understanding of the ground situation. The picture that the controllers see can, moreover, be data-linked directly down to multiple nearby ground units so that all can have a shared

appreciation of the battlespace. This situational awareness cuts both ways. The unmanned aircraft's controllers can work closely with local commanders to positively identify hostile forces and determine where civilians are located, ensuring attacks avoid collateral damage. In an important sense, the unmanned aircraft's exceptional persistence greatly facilitates discrimination between hostile forces, friendly units and civilians.

The unmanned aircraft flying high above an area can also give ground commanders a good understanding of where their own—often well-dispersed—forces are as well as their individual situations. This is particularly important in urban warfare where line-of-sight visibility is typically very restricted. During the Iraq war, armed unmanned aircraft supported on-scene ground commanders, giving them an enduring bird's-eye view that allowed the clearing of Baghdad city blocks of insurgents with minimal casualties. With armed unmanned aircraft overhead for extended periods, friendly ground forces could freely manoeuvre, confident that they would not be surprised or ambushed. In addition, when these friendly forces encountered an enemy strong point, the use of the unmanned aircraft's weapons quickly cleared it.

The unmanned aircraft's exceptional persistence greatly facilitates discrimination between hostile forces, friendly units and civilians.

In the converse situation, that of defence, the armed unmanned aircraft remains invaluable. The aircraft controllers can continually monitor potentially vulnerable friendly forces, providing rapid air support if these units look like being seriously threatened

or overrun. If tactical circumstances require, the defenders can withdraw in the best possible order and direction, with overhead fire support ensuring they cannot be easily pursued.

For ground commanders in contemporary conflicts, the armed unmanned aircraft's combination of providing them both continuous full-motion video of the unfolding action and highly responsive air support in the offensive and defence is without equal. The armed unmanned aircraft, by comparison with other fire support options ranging from artillery to manned aircraft, is very effective and very efficient.

The armed unmanned aircraft's combination of providing ground commanders both continuous full-motion video of the unfolding action and highly responsive air support in the offensive and defence is without equal.

Even so, armed manned aircraft have some shortcomings. Their weapon load is relatively meagre, being suitable for precise point target attacks but of limited value if continuing area fire support is needed; for this, artillery is better. Moreover, if the target is large or needs considerable force to disable it, manned aircraft or armour with their heavier weapons loads, are preferable. Lastly, armed unmanned aircraft are quick to respond if overhead but their transit speed is slow. Once the on-station unmanned aircraft's ordnance is expended, replacing it with another may take considerable time. Astute planning can minimise this but sometimes in conflict there are surprises. In such an event, manned aircraft or artillery might be quicker to respond.

Proposition 5

Armed unmanned aircraft offer new ways to conduct interdiction operations and meet overall theatre strategy demands

Interdiction as a task is almost a mirror image of close air support. In being undertaken at some distance from friendly forces, there is less urgency and this means the actions taken can be proactive not reactive. The adversary does not dictate the pace as much as in close air support tasking. Accordingly, unmanned aircraft attacks can be undertaken at a time and place that best meets the demands of the overall theatre strategy.

Air attacks can be made when the adversary has formed into large groups to move *en masse* to the battlefield. Such attacks can be more effective than seemingly similar close air support missions as in the latter case the enemy is usually well dispersed, hidden and protected. Undertaking interdiction ensures the adversary has no rest, is kept 'on the run' and has no sanctuary. Recognising

this, in some conflicts hostile forces hide amongst the civilian population. Armed unmanned aircraft can overcome this tactic to a considerable degree.

The unmanned aircraft force can be cycled through an area, effectively remaining on station for extended periods, several days or more. This allows the aircraft controllers to build up a good understanding of the local situation and of the local pattern of life. Unusual events and abnormal activities can be readily recognised, closely investigated and armed responses made if and when appropriate. The armed unmanned aircraft can remain overhead, waiting for the best possible time—when civilians are clear—to engage.

The persistent stare tactics used by armed unmanned aircraft can mean that hostile forces, laying improvised explosive devices to attack friendly forces at some later time, can be both easily seen and then followed back to their base areas. This means that bomb-making factories can be located and destroyed using the armed unmanned aircraft's low collateral damage weapons.

The armed unmanned aircraft can remain overhead, waiting for the best possible time—when civilians are clear—to engage.

Such an approach can also be used to engage enemy commanders who may be operating from urbanised locations. The long-duration surveillance of an area by an armed unmanned aircraft can allow the commanders to be identified and localised by their activity patterns, their interaction with enemy tactical units and their communications chatter. In such circumstances, there may only be limited time after an adversary commander has been localised

before they are again lost amongst the busy urban background. The armed unmanned aircraft controllers, having built up an intimate knowledge of the situation, can quickly attack with high discrimination.

Armed unmanned aircraft are particularly effective for engaging such high-value, fleeting targets. Not surprisingly, and based on bitter experience, enemy commanders in recent conflicts have displayed considerable fear of possible armed unmanned aircraft attack. This apprehension has forced them to stay on the move, making communicating with their forces difficult and seriously interfering with their decision-making abilities.

In the interdiction task, armed unmanned aircraft can also provide a very useful assessment of the damage inflicted on the targets engaged. Bomb damage assessment can usually only be undertaken well after the attack when the smoke has cleared and the dust settled. The unmanned aircraft can remain for an extended period to confirm that the correct target has been hit and the damage inflicted meets the overall theatre strategy. If a second attack is required the aircraft, still being in the vicinity, can conduct it in a manner that builds on the earlier attack and which causes low collateral damage.

However, it must be recognised that the weapons payload is restricted by the need to maximise loiter time and that this is an important limitation of armed unmanned aircraft. Unexpectedly replacing an on-task unmanned aircraft that has expended all its weapons is time-consuming. An armed unmanned aircraft's controllers, knowing the aircraft may need to be on station for a day or more, will fire its weapons sparingly. Before a target is engaged it must be identified with a high degree of certainty as, once its weapons are fired, the air vehicle must return to base and rearm if further kinetic response is required. In such circumstances, expending weapons attacking targets whose importance, identity or vulnerability is uncertain is operationally unacceptable.

Proposition 6

Armed unmanned aircraft can be employed ethically

An often cited ethical concern with the use of armed unmanned aircraft is the contention that they change the character of war as traditionally understood. This line of reasoning is built around a view that war is fundamentally a duel and draws on 19th century German strategic thinker Carl von Clausewitz's observations that: 'war is nothing but a duel on an extensive scale' and that a 'countless number of duels … make up a war'. Clausewitz used duelling to help explain his view that the aim of war was to disarm the adversary and so 'compel our enemy to do our will'. The converse of this is taken to be that if the enemy is already disarmed the actions taken cannot be labelled as 'war'. Clausewitz writes: 'total non-resistance would be no war at all'.

Some ethicists extend this contention to compare and differentiate between the use of armed unmanned aircraft and a duel. The operators of unmanned aircraft, being distant to the immediate

battlefield, are able to engage the enemy at no risk to themselves, it is argued. If they do not risk their lives, then it is not a duel, a notion that implies the two parties involved expose themselves deliberately to the risk of being killed. There is a further inference in that duels are seen as being related to honour; one fights a duel to confirm one's honour in the face of doubts being cast upon it. This logic train then connects the micro-event of a duel to the macro-event of a war: if an engagement using an armed unmanned aircraft is not a duel then its use is not part of a war.

This is a somewhat abstract argument in that war has involved combatants seeking to distance themselves from each other since the invention of the spear. However, leaving these continuing efforts to improve combatant survival aside, there are several additional flaws in the line of reasoning that reduces war to a duel.

Risk is borne by the military organisation as a whole and cannot be reduced solely to one type of engagement.

Clausewitz used duelling to illustrate a particular idea rather than as a core argument; a few chapters later he writes: 'combat in war is not a contest between individuals'. The argument about duelling overlooks that war is distinguished not simply by some individual, specific engagements. Instead in a war, there are always many engagements happening simultaneously. Risk is borne by the military organisation as a whole and cannot be reduced solely to one type of engagement. For example, in the current Afghanistan conflict, some Taliban units may be at a tactical disadvantage when engaged by armed unmanned aircraft while simultaneously

Coalition forces are at risk from Taliban improvised explosive devices.

Beyond this, others observe that in today's wars the battlespace is not tightly constrained to some small area but is instead global. If terrorists can attack anywhere, then by inference they contend, the defending forces should have no geographical constraints in responding. If terrorist attacks can occur in the homeland, then responses can be controlled from the homeland. This means of course that the homeland controllers are also at some limited risk as they are combatants: risk is shared with the distant adversary.

Thinking more broadly, it is a stretch to say that the use of armed unmanned aircraft in itself innately disarms the enemy sufficiently for us to impose our will on them. Clearly this has not occurred across the last 15 years of armed unmanned aircraft use. In the 'disarming' argument, the tactical level of war and its strategic objectives have been confused but the two cannot be so readily merged. A tactical advantage does not directly translate into strategic success. The means used to make war and the aims of a war are different matters and cannot be so combined.

If war is about more than some sporadic individual engagements then the argument that armed unmanned aircraft inherently cannot be used to make 'war' seems too one-dimensional.

If war is about more than some sporadic individual engagements then the argument that armed unmanned aircraft inherently cannot be used to make 'war' seems too one-dimensional. It has grossly oversimplified the concept of war. The abstraction has been taken beyond where it is useful—or accurate.

The duelling argument has at times been further extended to advocate all involved in a war should share risk at the individual level. If the way a war is waged does not involve such reciprocity between the two sides, it is seen in some way as dishonourable. This approach draws upon notions of a 'warrior's honour', albeit traditionally these concern constraints on how violence is applied rather than concepts of shared risk. In reality, commanders generally try to lower the risk to their own forces relative to the adversary to gain effectiveness and efficiency and for important moral reasons. Seeking to share risk in some even-handed manner unethically imperils one's own forces. There is no more morally compelling reason to make one's forces as vulnerable as an opponent's, than to prohibit the police using body armour when they face dangerous armed criminals.

Seeking to share risk in some even-handed manner unethically imperils one's own forces.

The reciprocity debate also infers that both sides in a conflict have a moral equivalence. In some respects, military culture during earlier wars saw all soldiers as similar in both facing death together, albeit fighting for different causes. For example, the ANZACs fighting at Gallipoli came to regard the Turks as an honourable foe. Today though, the way adversaries in Afghanistan, Iraq and Syria make war argues strongly against any similar moral equivalence. Such notions seem mistaken—and repugnant.

This debate about 'warrior's honour' should perhaps be better focussed on its traditional intent, on concerns over using violence against people. This is an area where the controllers of armed

unmanned aircraft are entering new territory. The notion some have of aircrew controllers playing some kind of videogame is seriously misplaced.

The distant controllers may be individually at little physical risk during an engagement but a 'warrior's honour' is a mental construct. Like all warriors, some involved suffer psychological damage from feeling morally compromised by their role in killing others. The need for accurate, precise attacks means that the aircrew controllers using the unmanned aircraft's high-resolution sensors witness death in considerable detail.

Moreover, the after-action surveillance involves monitoring post-attack events for hours, sometimes days later. The infantry soldier may see people killed on the battlefield, or indeed take life. However, in the heat of conflict, the infantry soldier is unlikely to linger. Conversely, the remote operator, watching an area for some weeks to discern the 'pattern of life' before accurately engaging an adversary means humanising enemies in a way most individuals on the battlefield do not—and this has psychological impacts.

Proposition 7

Armed unmanned aircraft have been developed to meet the laws of armed conflict

The laws of armed conflict govern the use of armed unmanned aircraft as much as they regulate any weapon system on the battlefield. These laws have four core principles.

Firstly, the most important concept is discrimination, which involves a combatant observing a clear difference between civilians and combatants. Attacks must not be intentionally directed against civilians. Secondly, military necessity: no more force should be used than is necessary. Thirdly, unnecessary suffering: weapons and methods of warfare that could cause unnecessary injury or suffering are prohibited. Lastly, proportionality: the use of military force should not cause loss of civilian life or damage to civilian objects that is excessive for the objectives sought. Proportionality is the principle on which the modern stress on limiting collateral damage is based.

Armed unmanned aircraft technology has developed in a way that is fully compatible with these four core principles. The unmanned aircraft's long loiter times, its high-resolution sensors, its controllers' abilities to access intelligence and analysis networks and the fitment of small warhead, precision guided weapons all combine to provide a weapon system with potentially great discrimination able to consistently sharply limit collateral damage. For armed unmanned aircraft, persistence markedly facilitates discrimination.

> The laws of armed conflict govern the use of armed unmanned aircraft as much as they regulate any weapon system on the battlefield.

In this though, there are some issues. The laws of armed conflict are most applicable to wars between states but today's conflicts mainly involve states fighting non-state actors and this creates some legal debate. These debates can be usefully discussed by looking at two important matters: state sovereignty and the legality of attacking armed non-state actor groups, particularly their commanders.

Some sovereign states cannot adequately police their territory and so armed non-state actors are able to use parts of these countries as a base from which to attack other nations. Some argue that self-defence considerations then apply and the countries being attacked are legally allowed to strike back at the armed non-state actors' bases even if the state whose land these are within disagrees.

In practice, the contemporary use of armed unmanned aircraft to wage such attacks has generally relied on the agreement of the government in whose country the hostile armed non-state

actors are located. Difficulties have arisen though where these governments for domestic political reasons sign secret agreements or take an ambiguous position about whether such agreements are in place. There are many complex issues at stake in this matter and the legality of any such attacks in the future by armed unmanned aircraft would depend greatly on the context.

Beyond matters of state sovereignty, there are also issues related to armed non-state actors and whether they should enjoy the same legal privileges as state combatants. In this, the position generally taken by Western governments is that their armed forces should fight non-state enemies as they would a state adversary. The same legal constraints on the use of armed force then apply arguably appropriately although, there are some expressed concerns over the use of armed unmanned aircraft to attack the commanders of armed non-state groups.

Some branches of international law hold that to be judged a combatant and able to be attacked, individuals must be 'taking a direct part in hostilities.' Under this view the leadership of armed non-state groups, provided they are not using weapons against others, should be immune to attack. The counter argument is that attacks on the leadership of armed non-state actor groups is an act of self-defence. If not attacked, these leaders will continue to pose a danger to the friendly state and its citizens.

Others rebuff the self-defence argument noting ground troops could be deployed instead to arrest hostile non-state group leaders. This disregards that such an action would probably, as history indicates, involve considerably more loss of civilian life and damage to civilian property than a precision attack by armed unmanned aircraft. In this instance, the use of ground troops seems at odds with the principle of proportionality concerning the use of military force not causing a loss of civilian life excessive for the objectives sought.

There are no easy answers to this conundrum when armed non-state group commanders, conscious of law-of-war constraints on their professional military opponents, deliberately deeply embed themselves into civilian communities. This makes attacking them problematic whichever approach is adopted.

War involves the application of violence. The laws of armed conflict try to protect non-combatants but at the same time recognise that collateral damage during war has a certain degree of inevitability. The principle of distinction stipulates civilians not be intentionally targeted, but it does not then follow that all civilian casualties are illegal—or indeed unethical. While zero civilian casualties must always remain the objective of military forces, the best that might be hoped for in war is to minimise the collateral damage unintentionally inflicted. And for this, armed unmanned aircraft offer much.

The debate over the legal aspects of armed unmanned aircraft is wide-ranging. At its core however, the issue is about how armed unmanned aircraft might be directed and used rather than what armed unmanned aircraft are. In this, a sometimes obscured feature of armed unmanned aircraft is particularly pertinent. Unlike other battlefield weapon systems, armed unmanned aircraft transmit their images widely in real-time. Many others can instantaneously review and critique the decisions and actions the aircraft's controllers take. A high level of accountability is inherent but also means that every decision to fire missiles can be carefully scrutinised for its moral and legal standing before being actioned. How an armed unmanned aircraft is used is much more subject to ethical checks and legal constraints than some might believe or contend.


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Proposition 8

Armed unmanned aircraft offer unsurpassed basing and deployment options

Armed unmanned aircraft can be operated in a manner called 'remote split operations'. The ground control station elements, with the majority of the unit personnel, remain at the home base with the already established deep connections into the command, support and intelligence networks. A small team and several armed unmanned aircraft are deployed to an austere forward base. This team is responsible for maintaining, arming, launching and recovering the unmanned aircraft. The much larger home base team, using the networked communications architecture, then controls the distant armed unmanned aircraft on their many long-duration missions. Minimising the size of the element deployed to the forward base brings considerable benefits in limiting both unit personnel and logistic demands, and the size of the force protection units that must accompany them. The armed unmanned aircraft unit gains significant agility in being able to move into new theatres

of operations quickly and easily through maximising the advantages the remote split operation concept brings. There are other, larger gains through using this approach.

The remote split operation has meant that, in practice, about 80 per cent of a unit's armed unmanned aircraft deploy into theatre with the remainder kept at home base for training and maintenance purposes. By comparison, those units not using the remote split operation are able to deploy only about a third of their aircraft into theatre. A sizeable proportion remains behind for use by home-based crews for continuation training to prepare them for deployment. In terms of personnel, the ratio is similar. In the remote split operation more than 80 per cent of the unit's personnel remain at home base and are directly involved in flying combat missions. When not using this concept, a third of unit personnel are deployed into theatre, with another third being prepared to go and the remaining third being reconstituted after just returning from operations.

The armed unmanned aircraft unit gains significant agility in being able to move into new theatres of operations quickly and easily through maximising the advantages the remote split operation concept brings.

For smaller air forces, the differences are stark: using a remote split operation means from a nominal total force of 15 armed unmanned aircraft, 12 can be deployed into theatre; using the traditional approach only five can be deployed. As a rough generalisation, four armed unmanned aircraft are needed to keep one orbiting overhead a combat zone all day for seven days. With 12 aircraft in theatre

three orbits are possible, with five aircraft in theatre only one. Remote split operations are a significant force multiplier.

There is a further potential gain that leverages commercial thinking. Businesses well-understand that people perform at their best when working during normal daylight hours. Rather than working highly skilled people on late night and early morning shifts, companies when able embrace a 'follow the sun' approach. Teams of people, living in several different time zones around the globe, work during their day on the most complex and important problems. The teams are then operating at their best without the well-known cognitive deficiencies shift working imposes. In armed unmanned aircraft operations, only the in-theatre launch and recovery element needs to work round-the-clock. This possible type of remote split operations can allow crews controlling the armed unmanned aircraft to be at their mental best when others in theatre—friendly or adversary—are not.

Proposition 9

Armed unmanned aircraft are best suited for operations in areas where the air defences are limited or suppressed

The great persistence of armed unmanned aircraft and their integration into a net-centric system of systems drives their usefulness in modern military operations. While both aspects are positive attributes in some situations, they are not universally applicable. Great persistence at an affordable cost requires a relatively slow, high-flying, lightweight aircraft vulnerable to sophisticated air defences. Moreover, net-centricity means sensitivities to jamming, electronic warfare and cyber attack. The current generation of armed unmanned aircraft is accordingly best suited to operating in air environments where there is only a limited low altitude air defence threat.

It is in this area that the next developments in armed unmanned aircraft appear most likely. The US, UK, France, China and several

Image courtesy of BAE Systems

European countries are developing fast, jet-powered unmanned aircraft potentially capable of penetrating hostile air defences. These are generally flying wing designs that use stealth techniques to improve survivability. One, the UK's BAES Taranis, has already been tested at the RAAF's Woomera Range Complex in South Australia.

To operate successfully in a harsh, electronic-warfare environment featuring extensive jamming, the unmanned aircraft will need much greater autonomy than the current generation.

The problem though is not just that of more sophisticated airframe design and higher unmanned aircraft speeds. To operate successfully in a harsh, electronic-warfare environment featuring extensive jamming, the unmanned aircraft will need much greater autonomy than the current generation. Achieving this presents considerable technical challenges, raises new ethical and legal issues and may require new tactical employment concepts. There has accordingly been growing interest in the idea of robot wingmen, whereby multiple unmanned aircraft accompany a manned aircraft and operate as an extension of it, effectively increasing sensor and weapon carriage capacity.

Such ideas suggest new capabilities quite different to those offered by the current generation of armed unmanned aircraft. These new unmanned capabilities may be acquired at some future time if the operational case for them is compelling, however, they seem unlikely to supplant the current generation. Today's armed unmanned aircraft offer certain unique capabilities that appear particularly valuable going into an uncertain future. A future balanced air force will most probably operate a range of unmanned and manned aircraft offering diverse capabilities suitable for different types of conflicts and various peacetime operational tasks.

Proposition 10

Armed unmanned aircraft complement manned aircraft

Modern air forces are expected to have capabilities appropriate to both potential interstate and intrastate conflict, and for extensive peacetime tasks ranging from humanitarian and disaster relief to border protection. Such mission diversity means that the most sensible way to view unmanned aircraft is as a complement to manned aircraft. Both types of aircraft have particular strengths and weaknesses that can be exploited by potential adversaries or which mean that certain tasks cannot be undertaken. The most useful force structure for future well-balanced air forces to adopt appears to be a carefully considered blend of manned and unmanned aircraft.


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Conclusion

The development of the modern armed unmanned aircraft required the coming together in the 1990s of technological advances and a pressing operational need. The result today is that sophisticated armed unmanned aircraft are flying long-duration missions over Iraq and Syria and inflicting significant damage on Daesh. The ever-present fear of accurate air attack has made the manoeuvre of Daesh's combat forces progressively more difficult and forced the group's military leadership to hide to survive, making commanding their forces increasingly problematic. Importantly, the armed unmanned aircraft's impressive capabilities mean their controllers have time to accurately identify and verify targets, sharply reducing collateral damage concerns.

Even so, armed unmanned aircraft by themselves do not win wars, as recent combat experience has demonstrated. They provide new air power capabilities but are a normal weapon, being most effective only when used within an appropriate strategic framework. Moreover, contemporary armed unmanned aircraft, being designed to loiter for extended periods, are slow and vulnerable to sophisticated air defences. Their use is only sensible in permissive air environments or in areas where the air defences have been

suppressed. Armed unmanned aircraft are useful complements to fast jet manned aircraft but not their replacement.

The most common conflicts in the modern era have been protracted intra state wars where air defences are few and adversaries hide amongst the people, often in urban environments. These are just the kinds of conflicts contemporary armed unmanned aircraft—unlike modern fast jet manned aircraft—have been developed for. Such wars will hopefully lessen over the next few decades but armed unmanned aircraft have now been developed sufficiently to be able to undertake a much broader array of tasks. These include intelligence surveillance and reconnaissance, air interdiction, close air support, maritime air support, counter-terrorism, combat search and rescue, precision strike, convoy overwatch and forward air control. Unmanned aircraft can also undertake a variety of non-warlike humanitarian assistance and disaster relief roles when needed.

For a middle power to stay strategically relevant in an uncertain future, its air force needs to have capabilities useful across the full spectrum of conflict. Being able to participate in major wars with manned fast jet aircraft is necessary but no longer enough. Making meaningful contributions to the maintenance of the regional and global rules-based order is now considered both pressing and important. As Australia's major alliance partner and other middle powers have already decided, armed unmanned aircraft have a real role to play. To better meet today's strategic demands, it's time for Australian air power to take a new direction.

Image courtesy of UK Ministry of Defence