PATHFINDER

COLLECTION - VOLUME 8

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ISSN 1836-7712

Published and distributed by:

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Foreword

This eighth volume in the *Pathfinder Collection* series has grouped the fortnightly *Pathfinder* bulletins into four groups: Strategy, Technology, Future and History. The selection of these groups has been to draw together the themes of these diverse contributions that place air power issues in the public domain for discussion and debate.

In September 1995, Colonel Phillip Meilinger USAF, as the Dean of the School of Advanced Airpower Studies at Maxwell Air Force Base in Alabama outlined ten propositions regarding air power. The *Pathfinders* in this collection reflect some of these propositions, specifically: air power is an inherently strategic force; air power is about targeting, intelligence and analysis; air power is able to conduct parallel operations simultaneously at all levels of war; precision has redefined the meaning of mass; and the synergistic link between technology and air power.

The APDC is always seeking contributors both within and from outside the air force to increase intellectual discussions on topics of interest that enhances the understanding of air power's inherent characteristics. I would like to thank the *Pathfinder* contributors who have made this collection possible, as they have contributed to our collective professional mastery of air knowledge. Especially given if, knowledge is power then air knowledge makes for more effective air power.

I sincerely hope that you find this volume as enjoyable and informative as I have.

GPCAPT Andrew Gilbert
Director, APDC
July 2017

The Air Power Development Centre

The Air Power Development Centre, initially the Air Power Studies Centre, was established by the RAAF in August 1989, at the direction of the Chief of Air Force. Its function is to promote a greater understanding of the proper application of air and space power within the Australian Defence Force and in the wider community. This is being achieved through a variety of methods, including development and revision of indigenous doctrine, the incorporation of that doctrine into all levels of RAAF training, and increasing the level of air and space power awareness across the broadest possible spectrum. Comment on this publication or inquiry on any other air power related topic is welcome and should be forwarded to:

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Contents

Future

History

Strategy

On the Nature of Air Power (#260)

Key Points

- *The nature of air power is unique and underpinned by a number of factors*
- *A robust organisation and administration is critical to the effectiveness of air power*
- *The inherent characteristics and nature of air power make it uniquely suited to employing any of the strategies within the spectrum of strategies that support national security*

A Jesuit priest of the 17th century, Francesco de Lana-Terzi, ranks amongst the great visionaries of air power, writing in vivid detail about the military use of flying machines to transport troops by air and for the bombing of cities, fortresses and ships. However, he qualified his visions by also exhorting God to withhold such an invention from the grasp of mankind. However, about 275 years after the priest's entreaty to God and a mere 42 years after the first heavier-than-air flight, a Japanese city was destroyed by a single bomb dropped from a single aircraft. The influence of air power on international affairs had been emphasised and underlined in red.

The phenomenal rise of air power makes it necessary for statesmen and strategists alike to have a clear understanding of its nature and the challenges that have to be addressed in employing air power in the pursuit of national security. While air power is but one of the elements within the military force of a nation, it has become critically influential in international geopolitical dealings. On the one hand, air power has the capacity to facilitate the creation of military alliances amongst like-minded nations through technological interoperability. On the other hand, air power also retains the capacity to lead the world towards the apocalypse because of the extreme destructive power it can rapidly unleash. These are two sides of the same coin, making air power a special instrument of national power.

So what is the nature of air power? Viable air power, a nation's ability to project power from the air, needs to be organised. The importance of organisation in the employment of air power was

demonstrated as early as World War I. British air power was organised to pursue its end-goals through concerted efforts to secure air supremacy, the simultaneous organisation for intensive production of aircraft and the establishment of the Air Ministry to provide strategic guidance. The nature of air power is such that an appreciation of the need to combine strategic and overarching policy; the creation of a doctrine that provides guidelines for the development of concepts leading to operational excellence; and the technological expertise necessary to produce systems that function at the cutting-edge, are critical to its effectiveness. A robust organisation and allied administration become foundational requirements in this equation.

Such is the nature of air power that it requires greater understanding from a national perspective than any other power projection capability—the term 'national airmindedness' conveys this aspect. The inculcation of airmindedness in a nation involves bringing together a number of, at times, disparate entities. It starts with the technological orientation of the national education system, which in turn, creates the ability to conceive the systems and platforms to create air power of the necessary calibre. Air power is intensely technological in all aspects of its development and employment. A national ethos of airmindedness can only be achieved after the nation has developed an adequately high technology bias in its broader educational stance. The nature of military air power is such that it cannot exist without the support of an air-minded public. It is not the materiel alone that creates air power, but airmindedness of the people as a whole that sustains it.

Two enduring lessons were gleaned from World War II, and both have to do with the nature of air power. These are still valid even though the character and conduct of war have altered remarkably over the past decades. First is that an army without air power fighting another which has recourse to adequate air power capabilities is practically helpless. The ability to 'see' beyond the horizon of the surface forces makes air power a war-winning capability in these circumstances, even if its offensive capabilities are not used. The comparison is of a blind man fighting a sighted person. It is the nature of air power to have an enhanced perspective of the battlespace, unlike any other force projection capability.

The second lesson is of even greater contemporary importance and relevance—only air power can counter the employment of

air power by an adversary. There is an argument that air defence capabilities can be an effective counter to offensive air power. Under certain circumstances, air defence may be reasonably efficacious, but it will never provide an assured defence against aerial attacks. History is a pointer in this—whenever a new weapon superior to those previously in use has been developed, only systems with similar capabilities have been able to counter it. For example, the introduction of the bow and arrow made the archers dominate the battlefield until their opponents also armed themselves with the same weapons. The ubiquitous nature of air power makes it very difficult to counter by any other means other than a robust air power capability.

Over the past century, air power capabilities have developed to emphasise the core characteristics of speed, reach, flexibility and precision. The nature of air power is such that it is able to 'reach out' and 'touch' very rapidly without being constrained by geographical barriers or man-made sovereign boundaries. This capability transforms air power into a political instrument *par excellence*. Air power has a central role to play in all the strategies that secure a nation—from the strategy of influencing and shaping, through deterrence and coercion, to the high-end strategy of punishment. The inherent advantage of air power is that it has the capacity to function in a benign state while retaining the ability to employ lethal and destructive power very rapidly. This spread of capabilities can be converted to a powerful statement of intent to a potential adversary. This is the unique nature of air power and its employment can be tailored accordingly.

Five facets that set air power apart have been described above. A full appreciation of the nature of air power in all its nuances and the inimitable capabilities that it brings to national security is a complex subject of considerable detail; one that cannot be studied casually. What has been postulated above is not intended to be definitive or complete, but is a representative analysis of air power that highlights its pervasive nature.

The Strategic Dimension of Air Power (#258)

Key Points

- *Air power is an inherently strategic capability*
- *Air power has the ability to identify and neutralise the strategic centres of gravity of an adversary without having to defeat the opposing military force*
- *Air power must be employed in alignment with national security priorities to achieve strategic effects*

Almost a century ago in 1921, Giulio Douhet, the renowned Italian air power theorist, stated that the aeroplane was an inherently strategic weapon. In the contemporary world this statement still holds good and can be expected to mean that air power is a strategic capability. This means air power, because of its ability to operate in the third dimension, is able to bypass the counterforce battles that the armies and navies have to fight and directly target the centres of gravity of the opposing nation. Dependent on the context of the battle, campaign or war being fought, these centres could be industrial, military, economic or political loci of the adversary group. This routine ability to create strategic effects has been a central characteristic that has guided air power employment over the years.

The differences in the application of air power have come about not because of any dissonance in understanding its strategic capabilities, but by the selection of targets that when neutralised would create the desired effect. The process of identifying and selecting the appropriate target is influenced by a number of factors, with most of them being outside the immediate control of the air campaign planners. However, it is important for everyone associated with the application of air power—from the highest level of political leadership to the operational level air commanders—to understand the diversity of the strategies that can be supported by air power through the selection of appropriate targets, for collectively they define the boundaries of strategic air power capabilities. They clarify the relationship between air power and its role in national security.

Almost immediately from its first use as a weapon of war, air power and air warfare were recognised as being fundamentally different to land power and surface warfare. Over the past several centuries, surface warfare has evolved in a somewhat steady manner, resulting in centuries-old theories dealing with firepower, manoeuvre, logistics, administration, command and control, technology and many others that collectively entrench a doctrine that has needed refinement only at the operational level and in the development of concepts of operations. The operational techniques of the 'Great Captains'—starting from Alexander, through Fredrick, Napoleon and Guderian, all the way to Schwarzkopf—employed in winning their battles and campaigns are surprisingly similar in their purpose and execution.

Air power is different. Given that air power was 'invented' rather than arrived at as a progression, it was only natural that its theories would also be revolutionary rather than the product of long-drawn-out evolutionary processes. Further, air power did not have the luxury of being able to reach back to experience when confronted with a challenge, having to innovate a new theory of warfare and strategies to support it. In the initial stages of this development, the horrendous human losses of World War I was a credible influence, making the leading thinkers search for a direct connection to strategic defeat of the adversary through the identification and neutralisation of their centres of gravity rather than tactical and operational defeat of the military forces in the battlefield.

This does not diminish the crucial role that air power plays in the actual battles on the ground. In fact, there was a school of thought, at the very infancy of air power theory development, that advocated the destruction of the enemy military forces, both on land and at sea, as a prerequisite for victory. The argument was that air power could achieve this end-state far more rapidly and effectively than the slugging match that land warfare had deteriorated to in World War I. Even at the beginning of World War II, the destruction of the enemy army was considered the first priority for air power by some theorists. Indeed, there are some who, even today, claim that it was the tactical air campaign against the Iraqi Army in Kuwait that led to the Coalition victory in the 1991 Gulf War and not the air campaign against the strategic centres of gravity in Baghdad.

The truth is that air power must be employed in a contextualised manner and the selection of targets also will have to be done with the desired end-state in view. Further, as the conduct and characteristics of war have continued to evolve over the decades, the clear distinction that existed between strategic and tactical targets—which meant that their destruction would create strategic or tactical effects upon the adversary—has now become ambiguous. This has translated to a situation wherein a target on the battlefield could be of strategic importance in the wider view of the effects that its destruction would create. However, this kind of situation is still infrequent.

The central assumption in the application of air power is that the adversary is built around a complex system comprising of centres of gravity with varying importance. The ability of air power to target any one of them at will makes air power the ultimate strategic capability, from a military point of view. In addition, the non-lethal capabilities of air power produce a completely different set of strategic effects that are of politically high value. The reach of air power, the ability to 'touch' that is optimised through a combination of range and speed, is a potent tool of diplomacy when a nation decides to assist another in times of natural or man-made catastrophes. The delivery of humanitarian aid and disaster relief through airlift is a powerful message of solidarity that can turn even recalcitrant recipients to friends. Contemporary air power has the innate capability to become the preferred tool for projecting a nation's intent—benign or lethal.

Air power is a strategic element of national power. Its use as a tactical tool will always limit its full potential to produce the desired effect. Air power is best employed when the desired strategic end-state has been defined at the national security level and thereafter it is employed by air power professionals to create the necessary strategic effects to achieve that end-state. Any deviation from this process will invariably lead to the dilution of air power effectiveness. Considering that balanced air power capabilities are cost-intensive to acquire, operate and sustain, such employment would be an unpardonable waste of national resources.

The Impact of Air Power (#261)

Key Points

- *The advent of air power neutralised the advantage provided by natural geographic features as a means of defence for a nation.*
- *Since air power can only be countered by air power, it became necessary to maintain a 'standing force' to ensure national security.*
- *Commercial aviation along with information technology has been a prime mover in what has been called 'globalisation' of the world.*

The advent of air power provided a new medium for intercourse between nations in conducting trade, communications, diplomacy and warfare. Therefore, the term air power is not restricted to solely military application. In simple terms, air power is the total ability of a nation to fly. In the span of a mere century, air power has shrunk the traditional concepts of time, distance, speed and direction into relatively meaningless dimensions. The reach and rapid reaction capability, in combination with the extreme destructive power of air-launched weapons, has made air power a dominant element in the art of warfare and national security. It is not surprising that the capability to exploit the third dimension, the medium of air, and deny its use to an adversary has become one of the underpinning requirements in securing a nation.

Air power was born in war, with air forces coming of age by 1918, at the end of World War I. There was phenomenal growth of commercial air transportation between the two great wars. During World War II, all arguments regarding whether or not air power was an instrument of national power were settled emphatically. By the end of World War II, the debate on the utility of air power revolved around the extent to which it was influential in determining the security and welfare of a nation. It was understood that air power, as an instrument of national power, had arrived. Air power had demonstrated its dominance in war and in the ensuing peace, it created a new appreciation of the time-distance relationship.

The influence of air power on all human activities was achieved in the span of a few decades and therefore was difficult to be fully comprehended. The first impact was that the advantage provided by natural geographic features as a means of defence was once and for all neutralised. The distance between nations, previously a consideration in military planning, took on a different meaning in the newly established time-distance reality. In other words, a nation can neither be impervious to attacks in the case of war, nor can it create assured security in-depth against an adversary with credible air capabilities.

In the second half of the 20th century, the increasing importance of air power, not only in the conflicts of the time but also in the field of commerce, made it a critical element in political considerations. From a military perspective, air power finally provided a satisfactory solution to the age-old challenge of meeting the principles of mobility and concentration of force in the conduct of war. Similarly, air power, in its more benign application, has made it possible to provide humanitarian aid during natural or man-made disasters, starting with the famous Berlin airlift in the immediate aftermath of World War II. It has also promoted peaceful commerce and exchange between people on a global scale including creating a vast industry of international travel, not possible just a few decades before.

The second impact of air power is more subtle and therefore, difficult to appreciate in a cursory manner. Since air power can only be countered by air power and can target the very nerve centre of a society, the necessity to maintain a 'standing force' has become an imperative in national security. The inability of a modern nation-state to prevent war in an assured manner is a key vulnerability introduced by the advent of air power, leading to the creation of deterrent forces. The so-called 'arms race' has been the result. Today, professional air forces of great capability have been created and are maintained at heightened readiness as a contributory element to the overall deterrent stance of a nation. The influence of the threat of air attacks on political thought and development of security strategies, even during times of relative peace, has been extraordinary. The exploitation of air power through its ability to control, and contest control, of the third dimension has created a lasting effect on the concept of national security.

The result has been that the political relationships between nation-states have been drastically altered. It is clear that not possessing

sufficient air power capabilities will leave a nation at a severe disadvantage in the event of war. Since geographical barriers or position do not provide depth in defence, eternal vigilance is required to ensure national security. In terms of air power, this comes at a high price.

The third impact has been that although less spectacular than the military impact of air power, commercial aviation, along with information technology, has been a prime mover in what has been called 'globalisation' of the world. Aircraft have always been a means of transportation, though the nature of their military employment has at times clouded this fundamental fact. Barriers to travel and the movement of goods have now become purely man-made legal restrictions in terms of the right of entry, customs and the like. Like their military bomber counterparts, commercial aircraft challenge the sanctity of the long-term legal precept of 'national sovereignty' itself. While sovereign airspace has been legally defined, the wherewithal to defend it comprehensively is possessed by only a few nations and therefore, for all practical purposes, international airspace is a pervasive element of the global commons.

The three impacts reiterate the fact that air power is indivisible—military air force and civil aviation are two sides of the same coin that contribute directly to national power. However, there are a number of factors that directly influence the development of national air power. The first, and perhaps the most important, is the availability of economic resources to acquire the necessary capabilities that form the foundation for air power development. The contemporary sophistication of aeronautical technology is such that very few nations can afford holistic manufacturing industries for the construction of air power systems. In turn, this means that the air power capabilities of a middle-power nation become intrinsically attached to its political affiliation with the more powerful nations of the world. In a cyclic manner, it can be seen that air power impacts the politics and strategic security of a nation and that politics influences the ability of a nation to acquire, maintain and efficiently operate air power systems.

Air power, however, is not merely about resources and political alliances. It also requires a complex technological ability resident within the nation to optimise its employment, in peace and war. In turn, a national ability to have sufficient technological depth has to be created

through a concerted education program that promotes a technology orientation across the student spectrum.

Air power today is one of the most dynamic elements of national power; capable of furthering peace, stability and progress or dramatically threatening the general security of a region.

Air Power and National Security (#279)

Key Points

- *Military air power is primarily resident in the air force of the nation and forms part of the broader national air power capability*
- *Air power doctrine needs to be dynamic and flexible*
- *A proficient air force is critically necessary to ensure national security.*

The character of war has changed in the past few decades to an extent that theorists and practitioners alike are starting to question whether a conventional war, as the world has known in the past, will ever be fought. This is a debate that is unlikely to produce a unanimous verdict. However, what has become clear is that wars are fought today not solely by the military forces of a nation, but by the entire nation in a united effort to ensure its safety and security.

In the evolving concept of hybrid wars, air power, being unique in its ability to respond rapidly to emerging challenges even at great range, will undoubtedly be the first to engage an immediate threat. If this engagement can be done early enough, it may even negate the necessity for extended surface combat. A combination of the contemporary adversaries' reluctance to engage in 'pitched' battles and the ubiquitous nature of air power reduces the requirement for the employment of massed armies to the surgical use of Special Forces on focused missions. Even though there are advocates who continue to harbour the notion that only physical occupation of territory achieved by large numbers of soldiers on the ground constitutes military victory in conflict. If the objective of the application of force is to secure one's nation, then this is an archaic proposal. It has been demonstrated in the past half century that the political objectives of a conflict can be achieved with the sagacious application of air power supported by minimalist Special Forces missions.

At the end of World War II in November 1945, General Henry 'Hap' Arnold, then commanding the US Army Air Forces, broadly defined air power as, 'a nation's ability to deliver cargo, people, destructive missiles, and war-making potential through the air

to a desired destination to accomplish a desired purpose'. If this statement is critically analysed, it becomes clear that air power is not composed merely of the war-making components of aviation. It encompasses the total aviation activity—operations, industry, research and development—of the nation, both existing and possible future developments.

Military air power is critically dependent upon the national air 'potential', which in turn encompasses myriad factors that could be combined within the term 'air mindedness'. The development of this holistic and complex capability requires judicious coordination and planning to be undertaken at the strategic level of government. In most nations, the air force is the repository of the majority of military air power with limited capabilities resident in the other military services. However, air forces are almost always on the verge of obsolescence, especially in times of relative peace when its size and capability replacement rate will be inadequate to meet the demands of full-fledged war. The connection between national air power and the air force is the bridge that spans this gap. National air power should have the inherent ability to absorb the increase in capacity required of the air force in times of emergency by being the repository of new concepts and technological developments.

National security would be endangered by an air force whose doctrines, concepts and techniques are embedded purely within the existing systems and processes. Current systems are but another step in the progressive evolution of capability. It is a well understood paradigm that any air force that does not keep its doctrines ahead of its existing systems and does not harbour a vision that dwells far into the future, will not be able to provide the necessary level of national security. The necessity to investigate and fully integrate autonomous systems and artificial intelligence into the overall capability of the air force is inherent in this statement.

In order to ensure that the doctrine and concepts of the air force are aligned to the needs of national security, it is necessary to build them within the precepts of a larger concept of national air power. An air force should be able to demonstrate a number of capabilities within the national security agenda to be considered an element of national power. It should be a deterrent force by maintaining a credible offensive strike force; it should have adequate expeditionary capabilities to be

able to operate at short notice in theatres away from home; it should retain sufficient stand-alone capabilities while also being interoperable with allies; it should be able to operate jointly with the other military services, if necessary being the catalyst for joint operations; and it should have the agility to reorientate the axis of operations rapidly.

The employment of air power in the pursuit of national security is no longer a local or regional activity, but a truly global undertaking. The inherent range of air power now necessitates a greater understanding of the potential adversary's centres of gravity and modus operandi. The precision, proportionality and discrimination of the destructive capability of air power in combination with the accuracy of airborne intelligence, surveillance and reconnaissance (ISR) ensures that there are almost no targets that are safe from a determined air attack. Further, although air defences have been attempting to keep pace with the advances in strike capability, the resource-intensive nature of the effort has been a dampener. Air attacks are almost omnipotent.

Irrespective of the character of the conflict and the roles that are delineated to the different military services, the establishment of adequate control of the air is a prerequisite to any successful operation—air, maritime or on land. Control of the air is the first essential condition for the conduct of any effective offensive or defensive action. This can only be achieved by an air force. Considering the criticality of being able to apply air power efficiently, the planning, development, organisation and training of an air force needs to cover all aspects of air warfare with the ability to continuously develop new and versatile concepts. Accordingly, the air power doctrine of the air force must be kept flexible and free of inhibiting tradition.

An air force is a complex combination of many systems and varied personnel supported by the industrial and scientific resources of a nation. Even though the fundamental nature and principles of war have not changed appreciably, evolving weapon systems and new concepts of operations alter the characteristics of war. It is in understanding and catering for these subtle changes that the application of air power in the pursuit of national security becomes a viable proposition.

Retaining a modern, autonomous and well-trained professional air force in being at all times will not, by itself, be sufficient, but without it there can be no national security.

The Increasing Importance of Maritime Patrol Aircraft (#259)

Key Points

- *The proliferation of submarines has enhanced the ability of nations to achieve sea-denial, even with limited resources*
- *The importance of maritime patrolling capabilities has increased in a commensurate manner*
- *The maritime interests of a nation can only be protected when adequate maritime patrolling capabilities, resident in both small and large MPAs, are available*

All maritime nations are aware of the diverse spectrum of threats against both their maritime territorial and economic interests. This has contributed to an expansion in undersea warfare capabilities of navies who appreciate the advantages that even a modest submarine force offers. For example, even the potential presence of an adversary submarine can create significant sea-denial and anti-access effects that could hinder maritime movement. Neutralising such a threat, whether real or not, will require expending a considerable amount of resources to find, track and prosecute it. Long-range and high-endurance diesel-electric submarines have proliferated in recent years, particularly in the Asia-Pacific. The submarine threat seems to be also increasing in the Middle East, and Central and South America. This trend is likely to continue.

The growth of submarine fleets has reinforced the argument for maritime patrol aircraft (MPA) that are capable of performing anti-submarine warfare (ASW) and anti-surface warfare (ASuW) as the need for countermeasures able to secure territorial and economic interests becomes apparent to maritime nations. MPAs are multi-role platforms that are capable of performing a wide spectrum of missions ranging from maritime surveillance to high-end naval combat operations. In recent times, the term maritime surveillance aircraft has been used to denote unarmed airborne platforms that are used only for surveillance and reconnaissance. The subtle difference between the two

terms is that the surveillance platform does not have the ability to carry weapons and therefore cannot by itself prosecute a target.

While the role of the MPA is not new, ASW operations against sophisticated state-of-the-art submarines, especially when they are operating in littoral waters, present a unique set of increasingly complex challenges. The complexity of littoral waters and increased shipping activity close to the shore makes it necessary to have technologically advanced sensors on board an MPA to achieve sufficient discrimination to detect and localise submarines. The latest diesel-electric submarines have the ability to shut down the diesel generators and run on electric batteries for fairly long periods, which makes detecting them when they are close to the shore extremely difficult.

MPAs need to have the characteristics of: long endurance, great range at relatively low altitudes, and the ability to carry sufficient numbers and variety of weaponry such as anti-ship missiles, depth charges, mines and torpedoes. They also need sufficient internal space, and electrical power generation capacity to support a large number of mission systems and operator consoles. These requirements translate to the MPAs being large platforms. Newer MPAs, such as Boeing's twin-turbofan P-8 Poseidon MPA, have between 30 and 50 percent excess internal space margins to cater for increased load carrying requirements. This also improves the multi-role capabilities of the aircraft.

As is usual in the case of airborne systems, the high-end MPA platforms are not inexpensive to acquire, 'operationalise' and maintain. Once acquired, the cost of crew training and, more importantly, the command and control protocols that are needed at the strategic and operational levels to ensure their decisive employment, add to the total system cost. Maritime patrol is a complex mission that involves a number of systems functioning in harmony. A single MPA patrolling a vast ocean is only the visible end of a spear with an extremely long support shaft. Without exaggeration, it can be stated that an effective maritime patrol capability takes years to build, refine and effectively employ. Crew training is the first step to achieving this multifaceted capability.

The high costs associated with high-end systems such as the P-8, are driving manufacturers to provide cheaper options that are attractive to nations that are not well resourced, but still feel the need to have the

capability. Considering the high cost of large MPA acquisition, the way forward for many nations may be the adoption of cheaper solutions through the acquisition of multi-role aircraft that have a 'part-time' maritime patrol role along with search and rescue, and even passenger/cargo carriage.

As the increasing importance of MPAs is being accepted, there is also recognition that many countries have to cope with decreasing manpower and difficulties in achieving their defence recruitment targets. Newer and smaller MPAs have factored this trend into their design philosophy. Accordingly, the emphasis has been on reducing maintenance upkeep by introducing self-diagnostic capabilities that perform automatic remedial actions within the mission systems. Of greater significance is the computerisation of mission systems that permit their fully automated functioning from target search, detection and tracking. Human interface takes place only at the final decision-making stage of prosecuting a target. This is a quantum jump in MPA mission capacity.

Advances in technology and miniaturisation have made it possible to gradually shift the focus from the platform to the mission system, which is being developed and integrated almost in a custom-built fashion. This has been welcomed by MPA operators, since one of the key challenges that they face is the effectiveness of the mission systems, which are capable of collecting vast amounts of data that could potentially overwhelm the operators. The latest systems are designed from the outset to discriminate and prioritise surveillance based on the rules, regulations and concept of operations of the customer. Such automation is becoming an increasingly common feature of many military platforms.

While the smaller-sized MPAs may be suitable as a cheaper option, they are unlikely to fully replace the larger ones, primarily because of the ability of the larger platforms to carry sufficient weaponry without having to sacrifice their range or endurance. Therefore, the larger platforms will continue to be relevant and sought after, within the resource and personnel constraints that most military forces face. What has emerged is a market of MPA options suited to a range of budgets and strategic geographic environments.

Most maritime nations are seeking to procure sophisticated sea-denial and anti-access assets while simultaneously attempting

to enhance maritime patrol capabilities. Defence industries have responded accordingly—submarines have proliferated and a range of MPAs are being fielded, both in sizeable numbers. The cycle of trying to neutralise one capability with a countermeasure and then a counter-countermeasure evolving to counter it is never ending. This is equally visible in the development of MPAs. However, the fact remains that the protection of a nation's maritime interests cannot be ensured without adequate maritime patrolling capabilities, irrespective of whether it has a credible submarine capability or not.

Air Power in Small Wars and Limited Military Operations (#283)

Key Points

- *Air power has been employed in small wars and limited military operations from the time that it was accepted as an element of military power.*
- *The lessons from an individual small war cannot be considered to have universal application and must be contextualised to ensure their veracity.*
- *Flexibility and versatility are the hallmarks of air power employment in small or hybrid warfare.*

There have been few periods in word history when wars have not been taking place somewhere around the globe. From its advent as an instrument of military power, in the early years of the 20th century, air power has played an increasingly prominent role in the conduct of war, from large scale to limited military operations. With the maturing of conceptual thinking and the leapfrogging improvements through technology, air power has become an instrument of national policy in its own right, as well as an essential component of an integrated military force.

In the past few decades, small wars have started to be compartmentalised by using and defining terms such as 'limited war', 'irregular war', 'counterinsurgency operations', and more recently 'hybrid war'. Each of these terms have their own peculiar connotations and nuances, but all of them could be grouped under the term 'small wars'. Small wars are generally localised in geographical dimension and generally characterised by restrained political objectives. These types of conflict require control of the air for the employment of conventional military forces, a truism that is now being taken for granted by Western forces.

A small war environment is arguably the most complex that military forces can operate in and could encompass a wide range of missions within the same theatre. Air power could be simultaneously conducting humanitarian relief missions while providing control of

the air as well as proactive and reactive air-to-surface precision strikes. Effectiveness in conducting such a wide ranging spectrum of missions is fundamentally dependent on the flexibility and versatility of the force as well as the correct balance of capabilities. Here again, the balance of capabilities to conduct the demanded spectrum of missions itself is a wide spectrum, at times beyond the resource availability of many nations.

By virtue of its technological complexity and the associated resource implications, air power has largely remained the prerogative of nations with adequate resources and national technology base. Limited military operations and/or small wars involving the national interests of major powers have often seen the employment of air power through proxy air forces in a localised, but extensive manner. The Spanish Civil War and later, the Korean War are early examples of such usage of air power. However, lessons drawn from these conflicts, where both sides employed air forces, must always be qualified by the strategic context of the war being analysed. Similarly, no enduring lesson regarding the use of air power can be safely drawn from the experiences in small wars either. The mercurial nature of the political objectives that define the characteristics, conduct and scope of any small war makes it necessary to analyse the application of air power within a strict context of the prevailing balance of military power. Therefore, there can be no universal lessons that can be gleaned from any one small war.

Compared to wars fought by proxy air forces in the past, the situation is very different in limited conflicts wherein only one of the belligerents use air power. In such one-sided conflicts, from an air power perspective, air superiority prevails for the side that possesses air power, almost from the outset. Even so, the pre-condition of 'air superiority' or at least adequate control of the air for any military success holds true even in such circumstances. However, it must be emphasised that this condition does not automatically lead to victory in all military combat operations in small wars or limited military campaigns. Restraints imposed by political objectives, terrain and the composition of the adversary force could all impose varying levels of limitations in achieving outright military victory.

By their very nature, small wars will be politically sensitive and intervention with troops-on-the-ground may not be an attractive option. In such circumstances air power, which does not need to leave a

footprint in the operating theatre, would provide a viable and appealing option. Air power's range and effectiveness provides it with the capacity to create the necessary effects in an increased geographical area. When this is combined with the very broad spectrum of weapon-effects that is inherent to air power, it becomes a potent capability. Today, air power has become a 'must have' capability for conventional military forces of a nation that is involved in small wars and limited military operations.

Air power can be tailored for selective or large scale employment, depending on strategic circumstances. Air power is usually the first and last element involved, particularly in the delivery of combat forces and material through ubiquitous air mobility. Air power also remains capable of tailoring itself to achieve limited political objectives that are common in small wars. It even has the ability to deliver effects on its own, if the need arises, as Operation *El Dorado Canyon*, the one-off air strike on Libya in 1986 demonstrated. This intertwining of political ends and military means comes into focus in the employment of air power in small wars and limited operations. Air power can be very attractive in the application of military power in short time frames and to achieve limited objectives. Statesmen and military strategists alike will have to grapple with this inextricable mix to ensure political objectives and military force are compatible. While this endeavour remains a difficult task in conventional wars, it becomes more complicated in the conduct of small wars.

In the prevailing global political climate, most nations would deploy their air power as part of a larger coalition. Integrating into a multinational coalition poses significant issues from the tactical to the strategic. At the operational level, most of the issues can be overcome if assured interoperability can be achieved. However, in all circumstances, the air force will have to function at the lowest common denominator of the coalition. For a technologically sophisticated air force, this could mean having to 'ramp down' capabilities, which could pose almost insurmountable challenges and also lead to the degradation of the performance edge. Here again, the flexibility of the force will be the game changer.

Conducting a small or hybrid war requires the concerted application of military power, most often with air power in the vanguard, and the ability to function in a multi-agency environment. Air power has the ability to be an 'envelope capability' that can provide

the cohesion required to bring together disparate groups with divergent capabilities that could otherwise exhibit 'seams' impacting on success. Air power is adept at straddling a large spectrum of missions—from providing humanitarian assistance to applying lethal kinetic force in a precise, proportionate and discriminate manner. Finally, the rapidity with which flexible air power can be brought to bear, across the spectrum of conflict, remains its defining mark.

Air Defence of Maritime Forces (#262)

Key Points

- *Sea power is the core element in the creation of a maritime force.*
- *Air threats to a maritime task force can be delivered without the platform or system being seen, visually or electronically.*
- *A mobile protective umbrella provided by air power is the safest way to ensure the security of a maritime task force, amphibious or otherwise.*

The on-going globalisation of trade and economic interests has resulted in the strategic interests of a nation now spreading across oceans. This may necessitate the creation of maritime military effects thousands of kilometres away from the borders of the nation. Under these circumstances, a number of nations have focused on creating maritime forces to protect their actual and/or perceived strategic interests. Proliferation of maritime forces is the obvious fallout.

Sea power is the core element in the creation of a maritime force, whether it is an amphibious task group meant to operate in the littoral, or a truly naval task group meant for control and denial of the sea. It has the inherent advantage of being able to stay on station, far away from home port, for extended periods of time. However, naval vessels remain vulnerable to subsurface, surface and air threats. In order to secure a maritime task force it is necessary to ensure that a protective bubble is created around it. This bubble will encompass the sub-surface sea space, the surface area and the airspace above. The dimensions of the bubble—its depth, breadth and height—will be a function of the perceived threats in the area of operations, balanced by the capabilities of the maritime task force to enforce such a bubble. Further, this protective security bubble must be able to move along with the task force at the pace required, like a protective umbrella being held by another person while one is walking in the rain, to ensure its continuous protection.

To a very large extent, the sub-surface protection is provided by submarines and complemented by anti-submarine capabilities

resident in air power. Normally, the submarine force will be integral to the maritime task force. The situation is different when it comes to the surface and air protection bubble. Threats that emanate from the surface can be dealt with even beyond the horizon if there is a sufficiently capable air element that can detect, assess, target and prosecute sea-borne adversaries. While the same could be achieved by the naval vessels, air elements will be able to engage potential threats even outside the protective bubble the task force will be capable of generating on its own.

Air threats to a maritime task force are as dangerous as ones stemming from the other domains. Air elements also bring with them the added risk of being able to carry out their attacks in a stand-off mode that could be beyond visual and electronic detection range. In other words, contemporary air power can attack a maritime task force without having to let its platforms and systems be seen by the protective elements of the naval vessels. Only the weapon would be detected, leaving a very limited time for the task force to react and initiate defensive measures. This situation is a recipe for potential disaster. A protective air umbrella is the answer to this threat to a maritime force.

Creating and maintaining a protective air umbrella above a task force is not easy. This umbrella will need to be in place at all times when a risk is anticipated and irrespective of the operating distance and duration of the maritime force. The obvious answer to such a requirement is to carry the necessary air power assets with the task force—the primary rationale for the creation of an aircraft carrier group. Fixed wing carrier aircraft can create and sustain the protective umbrella thousands of nautical miles from land and home base. A strong carrier group can counter most potential threats, including ones that originate from other similar carrier groups or from land-based aircraft equipped with the latest long-range anti-ship missiles.

However, it is conventional wisdom that a carrier group is prohibitively expensive to build and operate. The technology necessary to create such a force is only available to a small group of nations. In order to have one carrier group deployed continually, a minimum of three carriers are required and the skill sets needed to operate a carrier group efficiently is difficult to inculcate and is a lengthy process. The

personnel requirements of such a fleet are normally far beyond the capacity of medium-sized navies to maintain for any length of time.

The alternative to 'floating' airfields is the use of conventional air power to provide fleet protection. For an air element that is land-based, creating a protective umbrella for a naval task force is a complex undertaking. In fact there are two contradictory factors to be considered in creating such a joint task force. First is the requirement for the air element to be able to move the protective umbrella along with the maritime force and maintain it without a break for the desired duration. Second is the fact that the effective operational range of land-based air combat assets is somewhat restricted, in comparison to the free-ranging capability of naval forces. Even with the use of air-to-air refuelling, the air element will not be able to match the naval radius of action. This means that the task force may have to tailor its operational radius of action in accordance with the range of land-based air assets or risk being outside the protective umbrella. One does not have to think very hard to come to the conclusion that operating outside the air protection umbrella in a contested environment will not be a wise decision. The limitation that maritime task groups face is based on the extent to which they can carry their own integral defensive systems, including air defence capabilities.

From an air power perspective, the demands of creating the protective umbrella over a maritime task force can become extremely asset intensive. In a contested air environment the assets required, in terms of both quality and quantity, to protect the task force— as well as the other enabling air elements, such as air-to-air refuelling and airborne early warning and control aircraft that are critical to the success of the air campaign—could become overwhelming even for middle-power air forces. In addition, if the maritime task group is amphibious in nature, the need to provide timely, accurate and concentrated air power during critical phases of the operation will add to the demand. A corollary is that amphibious operations may also be restricted to being conducted within the operational radius of the air elements. In an indirect manner, the success of a maritime task force is inextricably tied to the ability of air power to provide a mobile protective umbrella from under which to operate; and to its ability to provide fire power on an as-required basis to amphibious operations. In a contested air environment, there is no other alternative.

Air Power and Hybrid Warfare (#277)

Key Points

- *Hybrid warfare is one involving a combination of conventional military forces and irregulars, which could include both state and non-state actors.*
- *The roles that air power undertakes in hybrid warfare will remain the same as in a conventional war—control of the air, strike, air mobility and ISR.*
- *Air power brings to the conduct of hybrid warfare its inherently unique characteristics.*

At no time in history has the above observation by Clausewitz, the Prussian military philosopher, been more apt than in contemporary conflict. Even though the fundamental aspects of war have not changed, it remains a combination of violence, probability and politics. However in the late 20th and early 21st centuries, war has taken on forms that were hitherto unfamiliar as new characteristics evolved that combine features of regular and irregular military forces. Military analysts have started to posit the emergence of a new type of war—'hybrid warfare'. The term 'hybrid warfare' by itself is not new and has been part of the military lexicon for some time. Even so, there is no universally accepted definition of hybrid warfare, which often leads to ambiguity.

Hybrid warfare can be defined as a conflict involving a combination of conventional military forces and irregulars—guerrillas, insurgents and/or terrorists—which could include both state and non-state actors, aimed at achieving a common political purpose. This definition is adapted from Peter R Mansoor's 'Introduction' in *Hybrid Warfare*, published in 2012. In a broad sense, the term attempts to blend conventional and irregular warfare, at times superimposed by belligerent activities in the cyber domain. In hybrid warfare, irregular forces need not be centrally controlled or even directed, although in a number of cases, they form part of a coherent strategy especially when employed to oppose invading or occupying forces. Further, hybrid warfare plays out at all levels of war, from the strategic to the operational and tactical, although this

interplay need not take place simultaneously or in any predetermined sequence.

Hybrid warfare is characterised by the following: operations are conducted by both state and non-state actors; normal conventional military capabilities are used while employing irregular tactics; the conflict could, and normally does, involve indiscriminate violence against non-combatant civilians and it fuses multi-modal activities. Military forces that are not agile and remain mired in the traditional mode will find their effectiveness reduced continually when operating in hybrid warfare scenarios. Clausewitz wrote in his famous treatise *On War* that, 'Every age has its own kind of war, its own limiting conditions and its own peculiar preconceptions'. Hybrid warfare is the kind of warfare that contemporary military forces will have to contend with for the near to mid-term future.

So where does air power fit into this complex scenario of hybrid warfare? From the outset, it must be understood that the tactical application of air power possesses an inherent advantage over other forms of force projection capabilities—it does not need additional training to adapt the application to a particular kind of warfare. At the fundamental level, the training required for the application of air power remains the same. The roles that air power undertake will also remain the same—control of the air, strike, air mobility and intelligence, surveillance and reconnaissance (ISR). The difference in its application will only be the emphasis placed on the roles, which will vary contextually.

The inherent flexibility of air power, in combination with its ability to respond rapidly and simultaneously to emerging strategic, operational and/or tactical situations can be leveraged as a short-term substitution for ground forces in volatile circumstances. This is particularly applicable in hybrid warfare, where the presence of ground forces could exacerbate an already hostile situation. The success of the application of air power in hybrid warfare is based on four factors—its capacity to generate timely and accurate intelligence; its capacity to enable decision-superiority for the entire force; its ability to match weapons-to-target in order to generate the desired effect, both kinetic and non-kinetic; and its proficiency to respond rapidly across the full spectrum of hybrid threats.

The conventional employment of air power is fairly clear and not overly complex. In hybrid warfare, the employment will have to be both innovative and contextual. Essentially, control of the air remains unchanged in this context. In recent times, Western military forces have been operating unchallenged within an uncontested airspace, where their own air superiority is assured. This has led to a less-than-optimum understanding of the need to fight for, obtain and maintain the necessary level of control of the air. Air power capabilities, necessary to achieve control of the air, are not part of a 'good to have' set, but form an indelible part of the 'must have' set, irrespective of the kind of war that is being fought. Control of the air, and the ability to achieve it, remain critical to the success of all other operations.

Strike operations in hybrid warfare will be restricted by the Law of Armed Conflict (LOAC) principles of precision, proportionality and discrimination. The demand for precision or accuracy might require the cancellation of a strike mission at the very last minute to avoid collateral damage. Although LOAC states that there must be an acceptable relationship between the legitimate destruction of a 'military' target and the ensuing collateral damage, the current geo-political environment, especially when viewed through the gaze of the media, is almost intolerant of any collateral damage. In hybrid warfare, air power will have to be cognisant of the need to carefully manage this perception challenge.

Air mobility is at the centre of hybrid warfare. The ability to insert, sustain and extract small teams of special forces is a prized capability that is largely dependent on air mobility. Through the effective employment of air mobility, a numerically small force can enforce its will over a large geographical area. Similarly, ISR is a pillar of all hybrid warfare operations. Persistent airborne ISR that creates continuous situational awareness through wide-area sweeps, the provision of spot, as well as detailed, moving target indicators (MTI) and radar imagery is critical to the discovery of adversary targets and centres of gravity. This in turn facilitates a rapid decision-destruction cycle, which is a fundamental requirement in the successful prosecution of hybrid warfare.

Contemporary warfare is gradually fusing to become a single hybrid form—a new model that is being embraced by both state and non-state actors. Air power, through control of the air, precision

strike, air mobility and persistent ISR, will provide the foundation to successfully conduct hybrid warfare.

Air Power and Energy Security (#270)

Key Points

- *Oil-based fuels have been crucial to the growth of the global economy since World War II.*
- *The three core elements of energy security are availability, affordability and reliability.*
- *The Air Force's mission in the future will rely on the available, affordable and reliable supply of liquid fuels.*

The availability of cheap, abundant energy has played a crucial role in the rapid and sustained growth of the global economy since World War II. The seemingly limitless supply of energy has enabled civilisation to reach a level of complexity previously unimagined. The way we have structured our societies, economies, governments, lifestyles and even warfare, has been transformed. However, there is now mounting concern that there will be insufficient resources to meet the world's demand for oil in the decades ahead. There is a growing consensus that the world is now embarking upon a great oil transition, which is likely to have serious implications for a civilisation fundamentally reliant on, and structured for, cheap and abundant oil-based energy.

In the twenty-first century, continued access to oil depends on open global markets and a vast infrastructure network of offshore platforms, pipelines, tankers, refineries, storage and distribution systems. Global demand for oil continues to rise and there is a growing reliance on an ever-smaller group of oil suppliers. Oil is transported via cross-border pipelines and strategic maritime chokepoints. This complexity brings heightened risks from political conflict or war, technical system failures, accidents, sabotage, extreme weather events or financial market turmoil.

This is the context in which energy security has risen high on the policy agenda of governments around the world and the term 'energy security' has quietly slipped into the energy lexicon. Energy security is highly relevant to all nations due to the anticipated decline in global oil production, instability of market suppliers, growing geopolitical tensions and the threats posed by terrorism. While there is no

commonly accepted definition of energy security, most descriptions include three core elements of *availability*, *affordability* and *reliability*.

The first element refers to the *availability* of energy to the end user, or consumer. Over recent decades, demand for energy has risen steeply across the globe due to sustained economic growth in industrialised countries and accelerated growth in China, India, and other emerging economic powers. The transportation sector, which depends heavily on oil-based fuels, has expanded especially rapidly. Previous oil development has depleted the relatively easy-to-access oil reserves. Future oil development will involve deposits that are scarcer, farther from existing demand centres, deeper and harder to extract, located in poorer countries with risks of political instability, and concentrated in areas where governments restrict access.

Energy that is not affordable in absolute terms, is energy that cannot be used. However the *affordability* element of energy security is not just a question of whether energy prices are high or low relative to income. The volatility of prices is even more central. Price shocks often cause serious humanitarian or economic hardship, even political instability, as energy consumers struggle to cope with unexpected financial shocks.

The element of *reliability* considers the extent to which energy services are protected from interruption. Energy is an essential building block of economic activity and interruptions jeopardise the ability to run factories, illuminate hospitals, and heat homes continuously. In some cases, therefore, energy reliability can be a matter of life and death.

For Air Force, energy security means that liquid fuels are *available* at an *affordable* price and that supplies are delivered *reliably* as needed. In this respect, there are a variety of ways that Air Force's ability to deliver air power effects for Australia's interests could be negatively affected by declining energy security in the coming decades.

As a large consumer of liquid fuels, Air Force, and the ADF, is dependent upon the prevailing oil market conditions to ensure energy availability. As the oil transition progresses, the supply of oil may no longer be able to meet the demands of all consumers, whether due to physical depletion or because of above ground factors such as technology, economics or geopolitics. This situation may well drive oil prices higher in the longer term and result in more volatile markets in

the meantime. Declining energy security could drive negative economic conditions in Australia, potentially putting the Defence budget under threat in the longer term.

In the coming decades, Australia's national security is likely to be increasingly linked to Australia's energy security, and this could drive the country's strategic Defence objectives in ways that are not yet obvious. Geopolitically, the oil transition could result in the increased militarisation of energy security and may produce increasing threats to Australia's strategic interests. In order to counter these threats, air power capabilities will continue to develop in technological complexity, likely driving a corresponding increase in fuel demand to operate those platforms. Additionally, there is a reasonable probability that in an era of increased militarisation of energy security, Air Force operational tempo will increase, further driving demands for fuel.

Moreover, as fuel demand increases, so too does the total expenditure spent on fuel. Air Force's reliance on oil-based liquid fuels means that the percentage of Air Force's budget being allocated to fuel may be driven by increasing fuel demands, whilst at the same time being subjected to increasingly high and volatile global oil prices. Under these conditions, the sustainment of operations will be more costly and may divert funds from future capability development.

Finally, Air Force is reliant on the fuel supply chain for the delivery of fuel, where and when it is needed. In the event of a liquid fuel disruption, Australia relies on the normal stockholding practices of commercial suppliers. However, these practices have been established to achieve economic benefits for the petroleum industry, and not to ensure that Defence can achieve its strategic objectives. There are no guarantees that these market-based mechanisms will work under all conditions, especially during times of conflict.

The mission of Air Force, to deliver air power effects for Australia's interests, relies on the available, affordable and reliable supply of liquid fuels. In the coming decades, Air Force's ability to deliver air power may be affected by declining energy security, and the risks are currently poorly understood. Without a solid appreciation of these potential risks, Air Force will have difficulty mitigating or adapting to the challenges presented.

Operation *Solania*: Regional Security in the South West Pacific (#281)

Key Points

- *The security of the Pacific island countries depends on the effective control of the resources in their respective EEZs.*
- *Through Operation Solania, Australia directly contributes to the economic livelihood of the Pacific island countries.*
- *The introduction of the P-8A Poseidon, soon to be followed by the MQ-4A Triton, will greatly improve Australia's regional maritime surveillance.*

One of the Strategic Defence Interests identified in the *2016 Defence White Paper* 'is in a secure nearer region, encompassing maritime South East Asia and the South Pacific'. To further this interest, the Government requires Defence to 'support the security of maritime South East Asia and support the governments of Papua New Guinea, Timor-Leste and Pacific island countries to build and strengthen their security'. The White Paper reaffirms Australia's posture to continue to seek to be the principal security partner for Papua New Guinea, Timor-Leste and Pacific island countries in the South West Pacific.

Although cast in new language, Defence has played an enduring role in contributing to the security of the Pacific island countries. One of the most visible missions by which the Australian Defence Force (ADF) has done this is through the conduct of fisheries patrols as part of Operation *Solania* by the employment of airborne intelligence surveillance and reconnaissance (ISR) capabilities.

Operation *Solania* is the ADF's contribution to a multinational operation led by the Pacific island-based Forum Fisheries Agency (FFA). These operations, which occur four times a year, are conducted to monitor fishing activity across the South West Pacific, in particular seeking to detect, localise and intercept illegal fishing activity within the Exclusive Economic Zones (EEZ) of the Pacific island countries.

The size of the EEZs relative to the Pacific islands countries means that the task of countering illegal fishing in the region is beyond the capabilities of the countries themselves. Accordingly, the four dedicated operations conducted by the FFA each year are supported by contributions from Australia, New Zealand, the United States of America and France (a collection of states referred to as the Quadrilateral Nations or QUADS). Each member of the QUADS provides support to the FFA-led operations in the form of air or naval assets, which significantly increase the FFA's ability to effectively patrol and enforce the economic rights that are critical to the security and economic livelihood of the Pacific island countries.

The first of these operations for 2016 was Operation *Rai Balang*[1] *2016* which was conducted in April 2016. In addition to the participation from the QUADS, participants were provided from the Federal State of Micronesia, Nauru, Palau, Papua New Guinea, Republic of the Marshal Islands, Solomon Islands and Vanuatu. The operation included seven Pacific-class patrol boats from participating island nations, a United States Coast Guard cutter, a French patrol boat and five maritime patrol aircraft provided by QUADs nations: a RAAF AP-3C, a RNZAF P-3K2, a French F200 Guardian, a US Coast Guard HC-130 and a USN P-8. The ADF contribution was one RAAF AP-3C and an air liaison officer to support the FFA Regional Fisheries Surveillance Centre in Honiara. The QUADS' aircraft were deployed and operated from different locations across the South West Pacific to provide extended reach, improved coverage of the area and dedicated support to the patrol boats of participating countries.

A total of 26 sorties were flown by the five participating aircraft, providing a total of 135 on-station hours and patrolling nearly 2 million nautical square miles of ocean. With the potential illegal fishing contacts reported directly to the control centres, the aircraft involved in the operation enabled the supported maritime forces to conduct 60 high sea vessels boardings, leading to two infringements and three arrests. Although these numbers appear small, they send a strong message to illegal fishers and represent an invaluable contribution to ensuring the economic security of the regional states through both apprehending those detected engaging illegal fishing, as well as deterring future activity.

In addition to countering potential illegal fishing activity, the operation provided opportunities and benefits by enhancing Pacific

1 The operation's name is a term for Yapese (Micronesia) stone money.

island country involvement, participation and capacity in maritime fisheries surveillance and response operations and intelligence exchanges. This allows future operations to be more responsive to intelligence cueing. Like all deployed, low-footprint tropical operations, weather played a significant part, and technical support is always a limiting factor.

Post-mission intelligence analysis of the operation showed validation of the intelligence, and fisheries tracking and monitoring systems of the FFA, with many useful lessons identified. The deployed Air Force AP-3C Orion provided a large volume of mission imagery through the simple exchange of an unclassified DVD. The operation successfully practised exchanging regional coordination information of fishing activities and demonstrated Australia's commitment to conduct regional maritime surveillance enabling regional nations to practise local maritime security operations.

Due to the enormous size of the area, air power plays a critical role in Operation *Solania*. The AP-3C will continue to contribute to this operation until its planned withdrawal from service at the end of 2018. However, over the coming years, the ADF will introduce new capabilities that will continue to improve Australia's ability to contribute to regional maritime surveillance. In the coming years, the P-8A Poseidon will replace the AP-3C. The P-8A will provide increased availability, faster response and updated sensors, weapons and communications. In the next decade, the introduction of the uninhabited MQ-4A Triton will further enhance the Australia's ability to patrol its maritime area of interest, by providing unrivalled endurance, area coverage and all weather sensors including the multifunction active sensor radar for detecting and identifying targets at sea.

The challenge for Air Force will be to integrate these new capabilities with regional operations, both technically and conceptually, providing optimal outcomes across a diverse range of partners and capabilities. There will be significant challenges in enabling the integrated and networked sharing of data characterised by the volume, and variety of data format.

The security and stability of the South West Pacific is well served by Australian contribution of airborne ISR capabilities, crews and support personnel to the fisheries surveillance role. Operation *Rai Balang 2016* has helped to demonstrate that Operation *Solania* is

integral to the Defence meeting the Pacific security objectives outlined in the White Paper now and into the future.

Weaving the Golden Thread: Australia's Defence Strategy Framework (#287)

Key Points

- *Defence is a strategy-led department.*
- *The Strategy Framework strengthens the links between strategy, capability and resources, while appreciating strategic risk.*
- *The seminal documents in the framework that implement Government direction are the Defence Planning Guidance and Australia's Military Strategy.*

In the past, there have been some tenuous links between Government Defence policy, on the one hand, and the capability and preparedness of the Australian Defence Force (ADF).The *First Principles Review* identified the need for Defence to be a strategy-led organisation. This recommendation is being implemented by the recent release of *Strategy Framework 2017*.

Strategy Framework 2017 satisfies Defence's desire for doing business smarter. It describes how Government direction is delivered across the Defence enterprise, including in relation to military capability, preparedness, investment, organisational capability, international engagement and corporate planning. It is also a critical element of Defence enterprise performance management and supports Government decision-making in relation to strategic Defence policy.

The framework weaves together Government direction, classified Defence strategic policy guidance and military strategy. Within the framework, the highest-level documents are policy direction from Government including *Defence White Paper*, the *Integrated Investment Program*, the *Defence Industry Policy Statement*, the *First Principles Review* and the *Defence Budget*. Much of the work in the Strategic Policy and Intelligence Group is drawing a thread of logic through these higher-level publications and enabling strategy to direct the operations, activities and actions of the Department.

At the next level of the framework is the *Defence Planning Guidance* (DPG) which is the seminal classified policy document for Defence. In essence, it details *what* Defence needs to be able to do out to 2035 and provides guidance on *how* we do those things. It describes the missions expected of the ADF and explains what strategic success looks like. The DPG informs *Australia's Military Strategy*, *Defence International Engagement Policy*, *Chief of Defence Force Preparedness Directive (CPD)*, *Australian Joint Operating Concept (AJOC)*, the *Defence Corporate Plan*, *Defence Business Plan*, *Defence Budget* and ADF workforce plans. It also informs the implementation of the *Integrated Investment Program* and *Defence Industry Policy Statement*, and is a key input to contingency planning by Joint Operations Command. The Defence Strategic Policy Committee considers proposed updates to the DPG annually.

Australia's Military Strategy (AMS) is a companion document to the DPG and provides understanding of the 'ways and means' by which Defence achieves the strategic 'ends' described in the DPG. It is a classified account of the military strategy that gives guidance to inform force posture, force design and operational planning. This is achieved by providing further direction to the ADF on the Strategic Defence Objectives via documents such as *Capability Program Narratives* (CPN), *Military Strategic Estimates* (MSE) and *Theatre Operational Risk Plan* (TORP). Thus, the AMS examines the *ways* Defence will achieve the Strategic Defence Objectives, as well as guiding management of the *means*.

While the fundamentals of national security are enduring, security circumstances are subject to continual change at short notice. Therefore, Government can and does adjust policy to respond to dynamic circumstances. The Government can provide updated strategic direction to Defence through the decisions of the Prime Minister, the National Security Committee of Cabinet or Ministerial decisions. Updating Government guidance to Defence is routinely done quarterly and annually.

The *Quarterly Strategic Review* (QSR) provides advice on potential changes in Australia's strategic environment and strategic-level issues that might arise within the next 3–24 months. It aims to inform future demand on our force. The QSR examines whether a Defence response to these potential changes to our strategic environment is required,

such as a change to force posture or readiness. As such, the QSR is used to provide 'early-course correction' for the DPG and fine-tune and set near-term priorities for preparedness. The QSR is presented to senior leadership for consideration with *Defence Preparedness Assessment Statement*, in a 'supply' and 'demand' relationship.

The first *Annual Strategic Review* (ASR) will be released in 2017. The purpose of the ASR is to provide advice on potential longer-term changes in Australia's strategic environment and strategic-level issues that might arise within the next two to five years. Similar to the QSR, the ASR also examines issues that may require a 'mid-course correction' or change to force posture or readiness, in response to an emerging or changing situation.

Strategic policy statements provide classified guidance to policy development on Australia's strategic interests and priorities on specific issues, such as geographic areas, capabilities and operations. They provide policy options, policy direction, or can be a discussion document covering a range of issues to inform whole-of-government, like-minded allies, or for internal Defence consideration. Strategic policy statements are released by the Secretary after endorsement at the Defence Strategic Policy Committee.

Within Defence, the Strategic Centre is the senior management structure that sets priorities, manages resources and is responsible for steering Defence to implement the Government's Defence policies. The Strategic Centre has the authority to set direction for all of Defence's activities and will maintain close oversight of the delivery and the management of strategy, capability and resources to achieve Government-directed outcomes.

In 2017, Defence will measure its classified strategic policy performance for the first time. Strategic Policy and Intelligence (SP&I) Group will work with groups' and Services' leads to understand how Defence is tracking against its strategic objectives. It will assess what is working, what is not and what are the implications for strategy, planning and resourcing.

Australia's strategy is forward looking, but subject to review whenever Government may require, or emerging threats and changing strategic risk may necessitate. Within the strategy framework, Defence has the instruments it needs to articulate associated strategic risk and identify how this risk can be mitigated.

The launch of the *Strategy Framework 2017* has focused Defence on being strategy-led by a strong Strategic Centre. The framework details the relationship of Government policy to military strategy. This connects the *Defence White Paper* with a broad range of activities and outputs undertaken by Defence, including operational tasks and international engagement, through to concepts, design and preparedness. *Strategy Framework 2017* ensures the 'golden thread' of Government policy is weaved through classified strategic guidance to the outputs or means of Defence. It ensures strategy remains linked to and guides capability and resources.

An Australian View on the US 3rd Offset Strategy (#267)

Key Points

- *The DoD's 3rd Offset Strategy is actively encouraging the participation of allies.*
- *The RAAF has considerable currency for involvement in the development of future technologies and operating concepts under this initiative.*
- *Exploiting these opportunities is consistent with RAAF's priority to realise a networked, integrated 5th-generation force.*

On 3 September 2014, then US Secretary for Defense, Chuck Hagel, delivered a keynote speech on innovation to the South-Eastern New England Defense Industry Alliance in Newport, Rhode Island. It was arguably the most important address of his tenure. During his speech, Secretary Hagel announced the launch of a Defense Innovation Initiative (DII), the catalyst within the Department of Defense (DoD) for a major change in strategic direction. It was the birth of the 3rd Offset Strategy.

In military terminology, an offset strategy is one that seeks to change an unattractive competitive situation to one that is more advantageous to the implementer. In US military parlance, the 1st Offset Strategy occurred in the 1950s when President Eisenhower used nuclear superiority to avoid the huge cost of maintaining sufficient conventional forces to deter the Warsaw Pact countries. The 2nd Offset Strategy was used from 1975 until the collapse of the Soviet Union in 1989, and leveraged technical superiority to counterbalance the superior numbers of conventional forces in non-allied countries. The research programs that were part of the 2nd Offset Strategy resulted in improved AEW&C aircraft, precision-guided munitions, stealth aircraft, and space-based communications and navigation capabilities. These systems and weapons proved to be war-winning capabilities in the 1991 Gulf War.

In his speech, Secretary Hagel acknowledged that the US is facing a period of fiscal uncertainty of unknown duration. This, he observed, is occurring concurrently with long-term, comprehensive modernisation

programs being pursued by China and Russia and the proliferation by numerous actors, of destructive technologies and weapons many of which were previously only available to advanced nations. He challenged the DoD, US industry and academic institutions to identify innovations to sustain the military advantage the US had enjoyed after the Cold War and into the 21st century. The 3rd Offset was the initiation of a long-term competitive strategy; in essence, a peacetime competition between rival defence establishments that aimed to generate a sustained strategic advantage for the US and her allies. This strategy is about finding the right combination of technology and operational constructs to achieve decision-advantage in warfighting, and in doing so, bolster conventional deterrence.

While not solely concerned with technological advantages, offset strategies historically tend to have a powerful technological component, as is evident in the two prior offset strategies employed by the US. The 3rd Offset Strategy appears to have settled on six areas of technological innovation: counter anti-access / area denial technologies; advances in and repurposing of guided munitions; undersea warfare; development of cyberspace and electronic-warfare capabilities; advanced human-machine teaming where soldiers work with unmanned platforms; and wargaming and testing of 3rd Offset operational concepts. The program's aim is to identify and employ advanced game-changing technologies, then integrate these with re-purposed conventional weapon systems. A high-low technology mix will provide the US with a 'capability overmatch' against its adversaries.

The 3rd Offset agenda continues to be pursued by the current Secretary of Defense, Ash Carter. In its 2017 budget, the Pentagon has allocated funds for research and development of 3rd Offset technologies and operational concepts over the coming five years. Much of this money is assigned to Air Force and Navy programs, with the greatest allocation to counter anti-access / area denial technologies.

As an element of the 3rd Offset program, the DoD's acquisition processes were reviewed with the aim of improving their productivity, efficiency and effectiveness. This has reinvigorated the Better Buying Power initiative which contains 34 steps to delivering greater affordability including the implementation of industry incentives, increased competition, reducing bureaucracy, improving the acquisition of contracted services and greater professionalism. The

aim of the initiative is to seek efficiencies in technology acquisition 'reducing cycle time for production development,' and removing 'barriers to greater use of commercial and international sources of technology.' This has already contributed to reduced delays in the Joint Requirements Oversight Council process. Project requirement approval times over the last financial year have been reduced from nine months to six, with the realistic expectation that they will be further reduced to three months. This aspect of the 3rd Offset program parallels the RAAF's Plan *Jericho* which aims to 'transform our relationship with industry to ensure we procure and innovate in alignment with the breathtaking speed at which technological change is occurring in the information age.'

Of particular interest to the ADF are the repeated calls from Secretaries Hagel and Carter for the involvement of allies. The calls have suggested that the 'US can no longer do it alone'. Themes of allied collaboration in the development of operating concepts, mission-specific technologies and investments in future capabilities are common in public announcements by Deputy Secretary of Defense Robert O. Work. He leaves little doubt as to his willingness to share the investment burden, encouraging allies to 'push the boundaries of innovation' and collaboration.

Given the DoD's commitment to its Asian rebalance and the focus on countering the emergent capabilities of the People's Liberation Army, the ADF is well placed to exploit the US Government's willingness to collaborate. The current recapitalisation programs being implemented by the RAAF will see it mature over the next decade into the first truly 5th generation–capable Air Force in the world. The employment of modern air power force elements, combined with US interest in ADF participation in sensitive and critical areas of capability development, gives the RAAF (and other Australian Defence agencies) considerable currency for participation in 3rd Offset initiatives.

Many of the themes of the US 3rd Offset lexicon are being echoed in the Australian First Principles Review. Calls for a strategy-driven, integrated force supported by a streamlined acquisition process are evident in both programs. This presents an alignment of ADF and US DoD interests evident in the *Plan Jericho Program of Work*, science and technology research priorities, areas of operational analysis and

wargaming, and joint force design and the development of operating concepts.

Collaborative opportunities exist across a broad range of programs within the US defence enterprise providing genuine opportunity for the ADF to enhance the effectiveness of its future force and maintain high levels of interoperability with its principle ally. The RAAF (and ADF) should seek to exploit these opportunities while being a proactive partner in the DoD's efforts to define the next offset strategy.

Technology

Technology as a Force Multiplier (#257)

Key Points

- *The global security environment is changing rapidly and there are a number destabilising factors that may not be containable*
- *Situational awareness, in a time-sensitive manner is a critical requirement for the successful application of military force*
- *Technology now acts as a force multiplier for the employment of air power to create precise, discriminate and proportional effects, when and where necessary*

The past two decades have been the most demanding times in recent history in terms of challenges to national security through the diversity and proliferation of threats. When combined with the rapid pace of global sociological, technological and economic changes, the situation lends itself to high levels of uncertainty in the security environment. The list of destabilising factors with long tentacles is extensive—the emergence of a terrorist quasi-state in the Middle East; the mass migration of to Europe of thousands of refugees that the war in the region has spawned; increasing cyber attacks; home-grown terrorism in the more developed nations of the world; the rise of China; a resurgent Russia intent on regaining lost global status; and instability caused by the so-called 'rogue' nations like North Korea. All of these create unsettling ripples in the security environment that cannot be contained within a region or group of nations.

In this fundamentally volatile environment, nation-states tend to place increased emphasis on the employment of military forces in the pursuit of national security. However, the unpredictability of the transforming scenario makes it extremely difficult for military forces to have the absolutely correct capability to deal with emerging threats. Even though military capabilities have evolved, and are continually changing, such capabilities can never be completely optimised to meet emerging threats. This is where advanced technology comes into play.

If security threats are continually changing and adapting, then the highest priority in military capability-development should be given to

intelligence gathering. In all domains of military operations—in the air, on the ground, on or under water, and in space—the pre-eminent requirement is to 'know' and understand what is going on, within a timeframe that is as close to real-time as possible. No military force can today be successful without having sufficiently robust and timely situational awareness.

Modern military forces operate within a cycle, which is intelligence focused and starts with the gathering, analysis and assessment of emerging situations before the decision to act is made. Intelligence, surveillance and reconnaissance (ISR) capability therefore is one of the foundational capabilities required for the optimised application of force, both lethal and non-lethal.

The contemporary battlespace is fast paced and requires actionable ISR in a pervasive manner for a force to successfully compete and win within it. This requires the ability to collect information through the dynamic fusing of sourced data between different intelligence agencies and the ability to disseminate the resultant 'knowledge' to the key decision-makers in a time-sensitive manner so that they have at least the minimum necessary situational awareness to act. The crux of the matter therefore is persistent ISR, which in turn provides the advantage of decision-superiority.

Airborne systems have unparalleled capability to provide persistent ISR. Specialised ISR air assets have unique capabilities—they can deploy into an area of interest, far more rapidly than any other capability; they can do so at a time and place of the commander's choosing to cater for the need of the hour; they have sensors that can carry out wide area surveillance; and they have very long endurance. Perhaps the most important characteristic of airborne ISR capabilities is that they are automatically aligned for collaboration with uninhabited technologies. The necessity for persistence means that most missions would be exceedingly dull and boring and beyond human endurance, which would then become the limiting factor. These missions could also become dangerous and the uninhabited status makes it possible to accept a higher risk factor meaning that probability of mission success also is higher. Such systems are already operational and only need to be employed within a mature concept of operation to become force multipliers.

Uninhabited systems have also been armed in recent times, giving them the capacity to add to the 'act' part of the cycle with the same airborne platform that performs persistent ISR. One of the hallmarks of air power is its ability to strike with precision, discrimination and proportionality, thereby ensuring that the chances of collateral damage are minimised. When a time-sensitive competence is added to this, the strike capability of air power assumes an exponentially greater effectiveness. In the face of irregular adversaries presenting an asymmetric threat, the importance of such a strike capability cannot be overemphasised. Armed unmanned aerial vehicles (UAVs), which are technology-enabled, would start to be force multipliers when employed in this manner.

Technology is also pushing the envelope in providing greater autonomy to the armed UAVs that are already operational. Significant research is being carried out in the realm of artificial intelligence (AI). This does not mean that the 'man-in-the-loop' will be removed. It only means that the 'man' will be placed in another part of the loop that provides a relatively easier way to combine situational awareness and decisive action in a more time-sensitive manner. In other words, the 'man' will be able to function in a better connected environment with access to faster data fusion facilities and instant communications. AI will increase autonomy of uninhabited airborne platforms and also make them even more time-sensitive.

Technology has already provided air power with the ability to deliver lethal force from the air with near-absolute precision. It now provides the ability to combine the unique characteristics of air power in an optimum manner to enhance the effects that can be created. Today air power is not merely about airborne platforms—no doubt they are the mainstay for the application of air power—but about the manner in which different assets can be connected to build a system of systems that can create the desired precision effects. Technology is now about developing the ability for different systems to interoperate within a broad area of instantaneously shared information that creates a common picture of the battlespace available to all participants simultaneously. The force multiplication effect of achieving this can only be understood when it is witnessed from the opponent's viewpoint.

From its inception, air power has been technology-enabled. It is now evolving into becoming technology-empowered with the ability to create effects at a time and place of one's own choosing with great precision, proportionality and discrimination. Technology has become a force multiplier for air power, as never before.

Air Power: Creating Precise Effects (#255)

Key Points

- *Contemporary air power has the ability to strike any target with precision, discrimination and proportionality*
- *Intelligence, gathered from a number of sources, can never be infallible*
- *With adequate intelligence, air power can create carefully tailored and precise effects in the battlefield as well as at the strategic level of decision-making*

The US Air Force carried out three strikes in the vicinity of the city of Kunduz, Afghanistan, on 2 October 2015. The first two were on a warehouse and a mansion in two densely populated residential areas, according to local officials. No-one was killed in these attacks, but the targets were completely destroyed and the windows of nearby houses were shattered. The third attack on a hospital, staffed by Doctors Without Borders, killed 30 medical staff and patients, making it one of the deadliest civilian casualty incidents stemming from coalition air strikes in Afghanistan. It triggered an international outcry and investigations by the Pentagon and NATO.

There is conflicting information being selectively released that is meant to allocate blame for the 'mistake' that took place in striking the hospital, including reports that the Taliban were using the hospital as a base for attacking Afghan Government forces. Irrespective of the results of the investigation, the destruction of the hospital is being labelled as a failure that highlights the fallibility of air power, particularly its employment in the strike role. This conclusion is biased and not based on any comprehensive analysis of air power capabilities and does not take into account myriad human inputs into the process of an air strike.

It is no exaggeration to state that contemporary air power has the ability to strike any target with precision, discrimination and proportionality. All three of these characteristics were openly displayed in the strikes on the warehouse and the mansion, where the 'accuracy' was exemplary. So what went wrong in the attack on the hospital? Even in this strike, air power delivered the necessary ordnance on the

designated target without any other collateral damage. The failure here was that the intelligence provided to the air planners was incorrect or inaccurate. The fault lay not in the planning or execution of the strike, but in the intelligence on which the entire process was based.

A precision air strike has two elements to it. The first is the decision-making process that permits the conduct of a strike and the second is the actual operational and tactical part, which is predominantly based on the technology of air power.

The decision to carry out a strike is never casually made—it is always a considered one, made after ensuring that safeguards are in place and taking into account all possible repercussions that could emanate from the neutralisation of the selected target. Essentially, the effect that the strike will create—on the battlefield at the tactical level, in the theatre at the operational level, and at the highest levels of government at the strategic level—is carefully calculated and weighed against the probability of collateral damage and possible fallouts before authorising a strike. This process has been arrived at after a great deal of thought and consideration of the effects that may not always be aligned to the desired objectives.

The decision-making process is almost completely reliant on the intelligence that is available. Such intelligence straddles the entire spectrum of conflict from the tactical to the strategic. The fundamental challenge to decision-makers is the fact that intelligence is always fallible and can never be completely fool-proof and one-hundred per cent correct. The reasons for this are many. At the tactical level, the heat and dust of battle could skew intelligence analysis and at the strategic level, the Clausewitzian fog of war could obscure critical information and create a situation where wrong decisions are made with all good intentions. In almost all cases of incorrect intelligence being made the basis for decisions that subsequently prove to be disastrous, there will be an element of human error. The quality and reliability of intelligence being made available is the foundation for the selection and targeting of the correct centres of gravity.

The technology of air power that provides it with the ability to strike with pinpoint accuracy does not need elaboration since it has been demonstrated repeatedly. Into this combined equation is now introduced the consideration of the effect that is to be created. When air power came of age in World War II, the consideration of the effect

of air strikes was very broad and almost always strategic in intent. The tactical application of air power in contributing to the surface conflict was in its infancy and close air support of advancing ground forces was a novel concept. The weapon systems did not have the technological competence to assure absolute precision. In these circumstances air power could not state with any assurance that it would be able to create the effects that were desired. Therefore, the reliance on air power to provide fire support was limited.

The assurance of accurate air strikes through the advent of precision-guided munitions in combination with small diameter bombs that ensure discrimination and proportionality, altered the entire scenario. Air power could now neutralise targets with an efficiency that had not been achieved by any other power projection capability. The result was that planners could now turn to finetuning the effects that were required to be created to win the battle, campaign and war. It became possible to visualise and draw the connecting thread between tactical actions and strategic actions. There was also a downside to the arrival of such a capability. A strike, like the one on the Kunduz hospital, that could be tactically precise has the potential to create strategic repercussions that could have detrimental impact on the overall progress of the campaign. This is particularly visible in irregular wars where local public opinion is a critical element for success.

Contemporary, high-calibre air power is now capable of creating tailored and nuanced effects that can either be fully restricted to the tactical level or ones that have clear cascading effects that will ripple all the way to the strategic level. The selection of the appropriate centre of gravity and the decision-making process, both of which are reliant on intelligence as the primary input, will have to ensure that the cascading effects are not unwanted and/or unanticipated. If there is a failure in this process, it is likely to be that of intelligence since the technological aspects of an air strike has now become almost fully infallible in its accuracy.

The optimum situation is where the intelligence, which has an assurance level that precludes the selection of a wrong target and is as near to real-time as possible, is combined with strike capabilities that have the ability to react rapidly. This combination will permit air power to create carefully tailored precise effects at all levels of war, a capability that is unique to air power.

Precision, Accuracy and Effects (#253)

Key Points

- *The success of air-launched PGMs in combination with air power's inherent characteristics of speed, reach and flexibility has made air power the first-choice option for lethal power projection*
- *Intelligence can never be completely infallible*
- *The accuracy of an air strike is dependent both on the PGMs precision and the availability of verifiable and accurate intelligence*

Over the past two or three decades, precision-guided munitions (PGMs) have become synonymous with the application of lethal air power. So much so, there have been recent articles in reputed magazines reporting their perception that the Russian Air Force possesses only a limited stock of PGMs and therefore raising the question of its ability to carry out effective strikes and be successful in the current operations in the Middle East. Such analyses create the impression in the minds of the less informed that, firstly PGMs are infallible and secondly, that the application of air power can only be successful with the employment of these undoubtedly sophisticated weapons.

On the other hand, the enviable success of air-launched PGMs when combined with air power's inherent characteristics of speed, reach and flexibility has unobtrusively moved air power to the position of first-choice option when lethal power projection is required in the pursuit of national security, irrespective of the fundamental strategy being adopted. When PGMs are employed, air power is capable of creating the desired effects with extremely minimised chances of collateral damage even when the target to be prosecuted is time-sensitive and offers only a fleeting window of opportunity. This capability has created an perception of infallibility in the application of air power, which creates its own pitfalls. Therefore, when collateral damage does occur during air strikes, the repercussions in terms of adverse reportage is at times overwhelming.

In order to appreciate the 'cult-status' that PGMs have achieved in both military circles and, more importantly, with the media, it

is crucial to fully understand the meaning of the words **precision** and **accuracy** as well as the connection and differences between the two. Subsequently, it is also necessary to analyse and place on record the impossibility of achieving a completely fool-proof result in the application of a PGM. The expectations of both the political leadership and the general public regarding the application of lethal force from the air must be tempered with facts and a clear understanding of the variables that are in play when air attacks are conducted in war zones.

So, what does precision mean? **Precision** is the quality or state of being precise; and precise means definite or exact. When translated to air delivered weapons it would mean that the weapon will do exactly what it was intended to do and strike the pre-programmed target that was chosen, nothing more nor less. In itself this is a unique capability and will produce spectacular results when employed successfully. However, the challenges regarding the application of lethal force emerge when the precision capability of air power is combined with the need to find, identify and then attack a target considered to be critical enough to be neutralised. These two aspects—the physical aspect of the capability of the PGM and the more virtual aspect of gathering intelligence regarding the target—when combined optimally, have the potential to create the precise effect required. When both are aligned, they almost always do.

The issue of collateral damage has taken centre stage, especially when air strikes are analysed. The demand—both political and military—is to avoid collateral damage at all costs, at times even at the cost of not being able to carry the fight to the adversary. In purely military terms this is a retrograde step, since the fundamental objective of any military campaign is to degrade and defeat the adversary with minimal cost to one's own forces. This is where PGMs come into their own. PGMs have now sufficiently matured to be able to hit the selected target with almost complete assurance. The issue of failure therefore stems from the 'virtual' element of the combination, the ability of the joint force to find and identify the 'correct' target so that it can then be attacked with precision from the air.

An air attack where the proper and approved target has been correctly identified—and then been neutralised by a PGM with precision—is what can be termed as an accurate strike. There is a connection as well as a subtle difference between being precise and

accurate. **Accurate** means, in exact conformity to a standard or rule; free from error. It is clear that only accurate strikes will create the desired precise effect. Further, the inaccuracy of a strike using PGMs would, in most cases, be attributable to the failure of the 'find and identify' side of the combination and not that of the PGMs per se. Therefore an accurate strike is a combination of a PGM and correct intelligence. Inaccuracies in air strikes, irrespective of the sophistication of the weapon being employed, will have to be accepted as long as the target identification process contains even the slightest degree of fallibility. However, air power and its practitioners have done an admirable job in the great majority of cases to meet the demands placed on them for accuracy and timeliness of air attacks, and thereby have almost always been able to create the desired precise effects.

The reason for air power having become the first-choice military element to create precise effects is not difficult to discern. The severe criticism levelled at air power when it fails to achieve the desired outcome, however small the percentage of such incidence compared to its greater achievements and even when it has not violated any international norms, is far greater than what it should be in highly volatile operations. Even when the inaccuracy of the attack can be clearly attributed to flawed intelligence that may have emanated from other agencies, air power is set to wear the blame. This could be attributed to the difficulty in understanding the nuances of delivering a PGM in a time-sensitive manner within a war zone and from a fast moving platform where the time available for the human in the loop to make the decision is very limited and amounts to only a few seconds. Secondly, in all cases of mistaken targets being attacked and the obvious collateral damage that is created, there is always the need to assign blame—air power fits the bill fully, being demonstrably spectacular in its strikes and also having vociferous advocates who are not averse to accepting the fallibility of intelligence, while stoutly defending the capabilities of air power.

Air power and its PGMs are the best innovations that have taken place in recent times in the sphere of lethal application of military force. When this capability is combined with the intelligence gathering capacity of a joint military force, the PGMs become accurate weapons of destruction that can create the desired joint effect precisely. Precision by itself without having the ability to identify the target accurately will

not always create the desired effects, which will immediately contribute to the pursuance of the objectives of the battle, campaign and/or war. As long as there is misunderstanding between the concept of precision and accuracy, air power whenever it fails—occasions that are few and far between—will always have detractors who will never be able to appreciate its effectiveness as a potent element of national power.

Air Warfare Innovation and Integration (#265)

Key Points

- *Experience has shown that new technology does not necessarily equate to increased capability*
- *The full potential of new weapon systems like F-35 will be dependent on their integration into overall Air Force and broader Defence capability through innovative thinking and implementation.*
- *The Air Warfare Centre drives integration and provides mechanisms to transform the potential of new weapon systems into 5th-generation capability.*

With the first P-8 Poseidon due to arrive later this year and only Triton and the Joint Strike Fighter to come, the Air Force is close to realising the future force that was envisaged ten years ago. While new weapons and platforms have promised a technological edge, experience has shown that it is only through underpinning new technology with innovative thought, tactics and doctrine, that true potential will be realised. Noting that the introduction of new weapon systems, like the F-35, offer remarkable capabilities, our true potential to become a 5th-generation air force will be largely dependent on the weapon system's integration into the broader Air Force capability through innovative and integrated thinking. The creation of the new RAAF Air Warfare Centre provides the mechanism to drive capability realisation by analysing and resolving challenging issues across the operational Air Force.

The experience of war has clearly demonstrated that the introduction of new weapon systems will not necessarily realise the immense potential they promised. Although the employment of air power in World War I provided a glimpse of what it could provide, it was not until air warfare operational concepts were developed between the wars that aircraft became a critical and effective capability in warfare. In Europe, post World War I scrutiny of the failure of trench warfare resulted in the

aircraft being closely integrated with the tank and mechanised infantry to become a key component in a more decisive form of manoeuvre warfare. In the USA, the US Army Air Corps Tactics School developed the conceptual thinking for the decisive employment of US air power during World War II. Similarly, Air Marshal Hugh Dowding, RAF developed the notion of an integrated air defence system integrating fighter aircraft, radar, and command networks into a robust air defence capability.

The introduction of weapon systems such as the F-35 provide similar challenges and opportunities for the RAAF as it pursues development of a 5th-generation air force. For example, as a weapon system, the F-35 offers enormous potential with its capacity to excel in the air power roles of control of the air, strike and ISR (intelligence, surveillance and reconnaissance). However, to fully realise its potential in these roles, there is a need to develop operational employment concepts and tactics for its use across those domains. This requires the expertise of not just fast jet specialists but other subject matter experts such as ISR, targeting, weapons and communications personnel to collaborate in developing integrated tactics and capability.

The creation of the new Air Warfare Centre provides the RAAF with the tool to identify and analyse air warfare lessons, develop integrated tactics and then deliver the advanced air warfare training required to translate those tactics into 5th-generation operational capability. Through operational analysis, lessons will be identified to drive tactics development. Within the new Tactics and Training Directorate, subject matter experts from across the Air Force's specialisations will, through collaboration, develop integrated tactics that will then be taught, documented and form the basis of advanced education through a new Air Warfare School. This process will drive more realistic integrated exercises designed to validate tactics and capability. Further, the development of a live, virtual and constructive (LVC) training and evaluation environment will allow tactics to be tested and exercised in an artificial yet realistic and high threat environment.

Another key aspect to realising the desired integrated capability is providing rapid problem solving for challenging issues impacting Air Force operations. The recently completed Exercise *Jericho Dawn 16-3*, led by the Air Warfare Centre, demonstrated the value of such

collaborative problem solving. Bringing together various stakeholders from defence industry, Army and Air Force, the exercise successfully evaluated the efficacy of a potential airborne gateway communications node to relay data and information between dissimilar datalink systems and communication paths. Such capability is key to warfighters accessing common data and information, and thus enabling them to operate in a more integrated battlespace despite the plethora of different weapon systems and communications links.

This bottom-up-innovation approach will also be valuable in addressing challenging air operations issues where a more holistic approach is required, rather than one focussed on a specific weapon. For example, the emergence of a new threat system will have, not only discrete implications for individual weapon systems, but also for the conduct of air operations as a whole requiring a collaborative approach to understanding the threat at a broader integrated level rather than a platform-focussed, stove-piped approach. The coming together of specific air-minded specialists to analyse and develop complex operational scenarios together will provide a more holistic, balanced and operationally focused approach.

In essence, this aspect reinforces the importance of the most basic element of warfare – the human element. While the rise of air forces and air power over the last century is partly one of technology and aircraft, it is also one inherently about the professionalism of its people. It is that human dimension that drives innovative thinking and translates technology into real capability improvement. People are what make an air force successful.

The creation of the Air Warfare Centre provides Air Force with the mechanism to promote the innovative thinking required to drive integrated capability across the operational level of the Air Force. The Air Warfare Centre is focussed on the delivery of rapid and innovative solutions and serves as a catalyst for organisational change. It is therefore key to our transformation into a 5th-generation air force. While air forces and air power have always been technology-driven, it is their people, through understanding not only their own tradecraft but also the nature of air power and air warfare, who have generated capability by fully exploiting the potential of technology. The Air Warfare Centre will bring these people together.

MEAO Sub Hunters Track Down IEDs (#275)

Key Points

- *Adaptable, flexible, committed and highly trained air and ground crew, and well-resourced logistics support are essential to successful air operations, as exemplified by the RAAF's marathon commitment to operations in the MEAO.*
- *Platforms employed by the RAAF must have the capacity to accept upgrades in response to changing roles and new threats.*
- *Interoperability and good communications with ground forces are key to the effective delivery of air power's effects.*

Throughout the course of Operations *Falconer*, *Catalyst* and *Slipper* the improvised explosive device (IED) emerged as the clear weapon of choice for the insurgents and was the greatest threat faced by the coalition forces. While the use of IEDs reduced the need for insurgents to directly engage with Western forces, these potent weapons caused more deaths and injuries to coalition forces and the civilian populations in both Iraq and Afghanistan than any other weapons system. Coalition fatalities attributable to IEDs escalated sharply from 20 in 2005 to 368 in 2010. Approximately 40 per cent of Australian soldiers killed in action and over 60 per cent of those wounded were as a direct result of IED attacks. High as those casualty figures are, coalition development and deployment of a variety of increasingly successful countermeasures prevented the IED toll from being still higher. These measures resulting in IED casualty numbers declining from 2011.

Much of the coalition's multi-faceted response to IEDs has been well documented, including the use of courageous, highly trained, dismounted combat engineers conducting manual searches to detect and neutralise IED threats, explosive detector dogs, and more recently, safer, vehicle-mounted detection equipment. However, far less is known about the counter-IED role

played by the RAAF's P-3C, and later, AP-3C aircraft and their crews deployed to the Middle East Area of Operations (MEAO).

From January 2003 until December 2012, RAAF crews from No 92 Wing flew demanding, high-tempo operations while force assigned for Operations *Falconer*, *Catalyst* and *Slipper*. During these operations, the RAAF flew 2 410 missions, totalling over 22 500 hours flown and achieving a 96 per cent success rate. At the commencement of operations, the RAAF detachment was employed in their traditional maritime intelligence, surveillance and reconnaissance (ISR) role in the Arabian Gulf. These early missions helped provide coalition forces with the battlespace awareness vital to the success of the air, sea and land campaigns conducted against Saddam Hussein's Iraq. Following the defeat of the regular Iraqi military, the RAAF continued to fly missions in the Persian Gulf and Arabian Sea to protect essential sea-lanes of communication and vital installations from insurgent attack. Such missions were critical for the security of coalition forces and the stability of the Iraqi economy dependent on the output from its offshore oil platforms.

As the scale of the Iraqi insurgency increased, the focus of coalition forces changed to conducting stabilisation operations in conjunction with Iraqi security forces. These operations required significantly more airborne ISR assets than were available from assets normally employed in this role, and led to the RAAF detachment being tasked in the non-traditional overland ISR role. The first RAAF mission in this role was flown in March 2003 when the RAAF detachment was still equipped with the 'basic' P-3C. By August that year the Air Force, tasked on increasingly complex overland ISR missions over Iraq, were operating the AP-3C, with its greatly enhanced sensor fit and associated improvements in capabilities.

The development of the overland ISR role required an extraordinary effort across No 92 Wing and other key support organisations. Reconfiguration of the aircraft with significant new sensor and communications systems, integration of those systems with coalition systems, development of new tactics, techniques and procedures, and the associated training and certification of air and ground crews occurred within a greatly condensed timeframe to cater for operational imperatives. Notably, much of this occurred in-theatre while the detachment was continuing to undertake other tasking.

The scope and complexity of the overland ISR missions grew rapidly. They were often conducted at short notice, or after inflight re-tasking between disparate roles in response to the dynamics associated with coalition ground troops in contact with insurgents. The RAAF operated in a fragile strategic environment, in close proximity to sensitive international boundaries and the potentially hostile military assets of regional neighbours.

In July 2009, while continuing maritime operations, (now on anti-piracy missions in the Gulf of Aden, Red Sea and Indian Ocean), RAAF AP-3Cs commenced overland operations in Afghanistan in support of Coalition ground forces. In this theatre Taliban-deployed IEDs again represented a potent threat to coalition forces and the civilian population.

Throughout its involvement in counter-IED operations, the P-3C's (and later, AP-3C's) comprehensive sensor suite, the aircraft's long endurance and relatively large crew permitted the aircraft to remain on station for extended periods, obtaining the detailed intelligence and associated pattern of life information necessary to cue coalition forces to neutralise IED cells in both Iraq and Afghanistan. From covert stand-off ranges, crews detected IED factory and cache locations, IEDs that had been deployed and, on occasion, insurgents in the process of laying IEDs. The latter role included the provision of overwatch until and during the response by coalition ground forces.

Use of RAAF P-3 aircraft in the counter IED role reflected the aircraft's inherent agility and flexibility, its capacity to be upgraded with increasingly capable sensor and communication equipment, new software programs and upgrades, the ability of aircrew to readily adapt to changing tasking in a complex operational environment, and the remarkable support effort from technicians, maintenance personnel, intelligence, operations and training staff.

While No 92 Wing has generally been regarded as 'the quiet achiever' for past operational excellence, deserved recognition has been given for the wing's sustained and outstanding service for almost a decade in support of warlike operations in the MEAO during Operations *Falconer*, *Catalyst* and *Slipper*. Not only did No 92 Wing excel in its traditional maritime role, it also adapted to new roles such as counter-IED patrols to the considerable advantage of coalition forces and those they sought to protect.

Air Power and the Maritime Tactical UAS (#280)

Key Points

- *The persistence of naval vessels on operations favours embarked UAS to provide sustainable situational awareness.*
- *Embarked Maritime Tactical UAS complement other maritime air power assets.*
- *Maritime UAS will develop to complement the maritime air power provided by Air Force under emerging joint operating concepts.*

The importance of air power to military operations has reached the point that aviation platforms and systems have become common in the orders-of-battle of land and maritime forces and are no longer confined predominantly to air forces. This is certainly the case with the ADF, even though the delivery of air power remains the core role of Air Force and so requires all Air Force members to be air power professionals. As air power professionals, we must understand not only how air power is delivered by our own Service but also by a joint and integrated ADF. The unmanned aircraft system (UAS) provides an excellent example of how all three Services use a similar platform type to deliver air power for different but coherent purposes.

The UAS effectively addresses one of the shortcomings of air power—impermanence. As described in a Pathfinder #268 (see p.99), the main battle tank provides overt permanence in the land environment. The UAS can complement this with its attributes of low probability of counter detection, persistent overwatch or wide-area search and, in the case of armed UAS, kinetic response options. These attributes also provide a cogent case for the use of UAS in uncontested maritime environments.

Warships provide an overt and persistent maritime presence, akin to that of the tank in the land environment. The submarine provides a persistent covert surveillance, strategic strike and threat-in-being capability. The maritime commander's ability to manoeuvre these relatively slow (in relation to aircraft) platforms to maintain the

initiative against an adversary depends on a high level of situational awareness.

Providing persistent input to the common maritime operating picture is a role for the maritime tactical UAS (MTUAS). Land-based ISR assets are often constrained by range and endurance from contributing to this picture while scarce space-based assets cannot always be responsive to the needs of the tactical commander. An embarked MTUAS provides an accessible capability for a naval task group (NTG) that can augment land and space-based assets when they are available.

Persistent maritime ISR is primarily focussed on identifying and monitoring all contacts within the (moving) NTG's area of interest. This is subtly different to the main purpose of ISR in the land environment—the continuous observation of a (stationary) specific area of interest. The maritime ISR asset usually looks FOR something, whilst the land ISR asset usually looks AT something. This difference determines the types of sensors and air vehicles most suitable for the maritime ISR task, which in turn can affect the analysis tools and personnel required.

Sustainment of sensors airborne for long periods of time is a task particularly suited to an unmanned system. In most operational maritime scenarios, situational awareness and combat-effectiveness can be meaningfully augmented by UAS—either organic to the vessels or tasked in support.

Defence White Paper 2016 makes provision for the acquisition of land-based, Air Force operated UAS systems: the MQ-4C Triton ISR UAS and a yet-to-be identified armed ISR UAS. The White Paper also signals the intent to acquire MTUAS that are capable of being embarked and operated from a range of vessels. These systems, when combined with Air Force and Army UAS, will provide the joint force with layered and flexible options to support operations in all domains.

Navy intends to operate its tactical UAS in support of task groups, the usual operational organisation for its warships. Capital ships, such as the Canberra Class LHD and Hobart Class DDG, will provide the core around which amphibious task groups (ATGs) and surface action groups (SAGs) will be formed. This will require the MTUAS to operate in two key environments—the littoral and maritime. In the littoral, UAS will support amphibious operations by providing effects such as rapid environmental assessment, local

area ISR and targeting. In the maritime environment, UAS will support SAGs by providing wide-area ISR, anti-surface warfare, anti-submarine warfare, battle-damage assessment and electronic warfare.

MTUAS are by definition **organic**, meaning they are under command of the officer in tactical control and used as an extension of the ship's or task group's own sensors. Given the limited space available on naval vessels, maritime UAS must be **compact** including mission control systems; launch, recovery and maintenance equipment; air vehicles, payloads and spares. As naval deployments may last up to nine months without access to deeper maintenance facilities, embarked UAS systems must be **low-maintenance**. Finally, given the limited cabin-space of naval vessels, the UAS crew has to be small, making the system **personnel efficient**.

Collectively, these requirements dictate that MTUAS must be **smaller** than its land-based equivalent yet still capable of meeting the full range of UAS operational requirements. However, there is some latitude for capital ships such as LHDs. Maritime UAS must be a **flexible** system capable of supporting multiple payloads that can be rapidly reconfigured to meet mission-specific requirements. The maritime operating environment also dictates that the MTUAS **operate within radio line-of-sight** rather than relying on less-certain, over-the-horizon datalinks such as broadband SATCOM. MTUAS must maintain constant communication directly with the controlling ship or task group, which if required, can then 're-broadcast' ISR information. This does not prevent the UAS also being able to transmit data to multiple task group assets, however the command element requires consistent connectivity.

Current MTUAS require line of sight connectivity and this limits the value proposition of UAS autonomy. Nevertheless, high levels of **automation** are highly desirable in order to reduce the number of personnel required to operate the platform and undertake processing, exploitation and dissemination of the gathered data.

While this discussion has focussed on the unarmed ISR UAS in the maritime domain, developments in land-based UAS indicate further development of the maritime UAS is likely. Given their significant deck and hangar spaces, Canberra Class LHD are capable of employing sophisticated and capable MTUAS or even medium-sized strategic UAS.

KC-30A Update (#276)

Key Points

- *An integrated and networked tanker, such as the KC-30A, provides a significant increase in capability and enables extended air power projection.*
- *On Operation Okra, the KC-30A has provided significant fuel offload capability and demonstrated the advantages of next-generation tankers.*
- *Future fleet expansion, receiver clearance and modification programs will further enhance the KC-30A capability.*

Reach is one of air power's most important characteristics, but for the first four decades of military aviation, reach was limited by the range and endurance of most aircraft. Since the early 1920's, the United States Army Air Service conducted experimental air-to-air refuelling and in 1923 managed to keep a DH-4B airborne for more than 37 hours, with nine air-to-air refuels. Similar trials were being conducted in Britain and France. By the end of the World War II, the RAF had converted a Halifax bomber into a tanker aircraft that was capable of refuelling Lancaster aircraft which could have been used to bomb the Japanese mainland. The British system was later developed into the system now known as the probe-and-drogue system. In the 1950's, Boeing developed the boom-and-receptacle refuelling method for the USAF to allow greater fuel flow rates than was possible with the probe-and-drogue system. The first boom-fitted KC-97 tankers flew in 1950. The newest generation of tankers the KC-30A and KC-46 continue the improvement of air-to-air refuelling whilst including advances in communications, tactical awareness and self protection.

An effective tanker force allows the projection of a nation's air power far beyond what it would be without air-to-air refuelling. Five KC-30A aircraft are currently operated by No 33 Squadron at RAAF Base Amberley in Queensland. An additional two aircraft will be delivered by 2019 and the recent *2016 Defence White Paper* provided options for a further two aircraft, at the Government's discretion.

With a maximum takeoff weight of 233 tonnes and a wingspan of 60 metres, the KC-30A is the largest aircraft in the RAAF. It requires significant coordination, personnel, ground support, equipment, maintenance and logistics support to enable effective operations. The KC-30A is a multi-role tanker transport aircraft capable of carrying a combination of up to 270 passengers, 8 military pallets and 110 tonnes of fuel. The KC-30A flies globally in all roles, tanker, cargo and passenger transport. With an empty-weight range of 14 000 km, it can be repositioned to support operations around the world within 24 hours.

The typical KC-30A operating crew includes two pilots, an air refuelling operator and crew attendants as required to support passenger movements. Maintenance and support personnel are required for away base and extended operations. No 33 Squadron uses the KC-30A to support domestic and international tasking, exercises and training missions. The aircraft has the capability to be refuelled by another tanker, enabling it to conduct ultra-long range air-to-air refuelling or transport missions. The majority of air-to-air refuelling missions are in support of the F/A-18 Classic and Super Hornets in their major training areas and regularly facilitates long-range accompanied strike and air patrols across Australia.

The KC-30A is equipped with a number of radios, Link 16 datalink and mission planning systems, which combine to provide a high level of situation awareness to the pilots and air refuelling operator. This allows the crew to communicate securely with receiver aircraft and coordinating agencies. These enhanced communication capabilities allow the real time repositioning of the aircraft in anticipation of coalition requirements minimising the duration of the refuelling event and the time the receiver aircraft is away from its primary mission of providing tactical or close air support.

Since September 2014, No 33 Squadron has deployed a single KC-30A aircraft in support of Operation *Okra* in the Middle East as part of coalition operations against the Daesh in Iraq and Syria. With approximately 30 personnel, the detachment has conducted over 800 sorties expending 6400 flying hours and offloading 65 million pounds of fuel to RAAF and coalition aircraft. In Operation *Okra*, the KC-30A is delivering approximately twice the rate of effort and capability than a previous-generation tanker, such as a KC-135.

This operation has demonstrated how the next-generation tanker can integrate into the air and ground network, ensuring maximum capability and flexibility while retaining its core function of providing fuel to other aircraft.

In addition to Operation *Okra*, the KC-30A is involved in a number of other significant activities.

- Receiver clearance programs, requiring significant engineering and flight test programs, are being conducted to enable safe and efficient refuelling of RAAF and allied aircraft by the KC-30A. The RAAF has recently completed F-35, F-16 and C-17 programs with plans to conduct additional programs with coalition partners over the next few years
- RAAF KC-30A aircraft have participated in domestic and international exercises including Exercises *Pitch Black*, *Talisman Saber*, *Red Flag* and *Cope North*.
- The aircraft have also carried out national tasking supporting Government, ADF and coalition-partner activities, including fighter aircraft deployments to the Middle East, South-East Asia and the Pacific regions.
- The squadron also conducts ongoing aircrew and maintenance training.

In addition to the above activities, No 33 Squadron is expanding its KC-30A fleet and conducting a number of key program upgrades as part of Plan *Jericho*. Two additional aircraft will be added during 2017-2019, bringing the total fleet to seven. Plan *Jericho* will enable upgrades to communications and datalink node capability, mission system, advanced refuelling boom system, and many other systems. The additional aircraft, upgrades, training and development of RAAF aircrew and support personnel will all improve the functionality and employability of the KC-30A, further enhancing its reputation as the tanker of choice.

The KC-30A has enabled the RAAF to make a significant leap forward from legacy tankers used 'behind the fight and out of sight'. The KC-30A will continue to mature and expand providing a fully networked and flexible multi-role aircraft that will be critical to the defence of Australia, protection of allied interests and support to domestic and regional incidents.

Targeting GPS Weapons: Not as Simple as You May Think (#288)

Key Points

- *GPS provides unparalleled accuracy and precision in targeting.*
- *Targeting coordinates used in GPS-aided weapons have multiple error risks from many sources.*
- *These risks demand rigorous governance and the ADF has achieved and retained accreditation in GPS targeting.*

The ability to get a weapon on a target has been a critical enabler of air power since the beginning of aviation. With the introduction of high-technology navigation systems, such as Global Positioning System (GPS), the geosciences of mapping and locational accuracy became even more important to the targeting process.

The most primitive form of navigation used features on the Earth's surface, such as mountains, coastlines and rivers. This evolved with the mathematics of trigonometry to give us survey and targeting as science. Later navigators used observations of the sun, planets, moon or stars to calculate their absolute position which is position determined without reference to surface features. Even some relatively advanced systems used astro-navigation. The first generation of intercontinental jet airliners and ballistic missiles navigated by the stars until more accurate systems were developed. GPS introduced the concept of absolute position referenced to a man-made constellation of satellites instead of natural constellations.

The heart of the GPS is a constellation of satellites which orbit the Earth twice per day at an altitude of some 20 000 km. The GPS receiver determines its position by comparing the time of arrival of signals from a number of satellites and displays this as latitude, longitude and elevation.

Traditionally, targeting was done by one of two methods. The first method was line-of-sight where the target was sighted and the weapon was released at a point determined by operator experience

or guidance from a bombsight. Later, technology provided a second method in which a weapon release point was calculated in the form of range and bearing from the target. The aircraft was flown to the release point using radar or inertial navigation system positional information, and the weapon released without the target ever being sighted. Laser designation gave us unheralded accuracy and precision as targets were illuminated with a laser spot to which weapons could home on. The introduction of GPS in 1995 allowed a new form of targeting where the weapon, once released, flew to its target's coordinates using GPS information alone. However, the accuracy and simplicity of this last method was not without its difficulties and presented two major challenges.

The first challenge is the accuracy of elevation information. The most common use of GPS in navigation is in two-dimensional situations such as driving or walking on the Earth's surface. Location is presented as a marker on a map. When the third dimension of elevation is required, some problems start to appear. In the past, elevation was provided in the form of height above mean sea level, the datum for which was an imaginary sphere of constant radius from the centre of the Earth. But this led to inaccuracies because the world is not a sphere—it is an oblate spheroid with significant lumps and bumps. Inaccuracies in elevation data would not be a problem if bombs fell vertically, but when they follow a trajectory, an elevation error of several metres can cause the weapon to miss its target.

To provide the accuracy required to drop weapons, a new reference system called the Digital Point Precision Data Base (DPPDB) or 'D-Point- was created by the US Department of Defense. DPPDB is a fundamental change from historical projections in that it references every point on earth to an X, Y and Z measurement from a theoretical centre point of the Earth.

The second great challenge came from the issue that there are places that we can never set foot due to either inaccessible terrain or the closed borders of a hostile nation. This problem is addressed by imaging satellites, which provide the ultimate 'high ground' from which to observe and record. Orbiting satellites take overlapping two-dimensional images and, by the use of stereoscopic analysis, recreate a three-dimensional model of the surface. However, in doing so, sophisticated algorithms are needed to stretch and compress the flat

images back into an accurate model. The greater the vertical change or slope, the greater is the possibility of error in the height or elevation. In dense urban terrain such as Manhattan or the Sydney CBD, the heights of adjacent surfaces (tops of buildings) may vary by 200 metres or more. A similar problem in mountainous terrain can also introduce significant errors.

Accuracy in the selection of target coordinates is critical; any error may result in, at best, a miss or at worst, collateral damage that could undermine legitimacy of a targeting activity in the first place. Hence, in urban warfare, where the risk of collateral damage is greatest, the likelihood of vertical error is also greatest.

Identifying this risk, the US introduced the Precise Point Mensuration (PPM) program whereby units were rigorously tested in an accreditation program. The selection of aim points in the targeting process became a controlled activity limited to certified organisations and individuals. Target coordinates were 'dropped' a number of times and assessed by independent assessors. Selected aim points have a 'life' before needing revalidation in recognition of changes that frequently occur in the human terrain.

The introduction of GPS weapons into the ADF was accompanied by recognition of the need for governance of the use of GPS in targeting. The ADF PPM Program Management Office was awarded accreditation in 2013, the first entity outside of the United States to be awarded accreditation by the United States National Geospatial Intelligence Organisation. Full accreditation was renewed in May 2017 ensuring ADF precision targeting remains world best practice.

The key point to remember about GPS-aided weapons is that they are released with a set of three-dimensional coordinates that will determine where the weapon strikes. The coordinates were determined from significant mathematical modelling while drawing data from two satellites systems wobbling in their orbits as they pass through variations in the Earth's gravitation field. The coordinates may have also been based on imagery collected through electro-optical lenses that were subject to the rigours of space, recorded on a flat collector frame and reconstructed, after transmission to a ground station, by superimposing two stereoscopic flat images to reconstruct a three-dimensional image based on an Earth-centred, Earth-fixed global reference frame.

Every precaution should be taken to ensure the coordinates are as accurate as possible. Too much is at stake to let avoidable errors creep in.

The Hidden Dangers of the Smart Phone: Integrating Location Information with Social Media (#282)

Key Points

- *The combination of a smart phone and a lack of knowledge by the unsuspecting user makes it possible to locate an individual easily*
- *At the time of their introduction, GPS devices and social media platforms were two completely separate forms of technology*
- *The modern smart phone is capable of storing data that has the potential to compromise the security of individuals and organisations.*

It wasn't long ago when the process of locating someone based on data from their mobile phone meant using triangulation algorithms combined with accurate aerial imagery. This process was not only complicated and time consuming but was well beyond the skill of the everyday user. Today, we live in a vastly different world. Rapidly evolving technology, combined with a general ignorance of that technology is a 'perfect storm' for privacy and personal security. Users need to be aware of the information that is stored on their mobile device, and how it can be exploited.

High fidelity geospatial information has increasingly become easy to use and freely accessible to the everyday user. However, since the introduction of personal global positioning system (GPS) devices by companies such as Tom-Tom in 2001, this individual data has become readily available to the wider community. Around the same time that personal GPS devices were becoming household items in the mid 2000's, social media platforms such as Facebook (in 2004) were also being introduced. At the time of their introduction, GPS devices and social media platforms were two separate technology markets and the degree to which their interdependence would develop was not widely understood.

The introduction of the smart phone from 2007 provided a platform with the ability to integrate both geospatial and personal

information of the user into one easy-to-use device. Over the last decade, the smart phone has become a common household item and its usefulness has been enhanced through the introduction of various applications, or 'apps'. These apps are designed to improve the quality of day-to-day life and efficiency of the user. In most cases the app does this by collecting and storing both personal and geospatial information and presenting it on demand in a way that is easy to use. However, the full implications for privacy and security were not transparent.

Today, the majority of smart phone users depend on their phones for storing all manner of personal information for their day-to-day usage. Such information can include anything from their date of birth to personal photos, banking details and contacts. Although this type of personal information is usually stored knowingly by the user, the modern smart phone is also capable of sharing data unbeknown to its user. Such information includes the location information embedded into photographs and the ability for apps to track the user's location even when the app has not been opened. It is this direct integration of the user's personal details combined with the near real-time geospatial data that makes the application so useful, while at the same time making it a potential privacy concern, especially if the capability is not fully understood.

The simplest example is in the traffic display on Google Maps as you sit on a congested freeway. You, along with your fellow motorists are contributing to a geospatial 'crowd sourcing' by Google, showing congestion and velocity of traffic, via the harvesting of data from your mobile device. Similarly, insurance companies are increasingly asking for imagery (perhaps with geospatial information) of insured items. After damage or loss, their websites seek post-damage or loss imagery and geospatial and temporal data.

To the reader with a background in air operations, or for that matter any military endeavour, the correlation between this data fusion and the aspiration of intelligence preparation of the battlespace, intelligence, surveillance and reconnaissance and indeed battle damage assessment, must be self-evident. When the opportunities for network analysis are added, such as information regarding who has been called and responded to (and indeed the priorities of the response or dismissal), what is presented as convenience and efficiency also becomes fertile ground for those with a darker purpose.

It is now clear that a lack of knowledge and understanding of what information can be stored automatically by mobile devices can cause significant privacy and security risks to the user. Not only is the device collecting data, and connecting to overt geospatial tools such as Google Maps, but it is also interacting with social media sites that are automatically collecting the embedded location information stored within a digital photograph.

As an experiment, a photograph was saved from a firearms forum in the USA directly onto an iPad. This photograph clearly showed the make of firearm and type of cabinet used to store the firearm. The iPad user was then able to see exactly where the photograph was taken using the 'Places' function within the iPad software. Using the satellite image background layer, the address and the approximate location on the property where the photograph was taken could be obtained. This experiment demonstrated the ease with which this type of information could be obtained and misused. Fortunately, major social media sites such as Facebook and Twitter now automatically remove the embedded location information as a photograph is uploaded on their sites.

The above example highlights the importance of understanding the risks and implications associated with using the automatic link between personal and geospatial information. However, this is only the tip of the iceberg. The ability of applications and social media to link personal information with near real-time geospatial information of a user should not be taken lightly. This capability opens the possibility to build up a profile outlining the user's daily routine. What was once the purview of sophisticated intelligence collection is now available to criminal and/or terrorist activities and could be used to compromise missions conducted by Defence and Security staff. Throughout history, military forces have taken great pains to manage operational security. However, to remain functional in modern society, individuals have become dependent on technology that has the potential to make individual information available on a daily and hourly basis. The last century has seen the 'front line' morph into 'manoeuvre warfare', into 'hybrid warfare'; just how aware and prepared are military forces to deal with the emerging future challenge when 5th-generation military platforms co-exist with a 5th-generation civil society?

More information regarding protecting individual privacy while using smart phones (for both iOS and Android smart phones) can

be found at the following site: https://www.staysmartonline.gov.au/mobile-devices

Australian Space Situational Awareness (#273)

Key Points

- *Collecting and analyzing information and tracking space objects are global challenges.*
- *Australian SSA capabilities will contribute to space security for Australia, as well as its allies and partners.*
- *SSA will contribute to aiding assured availability of space-based systems needed by the 5th Generation Air Force for network connectivity.*

An Aboriginal legend describes the Milky Way galaxy as representing the spirit form of an emu that had been hunted and banished to the celestial sky. At different times throughout the year, the emu appears to an observer's unaided eye to be either running or resting. For the Aborigines, this indicated the appropriate time to hunt for emus or collect their eggs. Ever since these early aboriginal observations of the sky overhead that improved their situational awareness of the environment, the use of space-enabled capabilities has become an indispensable component of modern lifestyle, business activities and ensuring national security.

The RAAF has, over the years, evolved into a modern force. Like all other modern military forces, it is critically dependent on space-based capabilities to obtain timely and accurate information and to ensure robust communications. Securing access to the space environment, therefore, becomes extremely important. It also requires awareness of space systems and activities as well as threats to space-based capabilities to ensure that challenges to ongoing access to space support can be ameliorated.

Accordingly, Air Force is investing in new Space Situational Awareness (SSA) capabilities in order to understand the potential risks to space infrastructure and Australia's interests. This is crucial to ensuring the viability of ADF operations now and into the future. Although the use and reliance on space has evolved since the

Aborigines' observations of the sky overhead, its importance remains undiminished.

Australia's geographic location is such that it is remote from the international centres where it conducts business and trade. Further, in keeping with the national security strategy, most ADF deployments will invariably be undertaken in distant locations. This geostrategic reality makes it imperative for Australia to maintain reliable access to space-based capabilities that provide reliable information and communication services. Whilst Australia does own a number of geostationary communications satellites that service the Australian domestic population and ADF military operations, many other space-based capabilities are obtained under allied military agreements and commercial arrangements with foreign satellite owners. Air Force aims to employ SSA capabilities to gather information on the status of risks to space-based capabilities that would affect both Australia and its allies and partners.

Since the first satellite Sputnik was launched in 1957, over 39 000 objects have been catalogued as having been placed into space orbit. Although many have since re-entered Earth's atmosphere, there are still more than 16,000 tracked objects in orbit around Earth. About 5 per cent of these tracks are functioning satellites, 8 per cent are rocket bodies, and about 87 per cent are just space debris. Currently, the US global space surveillance network makes about 420 000 observations per day of these objects. In 2014, US Air Force Space Command (AFSPC) purportedly issued 671 000 notifications to satellite owners of predicted orbital collisions.

Under international agreements, each country is responsible for the objects they insert into orbit, throughout its entire life cycle. Currently, Australia has ownership responsibilities for 18 orbiting objects that include 14 functioning satellites, two spent rocket boosters, and two expired satellites. Sharing SSA data with the global SSA community enhances the awareness of both the status and associated risks posed by other objects to Australian satellites and vice versa.

Australia's SSA capabilities are ground-based surveillance sensors being operated by No 1 Remote Sensing Unit (1RSU) to monitor activities in space and the potential hazards that might result from on-orbit collisions, catastrophic failures of satellites and launch vehicles, orbital re-entries, in-orbit separation events, severe space weather

damage effects on satellites, and potential strikes against satellites by asteroids and cosmic debris crossing Earth's orbit. Ultimately, Air Force SSA will detect, predict, and assess the risk to life on the Earth's surface, equipment in orbit and on the ground, and potential disruptions to ADF operations.

Australian SSA Elements include:

No 1 Remote Sensing Unit (1RSU) Established in 1992 at RAAF Base Edinburgh, 1RSU is responsible for the operation of the Jindalee high frequency Skywave Over-The-Horizon-Radar (OTHR) and Space Situational Awareness (SSA) sensors. Air Force operators have also been, and continue to be, part of an exchange program with the USAF 2nd Space Warning Squadron, based in Colorado.

1RSU Optical Space Surveillance Telescope (SST) A first of type, highly advanced US-owned ground-based optical telescope that is being relocated to a new purpose-built facility at Naval Communications Station (NAVCOMSTA) Harold E Holt. 1RSU will remotely operate the SST, in collaboration with US AFSPC to provide an awareness of space activities and determine if these activities are likely to affect Australia's national interests.

1RSU C-band Space Surveillance Radar A US-owned radar system that has been relocated from Antigua to an Australian modified facility at NAVCOMSTA Harold E. Holt. 1RSU remotely operates the radar in collaboration with US AFSPC to track space assets and debris. Full Operational Capability is planned to be achieved by late 2016.

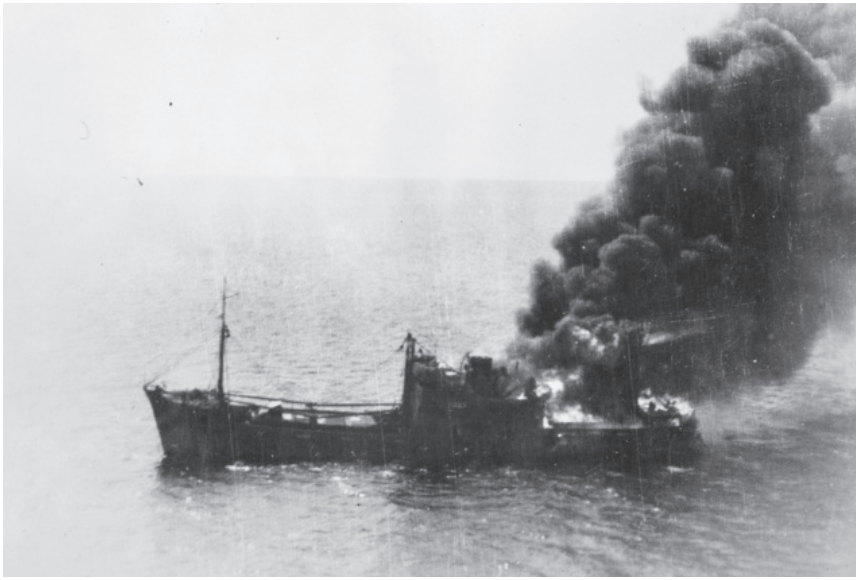
1RSU Space-Based Infra Red System (SBIRS) a US AFSPC deployed constellation of Earth observation satellites that provides global coverage for the detection of ballistic missile launch and activities that could impact battlespace awareness. 1RSU has operator access to this system for Australia's surveillance and situational awareness needs, in collaboration with US AFSPC.

Learmonth Solar Observatory (LSO) is a facility jointly operated by the Bureau of Meteorology, Defence Science and Technology Group, and US Air Force. LSO is part of the US-established world-wide network for monitoring and analysing solar activity that support space and terrestrial weather monitoring and predictions.

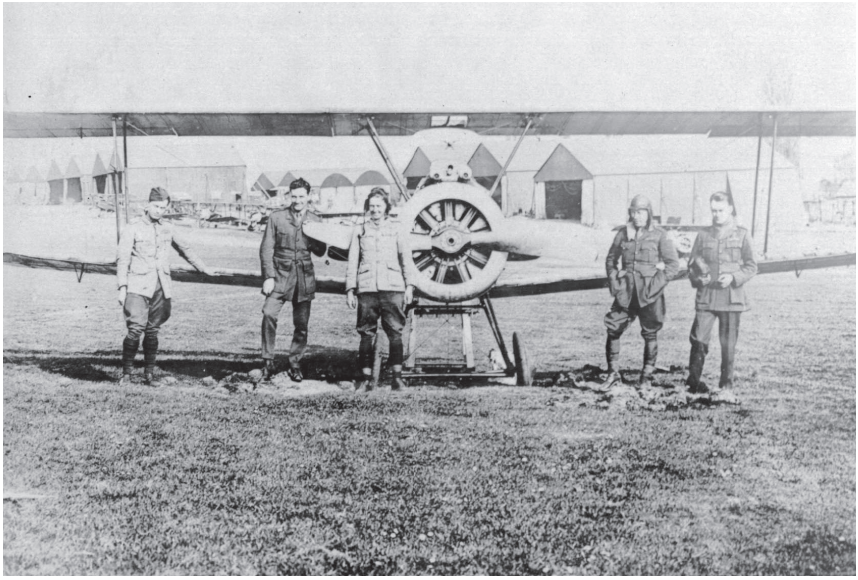
Falcon Telescope Network (FTN) a global network of small aperture optical telescopes developed by the US Air Force Academy in collaboration with international educational partners, including UNSW

Canberra, for the purpose of supporting undergraduate research, education, and community outreach programs.

Space-based systems are an integral part of the overall ADF combat capability. ADF warfighting effectiveness depends on having assured access to space-based and/or space-enabled capabilities. This dependence will continue to increase, particularly with the emphasis shifting to networked operations. The 5th generation Air Force will be critically dependent on space-enabled network connectivity that will extend the reach of air power across the battlespace. Air Force SSA is vital to assure ADF access to space.



Japanese vessel under attackduring the Battle of the Bismarck Sea.
(Pathfinder #256)



Sopwith Camel of No 4 Squadron in France during World War II.
(Pathfinder #261)

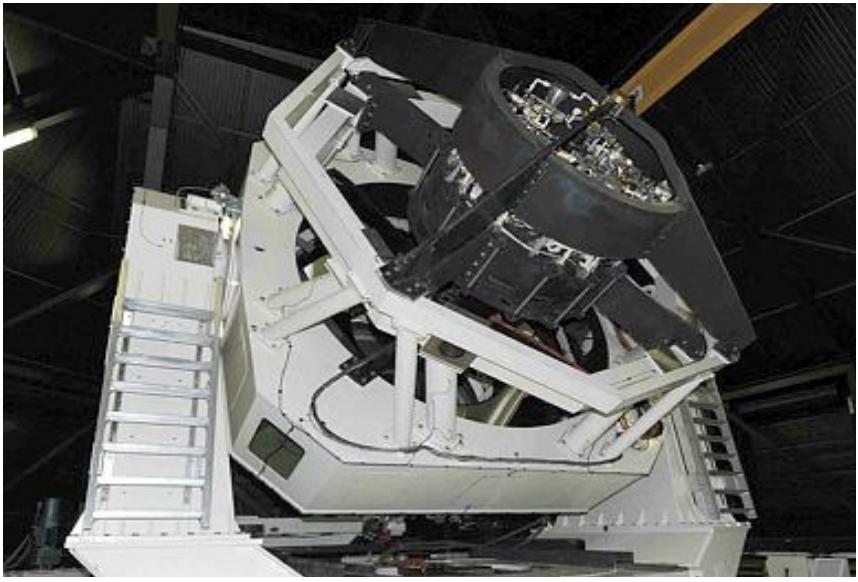
Air movements staff load humanitarian aid onto a C-17A Globemaster III for Operation NARGIS ASSIST.
(Pathfinder #258)

The Star Safire camera fitted to the AP-3C Orion undergoing inspection. The capable and versatile camera is an important component of the Orion's overland ISR capability.
(Pathfinder #275)

First air-to-air refuelling trials between a RAAF KC-30A Multi Role Tanker Transport and a RAAF C-17A Globemaster III on 27 April 2016.
(Pathfinder #264)

Afghan and Australian soldiers board a Mi-17 helicopter for a special operations mission in Afghanistan.
(Pathfinder #277)

A Bombardier CL327 Guardian MTUAS.
(Pathfinder #280)



1RSU Optical Space Surveillance Telescope (SST) will commence operation in about 2020.
(Pathfinder #273)

Future

5th-Generation Air Force (#264)

Until recently, Air Force has not spoken of itself in generational terms. However, with the imminent introduction to service of the 5th-generation combat aircraft, the F-35A Lighting II, the terms '5th generation–enabled' and more generic '5th-generation' Air Force have begun to appear in common use. What is meant by these terms?

Key Points

- *Air Force has evolved through a series of technology-driven step changes in capability.*
- *The 5th-generation Air Force will deliver a new level of capability through the ability to produce a synthesised appreciation of the battlespace, networked among more capable sensors and platforms.*
- *With its 5th-generation capabilities, Air Force will be a critical contributor to, and enabler of, the joint force.*

The development of combat aircraft is well documented and is currently described as five generations of capability evolution since the advent of the jet fighter towards the end of World War II (see *Pathfinder No 170* for a full explanation of generations of combat aircraft). As an example of a 5th-generation asset, the F-35's immediately recognisable '5th-gen' feature is its physical design for radar signature management, or 'stealth'. It is readily apparent by simply looking at the latest combat aircraft that their shapes are part of their ability to avoid detection, to permit them to penetrate and operate in hostile environments. However, just as important is what lies under the skin.

Fifth-generation aircraft, certainly the Western examples, feature a degree of on- and off-board data, sensor, weapon and communication fusion not possible in earlier combat aircraft. This inherent capability provides the crew with synthesised and coherent awareness of the combat environment. In contrast, earlier generations featured multiple displays and information inputs which the crew had to fuse in their head, called 'building situational awareness'. It is fair to say that in 3rd- and 4th-generation aircraft, the volume of data to be fused by the crew presented a major

challenge, particularly in single-seat aircraft. It made the aircraft difficult and demanding to operate, pushed the limits of human cognition, and in demanding environments, increased mission risk. To help alleviate the problem, some aircraft were multi-crewed to provide the capacity to interpret, fuse and exploit the information presented to them. Otherwise, the problem was addressed by selecting and training truly superior aircrew, but people with the right combination of skill and temperament are quite rare.

Until the arrival of 5th-generation aircraft, military response options were based on a combination of discrete role-specific systems (e.g. specialist platforms, skilled people, semi-autonomous data processing and information exchange systems), with their separate outputs combined to support the achievement of a common task. As a result, the battlespace was occupied by a variety of platforms, each with its own unique, often self-contained, interpretation of that battlespace.

Advances in networking the battlespace through the ongoing development and deployment of datalinks means information synthesised in one platform can be shared between systems to increase the awareness of those other systems operating in the battlespace: other fighters, aircraft conducting other missions, command and control agencies, and land and naval assets. Similarly, several platforms may contribute information via datalink to build the synthesised view.

These two attributes—a readily available, synthesised appreciation of the battlespace and the ability to share or build it with others—are the key characteristics of the 5th generation. Taken to the force level, one can begin to see a 5th generation–Air Force emerge, one where these attributes permeate the battlespace.

With the F-35 as a trigger, Air Force is on the verge of becoming a 5th-generation, or in other words, a comprehensively networked force—a force with the advantages embodied in its 5th-generation combat aircraft being shared across the battlespace. Other systems may not themselves embody all the 5th-generation attributes, however, their ability to contribute to and share a common view of the battlespace, and pass it to others, make them worthy of inclusion in a 5th-generation force. So, while a KC-30 aerial refueller may not be stealthy, its ability to know how far it can safely move forward in support of combat aircraft, informed by its access to a common and accurate picture of the battlespace, makes it an enhanced element of the force. Similarly, it can

relay the picture it accesses for other assets to make their own decisions concerning their contribution to the fight. Those other platforms need not be air assets. Land and naval forces, suitably equipped, will also be recipients of and share in a common appreciation of the battlespace. Air Force is actively preparing for this imminent future.

Through its program of experiments and demonstrations, Plan *Jericho* is already beginning to show what might be possible. Sensor video of an area of interest has been streamed live from a UAV into the cargo compartment of a C-17, enabling commanders *en route* to a situation, be it a combat or humanitarian assistance/disaster relief scenario, to develop an operational plan—before arriving at the scene. The current problem of incompatibility between legacy datalinks, which have often evolved to solve a particular mission set in the battlespace, has been shown to be solvable. An airborne gateway has demonstrated the ability for the incompatible protocols of datalinks used by Super Hornets, ARH Tigers and ground forces to be overcome by providing an 'airborne translator'.

The capabilities Air Force has deployed on Operation *Okra*—Hornets, Wedgetail and KC-30—are evolving and implementing innovative new methods of operation while undertaking combat and combat support tasking. While technically not 5th-generation platforms individually, their evolving modes of operation exhibit the characteristics of a 5th-generation force. Their operationally derived lessons learned will prepare Air Force for the transformation that the arrival of the F-35A will enable.

The 5th-generation Air Force is being designed to better connect, among its own systems and with the rest of Defence, to assure military advantages to the joint force over potential adversaries. The introduction and integration of the F-35A will mark the arrival of a 5th-generation Air Force—one that will provide new levels of potency, agility, and capability advantage. It will ensure Air Force collects the right information for timely use by the right people. It will contribute to ensuring Air Force maintains decision superiority into the future.

Air Power and the Main Battle Tank (#268)

Key Points

- *The joint force concept enables the selection of capabilities from the air, land and maritime domains, which complement each other to provide effects optimised for the mission.*
- *Air power's strengths are well suited to the Australian environment, but its acknowledged weaknesses require that it be applied in concert with capabilities which overcome them.*
- *Air power's impermanence over the contested land battlespace can be effectively overcome by the employment of the tank.*

The 5th-generation Air Force will be capable, agile and potent, both in its own right and, more importantly, as part of the future integrated joint force. A capable and effective joint force, based on the optimum combination of ADF capabilities, will be critical to providing Government with its best possible military options. This is not to suggest that all the Services will always contribute to every mission. Maritime, land and air power each have their own characteristics that influence how well-suited they are to particular scenarios. This means that despite the critical importance of air power to modern military operations, there will remain tasks that are better undertaken by forces operating in the land and maritime domains.

Air Force doctrine articulates the characteristics of air power, with an emphasis on its strengths. *Speed* and *reach* are two of these characteristics that serve Australia particularly well given the isolation and vastness of our country. Be it in response to threats to Australian sovereignty, or to project force into the region in support of military or humanitarian objectives, speed and reach are of enduring value to the ADF and the nation.

However, as a mature and self-critical organisation, Air Force also acknowledges in its doctrine, the limits of air power's effectiveness.

Impermanence is a stated characteristic of air power that acknowledges the effects delivered from the air tend to have limited persistence in the battlespace. Despite the force multiplying effects of air-to-air refuelling, an inhabited airborne platform has a finite endurance based on the limitations of its human crew. While uninhabited platforms and systems might be able to overcome human frailty, they still share the other limitations of inhabited platforms such as weapons depletion, technical servicing requirements and weather constraints. As some missions and tasks require an ongoing presence on the battlefield, they do not lend themselves easily to a quick solution. Any or all of these limitations can prevent the application of air power at the appropriate time and for the necessary duration to achieve the desired military effect.

The lack of a clear-sighted, impartial and critical appreciation of both the strengths and weaknesses of air power, as well as those of maritime and land power, can lead to potentially flawed views in regards to force design and the conduct of military operations. Perhaps there is no better example of the need for air power professionals to be objective in their thinking than in the case of the main battle tank[1].

Some air power proponents are quick to dismiss the tank as an anachronism on the basis of its perceived inferiority to air power in delivering firepower effects, its vulnerability to modern weapons and its lack of mobility. However, these arguments focus on only one function of the tank, exaggerating the tank's vulnerabilities while glossing over those of air power. This effectively promotes a perception of an ADF capability 'system' that it lacks flexibility and resilience. Accordingly, a brief review of these arguments is warranted.

Whenever Australia is compelled or chooses to commit troops to ground operations, from peacekeeping to high-end conflict, the tank provides the option of an essential mix of direct firepower, armoured protection, mobility and C4. Air power is undeniably critical to the overall success of military operations but it will not always be able to provide the level of *intimate support* essential to the successful conduct of close combat. While air power can destroy targets, it cannot

1. This article focuses on the 'main battle tank' ('tank' for short) rather than the broader category of 'armour', which comprises 'tanks', 'infantry fighting vehicles' and other armoured vehicles.

replicate the tank's enduring presence on the battlefield nor provide soldiers with a physical shield. In terms of this shielding function, the tank can build on its basic armoured protection by adding advanced sensor and communications systems, electronic countermeasures and counter-rocket and counter-missile suites. Accordingly, claims of the tank's vulnerability, particularly in operating outside of flat and open terrain, are frequently exaggerated—as are claims about the vehicle's lack of mobility.

The size and weight of the modern main battle tank belie its tactical mobility. While the Australian Abrams M1 weighs around 63 tonnes, it exerts a ground pressure through its tracks of around half of that of an average passenger car and is capable of on-road speeds of 65 kph and cross-country speeds of around 50 kph. Furthermore, its powerful gas turbine engine provides a very high power-to-weight ratio that makes the tank equally capable of pushing through buildings or thick vegetation. Arguments that tanks are unsuited to, and unemployable in, our region are disproved by the widespread use of tanks by the United States Army and Marine Corps, as well as the Australian Army, in the Pacific Campaign of World War II. There, they proved critical in overcoming fortified and fanatical Japanese defenders. In terms of strategic mobility, both the RAAF C-17 and RAN Landing Helicopter Dock are capable of transporting the M1.

The preceding discussion is not meant to suggest that tanks do not suffer their own limitations—Army doctrine highlights, for example, the logistical challenges of sustaining tanks in the field. However, the discussion does support the need for the ADF to be a balanced joint force and undermines arguments that air power can replace the tank. Such claims are akin to arguing that a surface-to-air missile could replace a fighter aircraft—at best, the missile might replace *some* aircraft functions in *some* circumstances. Naval, land and air forces provide complementary effects for the joint force and, when operated together, provide flexible and robust military capabilities. For example, the F-35 will possess devastating firepower and unparalleled sensor capabilities but this will be cold comfort to an infantry platoon in close contact with the enemy if the aircraft has higher priority tasking, has depleted its weapons or cannot get airborne because of a thunderstorm. There is significant risk in putting all our 'force protection eggs' in one basket.

Joint operations combining air power and armour are not new; they date to the infancy of both military aircraft and tanks during World War I. The Australian General Sir John Monash was one of the most accomplished early proponents of joint warfare. He later commented that at the Battle of Hamel in July 1918, to 'prevent the noise of the tank engines being overheard when they were moving forward to reach the starting line, RE8 observation aircraft from No. 3 Squadron Australian Flying Corps (AFC) were directed to fly up and down the entire Army front when the armour was running.'[2] Monash also tasked aircraft to strafe enemy troops and guns and to airdrop ammunition to the advancing Australian troops.

In conclusion, there is little doubt that air power is and will remain instrumental in ensuring Australia's security. However, as effective as it is, air power has its limitations and air power professionals have an obligation to acknowledge and understand them. Doing so will allow the ADF to be a genuinely joint force that is able to exploit the strengths of its constituent parts while mitigating their weaknesses. Viewed through this prism, the main battle tank has a clear and important place in the ADF's order of battle.

2 Lieutenant General Sir John Monash, *The Australian Victories in France 1918*, first published 1920, reprinted Naval & Military Press, Sussex, UK, 2013.

The Australian Response to Potential Space Warfare (#272)

Key Points

- *Australian society and the ADF are now critically reliant on space.*
- *Over-reliance on space is a significant vulnerability.*
- *The ADF is taking measures to assure its access to space.*

Advances in space technology have precipitated radical changes to how modern societies function in all areas, from the commercial to the military. The combination of perspective, persistence and freedom of operation provided by the space domain cannot be bestowed to the same degree by the land, sea and air domains. Nations that can exploit space are able to maintain a significant advantage over those less able to do so.

Space capabilities provide advantages not only for military operations but for many aspects of civil and commercial life as well, regardless of a country's ownership of indigenous space-based capabilities. Space pervades modern Australian life: credit card, automatic teller machine and stock market transactions; precision farming; natural resource management; search and rescue; and disaster response are reliant on the continuous and dependable availability of space capabilities. Space is now fundamental to the way of life of all Australians.

Western military forces are so highly dependent on space to conduct even relatively basic functions in the other domains that space has become a potential vulnerability for them. Removing access to space capabilities would seriously degrade the ability of modern land, sea and air forces to conduct effective operations. Consequently, an adversary is likely to regard space capabilities as priority targets because neutralising them would not only remove important space-based capabilities but significantly reduce the effectiveness of capabilities in the other domains as well.

The United Nations Outer Space Treaty provides the framework for international space law, however it does not clearly ban the pursuit of warfare in space. While international law might superficially appear

to have so far prevented warfare extending to space, the real reason is probably far more basic in that most states have not yet developed the necessary capability to do so. Certainly, the 2016 Defence White Paper highlights that international law is unlikely on its own to prevent warfare in space.

The United States and its allies still seek to maintain a technological edge in space, both directly through stand-alone space capabilities and indirectly by using space to leverage advantages in the other domains. However, excessive reliance on vulnerable space systems could be viewed as a critical point of weakness. Indeed, many observers believe the United States military's space architecture is its Achilles' heel.

The development of anti-satellite (ASAT) technologies is one more step towards warfare in space. China and the US have both demonstrated direct ascent ASAT capabilities by destroying one of their own satellites in 2007 and 2008 respectively. Co-orbital ASAT technology is also being developed that would allow a satellite to be manoeuvred to within close range of a target satellite such that the target could be impaired or destroyed. Attacks by co-orbital ASATs would be difficult to attribute to deliberate action and could be plausibly denied by an attacker. For an adversary, the combination of Western dependence on space and the potential to attack anonymously could make the United States space architecture a particularly tempting target.

Yet, if warfare in space would have serious consequences for modern militaries, the consequences for Western societies could be far worse, given the lack of viable alternate options. The targeting of dual-use military/civilian satellites combined with the potentially indiscriminate secondary effects of kinetic ASAT weapons that significantly increase the space debris population means civilian platforms are also likely to be damaged, deliberately or collaterally. Maintaining assured access to space is vital to Australia, and Australia's commitment to a rules-based global order extends to space. It encourages the responsible use of space through the creation of international transparency and confidence-building measures, including the development of guidelines that help establish norms of international behaviour.

Australia is investing substantial resources in the improvement of space situational awareness (SSA). Phase One of Joint Project 3029

has relocated a United States–owned, C-band space surveillance radar to North West Cape in Western Australia. Phase Two of this project will relocate an advanced, United States space surveillance telescope to the same area. These sensors will be jointly funded and provide Space Surveillance Network coverage across a geographic region that is becoming increasingly active for space launches and the operation of geostationary satellites.

The next project in the programme will seek to provide a SSA Mission System that will also allow the development of Australian expertise in orbital analysis and collision prediction. Later projects will seek to develop space surveillance sensors in Australia and promote Australian capabilities that increase the resilience of its space systems. Ultimately, Australia might consider the acquisition of indigenous satellites.

Australia has had an extremely productive bilateral space engagement with the United States since the 1970s. This arrangement has been furthered with the signing of a Combined Space Operations (CSpO) initiative memorandum of understanding with its Five-Eyes partners (US, UK, Canada and New Zealand). The CSpO initiative seeks to enhance the resilience of space operations, and share the burden of conducting them. The CSpO partners also collectively promote the responsible use of space through co-ordinated diplomacy. Yet there is no certainty that warfare in space will be avoided and so Australia is seeking to increase the resilience of its space capabilities.

The 2016 Defence White Paper is funding the exploration of a range of areas where Australia, in conjunction with its allies, could invest in making the space architecture more robust. Examples are technologies that provide an increased level of protection to jamming, including advanced protected satellite communications and more resilient global positioning system receivers. Australia is also supportive of allied efforts to disaggregate the space segment by spreading space-based systems over a greater number of satellites. Further, Australia is interested in cooperating with allies to investigate how to reconstitute damaged or destroyed space-based systems through the use of fast-turnaround launch systems and relatively inexpensive, short-life microsatellites to temporarily fill gaps in capability.

The ADF is also preparing for operations in a congested, degraded and operationally-limited environment. This includes investigating the

use of alternative technologies, such as advanced high-frequency radio systems and terrestrial navigation and timing systems that can provide the ADF with the ability to fight on and win in the event the space architecture does fail. Additionally, the ADF has begun to train to fight in a space-denied or -degraded environment.

The ADF's space capabilities are becoming increasingly vulnerable. While protecting the assets is still not guaranteed, the threats have been recognised and measures are being instituted to counter them.

Fifth-Generation Command and Control (#278)

Key Points

- *Effective employment of the F-35 will require the development of new concepts for C2 and ISR.*
- *New concepts of C2 and ISR will need real-time collaboration and robust and redundant ICT as well as adequate professional mastery in the force.*
- *New concepts of C2 and ISR could be based on the need to employ the idea of 'distributed control' which will enhance operational agility.*

When the Air Force, the Royal Netherlands Air Force (RNLAF) and several allied nations introduce the F-35 into service, it will bring new capabilities such as stealth and advanced sensor-fusion. This will require the development of new concepts for command and control (C2), and intelligence, surveillance and reconnaissance (ISR) to use the F-35 to its full potential.

The F-35 will present the operator with an unprecedented level of situational awareness (SA) through its inherent ISR capability. The enhanced SA will assist the exercise of C2 at the tactical level. This SA could also be extended across the force at tactical, operational and even strategic levels. This enhanced force-wide SA will enable commanders and operators to respond to emerging threats and opportunities rapidly, thereby controlling operational tempo and enhancing agility. Enhanced agility also requires decentralised execution down to the tactical level, ensuring that actions are aligned with operational and strategic objectives. An inherent level of trust is necessary to achieve this.

Developing and applying new concepts for C2 and ISR require an integrated approach developed through professional mastery. Since these new concepts will have to be employed at all levels of operations, it is important that Air Force personnel gain and maintain not only tactical proficiency but also operational level understanding and strategic level awareness.

The new concept that is being suggested is that of 'distributed control' as opposed to the current C2 tenet of centralised (command and) control, decentralised execution. This could be considered a new concept, as it facilitates the empowerment of subordinate units. Two essential enablers of this concept are collaboration, and information and communication technology (ICT). Without the means for units and operators to collaborate in near real-time, it will be hard, if not impossible, to effectively employ the concept of distributed control. In turn, near real-time collaboration needs support by robust and redundant ICT, especially if the new concept of C2 and ISR is being employed in a contested environment.

The above concept can be moulded into a framework for 5th-generation C2 and ISR that will assist both the RAAF and RNLAF to employ the F-35 to its full 5th-generation potential and ultimately enhance operational agility.

In addition to the introduction of the F-35, the following trends are also driving a major rethink of command and control of air operations:

- the emergence of long range and very fast missile threats,
- the ever-increasing demand for bandwidth to support military operations and the parallel development of increasingly sophisticated means to disrupt and/or deny access to that bandwidth, and
- the proliferation of sensor systems and the consequential need to analyse and make sense of huge volumes of data—the 'big data' problem.

These are but three of a larger number of challenges that are likely to confront commanders and operators in the next few decades. As much as the F-35, they are hallmarks of the information age.

In order to understand this new age, it is necessary to ask, 'what has changed?' At its most basic, it could be argued 'not much.' John Boyd's famous OODA loop—observe, orient, decide, act—is as relevant today as it was when first conceived. It is an elegant model which transcends the technology of the day because it describes an essentially human process that can be applied to every human activity.

Chief Information Officer Group's *Networked Warfare Reference Architecture* depicts the process succinctly, as shown. In a warfighting context, the observe phase is essentially a machine process, where sensor data is correlated and fused by machines in accordance

with complex algorithms. This sensor data is then 'oriented' or contextualised through a complex process involving both machine and human cognitive functions. Machines may, for example, perform pattern matching by comparing the newly acquired sensor data with historical reference data. For example, in an air surveillance scenario, a new air track might be compared with thousands of historical air tracks on the basis of its three dimensional position, heading, vertical and horizontal speed to refine its status. Simultaneously, a human operator may receive specific intelligence information about that same track, facilitating even greater refinement of its status. The challenge at this point is to present the amalgamation of all that is known about an entity—be that real-time sensor data or an intelligence snippet several hours old—to the decision-maker in such a way as to maximise his/her situational awareness to beyond that of their adversary.

In the information age, the 'decide' stage of the OODA loop is shaping up as the real battleground where the battle, campaign or war will be won or lost. To prevail on the contemporary battlefield, one must attain decision superiority, which means making better decisions than the adversary; better in terms of both their relative quality and speed. The ability to make relatively faster decisions is of the essence.

The *Networked Warfare Reference Architecture* describes decision superiority as requiring both an information and a cognitive advantage. In other words, it needs sufficient quantity of timely, accurate and relevant information to minimise situational uncertainty and it also needs decision-makers with the cognitive capacity and agility to exploit this advantage to deliver 'better' decisions than the adversary.

This then is the goal of the Air Force's Future C2 Study which is being undertaken in cooperation with MITRE Corporation. The study is a review of Air Force's C2 structure and processes to ensure that they afford the force of 2025 the best chance of attaining and retaining decision superiority. The study forms part of Plan *Jericho*'s *Program of Works*, and will develop and test different C2 approaches with a view to recommending one or more C2 models for the future force. Interoperability with the other Services and with Australia's allies will remain a fundamental requirement of any proposed model. Models will be differentiated by the extent to which they delegate decision-making authority forward and by their reliance or otherwise on reach-back to higher authorities.

The very fact that Air Force is investing in a Future C2 Study acknowledges the central role effective C2 will play in exploiting the full potential of the future force. Innovative thinking on how best to achieve this will be the next challenge.

Integrating Airborne Electronic Attack into the Australian Defence Force (#285)

Key Points

- *Growler is now part of the RAAF inventory with IOC scheduled for July 2018.*
- *As the only operator of the EA-18G outside of the US Navy, Australia is now able to deliver a force-level EW capability to influence the electromagnetic spectrum.*
- *The Growler capability requires change throughout Defence in training and EW command and control systems.*

At 1332 Pacific Standard Time on 24 January 2017, two EA-18G Growlers of No 6 Squadron RAAF roared into the air from Naval Air Station Whidbey Island. These first flights marked the Growler Airborne Electronic Attack (AEA) transition from acquisition to in-service. The RAAF has become the only operator of Growler outside of the United States Navy, the result of a dedicated, collaborative effort from both sides of the Pacific. The exceptional level of integration between the two services was showcased during the Australian International Air Show in March 2017 with the US Commander Electronic Attack Wing Pacific flying on board one of the RAAF Growlers.

The initial cadre of Australian aircrew commenced training with the US Navy in 2013. They flew in various operational and instructional roles embedded within US Navy squadrons to maximise experience. The aircrew transitioned back from this secondment at the same time as No 6 Squadron's switch from being a Super Hornet squadron to a Growler squadron in December 2016. The squadron, however, will continue to operate from Whidbey Island until June 2017. The US basing is required to complete acceptance of all twelve Growlers and to conduct initial operational test and evaluation. The test activities will conclude with a deployment to Naval Air Weapons Station China Lake for advanced electronic warfare and weapons testing. Once back in Australia, the focus will be on integrating the Growler capability into Air Force and

the wider Defence. This level of electronic attack and electronic warfare capability will, as Admiral Greenert observed, be a transformational activity to the way the ADF conducts training and operations.

From purely a platform perspective, Growler is ready to be unleashed. The aircraft is 90 per cent common with the F/A-18F model, demanding expansion, but not wholesale change to support services. Despite the airframe similarities, the unique electronic attack role provides several challenges for Air Force. The Growler is not a fighter aircraft and although the aircrew require similar core skills, No 6 Squadron will not operate in any way like an existing fighter unit. Instead, concurrent, small deployments in support of the joint force will be the norm. Growler is also not a traditional intelligence, surveillance and reconnaissance (ISR) platform; it delivers the capability to influence the electromagnetic spectrum rather than just monitor it. Successfully integrating this capability into the ADF will be the challenge for declaring Initial Operating Capability (IOC) in July 2018.

Some elements of the capability will require significant change and introduction of the support base. Training Growler aircrew for current and future threats is a case in point. The electronic attack project includes resources to introduce force-level electronic warfare training at Delamere Air Weapons Range This will be delivered in the form of the Mobile Threat Training Emitter System; emitters designed to provide electronic warfare training for other ADF aircraft as well as targets for Growler. The infrastructure, security procedures and information flow at Delamere is shaping future RAAF range management. Delamere is providing the 'live' starting point for the Air Warfare Centre's endeavour to deliver a robust live, virtual and constructive (LVC) training environment. The training complexity in high-threat scenarios and the integrated nature of mission sets steer Growler toward this future of this level of simulation and training. Additionally, a distributed mission training system is required to ensure the electronic attack capability becomes a normal part of exercises and operations. It is to ensure Australian forces achieve their objectives in the congested and increasingly contested electromagnetic spectrum.

Like the F-35, the EA-18G is the sharp end of allied intelligence and operational data and analysis. It fuses this intelligence with data from on-board sensors and other capabilities in order to provide enhanced understanding of the battlespace, which in turn, enhances

the capabilities of the joint force. The wider Australian intelligence community is key to the production and management of this intelligence data. Significant success has already been achieved through the commitment and support between Australian agencies and the US Navy in particular, but a lot of work remains for Defence and industry to develop the systems and architecture required to counter complex future threats. The Growler project is already contributing a number of personnel to intelligence agencies in order to drive production of the data that is required.

Growler is the first 'cab off the rank' of several major systems coming for the ADF that will operate in and affect the electromagnetic spectrum. EA-18G is therefore both the champion and test case for groundbreaking reform across the operational level of command. Growler is a true joint force capability, with the ability to both support and affect activities across the spectrum of operations. Growler will require an unprecedented level of integration into operational planning and execution across the joint force. Integration will require the use of innovative new planning and execution tools to support revised operational processes. Industry will have a significant role to play in helping to define and develop these integration tools. The Growler project is at the vanguard of significant change to define new requirements, mission planning tools and processes, particularly those of joint electromagnetic spectrum operations. This year the Growler project is providing establishment to the Air Operations Centre in order to create and develop the Air Force Electromagnetic Spectrum Operations Cell; force-level electronic warfare is about to be realised as a new capability.

Growler is a catalyst for change in force training and electronic warfare command and control throughout the ADF. The transformation will extend well into the next decade as the airborne electronic attack capability matures and fighting in the electromagnetic spectrum becomes part and parcel of normal operations. The challenge for Air Force will be to ensure that when Growler strikes, it will do so as a controlled, coordinated and precise effect in the battlespace.

Operational Art in the 5th-Generation Era (#286)

Key Points

- *Fifth-generation air warfare comprises a network, a combat cloud operational concept, a multi-domain focus and a fusion warfare construct.*
- *Fifth-generation air warfare requires moving data around 'system of systems' networks.*
- *Symmetrical 5th-generation, air-warfare, battle-network conflicts might be fast-paced and progressively accelerate.*

In the late 1990s, military thinkers realised that commercial information technology developments could lead to a new type of warfare built on digital computer networks. These ideas have progressively evolved into the 5th-generation air warfare concept that now comprises the following four major parts.

1. **Networks**. In a conceptual sense, four interconnected and interdependent virtual grids—information, sensing, effects and command—overlay the operational theatre. The various force elements, from individuals and single platforms to battle groups, are then interacting nodes on the grids. Each node can receive, act on, or pass forward data provided from the various grids as appropriate.
2. **Combat Cloud**. In working together, the grids can form a virtual combat cloud that the various nodes can pull data from, and add data to, as necessary. This brings several tactical benefits including considerably improving situational awareness, making long-range engagements more practical, ensuring no single node is critical to mission success, allowing each node to designate targets to other nodes and ensuring the best use is made of the different diverse capabilities offered by each node.
3. **Multi-Domain Battle**. There are five operational domains: land, sea, air, space and cyber. The key idea animating multi-domain battle is cross-domain synergy—the use of armed force across two or more domains to achieve an operational advantage. Acting

in a complementary manner, rather than an additive one, each capability enhances the effectiveness of the whole while lessening the individual vulnerabilities of each platform. Linking across domains means that the integrated force overall can be self-healing in that destruction of any single node may be able to be compensated for by another node in a different domain.

4. **Fusion warfare**. The fusion warfare concept seeks to address command and control concerns arising from the increasing volume and speed of information flows, software incompatibilities and intrinsic vulnerabilities to attack and deception.

Fifth-generation air warfare offers much but its practical implementation is not easy. Considerable effort is required to create decision-quality data and then establish the robust network connectivity needed to support combat cloud, multi-domain battle and fusion warfare concepts. Fifth-generation air warfare is a very complicated way of war that requires substantial focused preparation being undertaken before a conflict, and significant dedicated support during it. Success in 5th-generation air warfare is hard won.

There are two in-built vulnerabilities given the information technology foundation of 5th-generation air warfare. Digital systems are inherently susceptible to cyber intrusions that may steal data, delete data, change data or insert false data that can quickly spread across the network. While cyber-security techniques are steadily improving, so are cyber intrusion methods; this interplay between offence or defence continues overtime with neither being dominant long-term. Moreover, 5th-generation air warfare relies on datalinks that need to transmit to send information and sometimes to receive it. Emitters are inherently vulnerable to detection, meaning that network participants can be located and tracked—and thereby targeted by precision-guided weapons. Some datalinks are harder to detect than others; however just like in cyber, technology continually improves. Again, this interplay looks set to continue indefinitely into the future. Cyber security and datalink emission tracking will remain concerning issues for the operational life of 5th-generation air warfare. They may be its Achilles heel.

Fifth-generation air warfare capabilities principally exist for the purpose of fighting wars. In this, such capabilities are generally seen as most appropriate to high-technology wars which, in the modern

era, means wars involving advanced information technology. Such a conflict would then probably be a symmetrical one where a friendly battle network grappled with an adversary battle network, with both sides searching to determine which nodes on which grids are the best ones to attack to defeat the other battle network. Battle network wars would be fast paced but given the complicated nature of 5th-generation air-warfare capabilities keeping up would be problematic. Asymmetric hybrid/proxy wars, being slower-paced, would ease the difficulties associated with carefully choreographing cross-domain synergy; albeit these types of wars introduce other difficulties, some of which favour the adversary. Achieving success in either kinds of war would make real demands on 5th-generation air warfare capabilities and the air forces that employed them

Major power thinking is divergent on warfare across domains. Much of western thinking has been driven in an environment of discretionary wars not of national survival. Some major power thinking, including Chinese and Russian, seem to take a more expansive view of many of the underlying ideas behind 5th-generation air warfare. The 5th-generation idea implicitly suggests conflict being constrained to a well-defined battlespace but Chinese and Russian thinkers demur. No part of an adversary's territory or any of the various national 'systems' of politics, economics, law and public opinion are considered off-limits. Both hold that 'informationised warfare' can achieve success at low cost in blood or treasure.

Chinese and Russian 5th-generation warfare thinking is also alike in that neither focus on the effects grid's nodes. They both seek to avoid force-on-force, high-attrition wars. Chinese thinkers suggest focusing their efforts on attacking key sensing and information grid nodes with Russian thinkers stressing assaulting the command grid—for them people's minds are the real battlefield. In this, Chinese concepts favour using mainly military means to inflict multi-domain kinetic and non-kinetic damage. In contrast, Russian conceptions stress the cross-domain use of non-military means in preference to military means, with a 4:1 ratio suggested. Chinese battle network ideas accordingly imply fighting symmetrical wars whereas Russian ideas are very heavily oriented towards asymmetrical approaches. Asymmetry is, by its nature, attempting to bypass a competitor's or opponent's advantage. The concern is that in a multi-polar and inter-connected world, warfare

across domains may create a significant and unintended collateral effect, potentially against a third party. It may also, by disrupting a nation state's function, unintentionally cross a 'red-line' of national security or survival.

The 5th-generation air warfare concept is a complicated one. Implementing this concept, turning it into an on-call warfighting capability, seems a truly daunting prospect, even if it accords with the zeitgeist—the spirit of the time—of our information age. Becoming a 5th-generation air force involves a substantial long-term technological and intellectual investment much greater than simply acquiring new platforms. It indeed requires an air force to completely transform itself.

History

Mental Health and Personnel Management (#263)

Since 2001, the ADF has increasingly focused on the diagnosis, treatment and mitigation of mental health issues associated with operational service. With the likelihood that ADF personnel will be exposed to challenging environments, combined with an increase in the reported number of mental health issues being suffered by ADF personnel, there is widespread appreciation of the enduring need for a whole-of-government response to mental health problems being experienced by ADF members.

The current ADF approach is in marked contrast to the policies and treatment of personnel in past conflicts. During World Wars I and II, 'shell shock' and 'battle fatigue' became commonplace terms to label a condition many veterans suffered as a result of active service. Poorly understood, and at times not widely accepted as a legitimate medical condition, there was a gradually growing appreciation that the experience of combat operations could have serious consequences to mental health. What was not fully appreciated was why some members might be more susceptible than others with similar experiences, the cumulative effects of repeated exposure to traumatic or stressful events and how time may not be a healer, but a period of incubation for more debilitating symptoms.

Key Points

- *Mental health issues as a result of operational service are not new, but the means to identify and treat members has developed into a more meaningful capability.*
- *To remain relevant, air forces should evolve and change. This is not limited to how technology is employed, but the policies and practices of how its members are employed and supported.*
- *For more information regarding mental health in the ADF go to: http://drnet.defence.gov.au/VCDF/ADFHealthWellbeing*

In the case of Bomber Command during World War II, the limited understanding of mental health issues gave rise to what would be considered today as less-than-sympathetic policies and personnel management practices. The term 'lack of moral fibre' began to be applied to personnel who were unable to perform their duty to a standard expected by their chain of command. This problem was at times further exacerbated by the demands of war and an expectation that the threat to national security took precedence over all other considerations, especially the needs of the individual.

The experience of RAAF personnel serving in the RAF's Bomber Command of the management of mental health problems was not atypical. The high casualty rates and long, stressful missions typical of bomber operations coupled to produce an intense environment likely to cause any number of mental health issues. While policies on how to treat and manage these members progressively developed during the war, there was not a sufficient appreciation within the medical community and among the commanders on the bases of the nature of mental health problems which might have ensured a more sympathetic approach to many members.

The case of a RAAF navigator, FSGT Peter Hudson, in 1945 highlights the complex nature of mental health issues. Hudson's case also illustrated how administrative policy as well as medical practices must be aligned to ensure the interests of the service and the affected member are looked after.

Hudson initially joined the Australian Army in 1940 and served as a combat engineer with the 2/5th Field Company through the Western Desert and later the Kokoda Track campaigns. In 1943, Hudson transferred to the RAAF as aircrew and was trained as a navigator. As was typical of the period, Hudson was posted to the RAF as part of the Empire Air Training Scheme for service with a RAF squadron. On arrival in the United Kingdom, he underwent operational conversion training on heavy bombers and was part of a crew almost at the point of being sent on operations over Germany in late 1944 when he reported problems to his commanding officer.

In essence, Hudson began suffering extreme anxiety each time he flew to the point he felt unable to function while in the air. As bomber crews only included one navigator, Hudson was certain he was placing the safety of his crewmates in jeopardy by his inability to control his

anxiety and to function effectively. Initially, the response from Hudson's chain of command was sympathetic and a course of medical treatment and rest was pursued. However after Hudson felt that it made no difference to his condition, he requested that he be removed from flying duties. It was at this point that the limited appreciation of mental health circa 1944 and the administrative policies of the time combined in a manner which resulted in Hudson being considered to be lacking moral fibre and he was discharged 'service no longer required, with disciplinary effect' in October 1945.

In light of Hudson's service in North Africa and PNG, the manner of his discharge seems harsh. The origins of the policy which generated this outcome can be found in a 1942 Bomber Command study on the cumulative effects of the stress experienced on missions over Germany. The study found that some aircrew who experienced repeated stressful events while on operations were more prone to suffering extreme fatigue, difficulties in concentration, sleeplessness and anxiety. In response to the study and to manpower concerns, the Air Ministry issued Memorandum S.61141/S.7.c. This memorandum spelt out the RAF policy on dealing with aircrew suffering from stress related conditions and the actions to be taken in cases where there were no identifiable flying stressors involved.

The policy reflected an organisational belief that if left unchecked, the numbers of aircrew refusing to fly due to anxiety or stress would cripple Bomber Command's war effort. To act as a deterrent, aircrew who were unable to demonstrate how events while on flying operations had had a cumulative effect on their health lost all rank, their flying brevet and were discharged for 'lack of moral fibre' or for 'disciplinary effect'. The policy did not recognise that a member may have experienced extreme stress in other periods of service not flying related.

In Hudson's case, notes on his file indicate that in one doctor's view, it was 'not a case of being afraid but the consequences of nervous strain'. The same doctor was also of the opinion that Hudson's previous Army service contributed to his condition. However, as no flying-related stress could be identified, the administrative system could not comprehend any alternative but discharge under the harsh policy of the day.

The stigma felt by Hudson was unnecessary; he had served with honour but was forced out by a policy which, while well informed by the standards of the time, did not recognise there are many contributing factors to mental health problems which may not be immediate or obvious. The policy was too simplistic to balance the good of the service with the needs of the individual. To ensure that Air Force meets its responsibilities to its members and to project air power on current and future operations, it remains an imperative that the complex nature of metal health is understood and that support mechanisms are in place to aid personnel who suffer as a result of their service.

Translating Technology and Innovation into Capability: Some Lessons from Between the Wars (#266)

Key Points

- *While aircraft promised much for warfare between the wars, various factors restricted the extent to which nations developed decisive capabilities by the start of World War II.*
- *The RAF demonstrated how the new technology of radar when combined with fighter aircraft, observers, and command and communication systems could be successfully translated into decisive capability.*
- *Experience has shown that new technology does not necessarily equate to new capability.*

While the experience of warfare reflects the many attempts to gain that decisive advantage over the adversary through better technology, it also shows that the introduction of new technology will not necessarily produce the desired advantage. For example, while the tank first appeared on the battlefield as early as 1916 in World War I, it was not until it was integrated into new and innovative operational concepts and tactics that it really became a decisive element in manoeuvre warfare during World War II. The development of air power between the two world wars provides outstanding case studies of nations both successfully and unsuccessfully learning from operational experience and transforming the technology offered by aircraft into military capability.

With some exceptions, World War I is largely remembered for its devastating quagmire of trench warfare. While air power in World War I provided a glimpse of what it could provide, it did not fundamentally change the dominating trench warfare. However, there was sufficient evidence to demonstrate that reconnaissance and surveillance, control of the air, strike and close air support were going to be critical capabilities in future wars. Strategists in several nations identified lessons from which they could develop new concepts

and capabilities that would avoid the stalemate that was World War I. Remarkably, some of these major lessons were either forgotten or discarded in the lead-up to World War II.

The notion of strategic strike promised the capacity to strike deep into the adversary's territory, while bypassing static defences and avoiding the risk of degenerating into trench warfare. Although Britain and the USA actively pursued a strategic bombing capability between the wars, their attempts were hampered by factors such as poor appreciation of the actual accuracy and capacity of aircraft at the time. While Britain had bomber aircraft with the range to reach German targets, they lacked sufficient defences to fight off German fighters and carried only a small bomb load. Unable to achieve control of the air over enemy territory during daylight raids, the RAF bombers suffered heavy losses on initial raids, forcing the RAF to adopt night bombing strategies. However, the bomber crews initially lacked the navigation equipment and training to find and bomb their targets at night.

Meanwhile, the US Army Air Service did exhibit some ability to analyse aircraft and tactics through establishments like the Air Corps Tactical School, which was established in 1920 and was largely responsible for developing the Army Air Force's doctrine of daylight precision bombing. However, such analysis was undermined by the desire to sell air power and the concept of independent strike forces. This resulted in blinkered thinking that too easily dismissed other key lessons such as the need for control of the air when conducting strategic bombing missions. The first USAAF bombing missions conducted over Europe, without control of the air, resulted in devastating losses and the postponement of the daylight bombing campaign. It was not until 1944 that daylight bombing missions over Germany were resumed when long-range fighters, such as the P-51 Mustang, became available to escort the bombers and protect them from German fighters. In reality, both the Americans and the British failed to fully capitalise on the promise of strategic bombing by failing to understand and effectively integrate technology, strategy, and tactics.

Interestingly, the same issues tended to overshadow the British and American development of the effective employment of air power in ground support between the wars. Despite World War I highlighting that air power had an important role in supporting ground operations, both Britain and the USA entered the war with limited ground support

capability. Although both services had light and medium bombers at the start of the war, there was no doctrine for air/land cooperation and the squadrons' headquarters lacked the staffing, communications lines and organisation structure to coordinate close air support.

In contrast, Germany recognised the value of air power to ground operations and successfully integrated air power into its continental manoeuvre warfare strategy. The Luftwaffe was developed as an operational air force that could not only operate closely with ground forces at the tactical level but could also successfully conduct interdiction behind the front line after having achieved control of the air over the battlefield. While the Junkers 87 *Stuka* dive bomber may be perceived as the front line of the Luftwaffe's ground support capability, it was actually their integration of medium-level, twin-engined bombers and modern fighters into a more balanced operational force closely aligned with robust tactics and doctrine that ensured German air power delivered the effects their mechanised warfare strategy required.

Although Britain had problems in translating air power technology into effective strategic bombing and close air support capability between the wars, it did successfully integrate fighter aircraft and radar into an effective military capability by creating the air defence system. Many nations, including Germany and the United States, had been developing radar but it was Britain, largely through the drive of Air Chief Marshal Hugh Dowding, that successfully integrated radar with fighter aircraft, observers, and command and communication systems into an operational, integrated air defence system (the Dowding System). While the popular histories of the Battle of Britain tend to highlight the achievements of the fighter pilots, the Dowding System was a force multiplier that was decisive in the RAF defeat of the Luftwaffe. In this respect, the radar and the Dowding System provide the pre-eminent example of the successful translation of technology into military capability between the wars.

The development of air power between the wars highlights the maxim that technology alone may not deliver the war-winning edge. The countries that did successfully develop their air capabilities—Germany with its tactical air support and Britain with its integrated air defence system—did so over a period of years, testing and developing their equipment, tactics and doctrine until they formed an effective

capability. This process will be essential for the Air Force to develop its new capabilities and become a 5th-generation air force. The Air Warfare Centre will be at the hub of Air Force's efforts to ensure the lesson of 'thorough operational analysis and the application of lessons learned' is not lost.

The RAAF and Fuel Security in World War II (#271)

Key Points

- *Without strategic energy reserves the ability of fuel dependent forces to meet national security requirements can be readily compromised.*
- *Energy security is a whole-of-nation imperative, requiring a whole-of-nation response.*
- *Threats to the means of sustainment must be factored into the planning for war reserve holdings.*

It was highlighted in Pathfinder #270, *Air Power and Energy Security,* that in the future the air force's ability to deliver air power may be adversely affected by the impact of declining energy security on the availability, affordability and reliability of liquid fuels. When World War II broke out the Air Force had similar concerns. The large scope of the construction and capability development programs undertaken to establish adequate aviation fuel security in Australia during World War II illustrates the magnitude of effort required to ensure energy reserves for Australia's armed forces.

When World War II started in 1939 the Air Force faced a two-fold challenge in guaranteeing access to aviation fuel. The first element of the challenge was that there was insufficient refining capability in Australia to fully meet the Air Force's fuel needs. The development plans for the Air Force at that point was to increase the strength from 12 to 19 flying squadrons by June 1941 (later increased to 32 squadrons) and a commitment to train up to 14 000 aircrew per year for service with the RAF in Europe. All the aviation fuel required to sustain the increased flying rate to achieve these targets would have to be imported and stored for exclusive use by the Air Force.

The need to import its entire fuel needs gave rise to the second element of the Air Force's challenge. The increase in aviation fuel consumption in Europe, and war related threats to both refining capability and maritime routes indicated that a large fuel reserve was required in Australia to mitigate a possible interruption to supply. The

solution was to establish three fuel depots with a combined capacity of 1.8 million gallons (8.2 million litres) in south east Queensland, north east New South Wales and central Victoria respectively. The total storage capacity of the depots represented six months of projected consumption. The locations were determined by the proximity to rail heads and distribution corridors to the main end user airfields. The threat to the depots from enemy attack, while also taken into consideration was not in the first instance thought of as a major issue. For Air Force, the depots represented a strategic reserve and distribution centre. They were not intended to be operated in the same manner as a base level fuel farm.

As planning and construction of the fuel depots got under way there arose inevitable difficulties and changes to requirements which had to be resolved. The first problem was one of imminent oversupply. Delivery of the first 1.8 million gallons of fuel was far more prompt than expected and temporary storage at commercial facilities had to be arranged. It was however the constant increases to the projected size of the Air Force in terms of flying units and training requirements which caused the biggest issues. Between January and November 1940 the estimated six month usage of fuel went from 1.8 million to 3.2 million gallons and consequently the number of depots required increased from three to eleven.

The effects on the cost, manpower and transportation requirements of every additional depot were significant. A 200 000 gallon fuel tank cost £3 300 and required 54 tons of steel. The additional real estate, railway branch lines and associated infrastructure all added to the cost and complexity of the project. The single biggest challenge to the project came when the imperative for a strategic fuel reserve went from 'essential' to one of national security imperative in December 1941 when Japan entered the war.

Until Japan's entry into the war the sense of urgency in establishing the inland fuel depots could be described as 'determined', but by January 1942, the mood of the works committee became noticeably more focused and hurried. With the invasion of Australia possible, the Air Force expansion plans grew even more. The six month usage estimates went from 3.2 to 15 million gallons during December 1941 and by the end of January it had climbed to 40 million gallons for the Air Force and an addition 10 million gallons for the US Army Air Corps units

being dispatched to Australia. The number of depots required went from 18 to 31 with additional and larger tanks being planned within each depot. By 1945 the Air Force had fuel depots in every mainland state in Australia as well as in the Northern Territory.

As the expanded program took shape the nature of the construction plans changed considerably. Precautions around security went from preventing local pilfering and reducing the fire risk to consideration of potential for air and ground attack. Accommodation for armed guards was included in all depots and anti-aircraft gun emplacements were considered. Similarly, the threat of sabotage prompted suggestions for the Air Force to develop units similar to the RAF Regiments–what the Air Force came to call Airfield Defence Guards. As the bombing of Darwin had shown that the threat of air attack was a serious possibility, the new depots had to be sited further inland, while additional protective walls and camouflage netting was constructed around tanks in the more vulnerable locations. The Inland Fuel Depots, as they were called, were not all completed until late 1943.

In order to sustain Air Force aviation fuel needs, not only were the fuels depots required, but wider infrastructure also had to be developed. By February 1942, an additional 208 fuel tankers were required in order to support air operations at the growing number of Air Force stations across Australia. In Queensland, the 1.6 million gallons of aviation fuel that needed to be transported each month from seaport to depots and then on to the airbases required an additional 80 fuel specific railway cars and an additional 10 locomotives to be constructed in the state's rail yards. The difficulties in delivering this capability was magnified by the increasing demand for steel from other Defence related industries such as ship building and a decreasing supply of skilled workers.

Australia was only able to develop a strategic fuel reserve capable of meeting its own and its coalition partner's needs due to there being a sufficiently developed steel and manufacturing capacity in Australia at the time. Without this capacity, construction of the fuel depots could not have been achieved. Similarly, had there not been a commitment to establishing a strategic reserve in 1939, the consequences of not being able to support an operational surge in 1942 may have been even greater than was actually experienced.

When the war ended, the downsizing of the Air Force and reduced flying rates resulted in the Government directing that all the fuel depots

be sold off by the Department of Supply. Should Australia need to re-establish a strategic reserve of aviation fuel, a similar construction and development program will be required. As the World War II experience demonstrated, a strategic fuel reserve that is adequate to meet demand, secure and accessible requires significant lead time to develop and a commitment of adequate resources.

Failure of Fighter Development in Australia 1934-39 (#284)

Key Points

- *Control of the air is central to air power strategy; the capability to gain and retain control of the air must be central to development of a balanced force.*
- *Budgetary restraints and poor threat analysis can prevent the acquisition process from producing the required level of capability.*

The experience of World Wars I and II established the tenet that control of the air is the primary role of an air force and is a prerequisite for military success. From the time the Fokker Eindecker dominated the skies over the Western Front in 1915, the primary tool in the control-of-the-air mission has been the fighter aircraft.

Considering the strategic significance of obtaining control of the air, it seems unthinkable that an air force would not seek the best fighter aircraft available to meet this need. However, despite having undergone a three-year modernisation program, this was exactly the situation Australia found itself in when World War II broke out in September 1939. Of the 246 operational aircraft of the Air Force, not one was a modern fighter. Also missing was a mature doctrine to guide the decisions of the Air Board in developing a balanced, capable air force. Consequently, it was two and a half years into the war before Australia had a contemporary fighter force available for air defence duties.

The shortfall in fighter aircraft development in Australia during the 1930s was due to a number of issues—the first of these being the outcomes of the Imperial Defence Conferences from 1923–37. The formulation of the Singapore strategy during the 1923 conference established a maritime-centric plan based on the assumption that the defence of Australia would be best met by a strong British naval presence at Singapore. While valid in 1923, by 1937 the plan was deficient in its appreciation of the development and proliferation of air power across the region, in particular, the development of carrier-based aviation.

The impact of the Singapore strategy on the Air Force was specifically evident after the 1930 Imperial Defence Conference. It was assumed, almost as an article of faith, that the main air threat to Australia would be from low-performance aircraft launched from cruisers. This assumption resulted in the main role for the Air Force being limited to surveillance and reconnaissance duties with the secondary function of responding to small-scale raids by surface or airborne adversaries. These assumptions heavily influenced Air Force modernisation plans.

In 1928, the Salmond Report, written by the RAF Chief of Air Staff at the request of the Australian Government, drove home the degree to which the Government had allowed the Air Force to deteriorate. While the criticality for the Air Force to address the report's findings was accepted, the Great Depression prevented any action on the report's recommendations until the national economy began to recover in 1934. When action was finally taken, the available funding was insufficient to address all requirements simultaneously. Second, the numerically small Air Force of 1936 with only 1262 personnel was simply too small to expand rapidly enough to cope with an infrastructure development program as well as an influx of new aircraft, personnel and equipment.

The question of 'which aircraft for Australia?' also proved to be highly problematic for the Air Board. By 1938, the prevailing view was that as Australia's strategic assets were predominately situated on the eastern coastline, the detection and response to raids would have to be addressed through coastal patrols by maritime and airborne surveillance assets. It was further considered that the most effective means of disrupting attacks from the seaward approaches would be to intercept the threat as far out to sea as possible.

Deliberations by the Air Board over 1938-39 resulted in a decision to purchase the Bristol Beaufighter aircraft as a long-range interceptor. In many ways, the type's selection addressed a number of Australia's geo-strategic demands. The Beaufighter's performance clearly met the requirement for deploying across the long distances between Australia's population centres and the role of long-range interception of enemy aircraft far out to sea. However, the cost of the Beaufighter caused the Air Board to later drop the project and instead adapt the CAC Wirraway general-purpose aircraft to the 'fighter' role.

In 1939, a second report on the Air Force's fighter requirements put paid to a long-range fighter; in fact, it put paid to any consideration of a specialist fighter at all. The report noted that given the warning time provided by seaward reconnaissance and that the probable threat would be low performance strike aircraft, the general-purpose CAC Wirraway, then being produced in Australia, would be more than adequate for point defence of strategic assets. The report further stated that while the Wirraway may lack high performance by the standards of modern fighters, it was nevertheless up to the task of addressing the likely threat posed by small raids. The report failed to explain why only small raids were considered the only threats to Australia or why the modern carrier forces of the Japanese, then identified as the most likely adversary, would not be employed against Australian cities.

The report ended in recommending the Beaufighter purchase be cancelled and the funds so released transferred to the purchase of additional Lockheed Hudson light bomber/surveillance aircraft and increase Wirraway production. The combination of Hudson and Wirraway aircraft was considered the best air defence option for Australia. These recommendations were accepted by the Air Board and no modern fighter of any description was envisioned for the Air Force for the near future.

The deficiencies in the Air Force air defence capability would be the cause of much debate in the months following Japan's entry into World War II. The loss of air superiority over the Malay Peninsular eventually resulted in the loss Malaya and Singapore and the sinking of HM Ships *Repulse* and *Prince of Wales*. On 19 February 1942, a wave of high-performance fighter and bomber aircraft, launched from aircraft carriers to Australia's north, bombed Darwin. A second wave of land-based bombers followed up with even more destructive attacks on the city and surrounding Defence infrastructure. Included in the losses were a number of Hudson and Wirraway aircraft intended to have been the vanguard against such an attack.

It was only in February 1942 that the Air Force finally gained fighter squadrons with modern aircraft. Equipped with Curtis Kittyhawk fighters, Nos 75, 76 and 77 Squadron were the first of the Australian-based fighter squadrons capable of both offensive and defensive control of the air missions.

The Origins of the RAAF Commitment to the Vietnam War (#274)

Key Points

- *The RAAF commitment to the war in Vietnam was in response to national security requirements in a period when Australia was increasingly acting independently of previous Commonwealth policies.*
- *The development of RAAF capability and its ability to support multiple operational deployments in the 1960s was limited by force size and budget.*
- *Force development must take into account the possibility of concurrent operational commitments.*

The origins of the RAAF's involvement in Vietnam 1963-75 can be traced to the 1954 Geneva Conference called to finalise the armistice agreement which ended the fighting in the Korean War. Also on the conference agenda were discussions around the emerging independent states of Indochina (Laos, Cambodia and Vietnam). While the Geneva Conference failed to reach a meaningful agreement on the situation in Korea, it did result in a decision on the withdrawal of French forces from Indochina and the partition of Vietnam along the 17th Parallel, separated into a communist North and a republican South. Elections were to be held no later than July 1956 to enable the Vietnamese to decide on the nature of their government on reunification.

In a move intended to curb communist influence and encourage stability within the Indochina region, Australia joined with several other powers, most notably Britain, France and the US, to form the South-East Asia Treaty Organisation (SEATO) in 1955. The aim of SEATO was to underwrite the sovereign independence of South-East Asian states. More specifically, the US increasingly directed SEATO initiatives towards curbing the spread of communism in the region. As the security and political situation in South Vietnam deteriorated, due in no small measure to the Viet Cong communist insurgency backed

by North Vietnam, Australia and the US became increasingly drawn into a war aimed at resisting further North Vietnamese incursions into the South. The escalation was gradual: as Viet Cong operations developed into almost routine attacks against government officials, the response from the US, and later Australia, was to increase direct military assistance to the Republic of Vietnam Army. In August 1962, 30 Australian Army advisors were deployed to South Vietnam as the Australian Army Training Team Vietnam.

The first meaningful RAAF commitment in South Vietnam occurred in May 1963 when an Air Attaché, Group Captain Brinsley was appointed to the Australian Embassy in Saigon. This was followed within days by the first operational missions in South Vietnam by a RAAF aircraft. Over the period 9-21 May 1963, Dakota A65-119 from No 2 Squadron's transport flight based at RAAF Base Butterworth and captained by Flying Officer David Cooper, conducted 28 sorties in South Vietnam. The missions were predominantly humanitarian aid flights, delivering some 25 000 kg of food and medical supplies to Montagnard refugees displaced by the Viet Cong insurgency. This short deployment marked the beginning of the RAAF presence in Vietnam, which was to continue in varying forms and with only minor breaks until 1975.

Prior to the relief flights of May 1963, Australia had been under increasing pressure from the South Vietnamese and US governments to commit transport aircraft to provide supply and administrative support to the counterinsurgency effort. These requests escalated to include more aircrew to provide additional airlift capacity to the Vietnamese Air Force (VNAF).

Until 1963, these calls had been resisted for three interrelated reasons. First, the RAAF was undergoing a major re-equipment program which required the transition of a majority of its aircrew and technical personnel to new aircraft types. Furthermore, the management of the induction of the new platforms had to be balanced against the retirement of the outgoing aircraft. With the Dassault Mirage replacing the CAC Sabre, the de Havilland Caribou replacing the C-47 Dakota, along with the introduction to service of UH-1 Iroquois helicopters, Lockheed Neptunes and Orions, the manpower of the RAAF was becoming stretched.

The second reason for resisting a commitment to Vietnam was the RAAF's existing counterinsurgency and Far East Strategic Reserve commitments in Ubon, Thailand and at Butterworth, Malaysia. With base support units, a control and reporting unit and three fighter, one bomber and a helicopter squadron operating in the region, the limited resources of the RAAF were stretched even further.

The cost of both the equipment replacement program and the operational tempo of the early 1960s combined to generate the third challenge the RAAF faced in supporting additional commitments. In 1962, the RAAF was on the cusp of deciding on its next generation of strike aircraft, and although the preferred platform had yet to be identified, the cost of the possible options were to make it one of the most expensive acquisitions in RAAF history. The Chief of the Air Staff (CAS) at the time, Air Marshal Valston Hancock, was understandably concerned that the RAAF budget was already fully committed and any additional costs incurred due to further operational deployments would potentially curtail the Air Force's development plans.

The turning point in the RAAF's ability to support a deployment to Vietnam came in 1964 as No 38 Squadron began its transition to the de Havilland Caribou aircraft. With potential to deploy six Caribous on the horizon, the capacity of the RAAF to supply meaningful tactical transport capability in Vietnam was realised. The timing of these developments proved critical.

During 1964, the Government of South Vietnam was destabilised by two military coups. These events led to a surge in the Viet Cong insurgency seeking to take advantage of the now dysfunctional leadership in South Vietnam. In response to requests for increased military aid to the war from both South Vietnam and the US, the Australian Government decided it was in the best interests of the nation and those of its allies to agree to an increase in the Australian commitment. As part of this increase, the commitment of a RAAF Caribou deployment was announced on 8 June 1964.

While the decision to deploy the Caribous was established on paper, there was a significant amount of work required before the aircraft were available for deployment. So new was the Caribou in RAAF service that there were only sufficient aircraft in Australia to sustain a training capability, necessitating the formation of the RAAF

Transport Flight Vietnam (RTFV) at RAAF Base Butterworth, from aircraft delivered directly from the de Havilland factory in Canada.

The formation of the RTFV and its arrival in Vietnam in August 1964 marked the beginning of a significant RAAF presence in Vietnam which lasted until 1971. The RAAF commitment to the war resulted in the appointment of a one-star Commander RAAF Forces Vietnam in June 1966 and the expansion of the RTFV into No 35 Squadron. It would be joined in theatre by Nos 2 and 9 Squadrons, flying Canberra bombers and Iroquois helicopters, respectively, No 1 Operational Support Unit and No 5 Airfield Construction Squadron. Reflecting the fact that the Australian forces in Vietnam were there as contributions to a coalition, not all of the RAAF units served together under common operational lines of command. While Nos 2 and 35 Squadron were allocated for duty with the USAF Seventh Air Force, No 9 Squadron was under the direct control of No 1 Australian Task Force.

The commitment of RAAF forces to Vietnam mirrored the incremental commitment of Australian forces to the Vietnam War as a whole. These were not made as a simple response to the demands of the conflict, but rather to Australian Government policy developed in the pursuit of national security aims. The involvement of Australia in the conflict was one of choice rather than one of necessity as had been the case in World Wars I and II. The Vietnam War, like the Korean War before it, marked the transition of Australia's defence posture from one of simply being a partner in the Imperial Defence arrangements, to one of an independent actor.

The Legacy of Indigenous RAAF Members from World War II (#269)

Key Points

- *The contribution of Indigenous people to the defence of Australia over the last 100 years is not well known.*
- *During World War II, Indigenous Australians served in the Air Force in all operational theatres.*
- *Today's Air Force has inherited a proud history of service, courage, dedication and determination by Indigenous members that should be remembered.*

Although approximately 3000 Aboriginals and 850 Torres Strait Islanders served in Australia's armed forces during World War II, few Australians know the details of any notable Indigenous soldiers, airmen or sailors. The Air Force was at the forefront of recruiting non-Europeans during World War II, due largely to the need to supply 27 000 airmen to Britain under the Empire Air Training Scheme. The Indigenous airmen who served in that conflict are part of the heritage of today's Air Force.

Born at Euraba Mission in far northern New South Wales in 1924, Leonard Waters grew up in country south-west Queensland. He left school aged 14 during the Great Depression, and was compelled to work with his father as a ring-barker and then as a shearer. Inspired at an early age by the exploits of aviation pioneers such as Kingsford-Smith, Hinkler, Lindbergh and Johnson, Waters volunteered for the Air Force in August 1942.

Initially trained as an aircraft mechanic, he was accepted into aircrew training in December 1943. Fearing his education would preclude him from becoming a pilot, which was his preference, he studied tirelessly to enhance his chances of being selected for his preferred category. He went so far as to bet against himself on three occasions, believing he would not be selected. His fears were not helped by staff asking him to imagine himself as a tail gunner in a heavy bomber. However, his efforts paid off when he was selected for pilot training at the end of his initial training.

Waters converted to P-40 Kittyhawk aircraft at No 2 Operational Training Unit at Mildura and was posted to No 78 Squadron. Based at Noemfoor, Dutch East Indies, the squadron flew ground attack missions against the Japanese on neighbouring islands. Between November 1944 and August 1945, Waters flew 95 operational sorties in an aircraft that had been named 'Black Magic' by a previous pilot—a name that Waters found appropriate and retained. On one sortie, a 37-mm anti-aircraft artillery shell hit his aircraft and failed to detonate, lodging itself behind his head at the rear of the canopy. Showing immense courage and airmanship, Waters continued flying for another two hours before safely returning to base. By the end of his operational tour, Waters had been promoted to flight sergeant and was leading missions on a regular basis. Promoted to warrant officer at the end of the war, he declined the opportunity to deploy to Japan as part of the British Commonwealth Occupation Force and left the Air Force. Despite showing immense interest in establishing a regional civil airline, he could not obtain financial or Government support. After the war, he never flew again, eventually returning to shearing.

A lesser-known Indigenous RAAF pilot, David Paul, served with distinction in the European Theatre during World War II. Born in 1920 in Sydney, Paul did not disclose his Indigenous heritage (his great grandmother was Aboriginal) until after the war. Like Waters, Paul left school at 14 to become a drover. With the declaration of war in 1939, he saw his future in the Air Force and enrolled at a local technical college to improve his education. Paul enlisted in January 1941 and travelled to Rhodesia (now Zimbabwe) for training under the Empire Air Training Scheme.

In late 1941, having successfully completed pilot training, Paul was posted to No 454 Squadron where he conducted maritime patrol missions over the Aegean Sea for the next two years. In December 1943 on the final sortie of his operational tour, Paul's Baltimore Bomber was shot down by two German Bf 109F fighters. Despite his aircraft's fuel tanks bursting into flames, Paul successfully ditched the aircraft and swam through flames to rescue another crewmember. Three surviving aircrew, including Paul, were captured by German forces. Following initial interrogation, they were made prisoners of war in a German Stalag. Paul's family learned of his fate three months after his aircraft was shot down.

Paul was well respected and experienced, being one of No 454 Squadron's initial cadre of pilots when it formed. His Commanding Officer, Wing Commander John Coates, described him as one of the squadron's most outstanding pilots. This assessment was confirmed by the award of a Distinguished Flying Cross (DFC) for Paul's outstanding actions over numerous missions, often in the face of aggressive enemy attacks. The citation noted his outstanding leadership, initiative and determination. Returning to Australia after the war, David Paul had a distinguished career with the New South Wales Police Force and served as a squadron leader in the RAAF Reserve until his death in 1973.

The account of Flight Sergeant Arnold Lockyer provides a more sobering example of the sacrifices made by Indigenous members during World War II. Lockyer joined the Air Force in May 1942, aged 27, and served as an aircraft mechanic with No 17 Repair and Salvage Unit at Cunderdin, Western Australia. Like Waters and Paul, Lockyer wanted to fly so in 1944, he applied for and successfully completed flight engineer training on B-24 Liberator bombers at Tocumwal, New South Wales.

Promoted to sergeant, Lockyer was posted to No 24 Squadron in April 1945 as a flight engineer, and saw service in the Northern Territory, Morotai, Netherlands East Indies and Balikpapan. While based at Morotai on 27 July, Lockyer temporarily joined the crew of a No 21 Squadron Liberator (A72-92) as flight engineer for a photo-reconnaissance mission over the Celebes. When his aircraft was hit by anti-aircraft fire, Lockyer was one of three aircrew to successfully parachute from the doomed aircraft, only to be captured by Japanese soldiers. One of the aircrew was killed by their captors the following day. Lockyer and the other crewmember were interrogated and imprisoned near Manado, in what is now Sulawesi, Indonesia. Both crewmembers were subsequently murdered by Japanese soldiers on 21 August 1945—six days after the Japanese surrender. Of the five Lockyer brothers who served in World War II, three survived.

The accounts of Waters, Paul and Lockyer are inspiring but little known. They highlight the proud heritage that the RAAF has, with Aboriginal and Torres Strait Islanders having served with distinction in World War II. Their service and sacrifice should be commemorated by current and future RAAF personnel as examples of not only

Indigenous, but Air Force courage, determination and dedication. They are key contributors to Australian military history.

Taipan in Afghanistan (#254)

Key Points

- *Until 2007, RAAF air defence units had not deployed on operations since 1966.*
- *The differences between tempo, mission demands and equipment capabilities in Afghanistan and Australia required equipment upgrades and flexible approaches to training and procedures.*
- *Taipan had a unique perspective that allowed the optimum placement of aircraft to support Coalition land operations and facilitated centralised control and decentralised execution of air operations over Afghanistan.*

Like the rest of the RAAF, the air defence component peaked at the end of World War II with some 210 radar sites operating around Australia and the South-West Pacific. The post-war force reductions saw the air defence force and capability reduced to a shadow of its former self, and by the 1950s it was operating only a single radar and height finder. However, because of the worsening regional security situation from the late 1950s, the RAAF began to regain some of its previous strength, which included an improved air defence force of three radar units. While much of the RAAF deployed on operations post-war, the air defence community was rarely committed to overseas operations, focussing most of its effort on national tasks that included the Olympic and Commonwealth Games, and border protection. Until Afghanistan in 2007, its sole, off-shore post-war operational mission was as part of the Commonwealth's response during the Indonesian Confrontation, a mission which ended in 1966.

The Afghanistan deployment came at the request of the USAF who had been the major air battlespace authority in Afghanistan since 2005. The USAF had an Air Control Squadron (ACS) at Kandahar with the RAF's No 1 Air Control Centre managing the UK's discrete airspace around Helmand Province. These two elements, sometimes supported by a USAF E-3, were responsible for military radar coverage

and air battlespace management throughout the theatre. By 2007, the older, maintenance-heavy control cabins and TPS-75 radars of the USAF's ACS were in need of a period of rest and re-constitution.

The USAF requested Australia to provide a similar capability, initially for a 12 month period, to allow the USAF ACS to re-equip. As part of an increased Australian commitment to Coalition operations in Afghanistan, the Australian Prime Minister agreed to the request on 10 April 2007. The planning and conduct of the deployment quickly devolved to the RAAF, especially No 41 Wing (41WG).

No 41 Wing conducted an early reconnaissance and noted the need for airfield works at Kandahar and for essential equipment upgrades in order to match the USAF's in-theatre capability. The plan saw No 114 Mobile and Control Reporting Unit (114MCRU), callsign 'Taipan', form the core of the initial deployment, with subsequent rotations being made up from all parts of the RAAF's air surveillance and battlespace management community.

No 41 Wing developed a multi-phased plan to enable Taipan to match the USAF's in-theatre capability; the USAF could not withdraw until this was achieved. An initial cadre of 41WG air battle managers and air surveillance operators would prepare the site and qualify on the USAF equipment, permitting the USAF to commence winding back their operations. The early move of the radar and cabins was made using chartered Antonov aircraft, a first for 41WG. Taipan would only take full responsibility for the mission once sufficient personnel and equipment were fully operational and certified at Kandahar. After this, operational control of Taipan would pass to the USAF Combined Air Operations Centre (CAOC) at Al Udeid Air Force Base. In common with other ADF units in theatre, national command remained with CJTF 633 while technical control (TECHCON) stayed with CAF. OC 41 WG was delegated as his representative.

OC 41WG TECHCON responsibilities centred on supporting the radar and cabins, managing upgrades and providing specialist personnel. To meet the unit's establishment of about 75 personnel, most of 41WG's specialist personnel would rotate through Kandahar. Providing 24 hour, 7 day coverage required a minimum of 59 personnel—34 operations and 25 maintenance staff, even with the USAF providing communications and ISAF providing catering, most medical needs and external force protection. A small support and

command element rounded out the unit. Unlike many ADF units, Taipan had an additional requirement to qualify operators in theatre as it proved impossible to simulate the scale and tempo of Afghanistan operations at home in Australia.

Fortunately for the unit's personnel, its radar and cabins were essentially new and state of the art; with the TPS-77 radar and Warden operating system having been introduced into service shortly before deployment. Although it was an impressive system, some additional capabilities were still needed to optimise its performance in theatre. In particular, a full tactical data link capability, Link-16, was necessary as was secure, same-time chat. Installing new equipment wasn't the only demand placed on the maintenance flight: the extreme operating environment, while having been anticipated, could only be fully comprehended after experiencing the weather at Kandahar. Extreme temperature ranges and fine dust tested both the maintenance staff and the equipment. Nevertheless, Taipan achieved better than 98 per cent serviceability throughout the deployment.

With both equipment and personnel in place, the unit started its task of controlling and coordinating all Coalition fixed wing aircraft, and compiling the airspace picture. Taipan's airspace picture was disseminated to the CAOC and throughout the region via tactical datalinks. With up to 120 aircraft operating in their airspace at any one time, the unit coordinated the air support for over 5000 combat engagements in the just over two year period that they were deployed in-theatre. When combined with feeds from other radars, Taipan had a unique perspective from which to conduct their complicated task.

For most Australian operators, not only was Afghanistan their first operational deployment but it was also their first exposure to Link-16 and managing complex air-to-air refuelling operations. Both of these tasks were critical enablers for the highest priority task, that of coordinating and marshalling aircraft to provide close air support to Coalition troops in contact. Contacts occurred throughout the deployment but it soon became apparent that there was a marked difference between ground operations conducted by day and those conducted at night. Normally daylight ground operations were larger and reactive which necessitated flexible responses from both Taipan and air elements. Night operations frequently were more discrete and focussed tasks conducted over a shorter period. Taipan operators

tended to remain on either day or night shift for the duration of their deployment enabling them to acquire specialised skills in supporting the different type of operations.

By early 2009, the unit commenced planning for return to Australia. In common with most ADF units, a great deal of effort was put into meeting the exacting Australian biosecurity requirements for the homeward trip. Getting the unit's equipment re-constituted also figured prominently in planning, as did a robust hand-over to the incoming USAF unit. The USAF had elected to remote data from the relief USAF radar to the new Battlespace Command and Control Centre (BC3) located outside Afghanistan. The withdrawal of Taipan from Afghanistan did not mean the end of a RAAF air battlespace management contribution since a small contingent of RAAF members continues to form part of the USAF's BC3.

By agreeing to replace the USAF's air battlespace control element in Afghanistan, the RAAF had a unique opportunity to gain invaluable operational experience for its air defence units while contributing directly to the Coalition effort. The deployment placed considerable demands on the relatively small operational and maintenance workforce in 41 Wing. However, the success of the deployment brought RAAF capability into line with Allied skills and capabilities.

Battle of the Bismarck Sea (#256)

The Battle of the Bismarck Sea which took place on Australia's doorsteps from 2 to 4 March 1943 has a special place in Australia's military history. It was a defining battle that thwarted Japan's attempt to secure a permanent foothold in Australia's nearest neighbour, which was then the Australian territory of Papua and territory protectorate of New Guinea. While action in the battle occurred at sea, it was Allied air power that was the deciding factor. The success of air power was only made possible through a series of carefully planned and orchestrated operations, which today would be collectively termed a joint operation.

Key Points

- *Allied Air Forces involved in the Battle of the Bismarck Sea included elements of the United States Army Air Force, the Royal Australian Air Force, the Royal Air Force, the Royal New Zealand Air Force and the Netherlands East Indies Air Force.*
- *The Japanese convoy was decimated by a three wave attack made over three levels, with the majority of ships lost at the expense of only a few Allied aircraft.*
- *The success gained in the Battle of the Bismarck Sea paved the way ahead for other Australian and Allied operations in New Guinea.*

Japan was providing vital logistics support from Rabaul to their New Guinea base in Lae. The Allies missed an opportunity to intercept a Japanese convoy in January 1943 but they knew well that further convoys were needed to support the Japanese advance over the Owen Stanley Range to their final prize of securing Port Moresby, the capital of Papua. Intelligence reports were filtering into the Allies from a number of sources that included Australian Coastwatchers who had oversight of all shipping that left Rabaul harbour, the monitoring of Japanese communications, air reconnaissance and the use of radar surveillance.

On 1 March 1943, a patrolling US Liberator aircraft sighted an enemy convoy outward-bound from Rabaul. The convoy consisted of

eight troop transports escorted by eight destroyers with air cover being provided by Zero aircraft operating out of both Rabaul and Lae. This was a much bigger convoy than the one that landed Japanese troops at Lae on 7 January. At first, bad weather hid this second fleet from Allied reconnaissance aircraft, and the convoy was not sighted again until the following day.

In a seemingly unconnected operation, on 2 March, six Boston aircraft from the RAAF's No 22 Squadron made a dawn raid on Lae airfield. While easily seen as just another raid, the attack was in fact mounted to prevent Japanese aircraft intended as the fighter escort for the convoy from operating from the airstrips, thereby ceding air control over the convoy to the Allies.

Searching United States Army Air Force (USAAF) Liberator aircraft relocated the convoy mid-morning. Eight Flying Fortresses were launched, followed shortly afterwards by 20 more. The Flying Fortresses attacked the convoy from 6500 feet using 100 lb demolition bombs, and one transport was sunk. Later in the day, a further attack was conducted by 11 Flying Fortresses, but this attack yielded no results. After dusk, RAAF Catalinas from No 11 Squadron shadowed the convoy throughout the night with the purpose of providing detailed information on the movements of the convoy to the various Allied headquarters located throughout the South West Pacific.

Throughout the night, the extremely poor weather conditions favoured the Japanese convoy. A lone Beaufort from No 100 Squadron made an unsuccessful torpedo attack while the Japanese transited Vitiaz Strait.

On the morning of 3 March, eight Beauforts from No 100 Squadron made an unsuccessful dawn torpedo attack. This was a precursor to a more coordinated attack to be made later, which involved RAAF Bostons, Beauforts and Beaufighters working in unison with USAAF Flying Fortress, Mitchell and Boston aircraft. By 0930 hrs, over 90 Allied aircraft rallied at the rendezvous point over Cape Ward Hunt to synchronise their strike on the convoy. Their attacks were made in three waves and from different levels with split-second timing.

Firstly, 13 USAAF Flying Fortresses bombed from medium altitude. In addition to the obvious objective of sinking ships, these attacks were intended to disperse the convoy by forcing vessels to break their tight convoy grouping to avoid being hit.

Secondly, 13 RAAF Beaufighters from No 30 Squadron hit the enemy from very low altitude, lining up on their targets as the bombs from the Flying Fortresses were exploding. The Australians' job was twofold: to suppress anti-aircraft fire, and to target the ships executives located on the bridge of the ships.

The Beaufighters initially approached at 150 metres (around 400 feet) in line-astern formation. The pilots then dived to mast-level height, set full power on their engines, changed into the abreast formation, and approached their targets at 420 km/h (around 225 knots). It seems that some of the Japanese captains thought the Beaufighters were going to make a torpedo attack because they altered course to meet the Australians head-on, to present a smaller profile. Instead, this exposed the bridge of the vessels and made them better targets for strafing as the Beaufighters altered their heading in response and raked the ships from bow to stern, subjecting the enemy to a storm of cannon and machine gun fire.

With the convoy now dispersed and in disarray, the third wave of attackers was able to concentrate on sinking ships. Thirteen USAAF Mitchells made a medium-level bombing strike and made low level 'skip bombing' attacks while, simultaneously, a mast-level attack was made by 12 other specially modified USAAF Mitchells, commonly referred to as 'commerce destroyers' because of their heavy armament. The commerce destroyers were devastating, claiming 17 direct hits. Close behind the Mitchells, USAAF Bostons added more firepower.

Following the coordinated onslaught, Beaufighters, Mitchells and Bostons intermingled as they swept back and forth over the convoy, strafing and bombing selected targets at will. The Japanese ships were now listing and sinking, their superstructures smashed and blazing, producing great clouds of smoke. Above the surface battle, 28 USAAF Lightning fighters provided air defence for the strike force. In their combat with the Zeros which were attempting to protect the convoy three of the Lightnings were shot down, but in turn the American pilots claimed 20 kills. The only other USAAF aircraft lost was a single Flying Fortress, shot down by a Zero.

By midday on 3 March the Allied aircraft then returned to Port Moresby for refuelling and rearming. The attacks on the convoy continued throughout the afternoon. Again, USAAF Flying Fortresses struck from medium level, this time in cooperation with USAAF

Mitchells and five RAAF Bostons from No 22 Squadron flying at very low level. At least 20 direct hits were claimed against the by-now devastated convoy.

On 4 March, Allied aircraft attacked Malahang airfield near Lae and destroyed many enemy aircraft and ground installations. This was the last to be seen of the invading Japanese convoy. In the days following the attacks, RAAF and USAAF aircraft patrolled the Huon Gulf area between Lae and Rabaul in what was described by official historian Douglas Gillison as 'the terrible yet essential finale', destroying barges and rafts crowded with Japanese survivors.

The Battle of the Bismarck Sea provides a classic example of the effective integration of a wide range of air power roles. For the loss of a handful of aircraft, the Allied air forces had sunk 12 ships–all eight of the troop transports and four of the eight destroyers–and killed nearly 3 000 enemy soldiers. The brilliantly conceived and executed operation had smashed Japanese hopes of regaining the initiative in their New Guinea campaign and eliminated any possibility that Australia might be invaded. It also allowed the Australian Army to prepare for the Salamaua and Lae campaigns later in 1943. General MacArthur described the battle as 'the decisive aerial engagement' of the war in the South-West Pacific Area.

Contributors

List of Contributors

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Index

Index