PATHFINDER

COLLECTION – VOLUME 6

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Foreword

The Air Power Development Centre (APDC) produces two Pathfinder articles each month—one related to a historical development in the RAAF and the other analysing a contemporary air power issue. Over a period of time it has been found useful to collect and publish these articles as 'Pathfinder Collections'. This is the sixth volume in the series. It reflects a number of themes and ideas that have been examined over the past 18 months.

The 1000-word format of the Pathfinder series is meant to make it convenient for the reader to understand the basics of the topics being discussed, and to pique the interest of the professional to carry out further study on the subject as required. Within this ambit all matters regarding air power are open for consideration in the series—strategy, historical analysis, administration, education and training, operational concepts, technology and so on, the list is endless. All Pathfinders are aimed at delivering a focused answer to the question 'so what?' at the end of the discussion, essentially being a measure of analysis rather than a simple narrative.

Since its first appearance in June 2004, Pathfinders have appeared regularly every fortnight and gained a steadily widening readership within the Air Force, the wider community and even overseas. This is authentication that the topics that we discuss have relevance to the professional airman and to the broader community. APDC will continue to strive to maintain the quality of discussion in the Pathfinders and to be at the forefront in flagging contemporary and future challenges as well as innovations that are happening in the world of air power.

I commend this volume of the Pathfinder Collection to you.

Group Captain Peter Wood, CSM
Director, Air Power Development Centre

The Air Power Development Centre

The Air Power Development Centre, formerly the Aerospace 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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AIR POWER

If at any stage an air-to-air threat were to emerge, our fellows are highly flexible, very adaptable and they can swing straight into that role on request from our Coalition partners.

Air Marshal Angus Houston,
Chief of Air Force, 31 March 2003

Continuity in the Employment of Air Power

Air forces are integral and vital sub-elements of national defence and security, and are the principal repositories of the nation's offensive and strategic air power capabilities. In the less than 100 years of independent existence, air forces have realised a status as a Service that collectively possess a high level of professional knowledge. This has been the result of concerted development of well-articulated doctrine and innovative concepts of operations that have facilitated the optimum employment of air power in direct contribution to the achievement of national objectives. However, with the changes in the characteristics and conduct of war brought about in the past few decades, there are doubts being raised regarding the adequacy of available air power theory and concepts to efficiently address the fundamentally altered conflict situations and emerging threats.

Key Points

- *Air forces are the principle repositories of a nation's air power capabilities.*
- *The cumulative and evolving core of professional knowledge of air forces provides them the ability to rapidly adapt to the changing characteristics and conduct of war.*
- *Interdiction, close air support and air mobility are critical to success in irregular wars.*

There is a direct, but generally not well understood, relationship between air forces and national security. The military force is a foundational element of national power directly supporting national security initiatives. Air force, as an indelible part of any viable military force, automatically contributes to ensuring national security and protecting national interests. Essentially, air power is a vital part of the wider range of elements that assure a nation the secure environment necessary for it to prosper.

The changing characteristics of war, wherein contemporary conflict is almost completely irregular in nature as opposed to the traditional force-on-force concept of warfare, has raised a fundamental question regarding the continued relevance of air power in emerging conflict situations. As a corollary, peripheral doubts regarding the need for air power projection capabilities—meaning independent air forces—have also been subtly articulated. There are two primary factors that clearly dispel both these erroneous lines of thinking.

First, the foundation for the employment of air power is based on cumulative professional knowledge that is continually building on evolving theories, concepts and practical experience. At the same time, the guiding principles for its effective application remain the thread of continuity. Therefore, air power has the inherent strength and depth of professionalism to swiftly analyse and understand even rapid changes in warfighting characteristics and modality, and to adapt to the altered conditions. Second, air forces have matured sufficiently in their ability to interface with the other Services effectively, and to also operate with non-military national agencies. In effect, air power can and does contribute to a whole-of-government approach to containing contemporary threats.

In the current security environment, especially in conflict situations, the role and effectiveness of air power is constantly being analysed, questioned and at times denigrated, even though there is irrefutable proof of its efficacy. Barring a few notable exceptions, land forces have been seen as the primary military element conducting most contemporary, irregular conflict. The operations conducted by other military capabilities, particularly air power, without which none of the operations could conceive of success, are largely invisible. This invisibility is further exacerbated by the perception of combat air power not being available to the land forces when required. This discordance is not new and has existed from the time that air power became a military power projection capability. It can be explained as a result of a less than optimum understanding of the strategic role of air power even in the smallest of engagements, the limited air power asset availability in most cases, and prioritisation of their allocation at the highest levels.

Irregular wars are primarily characterised by decentralised and ever-changing battle spaces as well as the adversary's preference for urban combat. Air power comes up against a number of challenges in this scenario. At the strategic level, air power's ability to coerce, deny and punish is neutralised when combating irregular forces because they do not normally have a recognisable identity or command structure to coerce or deny. At the operational level it is difficult to distinguish combatants from non-combatants, and friend from foe from the air. The probability of collateral damage—which is politically undesirable and could also have strategic repercussions—is much higher in irregular conflicts.

In this rather amorphous state of affairs, air power lacks a viable, independent strategic role. However, it contributes in the critical areas of interdiction, close air support, air mobility and intelligence, surveillance and reconnaissance. Interdiction, while difficult in the context of an irregular war, is still effective in denying the adversary the resources necessary to continue the fight. Since irregular forces rely on speed and movement, they are dependent on regular resupply and, therefore, are more vulnerable to interdiction. The provision of close air support is also more difficult in comparison to conventional conflict. This is so because of the dispersed nature of irregular combat operations and the difficulty in recognising potentially critical points. However, close air support can be extremely effective and a 'game-changer' when delivered at the right time and place. Air mobility is critical to the insertion, sustainment and extraction of special force elements, especially in a dispersed battlespace where combat can erupt abruptly and at random. This is a particularly important capability in irregular conflicts, since it permits a numerically small force to influence and dominate a large geographical area.

The characteristics and conduct of conflict has undergone a sea change in the past few decades. Although faced with a number of challenges, and the ongoing changes in the arena of conflict, air power has continually adapted and contributed effectively to national security as a critical element of the state's military forces. This has been made possible through its entrenched and cumulative professional knowledge and competence. The guiding principles—drawn from accumulated experience and knowledge—are the visible threads of continuity in the employment of air power within the ever changing security environment.

The Importance of the Growler to Australia's National Security

> **Key Points**
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> - *The EA-18G Growler will be a key capability element in Australia's air power system.*
> - *The role that electronic warfare plays is a significant determinant in the effectiveness of air power.*
> - *In an increasingly complex battlespace, the Growler's electronic warfare capabilities will ensure Australian air power continues to meet its national security obligations.*

The conversion of 12 of the RAAF's F/A-18Fs to EA-18G Growlers will ensure Australia's air power retains its leading-edge effectiveness well into the middle of this century. But why is airborne electronic warfare, and the Growler in particular, so important to Australia's national security? The beginnings of airborne electronic warfare can be traced back to World War II, where the first widespread use of radar for navigation and targeting occurred, as did the listening to and disrupting of electronic communications. Airborne electronic warfare systems such as the British Mandrel airborne radar noise jammer and Window (chaff), were the first line of electronic protection systems. The almost immediate by-product of these advances were technologies to counter these electronic warfare capabilities, then counter-counter, and a continuing spiral of counter developments to the nth degree. The age of electronic warfare had begun, and the ability to dominate the electro-magnetic spectrum became a key determinant in achieving success across the operational domains.

Throughout World War II the 'Mark one eyeball' remained the primary means of identifying airborne targets. The extended range radar allowed detection of targets well beyond visual range facilitating long-range targeting, consequently negating much of the element of surprise. Today, nearly every weapon system relies on radar for detection, tracking or targeting. In fighter aircraft, head-up displays are slewed to radar information, and guns and close combat missiles rely on radar for developing their firing solutions. Advanced optical and infrared systems offset some of this reliance, but radar is still an important element in all facets of aerial engagements. The lesson from this is clear; reduce an enemy's ability to gain information from radar and the operational advantage can shift firmly in one's favour. Airborne electronic warfare provides this advantage.

Electronic warfare advances, however, were not confined to airborne systems alone. Surface-to-air missile (SAM) systems were developed to provide point and area defence against air attack and evolved over time to become significant threats to military aircraft. It was not long before missiles, both surface and air launched, contained their own radars and fire-and-forget systems, substantially increasing the lethality and threat posed by them. In addition, the widespread deployment of SAMs made high-altitude flight, even at high speed, extremely hazardous. Flying low and fast in aircraft such as the F-111 substantially increased survivability in contested airspace. Air power's advantages of speed and altitude had rapidly eroded.

Air power has rarely operated unimpeded over an adversary's airspace; whether it was threatened by anti-aircraft artillery or fighter aircraft, the exploitation of the electro-magnetic spectrum through SAMs and other means only complicated the equation. Suppression of Enemy Air Defences (SEAD), an air mission that dates back to World War I, evolved to exploit the electro-magnetic spectrum, swinging the pendulum back in favour of offensive air power. Aircraft such the EF-111 Raven and the EA-6 Prowler provided specialist electronic surveillance, airborne jamming and electronic countermeasures to defeat or deceive radar and disrupt communications, swinging the tactical advantage back to air power.

Today, most modern combat platforms, both fighters and transports, employ some degree of electronic warfare in the form of self protection systems. From chaff, a countermeasure to hide aircraft or provide a more attractive target for a radar-guided missile, to decoys that deceive enemy radars on the position of the target, to jammers that overwhelm radar receivers, electronic warfare has become an integral element of modern combat aircraft. But suppressing and deceiving radars are only two aspects of electronic warfare.

Success in military operations has long been closely tied to the ability to exchange data between tactical elements, as well as communications between commanders, their headquarters and operational and tactical units. Communication technology is heavily reliant on the electronic spectrum and, therefore, prone to exploitation through electronic warfare. Whether gaining intelligence and situational awareness by listening in on the adversary's communications, or degrading or disrupting the enemy's voice and data traffic, airborne electronic warfare will play a key role in the decision-making capability of commanders across the operational and tactical battlespace.

In any form of conflict, the better electronic eyes you have the better you are able to fight; be it with the use of a radar-guided missile from the ground or air, or synchronised anti-aircraft artillery. The lethality of modern weapon systems means that survivability in an aerial engagement with a near-peer competitor is in no way assured. With the performance of current air-to-air missiles, mutual assured destruction is the most likely outcome of aerial combat—an outcome small air forces cannot accept. Growler can swing the advantage onto the friendly side by blinding or distorting the opposition's electronic eyes.

Onboard electronic warfare systems provide aircraft some degree of protection but, with the growing complexity of weapon systems, much of this protection is localised to the individual platform. Growler will deliver a much broader span of protection to combat packages, such as a combat air patrol or strike force, and has the ability to electronically attack a threat source or, if needed, use anti-radiation missiles to kinetically neutralise the offending radar.

Jamming is the primary role of a specialist electronic warfare platform, as is the case with the Growler. High powered low, medium and high band jammers enable the electro-magnetic spectrum to be targeted, whether they cover voice or data communications, Global Positioning System, and/or surveillance and fire control systems. The jamming equipment is so effective, a Growler can disrupt the electronic devices of some improvised explosive devices used by the enemy to set off the charge.

Australia's national security is fundamentally based around a maritime strategy. Air power underpins this strategy. Australian air power, with its extant electronic protection equipment, is able to deliver the required effects across the nation's regional area of interest. However, continuing advances in regional defensive capabilities are likely to diminish this freedom. Australian national security requirements demand an integrated airborne electronic warfare platform capable of surviving in high threat environments, and able to ensure the survival of other combat packages. Growler is this platform. The Growler will deliver enhanced protection against emerging traditional and non-traditional threats, while holding at risk the adversary's electro-magnetic capabilities. Growler places the balance of risk on the enemy's side, maximising the RAAF's ability to obtain and maintain control of the air while minimising the risk to own forces. It truly will be a game changer.

Future Challenges for Remotely Piloted Aircraft

Key Points

- *RPAs provide critical capabilities to a modern military force.*
- *Their efficiency is likely to reduce if employed in contested airspaces.*
- *A delicate balance has to be maintained between cost-effectiveness and capability if RPAs have to continue to be a crucial element in conflicts.*

Over the past few decades remotely piloted aircraft (RPAs)—also referred to as uninhabited aerial vehicles (UAVs) or remotely piloted vehicles (RPVs)—have become an indispensable and often critical element in the employment of air power. As a result, most modern air forces now consider RPAs a priority capability for further development and integration into broader concepts of operations. The advantages that RPAs bring to operations have been articulated a number of times and are not in question. However, as the character of air operations continues to evolve, issues on the optimal employment of RPAs are coming to the fore. These challenges have to be carefully analysed if the full capabilities of these versatile vehicles are to be realised.

A major challenge that faces RPAs is an existentialist threat brought about by the proliferation of surface-to-air weapon systems. In the contemporary operational environment, most forces, including non-state entities, are able to acquire air defence missiles of varying sophistication, all of which have the potential to be extremely effective. The non-traditional adversary also perceives RPAs as the primary threat to their uninhibited operations because of the intelligence, surveillance and reconnaissance (ISR) capabilities that the RPAs possess. It is only natural that insurgents and other non-state entities consider the RPAs as priority targets. The outcome is that even though conventional forces obtain and maintain control of the air in the traditional mode, an RPA's freedom of operations will become more contested and their survivability less assured. While RPAs will continue to be treasured for their surveillance capability, as well as a strike capability in irregular warfare, their ability to function freely in high-intensity operations and in contested airspace is less certain.

The future of RPAs will be significantly influenced by the assessment of its survivability in contested air spaces and the technological and conceptual developments that will improve its effectiveness. This challenge is further complicated by the extraordinary budget constraints being faced by all the major military forces of the world. There are two questions that emerge from this challenge. First, whether or not RPAs will be able to penetrate and survive a hostile environment without diluting their primary characteristic of being uninhabited, which made them attractive in the first place. Second, if they have to be made survivable, would the technologies required to ensure survivability make them far too expensive to be allowed to operate in contested air spaces where there is a significantly higher probability of loss? In both cases, if the answer is not in favour of the RPAs, the inherent advantages of employing them become greatly diluted.

In little more than a decade, RPAs have become ubiquitous and have been exploited across all levels of conflict—strategic, operational and tactical. To an extent, they have become synonymous with the operations of the Western forces in all contexts. This increased USge was the result of a greater focus on irregular warfare, as well as the technological developments that made RPAs much more effective. But perhaps most importantly, RPA operations have been able to operate almost uninhibited in the permissive airspace of the Iraq and Afghanistan theatres of operations, where the bulk of Western operations have taken place within the past decade.

There has, however, been another conceptual development because of these operations—an unrealistically high expectation in the Western forces that control of the air will never have to be contested. In turn this has allowed operations to become highly reliant on the exploitation of effects available from even basic RPAs. Any challenge to friendly control of the air will have far greater impact on one's own operational efficacy than is currently being accepted or even considered in the planning stage.

The status of RPAs after operations wind down in Afghanistan will depend on the threat scenarios the joint force will face in the future. RPAs will be operated by all arms of the military, with the type of RPA determined by the operational or tactical effect desired by the user. RPAs will form part of the Air Force order of battle and operated to create effects across all roles of air power; but, requirements for RPA employment in contested airspace will drive the joint concept of operations along a significantly different path than witnessed during the Iraq/Afghanistan conflicts.

Another important aspect that will have significant impact on the future of RPAs is the question, and associated debate, regarding the employment of armed RPAs like the MQ-1 Predator and MQ-9 Reaper. It should be remembered that while the platform is unmanned, the decision-making and execution commands are all human based. The use of armed RPAs has increased in the Afghanistan theatre but their autonomy in actual operations is greatly restricted. The question commonly raised is the amount of autonomy that can be given to these systems. Autonomous weapon release is technically feasible on both RPA and manned platforms, however to ensure decision-making continues with a human-in-the-loop, it is unlikely that complete autonomy will be granted.

The actual control of the RPA rests solely with a human being, albeit operating from a remote location on the ground. Advances in technology can permit automation to a very high degree, allowing the controller of the RPA to monitor the progress of the aircraft during a pre-programmed flight—just like a pilot would do in a manned aircraft on autopilot. Equally, the controller can 'fly' the RPA with the use of controls located in a remotely positioned mission station.

Irrespective of the method of control adopted, the cultural issues of physically flying versus remotely flying RPAs must be addressed. A number of air forces report a cultural disconnect between the established 'pilot culture' of traditional air forces and those of the RPA operators. Some of this issue abates as an air force matures in its RPA operation, but this dichotomy needs to be addressed if the RPAs are to develop further.

The challenges facing the continued evolution of RPA operations in contested airspaces brings into focus the primary role of air forces—to obtain and maintain the necessary level of control of the air. Air superiority missions, necessary to achieve this, will continue to have to be given priority and are even more critical than before for two reasons. First, potential adversaries have closed the technology gap, especially in air defences, and are now capable of contesting control of the air even if in a limited manner and delineated in time and space. Second, the reliance on RPAs for the efficient conduct of the ISR role will require their survivability in a contested environment; therefore, air superiority will be critical to the success of joint campaigns.

Alongside their persistence, RPAs provide an acceptable means to carry out missions where the risk to a manned platform would be high. However, adopting this concept of employment is predicated on a cost-effective and readily replaceable capability. This can be achieved either by ensuring that losses are kept to a minimum, or by reducing the technological sophistication of the RPAs to minimise their per-unit cost. This is a fragile balance between cost-effectiveness and capability requirement. Any imbalance in this delicate equilibrium will be detrimental to the efficacy of RPAs in future conflicts.

Wedgetail Reaches IOC – But What Does This Really Mean?

A few days ago the E-7A Wedgetail, Australia's Airborne Early Warning and Control (AEW&C) system, achieved its Initial Operational Capability (IOC). With this milestone Australia, for the first time, has a single platform capable of controlling the battlespace, providing direction for fighter aircraft, surface combatants and land based elements, as well as coordinating the operations of aircraft such as tankers and other force multipliers. Wedgetail significantly enhances the effectiveness of the ongoing Navy, Army, Air Force and Coastwatch operations, and will help Australia maintain a capability edge well into the future.

Key Points

- *The achievement of IOC for the Wedgetail places Australia at the leading edge of battlespace management capabilities.*
- *Capability is a collective term that describes all the FIC that enable delivery of a specific effect for the designated time.*
- *IOC and FOC are capability states that signify when either a subset or the entire capability system, can be operationally employed.*

Wedgetail gathers information from a wide variety of sources, analyses it and distributes it to all friendly air and surface assets, greatly increasing the overall 'situational awareness' of the force. The AEW&C mission is to conduct surveillance and coordinate air defence, fleet support and surface operations in defence of Australian sovereignty and other national interests. When required, the AEW&C capability will also support civil or military operations aimed at law enforcement, regional cooperation and peacekeeping.

The sixth and final Wedgetail was accepted by Australia in June 2012. Based on the 737-700 commercial airliner airframe, this highly-modified aircraft features an advanced multi-role, electronically scanned radar and 10 state-of-the-art mission crew consoles that are able to track multiple airborne and maritime targets simultaneously.

Extensive testing and evaluation has overcome many challenges and has enabled the AEW&C to be certified to a level where it has achieved IOC. Wedgetail required the development and integration of technologies that remain at the leading edge of science and engineering.

Air Force's maturity in the AEW&C mission has grown with its increasing participation in complex air defence exercises, especially Exercise RED FLAG in June 2012. Through this and other exercises, Air Force was able to grow the capability of its people, train and integrate with coalition forces, and employ Wedgetail in a realistic operational environment. While the Air Force has proven its ability to achieve IOC, this is only one more milestone in achieving its goal of Final Operational Capability (FOC).

Wedgetail is one of several significant capabilities that Air Force, along with Capability Development Group (CDG) and Defence Materiel Organisation (DMO), is in the process of bringing to IOC and FOC, with several more to be realised by 2020.

So what are IOC and FOC, and why are they important to Air Force's ability to deliver air power for the security of Australia?

Both IOC and FOC are capability states that achieve outcomes endorsed by the Capability Manager, which for aerospace capabilities of the Australian Defence Force is the Chief of Air Force (CAF). These capability states are major milestones in the Australian Defence Organisation's Acceptance into Operational Service process that extends from the statement of requirements phase through to the acquisition and in-service induction phase. CAF, as the Aerospace Capability Manager, has the responsibility to raise, train and sustain forces that generate air power effects to contribute to Australia's national security. For all aerospace capabilities, such as Wedgetail or Super Hornet, CAF is responsible to Government, through the Chief of Defence Force and Secretary of Defence, for delivering the agreed capability, by the means of the Fundamentals Inputs to Capability (FIC).

But what is capability? In the military context, ***capability*** is the power to achieve a desired operational effect in a nominated environment within a specified time, and to sustain that effect for a designated period. It is generated by the FIC comprising: organisation, personnel, collective training, major systems, supplies, facilities and training areas, support, and command and management. Capability is not just an aircraft, a piece of equipment, system or a team of trained specialists. Capability is a collective term that describes the optimum combination of all the elements that deliver a required effect. Since CAF is responsible for generating air power effects for the security of Australia, he also holds the responsibility for reporting and declaring when a capability reaches a level suitable to provide an operational air power effect.

Initial Operational Capability is the point when one or more subsets of the entire capability system can be operationally employed. Because different capabilities produce different effects and draw on varying aspects of FIC, time to achieve IOC and the required operational effects will differ for each phase of the project. IOC is endorsed by the Capability Manager, CDG and DMO at Second Pass project approval. However, operational, technical and FIC requirements are responsive to real-world influences, thus it is common for the level of operational effect and dates for achievement of IOC to change.

Final Operational Capability is the point when the final subset of the system achieves IOC and the complete capability system can be operationally employed. Achieving FOC will result in the full capability effect to be generated through delivery of the entire range of the fundamental inputs to capability. Capability development and the acquisition process is complex so, for projects with many subsystems, IOC and FOC is normally achieved in a phased manner. Operational acceptance of a capability acknowledges that a system, or subset, has proven effective and suitable for the intended role and is ready for operational service. In most cases such suitability is demonstrated through Operational Test and Evaluation.

Because capabilities are directly linked to operational effects, a project can deliver its capabilities in an incremental manner. This is common practice, as rarely will a project deliver the entire range of a capability at one time and is the reason for a project to be broken into phases, with different phases having independent initial and final operational capabilities. An example of this approach is visible in Air 7000: the Future Maritime Patrol and Response project. Phase 1B will deliver a Multi-Mission Unmanned Aircraft System, while Phase 2B will see the delivery of the P-8A Poseidon. Each will have separate IOC and FOC milestones.

All projects, especially leading-edge technology ones such as the Wedgetail, contain risks and challenges associated with the inherent uncertainty regarding technology choices and the processes needed to achieve desired outcomes. Risk is the possibility or potential that an expected outcome is not achieved, or is replaced by another. Understanding the risk and its potential impacts is critical in appreciating why the requirements, project cost and delivery timeframe of milestones such as IOC and FOC change over the duration of the project. Risk management of Air Force capabilities is not discretionary, and is considered an essential component of management and sound corporate governance. In determining if a particular aerospace capability has achieved IOC or FOC, CAF takes into account the possible risk involved in the generation of the capability through each FIC.

For Australia, the achievement of IOC for Wedgetail represents a significant and defining step forward in assuring its future security. It is one more step in a path to generating the air power that Australia requires to protect its national security imperatives.

The P-8A Poseidon's Role in Australia's Maritime Strategy

The maritime environment has long been at the core of Australia's security strategy. Trade and continued access to the global maritime commons continue to be fundamental to Australia's prosperity. Australia's ability to function as a maritime trading nation is underpinned by the use of the oceans and airways surrounding its shores as reliable means of engaging with neighbours and trading partners. Security and stability of the maritime environment, therefore, lies at the heart of Australia's maritime security strategy. The Australian Defence Force's maritime strategy is predicated on influencing and shaping the environment where national interests lie, providing a deterrent to any action against Australia, and then, if absolutely necessary, defeating any adversary that attacks or threatens Australia and/or its interests.

Air power has long contributed to security in Australia's geo-strategic environment through the RAAF's maritime surveillance and strike capability. From the Sunderland and Catalina flying boat operations during World War II, through to Cold War patrols by P-2V Neptunes and AP-3C Orions, the Air Force has demonstrated its ability to secure Australian interests in the maritime environment. The AP-3C continues this tradition to the present day

Key Points

- *The air power effects delivered through airborne maritime ISR and response have long underpinned Australia's maritime strategy.*
- *The acquisition of the P-8A Poseidon as the manned platform for the AP-3C replacement provides the growth potential to meet future maritime ISR and response needs to support Australia's maritime strategy.*
- *The P-8A will operate across the full range of missions currently undertaken by the AP-3C and, in many cases, exceed those capabilities of its predecessor, and will be complimented in the future by a multi-mission unmanned air system.*

with its recently completed, decade-long operations in the Middle East, and its longstanding commitment to border security across Australia's northern approaches. However, while the AP-3C is still a highly capable platform, it is nearing the end of its service life and, despite a number of life-of-type extensions and mission system upgrades, the ability to expand its operational capabilities will have culminated by the end of this decade.

Australia's approach to replace the capability provided by the AP-3C represents a shift from traditional type-for-type replacement. In an effects-based approach to acquisition, the maritime patrol function will now be split between manned and remotely-piloted platforms. The Australian Government's announcement of the P-8A Poseidon as the manned platform replacement for the AP-3C ensures Australia's continued ability to maintain a responsive maritime patrol and overwater intelligence, surveillance and reconnaissance (ISR) and response capability. Under Phase 2B of Project Air 7000, Australia will acquire (subject to approval) sufficient numbers of P-8As as the manned platform element.

The P-8A Poseidon, recently introduced into service with the United States Navy, is based on a Boeing 737-800 airframe, but with significantly greater structural integrity to enable the low-level operations required of a maritime patrol aircraft. The P-8A is fitted with the larger 737-900 Extended Range wings to increase performance and fuel capacity. The P-8A has a ferry range of over 4000 nautical miles on internal fuel, or an ability to stay on-station for over four hours at a range of over 1200 nautical miles from base, placing its operational reach well into the Pacific, Indian or Southern Oceans.

Like the E-7A Wedgetail Airborne Early Warning and Control platform, the P-8A can carry out air-to-air refuelling from Australia's KC-30A Multi-Role Tankers Transport, which increases its range and endurance. This air-to-air refuelling function extends its area of influence, providing greater force protection coverage for maritime elements such as a Surface Action Group or Amphibious Task Force.

The P-8A will be capable of performing the full range of missions currently undertaken by the AP-3C though, as with almost all new capabilities, the way missions are conducted may differ from the previous platform. The performance of the P-8A and its advanced sensor suite enables the conduct of some operations at higher altitudes than typically conducted by the AP-3C. The P-8A will be able to take advantage of this capability to maximise its mission performance and endurance. Additionally, higher altitudes increase the range of the sensors, enhancing the radar and other sensor coverage that the P-8A can achieve.

But the P-8A is not just a high-altitude capability. When weather or operational conditions require, the P-8A can operate efficiently at low-level, just like the AP-3C. Its design, handling characteristics, systems and performance enable it to exceed many of the operational capabilities of the AP-3C.

The P-8A can carry over 20 000 pounds of weapons, including torpedoes and standoff anti-ship weapons across its internal weapons bay and on wing-mounted hard points. This creates deterrence and affords protection to Australian maritime elements while posing a threat to an adversary's naval capabilities. Its weapons, advanced sensors, processors and networking capability add teeth to Australia's maritime security strategy.

Submarines continue to proliferate across Australia's area of interest, creating an increased level of risk to Australia's trade routes and pose a threat to its naval combat elements. The P-8A's acoustic system, with new generation sonobuoys, enhanced buoy accuracy through Global Positioning System, improved algorithms and reduced signal losses will significantly increase Australia's ability to detect, localise, track and, if required, attack submarines. The P-8A does not come with the magnetic anomaly detector carried on many legacy maritime platforms, however the addition of multi-static acoustic sonobuoys and an advanced acoustic processor results in anti-submarine warfare performance far exceeding those of its predecessors.

As identified in the 'Australia in the Asian Century' White Paper, the Indian Ocean and Asia-Pacific regions will continue to be an area dominated by international shipping. In addition, the increasing maritime capabilities of regional nations will see more military activity than ever before in the same area. Australia's maritime strategy is predicated on security and stability across this area of interest, and the P-8A will continue the traditions of the AP-3C and its predecessors in contributing to the security of the maritime commons through its patrol and surveillance operations.

Manned maritime platforms provide a significant degree of flexibility and responsiveness, however the increased persistence available through remotely piloted aircraft will be leveraged in Australia's next generation maritime capability. Under Air 7000 Phase 1B, a Multi-mission Unmanned Aircraft System will be acquired for long endurance, persistent maritime ISR to compliment the P-8A operations.

No-one can accurately predict the future, but the P-8A Poseidon will provide Australia with the ability to grow its maritime ISR, anti-ship warfare, anti-submarine warfare and search and rescue capabilities to meet the security challenges of the future in the maritime environment.

Space Situational Awareness

> **Key Points**
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> - *Space is becoming more congested, contested and competitive from over 50 years of space activities and the significant increase in space debris.*
> - *Surveillance of space is conducted by a network of sensors.*
> - *In 2012, Australia and the US agreed to locate a C-Band space surveillance radar and a highly advanced Space Surveillance Telescope to Australia, enhancing their joint SSA capabilities.*

Since 1957, when the first man-made object was placed into earth's orbit, space has increasingly become a key enabler for nearly all military, governmental, commercial and individual operations. From mobile phones to precision weapons, the explosion of electronics into almost all facets of modern life has placed increasingly greater importance on space-based capabilities.

However, space—though an isolated and seemingly empty region—is becoming increasingly congested with active satellites and discarded space junk. Maintaining an awareness of the position and trajectory of these objects is important when the relative speed of closure between objects can be as high as 14 kilometres per second. The vulnerability of a space asset to a collision with even a minute piece of space junk makes Space Situational Awareness (SSA) an absolute necessity to successful operations in the space domain.

Military forces around the world are increasingly reliant on space-based capabilities for communications, positioning, timing and surveillance to enable the delivery of their primary effects. SSA provides the operators of space-based capabilities the ability to anticipate the influence of other space objects and take action to ensure continued and unimpeded operation of space vehicles. Commanders and decision makers use SSA to leverage the capabilities of space-based systems while exploiting the associated vulnerabilities of an adversary. SSA is provided through the tracking, classification and identification of space-based objects.

Air power is heavily dependent on space-based technology. Satellite communications deliver information in a timely manner to deployed forces to ensure mission effectiveness. Global navigation satellite systems, primarily the US Global Positioning System, provide accurate positioning, navigation and timing information to support Australian Defence Force (ADF) operations. Intelligence, surveillance and reconnaissance activities provide remote sensing products—such as imagery, missile and other threat warnings—and signals intelligence products as an enabler in creating air power and joint operations effects. Meteorological services are also reliant on space-based products, with these products providing vital information that enhance air, land and maritime operations. The loss of all or any one of these space-based services, and their associated products, will have a detrimental effect on joint operations through a reduction in mission effectiveness.

The growing dependence on space systems within the ADF, the increasing number of foreign space systems, and the rapidly increasing amount of space debris, constitute a growing vulnerability to operations. SSA provides the foundation for safe and responsible space operations. SSA is the fusion of many sources of data to predict, detect and provide warnings of any threats to space assets in order to ensure access to, and protection of, critical space capabilities. So what is involved in SSA? The various elements of SSA include: surveillance of space objects; knowledge of space weather; space object identification; and intelligence on space object capabilities and intent.

One of the key elements of SSA is the knowledge of the location of objects in Earth orbit. This is achieved through surveillance of space, which is the observation (both passive and/or active) of objects in orbit around the Earth. Surveillance of space involves the detection, tracking, identification and cataloguing of space objects using a global network of space surveillance sensors. Radars, both conventional and phased-array, provide the backbone of any space surveillance network. They are capable of providing 24-hour operations in nearly all weather conditions. Phased-array systems are capable of tracking multiple objects simultaneously and scanning large portions of space rapidly. Optical telescopes provide the second major type of space surveillance sensor. They are passive systems which rely upon the light reflected from a space object that is incident upon the sensor, typically a digital camera. Optical telescopes are able to cover large areas of space quickly and have a greater range than radars. However, they are not capable of 24-hour operations as they are affected by daylight and weather.

In addition to the traditional radar and optical tracking sensors, there are also other more specialised sensors which contribute to SSA. These include lasers for very accurate distance measurements, infrared sensors which detect heat, telescopes which take pictures of space objects, sensors which detect electronic emissions from space objects, and specialised imaging radars which create images of the objects. All of these various passive and active sensors can be located on the Earth, or onboard satellites in orbit.

There are several space surveillance networks involving amateur satellite observers, the scientific community and the military. The most prominent of these networks is the US Air Force Space Surveillance Network (SSN), which maintains the most complete catalogue of space objects. This is a network of 29 radar and optical sensors, and includes a US military operated space-based telescope onboard the Space-Based Surveillance Satellite. However, there is a limitation in the SSN, in that there is little to no coverage from the Southern Hemisphere and Asia.

Once positional data is obtained from the SSN, it is fused with the other elements of SSA to form an overall space picture (analogous to the air and sea picture). This space picture includes intelligence data on the capabilities, limitations, vulnerabilities of the system, and the doctrine and tactics of the state that owns and operates the system. Additionally, the environmental conditions are monitored and analysed, in order to anticipate terrestrial and space weather events, solar activity, and atmospheric weather effects. SSA also looks for any natural near-earth objects or potentially hazardous asteroids that may pose a threat to space objects and capabilities.

In 2010, Australia and the US signed an SSA Partnership Statement of Principles that recognises the importance of SSA to protect national interests, and support global peace and security. At the 2012 Australia-US Ministerial consultations, both nations affirmed their intention to relocate two space surveillance sensors—a C-Band space surveillance radar and a highly advanced Space Surveillance Telescope—from the US to Australia to strengthen the SSN's ability to track space objects and debris.

Within the ADF, the Australian Space Operations Centre (AUSSpOC) provides operational SSA utilising indigenous and coalition space assets to Government and operational commanders. AUSSpOC is located in the Air and Space Operations Centre within the Headquarters Joint Operations Command.

Space continues to be an essential enabler for the ADF in general and the Air Force specifically. Nearly every air power effect delivered by the Air Force is enabled by space operations to some degree. SSA is central to the continued delivery of space capabilities and its importance to air power continues to grow.

Jindalee – Nowhere to Hide

From Exmouth in the west to Cairns in the east, Australia's northern coastline extends nearly 15 000 kilometres. Before the introduction of the Jindalee Operational Radar Network (JORN), persistent surveillance of Australia's northern approaches was inconceivable. However, with impetus from technology, innovation and a succession of far-sighted Government decisions the impossible became reality, and today the 'air-sea gap' to Australia's north is under constant watch.

> **Key Points**
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> - *JORN is an essential element of Australian air power and is critical to the continued security of Australian national interests and its National Maritime Strategy.*
> - *Technological developments, scientific innovation and government support, combined to develop a state-of-the-art, world-leading surveillance capability.*
> - *Jindalee acts as a force multiplier for other ADF and Government capabilities, making it a truly strategic national asset.*

In World War II the Japanese, operating with technology far less capable than available today, demonstrated that major maritime and air operations could be mounted against the Australian continent. From bases in Java, Timor, Ambon, West Papua, Papua New Guinea and the Solomon Islands the Australian mainland was attacked with little warning and with great effect.

For the next 40 years there was very limited capability available to enable a persistent awareness of activities across the approaches to the North. Australia's resource base is insufficient to support the large number of air, maritime or space surveillance platforms that would be required to constantly monitor the northern approaches. An innovative solution was required to provide the persistent wide area surveillance necessary to make the self-reliant defence of Australia a successful strategy.

Australia's involvement in long-range persistent surveillance began in the early 1950's. The work was led by John Strath, a high frequency

(HF) and ionospheric research scientist who had worked on Britain's World War II 'Chain Home' radar system; arguably the technology that enabled the 'few' to get the drop on Germany's 'many' during the Battle of Britain. After the war, Strath led an Australian team to build a radar capable of detecting aircraft at ranges of up to 800 kilometeres. However, Strath realised that reliable detection required a much larger and more powerful emitter than what was available at the time. Work on the project stopped around 1955 and experimentation with HF radar began to take a different focus.

Australian interest in HF radar was revived in November of 1970, when the Minister of Defence approved Phase 1 of a HF studies program known as Geebung. Geebung confirmed the operational and technical viability of refracting HF signals off the ionosphere to conduct long-range surveillance. Project Jindalee commenced in 1974 with the construction of a prototype Over the Horizon Radar (OTHR) system at Mount Everard and Harts Range, near Alice Springs. The first successful aircraft detection occurred in 1976. Cabinet approved a second stage in May 1978, with the purpose of constructing a 'new and improved' OTHR next to the prototype site. The first successful detection of a surface vessel occurred in 1983.

The 'Defence of Australia' approach and policy of self-reliance that arose from the 1986 Dibb Report, and the 1987 Defence White paper, significantly altered Australia's Defence policy and provided a further stimulus to OTHR investment. The era of 'Forward Defence' ended and the self-reliance approach shaped Defence's strategy, planning and operations. Defence of Australia required the Australian Defence Force (ADF) to monitor activity and defend Australian interests in the northern 'air-sea gap'. This necessitated surveillance of the very long lines of communication that connect Australia to its major trading partners and allies. A constant and detailed awareness of air and sea activity throughout the northern approaches was vital to the Defence of Australia concept.

The Government approved Dibb recommendations for further development of the Jindalee OTHR. Four decades of research had proven that HF radar could detect aircraft (even those at low altitude), and maritime vessels at ranges up to 3000 kilometres from the transmitting station. For the first time, technical capabilities and Government intent combined to make persistent, wide area surveillance of the air-sea gap a real possibility.

The 1987 White Paper committed Australia to developing two additional HF radars at Laverton (WA) and Longreach (QLD), to link with the Alice Springs radar. Currently, control of all radars is centralised through No 1 Radar Surveillance Unit (RSU) in Edinburgh. JORN track data is fed to the Regional Operations Centre (ROC) at RAAF Williamtown for correlation with other sensors. OTHR tracks form part of Australia's Recognised Air Picture (RAP) and are disseminated to Defence and Government agencies via terrestrial communications and datalinks. The system was fully realised in 2003.

While the Jindalee radar has proven to be an excellent surveillance radar, ionospheric conditions can affect its operational performance, and it does not have the accuracy required to act as a targeting radar. Its value lies in its ability to act as a 'trip-wire' to cue other capabilities such as the Wedgetail and AP-3C Orion aircraft or the Navy's ships and submarines to carry out focussed surveillance and interception operations. Jindalee acts as a force multiplier for other ADF and Government capabilities, making it a truly strategic national asset.

While the most common application of Jindalee's capabilities is in the general detection of air and maritime traffic, the radar also provides other services to the ADF. For example, JORN could establish a surveillance 'bubble' around an Amphibious Task Group to detect any potential air or surface threats. JORN can alert the Task Group to a threat well before the Task Group's organic surveillance and tracking systems could detect it. Additionally, JORN can monitor specific airfields and ports to establish a normal pattern of movement profile that can then be used to identify abnormal activity in a given area.

Since the 1950s, successive governments, scientists and Defence administrators have recognised the potential of HF radar. Bold vision, sustained investment and technical commitment have transitioned Jindalee from a concept, to an experiment, and finally to a state-of-the-art, world-leading surveillance capability. JORN is an essential element of Australian air power and is critical to the continued security of Australian national interests and its National Maritime Strategy.

Jindalee – Bending Radar Waves to its Will

The 2013 Defence White Paper outlines four principle tasks for the Australian Defence Force (ADF), the first of these being to deter and defeat armed attacks on Australia. The White Paper acknowledges that Australia's geographic characteristics require a predominantly maritime strategy as a fundamental requirement to assure the security of its sovereign territories and national interests. The air-sea gap to the north of Australia covers millions of square kilometres and poses significant challenges for the ADF in maintaining situational awareness across this massive area. Australia's Over-the-Horizon Radar (OTHR) network provides the ADF with the means to establish and maintain surveillance across Australia's northern and western approaches. The three OTHRs that lie at the heart of the Jindalee Operational Radar Network (JORN) provide a layered surveillance system that covers the vital northern approaches. The effects delivered through JORN provide a clear demonstration of the air power characteristics of perspective, reach, penetration, responsiveness, flexibility, concurrent operations, concentration of force, and persistence.

Unlike conventional microwave radar, OTHR is not limited in range to the visual horizon. OTHR utilises the unique properties of a segment of

Key Points

- *The effects delivered through JORN exemplify the key air power characteristics of perspective, reach, penetration, responsiveness, flexibility, concurrent operations, concentration of force and persistence.*
- *The use of refracted HF beams negates traditional limitations of conventional radar systems caused by the curvature of the earth, and allows OTHR to detect and track targets between 1000 and 3000 kilometres from the radar site.*
- *JORN provides the ADF with the ability to conduct persistent surveillance across Australia's northern approaches and to respond rapidly to changing situations.*

the atmosphere known as the ionosphere to 'bounce' emitting radio waves beyond visual ranges. The ionosphere allows for the refraction of high frequency (HF) electromagnetic emissions, or HF waves, back towards the surface of the Earth. When these refracted HF waves hit a metallic surface of sufficient size, either in the airborne or maritime environment, some of the energy is reflected back along the transmission path to the OTHR receiver. The use of refracted HF beams negates the traditional limitations of line-of-sight caused by curvature of the earth, and allows OTHR to detect and track targets between 1000 and 3000 kilometres from the radar site. This perspective makes it difficult for ships or low-flying aircraft to operate in the air-sea gap undetected.

Reach and penetration are also important characteristics of OTHR. The reach of an airborne platform is characterised by the ability to project military power over long distances largely unconstrained by physical barriers. OTHR's unique operating method means that it is not constrained by limitations of aircraft, such as fuel, or by terrain and other physical barriers. From bases in Longreach, Alice Springs, Laverton and Adelaide, JORN can surveil the air-sea gap to Australia's north without any restrictions.

OTHR does not 'sweep' its area of coverage in a manner similar to conventional radars; rather it focuses emitted energy onto a particular area (or 'tile') through the utilisation of electronic beam steering. The tiles can be selected on the basis of long-term tasking requests, or can be moved quickly in response to intelligence queuing or a changing operating environment. The placement of each of these tiles requires a thorough understanding of the operating environment—the best results being achieved when JORN works cooperatively with intelligence agencies. JORN has a close relationship to intelligence for its optimised employment and is able to respond rapidly to changing operational requirements.

Tiles can be located across a very large geographic area, supporting multiple operations and searching for several target types. JORN has the capacity to detect vessels the size of Armidale Class patrol boats in the Torres Strait, then switch, within minutes, to tracking aircraft overflying oil rigs along the north-west shelf, or to supporting search and rescue activities near Darwin. No other surveillance capability within the ADF offers this level of responsiveness and flexibility. The capabilities of the three radars can also be concentrated to support high priority operations with multiple, overlapping tiles providing high quality surveillance of a smaller area of interest.

Effective use of OTHR radar can create persistent effects by generating a knowledge base of activities across Australia's northern approaches. This situational awareness allows the Australian Government and the ADF to maintain a level of information and decision superiority. Such an application of air power allows the achievement of a persistent effect in both the physical and virtual domains. OTHR's physical persistence is broadly known, and widespread awareness of the RAAF's JORN capability may shape the decision-making processes of those wishing to operate in Australia's northern approaches. This persistent effect could influence the actions of potential adversaries if they are aware that their maritime and air activities across the north and west of Australia can be detected and tracked by the ADF at will.

OTHR does have limitations, and these must be taken into account when integrating its product into operational plans. OTHR is designed to detect vessels down to an Armidale Class patrol boat sized vessel, and air targets of a similar size to a BAE Hawk-127 aircraft. Targets of smaller size may not offer a sufficient radar cross-section to reflect HF energy back to the receiver. Additionally, the ionosphere is a highly dynamic component of the atmosphere and presents additional difficulties. Diurnal (day/night) and seasonal changes as well as solar activity such as solar flares result in ionosphere inconsistencies, which can significantly impact the detection probability and characteristics of OTHR.

JORN's embodiment of air power characteristics such as perspective, reach and penetration combine to give the ADF the capability to conduct surveillance across a wide geographic area. JORN provides the ADF with the ability to conduct persistent surveillance across Australia's northern approaches and to respond rapidly to changing situations. The system's flexibility allows surveillance efforts to be diverted quickly and effectively from one target or object to another, or from one area to another, in response to shifting priorities. Alternately, surveillance operations can be focused on a single area of high interest. JORN's unique design and operating method make it integral to the delivery of air power to contribute to Australia's national security.

Operation SERVAL: Air Power Lessons from the French Intervention in Mali, 2013

In March 2012, a coup in Mali enabled three Islamic militant groups—Anser Dine, Al-Qaeda in Islamic Magreb and Movement for One & Jihad in West Africa—to combine with the local Tuareg National Movement for Liberation of Azawad (MNLA) to overrun Northern Mali. The United Nations approved the formation and employment of the African International Support mission in Mali (AFISMA) to recapture the overrun areas. To pre-empt the deployment, the militants launched an offensive into Southern Mali in early 2013, threatening thoUSnds of French citizens living mainly in Bamako. On 10 January the French Defence Minister, Mr. Le Drian, outlined intervention plans through Operation SERVAL. The aim was to assist Mali forces halt the militant offensive, recapture Northern Mali in conjunction with AFISMA forces and re-establish government control.

Key Points

- *In January 2013 French forces were deployed to assist weakened Mali military forces to halt a militant ground offensive threatening to overrun Southern Mali.*
- *The French employed airpower to slow the momentum of the militant offensive and thereafter combined operations to counter attack and retake Northern Mali.*
- *The operation demonstrated the viability of French forces undertaking combined operations at long-range in a benign air environment.*

The French were well positioned to respond quickly. Already located in theatre was an Operational Headquarters (HQ) at Dakar in Senegal, a Joint Force Air Combat Command (JFACC) at N'Djamena in Chad, and tactical HQ at Bamako in Mali; all connected via secure Syracuse satellite communications allowing voice and data exchange. Strategic intelligence, surveillance and reconnaissance (ISR) was available through the French Helios/Astrium satellite systems providing daily imagery on Mali. From 14 January, this was supplemented by US input from the Air Operations Centre (AOC) in Ramstein, Germany. Theatre ISR already in West Africa included two FI-CR and one Transall C-160 at N'Djamena in Chad, two Harfang Unmanned Aerial Vehicles (UAV) with a ground station at Niamey in Niger, and two Atlantique II aircraft at Dakar in Senegal.

Operating in a benign air environment enabled uninterrupted French build up at Bamako, 400 kilometres south of the militant advance. Forward operating bases included Mopti Harbour on the Niger River and Sevare Airport less than 50 kilometres from militant forces. Over 1800 personnel and light armoured vehicles deployed from Chad, Burkina Faso, the Ivory Coast and France during the first week. Lack of strategic airlift assets to shift outsized cargo required leasing and requests to allies for C-17 aircraft. Theatre airlift assets were stretched and there were requests for NATO assistance. The French Army Cheetah Plan was activated with paratroopers, helicopters and mechanised units readied for deployment by air and sealift.

Air power provided speed and surprise to reduce the offensive momentum of the militants and gave sufficient lead-time for ground forces to deploy in Central Mali. On 11 January, a surprise strike by four Gazelle armed helicopters launched from Sevare airport hit the mobile southern militant column near Konna, destroying vehicles and forcing a withdrawal. One Gazelle was hit by militant fire, but was recovered to base although the pilot succumbed later to injuries sustained. The northern militant column near Diabaly was struck by a surprise night air strike by four Mirage 2000D launched from N'Djamena over 2000 kilometres away, and required two refuellings. On 13 January, four Rafale and two C-135 tankers flew 3000 kilometres from France across Algeria to strike militant logistics and vehicle parks in Gao, dropping 21 precision weapons. The force flew a further 1690 kilometres to recover at N'Djamena. Subsequent air strikes were co-ordinated and launched daily from N'Djamena against a range of militant targets in Central and Northern Mali based on target priority and dependent on tanker availability.

On 15 January, French ground forces were committed against the southern militant positions near Konna resulting in a series of engagements before the militants withdrew. The continued push of the northern militant column past Diabaly required a switch in the operational axis to support Mali forces. Ground operations were supported by 60 strike, 10 attack helicopter, 40 ISR/tanker and 30 intra-theatre airlift sorties in the first week. These initial actions successfully halted the militant offensive.

French sealift and airlift continued to build forces enabling the commencement of operations against Northern Mali. Air assets were relocated to Bamako to provide more responsive air support. ISR focused on building a picture of militant activity in urban centres and the deployment of a Royal Air Force Sentinel aircraft enabled real time road traffic monitoring. The offensive began on 26 January against Gao and set a pattern for follow-up operations that resulted in the recapture of Timbuktu, Kidal and Tessalit by mid-February. ISR enabled early precision air strikes. This was followed by persistent surveillance by a combination of a UAV and an Atlantique II aircraft that enabled French paratroopers to air drop and secure the local airport before linking with mobile ground forces to recapture the urban areas. On 29-30 January, AFISMA forces attacked from Niger and linked up with French/Mali forces in Kidal. On 18 January, Operation PANTHER sought to destroy militant strongholds in the northern mountain regions resulting in the last major conventional confrontations.

From mid-February the militants began to switch to guerrilla warfare, hiding outside towns or moving to northern mountain strongholds. They also commenced suicide bomb attacks and hit-and-run raids against Government buildings and supporters. Allied forces increased pattern of life and compound surveillance sorties to locate and target militant hideouts, weapons, logistics caches and surviving militant leaders. The US increased persistent ISR support including Global Hawk and Predator UAS, EP-3 and other manned platforms to enable the French to increase air strikes on suspected militant targets. Implementing government control and rebuilding the Mali Armed Forces began in April.

The major air power lessons that came out were: the need to improve effects chain response; the importance of timely strategic and theatre level ISR, secure long-range communications and in-theatre persistent air assets; and sparsely deployed air assets (that included tactical fighters, manned ISR, UAS, air tankers, airlift and maritime patrol aircraft) require an appropriate level of networking to boost combined operations capability. Further, it was demonstrated that tactical aircraft could provide responsive and effective long-range strike support, although sortie rates are determined by tanker support; and that attack helicopters require good integration with ground forces and enough stand-off capability to avoid small arms ground fire. At the planning level it was seen that the availability of strategic and theatre airlift directly impacted the speed of response to a crisis.

The French Defence Review in late April provided an assessment of the impact of Operation SERVAL on future French planning. In a constrained financial environment, the French sought to boost investment in intelligence and power-projection forces. Proposed new acquisitions included manned persistent ISR platforms and unmanned Predator UAS. The review confirmed the importance of continuing the planned acquisition of Rafale fighter aircraft, tanker/transports and new tactical airlift assets. However, no increase in numbers was being funded.

Operation SERVAL tested the French ability to perform combined operations at long-range in a benign air environment. Many of the lessons mirror the challenges the ADF may face when undertaking crisis response at range in a regional context.

An Evolving Concept: Disposable Unmanned Aerial Systems

Key Points

- *Small UASs have demonstrated their utility in the battlespace by providing ISR and close fire support.*
- *Disposable SUASs are being developed to enhance the situational awareness of deployed forces.*
- *Cost-benefit analysis will be the deciding factor to SUASs becoming an integral part of the contemporary battlespace.*

There is one capability growth area in the realm of Unmanned Aerial Vehicles (UAV) that has not received the attention it deserves, primarily as awareness of unmanned systems is very often limited to those represented by the Reaper, Global Hawk, Predator and similar aircraft; that of disposable unmanned aerial systems (UAS). However, both the military and scientific communities have been quick to realise that the benefits that UAVs provide could be used in smaller UASs—now being called SUASs—to enhance the operational efficiency of the force. Primarily the concept hinges on using small systems to provide close intelligence, surveillance, and reconnaissance (ISR) at the tactical level of the battlespace; effectively giving a greater situational awareness to the soldier on patrol. With the improvements in the performance of the SUASs, this role was further enhanced to provide overwatch of convoys that required greater endurance. Today, SUASs represent the largest number of UAVs in service.

The evolution of the SUASs from the initial concept has been rapid. They represent the lower end of the UAV capability spectrum and are relatively easy to operate compared to the more sophisticated vehicles. Their field of operation is generally limited to 'looking over the hill' or horizon in the battlespace. There is emerging recognition that even smaller, and less expensive—meaning technologically and operationally simpler—systems could have great utility in the contemporary battlespace and could influence the manner in which operations are conducted in the future. The idea now is to make them within a cost regime that would permit these SUASs to be used as disposable assets. Disposable SUASs, that can be operated by personnel with minimal training, and which are small and light enough to be carried in numbers by a few soldiers, is an extremely attractive capability. The current SUASs available still need sufficient skill levels required to assemble them and are not light enough to be carried by an individual. Normally they require a vehicle support to be launched effectively and are therefore primarily employed from the base rather than by the patrol they are supporting.

In recent times, UAVs have convincingly demonstrated their usefulness in ensuring the safety of deployed troops, who are by far the most at risk in the contemporary battlefield. The provision of actionable ISR and even close fire support when necessary, and in a timely manner, can be force-multipliers for troops in contact with the enemy. However, currently these capabilities are not organic to the unit and therefore not readily available at all times 'on demand'. Conceptually, the operational need to have instantly available ISR of the immediate area of interest has been recognised, and this capability will particularly boost the effectiveness of highly mobile and small units like Special Forces, and the extreme forward elements of the ground forces that typically operate in highly dynamic environments. The current SUASs do not meet the requirement of these groups who, even if they could launch a small system, may not have the ability to recover it safely due to a number of operational constraints. Further, the available systems could be far too heavy for long distance manual portage and be manoeuvre-limiting for a force almost completely reliant on rapidity of manoeuvre for their effectiveness.

It is in these conditions that the concept of expendable SUASs that could also be operated without specialist training becomes appealing. While the concept is alluring, currently the development of such systems is far from completed; there are a number of challenges yet to be overcome. Fundamental to the development is the cost-benefit analysis. The need is to have a design that can be developed and produced at a unit cost that the user will accept as being affordable vis-à-vis the benefit that it provides in its one-time employment, much like a bullet or a rocket that is fired once and forgotten. As in all other weapon system development, the cost factor will be a primary determinant to SUAS design and production.

There are other technical issues also to be overcome before the concept can become an ubiquitous reality in the battlefield. For the system to be considered useful and seen as enhancing extant capabilities of the deployed forces, it must have inherent simplicity in its operations—not an easy task to achieve. Scientists state that operational simplicity can only be achieved by having extremely advanced technology in its avionics, navigation system and flight controls. The balance between operational simplicity and cost factor will be very delicate, and will determine the 'throw away' aspect, which is central to the concept. Further, for the system to provide the necessary ISR picture to the operator—who is untrained—it will be necessary to have a base level autopilot system on board to ensure that the aircraft is optimally placed to provide the best field of view. The system's utility will also be determined by its ability to manoeuvre in small operating spaces, a fairly high speed to transit and the aerodynamic efficiency that will permit the minimum required loiter and cruise time. Miniaturisation of avionics and other hardware, as well as energy storage technology to keep the weight and volume within a very small physical envelope, will be another technical challenge to overcome.

There are a number of systems in development, some of which have also been fielded operationally on a trial basis. US AeroVironment's 'Switchblade', Israel's UVision 'Hero', Aurora Flight Science's 'Skate', Oto Melara's 'Horus', and MIT and Draper Laboratories 'WASP', are all examples of SUASs in development and undergoing trials. The systems in development are all less than three kilograms in weight, normally storable in small canisters and have an endurance of about 15-20 minutes in the ISR role. The speeds range between 50 and 90 knots and the payload typically about one kilogram. The dimensions of the systems in development are an average span of about 65 cm and length in the 50-55 cm range.

The concept has been further expanded to deliver these systems to their intended operating areas by firing them from artillery pieces, tank guns or aircraft. This increases the utility of the SUASs significantly from merely being ISR assets for forward deployed ground forces. There is research being undertaken to make these disposable systems wide area surveillance projectiles. As a use-once-and-discard capability, the potential in this role is enormous, especially in the maritime surveillance role.

The application and progression of the concept of disposable small UASs will be dependent on the cost factor. In times of austere budgets and financial stringency the cost-benefit equation is the deciding factor—just the fact that a capability enhances the efficacy of the force in the battlespace does not guarantee its use. This factor aside, UASs are on the cusp of bringing in an evolutionary change at the operational level of contemporary conflict.

Air and Space Power in the Defence White Paper 2013

> **Key Points**
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> - *The 2013 Defence White Paper provides strategic direction to the ADF.*
> - *The RAAF's capabilities will be enhanced by the commitment to the acquisition of improved systems.*
> - *Air power is now an indispensable element of national power.*

The Defence White Paper released on 3 May 2013 provides strategic direction to the Australian Defence Force (ADF). It gives a holistic view of how the ADF's warfighting capabilities will be developed in the coming years.

In the White Paper the Government lists the four principal tasks the ADF is responsible to discharge. These tasks in order of priority are: to deter and defeat armed attacks on Australia; contribute to stability and security in the South Pacific and Timor-Leste; contribute to military contingencies in the Indo-Pacific region, with priority given to South-East Asia; and contribute to military contingencies in support of global security.

The highest priority task of defending Australia is hinged on a maritime military strategy. Controlling the sea and air approaches to the nation in order to deny them to an adversary and provide maximum freedom of action for own forces is the key to defending Australia. This strategy, focused on the maritime domain, aims to: deter adversaries from conducting attacks against Australia or attempting coercion; achieve and maintain air and sea control in places and at times of our choosing; deny or defeat adversary attacks and protect key sea lines of communication; deny adversary forces access to forward operating bases or the freedom to conduct strikes against Australia from beyond our maritime approaches; and project power by deploying joint task forces in the Indo-Pacific region and support the operations of regional partners when required.

The RAAF's role in this strategy can be examined through the lens of the core air power roles—control of the air, strike, air mobility and intelligence, surveillance & reconnaissance (ISR)—and the provisions that the Government has made to enhance its ability to carry them out effectively.

The current force mix of F/A-18A/B Hornet and F/A-18F Super Hornet platforms is capable of gaining and maintaining the necessary level of control of the air at specific times and locations as required to enable and support ADF joint operations. The introduction of the EA-18G Growler will add a transformational electronic warfare capability that will significantly enhance the RAAF's capability in all of the four core air power roles. Further enhancement will be realised with the replacement of the F/A-18A/B by the F-35A Joint Strike Fighter with its stealth attributes coupled with its new weapons, sensors, networks and data-fusion capacity. The combination of this fighter fleet and the air-to-air refuelling capacity provided by the KC-30A significantly expands the geographic area where the RAAF will be able to establish adequate control of the air. Additionally, the introduction of the E-7 Wedgetail Airborne Early Warning and Control (AEW&C) aircraft has revolutionised Australia's control and coordination of its air combat fleet. The highly capable radar and systems onboard the AEW&C provide a situational awareness edge to the ADF.

The E-7 can also improve the level of control of the air when the Cooperative Engagement Capability (CEC) is fitted to the aircraft, which will allow the E-7 to communicate with the Navy's CEC equipped Air Warfare Destroyers (AWD). Such communications will permit the AWD to engage air targets beyond its own radar horizon and maximise the potential of its SM-6 missile, which has a range in excess of 200 nautical miles.

The F/A-18 family and F-35A are multi-role aircraft, and will not only deliver control of the air, but will also provide capable strategic and maritime strike options and pose a potent threat to a potential adversary. This is a powerful deterrent capability. Supported by the KC-30A and the E-7, the force package will have wide ranging capabilities, superior situational awareness, and will be well coordinated. The employment of new standoff weapons—such as JASSM and JSOW—will increase the lethality and survivability of the force and complicate an adversary's defensive considerations.

Australia's continued commitment to the acquisition of the Boeing P-8A Poseidon to replace the AP-3C Orion will also enhance the RAAF's anti-submarine warfare (ASW) and anti-surface warfare

(ASuW) capabilities. With its enhanced sensors and weapons, and with support from the KC-30A air-to-air refueller, the P-8A will provide long-range, long-endurance ASW and ASuW across Australia's vast maritime area of interest.

The P-8A's maritime ISR role is being analysed with the intention of sharing the workload with an unmanned system that will undertake broad area maritime surveillance and fleet overwatch. Satellite systems and the Jindalee Operational Radar Network (JORN) will complement this combination of manned and unmanned platforms. This combined ISR capability will provide a comprehensive air and maritime surveillance system.

Air Force's contribution to land and Special Forces operations is usually understood to be supplied by its air mobility fleet consisting of the C-17, C-130J and KC-30A. In the future, 10 C-27J will be acquired, the CH-47F will replace the CH-47D, and the Blackhawk will be replaced by the MRH-90—changes that will significantly boost the ADF's tactical and heavy airlift capability. Additionally, the ISR capabilities of the E-7, P-8A and unmanned ISR platforms will contribute to improved situational awareness of these forces. The White Paper also mentions that Defence will 'investigate the expansion of the role of unmanned systems to include interdiction and close air support', a possible addition to the strike capabilities provided by the F/A-18 fleet and the F-35A.

Other ISR capabilities discussed in the White Paper include the continued development of JORN, satellite systems, and some further significant steps into space situational awareness capability. These steps include the relocation of a currently US-based C-band space object detection and tracking radar and a highly advanced optical space surveillance telescope from the US to Western Australia.

The White Paper recognises that cyber capabilities 'have continued their evolution toward being military capabilities of real value'. The establishment of a new Australian Cyber Security Centre will boost Australia's ability to protect networks against cyber attacks. The Department of Defence will play a principal role in ensuring cyber security along with the best cyber security experts from a variety of other government departments along with State, Territory, industry and international partners.

From a historical perspective, the 2013 White Paper demonstrates the advances that air power has made in Australian national security thinking over the past 93 years. In 1920, the question being asked was whether a new service should be formed to field Australia's air power, or whether air power should remain purely an adjunct to the Navy and Army to augment their capabilities with specialised development within each. The 2013 White Paper clearly indicates that the Air Force is the primary repository of Australian air power, although both the Navy and the Army field organic air power elements. In less than 100 years, air power has transitioned from being a support element that enhanced traditional military forces to an indispensable element of national power, and an essential service in its own right. Since airpower is common to all three services, it is a critical component of joint force interoperability, integration, and the delivery of joint effects.

The Future of Unmanned Aerial Systems

Key Points

- *UASs have become a critical capability of fielded forces in the past decade.*
- *Budgetary constraints in most of the nations will force a reduction in military budgets that in turn will have an adverse effect on the further development of UASs.*
- *Innovative concepts of operations and improvement of existing performance will ensure that UASs remain essential elements in the overall capability of a joint force.*

In slightly over a decade, Unmanned Aerial Systems (UAS) have become increasingly more important to the efficient conduct of combat operations. Their impact has been particularly noticeable in the conduct of counter-insurgency operations of the past decade in Afghanistan, where it has attained the status of a critical element. As a corollary, this focus on a land-locked operation has also meant that most of the developments in the UAS capability spectrum have been oriented towards its employment in counter-insurgency operations across largely uncontested airspace, which may not be the reality in future theatres of operations. As multi-national forces commence their withdrawal from Afghanistan, there is a perceived need to reorientate the operational employment and development of UASs.

While the efficacy of UASs in the battlefield has been accepted, further enhancement of their capabilities and the development of new UASs have hit a roadblock. Over the past few years the global financial crisis has forced governments across the world to reconsider and recast their national budgets. In these circumstances the debate tends to focus on whether or not the nation should engage itself in wars of choice. The answer normally, especially when the nation is facing financial stringency, would be in the negative. These are the circumstances that the democratic world faces today. When defence budgets are trimmed across the board in almost all nations, the resources available to further develop a fledgling idea—albeit one that has proven to be extremely efficacious—will also automatically dwindle. The development of UAS capability, therefore, is at a crossroads now.

The United States (US) has so far been the largest developer of UAS technology, and its military forces have been at the forefront of UAS employment in combat situations. However, with the US Government's sequestration plan that intents to cut US$500 billion from the defence budget over the next 10 years, the decision to curtail the number of UAS strikes, and the US pivot to the Asia-Pacific while withdrawing from Afghanistan combine to retard possible development initiatives in UAS technology. The developmental trajectory that UASs enjoyed in the last decade and more will, of necessity, decline and may even plateau. Since there are fewer resources available globally for indulging in cutting-edge research, the focus is likely to shift to improving the existing system performance and developing innovative concepts of operations.

Under these conditions, it would be worthwhile to examine the advantages that UASs bring to the combat capability of a military force. The fundamental benefits are extremely high endurance in relation to manned platforms, flexibility, the ability to provide timely intelligence and sophisticated targeting capabilities. Furthermore, armed UASs can act on freshly available intelligence much faster that other systems and thereby reduce the so-called 'sensor-to-shooter' timeframe, which can be a distinct advantage when operating against irregular adversaries. However, arming of UASs have become a politically fraught debate and therefore, nations at the forefront of such developments are likely to slow the developments in this direction. The four characteristics that make up the UASs' coveted capabilities have as much importance in maritime operations as in the current land-centric ones being carried out in Afghanistan, although the mainstay of the UAS in a maritime environment will be its long endurance and its unmatched capacity to carryout intelligence, surveillance and reconnaissance (ISR) role.

Smaller UASs that have already been operationalised permit small, forward-deployed units to function effectively even in semi-autonomous conditions. These small and relatively inexpensive UASs have captured the attention of all ground forces, but are specially prized by Special Forces who traditionally operate autonomously in small groups. This is one area of UAS employment that is bound to see further developments.

The changing focus of the US military towards the Asia-Pacific has highlighted the peculiarities of operating in a maritime environment. While the ADF has always been cognisant of the maritime environment, the renewed interest of Australia's closest ally to the Asia-Pacific is likely to bring about some salutary changes. For one, there is already a proposition to use UASs as relay platforms for long-distance communications that would be vital in a maritime environment. This conversion should not be cost-intensive and will provide another role for the existing long-endurance UASs. While this would involve a passive relay system, the concept could be further developed to provide a stop-gap solution in situations wherein satellite communications have been denied by an adversary.

Another concept that is attractive to fielded forces is the arming of small UASs operated by forward-deployed forces with small munitions of the calibre of a sniper rifle. The use of small calibre weapons could overcome the political pushback that is apparent when arming of a UAS involves weapon systems like the Hellfire missile that have a high probability of creating collateral damage. From a purely ISR role that provides a certain amount of force protection, small UASs could assume a more proactive role—almost akin to offensive air support, but in a more controlled manner.

UASs that can be towed by a normal vehicle and are easy to on- and off-load from ships for amphibious operations are likely to become more ubiquitous than they are currently. Further, the internal bays of these UASs are being converted to 'plug-and-play' facilities to increase the flexibility of the platform to carry out a number of roles. Some of the loads currently being tested include synthetic-aperture radar, ground-moving target indicator radar and communications relay systems. Already some of the UASs have swing role capabilities and this is likely to get further emphasised into the future. These developments will likely focus on UASs weighing less than 100 kilograms to retain surface mobility and ease of deployment.

Irrespective of the lack of resources to continue further developments, UASs have proven their worth in the battlefield in a number of ways and are therefore unlikely to become a redundant capability. There are a variety of innovative USges that are being envisaged for the existing family of UASs, without having to expend large amounts of resources to develop new versions. These new concepts will continue to retain the position of a 'must have' capability that the UASs have ascended to in the past two decades.

Air-Sea Battle Concept

The military forces of the United States (US) and its allies rely on unimpeded global movement to stabilise regions and deter threatening regimes. But the rise of anti-access/area denial (A2AD) capabilities pose a significant challenge to such movement, thwarting the US' ability to project power and force on its own terms. By developing an A2AD strategy and capabilities, regional adversaries are able to contest US power projection and presence, and to oppose the operational and strategic influence of the US.

In 2009, recognising a need to preserve ways to project power and maintain freedom of action in the global commons, the US Secretary of Defense directed the Departments of the Navy and the Air Force to address this challenge and to develop an operational concept to be called Air-Sea Battle (ASB). In November 2011, a multi-service office to advance the ASB concept was created—with Army, Marine Corps, Navy and Air Force members—to collaborate in developing and analysing new and innovative ways to address the A2AD military problem.

Key Points

- *Air-Sea Battle: Service Collaboration to Address Anti-Access & Area Denial Challenges is the first unclassified summary describing how the US will deal with A2AD challenges.*
- *The Air-Sea Battle solution is to develop networked, integrated forces capable of attack-in-depth to disrupt, destroy and defeat adversary forces.*
- *Air-Sea Battle aims to increase operational advantage across all domains, enhance Service capabilities, mitigate vulnerabilities, assure allies and deter potential adversaries.*

The recently released *Air-Sea Battle: Service Collaboration to Address Anti-Access & Area Denial Challenges* is the first unclassified, official summary of the classified ASB concept, detailing how the US will deal with extant—and emerging—A2AD challenges. A2AD capabilities are those which challenge and threaten the ability of friendly forces to both get to the fight and to fight effectively once there.

Notably, an adversary can use the same capability for both A2 and AD purposes, thereby making power projection increasingly difficult, and in some cases extremely dangerous.

A2 and AD are relatively new terms in the military lexicon. A2 consists of actions intended to slow deployment of friendly forces into an operational theatre or cause forces to operate from distances farther from the conflict than they would otherwise prefer. AD actions are intended to impede friendly operations within areas where an adversary cannot or will not prevent access. That is, A2 affects movement to a theatre, whereas AD affects manoeuvre within it.

A2AD ideas are not new. The desire to deny an adversary both access and the ability to manoeuvre have always been elements of successful warfare. However, the proliferation of technologicaly advanced weapons are empowering potentially aggressive actors with previously unattainable military capabilities leading to instability. A new generation of cruise, ballistic, air-to-air and surface-to-air missiles with improved range, accuracy and lethality are now freely available. Modern fighter aircraft and submarines are now part of military forces of even smaller nations, while sea mines are being equipped with mobility, discrimination and autonomy. The space domain is now integral to communications, surveillance and positioning, and along with the cyberspace domain, is becoming increasingly contested. The pervasiveness and advancement of computer technology and reliance on the Internet and USble networks are creating means and opportunity for debilitating cyber attacks by state and non-state aggressors.

Any concept aimed at addressing operational problems associated with A2AD must be based on realistic assumptions regarding how a potential adversary would employ A2AD capabilities. In developing its ASB concept, the US has identified five factors that provide a conservative view of what an adversary could do, and how they would influence the US response. The factors are: the adversary will initiate military activities with little or no warning; given the lack of warning, forward deployed friendly forces will need to address A2AD challenges at the commencement of hostilities; potential adversaries will attack US and allied territory considered to be supporting operations against adversary forces; all domains will be contested by the adversary—air, maritime, land, space, and cyberspace; and, no domain can be completely ceded to the adversary, as to cede one domain would inevitably lead to the eventual loss of the other interdependent domains.

ASB describes what is necessary for a joint force to sufficiently shape A2AD activities to enable concurrent or follow-on power projection operations. Although not officially identified as an operational plan or strategy for a specific region or adversary, ASB seeks to ensure the US' ability to gain and maintain freedom of action in the global commons against a sophisticated adversary. It includes an analysis of the threat and a set of classified concepts of operations, or CONOPS, describing how to counter A2AD challenges, both symmetrically and asymmetrically, and develop an integrated force with the necessary capabilities to succeed in denying A2AD activities. ASB is about building conceptual alignment, programmatic collaboration, and institutional commitment in an integrated manner across the military Services in order to develop forces and capabilities that can jointly address A2AD challenges. The purpose of ASB, therefore, is to increase operational advantage across all domains, enhance Service capabilities, and mitigate vulnerabilities.

The central idea behind ASB is to develop networked, integrated forces capable of attack-in-depth to disrupt, destroy and defeat adversary forces (NIA/D3). ASB's vision of networked, integrated and attack-in-depth operations requires the application of cross-domain operations across all the interdependent warfighting domains (air, maritime, land, space, and cyberspace), to disrupt, destroy and defeat A2AD capabilities, and provide maximum operational advantage to friendly joint and coalition forces. A networked force is people and equipment linked in time and purpose with interoperable procedures, command and control structures, and appropriate authorities capable of translating information into actions. An integrated joint force is better able to combine capabilities across multiple domains to conduct specific missions, but it needs to be embedded across Service lines as part of force development.

The attack-in-depth methodology is based on countering an adversary's process of finding, fixing, tracking, targeting, engaging and assessing an attack on friendly forces. Disrupt, destroy and defeat represents the lines of effort for ASB; namely, disrupt adversary command, control, communications, computers, intelligence, surveillance and reconnaissance (C4ISR); destroy adversary A2AD capabilities; and, defeat adversary employed weapons and formations. Disrupting these effects chains includes impacting an adversary's C4ISR capabilities, ideally precluding attack on friendly forces. Destroying or neutralising adversary weapons platforms enhances friendly survivability and provides freedom of action. Defeating employed weapons, post-launch, defends friendly forces from an adversary's attacks and allows sustained operations.

At its core, ASB is the professed solution to the A2AD challenge in the global commons. It is based on creating multi- and cross-domain capabilities that can be exploited in an agile manner, by operating inside the adversary's decision loop without them knowing or suspecting where the next blow is coming from, denying the adversary the ability to react to it. It is not necessary to disrupt, destroy or defeat every ship, missile or aircraft. One only has to gain and maintain dominance for the necessary time period at the specific place needed to achieve the required effect. The key is figuring out how to operate inside the adversary's decision loop, change or influence their calculus, and operate at a pace with cross-domain, multi-domain capabilities that deny the adversary the ability to limit friendly force freedom of manoeuvre and action.

Given the proliferation of advanced A2AD technologies, NIA/D3 solutions will be a necessary component for US and allied forces to continue to confidently operate forward and project power on a global or regional basis. Air-Sea Battle should be seen as a natural evolution of the joint force towards more networked and integrated operational solutions. At its simplest, it is about fostering institutional and materiel change, and conceptual alignment in the Services to preserve ways to project power and maintain freedom of action in the global commons.

Future Wars and Air Power

> **Key Points**
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> - *The most likely wars and conflicts of the future will be irregular in their characteristics and conduct.*
> - *Air forces will need to maintain full-spectrum air power capabilities to ensure defence of the nation while having to scale their capabilities to meet 'low tech' requirements.*
> - *Middle-power air forces face a challenge in being able to meet the broad spectrum of conflict that span benign operations to full-scale warfare because the future is unpredictable.*

The nature of war has not changed over the centuries—every war is initiated to achieve political objectives through the employment of military forces. However, the characteristics and conduct of war have been continuously evolving, a process influenced by the available technology, context of the conflict, and the cultural and behavioural ethos of the participants. War, or conflict, broadly means the employment of the military forces of a sovereign nation against adversaries who themselves may or may not constitute a regular military force.

For a few decades after World War II, war continued to be fought between the military forces of two or more nations. However, the Vietnam War altered this status quo conclusively. From the 1970s, most conflicts have been fought between military forces of a nation and non-traditional adversaries, labelled a plethora of names—guerrillas, irregular forces, terrorists, insurgents etc. This raises two factors that must be considered in order to predict the characteristics and conduct of future wars and understand their implications for air power and air forces.

First, wars can be classified broadly into either 'wars of choice' or 'wars of necessity'. This classification holds true irrespective of the characteristics or conduct of the conflict. Wars of choice are the ones in which the national security interests of the participating nation(s) are only peripherally or indirectly influenced by the outcome of the conflict, and from which a nation could withdraw at any time without serious prejudice to national security. Wars of necessity are different.

They are conflicts that a nation is compelled to fight because not doing so would directly impact the security of the nation. The consequences of losing such a conflict cover a broad spectrum, from limited and perhaps bearable to where a loss threatens the very existence of the nation. The extreme cases of 'wars of national survival' are thankfully rare, although wars of necessity are still distinct possibilities. Even though the world today is exposed to more regional conflicts than was the case during the Cold War, most of these conflicts are 'wars of choice', especially in the case of Western nations.

Second, most contemporary wars evolve into conflicts wherein one participant resorts to the use of non-traditional means, thereby introducing asymmetry and other irregular means to its conduct. Conventional military forces may struggle to adapt to such conflicts, since their doctrine, training and fighting ethos are oriented towards combating forces similar to themselves. In the past few decades, these conventional military forces have taken giant strides in adapting to the changed conditions of operations. It may be that, in some cases, the pendulum has swung too far in favour of irregular warfare in terms of training and the development of concepts of operations. A large military has the inherent capacity to train a certain part of the force to cater for the irregular aspects in the conduct of conflict while continuing to maintain a majority of the force oriented towards its raison d'etre—the defence of the sovereignty of the nation against any and all attacks.

Numerically smaller forces will be challenged to achieve this while still being able to perform their core function—to protect national interests in wars of necessity against a similarly arrayed adversary. A military force must be able to conduct and win a war of necessity against an opposing conventional force if it is to be able to fulfil its primary responsibility to the nation. The topical claim that 'low tech' irregular conflicts are the only foreseeable threat would seem to be short sighted.

Having said that, it is unlikely that the world will witness a significant state-on-state war in the near future. Irregular wars that have no fixed start or end time, and are of varying intensity and tempo, will continue to manifest in a number of areas globally. However, the assured intervention in these conflicts by a conventional military force also cannot be predicted, although it would be safe to assume that such intervention would take place. In these circumstances, it would be necessary to look at the expectations of a middle-power air force and how it could continue to be an element of strategic influence in national security. All middle-power air forces with credible capabilities are facing similar major challenges—lack of resources, a changing threat scenario, increased demands from the government to perform a much broader spectrum of operations than ever before, and longer deployment durations that tend to discretely impinge on the operational preparedness of the force. There is no single panacea solution that could be applied to address these issues. Each air force has to solve them individually, with no two contexts being the same, while taking into account the unique requirements of their national security.

When considering the future employment of air power there are two areas where a degree of commonality could be envisaged. First are the capabilities that must be inherent in air forces for them to continue to be of strategic influence. Only a full-spectrum capable air force that can carry out all air power roles—control of the air, strike, air mobility and ISR—can achieve this status. This means that an air force must have sufficient combat capabilities resident in it to assure the nation that its surface forces would be able to operate without undue interference from enemy air power at a time, place and duration of the nation's choosing. Such an all-round capability can only be delivered by an air force capable of operating at the leading edge of technology, since air power is technology-enabled and empowered. There are many factors that influence an air force's ability to achieve this outcome.

Second is the ability of such an air force to adapt the same capabilities for operations in an irregular war wherein the application of air power capabilities would be more nuanced and at times discrete. Medium-sized air forces need to tread carefully in achieving this adaptability because normally they do not have the spare capacity to transform for optimised use in irregular wars. Therefore, the limited quantum of air power capabilities resident in middle-power air forces would have to be such that they can be rapidly scaled for employment in the most probable conflicts of the future, while retaining the high-end ability to perform their fundamental job of defending the nation and its interests against all attacks. This is a tall order, especially within the constraints that have been mentioned earlier.

In simple terms the scenario is this: the probability of state-on-state conflict occurring is fairly low, although it cannot be dismissed outright; in order to remain strategically influential and to be considered a critical element of national security, air forces need to have full-spectrum capability; the same capability needs to be contextually flexible in order to be effective in irregular wars, the most probable kind of future conflict.

It will be an ill-judged move by a middle-power air force to neglect its capability to carry out its core responsibility to provide adequate control of the air in order to meet the unique demands of irregular wars. In the long-term, no air force will be considered a strategic asset if it cannot assure the security of the nation. The need of the hour is for middle-power, full-spectrum capable air forces to ensure that they are not reduced to a tactical tool of strategic insignificance.

The Relevance of Air Power in Irregular Wars

> **Key Points**
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> - *Irregular wars, normally the result of bad governance, will continue to erupt in the future with minimal warning.*
> - *Air power, after obtaining control of the air, can create a distinct advantage in the conduct of an IW campaign, through providing strike, air mobility and ISR.*
> - *IW campaigns can only be successfully prosecuted by adopting a whole-of-nation approach in which air power, as an element of military power, is only one element of national power.*

With the long-drawn conflicts in Iraq and Afghanistan winding down there is a belief in some quarters that irregular warfare (IW), as it has been known for the past few decades, is a thing of the past; that the lessons of these conflicts are no longer relevant. However, this perception does not take into account that 80 per cent of the wars fought after the end of World War II have been irregular in nature; further emphasised by the recent events in North Africa. In fact, it can be surmised that democratic nations will be involved in IW in the future and, like most conflicts, at inconvenient times. This would be the norm rather than the exception.

IW, like any other form of conflict, can only be prosecuted successfully with adequate control of the air, which air power provides. Air power is a critical element in the overall capability of the nation to conduct a successful IW campaign, especially since it provides an 'asymmetric' edge over the adversary to erode their power, will and influence. The ultimate aim of all participants in an IW campaign is to win over the population of the contested nation/area, which often means that an intervening force would have to change the status quo. In order to achieve this, air power carries out three core roles: strike, air mobility, and intelligence, surveillance and reconnaissance (ISR). Winning over the population, or 'winning the hearts and minds,' is a complex process. In such a situation, the application of kinetic force through air strikes may not be the most effective application of air power for a number of reasons. However, in certain conditions and in the appropriate context, air strikes may be the optimum response; therefore, the ability to do so must always be available to the military force engaged in IW.

Strikes are considered the most measured response from air power, after obtaining control of the air, in a conventional military campaign. However, in the case of IW, strikes could create a negative impact if they are not carefully crafted to ensure that there is minimal collateral damage. The advent of precision-guided munitions (PGMs) with extreme accuracy has somewhat ameliorated the chances of collateral damage in the traditional application of kinetic force from the air. However, the possibility of collateral damage to non-combatants and non-military assets is still high because of the conduct of such conflicts within or in close proximity to purely civilian population and assets. In these circumstances even limited tactical action can have broad strategic implications. Knowing when to use kinetic air power in IW is a complex decision, and its use is prone to creating unwarranted influence on popular perception through the biased manipulation of the general media.

The irregular adversary normally does not possess even the most rudimentary form of air power and consequently decries the slightest of collateral damage issues resulting from the use of air power. This is done because air power is extremely effective in the IW scenario; therefore, the employment of air power must be done in a manner that does not create the condition for the adversary to win a propaganda war relating to collateral damage. This can be achieved with smaller yield PGMs with improved accuracy in their delivery. In certain settings, the concept of carrying out strikes from smaller and slower turbo-prop aircraft has been found to have merit. This mode of delivery could further enhance the ability of air power to limit collateral damage in some contexts. In all cases, the fundamental aim is to avoid collateral damage at all costs.

The second role of air power in IW is air mobility that includes special recovery operations. Air mobility operations conducted by both fixed and rotary wing assets are at times even more important than the kinetic application of force through strike missions. In remote and inhospitable regions, air mobility permits the legitimate government to extend the rule of law and thereby stifle insurgencies at the initial stages itself. The rapid response to emerging situations that air mobility permits is a decisive advantage in IW, which is characterised by fluid situations and the ebb and flow of skirmishes over vast areas.

Countries or regions that are plagued by IW generally have poor communications and lack infrastructure, which could hamper the operations of a conventional force. However, this situation can be turned around to suit the conventional military force through the optimised employment of air mobility concepts. Air mobility shrinks the battlefield that irregular forces would typically like to expand and diffuse to their advantage; it permits forces to be applied at the time and place of choice irrespective of choke points in surface deployments; and avoids ground forces being subject to ambushes to a great extent. One of the key considerations in the conduct of IW is to manage the perception of the local population regarding the physical presence of foreign troops in the country. Air mobility permits a numerically smaller force to dominate a large area while also creating a much smaller footprint, thus alleviating the intervening force's perception issue. Of course, the maximum advantage of air mobility can only be leveraged after control of the air has been unquestionably established.

The third role of air power in IW is that of ISR. While intelligence is a critical requirement in all kinds of wars, IW is perhaps the most intelligence-driven form. Prosecuting a 'small war', as IW is at times referred to, cannot be successfully waged unless the force has the ability to fuse dedicated ISR capabilities with intelligence gathered by non-traditional ISR with a high degree of accuracy and as near to real-time as possible. The use of unmanned aerial vehicles that are also armed has changed the conduct of IW through being proactive in combining ISR and strike operations. The success of such combined missions is dependent on the adequacy of the force's inherent command and control capabilities. The importance of flexible command and control to optimise the employment of air power in IW has been demonstrated repeatedly in the past two decades.

Unlike in earlier wars, no one element of air power, or for that matter of a military force, can function in isolation and hope to achieve the broader strategic objectives. Each dedicated air power role needs to be complemented at the right time, place and context with other roles for success in complex operations such as IW. This is a seminal lesson that comes out of more than a decade of IW operations that must be carried forward for the future understanding of the application of air power. Finally, there is no doubt that IW campaigns will be the norm rather than the exception in the future and that air power provides a distinct advantage in their conduct. However, insurgencies that lead to IW are normally the result of bad governance and therefore, unlike conventional conflicts, the military forces are only one element of national power and part of the solution that must be employed in a concerted whole-of-nation approach to succeed in an IW.

Long-Range Strike Capability

> **Key Points**
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> - *National security is an evolving concept and consequently security strategies have also been dynamic.*
> - *Long-range strike capabilities have been an important and constant capability in the national security equation.*
> - *The ability to rapidly strike anywhere in the pursuit of national interest is a powerful deterrent and a coveted capability.*

Essential national security and protecting national interests have always been at the heart of a nation's security strategies. It is therefore only natural that the security strategies and the national power elements and their capabilities that ensure national security evolve and alter with the changing interpretations and perceptions of what constitutes national security. Irrespective of the nuances in understanding national security, the need to have long-range strike capabilities embedded in the military capabilities have remained a constant factor. As the application of lethal force through the protracted employment of military forces is becoming increasingly difficult to pursue as an option, nations have started to emphasise deterrence as a critical strategy to ensure national security. True and effective deterrence can only be achieved with the demonstrated ability to strike at the centres of gravity of the adversary. In a direct manner, deterrence is built around long-range strike capabilities.

Historically, long-range strike capabilities were built into air forces through operational strategic bombers although they were only available to the larger air forces of the world. However, the concept of 'strategic' bombing was an accepted role for air forces. Some even argue, incorrectly, that the United States Air Force (USF) won its independence in the post-World War II era riding on the back of this concept. The development of the Intercontinental Ballistic Missiles (ICBM) by the erstwhile Soviet Union and the US gave further impetus for the need to possess a long-range strike capability. As long as the Cold War continued to divide the world into two opposing political groups, long-range strike capabilities remained a powerful factor in the formulation of operational concepts and strategic debate.

With the collapse of the Soviet Union and the subsequent eruption of myriad 'bushfire conflicts' in different parts of the world, the perceived need for long-range strikes diminished. A decade of benign neglect of this concept then followed, mainly springing from a somewhat faulty appreciation of the evolution of the character of conflicts and wars, and the acceptability of the application of military power through the employment of multi-layered military forces. All this changed with the attacks on the World Trade Centre in September 2001 and the reaction of the US. The deployment of NATO forces into Afghanistan and the subsequent US-led invasion of Iraq brought irregular wars into focus. While the characteristics of such wars are different to conventional conflicts, the changes were more cyclical than linear. Irregular wars have spanned history and therefore this was more a renewal of focus than the adaption to a new mode of conflict. They also brought about an element of emphasis, and perhaps more importantly, international debate, on the political correctness of military intervention by surface forces in another sovereign country without a formal declaration of war.

While the debate of the politics of intervention is outside the scope of this paper, the changes in the characteristics of war impacted the concept of operations of traditional military forces. The forms of irregular warfare that the opponents adopted forced the military forces to adapt their own concepts and tactics. It also brought about a situation wherein a clear military victory was not achievable for the intervening nations. Combined with the casualty figures, public opinion started to waver and the democratic governments were hard pressed to justify the need to retain troops on the ground. At the same time it was also necessary to ensure that the irregular adversaries were aware of the ability of the regular military forces to strike them at will. The answer was once again to be found in long-range strike capabilities.

Long-range strike capabilities are now not resident in strategic bombers, but in a number of airborne platforms. The fundamental requirement is to be able to carry out time-sensitive targeting within the area of interest of a nation. Dependent on the primary area of interest, and the differences in the understanding of national security, the definition of long-range itself would vary from state to state. Long-range strikes could involve extended flights across continents, or attacks by cruise missiles or ICBMs. On the other hand, long-range strike could also be conducted by uninhabited combat aerial vehicles operating locally but controlled from a home base, like the ones being conducted in the tribal belt along the Afghanistan-Pakistan border. Although the debate regarding the efficacy of manned aircraft strikes and the cost-effectiveness of missiles have been on-going, it is not an issue that can be put to rest since it involves a large number of variables that have to be calculated in a contextual manner as each circumstance is unique.

The fundamental outcome brought about by the changes in the characteristics of war and the increasingly global debate that erupts when a military intervention takes place is that governments are reluctant to commit military forces on the ground. The result is that air strikes, when necessary and in extremis, are now being viewed as a first-choice option by most democratic governments albeit that strategic bombers are not within the resource capability of most nations to acquire, maintain and operate. It is also significant that since the B-2, the USF has continued to investigate designs for the next generation bomber without committing to a specific timeframe. Consequently the operational life of the venerable B-52 Stratofortress has been extended by another 20 years or more. Meanwhile, both Russia and China are pursuing the design plans for strategic bombers to be built in the near future. This difference in approach could well be explained by the US having a global strike capability resident in their carrier groups, which both China and Russia currently lack.

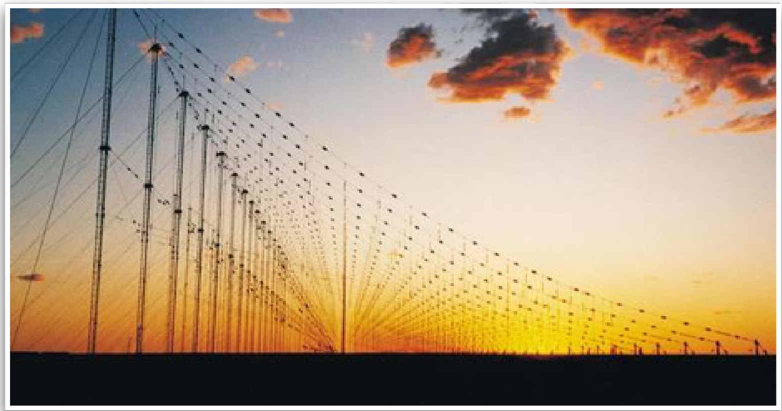
Conceptually, long-range strikes afford a nation two distinct advantages: one, that a demonstrated capability acts as a powerful deterrent factor, and two, through its application, a nation can avoid most of the political hue and cry that is bound to accompany direct intervention through the necessary long-term deployment of ground forces. Air forces around the world now consider long-range strike as one of the fundamental capabilities that they must possess in order to provide the government with a range of options in the national security equation. The ability to strike anywhere within the geographical area of interest of the nation—with precision, proportionality, and discrimination—has become a prized competence for all air forces of calibre. This is the hallmark of a balanced air force.

In a 1994 live fire exercise near Point Mugu, California, a B-2 drops 47 individual 500 lb (230 kg)-class Mark 82 bombs, which is more than half of a B-2's total ordnance payload (USAF, *Pathfinder #215*)

Luftwaffe Fighter Control Room (*Pathfinder #206*)

The Black Hornet: a Nano UAS personal reconaissance system (Prox Dynamics, *Pathfinder #205*)

The Hawker Demon, the most potent bomber of the RAAF in 1935 (*Pathfinder #218*)



JORN Transmit Array (*Pathfinder #199*)

No 1 Wireless Unit RAAF Leyte, 1944 (AWM, *Pathfinder #208*)

C-130A Hercules A97-214 (*Pathfinder #216*)

RAAF Wedgetail (*Pathfinder #192*)

HISTORY

Air power is capable, by vigorous attack on the enemy's air and ground forces, lines of communication and rear areas, of slowing down and contributing materially to the halting of his offensive.

NATO Strategic Guidance, December 1952, p. 17.

The Battle of Savo Island: A Failure of ISR

During the Allied assault on Guadalcanal (Operation WATCHTOWER), seven cruisers and a destroyer of the Japanese 8th Fleet under the command of Vice-Admiral Gunichi Mikawa, attacked and defeated a superior force of Allied ships (eight cruisers and 15 destroyers) at Savo Island. On the night of 8 August 1942, the Allies' warships were positioned to defend the supply and transport ships assembled to support the ground force that had landed at Guadalcanal the day before. The Japanese attack in the early hours of 9 August was a masterful demonstration of superior night fighting tactics that reduced four heavy cruisers, including HMAS *Canberra*, and two destroyers to sinking wrecks, and only narrowly missed the opportunity to destroy the Allies' vulnerable support ships. At the heart of Mikawa's success was the complete surprise he achieved by being able to transit over 1000 kilometres from Rabaul to Guadalcanal without arousing any suspicion as to his destination or intent. That Mikawa's strike force was sighted en route on no less than five occasions by Allied units, indicates that the element of surprise was as much due to a failure of the Allies' intelligence, surveillance and Reconnaissance system (ISR) as it was to Mikawa's skill.

Key Points

- *A fundamental tenet for the employment of air power is centralised command and de-centralised execution.*
- *ISR is an enabler that provides battlespace awareness and information superiority.*
- *ISR is an activity that synchronises and integrates the planning and operation of sensors, assets and processing, exploitation and dissemination systems in direct support of current and future operations.*

When the Allies were planning Operation WATCHTOWER, the threat posed by the major Japanese bases north of the landing area was well appreciated. Possessed of a strong force of both air and maritime units, the Japanese were more than capable of gathering significant force in response to any landings within the Solomon Island group. To provide early warning of any Japanese counter-offensive, the Allies established a surveillance and reporting network around existing ISR capability within the region. Included in the network were elements of the RAAF, such as No 32 Squadron—then operating a detachment of Lockheed Hudson aircraft out of Milne Bay. While the Operation WATCHTOWER amphibious force commander, Admiral Richmond Turner, was concerned about the schedule of some flights, the surveillance plan itself appeared to be adequate.

There were, in fact, several flaws within the ISR system that had a serious impact on the Allies' ability to appreciate the movements and intentions of Mikawa's strike force. Central to the systemic failures was how air power was employed as part of the surveillance capability. In particular, the performance of two RAAF Hudson crews from No 32 Squadron have often been unfairly criticised for failing to properly identify, report and track the Japanese strike force while still well north of Savo Island. In reality, the aircrew of the RAAF aircraft were as much victims of the systemic shortfalls of the Allied ISR system, which had contributed to the overall failure.

The first major flaw was that the surveillance and reporting network was not integrated under one command. For example, No 32 Squadron fell under General Douglas MacArthur's South West Pacific Area Command, while surveillance aircraft operating out of Espiritu Santo and New Caledonia fell under Rear Admiral Robert Ghormley's South Pacific Command, which itself was a sub command of Admiral Chester Nimitz's Pacific Area Ocean Command. Each headquarters had its own reporting chains, intelligence cells and communication networks. These command and control (C2) arrangements caused significant problems for the Operation WATCHTOWER task force. For example, when Admiral Turner noted that no surveillance flights were scheduled to be conducted to his immediate north during late afternoon of 8 August, his request for additional flights was lost in the complex C2 arrangements of the three different regional structures.

Another result of the inadequate C2 arrangements was poor information sharing. When No 32 Squadron aircrew conducted their surveillance flights on 8 August, a full 24 hours after the Guadalcanal landings had occurred, the unit had still not been briefed on Operation

WATCHTOWER, so it was unaware that Allied landings had taken place in the southern end of the Solomon Islands group. Without an appreciation of the change in operational circumstances within the area, the aircrew had no appreciation of the significance of the Japanese warships operating within striking distance of Guadalcanal.

The complexity of the structure also slowed the reporting of the intelligence gathered by the surveillance flights. Two different sighting reports from No 32 Squadron took in excess of six hours to reach the Operation WATCHTOWER commanders, having first to be relayed through five different headquarters and finally transmitted from Pearl Harbor to Guadalcanal. Furthermore, at some point in the long relay, the wording of one of the sighting reports was changed, leading to inaccurate intelligence assessments by Admiral Turner.

Had No 32 Squadron been briefed on Operation WATCHTOWER and had it been properly integrated into a direct reporting system, they could have relayed their sighting reports directly to the Allied task force. In fact, a direct reporting structure had been established for some elements of the ISR system, but not all. The Australian Coastwatchers in the region had all been properly briefed and were successfully reporting incoming air raids throughout the Guadalcanal landings. The exclusion of the wider ISR capability from the direct reporting system denied the Allied commanders valuable and timely intelligence.

The final flaw in the ISR system apparent from the experience of No 32 Squadron was one of poor training. The aircrews were not well trained in the art of ship recognition or the technical aspects of assessing a ship's course and speed. For example, the first sighting report made by No 32 Squadron crews detailed that the Japanese force was four cruisers, one destroyer and two seaplane tenders or gunboats. It also detailed the estimated speed and course. Both the force composition and course was wrong, as the aircrew were not sufficiently trained to differentiate ship characteristics that would enable correct identification. In addition, while the aircrew noted aircraft being launched from at least one ship, they did not appreciate that ships at sea may change course when launching or recovering aircraft. Hence, the course reported was not the actual heading the ships were maintaining. Both these errors led Admiral Turner at Guadalcanal to believe that the sighting report indicated that the Japanese were establishing a seaplane base to the north and were not moving to attack his ships.

Secure in the belief that there was no threat coming from their north, and mistaken in thinking that any such threat would be identified well before being in a position to attack, the Allied ships at Savo Island were truly surprised by the Japanese strike force. Had the ISR system been properly established and fully integrated, it is arguable that the defeat at the Battle of Savo Island may not have occurred on the scale that it did.

The RAAF Experience of Information Operations

Key Points

- *The RAAF has conducted IO since its inception.*
- *Australian airmen have gained considerable experience in psychological operations, deception, electronic warfare as well as presence, posture and profile actions.*
- *IO are necessary to achieve decision superiority and are vital for success in joint warfare.*

Periodically certain technologies such as gunpowder and the aeroplane precipitate a revolution, or perhaps more accurately accelerate an evolution, in military affairs. The information age and the advent of computer processors, small enough to fit in the pocket of an individual, coupled with rapid advances in the internet and social media have significantly transformed military operations and fundamentally changed the way information impacts the conduct of war. The information age is also helping to drive a shift towards creating non-kinetic effects in lieu of purely kinetic 'damage'. Today, information operations (IO) are broadly defined as the coordination of information effects to influence the decision-making and actions of a target audience and to protect and enhance our own decision-making and actions in support of national interests.

IO are the processes of bringing together different elements and focussing them to create specific effects. The elements of IO include operational security, psychological operations, deception, electronic warfare, civil-military cooperation, as well as military networking and posture, presence and profile. Although the principles of war have not changed, the importance of IO in modern warfare has increased. IO are inherently joint, with the Air Force being a major provider of capability. These operations have formed part of air campaigns since the very beginning of military aviation and the RAAF's experience demonstrates that many of its elements are really not all that new.

The earliest experiences of IO for Australian airmen occurred during World War I. For instance, in 1918, No 1 Squadron Australian Flying Corps flew posture and deception missions in support of the Arab Revolt irregulars fighting alongside Colonel T.E. Lawrence, ('Lawrence of Arabia'), against the Turks. They also dropped messages containing information on friendly and enemy troop concentrations that improved the Arab fighters' situational awareness.

During World War II, the RAAF conducted a broad range of IO over the Pacific and over Europe. These operations invariably demonstrated how they could be used to influence and undermine the decision-making cycles of the adversaries while at the same time also strengthening one's own decision-making cycles. In July 1942 the Far East Liaison Office (FELO) was formed in the South West Pacific Area (SWPA) to plan and direct propaganda operations against the Japanese. Personnel in FELO were drawn from each of the three Services, with the understanding that one had to be a soldier, sailor or airman to understand each Service's culture and thinking processes. In addition, it was felt that only an Allied airman could correctly understand how a Japanese airman thought and fought.

Established in secrecy and operating from forward posts, initially in Darwin and Port Moresby, FELO disseminated propaganda disparaging the courage and effectiveness of the Imperial Japanese Army and Navy Air Forces. A number of Japanese commanders were extremely irritated by this propaganda and their airmen were spoiling to dispel the Allied claims. In early 1943, when FELO undertook an Allied deception operation that portrayed Allied air defences at Port Moresby as in a weakened state, the Japanese took the bait and attacked. It was only when they were over Port Moresby on 12 April 1943 that the Japanese discovered that the Allied air defences were at full strength. The Allies destroyed 25 Japanese aircraft and recorded a further 10 aircraft as probables.

FELO continued operations until the end of the Pacific War, working eventually across the entire SWPA. A staggering 69 million items were printed by FELO between 1942 and 1945 and these were highly successful in capitalising on the will of indigenous populations, and also included instructions on how to assist downed Allied airmen, and encouraging isolated Japanese troops to surrender. RAAF and USAAF aircraft were used to distribute millions of leaflets across the area. At the end of World War II, a review of the effectiveness of FELO operations reported that 951 Japanese surrendered as a direct result of propaganda leaflets; over 20 per cent of those captured in the SWPA.

In Europe and the Middle East, No 462 (Australian) Squadron conducted more than two years of heavy bomber operations before its primary role changed to IO. From 1 January 1945, the squadron used aluminium chaff (code-named window) and wireless jamming equipment (airborne cigar) to give the impression to German radar operators that a much larger force was attacking than was actually the case. These aircraft were able to use electronic warfare (EW) to confuse German airmen and disrupt their commanders' decision-making cycles. As a consequence, the Luftwaffe wasted fighter aircraft sorties, aviation fuel and considerable ground-based air defence effort against a small deceptive force while the mainstream of bombers attacked their primary targets elsewhere. By flying such non-kinetic EW missions or 'spoof raids' in support of their Bomber Command colleagues, No 462 Squadron, one of the original EW squadrons, helped to save many lives.

The RAAF had considerable experience of IO during the Cold War, particularly during the Malayan Emergency and the Vietnam War. In Malaya, aircraft were used for 'sky shouting' to encourage Chinese 'terrorists' to surrender. In Vietnam, No 9 Squadron Iroquois helicopters often flew leaflet dropping missions in areas known to be occupied by Viet Cong forces.

The increasing importance of IO in recent conflicts is perhaps best demonstrated by Operation STABILISE, the ADF-led intervention in East Timor 1999-2000. The generation of IO, especially presence, posture and profile, were critical to that operation's success. From the start, the International Forces East Timor (INTERFET) commander directed that all rotary and fixed-wing aircraft were to fly at low level across the capital Dili. These air presence missions demonstrated INTERFET's resolve and helped to influence events on the ground by showing that INTERFET had arrived, it meant business and it was there to stay. The population was reassured and the level of violence subsided. By applying non-kinetic means, air power made a significant contribution in East Timor in deterring potential adversaries and positively influencing the people.

IO have been part of RAAF operations for decades but they were often not identified as a specific activity within the Air Force.

However, in March 2001 the Air Force formed a specialist IO squadron in recognition of the increasing importance of IO. In April 2005 this squadron was renamed No 462 Squadron in recognition of its World War II predecessor.

The RAAF at El Alamein

> **Key Points**
>
> - *Two RAAF Kittyhawk squadrons flew in the Battle of El Alamein.*
> - *The Allied Desert Air Force achieved control of the air over the battlefield.*
> - *The air-land doctrine developed by the Desert Air Force remains relevant today.*

The Battle of El Alamein was a major turning point in World War II, but it also showed the importance of coordination between air and land forces on the battlefield. It is not often recognised that the RAAF played a significant role in the battle for the air over El Alamein.

By July 1942, the Panzer Army Africa, composed of German and Italian units under Field Marshal Erwin Rommel, had struck deep into Egypt threatening the British control of the Suez Canal and the Middle Eastern oilfields. The British Eighth Army defended Egypt and the Canal near a small desert town called El Alamein. Here, in early July, the Axis advance was halted and both sides dug in and began replenishing their forces in preparation for the next major offensive, which the British launched under Lieutenant General Bernard Montgomery on 23 October.

In preparation for the offensive, Royal Air Force (RAF) Middle East Command shared with the Royal Navy the tasks of guarding British supply lines to the Middle East, and denying the enemy delivery of essential supplies, especially fuel. RAF squadrons, including a number of Australian squadrons, conducted reconnaissance of the Mediterranean Sea. Axis convoys heading for North African ports were subject to attack by aircraft, surface ships or submarines. The interdiction of supplies, particularly fuel, to the Panzer Army Africa deprived Rommel of manoeuvre in the desert war and was a major factor in the Allied victory at El Alamein.

The tasks of maintaining control of the air over the battlefield and attacking Axis ground forces were allocated to the Desert Air Force, commanded by Air Vice-Marshal Arthur Coningham RAF. Coningham had assumed command in 1941 and set about improving the equipment, doctrine and organisation of the Desert

Air Force, gradually achieving air superiority in North Africa for the first time. To provide better air support for the October land offensive, Coningham's headquarters was co-located with that of the Eighth Army at Burg el Arab, west of Alexandria.

Two RAAF squadrons, Nos 3 and 450, flew P-40 Kittyhawk fighter/ground attack aircraft as part of the Desert Air Force in 1942. These rugged aircraft proved highly capable of both air-to-air and air-to-ground attacks. For the two months leading up to the battle, the Australian squadrons were engaged in maintaining control of the air around El Alamein. This was achieved by intercepting any enemy aircraft in the battle zone and by attacking their airfields.

On 15 September, 18 Australian Kittyhawks were attacked by 15 Luftwaffe Messerschmitt Me-109s. The resulting dogfight continued until two squadrons of RAF Kittyhawks joined the fray driving off the Messerschmitts. On this occasion, the Australians claimed only one victim but themselves lost three pilots and a fourth wounded. On 6 October, heavy rains affected the airfields used by the Luftwaffe but not those of the Desert Air Force which took advantage of the situation to attack the German aircraft that were stuck on the ground.

The next phase in the air battle started on 20 October. While Allied ground units moved to positions ready for the planned surprise attack, the Desert Air Force kept the enemy air force from detecting these movements. During this phase, control of the air by the Allies was almost complete and enemy aircraft were rarely seen.

When the British ground offensive began on 23 October, the Desert Air Force continued to hold air supremacy over the battlefield. No 450 Squadron intercepted four Me-109s, shooting down two and forcing the other pair to withdraw. Over the next few days, the Australian squadron flew missions escorting British and American medium bombers on attacks against enemy armour and supply lines. When No 3 Squadron escorted Allied bombers attacking the airfield at Fuka on 28 October, the formation was attacked by three German fighters. The Commanding Officer, Squadron Leader 'Bobby' Gibbes (later Wing Commander Robert Gibbes, DSO, DFC and bar), shot down one and prevented the other two from reaching the bombers. A few days later, Gibbes shot down another aircraft, claiming the squadron's 200th victory since deploying to the Middle East in August

1940. At the time, this was the highest score among the Desert Air Force squadrons.

The Desert Air Force also worked closely with the ground forces to influence the air-land battle. On 26 October, nine Allied air attacks on armoured forces were mounted, three of these being led by No 3 Squadron. On 1 November, with the Australian 9th Division holding the northern-most sector, Rommel attempted to counter-attack with his panzer divisions. Four times on this day, the Australian squadrons successfully attacked these forces by bombing and strafing. In contrast, attacks by Axis aircraft on ground forces rarely succeeded because they were intercepted by Allied fighters before reaching their targets. The Luftwaffe could mount only one sortie for every five flown by the Allies and lacked the strength to effectively defend its own ground troops or airfields.

On 2 November, the Australian squadrons were ordered to prepare to advance. The next morning, advance parties were sent forward, at considerable risk, to reconnoitre and prepare airfields with the aircraft following later that day. By 4 November, the Axis armies were in full retreat, with the Desert Air Force in pursuit. The untiring and often dangerous leap-frogging advance of the RAAF ground parties permitted air operations against the retreating enemy to continue unabated.

Although only a small part of the Desert Air Force, Nos 3 and 450 Squadrons contributed significantly to the overall air campaign. Over a 34-day period, the squadrons flew 1442 missions, losing 20 aircraft and 16 pilots. Although only claiming 8.5 enemy aircraft destroyed and another 10 probably destroyed, the true testament to their efforts was the fact that air superiority had been maintained over the battlefield for the entire period.

The dominance of Allied air power was critical to the British victory at El Alamein. By maintaining control of the air over the battlefield and by denying resupplies to the Panzer Army Africa, the Desert Air Force set the scene for Montgomery's Eighth Army offensive from El Alamein across North Africa and into Italy. Indeed, the air power doctrine developed by Desert Air Force was used with success during Allied campaigns in Sicily, Italy and Normandy, and it remains the basis for modern air-land joint operations doctrine today.

Air Power at Cambrai, 1917

> **Key Points**
>
> - *Cambrai was not only notable as the world's First Great Tank Battle, but involved innovative use of artillery and air power also.*
> - *The foundations of 'all arms fighting' tested at Cambrai laid the basis for successes achieved by both sides in 1918, and ultimately in German Blitzkreig tactics of World War II.*
> - *No 2 Squadron, Australian Flying Corps, played a distinctive and frequently overlooked part in the air battle on the British side.*

The First World War operation begun outside the northern French town of Cambrai at dawn on 20 November 1917 has often been called the world's First Great Tank Battle. Before the day was over, the British assault force of six infantry divisions—led by 320 combat tanks—had created a hole in German defences almost 10 kilometres wide and six kilometres deep, with surprisingly few casualties. Success on this scale had eluded the Allies throughout 1917, including during the grinding Third Ypres offensive just ended. News of Cambrai set church bells ringing in England for the first time in the war, and had one London newspaper proclaiming that General Haig, the British Commander-in-Chief in France, was 'through the Hindenburg Line'.

In fact, the spectacular result achieved at Cambrai was not wholly attributable to the presence of the tanks, useful though they proved to be. Equally crucial to success was the contribution of other combat arms and elements, each using innovative tactics and techniques being tried out for the first time. For instance, supporting the assault were over 1000 guns and howitzers. Artillery staffs had devised a scheme for delivering a short preliminary bombardment to achieve surprise, employing predictive methods to silently register targets without observed ranging shots (which risked alerting the enemy to impending attack). The guns also used the No 106 graze fuze, designed to explode HE (high explosive) shells without cratering the ground ahead of the tanks.

Although historical accounts rarely mention the fact, also assembled was an aerial attack force of 14 Royal Flying Corps (RFC) squadrons, totaling 275 Sopwith Camels and Scouts, Bristol Fighters and DH4s and 5s. In the two days before the attack, aircraft noise had been used to mask the tanks as they moved up for the attack—a tactic repeated but not initiated (as sometimes claimed) at Hamel in July 1918. Despite the battlefield being shrouded in thick patchy fog, the aircraft engaged with machineguns and small bombs the enemy troops, trenches and gun emplacements in the opposing front line. While pursuing their supporting role, many pilots dropped down to only 30 feet to press their attacks, braving ferocious volumes of ground-fire directed at them.

In reality, the success of the opening thrust at Cambrai stands as an early triumph for the idea of the 'all arms fight', requiring close coordination of all the major components of combat power. Apart from the shock value of the tanks and their ability to breach wire obstacles, what worked here (in contrast to earlier instances of tank use since their debut on the Somme in September 1916) was the degree of coordination achieved between the tanks and the infantry. When the troops stayed or fell too far back from the assaulting tanks, as in the British centre, that was where the attack faltered.

Despite the success of the initial assault, all did not go as planned. Delays in the progress of the assault prevented a proper breakthrough being achieved, particularly on the British left, where the wooded Bourlon Ridge dominating the terrain in rear of Cambrai still remained in German hands at the end of the first day. This meant that the attacking force was committed to three more days of heavy fighting despite mounting losses of both tanks and infantry. Losses to pilots in the air squadrons were also significant, in most instances running at 30 per cent. All available troops had been committed to the initial assault and there were no British reserves to maintain momentum. By 27 November the attack was spent, and the exhausted force was ordered to consolidate their gains.

Unfortunately for the British, the Germans had brought up 20 divisions of troops and on 30 November launched a counter-offensive, which a week later had almost entirely erased the British gains. In mounting this response, the Germans resorted to innovations that matched the British. The infantry attack was spearheaded by 'stormtroopers' employing new Hutier infiltration tactics devised by General Oskar von Hutier against the Russians. Integral to the German counter-offensive was the aggressive role played in the air by Schlachtstaffeln (Battle Flights), which were transferred into this part of the front, including the air ace von Richthofen's elite squadrons. Many units had just received light, sturdy but nimble Halberstadt and Hannover two-seater aircraft, which were ideal for close-support and ground attack.

In the end, the gains and losses at Cambrai in terms of guns and casualties, including prisoners, were practically equal on both sides. Whereas the British had started out hailing Cambrai as a great victory, by mid-December it was all recrimination. Questions were asked in the War Cabinet, and General Haig was prompted to order a court of enquiry to examine what had gone wrong. The report of this body in January 1918 found that the success of the German counter-offensive was due in no small part to the use of close-support aircraft. It had been a case of the German Air Force better carrying out exactly the role that the RFC had itself attempted to perform on the opening days of the contest.

The tactics and techniques of 'all arms fighting' were developed further during the last year of World War I. Some historians have even come to consider that the origins of 'blitzkreig' style warfare are to be found in the big actions of 1918—the German Michael Offensive in March, and the '100 Days' advance begun by the Allies at Amiens in August. The true significance of Cambrai has frequently been overlooked, in particular the role of air power in facilitating what could potentially have been a war winning approach to breaking the stalemate of trench warfare.

RAAF Orions: Watching over the Middle East

> **Key Points**
>
> - *The longest deployment on combat operations in Air Force history.*
> - *The Orion was the ADF's primary ISR asset in the Middle East Area of Operations.*
> - *The Orion demonstrated the flexibility of air power, often doing multiple tasks on the same flight or being re-tasked in flight.*

The return to Australia of the No 92 Wing Detachment in the Middle East Area of Operations (MEAO) in November 2012 will mark the end of the longest deployment of an Air Force element on combat operations to date. While based in the Middle East, the aircraft and crews flew missions for four separate operations. During this highly successful, 10-year deployment, both the character of missions and the tactics employed to achieve success changed markedly.

On 16 and 17 January 2003, two Australian P-3C aircraft and approximately 160 aircrew, maintenance and support personnel arrived in the MEAO to take part in Operation SLIPPER, the ADF contribution to the International Coalition against Terrorism. On 28 January 2003, the detachment flew its first Operation SLIPPER mission over the Gulf of Oman and the first Persian Gulf sortie on 5 February 2003. Over the next seven weeks, the detachment flew one mission each day over the Persian Gulf to identify threats and to support the interdiction of any terrorist activities by Al-Qaeda or other organisations.

When Operation FALCONER, the combat operation to disarm Iraq, began on 18 March 2003, the Orion operations entered the next phase. One Coalition objective was the seizure and clearance of approaches to Umm Qasr, Iraq's only deep-water port, and the capture Iraq's offshore oil platforms. The Orions' role in this operation was to provide Coalition forces, which included RAN ships and Australian Army landing craft, with accurate surveillance of the surface activity in the operational area. The Orion's sensors, crews and analysis teams ensured that vessels posing a threat were observed and challenged well away from the fleet so operations were not interrupted. This activity resulted in the detection and capture of a number of Iraqi mine-laying vessels. As well as missions over the Persian Gulf, Australian Orions flew overland intelligence, surveillance and reconnaissance (ISR) missions over southern Iraq, starting from 18 March.

With the end of major combat operations in Iraq on 1 May 2003 and the start of Operation CATALYST in June 2003, the nature of the Orion's operations changed. Fewer missions were flown over the Gulf and more overland ISR missions provided increased support for Coalition ground forces in Iraq. These missions gave ground forces near real-time imagery of enemy activity, provided warning of suspicious activity to vehicle convoys, and detected signs of Improvised Explosive Devices (IEDs). They also monitored buildings suspected to be enemy meeting places or used to cache weapons and supplies. On occasions, the Orion crew alerted ground commanders to rioting and other dangerous activities of the civilian population, reducing the risk of a situation escalating out of control.

Countering IEDs was a major task for Coalition forces in the MEAO. Sophisticated electro-optical as well as visual and radar surveillance capabilities permitted the Orions to perform overwatch on strategic supply routes through Iraq monitoring for suspicious activity or threats. Cued by an Orion crew, ground patrols were able to move forward and investigate the possible IED or avoid the area. On occasions, Australian Orions tracked suspicious vehicles and personnel, which frequently led to the discovery of caches of IEDs and weapons. In this role, the Orion detachment directly contributed to the saving of Coalition lives and the preservation of essential land force capabilities.

Through 2007, 60 per cent of Australian Orion operations were focused on overland ISR across Iraq with the remaining 40 per cent on maritime surveillance of the Gulf. Improved data links enabled video streaming in near-real time to ground forces. This capability significantly increased the ground commander's situational awareness of the tactical situation. With the withdrawal of Australian ground forces from Iraq in July 2009, the Orions shifted their overland ISR missions to Afghanistan supporting Australian and allied ground forces primarily in Oruzgan and Helmand Provinces.

From the start of 2009, the Orion detachment joined an anti-piracy operation under the command arrangements of Operation SLIPPER. The rate of attacks by pirates on shipping around the Horn of Africa and the Arabian Sea had steadily increased from the mid 1990s. In January 2009, a UN mandate to the multinational Combined Maritime Forces (CMF) saw its operations around the Persian Gulf and Arabian Sea increase to include the protection of shipping from pirates. RAAF Orions and a number of RAN ships made up Australia's contribution to CMF operations.

One particular incident on 28 January 2011 demonstrated the flexibility of the Orions and their crews. During a routine surveillance patrol of the Persian Gulf, an Australian Orion received a distress call from the German merchant vessel *New York Star*, indicating it was under attack by pirates. The Australian crew observed pirates attempting to board the ship and firing rocket-propelled grenades. The crew flew a series of low level show-of-force passes and repeatedly broadcast via radio that the arrival of a warship was imminent. The Orion crew also communicated directly with the crew of the *New York Star* to assist in countering boarding operations by the pirate vessels. The actions by the Orion crew directly influenced the actions by the pirates, and when a Special Forces team landed on the deck of the *New York Star*, they found that the pirates had gone. The ship's crew, who had locked themselves inside a pirate-proof cabin, were unharmed. With the piracy incident over, the Orion crew resumed their surveillance task. Another day in the office for the Orion detachment.

Throughout its 10-year deployment in the MEAO, the No 92 Wing Detachment supported Orion operations from its base in the desert. Despite the 45-degree summer heat (actual tarmac temperature often over 55 degrees), aircraft serviceability was sustained at a high level. This extraordinary achievement was directly attributable to the professionalism and dedication of the maintenance personnel. Support personnel at the base provided 24-hour intelligence plus operations and analysis support to the crews planning their missions. Further, amongst all the activity surrounding Orion operations, base personnel maintained continual support to RAAF and other coalition aircraft transitting the MEAO.

The departure of the Orion detachment from the MEAO closes a chapter in Air Force history, but the index of credits is extensive. From counter-terrorism operations, maritime surveillance across the Persian Gulf and the Gulf of Oman, counter-piracy in and around the Horn of Africa, to ISR operations over Iraq and Afghanistan, the detachment upheld the operational traditions of the RAAF's maritime force. By December 2012, the detachment will have flown over 22 500 hours on more than 2400 missions in the MEAO and has earned its place in Air Force history. 'Watch and Ward', the motto of No 92 Wing, has been proudly upheld.

The RAAF's Malta Deployment 1952–1954

Key Points

- *Historically, Australia's national interests have had a global dimension.*
- *No 78 Wing, RAAF contributed to NATO exercises during 1953 and 1954.*
- *The RAAF has a long tradition of working alongside other national air forces and making useful contributions towards coalition air power.*

60 years ago this year, Australia made a significant contribution to the Cold War defence of western Europe through the North Atlantic Treaty Organization (NATO). In February 1951, the British had suggested that Australia may wish to contribute to the West's military presence in the Middle East. As Australia had a national security interest to defend the sea lines of communication which ran through the Middle East—to maintain international order and to protect trade routes—such a deployment was seen to be in the nation's strategic interests. Indeed, at that time, British imperial global strategy identified the Middle East as a higher priority for Australian forces than the Far East.

Discussion centred upon sending 'a token force'—a RAAF wing of two squadrons with half their wartime establishment. It was decided not to send Australian aircraft, rather 16 Vampire FB.9 fighters were leased from Britain for the deployment. Prime Minister Robert Menzies despatched No 78 (Fighter) Wing RAAF, that included Nos 75 and 76 Fighter Squadrons and associated support elements, to the Middle East, with the advanced party arriving in Malta on 9 July 1952. A month later the Australian pilots, led by Wing Commander (later Group Captain) Brian Eaton, commenced flying.

No 78 (Fighter) Wing served under No 205 Group RAF and were tasked by the RAF's Middle East Air Force (MEAF). The MEAF was responsible for the Mediterranean as well as the Middle East and reported to the NATO Commander-in-Chief Allied Forces Mediterranean. It was earmarked, in a crisis, to supplement other NATO forces in Europe under the Supreme Allied Commander Europe

(SACEUR). The stage was set for No 78 Wing's engagement with NATO.

NATO was founded in April 1949 as a western alliance aimed at countering aggression by the Union of Soviet Socialist Republics (USSR) in Europe. By early 1953, NATO believed it was in danger of being overwhelmed by the rapid expansion of Soviet forces in eastern Europe, the increasing number of Soviet nuclear weapons that undermined the American 'nuclear umbrella' deterrent, and the ongoing commitment to the United Nation's forces in Korea. NATO strategists believed that a massive build-up of Western military forces was necessary to deter the Soviets in Europe, and that offensive air power was a key deterrent against the Soviet's use of their conventional forces.

NATO's response to probable Soviet expansion was a show of force during the European summer of 1953—Exercise CORONET. As a physical demonstration of Western air power, CORONET brought together about 2000 aircraft and 40 000 personnel from nine NATO countries and one non-NATO country (Australia). Air units were deployed to West Germany from bases across Western Europe, Britain and the Mediterranean in defence of Central Europe. Commencing on 23 July and lasting for nine days, CORONET itself was based upon a complex scenario involving an initial conflict between two hypothetical regional powers—Westonia (2nd Allied Tactical Air Force (ATAF) area including Belgium, the Netherlands and the British Zone of Germany) and Fantasia (4th ATAF area including the American and French Zones of Germany and part of Eastern France). After five days, on 27 July, a third hypothetical major power intervened to end the conflict—Wessex (all UK-based raider forces).

CORONET brought together almost every type of military aircraft flown by the West at that time—Sabres, Meteors, Vampires and Venoms from 2nd ATAF; Sabres, Thunderjets, Shooting Stars, Vampires and Invaders from 4th ATAF; Greek and Italian Thunderjets and Portuguese Thunderbolts; as well as the Australian Vampire wing based at Malta. The United Kingdom bases provided common raider forces of Washingtons, Lincolns, Canberras, Valettas, Varsities, Meteors and Sabres; the last two types simulating high-level bombers. All the ground units supporting these aircraft were essentially expeditionary with as little use as possible being made of normal static facilities. The land battle was fictional and intended to provide practice for air-land support missions. In the end, CORONET achieved its desired outcome—it demonstrated the West's ability to use air power offensively to defeat a Soviet thrust in Central Europe.

The Australians based at Malta were delighted, if a little surprised, to be included in the NATO exercise. Group Captain Eaton described CORONET as 'so realistic that they were pretty near the real thing.' The only difference between it and actual war was that in this exercise gun cameras were used to film attacks instead of guns loaded with bullets and shells. Squadron Leader Ken Andrews, who was one of the most experienced fighter pilot instructors in the RAAF, stated that: 'This exercise placed a tremendous strain on everyone who took part in it, because of the many moments of tension and grimness. The normal hazards of jet flying were increased by so many aircraft milling about the sky over small areas at one time. The faces of men took on that hard look as their eyes scanned the sky when a plane failed to return to base, and there was that same nerve-wracking tenseness in the operation room as the men there waited for the phone to ring to tell them what had happened.'

The ground crew, despite having to improvise in the 'wartime' field conditions, performed extremely well. After eight days the Australian wing had the highest rate of aircraft serviceability among all the forces in the exercise. At the conclusion of CORONET, on 31 July, senior Royal Air Force officers and official observers from the United States Air Force and Western European air forces praised the Australians highly for their pilot's flying abilities and the achievements of the RAAF ground staff. Even though 78 Wing was 'a token force', its value as a physical symbol of Australia's national interests in the defence of the West was clearly demonstrated on the world stage during the NATO exercise.

No 78 Wing remained in Malta until December 1954, when higher priority defence commitments in Southeast Asia necessitated the wing's return to Australia. By that time, No 78 Wing had also participated in other NATO exercises, including Exercise SHIELD I which involved the air defence of Southern Italy and the central Mediterranean. On different occasions No 78 Wing pilots had flown alongside, or on exchange with, squadrons from France, Belgium, the United Kingdom, the United States, Turkey, Greece, Italy and New Zealand. Interestingly, New

Zealand deployed a Vampire squadron to Cyprus around the same time, and at times they operated as a third squadron of the Australian wing at Malta. Members of 78 Wing even represented Australia at Queen Elizabeth II's coronation. Although a token force, the Malta deployment demonstrated Australia's resolve to safeguard its strategic interests as well as the RAAF's high professional competency.

The RAAF's Evolving Weapon Systems

In December 2012, the RAAF announced that the new fleet of F/A-18F Super Hornet aircraft had achieved final operational capability. This announcement marked an important milestone of the introduction into service of a significantly improved version of the F/A-18A and B model Hornets first ordered by Australia in 1981. The Super Hornet differs to the classic Hornet in many aspects, not the least of which are a larger and redesigned airframe, improved avionics and radar systems, as well as significantly more powerful engines. While acquiring such an evolutionary platform is an exciting time for the RAAF, it is not the first time that it has operated an evolved design of an aircraft already in service.

In fact, from its inception, the RAAF has looked to newer versions of existing aircraft types to improve capability. The reasons have been varied—advances in technology, strategic imperatives, logistics challenges and industry developments have all influenced the choices of aircraft acquisition. An examination of just a few of the aircraft operated by the RAAF illustrates the influence of these factors on aircraft acquisition and capability development over the years.

Key Points

- *The decision to develop capability through evolved weapons systems or by the procurement of all new weapons systems is influenced by advances in technology as well as strategic and economic considerations.*
- *A strong domestic science and technology capability as well as a viable aviation industry is essential to sustaining air power in Australia.*
- *Knowing when to stop platform and weapon system evolution in order to pursue a step change in capability is a mark of professional mastery.*

The first occasion in which the RAAF operated an evolved aircraft design was when the DH9A was introduced into Australian service. This two seat, light, single engine bomber was a development of the

DH9, which itself was a development of the highly successful DH4 bomber of World War I. The acquisition of the DH9A was the result of a 1919 UK offer to the Imperial Dominions of sufficient numbers of aircraft with which to establish an air force. From the Australian and British perspective this offer had the advantage of strengthening the global Imperial Defence structure, in essence a coalition of nations of which Australia was a part, while also providing the British with a useful means of disposing aircraft surplus to their requirements. For Australia, the offer was a means to develop military aviation without the financial burden of having to buy aircraft. Designated with the serial 'A1', the DH9A became the first aircraft on the RAAF's books when it formed in March 1921. In a twist of fate, the aircraft from which the DH9A evolved, the smaller, underpowered DH9 was also introduced into RAAF service at the same time with the serial designation of 'A6'. While the fundamental design of the DH9 was sound, its inferiority to its descendent in terms of engine performance and overall reliability was marked, clearly illustrating the impact of technology on evolving aircraft design.

Technology improvements are not the only rationale for evolving existing platforms. During the 1930s as the probability of war became more likely, Australia became concerned that in any major conflict the supply of aircraft from the UK or the USA would become problematic. Although Australia's aircraft industry was embryonic at that time, the need to develop an indigenous aircraft design and manufacturing capability became a strategic imperative. Elements of Australian industry responded quickly to this need. In a partnership that began between a mining, metals and an automotive company, the Commonwealth Aircraft Company (CAC) was formed with blessing of the Australian Government, with the mandate to design and build aircraft for the RAAF.

It quickly became apparent that Australia simply did not have the wherewithal to design and build high performance military aircraft from scratch. So it was decided that the first project for CAC would be the licensed production of a general purpose aircraft based on an existing design. The North American NA-16 two seat trainer was chosen as the basis for what would become the CAC Wirraway general purpose aircraft. Design changes included the inclusion of two .303 Browning machine guns mounted in the nose section and an additional gun on a flex-mount in the rear cockpit. Further changes were made to expand on the standard radio installation and to enable a camera to be installed. Later improvements included the strengthening of the aircraft structure to include a bombing capability and fitting dive-bombing flap to the wings. From 1942 the Wirraway served in operational theatres from Malaysia through to the South Pacific, and also served in Australia as a trainer, finally being retired from RAAF service in 1959. What was initiated as a measure to address a strategic challenge in Australia's security became the foundation of an aircraft industry in Australia that went on to produce aircraft such as the Boomerang fighter, itself a derivative of the Wirraway, the Mustang, Sabre, Mirage and Jindivik UAV.

The extended life of the RAAF's AP-3C Orion fleet, and its vastly enhanced anti-submarine warfare (ASW) and intelligence, surveillance and reconnaissance (ISR) capability illustrates a pragmatic financial and risk mitigation rationale to platform evolution. The Orion started life as the already highly successful Lockheed Electra—a civilian transport aircraft with sufficient adaptability inherent in its design to allow modification to a maritime surveillance aircraft for the US Navy. Changes included the installation of air-to-surface radar, magnetic anomaly detection equipment, wing hard points and a bomb bay. Since incorporation of the structural modifications for these improvements in the late 1950s, the fundamental airframe configuration of the Orion platform has remained largely unchanged.

First introduced into RAAF service in 1968, the Orion's sound design and enduring qualities has enabled a constant evolutionary development focused on improving the onboard ASW and ISR systems as well as weapons carriage. This has been a significant advantage, since the inherent risks and financial overheads associated with developing an all new platform are thereby mitigated. Additionally, the training overhead on aircrew and maintenance personnel has been reduced, as well as having a lesser impact on logistics and support services. The success of the RAAF's AP-3C aircraft operating in recent counterinsurgency operations in both the maritime and overland environments has demonstrated the cost benefit of the investment in a systems approach rather than one based exclusively on platforms.

There are however, limits to the enhancement of capability of an existing platform or design. For example, the F-111 progressively evolved in capability and configuration over its entire service life. Its engines, avionics and weapons systems where subject to multiple improvement programs. However, evolving threats in its operating environment and increasing cost of operations resulted in its eventual retirement in 2010. Opportunities to operate evolved designs may also be impacted by the advanced technologies and materials that will change the way platforms are designed, built and kept viable within the battlespace. Global support services being developed around common joint capabilities will result in complex capability development decisions the RAAF is yet to experience. It remains to be seen if the evolution of platform designs to improve capability over protracted periods of time will continue to remain a feature of air power development.

C-130 Hercules: Fifty Years in RAAF Service

> **Key Points**
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> - *The optimal employment of air power requires an understanding of its characteristics, an integral part of professional mastery*
> - *The C-130's design and capabilities are well suited for Australia's geographic environment and overseas operational requirements*
> - *The success of the C-130 can be attributed to how the aircraft exploits the air power characteristics of speed, reach, payload, precision and flexibility.*

2013 marked 10 years of continuous operations by RAAF C-130s in the Middle East, a formidable milestone for any unit and capability in the ADF. This deployment, however, is only one chapter in the history of the C-130 in RAAF service. The RAAF has operated C-130s for over 50 years, with four different variants from the C-130A to C-130J conducting missions across the full spectrum of operations from peacetime humanitarian assistance to conventional warfare. The Australian experience is far from unique, with over 70 countries currently operating at least one variant of the type.

So how does one explain the exceptional popularity, longevity and utility of this ubiquitous platform? One approach would be to measure the platform's capability against the characteristics of air power—those key attributes of the air domain that are important to understand in order to realise the full potential of air power. Exploring how the design and operation of the C-130 embodies and exploits some of the more relevant characteristics of air power—***speed***, ***reach***, ***payload***, ***precision***, ***flexibility*** *and* ***dependency*** - gives some insight into the success of this aircraft.

The characteristics of air power are interdependent, and can be analysed and applied in clusters. The first cluster to be examined in relation to the C-130 comprises of reach, speed, payload and precision. The C-130As introduced into service in 1958 were the first turboprop aircraft operated by the RAAF. The new engine resulted in a combination of efficiency and speed that gave the C-130 a ***reach*** that enabled it to cover the entire South-East Asia and the Southern and Western Pacific regions, a capability repeatedly employed over the next five decades. A series of Defence White Papers has consistently emphasised the importance of the area for Australia's national security.

The C-130's ability to deliver passengers and cargo to destinations in the Asia-Pacific region, in response to natural disasters and in conducting Search and Survivor Assistance missions in the Southern Ocean, has been of great benefit to Australia. The archipelagic nature of the region, as well as Australia's reliance on maritime transportation for its economic well-being has made this an essential capability for the RAAF. The C-130 transits up to 20 times quicker than surface transport and is largely uninhibited by physical barriers of geography. Its transit ***speed*** is complemented by an effective cargo handling system and ramp, enabling it to offload cargo quickly and efficiently both on the ground and when airborne, further increasing its mission effectiveness.

The C-130 cannot match the sheer bulk capacity of the planned Canberra-class Land Helicopter Dock (LHD) and carries a lesser ***payload*** than its stable mate the C-17. It can, however, deliver a useful load of either 128 personnel; 8 pallets of cargo; military or civilian vehicles; small surface vessels; or aircraft up to the size of a Black Hawk. Surprisingly, in many cases, the most important load on the C-130 is the humble forklift, a critical enabler for any air mobility operation. Thoughtful load planning, whether loading equipment, supplies, medical teams or advance parties, can fully exploit the C-130s flexible payload capability.

The final characteristic in the cluster, ***precision***, is more often associated with the strike role than air mobility. The C-130, however, can exploit precision not only through accurate airdrop using GPS-guided parachutes such as the Joint Precision Air Drop System (JPADS), but also through generating a precise effect by delivering its load to, or extracting one from, a location at the critical time. Examples of this include the 1997 evacuation of 450 personnel from Phnom Penh by six RAAF C-130 sorties, or in a more spectacular fashion when four Israeli C-130s delivered a commando force 4000 kilometres to Entebbe airport in Uganda to rescue airline hostages in 1976.

Just as an effective understanding and employment of the air power characteristics can generate positive effects, poor application can result in limitations on the utility of the C-130. Without centralised control of an air mobility force, C-130 missions can be wasted if the aircraft is not fully utilised, either through suboptimal loading, or empty transit sectors. The ADF has employed centralised control and load allocation, provided by the Air and Space Operations Centre, Air Mobility Control Centre and No 1 Joint Movement Group, to mitigate this limitation. Effective management and coordination can optimise C-130 loads from different Services, countries, or non-government organisations.

The two characteristics of ***flexibility*** and ***dependency*** are also critical to the optimised employment of the C-130. Its robust design has not only allowed it to perform a number of roles such as airborne operations and aeromedical evacuation, but also enabled a wide range of modifications; the USAF AC-130H gunship and the KC-130 tankers used by many air forces are the most poignant examples of this. In RAAF service, modifications such as self- protection systems have increased the RAAF C-130s' capability, exploiting the flexibility and versatility inherent in this aircraft.

The strengths of the C-130 can be impacted by the final air power characteristic of ***dependency***: the reliance air power has on ground support. Without a suitable airfield or drop zone or without an effective training and safety framework and maintenance capability, the ***reach, speed, payload*** and ***precision*** capabilities of a C-130 can be critically inhibited. Poor maintenance and management of these complementary capabilities and enablers can significantly impact the effects the C-130 can generate.

The success and longevity of the C-130 can be attributed to how the aircraft, and the personnel that operate it, have been able to exploit the air power characteristics inherent in it. The ***speed, reach, payload, precision and flexibility*** of the C-130 has provided an invaluable service to Australia for more than five decades, and is particularly suited to the large area of responsibility and overseas deployments of the RAAF. Complemented by its new air mobility stable mates of the KC-30, C-17, C-27J and KA350, the C-130 can be relied on to generate quality air power for decades to come.

The RAAF in the Iraq War 2003 – Australia's Contribution to the Coalition Air Campaign

Key Points

- *The RAAF provided a vital and flexible air element to Coalition air power during the Iraq War 2003.*
- *The RAAF's expeditionary capabilities and professional mastery enabled Australia to be an effective partner in Coalition air operations.*
- *Despite considerable obstacles and extreme conditions, the RAAF performed exceedingly well in the Iraq War 2003.*

At 0530 hours Baghdad time on 20 March 2003, cruise missiles and bombs rained down on the Iraqi capital publically signalling the commencement of the operation that led to the end of Saddam Hussein's regime. In the lead up to this 'shock and awe' campaign more than 467 000 Coalition forces had amassed in the largest sea and airlift operation since the 1990-91 Gulf War. Iraqi air defence systems had been softened during Operation SOUTHERN WATCH, the 11-year UN mission to monitor and control airspace over Southern Iraq, but the 'Super MEZ' (Missile Engagement Zone) over Bagdad remained intact.

The job to take down the Super MEZ and run the air campaign for the US Operation IRAQI FREEDOM (OIF) fell to the Joint Force Air Component Commander (JFACC) Lieutenant General Michael (Buzz) Moseley. As JFACC, he commanded over 1800 aircraft and more than 55 000 personnel. The nerve centre of his command and control was the Coalition Air Operations Centre (CAOC), which at its peak had a staff of nearly 2000 including an embedded team of RAAF and Army personnel under the command of the then Group Captain (now Air Marshal) Geoff Brown. The CAOC planned and executed OIF air operations in line with the air power tenet of centralised control and decentralised execution.

The ADF contribution to the Iraq campaign consisted of 2050 personnel, including 620 RAAF members. In total, the ADF allocated

19 fixed-wing and three rotary wing aircraft for use in Coalition air operations.

In mid-January 2003 a detachment of two AP-3C Orion aircraft, with more than 150 personnel from the then Maritime Patrol Group and No 381 Expeditionary Combat Support Squadron (ECSS), were deployed as part of ADF Operations BASTILLE and FALCONER—the lead-up phase and the Australian contribution to the war in Iraq. For the next four months the Orion crews flew essential ISR missions providing valuable information to support the development and execution of maritime, land and air campaigns. On 16 July 2003, Operation CATALYST commenced as the ADF contribution to the US-led Multinational Force effort to develop a secure and stable environment in Iraq, to assist national recovery programs and facilitate the transition to Iraqi self-government. Orions continued to provide critical ISR capabilities across Iraq in support of operations until their withdrawal in 2011.

In early February 2003, three C-130H Hercules aircraft departed Australia for the Middle East Area of Operations (MEAO). About 100 personnel from the Air Lift Element Group, known as the Combat Air Lift Unit (CALU), formed part of a large multi-national air mobility effort. By mid-March 2003, the Hercules crews had lifted roughly 400 000 kilograms of cargo and 500 passengers across the MEAO, as well as training extensively with SAS troops who were to later operate across Iraq. Air personnel from No 36 Squadron and No 386 ECSS effectively contributed to the lightning campaign of manoeuvre undertaken by Coalition Special Forces. Three Australian CH-47 Chinook helicopters contributed to these missions in western Iraq by providing short duration, smaller payload flights into areas inaccessible to larger fixed-wing aircraft. Throughout the war, RAAF Hercules aircraft were used to fly supplies and equipment into Iraq, and later flew some of the first humanitarian aid missions into Baghdad International Airport. C-130J model Hercules of No 37 Squadron joined the C-130Hs to continue to provide airlift to Australian and Coalition forces.

During the second week of February 2003, a detachment of 14 F/A-18 Hornets from No 75 Squadron deployed to a base in the Middle East. With the personnel of No 382 CSS, approximately 250 RAAF personnel deployed from Air Combat Group. The decision to deploy the Hornets was criticised by some commentators, who believed deficiencies in the aircraft combat systems would limit their inclusion in initial operations. In reality, the Hornets sent to the Gulf had recently been upgraded to Hornet Upgrade Project (HUG) 2.1 standard, which made them at least as capable as the F/A-18C aircraft operated by the US Marine Corps and the US Navy. RAAF Hornets were initially engaged in defensive counter air (DCA) operations, however after nine days the Hornets were transitioned into air-ground operations—close air support and 'kill box' interdiction—in support of the Coalition advance. Targets varied from military barracks to missile launchers. The Iraq War saw the first bombs dropped by the RAAF in 32 years, and in keeping with the advances in technology, only precision-guided weapons were employed.

In addition, an Air Forward Command Element of about 70 RAAF personnel was deployed to Iraq as part of Operation FALCONER. This element was responsible for coordinating air operations with coalition partners and providing national control of RAAF assets. It included 42 staff attached to the CAOC, numerous liaison officers, several exchange officers and six imagery analysts. This element was embedded with their Coalition counterparts and took part in the planning for the employment of 1600 Coalition aircraft which flew on the daily Air Tasking Order (ATO) which tasked all the aircraft flying in support of OIF.

In May 2003, then Warrant Officer of the Air Force Peter Hall, summed up the RAAF contribution to the Iraq War 2003. 'I think it's the first time we had to really integrate with a coalition force and we proved that we could fit in, like a jigsaw puzzle', he said. 'I spoke with all the base chief master sergeants who have had nothing but praise for the Australians even though we were just a drop in the ocean compared with them. Our people have enhanced Australia's reputation and became the good citizens in the camps, and in some cases become leaders in the social push to get everyone together. We have gone out and done the business and not lost anyone, which, of course, is great. Our people over there have worked really hard, long hours.'

RAAF expeditionary capability and professional mastery were tested during the Iraq War 2003. Although the war generated some challenges, all obstacles were overcome and the Air Force was able to make a significant contribution to Coalition operations in the MEAO. The Australian airmen and women, who served in the MEAO during

2003, and in the decade since, have upheld the finest traditions of their predecessors and staked their claim in Air Force history.

Air Force Battle Honours

Key Points

- *Battle honours are a commendation for outstanding performance of a unit under combat conditions.*
- *Air Force battle honours were inherited from British Army traditions via the Royal Air Force.*
- *Battle honours may be less relevant today than in the past due to the force assignment procedures in current operations.*

For centuries, monarchs and governments have recognised outstanding performance by military units in battle by the granting of commendations. Battle honours, in which the name and year of the battle are emblazoned (embroidered) on the unit's colour or standard, forms part of such commendations. However, is the concept of battle honours, that originated on European battlefields in the eighteenth century, relevant to a modern air force?

Although the granting of battle honours had already occurred earlier, it was not until 1784 that British Army units were authorised to display their battle honours on their colours. The Royal Australian Air Force (RAAF), like the Royal Air Force (RAF), had no battle honours up to World War II. In 1943, King George VI approved the award of a standard to any RAF squadron that had 25 years of service or one that had received 'the King's appreciation for outstanding operations.' The approval included provision for battle honours to be added to each squadron's standard, even though the RAF at the time had no approved battle honours.

In due course, a list of air battles and campaigns in which the RAF took part was approved by the King as the first Air Force battle honours. This list included battles in both World Wars, and allowed RAF squadrons to inherit honours from their similarly numbered squadrons in the Royal Flying Corps and the Royal Naval Air Service. The list also included honours awarded to Australian squadrons, both Australian Flying Corps (AFC) and RAAF, that served under British command in both World Wars. However, many battles in the Pacific theatre did not have RAF involvement and therefore, were not awarded a battle honour at this time.

In 1952, the newly-crowned Queen Elizabeth II approved the award of standards to RAAF squadrons that also included the right to emblazon battle honours on each standard. Two years later, the Australian Prime Minister recommended to the Queen a list of proposed battle honours for the RAAF. This list included honours for battles such as Milne Bay and Bismarck Sea—battles which the RAF had not taken part in. In addition, the wording of the recommendation granted the authority for the Air Board to allot battle honours from the list to squadrons that had taken part in the battle. All recommendations were approved by Her Majesty on 1 October 1954.

In the next two decades, most existing Air Force squadrons were allotted the battle honours they had earned in World War II. Squadrons also inherited the World War I battle honours from their predecessors in the AFC. However, squadrons that had not reformed after the major disbanding of units in the demobilisation of 1947-48 were not bestowed any honours.

In 1979, during the process of recommending battle honours for operations in Korea, Malaya and Vietnam, it was found that each of the Australian Services had its own approving authority for battle honours. Reluctant to make three different recommendations, one for each Service, to the Queen, the Governor-General asked the Australian Government to develop a single approval process covering all three Services. In response, Her Majesty delegated to the Governor-General in 1981 the authority to approve the award of battle honours to all three Services as well as the authority to allot battle honours to participating units, on the recommendation of the Prime Minister. Battle honours for Australian operations in Korea and Vietnam were approved in the following year, although those for Malaya would not be considered for another two decades.

In 2009, the RAAF Historian initiated a review of Air Force battle honours which resulted in recommendations for nine new battle honours over the period 1945 to 2003. The new honours included awards for service in the Philippines, Malaysia, Thailand, East Timor and Iraq. All honours were approved by the Governor-General on 22 June 2009. As Operation SLIPPER, which included operations in Afghanistan, was still current at the time of the review, it was not considered for a battle honour.

Although air forces inherited the tradition of battle honours from armies, there are some significant differences between Army and Air Force honours. For air forces, battle honours are commonly awarded for campaigns and wars, with fewer awarded for individual battles. This is due to the very nature of air warfare and the Air Force perspective. Air battles cannot be defined in the same way as land battles. A land battle occurs at a given place or over a given area, and at a specific time or time period measured in hours or days. Whereas an air battle, even one fought as part of a land battle, may have begun before the ground phase and have been fought over a much greater area, perhaps even tens or hundreds of kilometres away. The Battle of the Bismarck Sea, for example, was fought between the islands of New Britain and New Guinea over a 6-day period in March 1943. The Battle of the Atlantic, on the other hand, was fought over the entire Atlantic Ocean over a period of five years and eight months.

In the modern era, battle honours present a dilemma. They have customarily been awarded to units for their performance as a unit—not as individuals. Since the INTERFET operation in East Timor in 1999, Air Force aircraft and personnel deploying for combat operations have been force-assigned to a Joint Task Force (JTF), which disbands as soon as the operation is over. Rarely is a whole unit or squadron deployed. The combat support squadrons deployed to East Timor in 1999 were made up of personnel drawn from combat support squadrons from all over Australia. If such a deployed squadron is to be commended for its performance, the question of the award of a battle honour remains. As the unit which actually carried out the operation no longer exists as a separate entity, the commendation serves no purpose because it cannot be displayed. For this reason RAAF unit lineage is an important heritage issue to consider before organisational change and deployments are implemented.

Battle honours have served the Air Force well in the past. They remind present squadron members of the great achievements of their predecessors and they foster confidence in the Australian public. However, in the current operational environment where deployed Air Force units are composed of parts of different permanent units and operate within a JTF, are battle honours relevant? Are they relevant to a modern Air Force or are they only appropriate to past wars? The jury may well be still out on this question.

History of Air Force Aeromedical Evacuations

> **Key Points**
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> - *Improvements in ADF medivac capability were largely dependent on the aircraft of the time.*
> - *Since World War II, aeromedical evacuation has been an important function of air power.*
> - *The Air Force's medivac capability contributes to national Air Power during emergencies and natural disasters.*

Over the last century, aeromedical evacuation (medivac) has evolved, like other aspects of air power, from a concept to a major Air Force capability. Tactical medivac, which is the evacuation of wounded from the place of injury to medical facilities within the Area of Operations (AO), has been carried out by various military services since World War I; however, strategic medivac (from the AO back to permanent facilities in Australia or another allied country) had to wait for the development of longer range aircraft in World War II.

Prior to World War II, Air Force medivac flights were carried out on an ad hoc basis with improvised equipment when suitable aircraft were available. When the Second Australian Imperial Force (2 AIF) deployed to the Middle East in 1940, the great distances within the AO and the scarcity of medical facilities demanded a rapid means of evacuating wounded soldiers. To meet this demand, the Air Force raised No 1 Air Ambulance Unit (1AAU) at RAAF Laverton, equipped with three DH-86 Express former airliners. These four-engined aircraft were fitted for aerial ambulance work under the supervision of FLTLT George Simpson, a former doctor with the Royal Flying Doctor Service (RFDS). The unit flew its first medivac mission in the Middle East on 3 August 1941 and supported the British Eighth Army in its campaigns across North Africa, Sicily, Malta and Italy, evacuating 8252 patients to safety.

In the Pacific theatre, No 2 Air Ambulance Unit (2AAU) flew its own Hudson, Gannet, Dragon and later Dakota aircraft on missions evacuating wounded from Papua New Guinea (PNG) to Australia. By

1943, the large number of casualties from heavy fighting required an expansion of the medivac organisation; however, under the Geneva Conventions, dedicated air ambulance aircraft displaying the Red Cross insignia could not be used to carry any non-medical equipment or personnel. Any increase in the number of dedicated air ambulance aircraft would have reduced the Air Force's air transport capacity at a time when it was needed most, therefore, the expansion was not undertaken.

The solution was to form units of medivac-trained personnel who utilised any available aircraft to conduct medivacs. From late 1944, No 1 Medical Air Evacuation Transport Unit (1MAETU) at Lae, PNG, 2MAETU at Morotai in the Dutch East Indies and 3MAETU at Townsville formed a chain to evacuate patients from the South-West Pacific battle zones to major hospitals in Brisbane. Evacuations from coastal and island locations were often conducted using Sunderland or Catalina flying boats, but the majority of medivacs were done using the faithful Dakota aircraft. Medical units at major airfields cared for the patients between flights. Thus by late 1944, the Air Force was operating a major strategic medivac organisation that carried more than 14 000 patients to medical care in Australia. The medivac role was not without risk though, as several flights and their crews and patients were lost in accidents.

With the end of hostilities in August 1945, thousands of Prisoners of War (POWs) needed medical care and rapid transport to long-term medical facilities in Australia. Every available aircraft was used for medivac—Liberators, Catalinas and Dakotas. Singapore quickly became the evacuation base, with a hospital set up by Air Force and Army medical staff. Approximately 7800 POWs of all nationalities were evacuated by Air Force units from Singapore to Australia.

During the Korean War, the Air Force used Dakota aircraft from No 30 Communication Unit, later renamed No 36 Squadron, to evacuate wounded Commonwealth personnel from Korea back to Iwakuni, Japan. After stabilisation, the wounded were often flown back to Australia on chartered Qantas DC-4 aircraft with a RAAF nurse and medical orderly accompanying the patients on the 27-hour journey.

In peacetime, the Air Force has often been called upon to medivac civilians. RAAF Catalina flying boats carried badly injured people from islands and isolated coastal communities to major cities. On 9 April

1955, a No 10 Squadron Lincoln bomber carrying a sick baby from Townsville to Brisbane, crashed into the side of Mt Superbus in south-east Queensland, killing the crew of four, the baby and a civilian nurse.

In 1962, Iroquois helicopters introduced a new medivac capability to the ADF. The ADF's first operational experience in helicopter medivacs came in 1964 when No 5 Squadron Iroquois supported Commonwealth operations against Communist insurgents in Malaya. The lessons learned in the jungles of Malaya were put to the test in Vietnam where No 9 Squadron crews flew in excess of 4000 medivac—code named 'dust-off'—missions to bring wounded soldiers back to medical facilities at Vung Tau or Bien Hoa. An Air Force or Army medical orderly usually accompanied each dust-off flight.

As well as providing a huge increase in airlift capability, the C-130 Hercules aircraft was a major advance in aeromedical evacuation. Faster, with longer range and pressurised, the Hercules could fly medivac missions that were impossible in earlier transport aircraft. During the Vietnam War, wounded soldiers in field hospitals were evacuated to Australia by C-130 usually with an overnight stay at No 4 RAAF Hospital at Butterworth. Many Air Force medical personnel also gained experience with a United States Air Force medivac squadron at Clark Air Force Base, Philippines.

The medivac experience gained in the Vietnam War came to the fore in a number of national disasters. When Cyclone Tracy devastated Darwin in 1974, Air Force C-130s and medivac crews evacuated approximately 600 patients on flights to southern cities. Following the bombing of nightclubs in Bali in October 2002, 66 patients, some critically injured, were evacuated by four C-130 Hercules aircraft first to Darwin and then to other civilian hospitals. After a tsunami struck Sumatra, Indonesia on 26 December 2004, Air Force medical teams evacuated 60 severely injured locals from the devastated area. During the operation, nine ADF members were killed in the crash of a Navy Sea King helicopter, including three Air Force medical staff.

During 12 years of combat operations in the Middle East, the wounded were evacuated from the battlefield to in-theatre medical facilities by various Coalition aircraft including helicopters and C-130s. After stabilisation, they were evacuated to Australia using the regular strategic airlift flights that had brought personnel and supplies to the Middle East. Initially, these utilised C-130 aircraft but later evacuations were done on chartered civil aircraft, regular airline flights and C-17 flights. On all flights back to Australia, an Air Force medivac team accompanied the patients.

Over 90 years of operations, the Air Force has developed extensive medivac experience and capability, which will be crucial to the treatment of the injured in future operations. Following any natural disaster or any other emergency, carrying out mass medivacs will be an important Air Force contribution to the civil community.

Air War Against the U-Boats, 1943

In late July 1943, a small number of Australians participated in one of the most remarkable actions in RAAF history—an episode that has become famous as the sinking of U-461 by the crew of aircraft 'U' of No 461 (Australian) Squadron. Less well known is the level of cooperation achieved between Allied aircraft and naval vessels that opposed the German U-boat menace in the Bay of Biscay at the time.

RAF Coastal Command carried out an offensive against the U-boats while they transited from bases in southern France, through the Bay of Biscay, to their operational areas in the Atlantic. On 30 July 1943, a RAF Liberator aircraft sighted three U-boats running on the surface across the Bay of Biscay trying to break out into the Atlantic. The German submarines applied a new tactic of remaining on the surface and using their anti-aircraft guns to produce a fury of fire against the attacking Allied aircraft. Soon six more aircraft joined the fight. The submarine U-462 was damaged in the air attacks and left dead in the water. After a short time, U-504 decided it was safer to dive than to fight on the surface. While the third submarine, U-461, was under simultaneous attack by two Liberators (one British and one American), a No 461 Squadron Sunderland flying boat, with nine crew who were mostly Australians under Flight Lieutenant Dudley Marrows, approached unnoticed to drop a stick of seven depth charges from a height of 50

Key Points

- *RAAF personnel serving with Coastal Command played a critical role in the victory gained over the German U-boats during World War II.*
- *The Allies developed an effective, coordinated ASW system of experienced and well-trained personnel operating relatively large numbers of aircraft and ships, each equipped with the latest practical ASW technology.*
- *The Allied ASW system was a team effort including Air Force and Navy personnel supported by dedicated civilians within Defence, industry and the scientific community.*

feet. U-461 was hit several times and appeared to break in two, sinking almost immediately, although some of its crew managed to escape. Meanwhile, five Royal Navy anti-submarine warfare (ASW) vessels were summoned to the area by the aircraft. They sank U-462 on the surface with gunfire. The ships then used ASDIC (sonar) to locate the submerged U-504 and sank it with depth charges. Approximately 70 German submariners were picked up from the scene by the ships and taken back to England as POWs.

The tactical advantage in this fight in the Bay swung between German submarines and Allied aircraft as each side gained temporary advantages in technology, intelligence and operational research. Submarines initially had an advantage as the Allies had limited number of operational maritime reconnaissance aircraft to patrol the area. Even when they did find a submarine, experienced submariners would normally see the aircraft first and crash-dive before an air attack could be executed.

During 1942, Wellington aircraft fitted with an early form of radar (ASV II) gained an advantage in daylight; however, within a few months, the Germans countered with a rudimentary radar detector (Metox). In March 1943, Coastal Command aircraft were fitted with new 10-centimetre radar (ASV III), which could not be detected by the German Metox, and air attacks once again became lethal against the U-boats during the day. The aircraft fitted with ASV III radars were also lethal at night when used in combination with the Leigh light, which could illuminate U-boats during the final phase of an attack. As a result, Admiral Karl Dönitz, Commander of German Navy, ordered submarines in the Bay of Biscay to submerge at night, surface in daylight to recharge batteries, and if attacked, fight back on the surface. This was a disastrous over-reaction to the Allied tactics.

By mid-1943, the Allies had built up an effective, coordinated ASW system, with well trained and experienced personnel operating relatively large numbers of aircraft and ships, equipped with the latest ASW technology. Area Combined Headquarters at Chatham, Gosport, Plymouth and Rosyth coordinated the Allied ASW effort, with joint operations rooms staffed by air force and naval personnel. Coastal Command headquarters was situated at Northwood, near London, close to the Admiralty. Signals intelligence (Ultra), high-frequency detection finding (HFDF), technical intelligence and other forms of

Allied intelligence were disseminated through these headquarters providing critical support to ASW operations.

The Allies' ASW system, which included air force and naval personnel, also relied upon a dedicated group of civilians within Defence, industry and the scientific community contributing to the overall ASW capability. In contrast, there was none of the productive interaction and coordination between the Kriegsmarine, Luftwaffe and comparable science, industrial and technology organisations that was so evident within the Allies' system. For the Germans, this meant that effective countermeasures were slow to be developed in response to the new Allied ASW capability that was increasingly being employed on operations.

It was the remarkable level of cooperation achieved between Allied air and naval forces that was instrumental in the success of the Atlantic campaign. Coastal Command—which included British (RAF and Fleet Air Arm), Canadian, Australian, Czechoslovakian, Norwegian, Dutch and American squadrons under its control—contributed to the Atlantic battles throughout the six years of war. Three Australian squadrons served with Coastal Command during this time: Nos 10, 455 and 461. In addition, approximately 43 per cent of the RAAF personnel in Coastal Command served with RAF or empire squadrons. Overall, more than 1600 RAAF personnel served with Coastal Command during the war and, of these, 408 lost their lives.

After the war, a small core of RAAF professionals retained the strategic lessons from the air war against the U-boats and formed a dedicated maritime air component within the RAAF, initially equipped with Catalina flying boats followed by the MR 31 Lincoln. When the Australian Neptunes entered service with No 11 Squadron in November 1951, it was the start of a new long-range ASW capability; one which has been upgraded, most significantly with the introduction of the P-3C Orion aircraft. As we now look forward to a combination of P-8A Poseidon aircraft and long-range unmanned aerial vehicles to maintain this ASW capability, it is worth remembering the ASW system that underpinned the Allied victory in the Battle of the Atlantic.

The Bomber Offensive and Electronic Warfare

The 2013 Defence White Paper includes an announcement that the RAAF would be developing a substantial electronic warfare (EW) capability. At the center of this new capability are 12 EA-18G Growler EW aircraft that will be significant force enablers. However, this new capability when operational will not represent the first Australian EW squadron. The honour of being the first Australian EW squadron rests with No 462 Squadron, an Empire Air Training Scheme Article XV squadron, which operated in World War II as part of the RAF Bomber Command offensive over Germany from late 1944 to the War's end in May 1945.

First formed at Fayid, Egypt in 1942, No 462 Squadron later reformed in March 1944 as an Australian squadron in RAF Bomber Command, flying MkIII Halifax aircraft out of Britain. After initially being employed on conventional bombing operations, the squadron was transferred to the RAF's 100 (Bomber Support) Group in December 1944 and began modifying their aircraft with a range of EW equipment.

The formation of 100 Group and the shift in role for No 462 Squadron was part of the capability being developed within Bomber Command to address the high casualty rates suffered by

Key Points

- *EW is the military action involving the use of electromagnetic spectrum and directed energy to determine, exploit, reduce or prevent hostile use of, and retain friendly use of, the electromagnetic spectrum.*
- *The conduct of air operations in the modern battlespace involves the close integration of a range of capabilities in order to defeat and disrupt adversary defensive and offensive measures.*
- *Australia has been involved in EW operations from the earliest employment of electronic countermeasures in World War II.*

the command since the opening days of the war. At the heart of the problem lay the fact that the strategic bomber offensive of the RAF was being conducted without adequate control of the air. Furthermore, Germany had developed a highly capable nightfighter force, an airborne and ground-based radar surveillance system and searchlight and anti-aircraft gun batteries, all linked and managed by a sophisticated warning and control network. These measures combined to ensure that the bomber streams had to battle their way to and from every target.

In response to the threats posed by the German air defence network, Bomber Command progressively developed a range of countermeasures designed to increase the chances of survival for the bomber aircraft. These measures were not aimed at taking control of the air, but rather intended to reduce the risk posed by the nightfighters and to degrade the cohesion of the warning and control network.

Illustrative of the countermeasures developed were the low-level 'Flower' air field patrols and the high level 'Mahmoud' operations conducted by the Australian No 456 Squadron and other RAF Mosquito nightfighter units. The 'Flower' patrols entailed orbiting in the vicinity of known German nightfighter airfields and carrying out attacks on aircraft and infrastructure in order to disrupt the operations of the enemy aircraft. Should a nightfighter get airborne, the Mosquito would use their airborne intercept radar (AI radar) to locate and shoot down the enemy before it could in turn intercept the bomber stream.

The 'Mahmoud' patrols were a form of close escort to the bomber aircraft. Here the Mosquitoes would use a range of warning devices and AI radar to first distract German nightfighters away from the bombers, and to intercept those enemy aircraft which were positioning to shoot down Allied aircraft.

It was into this dark and forbidding battlespace that the crews of No 462 Squadron were committed in the opening months of 1945. The unit mainly conducted two forms of EW operations. The first was to deceive and distract the German warning and control network by generating fake or 'spoof' raids. This was done through the generation of a range of radio and radar emissions sufficient to appear as if a much larger formation was approaching Germany than was the case. Included in the deception measures was the use of 'window' (now known as 'chaff'). This consisted of strips of aluminum foil, sized to correspond to specific radar signatures, which would form false radar returns and create the image of a much larger formation than was actually the case. If released in sufficient density, 'window' could create a curtain through which some radars types were not able to penetrate. At times these curtains were used to hide a real bomber stream or a smaller spoof raid. It was also used to mask a sudden course change of the bomber fleet, which would disrupt the intercept solutions of any aircraft being vectored on to the Allied bomber force, or to prevent the German warning and control network from determining the true targets for the night's raid.

If successful, these much smaller spoof formations would draw the Luftwaffe nightfighters away from the intended target areas of the main bomber force. With the enemy aircraft drawn away and ultimately forced to land and refuel, the spoof raids not only created gaps in the German air defence networks, but by keeping the Luftwaffe airborne in unproductive intercepts, also forced the consumption of valuable fuel and other resources which were already in short supply within Germany.

The second EW operation conducted by No 462 Squadron was known as 'Airborne Cigar' or 'ABC' missions. These missions involved the installation of additional VHF radio sets to the aircraft and the carriage of an additional radio operator. Known by the rest of the crew as the Special Operator (SO), these personnel were competent in understanding German. The role of the ABC missions was to fly in formation with the main or spoof bomber missions and to scan the VHF radio frequencies until the transmissions from the German ground controllers could be located. The SO would listen-in to gather what intelligence he could, then retransmit on the same frequency random sound, often an amplified transmission of the aircraft's engine noise, in order to drown out the ground controller's instructions to the German nightfighters.

This evolved into a cat and mouse game between the SOs and the German controllers. Once jammed, controllers would shift to alternative frequencies, they would pass on instructions via prerecorded music creating the illusion that they were a radio station, and they even faked whole dialogues between imaginary controllers and aircraft to distract the SOs from the real transmissions on a different frequency. In a more deadly variation, the nightfighters would home in on the

ABC transmissions and shoot down the ABC fitted aircraft. As a result, losses among ABC aircraft were higher than regular bomber aircraft.

Overall, the EW missions carried out by No 462 Squadron and 100 Group did not completely disrupt the German air defence network. However, assessments of raids in which the EW component was efficiently employed, found that losses of aircraft and crews were consistently lower than for those raids which were not shielded by EW operations. It is because of the ability of EW aircraft to disrupt, penetrate and deceive adversary electronic spectrums that EW has become a key enabler of air campaigns conducted in support of joint operations.

Air Intelligence: A People-Centric Capability

From the time that aircraft first went into combat in 1912, intelligence has always been a prerequisite for the successful planning, execution and assessment of air operations. In its earliest forms information was passed directly by pilots and observers to senior commanders and headquarters staff, yet over time the need for air intelligence has increased and specialised disciplines have evolved. Modern Air Forces now use air intelligence as a capability—which is synchronised with and integrated within each of the air power roles and used in direct support of current and future operations. For over 100 years, air intelligence has been a people-centric capability, reliant on data and information.

Key Points

- *Air Intelligence has been an integral part of Air Campaigns for over 100 years.*
- *The Air Force's Intelligence Branch was formed on 20 September 1963. Since then it has grown from strength to strength—providing direct support to air operations.*
- *Air Intelligence has always been heavily reliant upon its people.*

In its early days, the RAAF has not always understood that effective air operations are heavily reliant upon air intelligence, and that people are the backbone of an effective air intelligence system. As General Duties (GD) officers, aircrew were sometimes given intelligence tasks as secondary duties and the majority were quintessentially amateurs with little or no formal training. The experience and knowledge of intelligence that was available was essentially tactical—often limited to the squadron or wing level. On the other hand, a small number of Australians gained knowledge of air intelligence during World War I. When the RAAF was formed in 1921, one of these veterans, Wing Commander Richard Williams, was appointed as the Director of Intelligence and Operations. He was subsequently appointed Chief of Air Staff in October 1922. Williams and a few other like-minded RAAF officers—including Henry Wrigley, John McCauley, Joe Hewitt, Frank Bladin and Gerard Packer—managed to increase their air intelligence knowledge throughout the 1920s and 30s but their first duty was still to undertake and command operations. Air intelligence remained a secondary task. This small group of 'thinkers' managed to produce some useful air intelligence within the Australian context, but they could not get their message across to the Australian Government before the start of World War II.

In late 1939 the Royal Air Force (RAF) formed a specialist Air Intelligence Branch because war had highlighted the need for dedicated intelligence officers supported by experienced non-commissioned intelligence analysts of various musterings. Air intelligence was recognised as a profession demanded by modern air warfare. Within Australia this requirement was not as well established. The RAAF's main contribution to the war effort during the early years was through the Empire Air Training Scheme, which produced some 37 000 aircrew but did not produce other specialists such as intelligence personnel. The RAAF perspective of air intelligence in Europe was again almost completely limited to the tactical level. The official historian, Douglas Gillison, described the situation succinctly, '… no specific organisation on which a comprehensive Intelligence service might be built. At this stage, combat operations were far removed from Australia and the need for the development of Intelligence, though keenly appreciated by all concerned, was not immediately pressed.'

Dedicated officers like Wing Commander Gerard Packer, who became Director of Intelligence at RAAF Headquarters when it was split from Operations in September 1941, worked hard to highlight the major deficiencies within the Australian air intelligence community and the increasing air threat from Japan. Once again, most of Packer's efforts fell upon deaf ears. Even during the first few months of the Japanese onslaught, his proposals were refused. After Japanese air strikes on Darwin in February 1942, he gave damning evidence to (Sir) Charles Lowe's inquiry into the state of the RAAF's preparedness for war in the defence of Australia.

The Pacific War changed the RAAF's outlook on air intelligence forever. The Air Force quickly realised that it had to work with the United States Army Air Forces (USAAF) in the South West Pacific Area (SWPA) in order to be able to make a significant contribution to the air war. USAAF air intelligence doctrine, albeit modified for SWPA use, was the bedrock upon which a comprehensive RAAF air intelligence system was built. From 1942 until the end of the war, RAAF personnel worked with their American colleagues to generate high-value, multi-source air intelligence, which contributed significantly to the victory against the Japanese. The RAAF employed hundreds of intelligence staff, men and women, who undertook wide ranging air intelligence activities at all levels of command in what was a mature people-centric capability.

Unfortunately this capability did not survive post-war demobilisation and force rationalisation programs. Unlike the RAF and United States Air Force (formed in 1947) the RAAF had too few senior intelligence officers with World War II experience to maintain a critical mass in its air intelligence capability. Again, intelligence was not considered core RAAF business but a secondary responsibility for GD officers and a handful of junior Special Duties (Administrative) officers. As intelligence units were disbanded, the air intelligence personnel working within the related musterings almost vanished entirely. Despite attempts to raise the profile of intelligence within the RAAF, the momentum was lost and air intelligence returned to its pre-World War II norm—being mostly limited to the tactical level within a squadron or wing. The notable exception to this was the formation of No 3 Telecommunications Unit (3TU) at RAAF Pearce on 15 October 1946 as the key element of the RAAF contribution to Australia's strategic intelligence capability—it was only disbanded on 1 March 1992.

The RAAF's initial reluctance to recognise the critical role of air intelligence to air operations and to form an Intelligence Branch is difficult to understand. Perhaps the reason for the change can best be understood by Victor Hugo's famous quote, 'One cannot resist an idea whose time has come'. By 1963, the array of new and emerging systems, coupled with the increasing threat and Air Force commitments in South-East Asia, finally convinced the RAAF leadership that it needed a dedicated specialist air intelligence capability to support Australia's ongoing defence commitments. On 20 September 1963 the Air Board approved the formation of a dedicated Intelligence category within the Special Duties Branch under Air Board Agendum 13019. The change confirmed 24 Intelligence Officer (INTELO) positions and included two wing commanders and four squadron leaders. For the first time, the RAAF's intelligence airmen in the various signals and imagery trades would be led by specialist intelligence officers.

Over the last 50 years the Air Force's intelligence organisation has grown from strength to strength. Technologies have changed and the amount of information available from intelligence, surveillance and reconnaissance has increased exponentially, however the central requirement for Air Force people within the intelligence capability has not changed. This people-centric capability has served, and will serve, the nation well into the future.

Defence Airworthiness

> **Key Points**
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> - *Airworthiness is about ensuring that safe aircraft operate in a safe system*
> - *There was an unusual spike of accidents in 1990-91 that prompted the creation of a system of AwBs to oversee the technical and operational aspects of airworthiness*
> - *CAF is the Defence Aviation Authority*

Airworthiness in Defence is, at times, regarded as a fairly modern construct, although that is not the complete picture. In the 1930s, there were some tentative steps to incorporate consideration of airworthiness as part of the engineering management process of the Royal Australian Air Force (RAAF) aircraft fleet. Later, in both the 1950s and 1970s, there were attempts to integrate airworthiness into RAAF engineering. However, these were essentially ad-hoc arrangements that did not take hold. So while there were earlier forays in airworthiness, there was no lasting unified approach to the evaluation of the technical and operational risks for military aircraft in Australia.

Since World War II, the long-term fatal accident rates in the RAAF had some lows during the periods of peace, but increased markedly during wartime. There were improvements in safety as the RAAF fleet retired its older piston-engine aircraft, and inducted jet and turboprop aircraft, however, even in the peacetime environment that existed from 1972 to 1992, the number of fatal crashes exceeded two per year. It was as though crashes and fatalities were bound to occur in military aviation, and although there were years in which there were no crashes, these years were the exception to the rule.

Alongside the gradual trend away from operating the less-safe, piston-engine military aircraft, there was also a trend toward inducting more complex aircraft that employed advanced systems. An example of this increasing complexity in aircraft systems is the comparison of the Mustang fighter of late World War II and the 1950s to the software-enabled F/A-18 Hornet fighter that the RAAF has been operating from the mid-1980s to the present day. Besides the differences in the engines of these two aircraft, there is also a distinct difference between them in the complexity of their avionics and other operating systems. So far there have only been four fatal accidents for the Hornets in RAAF service, meaning that the enhanced capability has been delivered more safely than it was 50-60 years ago.

Another set of factors related to airworthiness emerged during the 1980s, as the RAAF had begun to acquire aircraft that already had civil-type certification. This new development was combined with the gradual transition to contracted engineering and maintenance functions. These two factors prompted the RAAF leadership to propose an airworthiness framework that retained the civil-type certification of these aircraft, while permitting the RAAF to operate the aircraft safely in the military environment. In 1989, a proposal was made to the RAAF Chief of Staff Committee to adopt a airworthiness model that included Airworthiness Boards (AwBs) for the various fleets of Defence aircraft.

Although the long-term accident rate for the years 1972 to 1992 averaged over two per year, there was an unusual spike in the accident rate during 1990 and the first five months of 1991 when there was a total of five fatal and one non-fatal accidents: ARDU Nomad (12 March 1990), No 75 Squadron Hornet (2 Aug 1990), No 76 Squadron Macchi (19 Nov 1990), Army Kiowa (25 Feb 1991), No 10 Squadron P-3C (26 Apr 1991), and the non-fatal accident, 2FTS Macchi (16 Oct 1990). It was hardly surprising that in late 1990, the Chief of Air Force (CAF) was appointed as the RAAF Airworthiness Authority, and a system of AwBs was established.

The general concept of the AwBs, made up of senior RAAF officers, was that they conducted a structured review process that examined the technical and operational airworthiness of the military aircraft. The first AwB was held on 9 May 1991.

The Boeing 707 was selected for review, as there was considerable interest in the engineering and civil-type certification of the large aircraft. There was also complex issues with the tanker modification project that was then underway. The AwB had two serving RAAF board members as the technical and operational members.

In the four months between the first and second AwBs (the second AwB was held October 1991), there was a further three fatal accidents: No 75 Squadron Hornet (5 Jun 1991), CFS PC-9 (5 Aug 1991), and Army Nomad (9 Sep 1991). There was also a serious incident involving a No 75 Squadron Nomad (17 Sep 1991). The Nomad was selected for review as it had civil-type certification, and there was also a high level of public interest in the safety of the Nomad following the crash of the ARDU Nomad in March 1990. The date for this AwB had already been notified before the fatal crash of another Nomad and the subsequent serious incident in September 1991. Six days after the second AwB, on 29 October 1991, a Boeing 707 of No 33 Squadron was involved in a fatal accident. Subsequently, on 12 December 1991, a civil-registered RAAF Museum Tiger Moth was also involved in a fatal accident.

In late 1993, another major review of RAAF engineering functions was undertaken, resulting in BluePrint 2020, which eventually led to the creation of the Directorate General of Technical Airworthiness and the development of a new technical airworthiness framework. The first version of the Technical Airworthiness Management Manual, incorporating the Technical Airworthiness Regulations, was issued in November 1994.

In 1998, as a combined response to the Defence Reform Program and recommendations from the June 1996 Black Hawk accident inquiry, CAF was appointed as the Australian Defence Force (ADF) Airworthiness Authority. The AwB board members thereafter reported to CAF. In 1999, the composition of AwB members commenced a transition from serving ADF senior officers to retired senior officers, increasing the independence of the review process. In 2011, CAF's appointment was changed to the Defence Aviation Authority coincident with the reissue of DI(G) OPS 02–2—Defence Aviation Safety Program.

The RAAF Airworthiness Manual was issued in 1991, but in 2001 it was reissued as the ADF Airworthiness Manual under Australian Air Publication (AAP) 7001.048(AM1), incorporating both Military Aviation Regulations and Operational Airworthiness Regulations (OAREGs). In 2005, the OAREGs were issued in a separate publication, the ADF Operational Airworthiness Manual (AAP 8000.010).

The fatal accident rate since 1992 shows a marked decrease. In addition to the improved reliability of modern aircraft, the implementation of the Defence airworthiness system, and major changes to the technical and operational cultures across Defence, has resulted in a dramatic reduction in the average accident rate for the period 1993 to 2012, which now stands at 0.4 fatal crashes per year.

It is also noteworthy that this 20-year period has not been without its dangers as the ADF was involved in operations in Iraq and Afghanistan. The focus on airworthiness has resulted in the ADF continuing to operate in these challenging theatres, while also achieving a safety record throughout this period that is the safest in Australian military history.

Australians in the RAF – World War II

In 1926, the RAAF entered an agreement with the British Government to train 10 Australian pilots per year at Point Cook. Those pilots would then serve as RAF officers on a short-service commission. At the end of their designated short service, the officers were free to return to Australia and serve in the Citizen Air Force, the fore-runner of today's Air Force Reserve. However, many of the Australian officers continued their careers with the RAF and made valuable contributions at all levels of the Service during World War II. Here are the stories of three of those pilots.

> **Key Points**
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> - *Between 1926 and 1938, 149 Australian pilots transferred to the RAF after training at Point Cook.*
> - *This pilot training scheme was an example of a coalition partnership in which both partners gained.*
> - *This scheme also demonstrated the feasibility of the huge Empire Air Training Scheme that followed in World War II.*

Leslie Redford Clisby was born in 1914 at McLaren Vale, SA and grew up in Adelaide. An active sportsman, Clisby's hobby of rebuilding motorbikes led him to join the RAAF as a mechanic in 1935 and train as a pilot the next year. Commissioned in the RAF and posted to No 1 (Fighter) Squadron, Clisby quickly mastered fighter tactics in the RAF's newest and fastest fighter—the Hurricane.

Following the outbreak of war in September 1939, Clisby's squadron deployed to France. Seven months later, Clisby shot down two German fighters in two days.

The German *blitzkrieg* invasion began on 10 May 1940, resulting in intense air battles. Over the next five days, Clisby flew aggressively, often attacking even when he was outnumbered more than three to one. On 12 May, in a melee between Clisby's squadron and 90-odd German fighters, Clisby was credited with shooting down three Messerschmitt Bf109 fighters and three Henschel Hs126 reconnaissance aircraft before running out of ammunition. For his achievements that day, he was awarded the Distinguished Flying Cross (DFC). Two days later, Clisby's flight of five Hurricanes attacked a formation of 30 Messerschmitt Bf110 fighters, with Clisby claiming two of them within minutes. However, he did not return from this mission and was listed as Missing-In-Action until his remains were found the next day in the burned-out wreckage of his aircraft. He was buried at the Choloy War Cemetery in north-east France.

In his few months of combat flying, Clisby showed courage and aggressive leadership. At the time of his death, he was the highest scoring pilot in his squadron, credited with downing 10 enemy aircraft. His true score was probably higher, as many of the squadron's records were lost during the retreat from France. At a desperate time for the RAF, Les Clisby fought with dedication and bravery.

Hughie Idwal Edwards came from Fremantle and, as a young man, played Australian Rules football for South Fremantle. In July 1935, he enlisted in the Air Force for pilot training at Point Cook. On graduation, he accepted a short-service commission in the RAF flying Blenheim bombers. In 1938, he was medically grounded after an aircraft accident but, by sheer determination, regained his fitness after two years of rehabilitation and returned to flying. By June 1941, as commander of No 105 (Blenheim Bomber) Squadron, Edwards flew missions against enemy shipping in the North Sea, earning the DFC. The following month, Edwards was awarded the Victoria Cross for leading a dangerous, low-level attack on the German city of Bremen.

Following a short tour at an operational training unit, Edwards returned to No 105 Squadron, which was now flying Mosquito bombers on low-level daylight precision attack missions against targets in occupied Europe. For leading the successful attack on the Philips factory at Eindhoven in December 1942, he was awarded the Distinguished Service Order (DSO). Promoted to Group Captain, Edwards was appointed commander of RAF Binbrook, the home of the Australian No 460 Squadron, and commenced flying Lancaster bombers. Post-war, he served in a range of posts in the RAF and was promoted to Air Commodore.

After retiring in 1963, Edwards was appointed Governor of Western Australia in 1974 and knighted the following October. Sir Hughie Edwards, VC, DSO, DFC was the most highly decorated Australian in World War II. His determination and courage, while leading at the squadron and formation level, brought out the best in those around him.

Donald Clifford Tyndall (Don) Bennett was born in Toowoomba, QLD and after schooling in Brisbane, was accepted for pilot training in 1930. After commissioning in the RAF, Bennett flew biplane fighters and flying boats in several squadrons and qualified as a flying instructor. Leaving the RAF at the end of his four-year commission, he published the book *The Complete Air Navigator*, which remained the standard text on this subject for the next 30 years. In the following years, Bennett flew the world's commercial air routes, specialising in long distance flights. In 1938, he made the world's first commercial, east-to-west, trans-Atlantic flight in a small four-engined flying boat, carried aloft on the back of larger flying boat. The next year, he took part in air-to-air refuelling trials. In 1940, Bennett became the initial chief pilot of the Atlantic Ferry Organisation, a company that flew US and Canadian built military aircraft across the Atlantic to Britain.

Rejoining the RAF in 1941, he initially set up a navigation school but, by December, was made commander of No 77 (Bomber) Squadron. When his Halifax was shot down over Norway during an attack on the German battleship *Tirpitz*, Bennett and several of his crew evaded capture and returned to Britain via Sweden. For this mission, he was awarded the DSO. In July 1942, Bennett was selected to create the Pathfinder Force—a force to find and mark targets for night bombing raids. His rare combination of navigation skills, flying accuracy and technical knowledge made him a superb commander of the new force, which expanded to eventually include 19 operational squadrons. As the force grew, Bennett remained its commander and was promoted accordingly. At the age of 33, Bennett was made acting Air Vice-Marshal, the youngest officer ever to hold that rank in the RAF.

After the war, Bennett returned to civil aviation and remained in England. In his wartime service, his influence as a senior member of Bomber Command was immense. His ideas made the Bomber Offensive in Europe more accurate and therefore more effective, thus shortening the war and saving lives.

Australian pilots, trained at Point Cook but commissioned in the RAF before World War II, made a significant contribution throughout the war. By July 1938, when the last Point Cook graduates sailed for England, 149 pilots had transferred to the RAF. By the start of the war, they had the experience to serve as leaders at all levels of the RAF—squadron, wing and higher. They created a tradition that continued when the graduates of the Empire Air Training Scheme reached RAF squadrons after the outbreak of World War II.

Triple DFC Recipients

Key Points

- *Six Australians have been awarded the DFC three times for their acts of valour and courage.*
- *Only Wing Commander Noel Quinn received his awards while serving exclusively with RAAF units under RAAF command.*
- *The Imperial Awards, which included the DFC, were replaced in 1975 with the new Australian honours system. The DFC has been replaced with the Medal of Gallantry.*

The Distinguished Flying Cross (DFC), instituted in 1918 by King George V, was awarded to Air Force officers for 'an act or acts of valour, courage or devotion to duty performed whilst flying in active operations against the enemy'. In 1932 this was altered to the simpler 'for exceptional valour, courage or devotion to duty whilst flying in active operations against the enemy'. Each successive award of the DFC to the same person was referred to as a 'Bar'. Since its inception there have been just under 22 500 awards of the DFC, together with just over 1000 first Bars and 60 second Bars. In the Australian context, the DFC was awarded to Australian military airmen who served in the Australian Flying Corps (AFC) and British air forces during World War I; to those who served with the RAAF, RAF, and other dominion air forces during World War II; to those who served with the RAAF during the Korean War and Malaya/Borneo emergencies, and with RAAF and USAF units in the Vietnam War. Only six Australians have been awarded the DFC three times—two while members of the AFC, and four for service during later conflicts, only one of whom was flying with the RAAF on all three occasions.

Captain Arthur Henry Cobby and Captain Ross Macpherson Smith were awarded their DFCs and subsequent Bars while serving in the AFC. Flight Lieutenant Frederick Anthony Owen Gaze, Squadron Leader Harold Brownlow Martin, and Flight Lieutenant Mack Donald Seale received theirs for deeds conducted during World War II. Wing Commander Noel Thomas Quinn received his DFC and first Bar during World War II, and subsequent second Bar for service during the Malaya Emergency. The exploits of Captain Cobby and Wing Commander Quinn are covered here in further detail.

Captain Arthur Cobby has the honour of being the first Australian to receive three DFCs. He was awarded his first DFC in July 1918 in recognition of his successes in combat, especially the destruction of heavily defended observation balloons that were considered a dangerous but valuable target. Known as a talented and aggressive pilot, on 21 May 1918 he attacked and destroyed an enemy balloon while flying a Sopwith Camel near Neuve Eglise. On 30 May 1918, after destroying another balloon near Estaires, Cobby was attacked by three German Albatross scouts, one of which he managed to shoot down. He then shot down a third balloon to the north of Estaires on 1 June 1918, following its descent to 2000 feet until it eventually burst into flames. That same day while leading an offensive patrol, Cobby shot down an Albatross scout near Merville. The falling aircraft also damaged the cable of an enemy balloon.

On 12 February 1919, it was confirmed that Captain Cobby was awarded both a first and second Bar to his DFC. The first was for his success in shooting down five enemy aircraft in 11 days including three German aircraft in one day, on 28 June 1918. The award of the second Bar was in recognition of his actions on 15 July 1918, for attacking five Pfalz scouts, resulting in two being destroyed—one fell in flames and one broke up in the air. The pilot of a second aircraft from Cobby's squadron brought down a third machine. While engaged in this combat, they were attacked from above by five enemy Fokker triplanes. Displaying cool judgement and brilliant flying, Captain Cobby evaded the attack and returned to British lines in safety.

Cobby's success as a leader is acknowledged as being not only due to great courage and brilliant flying, but also the clear judgement and presence of mind he invariably displayed. His example was of great value to other pilots in No 4 Squadron at the time.

Wing Commander Quinn is unique in that he received three DFCs while serving exclusively in RAAF units under RAAF command. Posted to No 8 Squadron on 17 April 1943 as a Squadron Leader, Quinn completed 31 operational sorties and night strikes operating Beaufort aircraft, that included conducting bombing attacks on a number of enemy airfields. He also conducted a torpedo attack on an enemy ship, later recorded as 'probably successful'. Quinn made a considerable contribution to the successes of the Squadron, displaying courage, skill and exceptional leadership at all times. On 8 November 1943, after a long flight at night through very bad weather, he made a torpedo attack on an enemy heavy cruiser. Despite encountering exceptionally strong enemy air defences, he pressed home his attack with great skill and determination. Later reconnaissance showed that the cruiser was probably damaged. It was Quinn's courage and devotion to duty in this instance that led to the award of his initial DFC.

Later, as commander of No 8 Squadron, on 4 December 1943, Squadron Leader Quinn led six Beaufort aircraft in a torpedo attack against a Japanese convoy near the Duke of York Islands. Information had been received by the Squadron that a 12 000 ton ship carrying bombs and ammunition would reach Rabaul approximately one hour ahead of the convoy. Poor visibility due to fading light at the end of the day prevented the convoy from being located, so Quinn made the perilous decision to fly low into Rabaul harbour. Dropping a torpedo on sighting the stern of a large merchant vessel, Quinn hit his target; the vessel exploded and sank almost immediately. Unfortunately his aircraft hit a cable at the same time and crashed into the water. Quinn and his observer survived the crash, but both were captured by the Japanese and taken prisoners of war. This daring attack by Quinn earned him a Bar to his DFC. It was also the last occasion in World War II that RAAF aircraft used aerial torpedoes.

Quinn's determination and courage continued as commander of No 1 (Bomber) Squadron in 1952-54, earning him a second Bar to his DFC. Wing Commander Quinn flew over 200 hours in Lincoln bombers on operations against communist terrorists in Malaya. The squadron was eminently successful against the terrorists, and fulfilled all tasks that were allocated to it. This success was largely due to the leadership and enthusiasm that Quinn brought to his command duties, his excellent personal example in the air, and his determination to achieve mission objectives at all times.

From 1992, Australians were no longer recommended for Imperial Awards as the new Australian honours system, which commenced in 1975, had largely been complete by then. Today's equivalent of the DFC is the Medal of Gallantry. Bravery such as that displayed by Captain

Cobby and Wing Commander Quinn is instilled into RAAF personnel as part of its enduring culture of determination and courage.

The Lille Air Raids of August 1918: Shaping and Preparing the Battlespace

In August 1918, Nos 2 and 4 Squadron of the Australian Flying Corps (AFC) conducted two raids on German airfields near Lille, France. These attacks resulted in the destruction of over 50 enemy aircraft, multiple hangars as well as associated airbase and transport infrastructure. These successful attacks at a tactical level also demonstrated how the application of air power had evolved over the course of the war. Starting from simple reconnaissance flights in August 1914, the concept of flying operations had developed to reflect a far more mature understanding of the need to control the air and the effects that air power could generate across the broader military campaign.

Key Points

- *Control of the air is a prerequisite for the success of any operation.*
- *Typically the air campaign should begin well before the ground campaign.*
- *The ability of air power to shape and prepare the battlespace is a key component of modern military operations.*

Established in September 1912 by Army Order 132/1912, the AFC began World War I with one flying unit consisting of four airworthy aircraft and only a rudimentary understanding of how the new air arm could be employed in conflict. By August 1918, the AFC had a Central Flying School, four squadrons deployed on operations—one in the Middle East and three on the Western Front—and four additional operational training squadrons based in the UK. Importantly, the experience gained by its members in the war equipped the AFC's officers with a mature understanding of the operational and tactical application of air power. The raids on the Lille airfields in August 1918 are an excellent example of how the understanding of the application of air power had progressed, not just within the AFC but also across the air arms of all the belligerent nations.

In the weeks leading up to the raids, the RAF's No 80 Wing, which included the AFC's Nos 2 (S.E.5a) and 4 Squadron (Sopwith Camels), conducted numerous offensive patrols in the area around Lille and the Lys Valley. These patrols resulted in frequent dogfights with German fighter aircraft such as the Fokker triplane and Pfalz scout. Wider operations included constant bombing and strafing attacks on troop concentrations, trench lines, supply lines and trains. Regardless of the nature of operation undertaken, the opportunity to engage with enemy aircraft was pursued with vigour. The overall intention was to weaken the German forward areas in preparation for the ground offensives planned for September along the front lines of the Flanders area.

It was unlikely that the almost random interception of enemy aircraft during the offensive patrols of this period could achieve control of the air. An assessment of the operations conducted during this period indicates that the rate at which the Germans were losing aircraft was well within their ability to replace. This fact was highlighted in late July when a noticeable increase in German aircraft was reported in the area. This increase in enemy numbers resulted in major air-to-air combat over Aubers Ridge on 31 July, as each side attempted to launch attacks on opposing ground forces in the area. It required a concentrated effort on the part of the Allied squadrons before local control of the air could be reasserted. The engagements of 31 July clearly indicated that if the Allies were to achieve any form of enduring control of the air, a significant change in operational tactics was required.

The first Allied response was to increase the size of the Allied fighter formations conducting offensive patrols. Encountering larger formations, the German air force would either leave the area or attempt to send up larger formations of their own. Quite naturally, this lead to more dogfights of considerable size and duration. Overall though, the Allies were able to exert a growing control of the air that enabled attacks on ground targets to be continued while limiting the occasions of German observation aircraft encroaching into Allied airspace.

The opportunity to make a significant difference to the degree of control of the air occurred in mid August. The offensive in the Somme on 8 August drew German reserves away from the Flanders area. To take advantage of the dislocation of the German forces, No 80 Wing launched two orchestrated raids on two of the largest German airbases in the Lille area—Haubourdin and Lomme—and also on the adjacent railway hubs. The twin intent of the raids was to destroy the air capability of the enemy at a time when they were least able to replace their losses, and to disrupt the main lines of supply prior to the forthcoming ground offensive.

Just after midday on 16 August, the AFC's Nos 2 and 4 Squadron launched from the airfield at Reclinghem, France, loaded with incendiary and explosive bombs and as much ammunition as could be carried. With their escort of the RAF's No 88 Squadron (Bristol Fighters) and No 92 Squadron (S.E.5a), the 65 aircraft assembled into a large, multilayered formation over the airfield. Flying east in a shallow arc via La Bassée, the large Allied formation forced any enemy aircraft in the area to retreat to their airfield. On arriving over Haubourdin air field, Harry Cobby, commanding No 4 Squadron, led what was to be a devastating attack with an estimated 37 aircraft destroyed on the ground and one in the air. Once the airfield and all possible targets had been attacked, the raid shifted focus to the adjacent railway lines, trains and rolling stock. Any clearly identifiable military vehicle or position became a target, as the AFC aircrews conducted a particularly thorough attack on the area.

On the following day the tactics were repeated. This time the airfield at Lomme was the primary target, followed by the surrounding railway infrastructure. Again the attack was effective; enemy aircraft in the air returned to base at the first sight of the approach of the large Allied formation, only to become targets for the bombing attacks. This raid achieved the same level of widespread destruction as the first, with at least 17 aircraft on the ground being destroyed. It was during this attack that the only casualty suffered by the AFC squadrons during course of the two days of fighting occurred, when Lt Edgar McCleery of No 4 Squadron was shot down and killed by anti-aircraft fire.

While the raids themselves were dramatic, the longer-term effects were even more so. In the following weeks the German air presence was markedly diminished, enabling Allied air power greater freedom of operations. This level of control of the air contributed directly to a series of successful ground assaults. Any attempt by the German airmen to conduct reconnaissance or artillery spotting flights was effectively blocked, while Allied air forces were almost completely free to conduct these operations themselves. Blinded and increasingly isolated from their supply routes, the German resistance in the Flanders area around Lille and the Lys Valley was significantly weakened, greatly facilitating the Allied ground advance into that area. Adaptive and effective use of air power had established the foundations of success on the ground in a manner that has been repeated in conflicts ever since: El Alamein, D-Day, DESERT STORM and Operation IRAQI FREEDOM, to name a few.

Selection of the C-130 Hercules

The venerable C-130 Hercules has been part of the RAAF inventory since 1958. Its introduction into service provided a significant boost to Australia's strategic lift capability. In the early 1950s, the World War II vintage C-47 Dakota, with its limited performance, had formed the core of the Air Force's airlift capability. Given Australia's strategic environment and the transit distances involved, it became obvious that the Dakota could not meet evolving operational needs. The result was the setting up of an Air Board focused on identifying a suitable replacement.

The essential requirement was that the selected aircraft—in suitable numbers—had to be capable of moving a battalion, including equipment, in one lift, supplemented where necessary by civil aircraft if available. While the notion of 'jointery' was in its infancy, the Air Board members recognised that the selected aircraft also had to meet the wider requirements of the Navy and the Army. However, meeting the Navy and Army expectations needed continuous refinement of the selection process. For example, at one point, albeit briefly, the selected aircraft was expected to be used for glider towing and the specifications had to be altered accordingly.

Key Points

- *The requirements for the Dakota replacement forced the RAAF out of its habit of buying British.*
- *The C-130A was clearly the most advanced and capable transport aircraft of the 1950s, superior to all other Western transport aircraft and the subsequent iterations of the aircraft confirmed its earlier selection.*
- *The C-130A provided the RAAF with a global airlift capability in line with Australia's geostrategic requirements and the concept of expeditionary operations.*

There was one aspect upon which all Air Board members agreed and that was that the selected aircraft had to be more comfortable for crew and passengers than the Dakota. Pressurisation, heating and cooling throughout the aircraft and more discrete facilities than the Dakota's 'thunderbox' were deemed necessary for the replacement aircraft. Perhaps the most significant operational disadvantage with the Dakota was that it was not a high-wing aircraft, and its side cargo door had major limitations.

The primary characteristics laid down for the replacement were a step change from the performance of the Dakota and were not easily met by the available contenders. In September 1954, the Prime Minister, Robert Menzies, directed that an RAAF mission (led by a two star) be conducted to review possible replacements for the Dakota. The mission was to report back within four months of receiving their directive. During the same review, the mission members were also required to recommend suitable aircraft to fulfill the RAAF's new medium bomber requirement (Vulcan or Victor recommended), fighter (F-104 recommended), and jet trainer aircraft (Vampire Mk 33 recommended).

Similar to today's tender evaluation process, the likely airlift contenders were a mix of 'paper' designs as well as developmental and in-production aircraft, albeit from only two nations—the United States and the United Kingdom. While the number of UK options reflected of the size of the then UK aerospace industry, in many ways the options also reflected the somewhat stagnant state of many of the UK companies. The US, on the other hand, had aircraft in production that were designed during World War II, and another that used those experiences to leapfrog the other contenders. The RAAF had started to move away from relying on UK aircraft, especially in the fighter world, but the habit of buying British was still strong, and it would take an exceptional aircraft to overcome this mindset.

The UK industry at this time was struggling to produce aircraft capable of meeting the RAF and wider Commonwealth's needs. The RAAF mission examined both 'paper' and in-production UK aircraft, even broadening their search to include other options at a later date. A few UK contenders made the final list, which are briefly described below:

Bristol Type 195. While only a design study (four engines, high-winged aircraft using many elements from the Britannia), the mission members nevertheless assessed that the Type 195 would meet the RAAF's requirements if it ever went into production. However, with an uncertain production status, it was deemed incapable meeting the RAAF's schedule.

Blackburn Beverley. The Beverley simply failed to come close to the RAAF's requirements, with its speed, payload and operating ceiling well below expectations. The lack of pressurisation and a fixed undercarriage was a throwback to the previous generation of aircraft.

Short PD 16/1. Looking very much like an early Armstrong-Whitworth Argosy, this was another 'paper' design offered to the mission members that was quickly discounted given the other options available.

In contrast, The USAF was developing a series of aircraft that met the demands of full spectrum airlift supported by a mature, vibrant industry that was moving to meet the growing needs of a Cold War USAF. The US contenders were:

Fairchild C-119. The C-119 was a successful attempt to produce a tactical transport aircraft which would replace the both the C-46 and C-47 in USAF service. However, it too failed to meet the RAAF's requirements, notably being unpressurised, with poor speed, range and payload.

Chase C-123. While reviewed by the mission members, the C-123 was unlikely to fulfill RAAF requirements as the aircraft was designed around a shorter-range platform used for air assault missions into unprepared airfields in the forward combat area. Again the speed, range and payload performance was below those needed by the RAAF.

C-130A with Rolls-Royce Engines. Lockheed had undertaken an assessment of the practicality and benefits of fitting a C-130 with Rolls-Royce engines. While some improvements in performance would be expected, the drawback of operating an orphan fleet quickly removed this option.

Lockheed C-130A. The mission members were impressed with the performance of the C-130A and with the USAF orders. The aircraft easily met the RAAF load carrying and performance demands, and the mission quickly went ahead with the recommendation to government to acquire the aircraft.

The Air Staff mission met its deadline and unanimously recommended the C-130A as 'being the only transport aircraft that conforms to all the important features of the Air Staff requirement.' Of note was the UK reaction—shortly after the RAAF's decision to acquire the C-130, Blackburn offered an unsolicited proposal of the Blackburn Beverley B107 (four radial piston-engined, high-winged aircraft), apparently at the behest of, Sir John Slessor. However, the selection of the C-130A sounded a death knell for the expectation that Australia would simply buy what the UK produced

The RAAF wanted 12 aircraft to meet its requirement but the now familiar tale of rationalisation experts providing advice reared its head. Senior bureaucrats held the view that six would be enough, and that any further aircraft procurement should be delayed. Fortunately this was overruled and 12 C-130A aircraft were ordered, making the RAAF the second operator of the C-130 after the USAF. With the purchase of the C-130, the RAAF obtained a modern airlift capability that set the standards for future developments in this important role.

CONTRIBUTORS

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