PATHFINDER

COLLECTION – VOLUME 4

PATHFINDER

COLLECTION – VOLUME 4

Edited by:

Dr Chris Clark and Dr Sanu Kainikara

Air Power Development Centre
CANBERRA

Cover image: 'RAAF's first operation over North Korea, 2 July 1950' by Robert Taylor (1986). Oil on canvas, 76 x 152.6 cm, Australian War Memorial (ART28996).

Since his paintings first became popular in the mid-1970s, Robert Taylor has been hailed by many critics as the world's leading aviation artist. He has lived all his life in the western English city of Bath, where he worked at an art gallery for 15 years before deciding to paint full-time. He has since exhibited internationally, including Australia. The exhibition of his works mounted in 1987 at the Smithsonian's National Air and Space Museum in Washington, D.C., was rated the most successful aviation art display ever. Rarely has Taylor chosen a subject which included the RAAF, but this one depicts six P51D Mustang fighters from No 77 Squadron escorting nine USAF Boeing B-29 Superfortress bombers on a raid against Yonpo, on the east coast of the Korean peninsula, a week after the Korean War began 60 years ago.

Foreword

Two strong themes will be noticed emanating from this volume of the Pathfinder Collection: Air Force Intelligence, Surveillance and Reconnaissance (ISR); and air power in irregular warfare. These subjects are two of the most important issues for the modern RAAF, like most other air forces, because of the nature of the conflict in which we are currently engaged. Air power is ever present over the battlespace in our current irregular conflicts – but its role is little understood and credited. Air power's role in irregular warfare therefore needs to be clearly understood by all airmen, and indeed by all members of the profession of arms. Likewise, ISR is perhaps the single biggest Air Force contributor to the irregular fight and yet ISR also has significant ramifications for the future Air Force across the spectrum of conflict.

Significant attention is also given to space. Space received considerable focus in the 2009 Defence White Paper and much effort has been spent on developing ADF joint doctrine and RAAF policy on space over the last year. As professional airmen, all members of the RAAF must understand space and its implications for warfare.

The final major theme that has played out over the last 18 months is the issue of air power doctrine itself. The current (Edition Five) of AAP 1000-D – *The Air Power Manual* was released in 2007 and, following the past practice of reviewing and republishing it every four to five years, it is expected that Edition Six will be published in early 2012. In this volume, there are four Pathfinders, two conceptual and two historical, which deal with Australian air power doctrine. Additionally, the work of the APDC over the last 18 months on ISR and irregular warfare will significantly add to the usefulness and veracity of the Edition Six.

On another note, the historical Pathfinders have explored some not so well known RAAF air campaigns and operations such as Syria and Burma during World War II and Khe Sanh and Long Tan in Vietnam. Additionally, other issues that have been analysed are: who was the Father of the RAAF; the missing man formation; the RAAF as the second oldest air force; and the RAAF as the fourth largest in the world at the end of World War II. The retirement of the Caribou in November 2009 after 45 years of service is also captured.

It is also fitting that the cover of Volume Four features a painting by Robert Taylor of No 77 Squadron conducting its first mission over North Korea with Mustangs. This year marks the 60th anniversary of the start of the Korean War, which claimed the lives of 35 RAAF personnel and a loss of 58 aircraft – a high price indeed for a small air force.

I commend Volume Four of the Pathfinder Collection to you.

Group Captain R.J. Keir, AM CSC
Director, Air Power Development Centre
November 2010

THE AIR POWER DEVELOPMENT CENTRE

The Air Power Development Centre, formerly the Aerospace Centre, was established by the Royal Australian Air Force 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:

The Director
Air Power Development Centre
TCC-3, Department of Defence
CANBERRA ACT 2600
Australia

Telephone: +61 2 6266 1355
Facsimile: +61 2 6266 1041
E-mail: airpower@defence.gov.au

Contents

AIR POWER

Leading an Air Force, directing an air campaign and controlling and conducting air operations is an art—the art of air power.

Air Marshal M. D. Binskin, AO
Chief of Air Force

Defining air power - part I: evolution of the term

Winston Churchill once suggested that, 'Air power is the most difficult of all forms of military force to measure, or even express in precise terms.' This statement was made when air power as a military capability was in its infancy. Now, more than sixty years later with air power a mature and indispensible military force, the statement is still a profound reflection of the complexity in understanding air power theory and its optimum application. In many respects, Churchill's observation is amplified by James Spaight, a 1930s air power theorist, who suggested that air power 'defies reduction to the confines of a sentence, or even an expanded definition.' He further stated, 'such a definition must always be related to the character of the state which uses air power and to the nature and stage in which it is used.' Spaight's statement illustrates the reason for the continuous evolution of the definition of air power. As the Royal Australian Air Force transitions to a future force capable of generating strategic effects over long distances and air power develops in response to new challenges as well as opportunities afforded through technological innovations, there is merit in analysing its definition in the evolving context.

> **Key Points**
> - Although the term was coined in 1908, 'air power' was defined only in 1925 for the first time.
> - Air power definitions have developed progressively over the past seven decades.
> - The direct link between air power and national security needs to be clearly enunciated.

The term 'air power' was first used by H. G. Wells in 1908 in his novel *The War in the Air*. While F. T. Jane used the term in the 1909 edition of All the Worlds Air-Ships, it became common use only in the late 1920s when air power theorists articulated broad definitions of air power. Of the acknowledged early air power theorists—Guilio

Douhet, Hugh Trenchard and William Mitchell—Douhet did not use the term at all, although he was the earliest proponent of command of the air and theories of aerial warfare. Likewise, although he published three pamphlets on air power in 1943, 1945 and 1946, Trenchard did not define the term. In 1925, Billy Mitchell defined air power as, 'the ability to do something in the air.' In his pre-war treatise Air Power and Armies, the articulate and thoughtful RAF Air Chief Marshal John Slessor, provided a clear definition of air power as, 'a compound of Air Forces and all those things on which Air Forces directly or indirectly depend, such as flourishing aircraft industry and civilian aviation, a good meteorological service, secure fuel supplies and so on.'

The dramatic impact of air power on the conduct of World War II brought recognition of the importance of air power to national security. The post-war definitions reflect this awareness. The US Army Air Force defined air power as 'the total ability of a nation to fly, to act through air space, to use controlled flight.' In later years Slessor provided a pragmatic and direct connection between national security and air power when he defined air power as 'the use of the air to enforce the national will.' In 1955, Alexander De Seversky, a keen air power proponent reaffirmed this linkage by defining air power as 'the ability of a nation to assert its will via the air medium.' General 'Hap' Arnold, Commanding General of the US Army Air Forces during World War II, also enunciated this connection when he suggested that 'air power includes a nation's ability to deliver cargo, people, destructive missiles and war-making potential through the air to a desired destination to accomplish a desired purpose.'

As air power development focussed more on its lethal capabilities, the definitions also tended to lose the connection between broader national security and the application of air power. In 1983, Richard Mason and Michael Armitage defined air power as 'the ability to project military force by or from a platform in the third dimension above the surface of the earth.' The RAAF embraced this definition and defined air power up to the third edition of its strategic doctrine,

The Air Power Manual, as 'the ability to project military force in the third dimension—which includes the environment of space—by or from a platform above the surface of the earth.' The definition was widely accepted by both Western (UK, USA) and non-western (India, Malaysia, Philippines) air forces and provided a degree of standardisation to the understanding of air power. However, this definition did not encapsulate all the effects that air power can create in pursuing national security and confined itself to projecting military force. Further, it also combined the air and space environments.

The idea of a combined air and space environment gained further prominence in the fourth edition of the strategic doctrine, titled *The Fundamentals of Australian Aerospace Power*, where air power was replaced with the term aerospace power. However, this focus quickly shifted and in 2007 the fifth edition of *The Air Power Manual* defined air power as 'the ability to create or enable the creation of effects by or from platforms using the atmosphere for manoeuvre.' Although this definition emphasises the creation of effects and the conduct of manoeuvre, it does not explicitly connect those effects to national security.

In 2003, the USAF defined air power as 'the synergistic application of air, space and information systems to project global strategic military power.' This is a significantly broader definition but reflects more the USAF's desire to dominate the three domains than a doctrinal correctness in understanding air power. The requirement for global power projection precludes the acceptance of this definition by smaller air forces.

Although the 2007 Canadian definition of air power—'that component of military power applied within or from the aerospace environment to achieve effects above, on or below the surface of the earth'—uses the term aerospace, it also reflects the growing perception that air power creates effects from the air environment. This is further reflected in the RAF definition that was published in 2009. It states that air power is 'the ability to project power from the air and space to influence the behaviour of people or the course

of events.' This is perhaps the most innovative of currently available definitions and clearly enunciates air power's position at the strategic level of national security.

A historical review of the definitions of air power reveals that they evolve along with air power itself. Although the term was first used only five years after the Wright brothers' first flight, it was not until the 1920s that the term was first defined. Theorists and strategists were quick to make the connection between air power and national security immediately after World War II. It is surprising that this direct and appreciable strategic connection was somehow overshadowed by the developments that took place in the ability of air power to project lethal force as part of the military power of a nation. Only in the recent past has air power's ability to create strategic effects—both lethal and non-lethal—in pursuance of national security been re-learned and articulated.

DEFINING AIR POWER - PART II: CONSIDERATIONS FOR A NEW DEFINITION

The previous article, *Defining Air Power: Part I Evolution of the Term*, outlined the attempts at defining air power by various air forces and air power thinkers. In particular, it noted that air power is a broad term and defining it has been an evolutionary process reflecting the changes in air power theory and application since the early 1900s. As the Royal Australian Air Force transitions through the Defence Capability Plan into a future force capable of generating global strategic

Key Points

- There is a need to clearly distinguish between air power and space power.
- As the RAAF develops the future force, it must have a concise understanding and interpretation of air power.
- Military air power, should be considered as a sub-component of national air power that encompasses industry and civil aviation.

effects, there is value in re-examining our own understanding and definition of air power. In order to achieve this, there are few key considerations that must be re-examined.

Definitions are important. In military doctrine, clear and concise definitions of terms enable a common understanding between and within Services and provide common foundations for the planning and conduct of effective joint operations. Doctrinal definitions will always be contextual as they reflect a military organisation's stance at the time—influenced by its culture, political and strategic experiences and history. At the strategic or philosophical level, doctrinal definitions will inevitably be broad as they need to encompass different perspectives. At the procedural or tactical level, doctrinal definitions will be more precise as they need to be more directive.

Defining air power is particularly important as it provides a foundation for further doctrine development. An effective air power definition will provide the spectrum within which an air force's roles,

functions and capabilities are situated. As definitions determine function, this directly relates to force structure as 'form follows function'.

Critical to defining air power is understanding what is power. The Macquarie Dictionary provides several definitions of power including: "an ability to do or act; capability of doing or affecting something; a particular faculty of body or mind; political or national strength; the possession of control or command of others; and lastly, ascendancy or influence." These definitions provide a valuable base from which to understand air power.

Likewise, there is also a need to clearly understand the air environment. *Pathfinder* #133 (see page 3) noted how space had been included on several occasions in air power definitions. The concept of aerospace power dates from the 1950s. It gained prominence in the ADF when the 4th edition of the RAAF Air Power Manual reflected USAF doctrine by embracing the term aerospace. But the notion of aerospace does not sit comfortably with a capable but smaller air force such as the RAAF. While large air forces like the USAF can integrate space power into their mission set, there is limited capacity for a smaller air force such as the RAAF to do so. There are more pragmatic reasons for separating space from air power concepts. While there are some similarities between the air and space environments, there are also distinct differences. Space provides a higher perspective that allows one to see the entire battlespace rather than a part of it. In space, speed and reach are considerably greater than in the air environment. Similarly, the airspace over a nation's territory is recognised as a sovereign territory, whereas there is no sovereignty in space. The significant differences between the two environments indicate that they should be defined as separate environments. As was highlighted in *Pathfinder* #4 (August 2004), the danger in not acknowledging space as a separate environment is that the ADF will not be able to develop meaningful space power doctrine and capabilities. Further, it could potentially impact upon

existing air power doctrine by causing a dilution of considerations specific to the air domain.

The contemporary discussion of effects in air power definitions reflects a growing understanding that air power is more than the ability to simply project force. Air power produces effects, which is essentially one's capacity to influence the adversary. Conflict is caused by differences of opinion between two or more entities. One way to resolve such differences is to change the adversary's intent. This invariably requires the creation of effects that are synergistically applied to influence the cognitive domain of the adversary in order to change their opinion. The characteristics of contemporary warfare reflect the complex environment in which irregular and military forces increasingly participate in multi-agency operations sharing a battlespace with non-government organisations. In such an environment, effects must be broader than purely military ones.

The ability of air power to create effects and align them to grand strategic objectives is an important element that has been overlooked in recent air power definitions, including the RAAF's current definition. The inherent strategic nature of air power allows it to create strategic effects that can directly have impact on national security. More importantly, understanding air power in national terms captures the broader aspects of a nation's air power capability that include the aviation industry and civilian aviation activities. This broader understanding of air power was evident post-World War II but has been somewhat relegated to the background in recent interpretations. However, several regional nations still recognise the broader definition. For example, the Indian Air Force identifies air power as 'the ability to assert its will through the medium of the air'. Likewise, the Indonesian Air Force recognises air power as 'the total capability of a nation to utilise airspace as a medium to achieve its national interests.' Such definitions acknowledge the many components of air power while also implying a linkage to a political or national objective. In effect, air power is a component of national power. However, these broad definitions tend to lose some focus

when applied in military terms. There is a case for defining military air power as a subcomponent of national air power.

There is no doubt that air power is a broad concept leading some thinkers such as Winston Churchill to suggest that it defies a simple definition. Nonetheless, it is important to have a clear and concise definition of air power—it establishes a baseline for determining and understanding an air force's role and responsibilities. Such a definition should clearly distinguish between air power and space power, noting that air and space are two unique environments. Lastly, there is a need to identify how air power can influence and create effects at the national strategic level. It is in this respect that military air power could be identified as a sub-component of national air power. As the Air Force develops the future force capabilities envisioned in the Defence White Paper 2009, it's doctrine must have a clear and concise understanding of air power that will fully reflect and maximise the potential strategic effects such capabilities can create at the national level.

Who are we fighting? The enemy in irregular warfare

There are many debates about the nature of war in the 21st Century but most agree with the Defence White Paper 2009 judgment that intra-state conflict will be the most common type of conflict over the next twenty years. Such conflicts are inherently messy, complicated and confusing, and aptly described by Rupert Smith as 'wars amongst the people'.

> ### Key Points
> - Air power can engage adversaries wherever and whenever required
> - In irregular warfare, the critical need is to understand the adversary and respond rapidly and therefore, ISR, air mobility and precision strike are critical air power roles
> - In IW air power is best employed within a whole-of-nation approach

In intra-state wars contemporary air power can generally engage adversaries whenever and wherever required. The central issue is developing a comprehensive understanding of the adversary's vulnerabilities and sensitivities. At its core, intra-state warfare is based on actionable knowledge, information superiority and rapid response making Intelligence, Surveillance and Reconnaissance (ISR) and air mobility critically important air power roles.

Several different types of opponents can be identified in intra-state conflicts, either singly or in some combination. These adversaries each have their own strategic ethos and operational logic, which could have some inherent vulnerabilities that can be exploited by air power.

Transnational Criminal Gangs. The longest running intra-state wars are what Moisés Naím (editor-in-chief of Foreign Policy magazine) termed the five wars of globalisation: the illegal international trade in drugs, arms, intellectual property, people and money. Criminal gangs, driven by the laws of demand and supply operate nomadically,

go where the money is, and rely on continued access to the global marketplace. These are market-driven enemies. Air power is best used to support the civilian authorities principally through ISR and air mobility.

Terrorists. Terrorists use opportunistic violence to try to provoke a seemingly disproportionate and senseless reaction from their opponents. A terrorist group does not seek legitimacy but aims to make their opponents' reactions appear illegitimate. Terrorists cannot win by their own actions and depend on media coverage to spread their ideas. These are message driven enemies. Actions against such groups must counter not reinforce their message. Air power is best used in a counterforce role to disrupt and degrade terrorist groups in their sanctuaries, and to closely monitor their movements and activities.

Warlords. Warlords are essentially large-scale gangsters who seek personal gain through the threat and use of violence. Their power resides in the 'army' they maintain. In keeping control through force, warlords are unconcerned about public opinion, support or legitimacy. They control their fiefdoms to increase personal wealth, generally through extorting locals, foreign governments and aid agencies. These are pay-off driven enemies. Air power is best used in a counter-value manner, monitoring and disrupting the warlord's economic activities that increases his operating costs and lowers financial gain.

Militias. Militias seek to provide security for their particular faction, group or clan and fight with a belief in the virtues and ideals of their community. Their ultimate loyalty is to their community not their commanders. Militia members value legitimacy and do not see themselves as bandits. Militias exist within the extant state and do not seek to overthrow it, although some community leaders may use their militia's prowess to access the national political arena. These are short-term, security driven enemies. Air power is best used to monitor militia growth and activities, to limit their access to military

capabilities and through helping the state protect the community, discourage the militia's continuance.

Insurgents.   Insurgents seek to take over the state apparatus; they want to be the government. For insurgents, legitimacy is important as they seek to govern all the people.   Insurgents therefore have a heavy footprint insisting on people choosing who they support. They have a long-term perspective of their objectives and are prone to protracted conflicts. These are political power driven enemies. Air power is best used to protect the population, placing emphasis on ISR, air mobility and—when the insurgents and population are clearly separated—precise, discriminatory air strikes. Air power employment must support the overriding message that the state is the only legitimate guardian of the people.

Territorial Separatists.   Separatists aim to capture part of the territory of the current state in order to set up an independent state on a long term, permanent basis.   They need the support of the people in the territory sought for legitimacy to govern that territory. However, they are unconcerned about the other members of the original state. These are territorial control driven enemies. Air power is best used in a counterforce role to disrupt, degrade and destroy the military units of the separatists.

Identity Separatists. Identity separatists seek to cleanse the territory of 'their' state and make it homogenous by expelling those 'others' who don't conform to their chosen identity discriminator. These differences may be cultural, ethnic or racial and are ruthlessly exploited by the identity separatists in their bid for political power. To succeed such separatists have to be recognised as legitimate within their chosen group, without which they will fail.   The identity separatists are unconcerned about appearing legitimate to outside groups and are therefore, less constrained in their use of force to achieve their aims. Identity separatists seek permanent solutions. These are identity driven enemies. Air power is best employed with a counterforce focus on disrupting, degrading and destroying the

separatist's military units although in some circumstances counter-value targeting may also be effective.

Proxy Warriors.   Proxy warriors fight on behalf of others in the territory of another, focusing on damaging the interests of the third party involved. Legitimacy is immaterial in such conflicts.   The intent is to fight a protracted war that has psychological effects on the third party opponent. In this case keeping the fight going is more important than the results.   Proxy warriors rely mainly on external resources provided by their sponsors, state or non-state, and so can have a relatively light local footprint. These are mind game driven enemies. Air power is best used in a counterforce role to disrupt, degrade and destroy the proxy military units, and where practical to interdict their supply routes.

The various potential opponents also differ in their abilities to equip for war—criminals and terrorists parasitically exploit their host societies' resources, warlords and insurgents access military capabilities from local and transnational sources, while separatists and proxy forces normally wage hybrid wars that mix older and very advanced technology.

In intra-state wars, adversaries may take many forms but understanding their nature is key to countering them.   Just as in inter-state warfare, the successful employment of air power will be based on a comprehensive knowledge of an opponent's objectives and their critical vulnerabilities.

The reality of air power and irregular warfare: a change in perception

Since the end of the Cold War in the 1990s, the world has witnessed a significant rise in the participation of Western forces in irregular wars (IW). This increased participation has initiated a debate in military circles about the utility of air power when applied to non-conventional conflict. This debate, fuelled by the lessons learned from Coalition operations against insurgents in Iraq and Afghanistan, has led to significant changes to both Joint and Air Force doctrine within the United States and United Kingdom. Furthermore, these changes reflect a general acceptance that IW will continue to form a major part of contemporary conflict for the foreseeable future, and is widely referred to in the US as the 'long war'. For Australia this debate has yet to occur, and given the Defence White Paper guidance, Defence planners need to consider the role of air power in IW as it is likely to remain the most common form of conflict for the foreseeable future.

Key Points

- IW is no longer considered a 'dumbed down' form of conventional conflict.
- Successful IW operations are hallmarked by the synchronisation of air and land forces across the battlespace.
- Even though this doctrinal evolution should be cognisant of the experiences of our Coalition partners, Australian doctrine needs to be fashioned within our own security context.

Doctrinal development in both the UK and the US regarding the conduct of IW is based on a realisation that firstly, the commitment will be ongoing and demanding, and secondly, that a reassessment of force structure and resource allocation is required if air forces are to remain strategically relevant and sustainable in the long term. This change in thinking is contrary to the widely held view that IW is exclusively the domain of land forces and that air power can at best play a supporting role.

The central tenet in the argument detracting from the utility of air power in IW, as summarised by Colin Gray in his paper *Understanding Air Power – Bonfire of the Fallacies*, is that IW conflicts are largely 'people wars' where hostile combatants seek refuge in the general population or disperse into remote areas or cross-borders into safe havens. This concealment by the adversary is considered to create an insurmountable problem for air power in the effective employment of its intelligence, reconnaissance and surveillance (ISR) capabilities in support of precision strike. Detractors of air power believe that it is only against a conventional opponent in which air power can truly shape the battlespace, through control of the air and precision strike. These critics point to the 2006 Israel-Hezbollah conflict in Lebanon as the most recent example of the failure of air power to deliver strategic effects in an IW conflict.

Further, critics argue that air power's application is often counter-productive and plays into the hands of the insurgents. The use of overwhelming firepower by Western air forces is portrayed by insurgents, and the media, as applying disproportionate force, and a form of collective punishment against a hostage population, affording insurgents no other means of fighting than from within the general populace. All air strikes, regardless of their merits or success are often portrayed as the killing of innocent civilians. As noted in recent UK doctrine, a similar standard of 'morality' is not applied to the often far more destructive and lethal application of force used by land forces in built-up environments. Studies of the Iraq war indicate that only 11 to 13 per cent of civilian causalities were caused by air strikes, with the majority of deaths the result of land based weapons ranging from small arms through to artillery. However, regardless of the death toll, land warfare is portrayed somehow as both discriminatory and proportional, a 'fair fight', as soldiers and insurgents target each other directly.

So is this the reality of IW? Should air forces be limited to being niche supporting players? Gray argues that in fact air power is an essential element of any successful IW operation. He proposes that

although air power will conduct a predominantly contributory role, its versatility and flexibility are vital to a successful IW campaign. It is air power's unique ability to insert, sustain and extract ground forces rapidly, as well as provide timely ISR, direct and indirect fires, and combat aero-medical evacuation that permits relatively small land force elements to dominate a disproportionately large area.

This vital air power role in the conduct of IW is exemplified by the Coalition's experiences in Iraq and Afghanistan, where ground forces work closely with Coalition air assets. Air power has proven essential in sustaining these small task forces in the field, providing mobility, resupply, ISR and precision strike. Moreover, this successful integration of air and ground forces optimises air power's unique precision strike capability, through the finding and fixing of hostile targets by ground force elements working within a complex environment. The role of air power within special operations is now so well-entrenched that the concept of these air operations being 'special' is becoming increasingly open to question.

Doctrinally within the US and UK, IW is no longer considered a 'dumbed down' form of conventional conflict or merely a coordination activity involving discrete elements of air power in support of a land commander. Rather, successful IW operations are hallmarked by the synchronisation of air and land forces across the battlespace. This changed approach to the conduct of IW is exemplified by recent Coalition doctrinal releases on IW and air-land integration (ALI). However, to date there has been no equivalent doctrinal development within Australia regarding the importance of air power in an IW context. Given the recent releases of the Defence White Paper and updated Coalition doctrine, 2009-10 would appear to be an ideal timeframe for the development of appropriate irregular warfare air power doctrine.

Even though this doctrinal evolution should be cognisant of the experiences of our Coalition partners, the Australian doctrine needs to be fashioned within our own security context, and heavily informed by the Defence White Paper. For the RAAF there is a

tremendous opportunity through the acquisition of advanced ISR, C2, mobility and strike systems to significantly enhance the ADF's IW capability. However, in order to fully maximise this potential, it is vital for the Air Force to further develop its doctrine, education and training in partnership with the other Services in order to position itself for the 'long war' whilst also delivering on its very extensive renewal program.

THE REALITY OF AIR POWER AND IRREGULAR WARFARE: STRIKING A BALANCE

In an era where the global security environment is predicted to be dominated by irregular warfare the RAAF needs to consider the challenges and implications of operating within this demanding environment. Irregular warfare, such as the one in Afghanistan, will continue to demand a significant air power contribution, and in order to be successful in the long term, Australian airmen should seek the doctrinal lessons from such contemporary conflicts and consider how to apply the relevant lessons to Australian air power.

Key Points

- Doctrinal lessons from contemporary conflicts should be analysed for their relevance to RAAF.
- The concept of selecting tailored capabilities whose technologies match the task, 'right tech' is appropriate for irregular warfare.
- Air-land integration is a key force multiplier for conventional forces in both operating domains.

The Defence White Paper 2009's national security strategy is primarily based on the ability of the ADF to control Australia's air and sea approaches against credible adversaries. Underpinning this strategy is the proposal to acquire a range of new high-end maritime and air power assets, including the Air Warfare Destroyers, Submarines and Joint Strike Fighters (F-35). The White Paper also recognises the prominence of irregular warfare, in the form of intra-state conflicts, which it forecasts will dominate warfare for the foreseeable future. Such a dynamic security environment creates a diverse and potentially competing range of strategic pressures for Air Force capability planners and doctrine developers. It demands the resources to sustain high-end warfighting capabilities to be balanced against those of conducting irregular warfare.

In considering RAAF capability and doctrine development, it is worth reviewing the parallel developments in the USAF and RAF. General

John Shaud, Director of Air Force Research Institute, '*In Service to the Nation – Air Force Research Institute Strategic Concept for 2018-2023*', argues for a review of force structure and doctrine for the USAF if it is to achieve its planned renewal program in conjunction with its waging of the 'long war'. Shaud proposes the concept of 'right tech', and argues that in irregular warfare there is benefit in reducing the use of resource intensive high-end platforms such as F-15/F-16, and developing new capabilities whose technologies are less expensive and better match the task. Shaud proposes that within an air superiority guaranteed environment, it would be significantly more efficient to operate a dedicated, simple aircraft designed for irregular warfare, capable of operating from austere in-theatre airfields and employing precision weapons and ISR pods.

The appropriate allocation of resources and weight of effort between preparing for conventional high-end state-on-state conflict and low-end irregular warfare is a major dilemma for coalition air forces. Within constrained resource environments there is a pressing need to strike the correct, and potentially painful, balance. Recently, Robert Gates, US Secretary of Defense, argued for altering the *status quo*, 'it is important to remember that every dollar spent to over-insure against a remote or diminishing risk … is a dollar not available to take care of our people, reset the force, win the wars we are in and improve capabilities in areas where we are underinvested and potentially vulnerable'. For the first time a US Secretary of Defense has proposed a ten per cent funding allocation for capabilities in irregular warfare.

For the RAAF, the force structure challenge falls within the White Paper capability development program, with the need to consider a host of competing enabling technologies, such as networks, sensors and weapons. It is in bringing into being the next generation of air power capabilities that the concept of 'right tech' may prove both appropriate and useful. For example, the potential for weapon systems more suited to irregular warfare, based on low-yield kinetic or non-kinetic technologies should be considered. The selected weapon

systems must be 'right tech' for RAAF, in that they should provide viable, cost effective and appropriate options.

Beyond the debate on force structure, the single most challenging issue for the RAAF will be its ability to balance the demand to integrate new capabilities into the force-in-being, whilst also achieving its on-going operational commitments, both in the workforce and resource allocation. This combination of security priorities and an extensive force structure renewal program is not unique to the RAAF and mirrors those of our allies and partners. Furthermore, any aspiration for an expanded role for air power in irregular warfare will require difficult choices regarding resource allocation priorities, given the constrained fiscal and workforce environment. For smaller air forces such as the RAAF, these choices are particularly difficult as the ability to generate the critical mass required to sustain viable all-round capabilities becomes a significant limiting factor. As a consequence, any acquisition of new capabilities usually comes at the detriment of existing ones, and as the saying goes 'there is no such thing as a free lunch', as trade-offs and compromises will be needed.

In parallel with the requirement to develop appropriate air force capabilities for the conduct of irregular warfare, there has been a commensurate doctrinal revision within the US and UK militaries centred on improving air-land integration (ALI). This revision of ALI doctrine is the result of analysing the enduring lessons from operations in Iraq and Afghanistan and is aimed at making effective integration a key force multiplier for conventional forces in both operating domains. Emphasis is being laid on surface and air forces training and exercising as joint force elements prior to engaging in irregular warfare conflicts. Additionally, the US/UK doctrinal changes highlight the requirement for greater integration of the command and control processes and an invigoration of senior air force and army commander educational programs regarding the use of air power in land-centric operations.

In Australia, improvement to ALI is primarily the responsibility of the recently established Air Land Integration Office (ALIO). The

ALIO is charged with synchronising the development of structures, equipment and training in order to maximise the ADF's ALI capability, specifically relating to the employment of offensive air support. The ALIO is focused on contributing to, and the strategic alignment of air-land operational concepts. The office aims to establish an environment where there is sustained improvement in ALI within the ADF, as well as alignment with coalition interoperability standards.

Overall, the initiatives to improve air power doctrine, force structure and ALI are all positive responses by our allied and partner air forces towards the preparation and conduct of irregular warfare. The challenges for the successful application of air power in irregular warfare are many and complex, and as with the majority of strategic challenges, can only be addressed by achieving an appropriate balance between capabilities and national security requirements. For the RAAF, despite the significant challenges, this is both a dynamic and exciting era of high operational tempo and force renewal. Thus, to maximise the potential of our people and new air power capabilities there needs to be a commensurate renewal of doctrine, air power education and leading edge thinking to prepare for the next century of war in the air.

The reality of air power and irregular warfare: what's in a name? 'Irregular warfare' and 'counterinsurgency'

Since the attacks of 11 September 2001 the United States and its coalition partners, including Australia, have been involved in a range of military operations in Afghanistan, Iraq and the Horn of Africa under various banners including the *Global War on Terror* (GWOT), the *International Coalition Against Terrorism* (ICAT) and the *Long War*. The scope, and in many cases the ferocity, of these operations has led many Western nations to reassess their military structures and modus operandi and shift their focus from conventional—or regular—warfighting to developing capabilities that can better meet the challenges of Irregular Warfare.

Key Points

- Although used inter-changeably, Irregular Warfare and Counterinsurgency do not mean the same thing.
- For air forces, Irregular Warfare doctrine is the strategic foundation for their involvement in non-conventional conflicts.
- The RAAF will use the term Irregular Warfare as it provides a broader strategic and more coherent operational foundation for its involvement in non-conventional conflict.

Irregular Warfare—which includes counterterrorism, insurgency support, counterinsurgency, shaping and deterring, and a number of other non-conventional warfighting techniques—is not new. IW operations typically use conventional military forces against an unconventionally formed, but complex, adaptive adversary, with a structure that reflects the manifold sources of their origin—be it nationalism, ideology, ethnic tensions or religious fanaticism, to name a few.

23

Many doctrine and concepts publications use the terms Irregular Warfare (IW) and Counterinsurgency (COIN) interchangeably to describe conflicts that do not fit the definition of conventional warfare. However, the two terms do not mean the same thing, and as a result, air forces have generally adopted the term IW and land forces have opted for COIN. These preferences are based on much more than semantics; indeed, they are indicative of how the respective Services view their roles in this type of conflict.

Currently, there is no joint Australian IW or COIN doctrine or definitions—but the Australian Army has drafted *LWD 3-0-1—Counterinsurgency* as developing doctrine. When there is no joint ADF definition, the standard practice is to use the NATO definition and as such, NATO's *AAP-6(2009)* gives the definition for COIN as: 'those military, paramilitary, political, economic, psychological, and civic actions taken to defeat insurgency.' There is no NATO IW definition.

The US armed forces have defined Irregular Warfare in their publication JP 1-02 as: 'a violent struggle among state and non-state actors for legitimacy and influence over the relevant population(s). Irregular warfare favours indirect and asymmetric approaches, though it may employ the full range of military and other capacities, in order to erode an adversary's power, influence and will.' The same publication describes COIN as: 'those military, paramilitary, political, economic, psychological and civic actions taken by a government to defeat insurgency' —basically the same as the NATO definition. It is believed that this definition will be further refined in the soon to be released US joint doctrine on COIN. (The relevant US Army and US Marine Corps doctrine is *FM 3-24/MCWP 3-33.5—Counterinsurgency* and the US Air Force doctrine is *AFDD 2-3—Irregular Warfare*.)

From these definitions it is apparent that IW is broader in its scope and encompasses a very wide spectrum of non-conventional warfare. In contrast, COIN is very specific and deals with the actions a government takes to counter a threat to its legitimacy and authority.

This distinction shapes the Services' view of how their respective capabilities can be applied to the joint campaign.

The primary focus of COIN doctrine or concepts of operation is the use of a land-centric force in a campaign to establish or restore a government's authority and legitimacy through securing the nation. Air forces recognise the land-centricity of COIN operations and contribute directly through intelligence, surveillance and reconnaissance (ISR), precision attack, air mobility, control of the air, and most importantly, command and control activities. Air power also has the capability to carry out shaping and deterrence operations—either through direct interdiction or by indirect ISR and presence operations. Although it uses US Air Force terminology, the Irregular Warfare Model below (drawn from the USAF doctrine, *AFDD 2-3—Irregular Warfare*)provides a useful visual description of IW activities and air power capabilities.

25
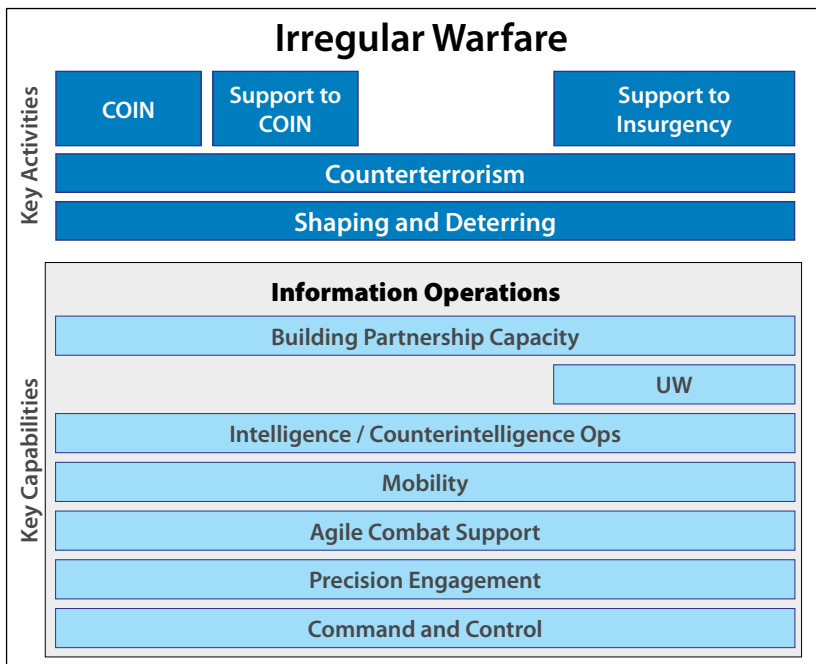
The RAAF preference for the term IW is based on the more strategic focus that it provides. As a consequence, the Air Force concentrates on the joint campaign through the multiple functions and roles that they perform, which also encompasses their contribution to COIN operations. For a variety of reasons, such as scarcity of assets, theatre wide responsibilities and multiple tasking, the command of air power is delegated by the Joint Task Force (JTF) Commander to an airman with professional mastery of air power, and controlled through an Air and Space Operations Centre (AOC) within the JTF. These air power elements will often contribute to COIN operations while concurrently undertaking other broader IW operations. An example of this is the detachment of RAAF AP-3C aircraft force assigned to Operation *Slipper* in the MEAO. These aircraft are capable of contributing concurrently to a number of IW tasks across the MEAO that may include overland ISR, maritime patrol and anti-piracy operations. It is therefore important for air forces to approach non-conventional conflict with a broad view instead of focusing purely on only one component of the spectrum of conflict.

Australia's geostrategic environment is also a determinant regarding the range of IW tasks that impact on its border security in the littoral and maritime approaches to the nation, wherein the RAAF contributes a range of ISR and response capabilities. These operations are carried out within a whole-of government approach to national security that relies on a number of agencies, not just the ADF. These operations are as vital to countering unconventional threats to Australia's security such as operations in Afghanistan or nation building in East Timor.

In examining the doctrine that guides IW and COIN operations, it is important to keep in mind the fact that although COIN operations have been at the forefront of recent Western military activities, it is not their exclusive role. Within IW, support for, rather than against an insurgency or civil uprising, through either direct or indirect means, may also be viewed as legitimate when the government being targeted is hostile, oppressive or belligerent towards its people or other

nations. Australia's own experience of irregular warfare, both within conventional and non-conventional wars, highlights the limitations of rigidly categorising conflicts. Australian forces have provided support and made common cause with partisan forces during both World Wars. Australians, including the airmen of No 1 Squadron AFC, fought alongside the irregular tribesmen in the Arab Revolt against the Ottoman Empire in during World War I. Similarly, the ADF contributed to the US Operation *Enduring Freedom* in Afghanistan by supporting the Northern Alliance of anti-Taliban Afghan forces alongside the US forces (predominantly air power, special forces and the CIA) that removed the Taliban Government in 2001.

There is an acknowledged need to develop both joint and single Service doctrine to guide the conduct of non-conventional conflict. Whether the ADF should follow the IW or COIN path in this process would appear to be largely moot on closer examination because there is a need for both. The RAAF uses the term Irregular Warfare as it provides a broader strategic and more coherent operational foundation for its involvement in non-conventional conflict.

WHAT IS ISR? CLARIFYING ISR AND ISTAR IN AIR POWER TERMS

"ISR has never been more important"
                    —General Moseley

General Moseley's observation on intelligence, surveillance and reconnaissance (ISR) is particularly pertinent for air power and air forces that are identifying how they can best realise the benefits of ISR. The current pre-dominance of Irregular Warfare in combination with rapidly advancing technologies

Key Points

- ISR is a primary air power role enabling information superiority and thus, decision superiority.
- There is a need to clearly delineate ISTAR as a purely tactical level activity.
- There is a need for single-service and joint ISR doctrine.

and concepts is placing greater demands on ISR and challenging its traditional understanding. Indeed, there appears to be many ideas of what is ISR. This has been further compounded by the misuse of the term ISTAR. There is a need to clarify what is ISR and ISTAR, their relationship to one another, and their relevance to air power. Therefore, the purpose of this *Pathfinder* is to take an 'operational pause' from the fast paced discussion of 'we need this piece of kit' or 'that definition' and develop a clear understanding of ISR and ISTAR in air power terms.

In military terminology, ISR was coined in the 1990s and gained momentum as an enabler for ideas such as the *Revolution in Military Affairs*. The ADF has been slow in developing ISR concepts, doctrine and definitions. The 2007 *Defence ISR Roadmap* describes what ISR does and is, rather than provides a specific definition. The *Air Power Manual* and *The Future Air and Space Operating Concept (FASOC)* likewise simply describe intelligence, surveillance and reconnaissance as air power roles that together realise the air power function of information superiority and support. Despite ISR being in general use for over ten years, the ADF only adopted an agreed joint definition

in 2008. The ADF embraced the US joint and NATO definition of ISR: '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.' Importantly, the definition indicates ISR is a word rather than an acronym; an important aspect that is often overlooked by those who simply see intelligence, surveillance and reconnaissance as separate entities. There is now a need for air power doctrine to align to the agreed definition and for single-service and joint doctrine to clearly reflect a common ISR understanding.

Recently, there has been an increased tendency to refer to Intelligence, Surveillance, Target Acquisition and Reconnaissance (ISTAR) as distinct to ISR. There is no agreed joint Australian, US, UK or NATO definition for ISTAR. The Australian Army has described ISTAR in developing doctrine as "the coordinated acquisition of timely, accurate, relevant and assured information that supports the planning and conduct of operations, as well as the targeting and integration of effects." The term has largely developed in parallel with that of unmanned aerial vehicles (UAVs) where the tactical real-time benefit of UAVs is particularly appropriate to the ISTAR concept. While it is commonly suggested that the target acquisition role of UAVs is new, and thus needs to be captured by a new doctrinal term, what a UAV does now for target acquisition is conceptually little different to what PAVETAC provided the F-111 fifteen years ago or balloons provided artillery spotting in the US Civil War. What is new and important is the need to adopt a collective view of that role within a modern, networked context that does not negate the prime importance and benefits that ISR offers.

From an air power perspective, the term ISTAR only has tactical utility due to the ISTAR concept inferring target acquisition lying completely within the boundaries of ISR. Modern air power doctrine clearly identifies target acquisition as part of the immediate targeting process (Find, Fix, Track, Target, Engage, Assess) and not part of ISR. The Targeting process is simply using an output from the ISR

process, which is a key doctrinal difference between the concepts of ISTAR and ISR.

While ISTAR may have relevance at the tactical level with respect to UAV operations, it has little application within air operations planning where ISR provides the means to effectively synchronise theatre wide ISR requirements and activities within the overall operational campaign plan, and in accordance with strategic and national intent. Overall, there is a need to clearly establish the differences and interfaces between ISR and ISTAR to ensure a clearer understanding of their respective meanings. In Australia, ISTAR is not used in the *Defence White Paper 2009* or the current *Defence Capability Plan*, though the need to develop a Defence ISR capability is clearly articulated. This reflects the primacy of the term ISR and the need for air forces to focus on ISR as a key air power role.

Intelligence has always been at the forefront of warfare and air power, with reconnaissance and surveillance first identified as key air power roles in World War I. ISR has increasingly grown in importance and complexity in recent years and is a critical enabler for concepts such as effects-based thinking and network centric warfare. The development of ISR has paralleled the exponential growth in ISR technology where today, ISR information in the battlespace is potentially limitless. Paradoxically, the warfighter often flags that they do not have enough ISR—demanding more and more. The subsequent need to prioritise and manage ISR activities has partly led to the development of ISR as a system to better synchronise intelligence, surveillance, and reconnaissance activities. This partly explains why ISR is defined as it is and has become so integrated in Air Operations Centres. The 'integrated' nature of ISR is a key notion. As LTGEN Deptula, Deputy Chief of Staff, ISR notes 'intelligence relies on surveillance and reconnaissance for its data and information … we do not know what to surveil … without intelligence.'

Current operations in the Middle East have highlighted how critical ISR is to the conduct of irregular warfare, where one of the most difficult tasks is the finding, fixing, tracking and assessing of an

unconventional adversary. The real issue has not been necessarily in finding an adversary or threat, but in identifying them as such, which requires the fusion of information from multiple sources and disciplines and then its transition into actionable intelligence. Simply put, data is not information, and information is not intelligence— intelligence provides the 'so what.' It is in this tactical environment where ISTAR has value in the immediacy of finding, confirming and prosecuting a target.

The battlespace is now populated by platforms with a complex array of sensors. In Afghanistan, the congestion of ISR platforms is causing deconfliction issues where ISR platforms under the control of disparate command elements are unknowingly transiting the operating areas of other platforms resulting in unsynchronised collection and degraded mission effectiveness. Further, as a former Secretary of the Air Force noted 'Every sensor will be a shooter and every shooter will be a sensor, linked across all domains and across the joint and coalition team.' Doctrinally, this has implications for the command and control of air operations and highlights the need to better integrate the intel and ops staffs supported by sound and robust joint and air power doctrine clearly defining the ISR and targeting processes.

In essence, ISR has become a word not an acronym—much like RADAR—and air forces and the joint military community need to embrace it as such in doctrine. ISTAR and ISR are not the same; they are not interchangeable. ISTAR is not simply ISR with TA added. While acknowledging the importance of ISTAR in the tactical environment and particularly in support of ground forces, ISR remains of paramount importance to air power and provides a critical mechanism that enables complex and diverse operations across the battlespace and thus realises information superiority. It provides an important interface that maps theatre level activities to national level objectives. The fundamental objective of ISR is 'getting the right information, to the right people, in the right format, at the right time'.

What is ISR?
The need for an air force ISR plan

Pathfinder #117 (see page 29) discussed the doctrinal aspects of intelligence, surveillance and reconnaissance (ISR) to clarify key aspects of the term. A key observation in it was the need to understand ISR as an integrating function, coordinating a system with many components. Indeed, several conclusions from that *Pathfinder* have specific implications for the RAAF in developing an ISR capability. Technology is showing the potential for a networked, seamless defence force, supported by a real-time pervasive ISR, able to prosecute any target anywhere in the battlespace. However, the reality is that such a capability is still well into the future for the ADF. Importantly, if this aspirational capability is to be realised then a robust ISR development plan is required. The RAAF appreciates that air power will be a major contributor to the ADF's ISR capability, and is already acquiring key components that will deliver the intended capability. The systemic and integrated nature of ISR means that an Air Force ISR plan must synchronise its initiatives with the Defence ISR Roadmap to create a coherent and integrated capability.

> ### Key Points
>
> - ISR is an enabler for Information Superiority that underpins the successful conduct of all ADF operations.
> - Air Force will provide a major ISR contribution to the Defence ISR capability.
> - The Air Force ISR capability must be developed in a coordinated manner that ensures it is synchronised with ADF capability development.

ISR is the core underpinning activity that enables information superiority, thus determining and creating the desired effects in the joint campaign. Former Chief of Air Force, Air Marshal Geoff Shepherd, referred to this critical nexus when he described ISR as one of the three core air power capabilities that Air Force provides to the

joint fight. More recently, the Defence White Paper 2009 identified ISR as one of the capability priorities for creating information superiority. Air Force will be a major contributor in realising this.

While it includes terms such as sensors, assets, processing, exploitation and dissemination systems, the critical word in the ADF approved ISR definition is 'integrate.' It infers the need to understand ISR in terms of a networked system of systems, that functions across all domains and command levels, interfacing with diverse sub-systems comprising sensors, platforms, humans, and weapons. The Defence ISR Roadmap notes the nature of this system of systems in using the term Defence ISR to 'describe a system of interconnected ISR elements that will seamlessly combine with the command and engagement systems to ensure that information can be readily exchanged in support of shared situational awareness, collaborative planning and cooperative action.' The complexity of the ISR system demands that Air Force develop a plan that synchronises and coordinates its ISR capability development, in order to create an integrated, layered and coherent capability aligned and operating within the Defence ISR system.

The battlespace is becoming dominated by multi-role air platforms with a multitude of sensors, information requirements and networks. The deployment of these platforms has major implications for those trying to enhance ISR capability, as the most important part of that capability is not the platforms themselves, but rather their enablers such as people and supporting networks. The key challenge will be the integration of such a diverse range of components into an effective ISR system of systems. Only successful integration will realise a Defence ISR capability that consolidates and deconflicts multiple traditional and non-traditional ISR feeds to create a coherent, uncluttered common operating picture.

The RAAF is currently acquiring significant ISR platforms, such as multi-mission UAV and AEW&C aircraft, and it is expected that all future acquisitions will also contribute to the joint ISR capability. The current trend is towards multi-role platforms whose primary

roles may not be ISR but will contribute to the integrated and networked Defence ISR system and thus, will be non-traditional ISR platforms. For example, the Joint Strike Fighter will be a significant air superiority and strike asset and will also be a network enabled ISR node that will collect, process and disseminate ISR data. There is also a need to develop a wide range of joint enabler projects that will enhance the future Air Force ISR capability when appropriately integrated.

While the management of these future platforms will principally be a Force Element Group (FEG) responsibility, the ISR capabilities they will deliver will be a broader Air Force responsibility. This has implications for the traditional Air Force FEG level capability management approach. Foremost, will be the need to develop a collective approach to ISR capability development unified under an Air Force ISR plan. ISR will be an Air Force wide enterprise and accordingly, requires capability management across the FEGs rather than within a single FEG. While Surveillance and Response Group clearly has a major role in ISR, so too have Aerospace Operational Support Group and Air Combat Group. A key part of an Air Force ISR plan will be coordinating the command and control and capability management responsibilities for the RAAF's ISR assets and enablers. Indeed, of all RAAFs major capabilities, ISR, along with C2, are the two that cannot be readily managed within a single FEG. While the Air Operations Centre will be the mechanism that coordinates and synchronises airborne ISR activities for the joint campaign, a coordinated Air Force approach, harmonised with joint ISR initiatives, will ensure its seamless integration into the Defence ISR capability.

The best way to realise this level of holistic Air Force ISR capability management is to develop an Air Force ISR plan identifying its desired ISR capability and addressing its integration into the Defence ISR system. The ISR plan must provide strong strategic guidance implemented through coordinated specific capability direction. The critical elements of this plan will not be the platforms themselves,

but the process to integrate the concepts of operations, mechanisms, supporting networks and human elements into a robust and effective ISR capability. The Air Force ISR plan therefore needs to be managed as an Air Force wide issue at the strategic level.

The USAF has made some significant steps in developing a coherent approach to enhancing ISR for the future by addressing areas of organisation, personnel and capability management including the establishment of an ISR Agency (previously the Air Intelligence Agency) and developing an ISR strategy. There is value in the RAAF exploring similar initiatives.

ISR is one of the critical enablers of air power within the joint campaign. The RAAF has a key role to play in the delivery of ISR, and is acquiring a wide and significant ISR focused inventory. To realise the potential of Air Force ISR as a key joint enabler, there is a need for the RAAF to develop and implement a coherent strategic ISR plan aligned and integrated with the Defence ISR Roadmap.

What is ISR?
Challenging traditional paradigms

Surveillance and reconnaissance have been important air power missions ever since the beginning of military aviation. In recent years, the traditional understanding of surveillance and reconnaissance has been challenged by the emergence of the concept of Intelligence, Surveillance and Reconnaissance—or ISR—as a single integrated activity and the resultant convergence of tactical and strategic missions. Recent operational experience indicates that ISR is now a critical air power role that incorporates both the traditional and singular aspects of surveillance and reconnaissance. The modern requirement is to not

Key Points

- The individual terms of 'surveillance' and 'reconnaissance' are no longer that relevant and are best captured by the term ISR.
- ISR is not inherently strategic, operational or tactical—its output may be used at all levels depending on the commander's requirements.
- The AOC has a unique and valuable capacity to plan, synchronise and coordinate theatre-wide airborne ISR activities in support of the joint commander.

maintain separate tactical or strategic, or surveillance or reconnaissance, capabilities but instead to have a singular and holistic ISR capability that operates across the spectrum of conflict and levels of war.

AAP 1000-D—The Air Power Manual defines surveillance as the 'systematic observation of air, space, surface or sub-surface areas, places, persons, or things, by visual, aural, electronic, photographic or other means.' It also states that 'reconnaissance is undertaken to obtain information about the activities and resources of a designated enemy, or to secure data concerning the meteorological, hydrographic or geographic characteristics of a particular area.'

Therefore, surveillance is systematic observation while reconnaissance is observation of a specific place at a specific time. The two air power

missions have in the past been complimentary, but now as ISR they allow the *Kill Chain* to be synergistically completed by Finding, Fixing and Tracking targets so they can be Targeted, Engaged and Assessed (F2T2EA). Together, surveillance and reconnaissance provide information that is transformed into intelligence by processing, exploitation and dissemination (PED) capabilities. The characteristics of air power such as perspective, reach, penetration, responsiveness, versatility and flexibility make ISR very effective when conducted in the air environment and as such, there is a particularly strong relationship between air power and ISR.

This relationship is clearly reflected by the fact that observation, or surveillance, was the first air power mission developed in air power thinking. It was first used in the Napoleonic Wars where the French established balloon contingents to observe the enemy. Reconnaissance developed into a key air power role during World War I where it was critical in both the ground and maritime environments for identifying and assessing the enemy. While airborne surveillance and reconnaissance developed further during World War II, it was in the Cold War environment where surveillance and reconnaissance became critical at the strategic level where they developed into sensitive national intelligence collection activities. Accordingly, there emerged a strong demarcation between strategic reconnaissance (missions undertaken to obtain information for strategic planning and targeting purposes such as infrastructure, industry, nuclear forces, etc) and tactical reconnaissance (missions undertaken to secure information for use on the battlefield such as orders of battle, force disposition, etc).

Recent operations have reinforced the importance of airborne ISR particularly in providing time-critical intelligence for targeting and force protection related situational awareness. While traditionally the RF-111C provided the RAAF its reconnaissance capability (see *Pathfinder* #128, page 45) and the AP-3C its maritime surveillance capability, recent RAAF AP-3C and Heron UAV missions have become synonymous with ISR. Whilst the term 'Overland ISR' (OISR) has come into common use since the RAAF started to use the AP-3C away

from its traditional maritime surveillance activities against land based targets in the Middle East, it is not a useful delineation as all AP-3C activities to find, fix and track targets—regardless of whether they are on or below the ocean's surface, or on land—are ISR.

Indeed, RAAF operations in the Middle East have seen the AP-3C aircraft become the ADF's primary airborne ISR platform. RAAF AP-3C aircraft have become important ISR platforms where their flexibility and responsiveness enables the aircraft to perform a range of ISR tasks against a range of targets. In 2006 an Australian AP-3C was tasked to conduct a mission in support of a counter-IED mission by surface forces. An hour prior to take-off the aircraft was urgently re-tasked to provide support over a city where coalition troops had been killed by an RPG, the local population had rioted and a curfew had been established. Towards the end of the on-task period the AP-3C was requested to provide route clearance for coalition forces exiting the area by road. On completing the route clearance, the crew were further tasked to provide route clearance for a coalition command element exiting the area over water. The AP-3C crew provided the necessary surveillance and clearance and also advised the command element of suspicious activity both on the water and on the land in the vicinity of their watercraft. After ensuring that the command element had safely reached their destination, the aircraft was again tasked to provide support to coalition surface forces that were under fire in a city about 50 miles away. On their transit back to base the crew imaged a static maritime rig to ensure that there were no vessels threatening the maritime task force. During this single mission the AP-3C undertook several 'Overland ISR' activities and maritime surveillance activities—both sequentially and simultaneously. Indeed, the AP-3C undertook a single ISR mission from takeoff to landing—against different targets and for different requirements. Such mission flexibility will become the new norm, is already evident in RAAF Heron UAV operations over Afghanistan, and will become more evident when the Wedgetail AEW&C enters service. The Jindalee Operational Radar Network (JORN) also operates in a similar manner now.

The traditional labelling of strategic or tactical missions subject to where the platform is operating and what information it is collecting is equally outdated. Surveillance and reconnaissance are now effectively ISR and are not inherently strategic, operational or tactical. ISR is used to satisfy the information requirements of commanders at all levels irrespective of whether the platform/sensor is thought of as a tactical or strategic asset. What has become particularly important, however, is the requirement to clearly synchronise and deconflict the command and control of the asset and its ISR mission with other activities across the battlespace. Recent operations have highlighted the potential for platforms under the control of disparate elements to unnecessarily duplicate collection efforts thus wasting precious collection capability as well as very limited exploitation and dissemination capacity.

Within Air Force the tenet of centralised control and decentralised execution as applied to all air operations by an air component commander within an Air and Space Operations Centre (AOC) allows a theatre wide perspective to be applied thus maximising the airborne ISR capabilities of the joint force. Indeed, in the modern battlespace, there is no such thing as 'Air Force' targets—just 'joint' targets—whether they are kinetic, non-kinetic or ISR. Optimisation of the employment of the ADF's limited airborne ISR capabilities can only be achieved when they are coordinated, synchronised and planned at AOC level.

In the past surveillance and reconnaissance have been key air power missions. However, in recent years their character has evolved to a point where traditional definitions are no longer relevant. Doctrinally, surveillance and reconnaissance now have diminishing relevance as discrete terms and there is greater value in collectively referring to them simply as ISR, which better reflects the capacity of air power to conduct intelligence focused multi-role missions. Likewise, ISR missions are neither strategic nor tactical—they are simply ISR missions with different commander's requirements. While ISR challenges many traditional air power paradigms, the inherent characteristics and joint focus of air power make it particularly well suited to conducting airborne ISR—a synchronised and integrated air power role.

What is ISR? An integrated activity and enterprise

Developing a coherent approach to Intelligence, Surveillance and Reconnaissance (ISR) has been a challenge for military forces, largely because of its complex nature as an integrating function which coordinates and interfaces with many components. The 2007 Defence ISR Roadmap highlighted this complexity in describing 'a system of interconnected ... elements that will seamlessly combine with the command and engagement systems to ensure that information can be readily exchanged in support of shared situational awareness, collaborative planning and cooperative action.' Understanding ISR as an enterprise is one way of portraying it in a more logical and coherent manner.

Key Points

- Air Force should embrace the broader US ISR definition that is more appropriate to air power in synchronising and integrating ISR across the battlespace and operations.
- ISR is an integrated function that synergies the tasking, collection and processing, exploitation and dissemination (PED) aspects.
- We need to better understand Air Force ISR as an enterprise comprising components and systems.

Despite the term 'ISR' being in general use for over ten years, the Australian Defence Force is only beginning to fully understand it. *ADDP 3.7 Collection Operations* (2009) defines ISR as 'a collection activity that synchronises and integrates the acquisition, processing and provision of information and single source intelligence by sources and agencies tasked to satisfy a collection requirement.' According to this view, ISR is an activity conducted during only the collection phase of the intelligence cycle. In its Foreword, however, the ADDP 3.7 notes that 'Air Force considers ISR as an overarching term that includes the entire intelligence cycle.' This is a broader

interpretation which emerged in the United States of America over the past decade and continues to be developed by allies. It views ISR as a synchronising and integrating activity, encapsulating not only collection and processing but also exploitation and dissemination of information and intelligence. Accordingly, its focus is more appropriate to air power and air forces.

From an air power doctrine perspective, identifying ISR solely as a collection activity fails to take full account of its integrated and synchronising nature across the battlespace, across all domains, and all command levels. For example, the ADDP 3.7 definition does not incorporate the processing of target coordinate information from a UAV collection asset directly to a weapon system for prosecution. The ADDP 3.7 definition effectively creates the separation in functions between intelligence, surveillance and reconnaissance that ISR actually requires to be fully integrated. It is for these reasons that the Royal Australian Air Force (RAAF) aligns itself more to the US joint definition.

Because ISR is a function that aims to provide the best possible information to commanders (producing actionable and predictive intelligence that can be quickly used to make sound and informed operational decisions), the objective of ISR can best be achieved by capitalising on the inherent synergies resulting from the interplay of the various airborne, space-based and ground-based ISR elements that the RAAF employs. In this respect, ISR is best viewed and understood in terms of a networked system of systems, interfacing with diverse sub-systems comprising sensors, platforms, humans, and weapons. For the RAAF, ISR is an Air Force wide enterprise made up of a complex system of systems.

The enterprise can be more easily understood in terms of the interplay of two primary groups: components and systems. Components comprise managers, collectors, producers, users, enablers or partners subject to their roles, responsibilities and capabilities. Managers are those elements of the enterprise that are responsible for ISR management—for example, AFHQ or HQAC. Collectors are

those platforms and sensors that are involved in the collection of ISR data and information. Producers, including units, AOC and national agencies, are those entities that produce ISR information and intelligence. Users, comprising commanders, warfighters, weapon systems and strategic organisations, are those elements of the enterprise that receive and use ISR product. An enabler is an element of the ISR enterprise that provides capability support (command and control, people, training, and communications) to the functioning of the enterprise. Lastly, partners are those organisations (eg national agencies, other ADF elements, allies, and industry) that are external to Air Force but provide critical support to the Air Force ISR enterprise via a partnership agreement.

ISR systems comprise the various platform, sensor and exploitation networks that support the RAAF ISR Enterprise. The ISR Enterprise comprises three system groups: environmental; information and communication technology (ICT); and cognitive. Environmental systems are those systems that reside in or operate in a particular environment (eg. air) and include things such as unmanned aerial systems and space-borne systems. ICT systems are those elements that provide the critical network connectivity and automatic processing capacity to support ISR information transmission and processing. ICT systems are communication or computational based. Meanwhile, the cognitive system represents the human dimension within ISR. It entails the integration of the human mind in receiving, interpreting, and acting on information within the processing and exploitation elements of the Processing, Exploitation and Dissemination (PED) components of ISR. Given its nature, the cognitive system is the most difficult to assess, quantify, develop and understand.

By its very nature, ISR is an activity that integrates the traditionally separate spheres of intelligence, surveillance and reconnaissance within the operational planning process into one single activity. In particular, it recognises that intelligence and operations are fully integrated and that it therefore should be understood in terms of

a networked enterprise that functions and interfaces with diverse networks comprising sensors, platforms, humans, and weapons. Alignment to allied ISR definitions that better reflect the integrated nature of ISR across the battlespace and operations will allow Air Force to realise the broader potential that ISR offers air power. In doing so, there is value in understanding the Air Force ISR capability in terms of an enterprise comprising components and systems. It is only then that Air Force will realise the potential significant synergy from the synchronisation and integration of ISR assets and capability. Overall, ISR effectiveness is not determined by the sum of the individual ISR sensors, it is largely by how effectively ISR components interact with each other as an enterprise.
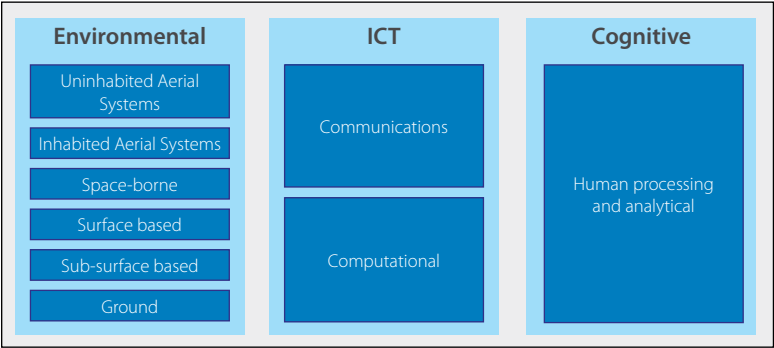
ISR Systems are the various physical and cognitive networks in the ISR enterprise
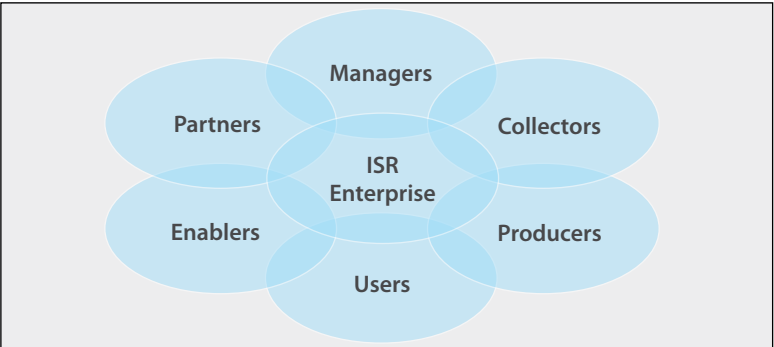
The Air Force ISR Enterprise comprises various inter-related components

Manned ISR: the RF-111C

In December 2010 the Royal Australian Air Force's F-111C and RF-111C aircraft will be retired, after principally meeting Australia's needs for strike and photographic reconnaissance—or to use the current term, ISR (Intelligence, Surveillance and Reconnaissance)—for the last four decades. The F-111 will be replaced by F/A-18F Super Hornets in the strike role, but not in an ISR role. Although the Super Hornet has some inherent ISR capability, and the United States Navy is fielding the Shared Reconnaissance Pod (SHARP) on

Key Points

- Australian forces used reconnaissance aircraft to gather intelligence in both World Wars.
- INTERFET operations in East Timor were the only time the F-111 fleet flew operational missions.
- The RF-111C provides an ISR capability to the ADF that is survivable, flexible and responsive in threat environments—a capability that is not identified in future acquistion plans.

many of its Super Hornets (a capability that comprises electro-optical and infra red sensors that can downlink imagery to a ground station), a dedicated ISR version of this aircraft is not being developed. So, how and why was the RF-111 reconnaissance aircraft placed into the RAAF order of battle and what will replace it?

During both world wars, Australian flying units conducted photographic reconnaissance missions using aircraft dedicated to the role. Between the wars and immediately afterwards, however, ISR capability was allowed to languish because of resource constraints. During the early 1960s, when the search began for a replacement for the Canberra bomber, the photographic reconnaissance role was reinstated. The choice was narrowed to the British Tactical Strike Reconnaissance 2 (TSR 2) and the American F-111A (see *Pathfinder* #72), both of which were planned to have a tactical reconnaissance version. In 1965, Australia contracted to buy 18 F-111A strike and

six RF-111A reconnaissance aircraft, but six strike aircraft were later accepted in lieu of the reconnaissance variant, with a plan to retrofit six aircraft with a reconnaissance pallet in the aircraft's weapon bay.

By 1971, it was clear that the USAF was no longer interested in a reconnaissance version of the F-111. They were willing, however, to sell the design of the reconnaissance pallet for US$3m—an offer too good to refuse. About this time, the number of aircraft to be modified was reduced from six to four. The 24 strike aircraft were finally accepted in 1973 and put into service with Nos 1 and 6 Squadrons.

In October 1978, F-111C A8-126 was flown to the General Dynamics plant at Fort Worth, Texas, for modification. The first RF-111C was rolled out on 18 April 1979 and commenced a four-month flight test program. After returning to Amberley in August 1979, the aircraft deployed to Darwin for tropical flight trials. The remaining three aircraft were converted at No 3 Aircraft Depot at Amberley during 1980, using kits supplied by General Dynamics. Once these aircraft were in service, and following acquisitions that allowed the setting up of a photographic processing and interpretation facility on the ground, the RAAF had its first dedicated processing, exploitation and dissemination (PED) system.

The RF-111C gives the RAAF an outstanding capability, with the aircraft capable of a 1000 nautical mile (1850 km) radius of action including 400 nautical miles (740 kms) at low level. Fitted with a range of sensors, the RF-111C can take high and low altitude, vertical, oblique and panoramic imagery. In addition, it was, until recently, fitted with an infra-red line scanner that could image at night or in low visibility conditions. In short, the aircraft can take detailed imagery of the smallest of targets in one high-speed, low or high level pass by day or night. Due to its speed and defensive aids, the aircraft can also survive in a wide range of threat environments.

In April 1983, the RF-111C hit the headlines in a totally unexpected way. The Federal Government was preparing a submission to the High Court to stop the building of the Franklin River dam in southwest

Tasmania. Staff in the office of the Attorney General, Senator Gareth Evans, requested HQ Operational Command to task an aircraft to photograph the dam site, to confirm that a court injunction to halt construction work was being obeyed. Because an RF-111C was not immediately available, a photo-reconnaissance Mirage flew to the area on 7 April and made several low passes. The next day an RF-111 was tasked and took further photos from high level, without attracting notice. The story hit the papers within days, and was raised in Parliament. The Commonwealth was accused of 'spying' on the States. The Prime Minister, the Chief Defence Force Staff, and the Chief of Air Staff had not been briefed about the flights and were furious that RAAF involvement in such a sensitive issue could occur without proper approval. Subsequently, Defence Instructions were amended to provide for a more rigorous approval before similar tasks could be accepted.

In the lead up to the Gulf War in 1990-91, American planners realised that their tactical reconnaissance capability was limited. The USAF recognised that the RAAF RF-111s were the best tactical reconnaissance aircraft in the western world and made approaches to the Australian Government for their deployment to the Middle East. After consideration of the risks involved, the Hawke Government chose to send RAN ships, a medical team and clearance divers, but not RF-111s. In July 1996, the RF-111C aircraft and the reconnaissance capability were transferred from No 6 Squadron to No 1 Squadron.

In June 1999, civil unrest broke out in East Timor. When militia gangs later threatened United Nations staff and Australian nationals as well as the East Timorese, Australian peacekeeping troops were inserted under Operation *Spitfire*. With tensions building, six aircraft (both F-111s and RF-111s) from Nos 1 and 6 Squadrons deployed to RAAF Tindal if called upon. When INTERFET forces arrived in Dili on 20 September, the situation on the ground was volatile. Requests for RF-111 overflights of East Timor were initially refused by the Indonesian Air Commander, but after Indonesian forces withdrew in

late October overflights were permitted. RF-111 missions began on 5 November and continued until four days later. These flights over East Timor were the only operational employment of the RAAF F-111 fleet.

The ISR capability provided by the RF-111C has provided Australia with the capacity to conduct effective independent strike operations. Although satellites and Unmanned Aerial Vehicles (UAVs) can provide some elements of the ISR required, they cannot provide all of the required capabilities. While UAVs are persistent, they are not survivable in high threat environments. Satellites are also limited by orbital mechanics and weather to a greater degree than manned aircraft. There is still a requirement for ISR capabilities exhibiting the inherent air power characteristics of perspective, reach, penetration, responsiveness and flexibility. As the ISR capability the RF-111C represents is not being replaced under current acquisition plans, there would appear to be a gap in the ADF's future ISR capability.

EFFECTS-BASED APPROACH: IS IT STILL VALID?

In late 2008, the Commander US Joint Forces Command (USJFCOM) reignited significant debate within the United States in declaring USJFCOM will no longer use, sponsor or export the terms and concepts related to effects-based operations (EBO). This statement is the most definitive official public revocation of effects-based thinking. While his outright rejection indicates a fundamental change in current US joint thinking regarding EBO, the statement does not change Australia's embracing of the effects-based approach (EBA)

> **Key Points**
> - Effects-based targeting is a primary mechanism by which air power supports the national approach to warfare.
> - Air power effects are generated by the AOC as a result of air campaign planning and are integrated within the overall joint campaign across the spectrum of conflict.
> - Air power effects are synchronised with all national power elements to achieve national security outcomes.

to warfare. EBA simply provides a mechanism where one identifies desired and negative effects through the planning process. It provides a mechanism to map effects to the strategic level and thus ensures the overall campaign plan supports the Whole of Government (WOG) approach. EBA remains a critical component in realising multidimensional manoeuvre—the basic tenet of Australia's approach to warfare. Consequently, the air campaign planning process is based on EBA.

Effects-based thinking is not revolutionary. Throughout the history of warfare, commanders and strategists have tried to identify the adversary's centres of gravity and the most effective means to create optimum effects against them. Even in World War I Allied strategists were attempting to identify German industrial targets that would affect German military operations as an alternative to the trench

warfare stalemate on the Western Front. Importantly, air power was the key capability to conduct such a campaign. Australian doctrine calls this, target systems analysis (TSA).

USJFCOM defines EBO as "a process for obtaining a desired strategic outcome or effect on the enemy through the synergistic and cumulative application of the full range of military and non-military capabilities at all levels of conflict." EBO places considerable importance on identifying and quantifying specific effects resulting from specific actions against specific targets. This requires vast information on the adversary; an aspect that sometimes draws criticism. It has been suggested that EBO requires unattainable levels of knowledge.

Critics have also suggested that effects based concepts are not suited to irregular warfare and they have had limited success during recent counterinsurgency operations in Iraq and Afghanistan. Many share General Mattis's view that EBO "... goes against the very nature of war", in that it is sometimes portrayed as having the ability to remove the friction and fog of war. As a result of these concerns, there has been greater support to recognise and adopt the broader philosophical aspects of effects based concepts. Both NATO and Australia have adopted this more flexible and practical approach in embracing an EBA as it provides a major link to WOG thinking. In this respect, it has significant value in addressing broader national security concerns across the spectrum of conflict (i.e. transnational security, terrorism, peacekeeping). EBA can be as effective in developing a campaign plan against terrorists as a conventional adversary. EBA cannot remove the fog and friction of war, but it can be valuable in mitigating this friction by increasing our understanding of the adversary as a system.

A key component of EBA is systems analysis. Systems analysis is the process of mapping critical nodes and their relationships across related networks. For example, if you want to target an air defence system you would want to not only identify the key nodes and their relationship to one another (i.e. radars, command and control, surface to air missiles, fighter aircraft) but also key enabler networks

(i.e. telecommunications, power, leadership, and POL). There is also a need to map these networks against key cognitive domains including cultural, religious, political and economic. The subsequent holistic systems analysis enables one to identify direct and indirect effects, positive and negative outcomes and causal relationships.

Effects-based thinking is one of the strategic foundations for ensuring Australia's security. In the Australian context, EBA has been defined as "the way of thinking and specific processes that, together, enable both the integration and effectiveness of the military contribution within a WOG approach and the realisation of strategic outcomes." EBA has direct benefits to multi-dimensional manoeuvre, the key principle in the Australian approach to war, and enables the ADF to operate within the adversary's decision cycle.

Although Australia has yet to develop formal EBA doctrine, EBA has been incorporated into Australian capstone and key functional doctrine. *The Future Joint Operating Concept (FJOC)* recognises that a national EBA underlies Australia's current approach to security and will be the basis for defence operations for the future. The *FJOC* indentifies EBA, together with seamless force and networked enabled operations, as the key tenets that support multi-dimensional manoeuvre. Headquarters Joint Operations Command has integrated EBA into campaign planning. Unfortunately, systems analysis mechanisms have not been effectively developed within Defence (such as the Australian intelligence community) and other government agencies to the extent required to support EBA. This will adversely impact the ADF's capacity to successfully implement an EBA.

The Air Force has incorporated an EBA into the *Air Power Manual* (AAP1000) and the *Operational Air Doctrine Manual* (AAP 1002). Effects-based targeting is key to Air and Space Operations Centre (AOC) planning processes. EBA is critical to identifying and prioritising targets in accordance with the overall campaign plan. When properly implemented, EBA has demonstrated great success in

making air campaign planning more effective and efficient (i.e. Gulf War air campaign).

EBA remains an important tenet for Australian and allied defence thinking. It is being integrated into ADF operational campaign planning and NATO doctrine, and given USJFCOM's amended position on effects based thinking, there may now be a need to reconcile the divergent perspectives on EBA within the allied community. Within Australia, consideration should be given to the development of a more holistic approach to EBA and articulation of a formal EBA doctrine. Lastly, Defence agencies need to provide greater support to the systems analysis process.

Air power and collateral damage: the strategic effect

Unintentional civilian deaths resulting from military action have always caused friction between civilians and the military. During 2009, the continued public remonstrations over civilian deaths in Afghanistan from air strikes forced NATO planners to change their tactics. More importantly, they highlighted the degree to which air power can cause major unintended negative effects that undermine the capacity of a Western nation's will to wage war. Modern Western military forces have recognised the need to avoid or minimise collateral damage—a term generally used to denote inadvertent injury or death to non-combatants or damage to civilian infrastructure. Australia has developed doctrine and methodologies to ensure warfighters appropriately estimate possible collateral damage prior to prosecuting a target.

> **Key Points**
>
> - Air power has gained an ill-deserved reputation for causing collateral damage in comparison to that of other operations.
> - Western air forces, including the RAAF, have developed significant mechanisms to minimise the potential for collateral damage.
> - Western air forces need to better educate commanders, governments, the media and the population on the capabilities and limitations of air power.

By its very nature, war is horrific and dangerous. During the 20th century, it is estimated that 180 million people died in war. The indiscriminate bombing of civilian areas during World War II prompted much emotional outcry, causing air power to be often viewed as the major perpetrator of civilian deaths in war. However, statistics show that of the 40 million civilian deaths incurred during World War II, less than 5 per cent were caused by air attack, indicating that the negative reputation of air power is not fully deserved.

The air power experience in recent Iraq and Afghanistan operations has been similar. In 2009, the *New England Journal of Medicine* assessed that air attacks accounted for only 5 per cent of total Iraqi civilian causalities between 2003 and 2008, with small arms fire accounting for 20 per cent and execution (by insurgents) for 33 per cent of deaths. Meanwhile, the Centre for Strategic and International Studies assessed that, since January 2007, insurgents have caused 80 per cent of civilian casualties in Afghanistan. Instances of air strikes causing inadvertent civilian casualties have been where air strikes were called in by ground forces to provide support to troops in contact in a time-critical manner. Sometimes the tactical benefits of employing air power in such cases do not justify the potential risks of a negative strategic effect resulting from collateral damage. Yet, paradoxically, it is the application of air power that is increasingly being questioned in the public eye and not the actual decision to call in air strikes.

This can be largely explained by the changing characteristics of 21st century warfare, Western societies' aversion to it and the adversaries' appreciation of this change. Firstly, warfare is increasingly characterised by combating ideologically-motivated irregular forces that depend on asymmetry, terrorism, guerilla tactics, insurgencies and criminal activities that threaten a nation state's national interests but not national survival. While irregular warfare has always existed, its primacy has been established in the void of a post-bipolar global community.

Secondly, while the adversary has embraced such tactics as integral to fighting a war of survival, Western society has largely detached itself from the concept of fighting such wars unless they are pushed to the extreme, such as the United States of America immediately after the September 11 attacks. It is in this climate that the adversary has found considerable success in exploiting the West's aversion, mainly because of lack of popular support, to irregular warfare. Irregular warfare is complex, dangerous, lengthy and difficult to wage for a military force largely equipped and trained to wage traditional inter-state warfare.

Western military forces have recognised the need to avoid or minimise collateral damage. This has driven the development of sensors and weapons that can discriminate the smallest targets and minimise blast effects in their immediate area. Likewise, Western forces adhere to the Laws of Armed Conflict and the principles of proportionality, necessity and discrimination. Rigorous methodologies have been developed to ensure such principles are integrated into targeting the adversary. However, there needs to be better understanding that such processes are not fail-proof and will only ensure that warfighters are required to estimate as best they can from the information available at the time that a specific mission is legal, necessary and proportional. This places significant demands on one's own intelligence process—a factor that is compounded by the nature of irregular warfare where intelligence assessment is particularly difficult. While technology provides incredible capacity to identify, track and monitor weapon systems, the irregular adversary concealed within a foreign population remains the most difficult target to identify. Precision targeting requires accurate intelligence.

But the Afghanistan and Iraq experience highlights the need for air forces to better understand collateral damage and the negative strategic effect that it can inadvertently create within Western populations and at the political level. However, it must also be kept in mind that air power is a key Western asymmetric advantage that the adversary seeks to neutralise. It is therefore necessary to have a broad appreciation of the employment of air power. There are few factors that make this easier. First, the limitations and dependencies of precision guided munitions must be understood while stressing their accuracy. Second, the need for accurate intelligence, which can be impacted by the fog of war but is integral to the success of a precision strike must be appropriately considered. Third, there is a need to educate an air force's partners and the media regarding the capabilities and limitations of air power, as well as the processes that have been instituted to mitigate collateral damage. Fourth, there is a requirement for personnel with professional mastery of air power to

employ it and minimise collateral damage in all conflicts. This will reduce the potential for negative strategic effect and adverse media exposure.

Surface forces must not only be trained to appreciate the broader effects that air strikes create but also be educated to understand the limitations of close air support when troops are in contact with the enemy, in terms of clear target identification, proximity of non-combatants to the engagement, and the effect of aerially delivered weapons. This would go a long way in reducing civilian casualties from air attacks in irregular warfare.

Air power has gained an ill-deserved reputation for causing collateral damage. Statistically, air power has incurred significantly less collateral damage both historically and in recent operations in Iraq and Afghanistan than that created by adversaries or ground forces. Despite this fact, there is a need for air power practitioners to appreciate the potential strategic effects that air power can inadvertently cause when manipulated by a politically adept adversary. This does not mean that air power is a liability; indeed, it actually reflects the true strategic potential of air power. However, it does mean that air forces need to educate commanders, governments, media and populations on such aspects, particularly in cases where an adversary deliberately plans for war among the people necessitating a time critical response.

Global positioning system in the ADF

As an example of a system that has become pervasive in next to no time at all, the US NAVSTAR Global Positioning System (GPS) is hard to beat. The ability to accurately determine time and position, without the use of expensive and complex systems, has revolutionised the way the world functions. So successful has this system been, that the GPS has become a utility—something that is assumed to be constantly available.

The NAVSTAR system has its origins in research conducted by

Key Points

- Both military and civilian activities have become highly dependent on the position, navigation and timing signals provided by the GPS system.

- Use of a commercial GPS receiver relies on a benign operating environment.

- The best means of assuring access to the GPS signal is through use of a PPS-capable receiver loaded with the appropriate cryptographic key.

the US Army, Navy and Air Force on competing designs for satellite-supported timing and positioning. A Navigation Satellite Executive Group (NSEG) was formed in 1968 to take a more holistic approach to space-based timing and navigation issues. Five years later, following a recommendation from the NSEG, the US Air Force was given the lead in developing a Defence satellite system. What followed was an initial testing period between 1974 and 1979—the tests being conducted using two US Navy Timation satellites, which placed the first atomic clocks in space. These tests were followed by the launch of 11 GPS Block I satellites between 1978 and 1985. Combined with ground-based transmitters that simulated a GPS signal, these satellites validated the concept of time-based-ranging using precise timing from space-based clocks.

Authorisation for full-scale development of the GPS system was given in 1979, but almost immediately the program received a 30

per cent budget cut, requiring a reduction in scope and the number of operational satellites. Like many space-based systems, NSEG had difficulties 'selling' its capabilities and benefits to operational users; although it had a wide variety of applications and users, none of them wished to bear the full cost of the system. This issue was finally addressed and the Block II satellites funded, but the program was again delayed by the loss of the Shuttle *Challenger*—the only planned launch vehicle for this class of satellites. Block IIs were eventually launched aboard Delta II boosters in 1989. Initial Operating Capability (IOC) was declared in 1993 when the system was able to sustain continuous positional accuracy of 100 metres, which was a joint a requirement of the US Departments of Defense and Commerce. Full Operational Capability was declared in 1995, once all 24 Block II satellites were in orbit and fully functional.

Given the dual civil/military applications of the GPS signal, it is not surprising that the system is configured for the two customer bases; the Standard Positioning Service (SPS) provided for civilian users and the Precise Positioning System (PPS), available to designated military/government users.

SPS is the freely available, unencrypted signal that is available to all GPS receivers. While possessing the same general qualities of accuracy as PPS, the SPS signal was originally degraded through the implementation of Selective Availability. Selective Availability enabled the accuracy of a SPS receiver to be controlled by the GPS operations centre. Given the overwhelming adoption of, and dependence on, GPS by the commercial and civilian communities, then-President Clinton directed the discontinuation of this feature.

PPS is designed to provide approved users with a signal capable of operating in an electronic warfare environment. The PPS signal characteristics are designed to enable its acquisition in a cluttered electromagnetic spectrum, to provide a measure of resilience to jamming and spoofing, and to indicate to an operator when such events occur. These characteristics are achieved through a second encrypted signal transmitted by each GPS satellite and

an appropriately encrypted receiver. The PPS is available only to military-grade receivers loaded with the appropriate cryptographic key, without which a military-grade receiver effectively operates only as a SPS receiver.

It is difficult to find an ADF project or capability that does not depend in some way on the GPS signal. Employment ranges from hand-held receivers (the vast majority of ADF receivers exist within Army), through to integration into vehicles, aircraft and ships, along with usage in an increasing number of weapons and munitions.

An often overlooked element of GPS is the realm of computer network coordination and timing. The majority of computer networks rely on precise timing to ensure the smooth passage of data between nodes. While alternative systems exist, they are expensive to implement and operate, especially compared to a 'free' signal from space. As such, many ADF and civilian networks are heavily reliant on the GPS timing signal. Such dependencies are difficult to quantify; similar to the Y2K issue, the impact of losing GPS can only be properly measured after the event.

While at face value it may appear that an SPS receiver will perform as well as its military-grade counterpart, this is only in benign environments. With the proliferation of electronic warfare equipment, and doctrine concerning the importance of controlling access to timing and navigation signals, the chances that the ADF will continue to operate in such a benign environment are increasingly slim. Indeed, it should be noted that the US DoD has a Navigation Warfare policy that includes denying access to non-PPS navigation signals—such an act would also impact on all SPS users in a theatre, whether or not they are allied with the US.

Given the near-global adoption of the GPS by Defence and supporting agencies outside of Defence, the impact of the loss of, or interference with, the GPS should be of concern to all users. From an ADF perspective, the best means of assuring our access to the GPS is through the use of appropriately endorsed PPS-capable receivers,

keyed with crypto. If only a commercial-grade GPS receiver is available, commanders must recognise the inherent risks in using such a device; particularly, the impact that erroneous position data could have on the effective employment of military forces.

Space: emerging capabilities and policy issues

Many of the capabilities employed today by the ADF depend on space-derived services for their effectiveness; indeed, some terrestrial missions could not be conducted without space-based navigation, imagery or communications support. Future capabilities envisioned for Defence aim to further exploit the advantages of space, allowing the ADF to conduct operations more effectively and efficiently. In order for these capabilities to deliver on their promise, the issues shaping the

> **Key Points**
> - The space operating environment is becoming increasingly congested and contested.
> - In order to meet future warfighting needs, Defence's expectation of space is changing.
> - The development of an ADF Space Roadmap is a means to meeting these challenges in a consistent and coordinated manner.

space operating environment and the Defence expectations for space need to be understood, and a clear vision articulated.

Space capability has traditionally been a high-cost endeavour limited to major powers willing to invest significant resources to achieve them. For a long time the providers of space-derived services could not exist without substantial government/military support. In such an environment, it was relatively easy to control the proliferation of technology involved in space operations. The recent growth in the commercial space sector, allied with the emergence of new Space Powers, has altered the situation in many respects. Nations, such as Australia, who used to have an advantage when it came to space capabilities (either indigenous or through alliance partners), can no longer assume this advantage.

From a technological perspective, space capabilities are becoming cheaper to build and operate. While historically the development of a space capability required the indigenous development of design and

construction skills, today there are a range of commercial vendors able to supply spacecraft, while another set of vendors are prepared to launch them at market rates. As such, nations without a space pedigree are increasingly able to purchase 'turn-key' national systems in a timely and affordable manner.

Space-derived services are becoming easier to acquire on-demand from the commercial sector. For those nations (or actors) unable or unwilling to purchase an entire capability, the commercial sector is able to meet many needs for communications and remote sensing data as an 'on-demand' utility. In addition to providing additional capability, such a development also blurs the line between civilian and military infrastructure. When both ally and adversary are dependent on the same commercial space-based service, the decision to interfere with that service becomes more difficult.

As a result of these factors, and the increasing threat of collision with debris or other space objects, the space environment is becoming more congested and contested. The notion of 'red' and 'blue' space objects is now being swamped by the 'green' (neutral) and 'grey' (commercial/unaligned) entries to the space catalogue. Besides difficulties in maintaining orders of battle, such an increase in objects impacts on the ability of satellite operators to maintain safe separation from other objects. The recent collision between an Iridium platform and a decommissioned Russian satellite demonstrate the issues that arise when accurate space situational awareness is lost or not achieved.

Due to the importance of space-derived services, the capability to degrade or deny these services is becoming more attractive to many nations. Whilst the Chinese ASAT test in 2007, and subsequent USA 193 shoot-down, have illustrated the potential for direct attack on satellites from the ground, this is not the limit of the threat. While operating in space, satellites and their systems are still vulnerable to the same principles of electronic warfare applied on Earth. Communications links can be jammed or spoofed; imagery and radar sensors can be jammed, dazzled or destroyed. Future operations

will increasingly need to consider such possibilities in planning and execution.

Space elements are already irreversibly embedded into Defence capability as shown in the table below, and will grow over the coming decade within the Joint Warfighting areas of force application, deployment, protection, sustainment, command and control and knowledge dominance. A review of the 2007–17 Defence Capability Plan shows that 54 per cent of projects have some form of space dependency.

The relevance of space capability to the pillars of Australian warfighting-2009

Function	Comms	Earth Observation	Position Navigation & Timing	Meteorology & Space Weather	Space Situational Awareness
	SATCOM	ISR	PNT	MET&SW	SSA
Force Application	H	VH	VH	VH	H
Force Deployment	H	H	H	M	M
Force Protection	H	H	H	H	VH
Force Generation & Sustainment	H	M	M	H	M
Command & Control	VH	H	M	M	H
Knowledge Dominance	VH	VH	M	H	H

(Relevance VH-Very High, H-high, M-medium, L-Low)

As the ADF continues to be employed nationally, regionally and globally, in an extensive array of operations, the requirements for space capabilities will evolve. Space power expands the strategic choices available to government on how to use and empower a relatively small force to greatest effect and the expectations are many. They include:

- A need for Defence to undertake a wider spectrum of operations across a wide area of operations.
- Defence activities characterised by multi-dimensional manoeuvre, within a non linear and diverse battlespace.
- Growth in the capability and application of space assets of key coalition partners, and expectations of Australian participation and interoperability.
- The move away from threat based planning to concept-led and effects-based themes.
- Adoption of network centric warfighting concepts, partially through space means.
- The need to rapidly scope and assess strategic and operational risk and countermeasures in asymmetric warfare and whole of government planning and execution.

Consistent with COSC direction, the ADF has embarked upon an approach to achieve a coordinated future for space through the formation of the Defence Space Coordination Office (DSCO) within AFHQ. This has led, in part, to the development of a draft space doctrine, and space input into the Future Joint Operating Concept. However the future path for Defence space suggests a transformational agenda for the way Defence uses space to:

- Develop and integrate space operations expertise
- Enhance indigenous Defence space capabilities
- Develop and enhance space relationships
- Promote space-related research and development
- Support national space initiatives

These are significant and aspirational goals which need to be clearly articulated through the near, medium and long term. Any transformation of such significance will create issues and new challenges. As such, in order to meet these goals in a consistent and coordinated manner, the development of an ADF Space Roadmap should be the next identified goal.

ADF SPACE CAPABILITIES AND ORGANISATIONS

The term capability has different meanings for different people. To Defence capability developers the term is most appropriately understood in terms of the Fundamental Inputs to Capability (FIC). To others it may simply mean having the ability to do something. The important question is this: Is ownership of the thing that provides the capability essential to the ADF's ability to achieve a defined outcome? This recurrent question is fundamental for space-based capabilities, as it has been for the basic air power tenet of centralised control and decentralised execution.

Key Points

- ADF is dependent on space capabilities for developing combat power.
- Defence space capabilities are enabled by access to space technologies and services through strategic partnerships with its allies.
- CAF is the ADF coordinating Capability Manager for space related activities.

In the context of space capabilities, the ADF has historically neither owned nor operated its own space assets, relying instead on the products and services of others. Over the past decade, however, there has been significant reduction in the ADF's reliance on commercial and foreign military space assets for satellite communications. But for other critical enablers, the reliance has deepened. This *Pathfinder* discusses the key space-based technologies and several organisations that provide the ADF with the space capabilities it requires.

The ADF's war fighting effectiveness is heavily dependent on four space-based services.

Satellite Communications (SATCOM). Satcom services are perhaps the most critical of all space-based services on which the ADF depends. They are essential for C2 of deployed forces and provide the conduit through which operational, administrative, logistic, medical and other

information are shared. Satcom services enhance operational tempo by providing capacity, accuracy and timeliness in the delivery of information.

Positioning, Navigation and Timing (PNT). The ADF makes extensive use of the Global Positioning System (GPS). This network is critical for accurate control and placement of fire power, including guided weapons; accurate navigation of air, land and maritime forces; and providing the essential timing needed to synchronise communications systems.

Intelligence, Surveillance and Reconnaissance (ISR). ISR activities enable information support and superiority for the conduct of ADF operations. A critical enabler of the ISR mission is space-based systems that provide imagery; missile and other threat warnings; and a range of signals and electronic intelligence, all of which contribute to enhanced situational awareness.

Meteorology (Met). Met information is used by all Services and is another important enabler for operations. Met satellites provide weather forecasts, tidal information for maritime operations, cloud and visibility information for air operations, rain fade for communications planning, and soil moisture content for analysing ground movement corridor trafficability.

The ADF's capabilities are enhanced by assured access to these four space-based services, facilitated through: Strategic Policy Division (SP Div), Chief Information Operations Group (CIOG), Defence Material Organisation (DMO), Defence Science and Technology Organisation, Headquarters Joint Operations Centre (HQJOC), and Defence Imagery and Geospatial Organisation (DIGO).

SP Div within the Strategy Group develops strategic policy on Defence's space requirements. Internationally, SP Div engages with key allies and regional partners on space policy through several staff posted overseas. SP Div develops strategic partnerships with allies, through policy guidance, negotiating terms and conditions, and obtaining Government approval. SP Div bears the responsibility for enabling ADF space capability through access to the four critical space services.

CIOG is the capability manager for Satellite Operations (SATOPS) and through the SATOPS cell in the Defence Network Operations Centre (DNOC) is responsible for the management of all ADF satellite communications services. SATOPS directly controls and manages the Defence Payload System (DPS) on the Optus C1 satellite. The DPS provides wide-band satellite communications services to Australia's immediate region through Australian regional, steerable spot beams, and Earth coverage beams at X- and Ka-bands, and Earth coverage within the military UHF band, as shown in the images below:

X-band   Ka-band   UHF-band
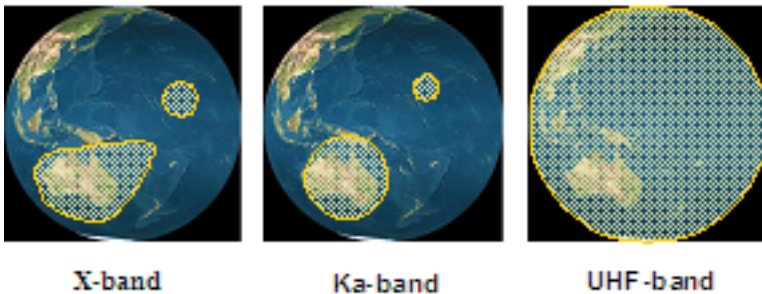
To support ADF operations outside these coverage areas, SATOPS arranges for the lease of communications bandwidth through commercial satellite service providers such as INTELSAT, INMARSAT and Iridium, and through reciprocal arrangements for access to wideband and UHF coverage with allies.

Australia has also partnered with the US in the Wideband Global Satcom (WGS) program, which will, when fully operational, include a constellation of at least six X- and Ka-band communications satellites in geostationary earth orbits providing nearly global coverage (except for the polar regions).

DMO is responsible for all aspects of the system or equipment life cycle, from acquisition through to disposal. For space systems, DMO acquires and maintains all hand-held, mobile and strategic system elements owned by the ADO. These include Iridium satellite phones, small terminals such as INMARSAT, large transportable elements like

the BTN Satellite Terminal Assemblage, and Satellite Ground Stations such as those at 136 and 138 Sig Sqns in Brisbane and Melbourne.

DSTO supports the ADF by providing scientific advice to Capability Development Group, DMO and the Services regarding space-based technologies and services.

HQJOC, is responsible for processing space support requests by operators through the embryonic space cell in the Air and Space Operations Centre (AOC). Services provided include satellite vulnerability reports (SATVULREP) for deployed elements, dissemination of the recognised space picture (RSP), and all liaison with the US Joint Space Operations Centre (JSpOC) and GPS Operations Centre (GPSOC).

DIGO is the coordinating capability manager for geospatial information. It is responsible for providing all forms of geospatial imagery products to war fighters and commanders to enhance situational awareness.

Chief of Air Force (CAF) is the Capability Manager (CM) for specific areas of space capabilities that include space-based position, navigation and timing, space related warfare and environmental awareness. CAF is also responsible for the coordination of all capability aspects of the space environment. The Defence Space Coordinating Office (DSCO), a joint element that functions within Air Force Headquarters, has the role of coordinating the defence space enterprise and supporting CAF in his role as the space CM. This includes coordination strategic planning of space related activities. Although primarily involved at the output level, DSCO is also responsible for the development of space expertise, guidance, engagement as well as concept exploration and exploitation.

Space-enabled capabilities are cost-intensive and also critical to ensure the effectiveness of the ADF. Therefore, it is vital to coordinate the employment of available space services to optimise their utilisation. The Air Force has a primary role to play in ensuring this.

Canada's evolving air force in Afghanistan

Note: In Canada, the Air Force operates all aircraft in the Canadian Forces, including maritime and land force helicopters.

Within a few weeks of the September 11 attacks on the United States in 2001, Canada committed military forces, including air force personnel and aircraft, to the Middle East, Persian Gulf/Arabian Sea and Southwest Asia regions as part of the US-led coalition campaign against terrorism. In 2010, the Canadian Air Force continues to provide many crucial air power capabilities to operations in those

Key Points

- Canada's air power contributions to operations in Afghanistan have evolved over time in reaction to the dynamic mission.
- Significant events like air-to-ground fratricide and the Manley Report had dramatic effects on the types and numbers of air capabilities deployed.
- The development and employment of TACPs has significantly improved Canadian air-land integration in joint operations.

regions. Some have evolved significantly over this period and some, which did not reside in the Air Force inventory in 2001, have been introduced to address capability gaps or unanticipated requirements. The nature of, and circumstances surrounding, Canada's evolving air force contributions to operations in this theatre and the importance of organisational agility provide important lessons for middle power air forces employing air power in dynamic military operating environments.

The initial Canadian Forces mission, Operation *Apollo*, was predominantly a maritime operation in support of the U.S. led Operation *Enduring Freedom* although it did include the deployment of an army battle group to southern Afghanistan from February to July 2002. The Canadian Air Force provided embarked CH124 Sea King maritime helicopters, CP140 Aurora (P-3) long range patrol

aircraft, and strategic/tactical airlift using the CC150 Polaris (A310) and the CC130 Hercules aircraft. The Canadian Forces established an air bridge to the Middle East and Southwest Asian theatre, basing the Theatre Support Element (TSE) at Camp Mirage in the Arabian region.

Operation *Athena*, Canada's military contribution to the International Security Assistance Force (ISAF) in Afghanistan, began on 17 July 2003, with a Canadian Army battle group forming part of ISAF's Kabul Multi-National Brigade. For Operation *Athena*, the Air Force continued to operate the TSE from Camp Mirage, providing airlift support to Canadian Joint Task Force Kabul, and handling such tasks as transport of personnel into and out of theatre, resupply operations and other equipment maintenance and administration support.

In August 2005, Canada altered its focus in Afghanistan, forming a whole of government Provincial Reconstruction Team in Kandahar and moving its battle group and army-acquired CU161 Sperwer Tactical Uninhabited Aerial Vehicle (TUAV) unit from Kabul to Kandahar to consolidate the majority of Canadian diplomatic, development and defence efforts in that province. A detachment of the Canadian Tactical Airlift Unit (TAU) from Camp Mirage subsequently moved to the Kandahar Air Field (KAF) to provide on site C-130 support to Canadian operations and ISAF coalition partners.

On 4 September 2006, a significant event took place during a battle group level offensive operation, when a USAF A-10 close air support aircraft, being controlled by a Canadian ground-based forward air controller, mistakenly strafed a Canadian infantry company just west of of the city of Kandahar, killing one soldier and wounding many others. Subsequently, the Canadian Board of Inquiry found that the lack of a properly manned Tactical Air Control Party (TACP) at regional command (brigade) or task force (battle group) levels, although not the cause of this incident, was a factor.

To improve the integration of air power into joint force operations in Afghanistan, the Canadian Air Force went from deploying one brigade air liaison officer, to continuously deploying six air force officers and up to six NCOs, split between TACPs at the brigade and battle group levels. These TACPs have proven to be invaluable additions to joint operations. Additionally, the Canadian Air Force has committed to permanent force structure changes, including forming three brigade TACPs and creating five additional battle group TACPs.

By mid-2007, the Canadian Air Force had increased its support to the deployed Canadian joint task force with the introduction of the CC177 (C-17) Globemaster III transport aircraft capable of flying large payloads directly into KAF. At roughly the same time, the Canadian Government commissioned an "Independent Panel on Canada's Future Role in Afghanistan", which produced a very influential report commonly known as the "Manley Report". The "Manley Report", released in January 2008, led to a motion in parliament to extend the Canadian military mission (combat operations) until July 2011, but made this extension conditional on providing additional support to Canadian troops in Afghanistan which included tactical helicopter transports and more robust intelligence, surveillance and reconnaissance (ISR) capabilities.

To meet these new requirements, the Canadian Air Force and the Canadian Expeditionary Force Command (ADF JOC equivalent) rapidly acquired and/or fielded:

- Six CH-47D Chinooks purchased from the US Army to provide tactical rotary wing air mobility.

- Eight Canadian Air Force Griffon armed utility helicopters (Bell 412/CH146) equipped with an EO/IR sensor to provide escort, convoy overwatch and light transport capabilities.

- Heron Medium Altitude Long Endurance UAVs (CU170) to provide an increased ISR capability.

- Civilian helicopter support to transport cargo to isolated Canadian forward operating bases.

- An air wing headquarters to manage these new capabilities.

These air power additions significantly increased Canadian Air Force contributions to the Canadian Joint Task Force Afghanistan (JTF-Afg) and Regional Command (South). Over the past year, the Chinooks and Griffons have flown over 26,000 passengers, while the Heron UAV has flown well over 5000 hours since being introduced.

In summary, the Canadian Air Forces's air power contributions to joint operations in Afghanistan have evolved over time to meet the dynamic political, strategic, operational and tactical environments. A significant number of air capabilities currently being employed by Canada's Air Force in Afghanistan did not reside in its inventory prior to Operation *Athena*. The rapid acquisition of these capabilities required an appreciable amount of organisational agility and innovative short-notice staff work by dedicated air and joint force personnel to bring these capabilities into being. Additionally, the Air Force has initiated organisational structure changes to improve long-term air-land integration and to capture TACP effectiveness lessons acquired during operations in Afghanistan.

What is stealth?

A majority of future airborne systems will incorporate the technology called low observability (LO), commonly known as 'stealth'. Stealth, in an air power context, primarily refers to special design features incorporated into military aircraft that permits it to fly deep into enemy territory and return, with reduced risk of detection and/or interception. Stealth is a complex design philosophy aimed at reducing the ability of an enemy's sensors (radar, laser, electromagnetic, infrared, ultraviolet, optical or acoustic) to detect, track and

> **Key Points**
>
> - An aircraft's survivability depends upon a complex mix of design features, performance, mission planning and tactics.
> - A true stealth aircraft is one where signature reduction is a major design objective from the start.
> - Stealth is a complex design philosophy aimed at reducing the ability of a defence system's sensors to detect, track and attack an aircraft.

attack an aircraft. The intent is to reduce an aircraft's signature to such an extent that it can get close enough to an enemy's air defence system without being detected in order to attack it, or fly through the air defence system unharmed so that the high value targets being protected can be attacked.

The principle driver behind the development of stealth technology has been the necessity to improve an aircraft's chances of surviving in a hostile environment while undertaking a broad range of missions. The traditional means of improving aircraft survivability—increasing speed, operating altitude and manoeuvrability—became almost redundant with the advent of radar controlled high-speed, high-altitude surface-to-air missiles in the 1960s. By the mid-1970s radar and missile technology had evolved beyond the capability of an aircraft to evade, even with sophisticated onboard electronic

countermeasure systems, thus reducing its chances of survival in a high-end warfare environment.

The quest to improve an aircraft's survivability examined both active and passive methods to reduce the air defence system's ability to detect and intercept an attacking aircraft. As radar continues to be the primary means of detecting aircraft, it was a logical starting point for the research. The initial proposal to minimise an aircraft's radar signature through design was articulated in a few theoretical papers published in Britain in 1941. By the 1960s this concept was being explored further. It was theorised that if an aircraft's shape returned less radar energy, the net effect would be to make the aircraft appear on the receiving radar later, thereby reducing the enemy's reaction time and improving the aircraft's chance of survival.

An aircraft's Radar Cross Section (RCS)—the area of the scattered wave field returned to the receiving radar—determines the amount of radar energy reflected back. Generally, the RCS of a conventional aircraft is much larger than its physical size and varies significantly with aspect.
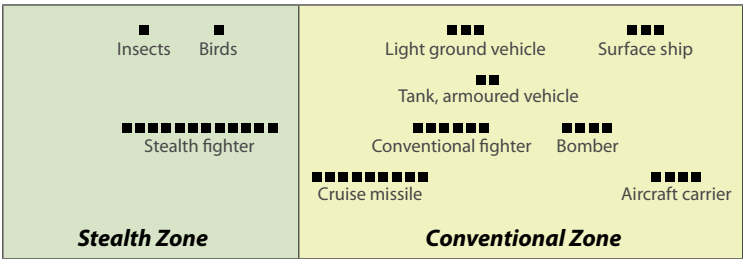
Typical RCS Comparison

Initial attempts at reducing RCS involved applying radar absorbent materials (RAM) to the aircraft's exterior. However, this provided only a minor reduction in RCS. It was realised that to make substantial reductions in RCS each part of the aircraft would have to be carefully designed to scatter radar energy away from its source. Early stealth

aircraft such as the F-117 used faceted surfaces to achieve this at the cost of reduced manoeuvrability because of aerodynamic penalties. However, considerable improvements in computational modelling techniques are now permitting the use of blended surfaces, such as those on the F-22 'Raptor', which reduces RCS significantly without the accompanying loss of manoeuvrability. Other design features that aid stealth include positioning the engine deep within the aircraft, trapping radar energy within aircraft structural components, avoiding perpendicular corners and surface seams, and not having any external protuberances such as antennas or drainage pipes.

While the reduction of RCS is a major component of stealth, it is not the only one. Lowering RCS can make an aircraft's infrared, ultraviolet, electromagnetic, visual and acoustic signatures more pronounced to the extent that they can become the prime means of detecting stealth aircraft. Therefore, to be truly stealthy, these signatures also need to be reduced.

The key to reducing an aircraft's infrared signature is to cool the engine exhaust gases as much as possible before they are vented to the atmosphere. This cooling is achieved by mixing cold air into the exhaust plume before it leaves the engine and running the resultant exhaust over long heat absorbing ducts.

The purpose of designing and operating a stealth aircraft will be negated if it gives itself away through its own emissions. Therefore a stealth aircraft, at least during the attack phase, must turn off all transmitters such as radar, radio, laser rangefinders and some navigational and formation keeping devices. Further, it must also reduce its electromagnetic reflections, especially ultraviolet reflections off glass surfaces, through careful selection of shapes and materials. As a result, while in stealth mode, the aircraft cannot operate as an active node in a C2 network and is dependent upon its passive self-protection systems for survivability if engaged.

Visual stealth typically incorporates low glint surfaces and low visibility paint—grey for day operations and black for night. There

are also research projects underway to design visual cloaking devices, though it will be many years before they enter operational service. In addition, stealth aircraft avoid operating at altitudes that create contrails (the white condensed water vapour trails seen behind high flying aircraft) and fuel additives are used to reduce visible smoke trails.

Acoustic signature reduction is achieved by a combination of flying at high altitudes, using high-bypass turbofan engines (besides being cooler they are also much quieter than turbojets), and flying at subsonic speeds to avoid sonic booms.

While stealth does provide substantial tactical advantages, it also has some limitations. Stealth technology is very expensive to build due to complex design requirements and the exotic materials required for fabrication. The designs also suffer from structural and weight compromises as stealth takes precedence over structural simplicity. The maintenance requirements of stealth aircraft are significant as any imperfection in the surface finish or alignment of access panels can compromise stealth capabilities. Finally, since the carriage of any external stores will compromise stealth characteristics, these aircraft have more limitations on their weapon and fuel loads as compared to non-stealth aircraft.

Like all military technological developments, there are counter-developments to stealth technology. One way to counter low RCS is to use very sensitive receivers coupled with very powerful radars to increase detection range. Another option is through a process called occlusion. Since stealth aircraft have significantly reduced signatures, they can be detected when they hide other objects, such as stars, as they pass in front of them. Another approach to counter stealth is to use bi-static or multi-static radars. Conventional mono-static radars place the transmitter and receiver in the same location. However, as stealth aircraft do reflect some radar energy, but away from the transmitter, bi-static or multi-static radars, which have their receivers located at a different location from the transmitter, could conceivably receive the reflected energy and detect stealth aircraft. Another

possible countermeasure is to place sensors above the anticipated flight path of stealth aircraft as their stealth is optimised against sensors that are either at the same or lower altitude as themselves.

Although counter-measures are being developed, so far only one stealth aircraft has been lost to enemy action—the F-117 shot down over Serbia in Operation *Allied Force* in 1999. It is believed that this was made possible not through anti-stealth measures, but because of the regularity of the route being followed by the attacking aircraft that made it possible to locate surface-to-air missiles appropriately in advance.

Stealth is a leading edge technology and will continue to be researched and developed despite its current limitations and evolving countermeasures, to maximise the effectiveness and survivability of emerging weapons systems and their crews.

The art of air power: observations from the 2010 RAAF Air Power Conference

The recently conducted 2010 RAAF Air Power Conference (2010APC) provided a valuable opportunity to consider key issues such as the role of air power in current and emerging national security concepts, Government requirements and intentions of the Air Force and the air power it generates, and what the Air Force can do in order to be prepared to meet emerging challenges as a first rate provider of air power. With the theme of *The Art of Air Power* (reflecting Sun Tzu's enduring treatise on war and strategy, *The Art of War*), the 2010APC analysed current perspectives of air power in terms of where it is now, what its future may be, and the implications of this for Australian air power. This *Pathfinder* summarises the key points that emerged from 2010APC. More importantly, it will be through the art of air power, enabled by professional mastery, that the Air Force can both transform to a future force and successfully deliver air power for Australian national security with that force.

> ## Key Points
>
> - Conflict, and the role of air power within it, is evolving and there is a need to ensure we understand such change in developing the future force.
> - The rise of ISR as a key air power role challenges traditional air power mindsets and the tenet that air power is primarily offensive in nature.
> - Mastering the art of air power, through professional mastery, will enable Air Force to transform to the future force and apply it to Australian national security interests.

The conference focused on four key areas of air power in Australian national security, namely, the role of air power in national security in terms of the Defence White Paper 2009; the challenges to air power in meeting its full potential in difficult geopolitical and security environments; the role of air power in irregular warfare; and the key

air power capability requirements such as space and ISR as identified in the Defence White Paper 2009.

There were five key outcomes from the conference. First, there is a need to understand the way conflict, and the critical role of air power within it, has evolved. Second, the need to study current and emerging characteristics of conflicts and the strategies required to prevail in them. Third, the need to have a strategic understanding of Government's requirements of the military for Australian national security; that is, having a military strategy that directly flows from a national security outlook. These three factors are critical for the Air Force to enable it to plan, prepare and conduct the increasingly complex operations Government requires of it across a broad spectrum of conflict. The fourth factor is the need to further develop air power enabled ISR and space capabilities in an integrated manner to meet the Future Joint Operating Concept and Future Air and Space Operating Concept in accordance with the Defence White Paper 2009. Lastly, Air Force needs to leverage the flexibility inherent in a balanced force to counter irregular and non-state adversaries operating in a complex battlespace, while at the same time, retaining capability to meet high-end conventional threats. Importantly, each of these factors is integral to the Air Force and its mission in providing air and space power for Australia's security.

Traditionally, the art of air power has been in applying the four key enduring air power roles: ensuring control of the air, affecting elements or events on the ground, observing things from the air and moving things through the air. Historically, control of the air has been viewed as the most important of these roles, however, there is a growing belief that information superiority is an equally important air power role. The Royal Air Force Chief of the Air Staff, ACM Sir Stephen Dalton reflected this emerging perspective in suggesting earlier this year 'it will be air power's ability to maximise its comparative advantage in the third and fourth dimensions and to dominate the information space that will underwrite its future utility as a useful, credible, viable and essential tool in both the influence

and hard elements of national power.' Such a statement challenges traditional air power mindsets and the notion that air power is primarily offensive in nature. ACM Dalton is not alone in suggesting such change. LTGEN David Deptula, a pilot like ACM Dalton, has led the USAF transformation of ISR stressing the operationalisation of intelligence. Both perspectives show the potential synergies in knowledge dominance that air power can provide to the joint commander. Knowledge dominance exploits the inherent strengths and characteristics of air power—theatre wide perspective, global reach, flexibility, penetration and responsiveness that can create strategic effects.

In his presentation to the conference, the Chief of the Defence Force, ACM Angus Houston, noted that the enhancement of the Air Force's ISR capability will be impressive. More importantly, he acknowledged that the Air Force will take a leading role in data sensor fusion. To do so, it must transform its ISR capabilities and take a leading role in developing and promoting the ISR concept across Air Force and within the wider joint community. Overall, there is much alignment in ACM Dalton's, LTGEN Deptula's and ACM Houston's understanding of the capacity of air power to be the primary provider of information superiority in the battlespace.

ISR is only part of the transformation that Australian air power will undergo in the coming decade. As the Minister and CDF outlined at the conference, the Air Force is transforming from a modern Air Force to a future force characterised by 5th generation air combat aircraft, uninhabited aerial systems, networked ISR, and global reach. This is a significant challenge that will require Air Force to not only apply the art of air power to operations but also to its transformation from a modern tactical Air Force to a future networked enabled and strategically influential force providing Government with effective air power in support of Australian national security.

However, the critical need for Air Force is not just the realisation of this future force through the application of the art of air power but effectively applying the future force's capabilities in support of

Australian national security. This will require a clear understanding and knowledge of air power and strategy. The fundamental building block to achieve this is professional mastery; a key priority highlighted by CAF in his Commander's Intent.

Having air power strategists who can articulate the integration of air power, and thus our future force, in national security—in essence, having air power statesmen—will represent the pinnacle of the art of air power. It is only then that Air Force will realise a future force capable of conducting integrated operations to address complex security challenges and providing Government with strategic response options in support of Australian national interests. More importantly, Australian air power will be effectively integrated into a national effects-based security strategy by statesmen of air power who can successfully articulate and integrate air power at the national level. This can only be achieved through mastering the art of air power.

*The Heron UAV, recently deployed into Afghanistan,
is the RAAF's latest ISR capability.*

An RAAF C-17 landing at Tarin Kowt, Afghanistan

Precision guided munitions have enhanced air power's ability to generate effects in the battlespace

The integration of USAF JTACs with Northern Alliance forces in 2001 is an example of itegrating air power with friendly irregular forces

Australia's Air Board, 1928.

RAAF and RNZAF bomber crew and RAF ground staff - July 1944

No 3 Squadron, RAAF, at Rosh Pinna airfield, June 1941

Formal arrival of RTFV at Saigon, 10 August 1964

HISTORY

The measure of airpower is the ability of a nation to exploit air space for its own purposes—and in wartime to deny it to an enemy.

Admiral Arthur Radford

HISTORICAL FOUNDATIONS OF AUSTRALIAN AIR POWER DOCTRINE: PART I

From its uncertain beginnings in 1921, the Royal Australian Air Force has grown into a leading small air force. In less than a century the Air Force has evolved from a small collection of men individually skilled in military aviation into a modern war-fighting organisation exercising professional mastery of air power. The history of the development and maturation of the Air Force is closely linked to the development of its strategic doctrine.

During World War I Australian airmen trained and operated with both the Australian Flying Corps (AFC) and the British armed air services, where they gained valuable experience in all aspects of air operations. Following the post-war demobilisation, Lieutenant Colonel Richard Williams advocated the need to create an independent air service to the Australian government. Williams' two most telling arguments were the establishment of the independent Royal Air Force in Britain and the financial economies that would accrue from operating a single air service. These arguments were given added impetus in 1920 when the British government offered a gift of aircraft and ancillary equipment to any of the Dominions willing to establish a standing air force. A year later the Australian Air Force was formed on 31 March 1921.

Key Points

- At its inception, the RAAF lacked clearly defined strategic concepts for the air defence of Australia.

- Between the wars, RAAF leaders were focused on the political battles for ensuring the survival of the independent Air Force, precluding the development of air power doctrine.

- The absence of an independent intellectual foundation for the development of air power in Australia resulted in the RAAF being ill-prepared to meet the demands of World War II at its outbreak.

At its inception the nascent Air Force had no formalised doctrine and was equipped with surplus aircraft donated by Britain, and not with weapon systems selected to meet Australia's strategic defence needs. Throughout the 1920s, the Army and Navy remained opposed to an independent air force and the RAAF's senior leadership was completely occupied defending their Service's very existence and obtaining sufficient resources just to remain operational. As a consequence, the focus of the organisation was on maintaining Air Force's core skills of flying and maintaining aircraft.

The majority of the Air Force's senior officers were decorated veterans of World War I, who valued individual aviation skills and courage above all else and promotions largely depended on an officer's flying skills. There was only limited interest within the RAAF for intellectual and educational development beyond the immediate technical requirements of aviation.

However, a few officers did demonstrate a more sustained interest in the development and application of air power. Henry Wrigley, an AFC veteran and future Air Vice-Marshal, wrote extensively during the 1920s and 1930s on air power based on his experiences on the Western Front with No 3 Squadron (see *Pathfinder* #58). In the absence of formal, officially endorsed texts on air power doctrine, Wrigley's remarkably detailed and thoughtful essays and notes reflect a profound understanding of war and air power. His theories and writings can be considered the earliest foundations of Australian air power doctrine.

In 1935, Squadron Leader John McCauley, future Air Marshal and Chief of the Air Staff, directed all flying units to examine their roles and tactics for the local defence of Australia and to prepare papers which would form the basis for formulating Air Staff policy. Modest though these efforts were, they represent the first positive steps within the RAAF towards developing a distinct air power doctrine for Australia.

That the value of such work was not clearly understood by the RAAF was symptomatic of the distinct lack of appreciation within the Service of the importance of doctrine and intellectual endeavour to the development and employment of air power.

The RAAF's actions to improve the air defence of Australia were limited to quantitative measures—the acquisition of more aircraft and the establishment of more RAAF Stations. In 1925, Wing Commander Richard Williams, now Chief of the Air Staff, set out in his *Memorandum Regarding the Air Defence of Australia* a case for the creation of an Air Force composed of 30 squadrons and over 300 aircraft at an annual cost of £2.5 million—a five-fold increase in the size and budget allocation of the RAAF. Unsurprisingly, Williams' ambitious proposal received little support from the Government or the other Services.

Despite AVM Wrigley's writings and concepts, the RAAF was content to be guided by the doctrine and concepts of employment of air power developed by the RAF. However, it is surprising that the *RAF Manual AP1300 Operations*, which had existed since 1928, was not considered for formal acceptance by the RAAF at this time. It was not until 1957, when the document was in its 4th edition, that it was finally adopted by the RAAF. This is indicative of the lack of emphasis placed on doctrine. Between the wars, senior RAAF officers attended the RAF Staff College in Britain and each year a proportion of the newly graduated pilots from Point Cook were offered short-service commissions with the RAF. As a result, the air defence of Australia was principally viewed in terms of the collective security of the British Empire—the RAAF expected to be called upon to dispatch expeditionary forces for service overseas in defence of the Empire and, in turn, relied on the timely arrival of Imperial forces to ensure Australia's security.

The lack of an independent air power doctrine and a national air strategy meant that, despite a rapid expansion undertaken in the late-1930s, the RAAF was ill-prepared for World War II. Aircraft acquisition was entirely dependent on what Britain was prepared to

sell to the RAAF rather than to meet Australia's strategic needs. As the possibility of another European war loomed, the Royal Air Force was also in the midst of an urgent re-armament program and reserved for itself the most modern aircraft being produced. As a consequence, the RAAF's initial contribution to the war was restricted to the supply of trained personnel.

World War II starkly exposed the RAAF's lack of independent strategic doctrine. The Air Force entered the war with obsolescent aircraft and limited understanding of the strategic doctrine to support its role in the defence of Australia. The RAAF, however, quickly rose to the challenge and operated as an independent air force in the Pacific theatre within the overall Allied air campaign. Although RAAF personnel repeatedly demonstrated their skills at the operational and tactical levels, the legacy of the RAAF's lack of strategic doctrine continued to be felt throughout World War II.

Several of the major problems encountered by Air Force during World War II, particularly in the higher command arrangements, equipment acquisition processes, and the operational roles and areas of operation assigned to the RAAF, had their origins in the pre-war strategic doctrinal vacuum. The next *Pathfinder* will explore RAAF's post-World War II doctrinal developments.

HISTORICAL FOUNDATIONS OF AUSTRALIAN AIR POWER DOCTRINE: PART II

This *Pathfinder* examines Australian air power doctrine developments from 1945-2002 and identifies lessons that can be learned for future air power doctrine iterations. As the RAAF transforms to a 21st century air force, it is critical to have an effective and flexible yet robust doctrine to support this transition. This will significantly enhance our ability to realise the intended future Air Force.

Post-World War II plans for the development of the Air Force in the defence of Australia included an

> **Key Points**
>
> - Australian air power doctrine has steadily evolved since 1990.
> - The air power doctrine development process should be robust enough to avoid ad hoc changes.
> - In some cases, there has been a tendency to cloud enduring basic philosophical doctrine with short term policy and strategy initiatives.
> - Air power doctrine should be simple and clear.

operational concept for the employment of air power that stressed air superiority as the first requirement for success. However, there were no formal doctrine publications developed. In a sign of future re-badging of another nation's air power doctrine, the Chief of Air Staff in 1945, Air Vice-Marshal Jones, forwarded an article written by the Commander, United States Army Air Force, on the future of air power to the Australian Secretary of Defence, requesting it be forwarded to the Prime Minister and Minister of Defence with a simple annotation noting its applicability to the RAAF.

While the delay in formalising doctrine was understandable between the World Wars when the fledgling RAAF was fighting for its very survival as an independent force, the inability of the RAAF to formulate doctrine post World War II is an anomaly. Although the RAAF was clearly in a state of demobilisation after 1945, there remained a core group of professionally competent officers who could

have captured and codified the valuable lessons from World War II into a distinctive Australian doctrine.

It was only in the mid 1950s that the RAAF adopted the *Royal Air Force Manual AP1300 Operations* as its first formal doctrinal reference. The AP1300 addressed the theory of war, nature and components of air power, and force enablers such as intelligence, force protection, communications, command, leadership, and morale. It served as a doctrinal basis for subsequent RAAF operations in the Malayan Emergency, the Confrontation with Indonesia and the Vietnam War.

In 1989-90, the RAAF identified the need to develop its own doctrine and produced the first edition of *AAP 1000 The Air Power Manual*. This was a major development, directed by Air Marshal Ray Funnell (the then Chief of Air Staff), who was particularly concerned with Air Force's inability to provide a sound conceptual basis for the role of air power in war.

The 1st Edition discussed the nature of air power and identified some tenets such as concurrent campaigns, unity, independence and balance as the guiding principles for the employment of air power. The document established an air power hierarchy comprising campaigns, operations, roles, tasks and missions. The apex of the hierarchy, the air campaign, comprised control of the air, air bombardment and air support for combat forces. Six supporting operations—counter air, independent strike, aerial reconnaissance, surveillance and electronic warfare, airlift, combat air support and sustainment—were identified. Air power roles supported operations through the conduct of missions and tasks. This framework was a logical way to portray the nested relationship between air campaigns, operations, and roles.

Published in 1994, the 2nd Edition was an evolutionary product. The three air campaign subsets were retained with air bombardment being renamed air strike. The six operations identified in the 1st Edition were restructured and separated into four generic air power roles—counter-air, strike and interdiction, anti-surface forces and force

enhancement— and five air power support functions (command, control, communications and intelligence, logistics, ground defence, infrastructure, and personnel and training). The hierarchical nature of air power was retained.

Produced in 1998, the 3rd Edition of AAP 1000 comprised only 57 pages (a notable decrease from the 250 plus pages in earlier editions). Like earlier editions, the 3rd Edition also focused on air power characteristics, capabilities, and roles. The edition introduced the notion of 'RAAF principles of air power' to augment the ADF principles of war. Such philosophical foundations for air power doctrine had not been stressed in earlier editions. The 3rd edition also introduced the three levels of air power doctrine that effectively mapped to the three levels of war: strategic, operational and tactical. The document noted that AAP 1000 presented strategic air power doctrine. Such changes reflected attempts to align to broader changes in the ADF such as the formation of Headquarters Australian Theatre in 1996.

Entitled the *Fundamentals of Australian Aerospace Power* and published in 2002, the 4th Edition was significantly re-formatted, integrating historical vignettes in an attempt to provide a more readable publication. There was recognition that air power doctrine should be understood by all Air Force personnel. The title '*Australian Aerospace*' reflects a more expanded purpose in providing doctrine for the broader ADF rather than just Air Force. A significant change was the embracing of the term **aerospace power** as distinct to **air power**. The change in terminology reflected a brief period in which the RAAF, like the USAF, appeared to be somewhat captured by the term aerospace. Significantly, the 4th Edition does not acknowledge the change of term or note the difference between air power and aerospace power. In some respects, the introduction of the term aerospace could be seen as a return to rebadging doctrine without critical analysis, as had been evident prior to 1990.

The heart of the 4th Edition was the traditional discussion of aerospace (read air power) characteristics, aerospace power capabilities

and roles and tasks. The air power hierarchy that was integral to earlier editions was changed. The notion of air campaigns as the apex of the hierarchy was discarded. Instead, four aerospace capabilities—offensive combat, rapid mobility, flexible combat support and surveillance and battlespace management—were identified as the strategic framework for Air Force capability management. The initiative was unusual as it was the first time a 'raise, train and sustain' capability aspect was integrated into air power doctrine. Although the air power roles were retained as the key to support operations, the number of roles performed by the Air Force increased from 10 to 26! Interestingly, counter-air, the term that replaced 'control of the air' as an air power role was positioned uncomfortably within the offensive combat capability.

An examination of air power doctrine development since World War II reveals the process to have been robust and evolutionary since 1990. Although there has been an enduring understanding of air power characteristics and roles in all AAP 1000 editions, a tendency to incorporate changes that on hindsight reflect doctrinal misunderstanding can be seen. The attempt to replace air power campaigns with capabilities and the abrupt change of terminology to **aerospace** are examples. In some respects, such changes have reflected external influences and a tendency to cloud basic and enduring air power doctrine with policy and strategy aspects. Further, there has been a noticeable trend in increasing the number of air power roles. Noting that air power roles should be enduring core functions, there is value in maintaining the number of recognised air power roles to a minimum. The next generation air power doctrine should therefore be developed with a focus on the enduring aspects of strategic air power doctrine.

The second oldest air force

The claim has been made for many years that when the RAAF was formed, exactly three years after Britain's Royal Air Force, it became the second independent air force in the world. Similar claims have been made by other countries which were active in military aviation in the same period, most notably Canada and South Africa—both former British Dominions like Australia. So what is the basis for the RAAF claim, and what is its validity in comparison to other contenders for the title of the second oldest air force?

An "air force" is defined, arguably, by something more than the operation of a single aircraft—which is the

> **Key Points**
>
> - After the RAF formed on 1 April 1918, the RAAF became the next truly separate and autonomous air force when it was established on 31 March 1921.
> - Among Britain's other Dominions, South Africa reached a comparable point on 1 February 1923 and Canada on 1 April 1924 —and even then both remained strongly subordinate to the Army for some time.
> - The basis on which the RAAF was originally constituted survived virtually unaltered for more than half a century.

basis on which Finland celebrates the start of the 'Finnish Aviation Force' as predating the RAF by 25 days! (The Finnish Air Force itself only came into formal existence on 4 May 1928.) It also requires that an air service has its own administrative structure and independent identity, rather than function simply as an adjunct of a standing army or navy. It was the autonomy of the RAF following its formation on 1 April 1918 that made it the world's first air force.

The event which prompted the rash of "air forces" immediately after World War I was the offer by Britain in June 1919 to give 100 war surplus aircraft free to any of its Dominions that wished to set up their own air force. The offer of this 'Imperial Gift' was accepted by all five dominion governments, but in two cases the result fell short

of emulating the RAF example. India, for example, used its aircraft for mainly civil purposes and relied solely on RAF squadrons until April 1933. New Zealand accepted only a third of its quota, and initially released most of these to civilian operators. The air service that began in New Zealand in 1923 remained under Army control, with separation finally achieved only in April 1937.

Australia's claim to be the first dominion with a true air force rests on the fact that the body it brought into being on 31 March 1921 was conspicuously separate from either the Army or Navy, even though it initially lacked separate legislative provisions. An Air Defence Bill to give formal recognition to the new 'Australian Air Force' (the Royal prefix did not follow until 13 August 1921) was introduced into Parliament on 8 April, but in the event there was no Air Force Act until September 1923.

The RAAF's actual status was demonstrated by the administrative arrangements which accompanied its establishment. Control was exercised by an Air Board of Administration that had direct parallels with the Naval and Military Boards controlling Australia's Navy and Army. From October 1922 Wing Commander Richard Williams headed the Air Board as 'Chief of the Air Staff', the equivalent in title to the uniformed heads of the Navy and Army. The Air Board had, in fact, been formed in November 1920, in clear anticipation that the new service would shortly supersede the Army's interim 'Australian Air Corps' which was maintaining Point Cook airbase and taking receipt of consignments of the Imperial Gift as these arrived in Melbourne from March 1920.

That the new Air Force was different to the Australian Air Corps (AAC) was obvious because separate recruiting for the RAAF had been conducted across Australia during March 1921, and many of the 149 personnel on strength on Day 1 had no previous connection with the AAC. Further, immediately on the RAAF's formation the new service adopted the rank titles of the RAF in place of the AAC's Army ones. In virtually every respect, the RAAF emerged on its

formation as a new and entirely separate organisation from what had existed before.

The South African Air Force (SAAF) dates its beginning from 1 February 1920, when Lieutenant Colonel H.A. ("Pierre") van Ryneveld was given temporary rank of Colonel and appointed Director of Air Services while tasked with setting up an air force from the Imperial Gift aircraft. In fact, Ryneveld's appointment occurred in June 1920 and was backdated to February, and the simple act of appointment did not instantly put him at the head of a viable flying service. The organisation Ryneveld was appointed to lead did not boast even a Flight until 26 April 1921. The title 'South African Air Force' was not used officially until 1 February 1923 when the SAAF was listed under the Union's reconstituted Defence Act as one of the corps of the Permanent Force. Even then Ryneveld did not stand outside the Army organisation, as demonstrated by his later appointments as commander of Army troops near Pretoria and commandant of the Military College, and even Chief of the General Staff—all while still running the Air Force!

In Canada's case the story is more problematic. A Canadian Air Force had been set up between February and April 1920 to supersede Army and Navy air services formed in the last months of World War I, but the new service was only a non-permanent body (that is, along militia lines) that existed mainly as a training facility for civil aviation operations. Although regarded by some as a 'travesty of a force', it nonetheless had a small staff of instructors and mechanics at Camp Borden and a sketchy headquarters in Ottawa. It also boasted an Air Vice-Marshal as Inspector-General (actually a retired British major-general) and an Air Commodore as first AOC (serving under the Army's Chief of the General Staff).

A new government elected in December 1921 jettisoned this organisation and Canada's air militia ceased to exist. The Air Board which had functioned since late 1919 disappeared into a Department of National Defence, and although the permanent cadre achieved recognition as the 'Royal' Canadian Air Force on 15 February 1923,

it took another year before Canada's real air force took shape. On 31 March 1924 the RCAF's 263 airmen were automatically discharged and required to join a new permanent Air Force; those who declined were replaced next day by new enlistments. On 1 April, the revamped RCAF also took the step of adopting the RAF Ensign, motto, uniforms and rank structure of the British service as its own. Even then, administrative control of the RCAF remained with Canadian Army officials until November 1938.

On the available evidence, it seems clear that the RAAF was formed in the strongest shape as a separate, autonomous air force organisation. What is equally interesting is that it broadly retained the administrative form with which it began for the next 55 years.

Who was the father of the RAAF

When Air Marshal Sir Richard Williams died in February 1980 at the age of 89, his passing was hailed as the 'end of an era' for the Air Force and many commentators referred to him as the 'Father of the RAAF'. This was not the first time this appellation had been applied to him, as it was recorded in the jacket blurb of his autobiography *These are facts*, published in 1977, that he was 'widely known' as such even then. In one sense this was ironic, because although twice married Williams never left any children of his own. Use of the title, however, gave clear recognition to a popular view that Williams had both brought the Air Force into being and provided strong parental guardianship and guidance during its early years.

Key Points

- Although widely known as 'Father of the RAAF' during the 1970s, AIRMSHL Sir Richard Williams was not the first person accorded the title.
- GPCAPT Eric Harrison was first recorded as being known as such in 1962, after an association with military aviation in Australia even longer than Williams.
- A third contender was Major H.A. Petre, whose appointment to flying duties in Australia preceded Harrison's but only lasted two years.

Over his 25-year career in the RAAF (1921-46) Williams had indeed been among its leading figures, though not always to the extent depicted in his autobiography, or as was sometimes claimed for him by others. For instance, there is no evidence that he had been formally selected to lead the Service upon its formation in March 1921. In fact, when the Board that was to run the new Air Force was first constituted in November 1920, Williams was but one of two uniformed officers appointed to its membership—both with equal rank and identical authority.

For the first two years of the Air Board's existence, Wing Commander Williams shared the management of the Service with Wing Commander S.J. Goble—Williams as Director of Intelligence &

Organisation, Goble as Director of Personnel & Training. Not until 2 October 1922 was the appointment of Chief of the Air Staff (CAS) brought into existence, which Williams technically held for the next 17 years. Even his accession to the prestigious CAS title, however, was matched by Goble's appointment at the same time as Chief of the Administrative Staff—a post which endured until December 1927. Moreover, two months after Williams became CAS he relinquished the chair to Goble to proceed overseas for the next 26 months; Goble also filled in for Williams for another 18-month period in 1932-34. It was, therefore, never the case that Williams had sole parental custody of the Air Force, or alone fought the 'turf wars' which the infant RAAF faced within the Defence family until World War II.

Also muddying the waters when weighing the validity of the 'Father of the RAAF' title is the fact that Williams was not the first person to whom it was applied. When Douglas Gillison wrote the air volume in the Official History series on Australia in World War II titled *Royal Australian Air Force 1939-1942* (published in 1962), he revealed that the 'Father' title had initially been accorded to Eric Harrison (1886-1945), one of the two pilots employed by the Australian Government to establish the first military flying school before World War I. It was not the question of whether the appellation properly belonged to Harrison or Williams that concerned Gillison, but rather that the other pilot appointed in 1912—this being Henry Aloysius Petre (1884-1962)—had equal entitlement to it.

Gillison appears to have had no special reason for discounting or ignoring any claims that Williams might have had to the title, apart from the fact that he was writing before Williams attained 'Grand Old Man' status in Air Force circles. He was a journalist who served in the RAAF in 1942-45, performing duty at various times as public relations officer (PRO) in New Guinea and London. After returning to civilian life after the war, he served as PRO in the Department of Civil Aviation 1953-59—which, perhaps significantly, Williams then ran as Director-General. In any event, Gillison was regarded as Australia's foremost aviation correspondent at the time that he wrote

his volume of the Official History, and can be adjudged to have thoroughly understood his subject.

For Gillison, the issue that mattered most appears to have been the different relative legacies that Australia's first two military aviators bequeathed to the Air Force. Petre had been appointed, along with a second pilot, in July 1912 to start up the Australian Government's military flying school, but when the second man withdrew his application in October, it was Harrison who was then appointed to fill the vacancy on 16 December. Unlike Petre, who was English-born with no Australian connection, Harrison was an Australian who had gone to England in March 1911 expressly to learn to fly. Having achieved that goal, he found employment with the Bristol Aircraft Co. as a flying instructor and was still with that company when he applied for the Defence job back in Australia.

Petre, it seems, arrived first in Australia during January 1913—in time to persuade the Defence authorities to change the proposed site of the new flying school from Canberra to Point Cook, Victoria, because of concerns over the terrain height of the national capital site. Harrison joined him at the new location in January 1914 and helped to set up the school. On 1 March Harrison made the first flight from Point Cook in a Bristol Box-kite. He was the principal instructor of the eight wartime flying courses conducted there after World War I broke out in August. Among the students he taught on the very first course was Lieutenant Richard Williams, who became the first to qualify as a pilot under his instruction.

Although Harrison was in charge of a small air detachment sent to New Guinea in September 1914, his party was back in Melbourne the following January without having even taken their aircraft out of their crates, and he stayed at Point Cook for the rest of the war. Petre, on the other hand, took the Half-Flight of the Australian Flying Corps on flying operations in Mesopotamia during 1915 and did not come back to Australia for the rest of the war. In fact, he only returned to Australia half a century later, when in retirement.

Promoted to Major in June 1917, Harrison went to England at the end of the war, after training commitments at Point Cook had undergone severe reduction, on attachment to Britain's Aeronautical Inspection Directorate. On the formation of the RAAF he transferred to the new service in the rank of Squadron Leader but stayed in England as liaison officer with the Air Ministry in London until 1925. When he finally returned to Australia he became assistant director of RAAF technical services until July 1928, when he was promoted director with rank of Wing Commander. His duties included membership of the Air Accident Investigation Committee, which probed the causes of accidents around Australia, and also the inspection of RAAF equipment. In January 1935 he was promoted to Group Captain.

Two years later Harrison visited Britain to study accident investigation procedures and aircraft production methods. He retired in March 1938 but continued on as director of aeronautical inspection in a civilian capacity, including during World War II when his technical staff had increased to over 1200 personnel. The strain of his position very likely contributed his death on 5 September 1945 from hypertensive cerebro-vascular disease. Although his impact in guiding the course of the RAAF had been very different to that provided by Williams, it is at least understandable why the first generation of Air Force personnel might have come to view him, rather than Williams, as the real 'Father' of the Service.

BATTLE OF BRITAIN AIR CAMPAIGN: THE AUSTRALIAN EXPERIENCE

The Battle of Britain, fought between July and October 1940, is one of the most famous air campaigns ever conducted—so famous, in fact, that it is still commemorated annually in parts of Australia, not least because of the involvement of Australians in what is widely seen as a defining moment in British history. According to accounts

> **Key Points**
> - An air campaign is the controlled conduct of a series of interrelated air operations to achieve specified objectives.
> - The potential scale of an air campaign often makes it the most pervasive in a theatre of operations.

published in Britain, there were 21 Australian fighter pilots who took part, and of these 14 were killed in action. There has long been a problem with this statistic, however, because the Roll of Honour at Westminster Abbey records the names of 24 Australians who were killed during the period of the battle. The discrepancy stems from a misunderstanding of what the Battle of Britain was, and what the air campaign that it represented actually entailed.

Although the battle is often perceived as a simple, classic struggle for air superiority, in fact the Royal Air Force (RAF) at the time was engaged in a much broader campaign aimed at disrupting German preparations for an invasion of the British homeland. Accordingly, it was the whole of the RAF—including Bomber and Coastal Command, not just Fighter Command—that contributed to the ultimate victory in what was, quite literally, a battle for Britain's survival. Because of this, when calculating the number of deaths suffered in the conflict it is necessary to include aircrew who perished in circumstances involving other than fighter combat alone.

The number of Australians serving across the RAF at the start of the battle is believed to be probably no more than about 450. Within this group, the number who wore RAAF uniform would have been

very small indeed at that stage of World War II, as Australia had only a single squadron based in England. This was the RAAF's No 10 Squadron, which in July 1939 had sent personnel to take delivery of new Sunderland flying boats and was subsequently ordered to stay and serve alongside the RAF after war was declared. It remained the only truly RAAF unit to operate from Britain until the war in Europe ended.

Many of the Australians serving with the RAF, including some who wore RAAF uniform, did so courtesy of a pre-war scheme by which a regular number of pilots for the RAF were trained by the RAAF at its flying school at Point Cook, Victoria. Under this arrangement, initially up to ten graduates from Point Cook courses (and later more) were sent to England on Short Service Commissions from November 1926, until July 1938 when the RAAF decided that it needed all the pilots it trained to meet its own expansion goals under rearmament plans. Although the intent behind the scheme was to create a reserve pool for the RAAF of trained pilots who would return to Australia after four or five years with the RAF, within a short period the question arose of allowing Australian pilots to pursue permanent careers in the RAF. As a result, no fewer than 149 RAAF-trained pilots had made the transfer by the time the scheme was suspended.

At the same time that this scheme operated, the RAF also recruited directly for trainee pilots from Australia. Although the RAAF assisted in running selection boards for applicants, the men accepted had mostly not received prior flying training—either at Point Cook or, in some cases, at all. Nonetheless, it was the products of these two schemes who represented the core of the group of pilots still described as "Australian" during the Battle of Britain. The rest were Australians who directly joined the RAF while working or studying in Britain. In consequence, it also appears that there may have been as many as 29 Australians among the 1495 Fighter Command pilots who defended Britain during the period of the battle.

The employment of the Australian pilots and the nature of the RAF's air campaign is typified by the operations undertaken on 13 August.

On this day the Luftwaffe launched '*Adler Tag*' (Eagle Day), involving massive and continuous raids intended to destroy Fighter Command on the ground and in the air. Approximately 15 Australian pilots flying in Fighter Command scrambled with their squadrons across Britain in response to these raids, aimed mainly at the RAF's fighter stations. Throughout the day the Spitfire and Hurricane pilots, guided by radar-directed ground controllers, intercepted raids emanating from Norway, Denmark, Belgium and France. Overall, the day was a disaster for the Luftwaffe, which lost 46 aircraft while destroying only 13 of the RAF's precious fighters. Among the RAF's casualties for the day was an Australian, Flying Officer Richard Glyde of No 87 Squadron, who was lost after intercepting a Junkers Ju 88 bomber.

While Fighter Command was fighting off the German onslaught, Bomber Command was taking the fight to the enemy, striking targets in Germany and, for the first time, in Italy. Also flying missions on 13 August were two Australian pilots, Flight Lieutenant Allen Mulligan and Flying Officer Ellis Ross, operating Handley Page Hampden bombers of No 83 Squadron. These two officers were part of a highly successful attack on the Dortmund-Ems Canal that severed a vital transport route between the Ruhr industrial hub and the North Sea. Both Australians were shot down, with Ross killed and Mulligan being captured. Ross was one of five Australians killed with Bomber Command during the battle, while Mulligan was one of 6 who became prisoners in the same period, out of 47 Australians reportedly serving on RAF bombers.

Bomber Command also conducted attacks on the German invasion fleet that was being assembled in ports along the Channel. By late September 1940, combined attacks had resulted in the destruction of 241 troop transports, barges and tugs. These attacks were not without cost in aircrew and machines. One such casualty was Australian pilot Flight Lieutenant Frederick Flood of No 235 Squadron, killed while escorting an attack on Calais Harbour. The effect of the attacks on the invasion fleet was to reinforce the German belief that no invasion

could be mounted while the RAF and the Royal Navy were still operational.

No 10 Squadron, RAAF, flew a considerable number of missions in support of Coastal Command's war effort even before the Battle of Britain was fought. Its main task was securing the western approaches to Britain in order to protect shipping. On 1 July 1940 the crew of Sunderland P9603 was credited with the unit's first confirmed U-boat "kill", and throughout the Battle of Britain the squadron continued to fly long, arduous sorties, conducting search and rescue missions, convoy escorts and anti-submarine patrols. Apart from No 10 Squadron, another 26 Australians flew with Coastal Command, and of these eight were killed.

Ultimately, the effectiveness of the RAF's air campaign proved greater than Germany's ability to mount an invasion of Britain. By 12 October 1940 the German High Command decided that further preparations for the invasion of Britain were futile. The RAF was still intact, large convoys of ships were still reaching English harbours and the Royal Navy, safe behind a screen of air power, was poised and ready to destroy any invasion fleet that attempted to cross the English Channel. By the time that Germany's Nazi dictator, Adolf Hitler, announced five days later that the invasion was definitely postponed, indefinitely, it was clear that the Battle of Britain had been won.

Empire Air Training Scheme: raise, train and sustain during World War II

During World War II, 37 000 Australians were enlisted into the Royal Australian Air Force (RAAF) as part of the Empire Air Training Scheme (EATS). The participation of Australia in this scheme—along with Canada, New Zealand and Rhodesia—made a substantial impact on the conduct of the air war in Europe and it remains a truly unique episode in the conduct of coalition warfare. The scheme was the RAAF's principal wartime activity up until the entry of Japan

Key Points

- This year marks the 70th anniversary of the commencement of EATS training in Australia.

- The enormous raise, train and sustain organisation established under EATS enabled the RAAF to rapidly expand Australia's air power to counter the threat from Japan.

- EATS represents a unique chapter in the conduct of coalition warfare.

into the war in December 1941. Furthermore, it established within Australia the raise, train and sustain facilities that enabled the rapid expansion of the RAAF during the early years of the war and that were subsequently crucial to the Air Force's ability to meet the Japanese threat in the Pacific.

On 29 April 1940 the first Australian EATS trainees were inducted into the RAAF at No 1 Initial Training School (ITS) at Somers, Victoria. They, and the thousands of men that followed, then passed on to elementary and service flying schools, or other specialised training schools in Australia and Canada, before going on to Europe for service with the Royal Air Force (RAF). Of the Australian EATS graduates, 13 000 served in RAF Bomber Command's strategic air offensive against Germany and Italy. Of these, 3486 lost their lives in skies over Europe—more than half of the total of all RAAF personnel killed in action, and almost 20 per cent of all Australian combat deaths in World War II.

At the outbreak of war, it was by no means clear that Australia's principal contribution to the war in Europe would be through the provision of trained aircrew to the RAF. Based on the experience of World War I, senior RAAF officers had always assumed that another general European war would require the raising of a contingent for service overseas—the same assumption that informed Australian army planning. In September 1939, the acting Chief of the Air Staff, Air Vice-Marshal S.J. (Jim) Goble, submitted a plan to the War Cabinet for the dispatch of an air expeditionary force composed of six squadrons and supporting units totalling 3200 personnel.

The RAAF's plan, however, was overtaken by events when the British government proposed that the Dominion air forces jointly contribute instead to a massive pool of trained aircrews for service with the RAF. On 5 October, the War Cabinet—without reference to the Air Board—agreed to the British proposal. Although the government stated that it remained committed to sending an air expeditionary force, Australia lacked trained personnel to implement both schemes. Australia also lacked suitable modern combat aircraft for the expeditionary force and the six squadrons would have to be equipped by the RAF on arrival in Britain.

The immediate dispatch of 3200 officers and airmen, from a force that consisted of 3489 all ranks at the outbreak of the war, meant that any air contingent would have involved sending almost the entire standing RAAF overseas. This would have left little capacity in Australia for raising and training the men required to expand the Air Force for home defence, or provide additional squadrons for what was expected to be a long war in Europe. Furthermore, the lack of a mature aircraft industry meant that Australia was unlikely to be able to do much more than provide trained personnel in the short term. On 31 October 1939, it was officially announced that the air expeditionary force had been put on hold; ultimately, it was never implemented. Although Australia did contribute three formed squadrons to the war in Europe and around the Mediterranean, these units were never brought together as an Australian air contingent.

In principle, Article XV of the EATS agreement had addressed the Dominions' primary concern for preserving distinctive national identity of the men being sent to serve in the war, by mandating the formation of nationally coherent squadrons within the RAF. In all, there were 17 Article XV "RAAF" squadrons—Nos 450-464 and 466-467. Four of these units served in Fighter Command, seven in Bomber Command, and one in Coastal Command; five were formed in the Middle East. Later in the war, two of the squadrons were sent from Britain to Australia for service in the war against Japan.

There were many shortcomings to the arrangement that was arrived at. The fact that RAAF personnel were dispersed throughout the RAF (more served in some 200 different squadrons than within the designated national units under Article XV) meant that it remained hard to discern anything that was unique or special to the RAAF contribution. Moreover, few Australian airmen got to exercise command beyond the squadron level, and neither the Australian government nor the RAAF's Overseas Headquarters in London had any say in the strategic direction of the air campaign or employment of Australian airmen serving with RAF squadrons.

Despite its limitations, EATS was a remarkable accomplishment and undoubtedly represented the most practical and substantial contribution the RAAF could make in the early years of the war. Under the auspices of the scheme the RAAF was rapidly transformed into an enormous organisation for raising and training aircrews. Some 36 schools were established across Australia, covering not just flying training but navigation, observation, bombing, gunnery and wireless work as well. These schools were established at airfields in every state and became crucial in enabling the RAAF to rapidly expand to a peak strength of 182 000 by mid-1944. Coincidentally, many of today's RAAF Bases and Australia's regional airports had their origins as EATS training facilities.

The global and multi-national character of EATS also remains a remarkable feat in the annals of coalition warfare. In addition to Australia's contribution, during the course of the war the other

participating Dominions supplied another 140 000 trained airmen to the RAF. The scheme's facilities in Canada were also used to provide training to over 40 000 British aircrew trainees as well as aircrews from several other Commonwealth nations and émigrés from the nations of occupied Europe. The final outcome was a formidable marshalling of air power resources that made an invaluable contribution to the Allied victory in World War II.

No 460 Squadron:
strikes and returns

From 1 July 2010, Air Force elements within the Defence Imagery and Geospatial Organisation (DIGO) will be formed into No 460 Squadron—the new unit will be an Air Intelligence Squadron and will form part of Air Force's Information Warfare Wing, alongside No 87 Squadron, No 462 Squadron, Joint Electronic Warfare Operational Support Unit and the RAAF Aeronautical Information Service. No 460 Squadron's roles will include the provision of target intelligence to the wider air targeting process and support to military operations. During World War II, No 460 Squadron flew bombing missions in the night skies over Germany and occupied Europe—the most dangerous and demanding of all the Allied theatres of war—where it established a reputation for courage and excellence second to none. Thus there are very clear links between the old No 460 Squadron as a heavy bomber unit and the new No 460 Squadron as a targeting unit. The decision by the Chief of Air Force, Air Marshal Mark Binskin AO, to reconstitute this squadron will open a new chapter in the service of one of the Air Force's most renowned combat units.

No 460 Squadron was first formed in England on 15 November 1941 under the auspices of Article XV of the Empire Air Training Scheme (EATS) agreement between Great Britain and the Dominions (see *Pathfinder* 132, page 103). No 460 Squadron was one of seven 'RAAF' heavy bomber squadrons that served with RAF

Key Points

- No 460 Squadron played an important part in the strategic bombing campaign against Nazi Germany—dropping the highest tonnage of bombs in RAAF Bomber Command.

- The squadron was the most decorated Australian unit of World War II.

- No 460 Squadron suffered the highest casualty rate of any unit in the entire history of the RAAF.

Bomber Command during the strategic bombing campaign against the Axis powers in Europe. Despite the squadron's designation as a RAAF unit, its Australian members served alongside men from across the British Commonwealth throughout the war. Initially equipped with Vickers Wellington medium bombers, the squadron was briefly assigned to No 8 Group of RAF Bomber Command, before moving to No 1 Group in January 1942.

Following four months of intensive training, five aircraft were assigned to the squadron's first operation on 12 March 1942 against the city of Emden. Bad weather impeded the effectiveness of the bombing, but all the squadron's Wellington bombers and their crews returned safely. The squadron's first major raid was on 30 May, when 18 aircraft and crews participated in an attack on Cologne. This was the very first of RAF Bomber Command's 1000 bomber raids and it marked a significant milestone in the intensification of the strategic bombing campaign against Germany.

In September 1942 the squadron was withdrawn from combat operations for conversion onto the aircraft with which it is most famously associated—the Avro Lancaster. The four-engined Lancaster heavy bomber was larger (increasing the crew compliment from six to seven), could carry a greater payload, and had a far longer range. The new aircraft also meant a redesignation from a medium to a heavy bomber squadron and increased the scope of the missions the squadron would be called upon to perform.

In March 1943, the squadron participated in the Battle of the Ruhr—attacking targets in Germany's industrial heartland. The crews of RAF Bomber Command referred to the Ruhr Valley as 'Happy Valley' due to the intense anti-aircraft fire and large number of German night fighters. The squadron flew on 46 nights, making 597 bombing sorties, and a further 20 on mine laying operations. The intensity of operations came at a considerable cost with the loss of 29 aircraft and their crews.

RAF Bomber Command then turned its attention to targets deeper inside enemy territory—conducting raids on Berlin and Hanover, and other cities in Germany, Czechoslovakia and Italy. At the conclusion of this offensive in October 1943, the squadron had flown missions on 28 nights for the loss of 18 aircraft and crews. It was at this stage of the war that No 460 Squadron earned the distinction of being the first squadron in the RAF to fly 1000 sorties in the Lancaster.

Between November 1943 and March 1944, Bomber Command launched a major campaign against the capital of Nazi Germany. During the Battle of Berlin, No 460 Squadron flew more sorties than any other squadron in RAF Bomber Command. On 22 March, the squadron dropped 131 tons of bombs on Frankfurt, a record for the highest tonnage of bombs dropped in one day. The ferocity of the German air defences over Berlin imposed a high toll on the squadrons of RAF Bomber Command—No 460 Squadron lost a total of 36 aircraft and their crews during the course of the battle.

As part of the preparations for the Allied invasion of mainland Europe in mid-1944, RAF Bomber Command turned its attention to Occupied France. No 460 Squadron conducted attacks against rail lines, marshalling yards, coastal defences and German troop concentrations. No 460 Squadron also played a role in the direct support of the land battle following the D-Day landings, bombing German defences and troop formations throughout Normandy. As the Allies pushed the Germans back across France, No 460 Squadron continued to bomb German positions and during the month of August it dropped a total 1867 tons of bombs—a record for No 1 Group.

From October 1944 until the end of war, the squadron returned to bombing raids on German cities. On 7 March 1945, the squadron became the first to fly 5000 sorties. The squadron's last attack was on Adolf Hitler's private retreat at Berchtesgaden in south-eastern Germany on 25 April—ANZAC Day.

In the final days of the war, the squadron was involved in Operation MANNA, a food drop to hungry Dutch citizens. The squadron's first humanitarian flight occurred on 1 May and involved 19 unarmed Lancasters. German troops still occupied the Netherlands, and although both sides were instructed not to fire upon each other, several aircraft returned to base with bullet holes from small arms fire. It is estimated that Operation MANNA saved over 1000 people a day from starvation. The squadron's last operation in the war was returning allied POWs to Britain as part of Operations EXODUS and DODGE. Between 28 April and 16 September 1945, the Squadron returned 1404 Allied servicemen from POW camps in Belgium and Italy.

By the end of the war, No 460 Squadron had flown 6264 operational sorties totalling 30 526 operational flying hours, and had dropped 24 856 tons of bombs, the most of any unit in RAF Bomber Command. Members of the squadron were awarded nine DSOs, 228 DFCs (including 14 Bars), one GCM, 101 DFMs and one DCM. During the course of the war the squadron lost 1018 aircrew (589 of whom were Australian) and had 181 aircraft destroyed.

The RAAF in the Syrian campaign, 1941: Operation *Exporter*

One of the lesser known campaigns of World War II was the Allied invasion of Syria in 1941. The enemy in this campaign was not the Germans or the Italians, but French troops loyal to the Vichy regime of Marshal Pétain. Australians played a major role in this campaign and the RAAF ably demonstrated the versatility and flexibility of air power. The Syrian campaign also presents a useful case study for contrasting different doctrinal approaches to air warfare.

Key Points

- Australian airmen, soldiers, and sailors played a central role in the Syrian campaign.

- Control of the air is the prerequisite for the conduct of all operations to achieve campaign objectives.

- Aircraft are most vulnerable on the ground, and protection of air bases by air and ground forces is essential for air power operations.

In May 1941, the increasingly collaborative Vichy regime had allowed German and Italian aircraft to use airfields in the French mandated territory of Syria to support an anti-British coup d'état in neighbouring Iraq that threatened Britain's access to vital oil supplies. Charles de Gaulle, the leader of the Free French forces, urged Churchill to occupy Syria and confidently predicted that Vichy troops would put up only token resistance.

General Archibald Wavell, Commander-in-Chief Middle East, had few troops to spare for another campaign. Only the Australian 7th Division, the 5th Indian Brigade and six Free French battalions were initially available for operations in Syria. Air Marshal Arthur Tedder, Air Officer Commanding-in-Chief RAF Middle East Command, was equally hard-pressed to find aircraft for the campaign. Immediately on hand were the P-40 Tomahawks of No 3 Squadron, RAAF, at RAF Station Aqir in British Palestine. They joined two RAF Hurricane squadrons and two RAF Blenheim light bomber squadrons for the

operation against Syria. The French had approximately 100 aircraft in Syria and during the course of the campaign the size and quality of the Vichy air force was substantially increased by reinforcements from French North Africa—including modern Dewoitine D.520 fighters and Glenn-Martin 167F (Maryland) light bombers.
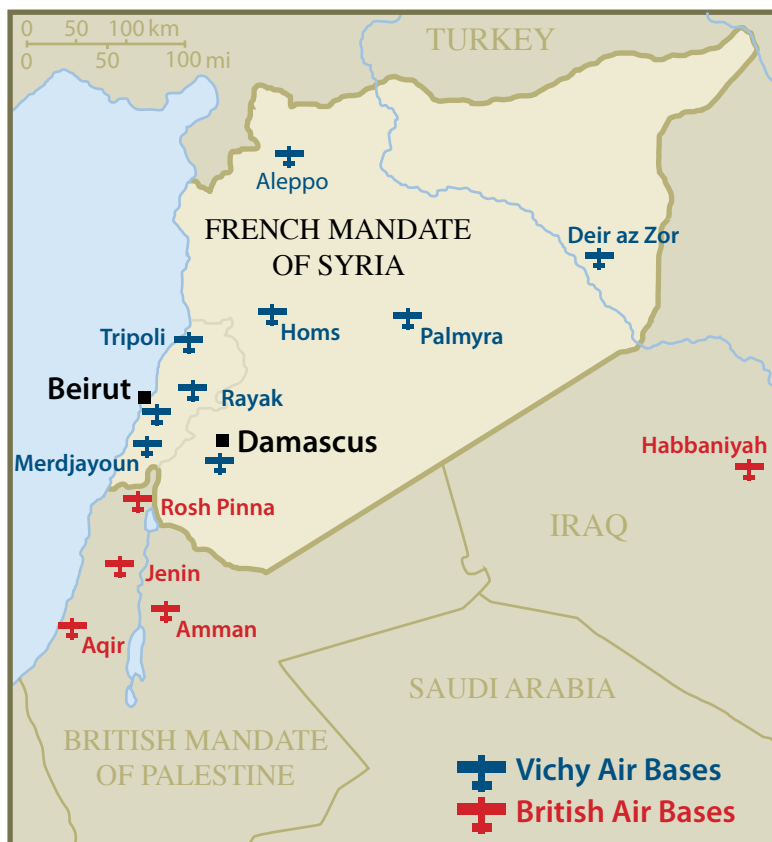
The Allied invasion, Operation *Exporter*, commenced on 8 June 1941 and any hope that the Vichy French would not fight were quickly dispelled. The Vichy troops fought with considerable determination and skill. The Vichy air force, however, lacked adequate anti-aircraft

defences for its airfields and its squadrons did not have the resources to match the high tempo of Allied air operations. On the very first day of the campaign, No 3 Squadron was in action attacking the principal Vichy air base at Rayak and escorting bombers during strikes on oil storage facilities in Beirut. No 3 Squadron engaged in a wide spectrum of air power missions during the campaign: from the conventional army co-operation roles of reconnaissance and close air support, through to counter-air operations (attacking enemy airfields and providing fighter escorts for Allied bombers and warships) and interdiction and counter-sea missions (striking enemy supply depots, road convoys, shipping and ports).

Towards the end of June, the Allies transferred additional squadrons to Syria and two more RAAF elements joined the fight. The ground crews from No 450 Squadron, RAAF—temporarily without their aircraft and aircrews—serviced the Hurricanes of No 260 Squadron, RAF, and members of No 9 Squadron, RAAF, saw action operating the Walrus seaplane embarked in HMAS *Perth*.

Above all, the Allies benefitted from a robust doctrinal approach to the application of air power that was developing within RAF Middle East Command. All the Allied squadrons were under the unified command of Air Commodore Leslie Brown, Air Officer Commanding Palestine and Transjordan. This centralised control granted Brown the flexibility to concentrate his forces at a time and place of his choosing and the ability to prioritise counter-air operations. Throughout the campaign, Allied squadrons carried out sustained attacks on Vichy airfields that destroyed over 60 aircraft on the ground and forced the French to evacuate their main airfields in the south. Obtaining and maintaining control of the air then enabled Air Commodore Brown to use his limited air assets to directly support surface operations. In early July, the use of captured airfields brought the last major Vichy aerodrome at Aleppo in the far north within range of Allied fighters. The destruction of the French air force was quickly followed by the capitulation of all Vichy forces in Syria.

In contrast, the French parceled out their air power for close air support and counter-sea missions under the direct control of army and naval commanders. Determined and repeated attacks by Vichy fighters and bombers were an important factor in French ground forces halting the initial Allied offensive. But, by dividing their air power, the French lost the ability to concentrate their forces and aggressively contest control of the air. As a result, the Allied fighters inflicted heavy and unsustainable losses on the French air force. On 28 June, nine Tomahawks from No 3 Squadron encountered six Glenn-Martin 167Fs attacking Allied ground forces south of Palmyra and shot them all down without loss—a single action that cost the Vichy air force half of its most modern bomber type in Syria. A further 30 French aircraft were destroyed in the air, for the loss of just 11 Allied planes. No 3 Squadron lost only one aircraft during the whole campaign. This occurred over Homs on 11 July when a Dewoitine fighter shot down Flying Officer Frank Fischer, who managed to crash-land unhurt. The Vichy fighter was immediately destroyed by Flying Officer Bobby Gibbes, the first victory for this distinguished officer who went on to become the squadron's Commanding Officer and one of Australia's leading fighter aces.

On 10 July, the Vichy commanders sought an armistice. When the fighting ceased two days later, the Allies had sustained over 4,000 casualties, including 416 Australians killed and 1,136 wounded. The Vichy air force, despite flying over 3,000 sorties in the five-week campaign, had been defeated by a smaller, but better armed and much better led opponent. Air Marshal Tedder was to further develop and apply the air power lessons learned in Syria during the hard-fought campaigns in North Africa and the Mediterranean over the next two years and, subsequently, across the English Channel for the liberation of France itself.

THE RAAF IN THE BURMA CAMPAIGN

The Burma Campaign of World War II was one of the largest and longest campaigns of the war, yet it is also one of the least known in historical terms. That a significant number of Australian airmen fought in this area has also largely escaped public attention, so that the contribution of these men of the Royal Australian Air Force to the ultimate defeat of Japan is now barely remembered.

In part, the problem stems from the secondary status accorded to the strategic objectives underpinning the operations undertaken in Burma. When Japanese forces invaded Burma in December 1941, their goal was not to seize vital natural resources but merely to secure the flank of more important operations underway in Malaya, while also severing the overland lines of communications across Burma which the Allies used to support the Chinese Nationalists resisting Japanese occupation in northern China. For the next two years Japanese forces were content to occupy central and southern Burma essentially for the disruption and complication this posed for the Allies.

> ## Key Points
>
> - Over 1000 members of the RAAF served on the India-Burma front in World War II, spread among more than 60 RAF squadrons
>
> - No formed RAAF squadrons were committed to the Burma Campaign, but some RAF units were heavily Australian in composition
>
> - Because Australian airmen were not concentrated in a few squadrons, there was a significant loss of heritage to the RAAF

Not until March 1944 did the Japanese launch a concerted effort to drive the British out of the rest of Burma, and pose a direct threat to British control of India with attacks against Assam. The battles of Imphal and Kohima have been described as the 'Stalingrad of the East', due to the close-quarter fighting that took place during the four-month siege, and the decisive nature of the defeat inflicted on the Japanese. Although the Japanese remained in Burma until

the very end of the Pacific War in August 1945, their forces there remained deprived of valuable resources and reinforcements.

Air power was an integral and critical part of Allied efforts to strike at the occupying Japanese, both with offensive operations in the Arakan region and the Hukawng Valley and through support of long-range raids mounted by Chindit columns. These operations placed heavy demands on air transport resources in particular, drawing in aircraft from other theatres. On the Japanese side, air power was the main means of maintaining a threat against India, with Japanese bombers striking as far west as Calcutta.

British air superiority was one of the deciding factors of the campaign. In early 1943 there were some 40 air squadrons in India to contain the Japanese threat on the Eastern frontier, and two years later this had grown to more than 60. Although none of these squadrons were formed RAAF units, there were many Australian airmen in theatre—mostly members of the RAAF who had been enlisted under the Empire Air Training Scheme (EATS) to bolster the RAF. Their numbers rose from 330 in April 1943 to a peak of 1091 in July 1944, before falling back to 923 six months later.

Dispersed though the RAAF contingent was, its members saw plenty of hard fighting against the Japanese. No fewer than five RAAF pilots regarded as fighter 'aces' received the Distinguished Flying Cross while serving on the India-Burma front. One of these men was Flying Officer C.A. Crombie, who already had the destruction of six enemy aircraft to his credit when he joined No 176 Squadron, RAF, from the Middle East in October 1942. He doubled his tally in India, and received the Distinguished Service Order to add to the DFC awarded for his earlier exploits.

The factor of dispersion of the Australian presence undoubtedly contributed to the lack of recognition of the RAAF members in India and Burma. It was rare for any one squadron to have large numbers of RAAF pilots on its strength, but there were exceptions. For example, No 11 Squadron, RAF (a Blenheim bomber unit) had around 90

per cent of its aircrews made up of Australians in 1943. As a result, it became known as the 'Australian squadron in the RAF', but this unique distinction disappeared later that same year when the unit converted to single-seater Hurricane fighters and crews were posted to other bomber units.

The number of Australian airmen serving in India led to the establishment of a RAAF Liaison Office in New Delhi, especially to administer them. In March 1944 the head of the Liaison Office, Wing Commander George Pape, tried to consolidate the Australians in the theatre into just two squadrons which could then be designated as distinctly 'RAAF'—as allowed under Article XV of the EATS Agreement. By January 1945 Pape was forced to concede that 'dominionisation' was not going to happen, because the tempo of operations had reached a stage where reorganizing these men into RAAF squadrons would have been too disruptive to be allowed.

Due to the large number of squadrons to which RAAF personnel in the India-Burma Theatre were posted, the pilots flew an equally large variety of aircraft, including Spitfires, Hurricanes, Vengeances, Blenheims and Beaufighters. Apart from combat types, many RAAF men flew Dakota transports. Some transport units—for example, No 62 Squadron—contained a large number of Australians. Given an inadequate road network across Burma and monsoonal weather conditions, resupply of the British Fourteenth Army was frequently impossible by ground means and had to be accomplished by air.

Not all the Australians in the Burma campaign were aircrew. Squadron Leader George Arnold was serving with the newly-created RAF Regiment, the equivalent of the RAAF's aerodrome defence squadrons. A veteran of the Australian Imperial Force in World War I, Arnold commanded 2944 Field Squadron in the defence of Imphal airfield from enemy ground attacks and air raids, ensuring that the RAF could continue to use both the airfield and its aircraft to attack the Japanese.

With the end of the war in Europe, the Australian Government moved to recall RAAF personnel serving with the RAF. Overseas Headquarters in London signalled Pape on 28 May 1945 to advise that all RAAF aircrew serving in Southeast Asia were to be replaced by RAF personnel as soon as possible, and would be either discharged or redeployed in the South-West Pacific Area depending on their length of service. Due to the Japanese surrender within a few months, the men were gradually sent home.

Although victory in Burma took a long time to achieve, that success—when it came—was overwhelming. The Japanese were forced to divert vital resources to shoring up their presence in Burma, which prevented these resources from being applied to other areas where they may have made a substantial difference. The sizeable RAAF presence in the theatre played a significant part in bringing about the Japanese defeat, so that the Burma Campaign deserves to be remembered as one of the more important fronts of World War II.

Organising for war: the RAAF air campaigns in the Pacific

Prior to the outbreak of World War II, the Royal Australian Air Force (RAAF) had not developed any substantial plans for the organisation and conduct of mobile air combat operations in defence of Australia and its northern approaches. It was assumed that the RAAF would be employed within global plans for the defence of the British Empire—much as had been done during World War I. The RAAF had also never been organised into an echelon command structure or operational formations above that of squadron level. In 1939, the RAAF's 12 flying squadrons, four stations, two aircraft depots and the flying training school were all directly commanded by RAAF Headquarters in Melbourne.

Key Points

- The RAAF entered World War II without any experience in planning or executing air campaigns for the defence of the Australian mainland.

- The RAAF initially adopted a geographical area command system to provide for the air defence of Australia and its immediate surrounds.

- As Allies moved on to the strategic offensive, a substantial part of the RAAF's operational air power in SWPA was organised into mobile air groups, and subsequently a tactical air force, for the conduct of offensive air campaigning.

The expansion of the RAAF following the outbreak of war in Europe necessitated reorganisation and the establishment of a higher command and control structure. The Chief of the Air Staff, Air Vice-Marshal S.J. (Jim) Goble, developed an air plan for the dispatch to Europe of an expeditionary Australian air force composed of six squadrons and the requisite support units, organised into one fighter and two bomber wings,. This plan, however, was never implemented following the War Cabinet's decision in October 1939 that Australia would participate in the Empire Air Training Scheme (EATS) to provide aircrews for service with the Royal Air Force (RAF). While EATS was accorded the highest

priority, the RAAF also continued to form additional squadrons in Australia to provide for home defence. In November 1939, as an interim measure to accommodate rapidly increasing operational and training strength, RAAF Headquarters created No 1 Group in Melbourne and No 2 Group in Sydney.

In March 1940, the RAAF adopted a geographical command structure that divided the nation's air defence into Southern, Eastern, Western and Northern Areas. Air Officers Commanding (AOC) in each area exercised operational and administrative control of all Air Force formations within their respective geographical boundaries. By the end of 1941, in addition to the RAAF units being formed in Australia and the EATS trainees being despatched to Canada and Britain, a number of RAAF squadrons were also serving with the RAF in Europe and the Middle East. Four more squadrons, under the command of a RAAF Group Headquarters, formed part of the RAF's Far East Air Force at Sembawang air base in Singapore. In November 1941, Sembawang was formally transferred to the RAAF, becoming its first overseas air station.

Following Japan's entry into the war and its stunning drive across the Asia-Pacific region, Malaya and Singapore fell and the remaining RAAF aircraft and personnel were hastily evacuated. In response to the Japanese threat to the north, it was felt that Northern Area was responsible for the air defence of too large an area and it was therefore re-organised into North-Western and North-Eastern Areas.

In March 1942, the Australian government accepted the appointment of General Douglas Macarthur as the Supreme Allied Commander, South West Pacific Area (SWPA) and all operational RAAF units in the Pacific came under his command. From late 1942 George Kenney, Commanding General Allied Air Forces, subdivided his command along national lines into the US 5th Air Force and RAAF Command. Air Vice-Marshal W.D. (Bill) Bostock, AOC RAAF Command, exercised operational control over all RAAF combat operations in the SWPA. Air Vice-Marshal George Jones, Chief of the Air Staff, however, retained administrative control of the RAAF as a whole. Unfortunately, to the detriment of the smooth functioning and reputation of the RAAF, this

organisational arrangement placed two strong-willed local officers of equal rank with distinct, but overlapping, command responsibilities for the Australian units and personnel in the SWPA.

By late 1942, after the Battles of the Coral Sea and Midway, the Allies moved onto the strategic offensive. The RAAF's static area commands, however, were predominantly defensive in nature and ill-suited to the conduct of mobile offensive operations. In September 1942, the RAAF reorganised operational units in Papua into No 9 (Operational) Group (No 9 OG), giving its Officer Commanding operational command of all RAAF combat formations operating in Papua and New Guinea. No 9 OG was organised as a self-contained tactical air force, which eventually grew to nine flying squadrons organised into three wings, an airfield construction wing, a radar wing, and supporting logistics and medical units.

The operational group structure gave the RAAF, for the first time, the capability to independently mount sustained and mobile air combat, strike and anti-shipping operations far from Australia in the inhospitable environs of New Guinea. The group played a major role in the campaigns in Papua and south-eastern New Guinea, including the Allied victory at the Battle of the Bismarck Sea. By early 1944, Allied offensive operations in the SWPA swung to the north-west, by-passing the large base the Japanese had established at Rabaul. In order to ensure that the Japanese forces in Rabaul were contained, No 9 OG remained in Papua, establishing a new headquarters at Milne Bay, and effectively became the RAAF area command for Papua and south-eastern New Guinea.

The RAAF's mobile air operations were assumed by No 10 (Operational) Group (No 10 OG). Formed in September 1943, No 10 OG began combat operations in north-western New Guinea and the Allied campaign in Western (Dutch) New Guinea. By September 1944, during the Battle of Morotai, No 10 OG had grown to encompass 12 flying squadrons and two airfield construction wings, as well as the requisite support units. As a result of this expansion in size, No 10 OG was renamed the First Tactical Air Force (1TAF) in October 1944.

As the Allied advance continued towards the Philippines and the Japanese home islands, the 1TAF was tasked with harassing and subduing the large Japanese forces in the Dutch East Indies that had been isolated and by-passed by Macarthur's American forces. During May to July 1945, 1TAF undertook its last major combat operations in support of the Allied campaigns in Borneo and surrounding islands. In July 1945, 1TAF had reached its peak strength of 20 Squadrons and over 18 000 RAAF personnel.

During the course of the Borneo Campaign, 1TAF headquarters and most of its combat and supporting elements were gradually relocated from Morotai to airfields in Borneo and the surrounding islands. In order to release 1TAF to undertake further offensive operations, No. 11 Group was formed on Morotai in July 1945 as an area command to assume air garrison duties and administrative control of all RAAF units in the Dutch East Indies, Sarawak and British Borneo.

The end of the war occasioned the large scale demobilisation of the RAAF. 1TAF and the overseas Groups were disbanded. The area command system, however, was retained and remained the basis of RAAF's organisational structure into the 1950s until Sir Donald Hardman introduced a command system along functional lines (see Pathfinder #106).
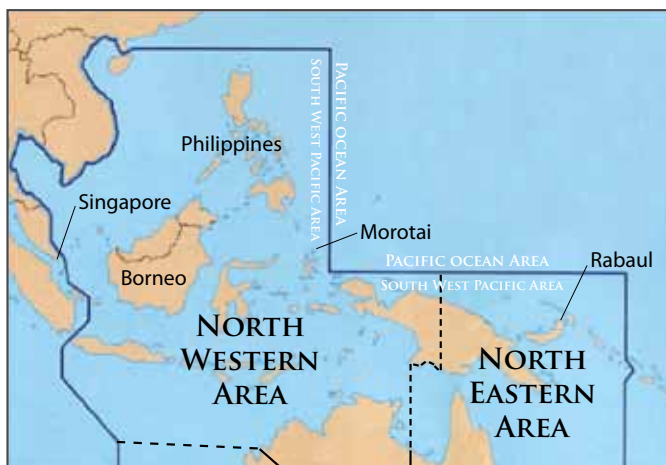
WORLD'S FOURTH LARGEST AIR FORCE?

Since at least the early 1980s, the claim has been made that, at the end of World War II, Australia was the country with 'the fourth largest air force in the world'. The same claim has been made by Canada, so is the Australian claim historically valid or is it just an example of journalistic licence?

With the surrender of Germany on 8 May 1945, followed by the surrender of Japan on 15 August, there is no doubting that the three great air powers remaining in the world were the United States, the Soviet Union and Britain—in that order.

Key Points

- At the end of World War II, the US, the Soviet Union and Britain were the three major air powers in the world.

- At its peak in 1944 the Royal Canadian Air Force provided the fourth largest allied air force, but after Germany's defeat it began a process of rapid reduction.

- On Japan's surrender, the RAAF stood as the fourth largest air force in the world—but did not remain so for long.

The US Army Air Forces (USAAF) had 2 253 000 people operating 63 715 aircraft, even without counting the air arms of the US Navy and Marine Corps. The size and strength of the latter can be appreciated from the fact that the US Navy was training 20 000 pilots annually in 1943–44, and in March 1946 established a program to place into storage 6000 of the aircraft it was then operating.

Reliable data on the Russian Air Force (VVS) is scarce, but with an estimated 18 500 aircraft, it was second only to the USAAF in size. The Royal Air Force came next with 1 079 835 men and women operating 9200 frontline aircraft alone.

What do the RAAF figures disclose about its size and shape at this stage? On 29 August 1945, a fortnight after the war against Japan ended, the RAAF had 173 622 personnel operating 5585 aircraft.

A majority, almost 132 000 (including the 17 243 women in the WAAAF), were serving in the Pacific. That theatre was also the focus for all but 20 of the RAAF's 75 flying squadrons.

This represented a fifty-fold expansion over the size of the air service which Australia had maintained at the start of World War II. In September 1939, the RAAF had 3489 officers and airmen in uniform, manning 12 flying squadrons with a total of 246 aircraft—164 of them operational (though obsolescent) types. It was even then in the midst of an expansion program intended to see it grow to 18 operational squadrons and 5000 personnel by mid-1941.

It is significant that the end of the war did not actually find the RAAF at its peak. That point had been reached a year earlier, in August 1944, when the number of personnel stood at 182 000. In that month, however, the Australian War Cabinet directed that 15 000 men were to be released by the RAAF to meet the manpower needs of civil industry. From this stage, while the number of operational squadrons continued to increase, the total number of personnel in the RAAF declined.

The story of the Royal Canadian Air Force (RCAF) is remarkably similar. From a strength in September 1939 of around a dozen squadrons, both permanent and auxiliary, and a plan to expand its full-time personnel strength to 5025 officers and airmen, the RCAF grew to 215 200 men and women filling 78 flying squadrons. It is therefore incontestable, then, that Canada had the fourth largest allied air force during the course of the war.

The crucial point of difference is that the RCAF hit its peak in January 1944. Moreover, because Europe was the focus of Canada's contribution to the allied war effort—it had 48 of its squadrons in that theatre in May 1945—as soon as Germany's defeat was imminent, the need to keep it at such levels diminished. By 31 May 1945, the RCAF had already shrunk to 164 846, and by the time of the Japanese surrender the Service was rapidly reducing towards a

figure of 16 000 that the Canadian government had decided upon as the RCAF's demobilisation target.

On that basis, the RAAF claim to have been fourth largest at the point when hostilities in all theatres had ceased is also correct. This was largely due to the fact that the RCAF was reducing faster than the RAAF, but anyway it was not a distinction that the RAAF kept for very long.

Like Canada, Australia also accelerated its demobilisation plans for the armed services, so that by the end of October 1946 the RAAF had dropped to 13 238 members. This process still had some way to go, with the post-war low for the RAAF being a strength of just 7897 reached at the end of 1948.

A further point to be considered when looking at the relative size and strengths of the RCAF and the RAAF is that personnel numbers alone were not a true indicator of the combat air power that each service was capable of generating. This is because both Canada and Australia had become partners in what was known as the British Commonwealth Air Training Plan or the Empire Air Training Scheme, designed to provide a pool of trained aircrew to help maintain and expand the wartime Royal Air Force.

This was an arrangement which required both countries to maintain abnormally large training establishments, but particularly Canada because it was the main training ground for advanced training for all four partner countries under the pooling scheme. According to the Canadian War Museum, the RCAF was obliged to run nearly 100 flying schools, utilising more than 10 000 aircraft and 100 000 personnel to administer. Australia had a similar commitment to EATS, albeit on a lower scale, operating 34 flying and seven technical schools.

The raw numbers used in this comparison also do not reflect the fact that Australia, to a far less extent than Canada, found itself facing a constant struggle to acquire capable modern aircraft until almost the last stages of the war. For the first four years, the RAAF

was obliged to make do with a large collection of mostly obsolescent and unsuitable aircraft which seriously impaired its operational effectiveness. On the other hand Canada, by virtue of its shared land border with the US, was able to establish itself as a virtual extension of the American aircraft industry and was well-placed to ensure that its needs for combat aircraft were adequately met throughout the war. To illustrate the point, production of military aircraft in Canada during the war years totalled more than 15 800, including types such as the Lancaster, Mosquito and Hurricane—and even the Helldiver for the US Navy.

In terms of actual combat power that the RCAF and RAAF were each capable of generating by 1945, there was probably little difference between the two services that can be usefully measured.

The RAAF at Long Tan

Late in the afternoon of 18 August 1966, the Australian Army fought what was arguably its most famous battle of the Vietnam War. While patrolling through a rubber plantation just north of the derelict village of Long Tan—situated four kilometres east of the operating base of 1st Australian Task Force at Nui Dat, in the centre of Phuoc Tuy (now called Ba Ria-Vung Tau Province)—D Company of the 6th Battalion, Royal Australian Regiment (6RAR), came into contact with a vastly superior enemy force and mounted a desperate defence lasting more than three hours.

Key Points

- The contribution of the RAAF helicopters to the battle was small, but was absolutely critical to the final outcome.
- Without the benefit of a range of supporting elements, Army as well as Air Force, American and New Zealand as well as Australian, D Company was unlikely to have survived against the odds they faced.
- The 9 Squadron mission to resupply ammunition to D Company was fully authorised by the Task Force Air Support Commander.

The Australian group of only 108 men (105 infantry and a three-man New Zealand artillery observer team) found itself pitted against an enemy force believed to number 2500 plus, comprising a Viet Cong Main Force regiment reinforced by local provincial units and at least one North Vietnamese regular battalion. Yet the Australian force survived with one-third of its strength as casualties, including 17 killed in action. Bodies left on the battlefield confirmed enemy losses had been at least 245 killed, but casualties estimated in the hundreds—both dead and wounded—were removed under cover of darkness after the action ended.

Long Tan was an outstanding battle fought against overwhelming odds, a triumph of arms which owed everything to the military skills, discipline and determination of the small band of Australian

soldiers and the junior leaders who commanded them. Yet this is not the whole story, by any means. As acknowledged by the D Company commander, Major Harry Smith, in an article written to commemorate the 40th anniversary of the action, the successful outcome was also a tribute to other supporting elements within the Task Force organisation, including the RAAF, and even Australia's allies in the field.

About an hour after the battle commenced at approximately 1600 hrs, Major Smith realised the enormity of the situation he and his company were in. With one of his three platoons pinned down and unable to withdraw, yet unable to relieve the pressure on this group because of the sheer weight of enemy numbers and volume of fire from automatic weapons, rocket-propelled grenades and mortars, Smith naturally called on the supporting arms that were available to him—not just the 18 105mm howitzers from the Task Force base and US 155mm medium guns that were within range, but also air power.

Smith's requests were for combat air support from United States Air Force (USAF) fighter aircraft, and ammunition resupply and reinforcement by an airborne insertion by helicopters. Unfortunately, these demands could not be immediately met. At almost the precise start of the action, the whole area had been subjected to a torrential monsoonal downpour. This meant that the coloured smoke grenades used to mark the position of friendly troops on the ground could not be recognised from the air, and the aircraft heard circling overhead could not be called in to safely deliver their fire power.

The weather factor also presented a dilemma in responding to the Company's urgent request for ammunition resupply. As it happened, there were two Iroquois helicopters of No 9 Squadron, RAAF, sitting on the landing pad at Nui Dat that were available for the task, these having earlier in the day transported a party of entertainers from Vung Tau who were giving concerts for the troops during the afternoon. But when the Task Force Air Support Commander, Group Captain

Peter Raw, received the request for a mission to be flown, he was initially doubtful that it was feasible due to the severe conditions.

This prevarication in the face of obviously desperate circumstances understandably upset the Task Force Commander, Brigadier O.D. Jackson, who commented that the possible loss of a couple of helicopters hardly seemed to matter against the likely loss of an entire company of a hundred men. Raw sensibly conferred with the pilots of the helicopters to determine whether the mission could be flown with any prospect of success. The four pilots (two aircraft captains and two co-pilots) represented various levels of operational experience, and opinion among the group was, not surprisingly, split equally.

It was the advice of Flight Lieutenant Bruce Lane, probably the most experienced of the four, which appears to have settled the matter. He told Raw that with two aircraft making the attempt there was at least a chance that one might get through, and from what was known of the dire situation developing outside the base there was no doubt that the attempt simply must be made, regardless of the risks involved. This advice was accepted by Raw, who was a bomber pilot by training with no special knowledge of helicopter operations, and the flight was duly authorised.

The decision taken at that point was for the ammunition to be loaded into one helicopter (flown by FLTLTs Dohle and Lane), which would then be guided by the other Iroquois (FLTLTs Riley and Grandin). When it came to getting the ammunition on board, it was soon realised that the packaging of the load (rounds still in boxes, wrapped in blankets to cushion the impact of free-dropping) meant that it was too heavy for a single aircraft to carry. Accordingly, some of the load was placed aboard the lead ship. An Army warrant officer was also taken on the second aircraft, to speed up delivery once in the drop zone.

Fortunately, at the time that the helicopters departed shortly before 1800 hrs, the heavy rain eased off for the few minutes that it took to

travel at tree-top level to reach D Company's position. Although rain clouds, mist and lingering smoke from shell-bursts still veiled the battlefield, the Company was not totally surrounded and by coming from the west the Iroquois did not directly overfly enemy positions. Each aircraft was able to hover directly above the Company and drop the boxes from barely 30 feet. None of the crews believed that they came under fire, and no aircraft was found to be holed on return to base.

Although ultimately found to have been not unduly risky, the mission was not without danger. But whatever the risk was assessed to have been, there was no question that the ammunition resupply delivered at this point in the battle—which still had an hour to run—came at a critical juncture. It has been stated that there was probably no more than 100 rounds available in the whole of D Company when the RAAF arrived overhead. It takes nothing away from the courage and tactical skill of the officers and men of 6RAR to say that, without the assistance of 9 Squadron, the outcome of Long Tan might have been very different. This was an instance of the air force effectively integrating with the ground forces to ensure success on the battlefield.

Air power in the siege of Khe Sanh

The Vietnam War is not a conflict in which air power is popularly credited with having made a major difference to what was ultimately an unsatisfactory outcome, even in the southern half of divided Vietnam where allied air power (principally the US Air Force) enjoyed uncontested supremacy. In what is still usually described as an irregular war—wrongly, as it was actually a "hybrid" conflict fought at many levels—there are also few major set-piece engagements where air power is considered to have provided the winning edge. The exception to this

> **Key Points**
>
> - Air power proved vital in ensuring that Khe Sanh did not become a shattering defeat like Dien Bien Phu.
>
> - The damage caused by the broader Tet Offensive erased the significance of the successful defence at Khe Sanh and delivered a psychological defeat for the allied cause in Vietnam.
>
> - No 2 Squadron, RAAF, played a little known part in halting the PAVN at Khe Sanh.

was the siege of the US Marine Corps outpost at Khe Sanh in 1968. From an Australian perspective it is notable that the RAAF had a generally unrecognised involvement in this epic battle.

Situated in the hills close to the western end of the Demilitarised Zone (DMZ) separating the southern Republic of Vietnam from its communist northern neighbour, Khe Sanh provided a valuable base for disrupting the route used by the People's Army of Vietnam (PAVN) to move supplies and reinforcements from the North into South Vietnam, through the neighbouring territory of Laos. It was to remove this threat that in late 1967 the PAVN commander, General Vo Nguyen Giap, began building up his forces. By the end of the year Giap had marshalled into the area three full divisions and a regiment of a fourth, numbering around 30,000 troops, in readiness to attack the 6000 Marines and Army troops within Khe Sanh.

Unknown to the allies, there was a sinister twist to the PAVN plan in that an assault on the American stronghold was intended to be merely the opening shot in a general offensive by communist insurgents across South Vietnam timed for the Tet national holiday that would mark the lunar New Year on 31 January 1968. The hope was that a large scale attack on Khe Sanh would draw American troops to the far north-western corner of South Vietnam, and away from the major population centres that would be targeted in the coming offensive. Giap undoubtedly expected that the loss of Khe Sanh would have the same dramatic effect on the Americans as the defeat he had inflicted on the French at Dien Bien Phu in 1954. He even sought to add to the symbolism of the undertaking by including the seasoned 304th Division—one of those that had humbled the French 14 years earlier—among those earmarked for the assault on Khe Sanh.

Giap's strategy was also essentially the same as that he employed at Dien Bien Phu. He would use the rugged terrain and isolation of the American base to surround and cut it off, before pounding it with artillery placed on the surrounding hills and finally overwhelming it by ground assault. However, the assumptions behind Giap's designs were flawed on this occasion because he had not fully taken into account the improved technology, particularly in aircraft, which the American and allied forces now possessed. Although Khe Sanh—just like Dien Bien Phu—was heavily dependent on an airfield for much of its outside supplies, especially once heavy monsoonal rains had made the few roads near the base impassable, the allies had on hand a large number of aircraft capable of delivering strikes to break the siege.

On the morning of 21 January, PAVN forces made their first attacks on Khe Sanh using artillery, rockets and mortars. One rocket landed in the base's ammunition dump and, at a single stroke, most of its stockpile of artillery rounds and explosives were lost. However, the US commander in Vietnam, General William Westmoreland, was determined that the base would hold out and poured staggering quantities of troops and other resources—including air power—into

its defence. Operation *Niagara*, as the siege was known, became a hard-fought affair that lasted for the next 77 days, only ending when the PAVN withdrew in mid-April.

The Australian involvement in events at Khe Sanh were represented by the missions carried out by the RAAF's No 2 Squadron. A year earlier, in April 1967, this unit had arrived at the American base at Phan Rang, 1000 kilometres to the south of Khe Sanh, to begin operations with the USAF's 35th Tactical Fighter Wing. For the next six months the squadron's aging Canberra jet bombers were engaged in night operations across South Vietnam involving bombing under radar direction. Only in September was the squadron employed on low-level daylight bombing sorties where it began to achieve a well-deserved reputation as the most accurate bombing unit in the Wing.

This change in role for the Canberras came in time for the Australians to participate in the defence of Khe Sanh. Within days of the siege's commencement, 2 Squadron began daylight bombing operations around the base, although they occasionally flew night missions also. The number of aircraft over Khe Sanh and the DMZ—not just from the US Air Force, but also the Navy and Marine Corps—was so large that the airspace frequently became congested. On 2 February, the 2 Squadron crews found they had to return to Phan Rang without being able to drop their bombs.

Over the course of the siege 115,000 tonnes of bombs, rockets and napalm were delivered by American and allied aircraft, frequently including B-52 strategic bombers. It was this weight of ordnance that primarily ensured that Khe Sanh did not fall. It is also believed to have caused 10,000-15,000 PAVN casualties (the exact number is not known), and helped keep the defenders' losses to about 1000 killed and 4,500 wounded. Although air power had been the primary factor in preventing the allied cause suffering a major defeat, this outcome did not come to be viewed as the success it undoubtedly was. This was for reasons which ultimately overshadowed the whole of the Khe Sanh story.

Two months after the siege ended, the US Marines abandoned Khe Sanh and deliberately destroyed the base so as not to give the PAVN a symbol of victory. By then it was already apparent that the successful defence mounted there had been essentially in vain. Even though the wider Tet Offensive had also been repelled, this had brought a reversal of fortune for the American cause which proved to be a turning point in the Vietnam conflict. Whereas a majority of the American (and Australian) population had previously supported the war, the ability of the PAVN and Viet Cong guerrilla fighters to wreak so much havoc appeared to reveal serious shortcomings in the conduct of the war, and also called into serious question claims by political and military leaders that final victory was in sight. Public opinion began to turn irreversibly against further escalation of the war, eventually compelling the American and allied forces to withdraw from Vietnam.

The missing man formation

There are few distinctive and common traditions which have proved constant or enduring in most air forces. Among those that the RAAF observes, none is more emotive than the use of the Missing Man Formation at a Service funeral. During a fly-over at the church or graveside, either the formation contains a gap where one aircraft is conspicuously missing or an aircraft in the formation abruptly pulls up during the flypast and climbs steeply away while the rest continue in level flight. The gesture is intended as more than a respectful farewell, for which a simple flypast would suffice; it is a personal tribute to the person who has passed away or fallen in combat—an expression that he/she will be sorely missed.

> **Key Points**
> - The Missing Man Formation has been in use for a long time as an aerial salute to farewell departed colleagues, not just airmen.
> - The custom exists in several forms and remains an informal practice.
> - Precedents suggest it is unlikely to become an exclusive Air Force tradition, even while the RAAF continues to observe it.

The Missing Man Formation is, first and foremost, a custom that is specific to airmen and air forces. Its use, therefore, during the recent funerals of two former chiefs of the Australian Defence Force—both of them Army generals—became the subject of much discussion among the RAAF community, mainly regarding the origins and meaning behind the practice. When is the use of such a formation appropriate and what are the conventions associated with its conduct?

The historical origins of the practice are quite obscure. Claims are often made that it began during World War I, when units returning from an operation routinely formed up on arrival over their home airfield to allow observers on the ground to see at a glance what the day's losses had been. If this was a recognised and common practice,

personal accounts by airmen of that war are strangely reticent about mentioning it.

Another popular myth seems to be that the formation was first flown by the Royal Air Force as a mark of respect for the fallen German ace, Manfred von Richthofen—the famous "Red Baron". If true, Australian sources would have been ideally placed to record the fact, since the funeral of this enemy airman was conducted by No 3 Squadron of the Australian Flying Corps at Bertangles, France, on 22 April 1918. Remarkably, not a single account mentions the use of the Missing Man Formation, nor indeed any flypast at all.

What is certain is that, after World War I, flypasts and aerobatic displays by aircraft from the armed services became increasingly common during ceremonial occasions and prominent public events. Flypasts at funerals, however, largely remained an informal and private arrangement within the military air services. The first officially recorded Missing Man Formation was flown in Britain in January 1936, during the funeral service of King George V—an honour rendered appropriate by the monarch's rank as a Marshal of the RAF.

In the United States, the first Missing Man Formation appears to have been flown at the funeral of Major General Oscar Westover, chief of the US Army Air Corps, in September 1938. When General Hoyt Vandenberg died in April 1954, he became the first senior officer of the USAF to be honoured with a Missing Man Formation flypast at Arlington National Cemetery, involving six B-47 Stratojets in a V-formation with the second position on the right vacant. What these instances demonstrated is that, far from being reserved exclusively for airmen at unit level, the Missing Man Formation has been regularly accorded to senior ranking officers.

Further blurring the picture is the fact that 'missing man' flights have taken on a wide appeal, so that they are no longer the sole preserve of air forces at all. Especially in the United States, private associations and groups also perform Missing Man Formations at funerals of prominent members of the community, not just veterans, and during

other commemorative occasions. Law enforcement agencies often conduct flypasts at the funerals of policemen killed in the line of duty, while commercial aviation companies also fly tributes at the funeral services of deceased pilots. This widening of application has produced some further refinement of the standard Missing Man Formation, as in the variant where the flight approaches from the south, preferably near sundown, and one of the aircraft suddenly peels off to the west and flies into the sunset.

The trend towards non-exclusivity with aerial salutes has also been evident in Australia, to the extent that when the pioneering female aviator Nancy Bird Walton died in January 2009, a Qantas A380 flew over St Andrews Cathedral at the commencement of her state funeral service in Sydney.

Within the RAAF, practice of the Missing Man Formation has largely followed the traditions established by the RAF. A large-scale flypast marked the funeral in 1980 of Sir Richard Williams, regarded as the "Father of the RAAF", involving four separate groups of RAAF aircraft – without, so far as is known, there being any empty gaps in the formations. At the funeral just four years later of the RAAF's first four-star officer, Air Chief Marshal Sir Frederick Scherger, a 'missing man' was flown by five RAAF Macchis.

While the Air Force's most senior and distinguished officers have frequently been accorded the 'missing man' honour in Australia, the same tribute has also been paid by individual RAAF units, particularly fighter squadrons, to their past and present members. After Wing Commander Ross Fox, Commanding Officer of No 75 Squadron, was killed in an aircraft accident at Tindal in 1990, a Missing Man Formation was flown by the squadron at his funeral service in Brisbane. And in 2006, Wing Commander ('Bobby') Gibbes and Wing Commander Richard ('Dick') Cresswell, two of Australia's most accomplished fighter pilots, were both accorded the honour on their passing away. Serving members of the units that these renowned airmen had once led in combat—No 3 and No 77 Squadron, respectively— flew the 'missing man' in F/A-18 Hornets.

Although the Missing Man Formation is an aerial salute that works best as an informal tribute by airmen to 'one of their own', history demonstrates that the custom has never been confined solely to airmen nor initiated only at unit level. While use at the close personal level of airmen farewelling a respected and cherished colleague is probably closest to the original intention of the gesture, certain historical precedents exist for the Missing Man Formation—in all its variants—to be used for departed senior and prominent figures, even without an Air Force background.

The RAAF in non-military operations

Operations by the Royal Australian Air Force in recent decades have frequently been as much about providing aid to civil authorities as they have with directly dealing with specific security and military situations. This has demonstrated that air power is, at its core, a commodity underpinning national interests well beyond the ordinary range of roles which form the primary focus of an Air Force. What is perhaps more surprising is that what is regarded as 'civil work' has been part of the RAAF mission-spread from the very beginning of the service's existence.

> **Key Points**
>
> - The RAAF has been involved in non-military duties in support of civilian national objectives since the beginning of its existence.
> - Air power's reach and responsiveness makes the RAAF remain at the forefront of Government's response to emergency situations.
> - Modern governments have recognised the special utility of air power as a practical instrument, and more freely wield air assets in pursuit of national interests, objectives and policies unrelated to defence.

Government in Australia has sought to use air power for non-warfighting purposes even before the RAAF was formed in 1921. For instance, in October 1917 aircraft from the Point Cook air base outside Melbourne were used to advertise the federal Treasury's bid to raise £20 million under a 'Liberty Loan' scheme. The exercise was repeated in August 1919 and mid-1920, for 'Peace Loans' to raise funds for the post-war economy. In September 1920 two aircraft from Point Cook were despatched to search for a missing coalboat off the east coast of Tasmania; one of the aircraft disappeared without trace, its two-man crew becoming the air service's first operational fatalities within Australia's borders.

As noted in a previous *Pathfinder* (see #25, June 05), even the very formation of the RAAF can be partly attributed to the desire of

the government of the day to have an Air Force that was capable of pioneering air mail services across Australia. Without this incentive, which was not a defence consideration, establishment of the Service may have been delayed well beyond what became the official birth date of the RAAF. A large part of the flying work done in the RAAF's first years was taken up with surveying the air routes needed to get mail services up and running.

Hard on the heels of these first ventures into civil work came others. In 1922 the RAAF had aircraft involved in exploring the hydrography of Lake Eyre in outback South Australia, and in 1923–24 flights were undertaken to provide various government departments and non-government agencies such as universities with aerial photography for planning, survey and exploratory purposes. Air Force leaders quickly discovered that the Government's expectations of the RAAF were varied and at times focused on purely 'civilian' duties. When the Acting Chief of the Air Force in 1924 attempted to suggest that taking on even more duties of general benefit to the public would be inimical to efficiency, he was told in no uncertain terms that the Air Force was unlikely to get more money unless it did.

Perhaps galvanised by this harsh imperative, the RAAF took on a diverse range of tasks in the years before World War II. The RAAF played a leading role in surveying the Great Barrier Reef and Northern Australia generally, potential oil fields in Papua New Guinea, and the forestry resources of Tasmania; search and rescue missions in the waters of Port Phillip Bay and across outback Australia; supporting exploration in Antarctica; and conducting summer bushfire patrols, aerial crop-dusting, and daily meteorological flights for the Weather Bureau. So extensive was its involvement in civil work in this period that it almost seemed that the RAAF's non-military duties had eclipsed its air combat role in Australia's defence.

While World War II provided the necessary incentive to turn the RAAF into a more professional and combat-oriented Service, in the post-war era civil demands on it did not diminish. Air Force resources were applied to assisting the CSIRO with rain-making

trials and a host of other experimental tasks. RAAF aircraft and crews were delegated to supporting national mapping priorities in Australia and across the Pacific region. They were also called out to respond to a range of disaster relief and community support situations: from Cyclone Tracy in 1974 to the Victorian bushfires of 2009; from delivering emergency supplies following earthquakes, tsunamis, cyclones to lesser calamities such as droughts, famine and floods; from evacuating casualties after terrorist atrocities such as the 2002 and 2005 Bali bombings to evacuating stranded civilians caught up in wars, rebellions and civil strife; from long-distance searches for yachtsmen in peril in the Southern Ocean to helping the storm-ravaged fleet in the 1998 Sydney-to-Hobart yacht race. These tasks have become a necessary part of the RAAF's operations, quite apart from its primary mission of the defence of Australia as a vital element of the Australian Defence Force.

The men and women of the RAAF can have no expectation that the call on their Service will reduce at any time in the future, since the inherent flexibility, reach and responsiveness of air power, resident in the RAAF, makes it the first-choice option in emergencies. Because air power is indispensible to coping with the vast distances associated with Australia's size and geographical location—no other agency of government is capable of responding so rapidly to many emergencies—a popular expectation has emerged that the RAAF will invariably respond whenever circumstances require. There is an evolving appreciation and visibility of the Air Force in Australia.

In the war-weary and disarmament-inclined days of the 1920s, there was a perception that money spent on defence was essentially a waste, and governments needed to extract some return on investment in the armed services by utilising them on projects for the larger public good wherever possible. More recently, the realisation has come that pursuing the national interest requires, more than ever, what is called a 'whole of government' approach. Because assuring national security involves more than one agency, assets and resources from across the

sphere of government often have to be used in ways and forms for which they were not primarily acquired.

In this context, air power has come to assume ascendancy among the elements of national power that are available to government. Political leaders find it convenient and expedient to turn to the RAAF whenever there is a need for a timely, flexible, far-reaching but 'light-footed' response both in war and peace. While the RAAF is structured as a war-fighting element, its inherent flexibility allows it to respond in a timely manner to other national exigencies.

THE RAAF EXPERIENCE OF SIMULATORS AND SIMULATION

In recent years, a steady stream of new simulators and simulation capability have been introduced into the Air Force, with operational flight trainers, mission simulators, and mission support systems for the C-130J, C-17, KC-30 and the Wedgetail aircraft platforms. Now, the Service is looking at a Visual Environment Maintenance Trainer for the F/A-18 Super Hornet. These acquisitions are often represented as 'bold steps into the future', but in reality they are merely the latest manifestations of a policy which the RAAF has been following for over 70 years.

> **Key Points**
> - The RAAF has a 70-year history of using simulators in the generation of air power.
> - New generation simulators represent opportunities for improved air and space capability.
> - Exploiting simulation in the future, as the RAAF has done in the past, will lead to even greater professional mastery of air power.

Simulators have played an important role in RAAF training since the mid-1930s. Flight training has always been an inherently dangerous activity. During the first decades of the RAAF's existence, deaths and serious injuries as a result of training accidents exacted a heavy toll on both trainee pilots and instructors. By 1930, when the RAAF had exhausted the stocks of war-surplus aircraft donated to Australia by the RAF, the continuing loss of aircraft destroyed or damaged during training also imposed considerable financial costs on the small inter-war Air Force.

As the RAAF acquired more advanced aircraft, flying training courses became longer and more demanding. Conversion courses onto new aircraft types also placed considerable burdens on both squadron personnel and expensive operational airframes. One solution that alleviated some of these problems was the introduction in 1938 of

the RAAF's first flight simulator—the Link Trainer, named after its American inventor Edwin Link. This electro-mechanical device allowed pilots to practice their instrument flying skills on the ground and was allocated the number A13 in the RAAF system of aircraft numbering. During World War II, an additional 140 Link Trainers were purchased to equip the flying training schools set up in Australia to train pilots for the Empire Air Training Scheme. Further advances in design allowed post-war Link Trainers to simulate jet-speeds and continued to provide valuable training for aircrew until 1971.

The responsibility of training the huge number of aircrews for large bomber aircraft in World War II prompted the RAAF to acquire three Celestial Navigation Trainers (CNT) in 1944. These trainers enabled an entire crew of pilot, navigator, bomb aimer and wireless operator to fly simulated bombing missions under a range of conditions. Images projected onto the ceiling and floor of the CNT room allowed navigators to practice fixing the aircraft's position and enabled the bomb-aimer to track the aircraft to the target. Only the CNT installed at RAAF Base East Sale reached full training capability, which it maintained until 1957 when it was superseded by other ground-based navigation trainers.

The RAAF's first true flight simulator, which could emulate a flight in an operational aircraft, was acquired for the Avon Sabre. The second was the C-130A Hercules simulator, acquired in 1960 to train crews in the procedures for this complex new-generation aircraft. After this, the acquisition of a flight simulator became a standard component of new aircraft projects such as the Mirage, P-3 Orion (both B and C models), C-130E, F-111C and all later operational aircraft.

The flight simulators purchased in the 1960s were not the full-motion simulators with wrap-around, computer-generated day visual systems that are common today. These simulators had no motion and no visual displays so they could not simulate takeoffs, landings or any other part of the mission requiring a visual component. They simulated flight in cloud conditions, by day or night. Within these limitations, however, these simulators were excellent for allowing

crews to practice flying in instrument conditions, to practice dealing with aircraft emergencies and to develop crew coordination skills. They were also particularly valuable in familiarising new crew members with the cockpit and controls of increasingly complex aircraft. Simulators allowed all of this to be achieved at no risk to safety and at a low monetary cost.

Although simulators are commonly associated with aircrew training, they have frequently been used in training many other trade groups in the RAAF. For example, in the late 1970s, an electro-mechanical 'audio-visual trainer' was designed and built at the School of Air Traffic Control at East Sale for the training of air traffic controllers in tower procedures. This trainer used lights on a large board to simulate the locations of aircraft in an airfield circuit area. In 1987, the RAAF's first digital air traffic control radar simulator was used in the training of radar controllers. And in a world-first, an Australian designed 'visual tower simulator', installed at East Sale, used computer generated graphics to produce a realistic visual environment for the training of tower controllers.

As RAAF aircraft became more complex, the training of technicians on each aircraft type also took longer. Classroom simulators which diagrammatically showed how an aircraft system operated greatly improved the efficiency of this training. At first, these were electro-mechanical simulators, but later digital versions proved more effective and more reliable. With each improvement in simulation came a corresponding increase in the efficiency of the training conducted and a lowering of the cost.

While the reduction of training costs was a major factor in developing simulators in the past, advances in simulation technology in recent years have produced simulators that are capable of more than just 'flying' a mission. Networking simulators in different locations has allowed aircrew of different services and nations to train together without the time and logistical costs of deploying forces long distances for exercises. Full-mission capable simulators also allow the rapid development of new tactics, techniques and procedures (TTP).

The recent introduction of Uninhabited Aerial Systems (UAS) into the order of battle has further blurred the line between simulation and reality. Perhaps the only real difference between simulated rehearsals of an UAS mission and the real mission is the outcome—the weapon release or the intelligence gathered. However, both rehearsals and the actual mission are very likely to need the same level of proficiency.

While many of the simulators of the past might not appear much more than procedural trainers capable of generating very little or no sense of reality, they were leading edge systems in their day. Most significantly, they produced remarkable improvements in the safety and efficiency of RAAF training. They gave the RAAF the experience and confidence in simulators that led to the active pursuit of even greater simulation capability. As the use of simulators and their capacity to simulate diverse and complex situations and environments increases, they will remain integral to the RAAF's ability to generate air power into the future—much as they have done over for last 70 years.

THE DHC-4 CARIBOU'S 45 YEARS SERVICE

On 27 November 2009, Caribou A4-140 flew into Canberra from RAAF Base Richmond on the last flight before this aircraft type ceased operations with the Royal Australian Air Force. In a small ceremony which followed, A4-140 was handed over to the Australian War Memorial. The transfer marked the end of the DHC-4 Caribou's remarkable 45-year career with the RAAF, encompassing service during the Vietnam War, several peacekeeping and peace enforcement operations, and multiple disaster relief and humanitarian missions across Australia and around the world. A total of only 29 airframes served with the RAAF, in No 35 and No 38 Squadrons, and this aircraft type holds the unique distinction of the longest record of constant operational service in the RAAF.

Key Points

- The Caribou was the RAAF's longest serving operational airframe.
- The Caribou's versatility in airlift and tactical transport made a major contribution to RAAF ability to project air power.
- For 45 years, Caribous served the RAAF and the Australian people in war, peacekeeping and peace enforcement missions, disaster relief and humanitarian missions across Australia and the globe.

The Canadian-built Caribou has made a major contribution to Australia's ability to project air power since 1964. The aircraft's robust construction and exceptional Short Take-Off and Landing (STOL) capability enabled it to operate from the most rudimentary of airstrips. The aircraft gave the RAAF considerable flexibility in the conduct of air mobility operations, enabling the tactical airlift of personnel and cargo across a wide variety of environments and conditions.

The ability of the Caribou to sustain a high operational tempo in arduous conditions was quickly demonstrated at the very outset of the aircraft's service life. In May 1964, just five weeks after the

first three aircraft (including A4-140) were delivered to Australia, the Government announced the decision to deploy the Caribou to Vietnam. Such was the sense of urgency to get the Caribous into theatre, that the third and fourth delivery ferry flights from Canada to Australia were redirected to South Vietnam, both arriving at Vung Tau during August to form the RAAF Transport Flight Vietnam (RTFV). The deployment of additional aircraft the following year brought the number of aircraft on strength to seven, and on 1 June 1966 the RTFV was re-designated No 35 Squadron and colloquially known as Wallaby Airlines. The Caribous supported allied military operations throughout Australia's commitment to the war in Vietnam, until their final withdrawal on 19 February 1972.

During service in Vietnam, the Caribou quickly demonstrated the air power capabilities and operational versatility that were to characterise the aircraft's service with the RAAF over the next 45 years. The design of the Caribou enabled the rapid loading and unloading of passengers and cargo from short, rough semi-prepared airfields that were inaccessible to most other aircraft. Range and payload considerations made the Caribou a better option than the rotary wing assets then available. While the Caribou was primarily engaged in short-haul airlift operations, it also performed paradrop, aeromedical evacuation and tactical troop insertions and extractions. The Caribou's ability to utilise rudimentary airstrips meant the aircraft and crews were often operating at the forward edge of the battlespace and under enemy ground fire. The cost to the Caribou fleet was high, with two aircraft lost to accidents and a third to enemy mortar fire. During the deployment to Vietnam, the Caribous transported 42 000 tonnes of freight and 679 984 passengers in 81 500 operational sorties utilising 115 airfields across South Vietnam.

Within three years of withdrawing from Vietnam, the Caribous were involved in the first of many international deployments. During a brief civil war in the former Portugese colony of East Timor in 1975, a Caribou (A4-140 from August to October, and later A4-199) was deployed to support Red Cross relief operations by ferrying supplies

around the country. During that deployment, armed East Timorese soldiers forced the crew of A4-140 at gun point to take off with 54 people on board and fly themselves and other refugees to Australia. A4-140 has the dubious distinction of being the only RAAF aircraft ever hijacked.

In the same year, No 38 Squadron also contributed an aircraft to the United Nations Military Observer Group in India and Pakistan (UNMOGIP). This commitment lasted until late 1978, but in later years the Caribous continued to be used on similar humanitarian tasks, providing support for peacekeeping, nation building (such as survey mapping) and disaster relief efforts throughout South Pacific region. The demanding flying environments of these remote localities often tested the ruggedness of the Caribou. In total, a further four RAAF Caribous were written off as a result of accidents overseas— on one occasion with the tragic loss of 27 people when a Caribou crashed in the mountainous terrain of Papua New Guinea.

The Caribou continued to work hard to the very end of its career. In 1999, the Caribou was at the forefront of the ADF's peace enforcement mission to East Timor. No 86 Wing Detachment 'C', composed of aircraft and personnel drawn from No 35 and No 38 Squadrons, operated two aircraft out of Baucau and later Dili. They remained in country from October 1999 until February 2001, conducting airlift sorties, aeromedical evacuations, information operations and surveillance missions. Not long after returning to Australia from East Timor, the Caribous were once again involved in the ADF's response to an international crisis. Two Caribous formed part of Operation ANODE, the peacekeeping mission to restore civil order to the Solomon Islands. The aircraft returned to Australia a year later, in July 2004, after completing its last international deployment on active service.

The service of the Caribou to Australia has not just been confined to international missions. For almost half a century the Caribou's capability has been on hand to serve Australia in both military and non-military applications. The aircraft has been one of the RAAF's

leading assets in response to natural disasters, search and rescue, aeromedical evacuations, and even security patrols over Bass Strait oil rigs. It has transported state police, fire fighters and visiting royalty. Throughout its entire service life, the Caribou has provided extensive support to the entire ADF, particularly airborne and tactical transport support to Army and Special Air Service training exercises.

The Caribou's service to Australia is significant beyond just the airlift roles that characterised its main employment. The effects generated in its deployments have underscored domestic security and safety, and provided strategic reach into the wider international region, enabling Australia to demonstrate its commitment to supporting peace and stability throughout South East Asia and the South Pacific. In the carriage of hundreds of thousands of people and tens of thousands of tonnes of humanitarian aid, from first flight till last, the Caribou provided Australia with a tactical airlift capability second to none.

LIST OF CONTRIBUTORS

List of Contributors

Burns, Squadron Leader Dave – 119*, 128, 130*

Clark, Dr Chris – 112*, 114, 116*, 119*, 134, 136*, 138, 144*

Clarke, Mr David – 110, 116*, 121, 132

Harrison, Squadron Leader Richard – 111, 122, 123

James, Mr Martin – 112*, 125

Kainikara, Dr Sanu – 120

Layton (Retd), Group Captain Peter – 135

Loch, Wing Commander Andrew – 143

Mitchell, Mr Rhett – 136*, 141, 142, 144*

Morrall, Group Captain Phil – 130*

Murray, Lieutenant Colonel Brian – 140

Nicholas, Wing Commander Paul – 113, 115

Weller, Wing Commander Greg – 109, 117, 118, 124, 126, 127, 129, 131, 133, 137, 139

* Joint Author

INDEX