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2016 RAAF AIR POWER CONFERENCE

Multi-Domain Integration – Enabling Future Joint Success

NATIONAL CONVENTION CENTRE, CANBERRA

15–16 MARCH 2016

Edited by

Squadron Leader David Burns

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THE AIR POWER DEVELOPMENT CENTRE

The Air Power Development Centre (APDC) was established by the Royal Australian Air Force in August 1989 at the direction of the then Chief of the Air Staff. Originally known as the Air Power Studies Centre, it was renamed the Aerospace Centre in 2000 and then became the Air Power Development Centre in 2004.

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 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.

Over the years, the APDC has evolved into an agency that provides subject matter expertise for air and space power education and has a well-developed publication program.

Comment on these proceedings or inquiry on any other air power–related topic is welcome and should be forwarded to:

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PREFACE

The papers and PowerPoint images contained herein are essentially as they were presented at the conference, with only minor changes to achieve some consistency in layout, spelling and terminology. Words in square brackets [ ] were added during the editing process for clarity.

Copies of the edited papers and transcripts were sent to the authors for comment and endorsement before publication.

David Burns
Editor
Air Power Development Centre
Canberra

November 2016

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NOTES ON CONTRIBUTORS

UNCLE HARRY ALLIE

Harry Allie was born in Charters Towers, QLD and is a descendant of the Gudjala Traditional Owners, and still has close ties to the Charters Towers/Townsville area.

Harry has been a resident of the Bankstown area for the last 30 years. He also served 23 years in the Royal Australian Air Force, and after leaving, was employed in a managerial role in Defence industry. From there, Harry joined the Australian Public Service where he was involved with programs for Indigenous people. He retired from the Australian Public Service in July 2010.

Although Harry has retired from the workforce, he is actively involved with Indigenous issues not only in his local area, but also across the wider Sydney area, and the national level.

Harry is tremendously proud of the opportunities and experiences which he was able to access, and wherever possible, now passes on that knowledge to try to improve the position and opportunities of all Aboriginal and Torres Strait Islander people.

AIR MARSHAL LEO DAVIES, AO, CSC

Air Marshal Leo Davies joined the Royal Australian Air Force as a cadet navigator in 1979 and graduated to fly P-3B and P-3C Orion aircraft with No 11 Squadron at Edinburgh in South Australia. In 1987, Air Marshal Davies completed pilot training and after completing F-111 conversion course was posted in 1988 to No 1 Squadron at RAAF Base Amberley.

In 1990, Air Marshal Davies was posted to Cannon Air Force Base, New Mexico, to fly F-111D aircraft on exchange with the United States Air Force. On return to Australia in 1993, he was posted to No 1 Squadron as the Operations Flight Commander followed by one year as Operations Officer at Headquarters No 82 Wing during 1996. After a posting in 1997 and 1998 as the Executive Officer at No 1 Squadron, he completed RAAF Command and Staff Course. In 2000, he commenced two years in Capability Systems within Defence Headquarters.

In 2002 and 2003, Air Marshal Davies' long association with No 1 Squadron was rekindled when he returned as Commanding Officer and achieved 2000 hours flying the F-111. He was Staff Officer to the Chief of Air Force during 2004, before taking up the post of Officer Commanding No 82 Wing at RAAF Base Amberley, where he was awarded a Conspicuous Service Cross (CSC) for outstanding achievement.

Air Marshal Davies worked as Director Combat Capability within Air Force Headquarters in 2006 and 2007, during which time he was deployed to the Middle East to work in the Combined Air Operations Centre. Between 2008 and 2010, Air Marshal Davies was the Director General Capability Planning within Air Force Headquarters. He was then posted to Washington as the Air Attaché, where he was awarded the United States Legion of Merit – Officer. Air Marshal Davies returned from Washington in January 2012 to take up his appointment as Deputy Chief of Air Force.

Air Marshal Davies was appointed an Officer of the Order of Australia (AO) in 2014 for distinguished service to the Australian Defence Force in senior command and staff appointments. He was promoted to Air Marshal and appointed Chief of Air Force on 4 July 2015.

He is married to Rhonda who is a Registered Nurse and they have two children—Erin who is also a Registered Nurse (midwife) and Jacob.

SENATOR THE HONOURABLE MARISE PAYNE

Senator the Honourable Marise Payne is Australia's 53rd Minister for Defence. She was sworn in on 21 September 2015 after previously serving as the Minister for Human Services for two years.

Senator Payne has almost two decades of Parliamentary experience after filling a casual vacancy in 1997 to represent the people of New South Wales in the Australian Senate. During her Parliamentary career, she has served as Shadow Minister for Indigenous Development and Employment, Shadow Minister for the Council of Australian Governments and Shadow Minister for Housing.

She has been a member of a number of Joint and Senate committees, including 12 years on the Joint Standing Committee on Foreign Affairs, Defence and Trade, including a period as Chair of its Human Rights subcommittee.

Prior to entering Parliament, Minister Payne worked as a political adviser before working as a public affairs adviser in the finance industry. A member of the Liberal Party since 1982, she was the National Young Liberal Movement's first female president. She also served on the NSW Liberal State Executive for 10 years and at branch and electorate levels.

She and her partner, NSW Minister for Trade, Tourism and Major Events, Stuart Ayres, live in western Sydney.

DR ALAN STEPHENS, OAM

Dr Alan Stephens is a Fellow of the Sir Richard Williams Foundation and a post-graduate supervisor at the University of New South Wales, Canberra. Previously, he has been a senior lecturer at University of NSW, the official Royal Australian Air Force Historian, an advisor on foreign affairs and defence in the Australian Federal Parliament, and a pilot in the RAAF where his experience included a tour in Vietnam and command of an operational squadron.

Dr Stephens has lectured and published extensively. His books include *Going Solo: The Royal Australian Air Force 1946-1971; Making Sense of War: Strategy for the 21st Century;* and *A Centenary History of the Royal Australian Air Force*. Recently he has contributed chapters on General George Kenney, the Korean War, Asian-Pacific Air Power, and Fifth-Generation Strategy to John Andreas Olsen's series of air power books. His work has been translated into some twenty languages.

In 2008, Dr Stephens was awarded Medal of the Order of Australia for his contribution to military history.

DR JOHN LEE

Dr John Lee is a senior fellow at the Hudson Institute in Washington, DC and an adjunct associate professor at the Australian National University. He is an internationally recognised expert in the Chinese political-economy, and the foreign and economic policies of China, countries in South-East Asia, Australia and the United States. His recent works include strategic and economic futures of Asia for prime ministerial and ministerial level officials in Japan, and for senior national security staff in the United States White House and Department of Defense, as well as strategic and defence planning projects for senior Australian officials. He also provides occasional advice to boards and executive officers of financial and asset management firms in Australia and the US on these issues.

Dr Lee received his Masters and Doctorate in International Relations from the University of Oxford.

GENERAL F JAVIER GARCIA ARNAIZ

Nominated by His Majesty the King, the 4-star General (General del Aire) F Javier García Arnaiz began his duties as the twentieth Spanish Air Force Chief of Staff on 27 July 2012.

Under the direct authority of the Minister of Defense, he is responsible for the organisation, training and equipping of 24 000 active-duty and civilian forces. He is also member of the National Defense Council.

General Arnaiz was born and primarily educated in Madrid. He joined the Spanish Air Force in 1972 and, after completing his studies in the Spanish Air Force Academy, he was posted to his first assignment in the 12th Fighter Wing, Torrejon Air Base, at that time equipped with F-4C. Since then, he had the opportunity to develop his fighter pilot career at three different operational wings: the aforementioned 12th Wing (F-4 and F-18), the 15th Fighter Wing (F-18) at Zaragoza Air Base and the 21st Fighter Wing (F-18) at Morón Air Base. In 2000, General Arnaiz was nominated Commander of the 12th Fighter Wing, flying the F-18 aircraft. He has accumulated around 4000 flying hours, mainly on the F-4 and the F-18.

In addition to his pilot activities, General Arnaiz has been assigned to several staff officer positions in Air Combat Command, the Chief of Staff Office and the Air Force Staff.

His international experience is also wide. Among others, he has had the following assignments: Balkans Operations, UNPROFOR Air Liaison Officer in Bosnia Herzegovina, Spanish representative to CAOC Vicenza for Operation *Deliberate Force*, Commander of the Forward Support Base Herat, Afghanistan, in the ISAF mission and in 2006 he was designated Deputy Spanish Military Representative to the NATO and EU Military Committees, in Brussels.

In 2010, General Arnaiz became Deputy Chief of Staff, and thereby responsible for the main organisation providing advice to the Chief of Staff. From this position, he was promoted to Chief of Staff two years later.

In January 2016, he was appointed Director of the European Air Group.

General Arnaiz is married and has two children.

GENERAL LORI ROBINSON

General Lori J Robinson is Commander, Pacific Air Forces (PACAF); Air Component Commander for US Pacific Command; and Executive Director, Pacific Air Combat Operations Staff, Joint Base Pearl Harbor-Hickam, Hawaii. PACAF is responsible for Air Force activities spread over half the globe in a command that supports more than 46 000 airmen serving principally in Japan, Korea, Hawaii, Alaska and Guam.

General Robinson entered the Air Force in 1982 through the ROTC program at the University of New Hampshire. She has served in a variety of positions as an air battle manager, including instructor and commander of the Command and Control Operations Division at the Air Force Fighter Weapons School, as well as Chief of Tactics in the 965th Airborne Warning and Control Squadron. She has commanded an operations group, a training wing, an air control wing and has deployed as Vice Commander of the 405th Air Expeditionary Wing, leading more than 2000 airmen flying B-1 Lancer, KC-135 Stratotanker and E-3 Sentry in Operations *Enduring Freedom* and *Iraqi Freedom*.

General Robinson was an Air Force Fellow at The Brookings Institution in Washington, DC and served at the Pentagon as Director of the Secretary of the Air Force and Chief of Staff of the Air Force Executive Action Group. She has also been Deputy Director for Force Application and Support, Directorate of Force Structure, Resources and Assessment, Joint Staff, the Pentagon. Following this, General Robinson was Director, Legislative Liaison, Office of the Secretary of the Air Force. General Robinson also served as the Deputy Commander, US Air Forces Central Command; Deputy, Combined Force Air Component Commander, US Central Command, Southwest Asia. Prior to her current assignment, General Robinson was the Vice Commander, Air Combat Command, Langley Air Force Base, Virginia.

DR SANU KAINIKARA

Dr Sanu Kainikara is the RAAF's Air Power Strategist at the Air Power Development Centre.

He is a former fighter pilot of the Indian Air Force (IAF) who retired as a wing commader after 21 years of commissioned service. He has vast operational flying experience in a number of modern fighter aircraft and has flown over 4000 hours. He has flown the MiG-21, -23, -25, -27, -29, Jaguar and Hunter aircraft. Dr Kainikara is a qualified flying instructor (A2), a graduate and directing staff of the Fighter Weapons School and was the commanding officer of an operational fighter squadron.

Dr Kainikara is the recipient of the Air Force Cross and two commendations from the IAF Chief of Air Staff and also a recipient of the RAAF Chief of Air Force's Commendation.

After leaving active duty with the Indian Air Force, he worked for four years as the senior analyst of a US training team in the Middle East, specialising in fighter operations, weapons and tactics, before migrating to Australia. He has presented papers at a number of international conferences and published papers on national security, strategy and air power in various international professional journals.

He is the author or editor of 11 books on air power: *Papers on Air Power* (2006), *Pathways to Victory* (2007), *Red Air: Politics in Russian Air Power* (2007), *Australian Security in the Asian Century* (2008) *A Fresh Look at Air Power Doctrine* (2008), *Seven Perennial Challenges to Air Forces* (2009), *Friends in High Places* (2009), *The Art of Air Power: Sun Tzu Revisited* (2010), *At the Critical Juncture* (2011), *Essays on Air Power* (2012) and The Bolt from the Blue (2013). He is the author of several books on Indian history.

Dr Kainikara was a lecturer in Aerospace Engineering at the RMIT University, Melbourne (1999-2001) and is currently an adjunct professor at the UNSW @ADFA in the School of Humanities and Social Sciences. He is also the inaugural distinguished fellow at the Institute for Regional Security based in Canberra.

He has also been a guest lecturer in the military colleges of USA, UK, Finland, Turkey, Saudi Arabia, India, Malaysia, Indonesia, Philippines and New Zealand.

Dr Kainikara is a graduate of the Indian National Defence Academy, Defence Services Staff College and the College of Air Warfare. He holds two bachelors degrees (Strategic Studies and Aerospace Engineering) and a Master of Science in Defence and Strategic Studies from the University of Madras. His doctorate in International Politics was awarded by the University of Adelaide.

AIR VICE-MARSHAL MEL HUPFELD, AO, DSC

Air Vice-Marshal Mel Hupfeld was born in Sydney in 1962. He joined the Royal Australian Air Force as an RAAF Academy cadet in January 1980, winning the Flying Prize for his year and graduating with a Bachelor of Science degree in 1983.

Air Vice-Marshal Hupfeld's early career was spent in a variety of flying positions on Mirage and F/A-18 aircraft, primarily with No 3 Squadron (3SQN) and No 2 Operational Conversion Unit (2OCU), before qualifying as a Fighter Combat Instructor in 1989. Following a period of service as B Flight Commander, 3SQN, he was appointed as the Executive Officer of 2OCU in 1995.

In 1997, Air Vice-Marshal Hupfeld was selected to attend the Royal Air Force Advanced Staff Course, graduating with a Master of Arts in Defence Studies from King's College in London, before taking up post as a Deputy Director in the Aerospace Development Branch.

In 2001, Air Vice-Marshal Hupfeld took command of No 75 Squadron (F/A-18s) and led the squadron in operations in Middle East on Operations *Bastille* and *Falconer*. In recognition of his squadron's performance in air combat operations over Iraq in 2003, he was awarded the Distinguished Service Cross and his squadron was recognised with a Meritorious Unit Citation.

On promotion to Group Captain in January 2004, Air Vice-Marshal Hupfeld was appointed Director Aerospace Combat Development in the Australian Defence Headquarters, before accepting appointment as Officer Commanding No 81 Wing in January 2006. Promoted to Air Commodore in November 2007, he became the Director of the Combined Air Operations Centre in the Middle East Area of Operations, before returning to Australia as the Director General Air / Director General Air Command Operations in March 2008. In December 2009, he took command of Air Combat Group where he oversaw all of the RAAF's fast-jet combat aircraft.

Air Vice-Marshal Hupfeld was promoted and appointed Air Commander Australia on 3 February 2012. In this position he provided specialist air advice on raise, train and sustain issues to the joint environment. In September 2014, he became Head Capability Systems Division in the Capability Development Group and took over as acting Chief Capability Development Group in mid-August 2015. Later that year, he was appointed an Officer of the Order of Australia (AO) for distinguished service to the Australian Defence Force in senior command and staff appointments.

Air Vice-Marshal Hupfeld is married to Louise, and his interests include mountain biking, running, fishing, light aircraft, and sailing.

VICE ADMIRAL TIM BARRETT, AO, CSC, RAN

Vice Admiral Tim Barrett joined the Royal Australian Navy in 1976 as a seaman officer and later specialised in aviation. He assumed command of the Royal Australian Navy on 1 July 2014.

A dual-qualified officer, Vice Admiral Barrett served in Her Majesty's Australian (HMA) Ships *Melbourne, Perth* and *Brisbane* and HMS *Orkney* as a seaman officer and then as flight commander in HMA Ships *Stalwart, Adelaide* and *Canberra*. His staff appointments include Deputy Director Air Warfare Development, Director Naval Officers' Postings and Director General of Defence Force Recruiting.

He has served as Commanding Officer 817 Squadron, Commanding Officer HMAS *Albatross*, Commander Australian Navy Aviation Group, Commander Border Protection Command and most recently as Commander Australian Fleet.

Receiving a Conspicuous Service Cross in 2006 for his achievements in naval aviation, Vice Admiral Barrett became a Member of the Order of Australia in 2009 for his service as Director Naval Officers' Postings and Commander Navy Aviation Group. He was made an Officer of the Order of Australia in 2014 for his leadership of Border Protection Command and the Australian Fleet.

Vice Admiral Barrett holds a Bachelor of Arts in Politics and History and a Masters of Defence Studies, both from the University of New South Wales. He recently completed the Advanced Management Program at Harvard Business School.

Vice Admiral Barrett and his wife, Jenny, have two daughters.

LIEUTENANT GENERAL ANGUS CAMPBELL, DSC, AM

Lieutenant General Angus Campbell joined the Australian Army in 1981, graduating from the Royal Military College–Duntroon in 1984. He was assigned to the Royal Australian Infantry Corps and initially served as a platoon commander in the 3rd Battalion (Parachute), The Royal Australian Regiment (3RAR).

He served in troop and squadron command appointments within the Special Air Service Regiment. In 2001, he was appointed the Commanding Officer of the 2nd Battalion, The Royal Australian Regiment and deployed with the battalion group to East Timor, as a component of the United Nations Transitional Administration East Timor.

Lieutenant General Campbell has also served in a range of staff appointments including as Aide-de-Camp to the Chief of Army, as a strategic policy officer in Army Headquarters, an instructor at the Australian Command and Staff College and as Chief of Staff to the Chief of the Defence Force.

In late 2005, he joined the Department of Prime Minister and Cabinet as a First Assistant Secretary to head the Office of National Security and was subsequently promoted to Deputy Secretary and appointed to the position of Deputy National Security Adviser. In these roles, he was responsible for the preparation of advice to the Prime Minister on national security matters and coordinating the development of whole-of-government national security policy.

Upon his return to the Australian Defence Force in early 2010, he was appointed to the rank of Major General and led the Military Strategic Commitments staff in Defence headquarters until January 2011, when he assumed command of Australian forces deployed in the Middle East. He subsequently served as Deputy Chief of Army until September 2013 when he was given command of the Joint Agency Task Force responsible for the implementation of Operation Sovereign Borders.

Lieutenant General Campbell was appointed Chief of the Australian Army on 16 May 2015. He holds a Bachelor of Science (Honours) from the University of New South Wales, a Master of Philosophy in International Relations from Cambridge University and is a graduate of the Australian Army Command and Staff College.

Lieutenant General Campbell's hobbies include hiking, distance running, military history and gardening. He is married to Stephanie and they have two adult children.

DR PAULA G THORNHILL

Dr Paula G Thornhill is a senior political scientist at the RAND Corporation and Director of the Strategy and Doctrine Program within RAND Project AIR FORCE.

She retired from the US Air Force as a brigadier general in 2009. Her last assignment was as the Commandant of the Air Force Institute of Technology at Wright-Patterson Air Force Base (2006-09). Just prior to her time as Commandant, Thornhill served as the Principal Director for Near Eastern and South Asian Affairs in the Office of the Secretary of Defense. In addition, she has taught at the Air Force Academy and been assigned to the Air Staff, the Joint Staff, US Strategic Command, and the Office of the Secretary of Defense. Thornhill served as the Dean of Faculty and Academic Programs at the National War College and as special assistant to the 15th Chairman of the Joint Chiefs of Staff, General Richard B. Myers, USAF. She is a member of the USAF Academy Board of Visitors, and she is also an adjunct professorial lecturer in strategic studies at the Johns Hopkins University School of Advanced International Studies.

Dr Thornhill has a Bachelor of Science degree from the US Air Force Academy, a Master of Arts in history from Stanford University, and a Doctor of Philosophy in history from Oxford University.

MR AUGUST COLE

August Cole is an author and analyst specialising in national security issues.

August is a non-resident senior fellow at the Brent Scowcroft Center on International Security at the Atlantic Council. He is the Director of the Art of Future War project, which explores narrative fiction and visual media for insight into the future of conflict. He is also writer-in-residence at Avascent, an independent strategy and management consulting firm focused on the defence and aerospace sectors.

His fiction writing tackles themes at the core of American foreign policy and national security in the 21st century. His first book *Ghost Fleet: A Novel of the Next World War* is a collaborative novel written with Peter W Singer and was published in June 2015. He also has written about the automotive and airline industries, as well as the internet economy.

From 2007 to 2010, August reported on the defence industry for the Wall Street Journal, covering companies ranging from Boeing to Blackwater, as well as broader defence policy and political matters. From 1998 to 2006, he worked as an editor and a reporter for MarketWatch, a financial news website, where he began covering defence issues, including private military contractors.

August was named to The Journal of Financial Reporting's Top 30 Journalists Under 30 in 2002 and 2003.

He received a Bachelor of Arts degree from the University of Pennsylvania and a Master in Public Administration degree from the John F. Kennedy School of Government at Harvard University. He is also a member of the International Institute for Strategic Studies.

August lives in the Boston area, where he is an avid rower and cyclist.

AIR VICE-MARSHAL GAVIN TURNBULL, AM

Air Vice-Marshal Turnbull completed his basic pilot training in 1984 and spent the next four years flying UH-1H helicopters as a member of No 9 Squadron, Amberley. This period included a short tour with the Australian Contingent Multinational Force and Observers—a peacekeeping force based in the Middle East.

In 1989, he served as a flying instructor at No 2 Flying Training School at Pearce, WA. Two years later, he transferred to fast jets and trained on Macchi and then F/A-18 at Williamtown, NSW. Following training, he was posted to No 75 Squadron in Tindal, NT for three and a half years as both line aircrew and as a flight commander. The following two years were spent in Headquarters Air Command where he was responsible for the planning of fast jet major exercises and international deployments.

Air Vice-Marshal Turnbull was posted as Executive Officer No 77 Squadron (F/A-18) in 1998, followed by Navy Command and Staff Course in Sydney. He returned to No 77 Squadron as Commanding Officer from January 2002 until December 2004. His staff appointments included Capability Management and Development role within Headquarters Tactical Fighter Group and as Director, Airworthiness Coordination and Policy Agency

Air Vice-Marshal Turnbull deployed to the Middle East in March 2007 as Chief of Staff in the Australian National Headquarters in Baghdad followed by appointment as Officer Commanding No 81 Wing (F/A-18) in November 2007. He again deployed to the Middle East in January 2012 as Director, US Central Command 609th Combined Air Operations Center. He returned to Australia in May 2012 to take up appointments as Director General Air Command Operations (at Headquarters Air Command) and Director General Air (at Headquarters Joint Operations Command).

Air Vice-Marshal Turnbull was promoted and appointed to his current position as the Air Commander Australia on 5 September 2014.

MR KENNETH A SHAW

Ken Shaw is Vice President and Managing Director of Boeing Defence Australia.

He has been Vice President of Supplier Management for Boeing Military Aircraft and previously held the same position within Global Services and Support. Since joining Boeing in 1992, he has held numerous positions within Supplier Management and Procurement, supporting a variety of defence and space programs.

Ken began his career in major subcontracts at Northrop Corporation's B-2 division and in 1992, moved to Boeing to join the C-17 Globemaster III program. He also was responsible for leading both the Avionics/Flight Controls and Aircraft Systems organisation and the Outside Manufacturing and Strategic Contracting organisation across multiple Southern California sites.

Ken holds a Master of Business Administration degree from the Marshall School of Business at the University of Southern California and a bachelor's degree from the University of California, Los Angeles.

GROUP CAPTAIN STUART BELLINGHAM, CSC

Group Captain Stuart Bellingham was born in Sydney, NSW and completed his secondary schooling at Newcastle High School. After graduating from the Australian Defence Force Academy in December 1989 with a Bachelor of Science, he completed pilot training and was posted to No 37 Squadron to fly C-130E Hercules aircraft. After this, he flew HS748 aircraft at No 32 Squadron at East Sale, including some time as deputy flight commander.

After a tour as a flying instructor on PC-9 aircraft at No 2 Flying Training School at Pearce, WA, Group Captain Bellingham was posted to No 77 Squadron as the Forward Air Control Flight flying instructor and later as flight commander. In 2002, he was appointed the first commanding officer of Forward Air Control Development Unit. In August 2002, he escorted the first ten ADF Special Forces joint terminal attack controllers (JTACs) into Kuwait to have them accredited to US standards prior to deploying on operations in Afghanistan.

In 2003, Group Captain Bellingham served as the Staff Officer for Air Operations Doctrine at the ADF Warfare Centre. During this posting, he was deployed as an air liaison officer and targets officer in support of Special Operations Task Group in Western Iraq. He was later posted as Executive Officer at No 2 Squadron preparing for the arrival of the Wedgetail AEW&C aircraft. In Jan 2008, he was appointed Director of the Air Land Integration Office which was reformed as the Air Surface Integration Directorate–Joint Fires.

In 2011, Group Captain Bellingham became Commanding Officer No 4 Squadron at a time when the unit's role focused on joint fires and air surface integration. This was followed by a posting as Director, Air and Space Operations Centre at Headquarters Joint Operations Command.

In June 2015, he deployed to the Middle East as Commander Air Task Group 630 on Operation *Okra*. On his return, he was posted to his current post as Officer Commanding No 42 Wing. Group Captain Bellingham was awarded the US Bronze Star and the Conspicuous Service Cross.

He is married with two children and continues to enjoy his sport, in particular soccer. His other interests include fishing, golf and camping.

GROUP CAPTAIN JAKE CAMPBELL

Group Captain Andrew 'Jake' Campbell joined the RAAF in 1986 and, following navigator training, commenced flying the P-3C Orion aircraft with No 11 Squadron. This was followed by a tour instructing on the P-3C aircraft at No 292 Squadron. He then completed the Aerospace Systems Course in Winnipeg, Canada.

Upon his return from Canada, Group Captain Campbell commenced electronic warfare flight test duties at Aircraft Research and Development Unit (ARDU) before being posted to the AP-3C Orion upgrade project in Texas. After four years on the project, he was posted as C Flight Commander at No 10 Squadron which was introducing the AP-3C aircraft into operational service at that time.

Group Captain Campbell then worked in Capability Development Group on AIR 7000—the Orion replacement project which included developing concepts for the employment of high altitude, long endurance UAVs [unmanned aerial vehicles]. After Australian Command and Staff Course in 2006, he worked on bringing the new air combat officer category and training systems into service. He was then made Commanding Officer, School of Air Warfare at East Sale.

In 2011, Group Captain Campbell returned to the AP-3C world as the Chief of Staff at Headquarters No 92 Wing and also completed an operational tour in the Middle East as Executive Officer to the Australian Air Component Commander. From January 2012, he assumed command of Information Warfare Wing at RAAF Edinburgh in South Australia, overseeing the Air Force's intelligence, electronic warfare and cyber capabilities.

Group Captain Campbell joined the Plan *Jericho* team in January 2015.

He is married to Rachel and they have two daughters, Taylor and Hannah.

GROUP CAPTAIN PHILLIP CHAMPION

Group Captain Champion joined the RAAF in 1983 as an airborne electronics analyst. He had two tours with No 10 Squadron flying P-3C aircraft with an instructional tour with No 292 Squadron in between. In 1991, he was commissioned in the air electronics officer category and following officer training, rejoined No 10 Squadron.

In 1993, Group Captain Champion completed tours as an instructor at the Australian Joint Acoustic Analysis Centre at HMAS *Albatross* and later at the ADF Warfare Centre. He then completed the inaugural Australian Command and Staff Course in Canberra in 2001. Tours as a flight commander at No 11 Squadron, Executive Officer at No 11 Squadron and Staff Officer Capability Development at Headquarters Maritime Patrol Group then followed.

After being the ADF exchange officer at Headquarters Joint Forces in New Zealand, GPCAPT Champion was posted as Chief of Staff at Headquarters No 92 Wing before commanding No 11 Squadron from 2009 to 2012. He was promoted and posted to the Supreme Headquarters Allied Powers in Europe (SHAPE) in Mons, Belgium where he oversaw NATO strategic operations in Afghanistan.

Group Captain Champion commenced his current posting as Officer Commanding No 92 Wing in January 2015.

He is married to Angela and has two grown-up daughters.

GROUP CAPTAIN STEWART DOWRIE

Group Captain Stewart Dowrie was born in Brisbane and grew up in North Queensland. After being an Air Training Corps cadet for several years, he entered the Australian Defence Force Academy in 1987. He graduated in 1989 with a Bachelor of Science and underwent pilot training. After flying HS748 aircraft with No 32 Squadron, he was posted back to the Academy as the Divisional Officer for the Advanced Student Squadron.

In 1996, Group Captain Dowrie flew C-130H aircraft with No 36 Squadron at RAAF Richmond, NSW, taking part in many operations including the 1997 Cambodian evacuations, East Timor evacuations in 1999 and missions to the Middle East and Afghanistan. This was followed by a tour as a flight commander and Executive Officer back at No 32 Squadron, flying the HS748 and its replacement, the King Air 350.

In 2007, he was a staff officer at Headquarters Joint Operations Command assisting with the planning for ADF operations in Afghanistan. He attended Command and Staff College in 2008 and subsequently ran the project to introduce the King Air 350 into No 38 Squadron.

In 2011, Group Captain Dowrie assumed command of No 38 Squadron. At the end of his command tour, this squadron was awarded the 2013 Pathfinder Squadron of the Year and the 2013 Air Force Safety Award. Group Captain Dowrie was posted to Headquarters Air Mobility Group at RAAF Richmond as the Staff Officer Capability Management, and later, to his current appointment as Chief of Staff.

Group Captain Dowrie holds a Bachelor of Science and a Master of Arts in Strategy and Policy, both from University of NSW. He is married to Kate and has a baby daughter, Emily.

WING COMMANDER DAVID HOWARD

Wing Commander David Howard was born in Port Fairy, Victoria in 1970, entered the Royal Australian Air Force in 1988 and completed pilot training. He flew C-130E Hercules with No 37 Squadron for several years, interspersed with postings to aviation physiology and operations staff roles in Headquarters Air Lift Group and Headquarters No 86 Wing.

In 1998, he was posted to the School of Air Navigation, later No 32 Squadron, to fly the B200 Super King Air and assumed the B Flight Commander position in 2000. He spent two years as the Air Liaison Officer to the 1st Brigade at Robertson Barracks in Darwin and remained in Darwin as the Executive Officer of No 321 Combat Support Squadron. In 2006, he moved to Staff Officer Operations at the Australian High Commission in Port Moresby, followed by Joint Command and Staff College in 2008.

His staff officer appointments in Headquarters Air Lift Group were as Deputy Director of the Air Mobility Control Centre and Staff Officer Capability Development. He was the Air Liaison Officer to the 1st Division at Gallipoli Barracks in Brisbane

Wing Commander Howard's operational deployments include Joint Task Force Commander for Operation *Kokoda Assist*—the operation to recover victims of an aircraft crash in Papua New Guinea; Commander Australian Contingent for Operation *Pacific Assist* providing relief aid after an earthquake and tsunami in Japan, and as Executive Officer and subsequently Commander of the Joint Task Force 633 Air Component in the Middle East In 2013/14.

Wing Commander Howard is currently posted to Headquarters Combat Support Group as Staff Officer Capability Management.

He lives in Brisbane with his partner, Nancy, and their two sons Bren and Jude.

GROUP CAPTAIN STEPHEN LONGBOTTOM

Group Captain Stephen Longbottom entered the Royal Australian Air Force Academy in 1969 and, after graduation, underwent pilot training. He has flown C-130 Hercules and Boeing 707 aircraft in the airlift role as well as being a qualified flying instructor on Macchi MB326 aircraft.

Group Captain Longbottom held staff appointments in the flying training and capability generation specialties. He commanded No 33 Squadron (B707s) at a time when the Air Force was developing its air-to-air refuelling capability and he commanded the No 86 Wing detachment that airlifted the Australian force from Somalia to Australia at the end of their duty with UNOSOM.

His representational posts included two years on the Air Attaché staff in the Australian embassy in Washington, DC.

In 1996, Group Captain Longbottom transferred to the RAAF Reserve. During a career in commercial international heavy freighter operations and domestic airlines, he remained engaged in flight- and simulation-based aviation training for pilots in the civil sphere. Since 2008, he has been supporting capability development of Air Combat Officer and Aviation Warfare Officer training within Air Force Training Group and Air Training Wing.

Group Captain Longbottom holds a Bachelor of Science from University of Melbourne. He is married and lives near Melbourne.

GROUP CAPTAIN TOBYN BEARMAN

Group Captain Tobyn Bearman graduated from the Australian Defence Force Academy in 1991 with a Bachelors Degree in Aerospace Engineering from the Royal Melbourne Institute of Technology and has served in maintenance, flight test, engineering and staff positions in Darwin, Adelaide, Madrid and Canberra. His postings have included roles in aircraft stores compatibility engineering, the conduct of flight test and the design and development of flight test instrumentation. Highlights of his career include Commanding Officer and Chief Engineer of Aerospace Engineering Squadron and Evaluation Manager for the KC-30 acquisition project. Prior to his current post, Group Captain Bearman was Director Enabling Capabilities in Capability Planning Branch, Air Force Headquarters.

Group Captain Bearman deployed to Afghanistan and was embedded in the NATO-led ISAF with the US Army 10th Mountain Division in Regional Command (South) as Chief–Stability Planning and Coordination.

Group Captain Bearman is a graduate of the Advanced Systems Engineering Course, RAF College Cranwell and has Masters Degrees in Engineering and Engineering Science from Loughborough College and University of New South Wales. He is a Fellow of the Institute of Engineers Australia.

Group Captain Bearman currently commands the Test and Evaluation Directorate, RAAF Air Warfare Centre and is responsible for conduct of RAAF developmental and operational test and evaluation activities.

GROUP CAPTAIN PETE MITCHELL, OAM

Group Captain Pete Mitchell joined the RAAF in January 1993 and graduated from the Australian Defence Force Academy in 1995 after completing an Arts degree in Management and Geography. After training as a pilot, he completed lead-in fighter training before being posted to fly F/A-18 Hornets at No 75 Squadron at RAAF Tindal in the Northern Territory.

Group Captain Mitchell held a staff officer post at Headquarters Air Command before being deployed to the Middle East in 2003. He deployed as part of the first headquarters detachment for Operation *Iraqi Freedom* and was awarded a Medal of the Order of Australia for his service in the operation. On his return to Australia, GPCAPT Mitchell flew F/A-18 aircraft with No 77 Squadron at RAAF Williamtown. In 2004, he started a two-year exchange flying F/A-18 aircraft with the US Marine Corps.

In 2007, Group Captain Mitchell became Commanding Officer Forward Air Control Development Unit at RAAF Williamtown. This was the first non-US unit to be accredited as a Joint Forces Command–recognised joint terminal attack controller (JTAC) training organisation and was responsible for the training and certification of all ADF JTACs. This tour was followed by a posting as Staff Officer Airworthiness and Capability Management at Headquarters Air Combat Group.

From 2010 to 2012, Group Captain Mitchell commanded the Joint Electronic Warfare Operational Support Unit, providing EW analysis, reprogramming and countermeasures support to ADF platforms. This tour included a four-month period as Officer Temporarily Commanding Information Warfare Wing.

In late 2012, Group Captain Mitchell returned to Hornet flying when he was appointed Commanding Officer No 75 Squadron. From March to September 2015, GPCAPT Mitchell led his squadron on the first 'classic' Hornet rotation deployed on Operation *Okra* in the Middle East and flew the first RAAF operational mission into Syria in mid-September 2015.

Group Captain Mitchell is currently the Director of Plan *Jericho* at Air Force Headquarters.

Group Captain Mitchell has over 2500 flight hours in military aircraft and lives in Canberra with his wife Emma and sons Hayden and Levi. His interests include cycling and camping.

MR BERNARD SALT

Bernard Salt is a Melbourne-based partner with the global advisory firm KPMG where he founded the specialist advisory business, KPMG Demographics.

Bernard writes two weekly columns for *The Australian* newspaper that deal with social, generational and demographic matters. For more than a decade, he has been a regular speaker on the Australian corporate speaking circuit. He is perhaps best known for his penchant for identifying and tagging new tribes and social behaviours such as 'the seachange shift', 'the man drought', 'pumcins' and 'the goats cheese curtain'.

He is an adjunct professor at Curtin University Business School and he holds a Master of Arts degree from Monash University.

Bernard has popularised demographics through his books, columns and media appearances for 25 years. He is the author of six books beginning with *The Big Shift* published in 2001 through to his most recent work *More Decent Obsessions* published in 2014.

AIR VICE-MARSHAL WARREN MCDONALD, AM, CSC

Air Vice-Marshal Warren McDonald was born in Hay, NSW and joined the RAAF at the age of 15 as an apprentice motor transport fitter. In 1989, he underwent pilot training and was commissioned. His first flying tour on the P-3C Orion at No 11 Squadron was followed by a posting to Canada to fly the CP-140 Aurora with 415 Squadron.

After a further tour flying the P-3C Orion with No 10 Squadron, he was posted to No 92 Wing's Maritime Test and Evaluation Unit to introduce the AP-3C Orion into service. In 2001, he served as a flight commander at No 10 Squadron. Moving to Butterworth, Malaysia, he commanded Detachment A which supported AP-3C operations in South-East Asia. After completing Australian Command and Staff Course in 2005, he was made Deputy Director, Air 7000 Phase 1—the project to replace the Orion.

In 2007, Air Vice-Marshal McDonald was appointed Commanding Officer of No 11 Squadron, becoming Officer Commanding No 92 Wing two years later. October 2011 saw him deployed as the Australian Air Component Commander for Joint Task Force 633 in support of Operation *Slipper* in the Middle East. Upon his return from the Middle East, he was made Director General Capability Planning–Air Force, before being appointed to command Air Mobility Group.

In July 2015, Air Vice-Marshal McDonald commenced his current position as Deputy Chief of Air Force.

He has over 5000 hours on the P-3 and has served on four operational tours in the Middle East, all in varying command positions. He was recently made a Member of the Order of Australia (AM).

Air-Vice Marshal McDonald is married to his very understanding wife, Sarah, and they have two school-age children.

ABBREVIATIONS AND ACRONYMS

AADC	Area Air Defence Commander (US)
AAR	air-to-air refuelling
ACG	Air Combat Group (RAAF)
ACO	air combat officer (RAAF)
ACOTS	air combat officer training system (RAAF)
ADF	Australian Defence Force
ADFA	Australian Defence Force Academy
AEW&C	airborne early warning and control
AFATD	advanced field artillery tactical data
AMG	Air Mobility Group (RAAF)
AMO	approved maintenance organisation
AO	area of operations
AOC	Air and Space Operations Centre (RAAF)
AOR	area of responsibility
ARH	armed reconnaissance helicopter
ASEAN	Association of South-East Asian Nations
ASW	anti-submarine warfare
ATG	Air Task Group
ATO	air tasking order
AvWO	aviation warfare officer (RAN)
AWC	Air Warfare Centre (RAAF)
BMD	ballistic missile defence
C2	command and control
C3	command, control and communications
C4ISR	command, control, communications, computers, intelligence, surveillance and reconnaissance
CAF	Chief of Air Force (RAAF)
CAOC	combined air operations centre/center
CAS	close air support
CASG	Capability, Acquisition and Sustainment Group (AUS)
CATG	Commander Air Task Group (RAAF)
CDD	cross-domain deterrence
CDF	Chief Defence Force (AUS)
CENTCOM	Central Command (US)
CFACC	Combined Force Air Component Commander

CIO	Chief Information Officer
CIS	communication information systems
CJOPS	Commander Joint Operations Command (AUS)
CONOPS	concept of operations
COP	common operating picture
CRIS	capability reporting and information system
CSG	Combat Support Group (RAAF)
DAOC	Director Air and Space Operations Centre (RAAF)
DCJOPS	Deputy Commander Joint Operations Command (AUS)
DRN	Defence Restricted Network
DSN	Defence Secret Network
DSTG	Defence Science and Technology Group
EASTROC	Eastern Regional Operations Centre (RAAF)
EO	electro-optical
EW	electronic warfare
FARP	forward arming and refuelling point
FEG	force element group
FMV	full-motion video
FOC	final operational capability
GBAD	ground-based air defence
GBAMD	ground-based air and missile defence
GPS	Global Positioning System
HA/DR	humanitarian assistance and disaster relief
HF	high frequency
IAF	Israeli Air Force
IAMD	integrated air and missile defence
ICBM	intercontinental ballistic missile
ICT	information communications technology
IET	initial employment training
IIP	Integrated Investment Program
IMS	Integrated Mission Support
INTEL	intelligence
IOC	initial operational capability
IP	intellectual property
IPT	integrated project team

ISAR	inverse synthetic aperture radar
ISIL	Islamic State of Iraq and the Levant
ISR	intelligence, surveillance and reconnaissance
ISREW	intelligence, surveillance and reconnaissance, electronic warfare
ISSC	interim-sustainment support contract
ISTAR	intelligence, surveillance, target acquisition and reconnaissance
JDAM	Joint Direct Attack Munition
JFACC	Joint Force Air Component Commander
JOC	Joint Operations Command (AUS)
JSOC	Joint Special Operations Command (US)
JTAC	joint terminal attack controller
LNIC	Land Network Integration Centre
LVC	live, virtual and constructive
LOAC	Law of Armed Conflict
MAF DMO	Mobility Air Force's Distributed Mission Operation (USAF)
MEAO	Middle East Area of Operations
mIRC	internet relay chat software
MIT	Massachusetts Institute of Technology
NASA	National Aeronautics and Space Administration
NATO	North Atlantic Treaty Organization
NCO	non-commissioned officer
NGO	non-government organisation
NIFTI	non-intrusive flight test instrumentation
NJF	networked joint force
OIR	Operation *Inherent Resolve* (US)
OODA	observe, orient, decide, act
PACE	primary, alternate, contingency, and emergency (communications)
PhD	doctorate of philosophy
RAAF	Royal Australian Air Force
RAF	Royal Air Force
ROE	rules of engagement
RPA	remotely piloted aircraft
SATCOM	satellite communications
SAW	School of Air Warfare (RAAF)
SME	small-to-medium enterprise, or subject matter expert

SPO	system project office (RAAF)
SRG	Surveillance and Response Group (RAAF)
STEM	science, technology, engineering and mathematics
TJFACC	Theater Joint Force Air Component Commander (US)
TLS	through life support
TTPs	tactics, techniques and procedures
UAS	unmanned aerial system
UAV	unmanned aerial vehicle
UN	United Nations
UNC	United Nations Command
US	United States
USAF	United States Air Force
USMC	United States Marine Corps
USN	United States Navy
VCDF	Vice Chief Defence Force (AUS)

OF COUNTRY

UNCLE HARRY ALLIE

Good morning to everyone. I'd like to acknowledge the Honourable Marise Payne—Minister for Defence, Air Marshal Davies—Chief of Air Force and Air Vice-Marshal McDonald—Deputy Chief of Air Force, distinguished guests, ladies and gentlemen.

I would like to thank Air Force for inviting me to provide the Acknowledgement of Country for today's conference and to acknowledge Air Force's recognition of the Aboriginal and Torres Strait Islander peoples and nations and the ongoing commitment to reconciliation. It's been this reconciliation that has given us the opportunity to better understand our own country's considerable natural and cultural heritage. As a descendant of the Gudjala people, I would like to acknowledge the Ngunnawal people, the traditional owners and custodians of the land where we are. On behalf of those custodians, I would like to extend a warm welcome to you all.

Through time, we have acknowledged our Elders, both past and present, who have ensured that our culture, history and stories have been passed down through time for safekeeping to the generations that will follow. May we continue to come together with the goodwill that has been passed on to us all. May we continue to respect and listen to each other, being receptive to new ideas, so that we can all continue to share this knowledge, not only with our vibrant communities, but also to those that call Australia home, who I am sure will be greatly enriched by the experience.

It was indeed an honour to be invited to be the inaugural Indigenous Air Force Elder in 2012 by Air Marshal Brown, who was Chief of Air Force at that time. In my role as Indigenous Air Force Elder, it has been a tremendous experience to be able to work with the Director of Organisational Behaviour and Culture – Air Force, with Aboriginal and Torres Strait Islander programs. My role, in a broad sense, is to promote Air Force as an employer of choice to Indigenous communities. Indigenous peoples provide Air Force with a diversity in their workforce, better reflecting Australian society and promoting inclusion, building on workforce cohesion and therefore increasing capability.

These are positive programs. Certainly, the highlight for me is to talk firsthand to the current generation who are interested in joining the Air Force or pursuing careers in the aviation industry and to pass on a little about my experiences. I am sure that efforts to make Air Force culturally mature will aid both the recruitment and the retention of those wishing to seek a career in the workforce.

As it is some 27 years since I left the Air Force, I have always been impressed with the way Air Force has stood out in meeting the many challenges that the Service has to meet. Probably of late, I have been greatly interested in the discussions which involve Air Force and where Air Force will be in five to ten years from now. Life continues to move forward. I must again thank those people who have given me another opportunity to be part of today's modern Air Force and it has certainly made me more positively biased towards Air Force than ever.

I can currently say that there is a lot of interest by Indigenous people in seeking a career in today's Air Force and it is something that we must continue to address. I've said many times, way back in the 70's, and which are now becoming realised in our policies, 'Let's not repeat the mistakes of our past and recognise that the journey that we've been on is as valid now as it has ever been'. I am sure that this is only the start of what can be achieved.

I would like to report here today that the Air Force strategy of respecting connections to Indigenous people and places have been greatly acknowledged by communities far and wide.

To you who are gathered here today, may I offer my best wishes to you for your Service career that lies ahead and I hope that when you feel you would like to leave, that you too, can look back on your career and feel proud that you have served your country proudly, like all those before us.

Once again, thank you for the kind invitation for me to be here with you all today and certainly hope you enjoy the day ahead for you. Thank you.

OPENING ADDRESS

AIR MARSHAL LEO DAVIES, AO, CSC

Minister Payne, Minister Tehan, fellow Service chiefs and their representatives, former Service chiefs, senior representatives of other Government departments, our guest speakers, distinguished guests, ladies and gentlemen, on behalf of the Royal Australian Air Force, welcome to the 2016 Air Power Conference.

As I said to those gathered at last evening's moving ceremony at the Australian War Memorial, I particularly appreciate the effort many of you have made to travel considerable distances to be here today. As you crossed oceans, and perhaps the desert interior of Australia to be here in Canberra, I trust you got an appreciation of the challenges we face in living in this part of the world. But I am heartened to see such a wide international representation here today. I certainly look forward to our engagement over the next few days as we explore the concept of multi-domain integration in the joint environment.

Multi-domain integration not only permits the services of a nation to better provide effects to assure sovereignty, it permits allied and coalition partners to come together seamlessly when responding to crises on the world stage. I am joined here by service chiefs, or their senior representatives, from 25 countries. We are honoured to be joined by so many of you and are proud that our conferences attract such a strong and distinguished audience. In total, there are over 1000 delegates assembled here today, a true Gathering of Eagles.

An event on this scale is made possible by the generous support provided by our sponsors and I would like to take the opportunity to acknowledge them. Our principal sponsor this year is Boeing who, including this year's event, has now sponsored the last six Air Power Conferences. Boeing continues to be a major partner to Air Force in the generation of Australian military air power. Rolls Royce and L3 have also generously contributed, as well as Defence Health and Defence Bank. Thank you all for your continued support.

These conferences provide a biennial opportunity to gather eminent strategic thinkers and practitioners of air power to discuss issues of importance to airmen and the broader Defence and aviation communities. In our busy schedules, these rare gatherings to reflect upon our calling are both valuable and important.

The first Air Power Conference convened by the Royal Australian Air Force, was held 25 years ago. The topic of the inaugural event in 1991 was *Smaller But Larger: Conventional Air Power into the 21st Century*. The Royal Australian Air Force is still modest when compared in fleet size to some air forces, but sizeable in capability thanks to our potent platforms and systems.

Standing on the cusp of our centenary as an air force—in March 2021—I confidently state that we are, and will continue to be, an effective force regionally and with much to offer Government in

responding on the international stage, both for humanitarian disaster response or contributing to coalition combat operations.

A little over a year ago, my predecessor, Air Marshal Geoff Brown, announced that Air Force was embarking on the implementation of Plan *Jericho*. This complex undertaking has as its goal the transformation of the Air Force into a 5th generation–enabled force, fully integrated to deliver air and space power effects in the information age. Someone not educated in air power might argue that this is a singular air domain solution. The air power professionals in the room would understand, however, that air power, heavily dependent on technology to deliver its output, is intrinsically linked to the cutting edge of that technology. In the 21st century, that is increasingly manifested in the space and the cyber domains. Air forces must be able to integrate with and exploit these domains to succeed. It is axiomatic for air power.

Ladies and gentlemen, thank you for attending the 2016 Royal Australian Air Force Air Power Conference. I look forward to the next two days of air power discussion and trust that you will find them equally stimulating.

I would like to now welcome Senator the Honourable Marise Payne, Minister for Defence, to our conference. Appointed Minister in September of last year, Senator Payne already has had a long and close interest in Defence matters, having served on parliamentary committees oversighting Defence for the majority of her nearly 19 years in Parliamentary service.

Minister, I'm appreciative that you were able to make some room in your very busy schedule to be with us today, particularly following the release of the Government's *Defence White Paper*. I look forward to working with you in delivering its outcomes and I would like to invite you to address the conference. Thank you ma'am.

MINISTERIAL ADDRESS

SENATOR THE HONOURABLE MARISE PAYNE

Good morning, ladies and gentlemen. Let me begin by acknowledging the traditional owners of the land on which we meet and pay my respects to their Elders past, present and future.

Chief of Air Force, Air Marshal Davies, I thank you very much for the invitation to address this important event and for your kind words of introduction. I also echo your welcome to all the delegates to the conference. In particular, I extend a very warm welcome to the many visiting chiefs of air forces and international delegations; particularly also to my ministerial colleague—the Minister for Defence Materiel, Dan Tehan; to our important partners from industry and our many other distinguished guests and invited speakers.

As the Chief of Air Force said, the fact that there are more than 1000 delegates gathered here today, including a significant number of international air force chiefs, a contingent of United States Commanders in the Pacific and senior air power representatives from around the world, does attest to the very high regard in which this conference is held, and I welcome you all to our nation's capital.

I say in advance, before the morning unfolds too much further, that for me and for Minister Tehan, this is a Parliamentary sitting day. Not all of you have ministers who are parts of your parliament. Some of you have cabinets, which sit separately from your parliaments or elected representatives. But for us, it is a case of be there in person to vote or else—as required by one's leaders. So we will both be departing relatively soon after I speak this morning. Please don't take that as a lack of interest. If I was choosing, I can promise you I would be spending a lot more time here than I would in my Parliamentary chamber today.

Ladies and gentlemen, this is a very important time for the Australian Department of Defence and also, of course, therefore for the Royal Australian Air Force. Three weeks ago the Prime Minister, Mr Turnbull, and I released the *2016 Defence White Paper.* This document is supported by a fully costed, *Integrated Investment Program* and a *Defence Industry Policy Statement*. The White Paper sets out the Turnbull Government's comprehensive and responsible long-term plan to ensure Australia's national security and to create a more capable, agile and potent ADF, and the RAAF is at the heart of this plan.

Australia has long seen itself as the 'lucky country'. Our richness in natural resources, geographic location, our historical and contemporary relationships and a well-educated, innovative and productive population have allowed us to benefit from the shift in global economic power to the Indo-Pacific region. However, as the White Paper makes clear, the parallel shift in strategic power makes for a more complex and demanding strategic environment. This may, in turn, give rise to a broader range of security challenges.

With our international partners, Australia works, therefore, to foster a rules-based global order. If Australia is to grasp the opportunities available to us and manage the risks, the Turnbull Government recognises that the ADF, including our Air Force, must become more capable, agile

and potent. Furthermore, we recognise that Australia's strong network of regional and global defence relationships will be even more important to us in the future.

So, in the White Paper for the first time, we have prioritised and funded Defence's international engagement as a core Defence function. The RAAF already has, and it will grow, a core role in our international engagement. Through the capability plans in the White Paper, the RAAF's ability to project its air power further across the globe will be strengthened.

The importance, for example, of our role in our region, and in this instance, in humanitarian assistance and disaster relief, has been underscored by the devastating effects of Cyclone Winston in Fiji. Our RAAF C-17s carrying supplies and our Army MRH-90 helicopters were amongst the earliest international responders to reach the devastated islands. And the ADF continues to provide invaluable support to Fiji through Operation *Fiji Assist*. With HMAS *Canberra* currently providing essential support on deployment, while the Army's 2nd Combat Engineer Regiment is assisting in helping the nation to rebuild its critical infrastructure.

Over the next two decades, Air Force will also be equipped with new and more capable platforms to patrol and respond in Australia's vast maritime approaches. As foreshadowed in the White Paper, I can indicate today that the Government has approved the acquisition of four additional P-8A Poseidon maritime surveillance and response aircraft, bringing the total number of P-8As on order to 12. The Government is also considering the acquisition of seven MQ-4C Triton unmanned aircraft systems. These two platforms will replace the aging AP-3C Orion aircraft, giving Australia a greater maritime intelligence, surveillance, reconnaissance and response capacity.

The first of the Poseidons is expected to be delivered late this year and 12 aircraft to be in service by 2022. Pending Government approval, a further three aircraft are planned to enter service late in the 2020's and the Triton is planned to be introduced into service in 2023. While the Orion fleet has performed exceptionally on operations throughout its distinguished service, the last of these aircraft will be almost 40 years old when they retire from service.

Ladies and gentlemen, Air Force is already operating some of the sophisticated platforms that will contribute to the networked joint force the White Paper will deliver. I had the opportunity to fly aboard and see first hand the impressive capabilities of the Wedgetail airborne early warning and control aircraft and crew, which is currently part of our contribution to the campaign against Daesh in Iraq and Syria. Australia's Air Task Group forms the combat element of the Turnbull Government's contribution to the coalition efforts targeting Daesh. This task group, with its Super Hornets, Hornets, Wedgetail and KC-30 tanker aircraft is a strong combat capability. In particular, it's the interoperability of our aircraft, including our KC-30 tanker aircraft and Wedgetail, with our coalition partners that is bringing unique capabilities to the air campaign.

The Chief of the Defence Force, Air Chief Marshal Mark Binskin, has previously remarked on the positive feedback he has received regarding the impressive capability of our Wedgetail aircraft. Our KC-30s and our C-17s are at the centre of our Air Force's ability to deploy across the globe and to work with our international partners to promote our interests. That capability will be further increased with the acquisition of a further two KC-30s, bringing the total number to seven, further increasing our ability to project our air power and sustain humanitarian, combat and search-and-rescue operations.

Over the next decade, the Australian Air Force's capability will be further strengthened with the introduction into service of the Joint Strike Fighter, the Growler electronic attack aircraft and armed, unmanned air systems. As the development of the Joint Strike Fighter continues, the pace of testing and evaluation is increasing and I'm pleased that another two Australian pilots have recently relocated to the United States to begin their training. Australia's JSF aircraft remain on track to arrive in Australia in 2018 with initial operating capability scheduled for 2021.

To maximise the capabilities of our current and future Air Force, our systems must be networked and integrated to a degree not previously achieved. Air, land and maritime forces need to exploit the high level of connectivity made possible by use of systems uniting them through the space and cyber domains. Much work has already begun in this regard under Plan *Jericho*, to which the Chief of Air Force referred, to ensure we have a fully networked joint future force across air, space, electromagnetic and cyber.

With its modernised inventory, Air Force will introduce and develop capabilities that will enhance its ability to work jointly with its sister forces, in many cases, before the systems they will network with, actually enter service with Army and Navy. The work being undertaken by Air Force now, in exploring the 'art of the possible', and reducing risks by experimentation or trials, means that the benefits of the joint force will be more rapidly realised, once the networked systems, committed to in the White Paper, enter Navy and Army service.

As the White Paper details, Defence's ICT systems have not necessarily kept pace with rapid advances in modern technology. To address this, we are making a significant commitment to modernising and transforming Defence's communications and information systems so that we can take advantage of the changes and improvements in technology.

The Government also acknowledges that the greater our reliance on information systems, the greater the potential risks from cyber attacks. And as a result, we have also provided for significant investment in cyber capabilities to safeguard Government agencies [and] critical infrastructure against cyber attack.

It is, of course, not just improved ICT networks and systems and capability that will underpin our future Air Force over the next two decades. One of the defining features of the *2016 Defence White Paper* and *Integrated Investment Program* is the renewed focus on enabling capabilities. In fact, 25 per

cent of the *Integrated Investment Program* is allocated to the enabling projects, which help to bind our capabilities, whether it's our airfields, our bases, our wharves, our ordinance facilities or our logistic systems, just to name several.

We have upgrades underway at a number of our airfields to accommodate some of our new capabilities, including RAAF Bases Tindal, Williamtown and Darwin. Over the next 20 years, in fact, we will spend up to $3 billion in upgrading our airfields across Australia to ensure that our next generation capabilities are properly supported. Without the attention and commitment to deliver these enabling systems, the force multiplying effect of a joint force will not be properly realised. I know that air forces love their technology, but without the right people, technology can't and doesn't become capability.

In Australia, which is a multicultural society with a relatively modest population and a vast territory—the vast territory is a land mass alone close in size to that of all of Europe—but with a population less than one-third of that of Germany's. So to deliver the capabilities of the technologically advanced future force outlined in the White Paper, the Government has also committed to grow the uniformed Defence Force to around 62 400 people over the next decade, which will be its largest size in two decades. To attract and sustain this expanded military workforce, Defence must recruit and retain its workforce from across that very diverse society—a society in which more than a quarter of all people were born overseas and over half of which are female.

In relation to women in the Air Force, they currently make up more than 18.5 per cent of Air Force personnel, with Air Force on track to reach its target of 25 per cent female representation by 2023. A number of initiatives are in place to embrace a more inclusive culture within Defence and significant work has been done to remove barriers to the career progression and employment of women, but there are still challenges, still barriers. Australia, for example, has never had a female fighter pilot, although I'm pleased to hear that may change very soon with one female pilot in training right now to become a fast jet pilot. The challenge, though, is to ensure that she's not the only one and that there is a steady stream of young women entering these programs, of which they've not traditionally been part.

We are also addressing the under-representation of Indigenous Australians and culturally diverse sections of our society in the ADF. Yesterday, I was at 'the home of the soldier'—Kapooka, our Army recruiting base, to launch Defence Force Recruiting's new Indigenous recruitment campaign, which was another important step towards creating an ADF that reflects the community from which it is recruited and which it is entrusted to protect. So that recruiting program—#seeyourself—displays the commitment of three or four young, Indigenous Australians who've been in the ADF for between five, eight, ten years themselves, across the three Services, and asks the viewer to 'see yourself' in their jobs, in their roles. And it does it in their own words. It's a very impactful, very powerful message to young Indigenous Australians that the Australian Defence Force is a great place to be and to come and work.

Ladies and gentlemen, as I've mentioned already today, the resources that workforce will have at its disposal—the aircraft, the vessels, the vehicles, the technology and the information systems—will be increasingly sophisticated and the Turnbull Government recognises that a strong, innovative and competitive Australian defence industry is essential. The *Defence Industry Policy Statement*, released alongside the White Paper, hasn't been very far from my side over the past three weeks. This document is designed to reset the relationship between industry and Defence; to maximise industry's innovation potential and to ensure Defence can benefit from, frankly, some amazing capabilities being developed right here in Australia.

One of the key initiatives of the Industry Policy Statement is the Centre for Defence Industry Capability, which the Prime Minister and the Minister for Industry and I announced last week, will be centred in Adelaide. It will have national reach and it will ensure that the defence industry knows what Defence's capability priorities are and importantly, it will help Defence identify what industry can offer because the Defence/industry relationship, for us, is very much a two-way street.

The Joint Strike Fighter Program is one area in which we have seen Australian industry compete and access export markets already worth $500 million, which is expected to rise to more than $2 billion by 2022/23. Over the last few months, I've been lucky enough to visit a number of impressive small-to-medium enterprises that have developed, or are in the process of developing, cutting-edge technologies that provide our Australian Defence Force with unique capabilities. The Centre for Defence Industry Capability will help to foster that relationship with industry, to build its capacity, to drive innovation and to open export markets so that we can find and help develop the next great Australian innovations. I know there are very many of them around this country.

Capability, agility and potency—these are the attributes the Government has invested in through its balanced approach to the future development of the Australian Defence Force as outlined in the 2016 White Paper. Cutting edge, networked and integrated technology; an expanded and empowered workforce; and an engaged industrial base are the means of its delivery. And our Air Force is very much at the centre of our high-technology future force.

Air Marshal Davies, thank you very much for inviting me to address the Air Force's Air Power Conference. I wish you and all of the participants, presenters and delegates a very productive conference and thank you for the opportunity to be here this morning.

KEYNOTE ADDRESS

DR ALAN STEPHENS, OAM

This conference should be framed by two inconvenient truths. The first is that Western military campaigns currently are dominated by the application of air power. Indeed, looking back in a quarter of a century from now, military historians are likely to describe the period from 1967 to 2030 as the time of air power. They'll identify the period as having started with the Israeli Air Force's remarkable series of victories between 1967 and 1982, followed by the equally remarkable series of air campaigns led by the United States in the Middle East, the Balkans, and Central Asia from 1991 up until today. And given the present balance of military affairs, it's not too much of a gamble to suggest that air power will remain the West's greatest comparative advantage from now until at least 2030.

It's unfortunate that it's taken our political and military leaders so long to comprehend this truth. Albert Einstein is often credited with saying that doing the same thing repeatedly and hoping for a different result is a definition of insanity. He might well have been referring to the West's preferred military strategy from the 1960s until the recent past.

Despite clear and continual evidence that we win in the air and we lose on the ground, for half a century, the West repeatedly tried, and failed, to conduct land-centric campaigns based on the intellectually unsustainable theory of counterinsurgency warfare. We should be asking why senior military commanders, including Australia's, continued for so long to tell ingenuous politicians that they could fight and win wars 'amongst the people'.

It was, when you think about it, extraordinarily arrogant to believe that we could engineer profound social, cultural, and political change–that we could 'win hearts and minds'–by invading and occupying societies that mostly didn't want us there, whom we barely understood, and who held emotionally compelling beliefs developed over thousands of years. Nor is there any comfort to be taken from the fact that, when our politicians finally began to reject the cult of counterinsurgency warfare, they did so, not from any strategic epiphany, but because land war in the Middle East had become politically unpopular.

It now seems to be generally recognised that if we must go to war–and it's very hard to argue how we could not, for example, take up arms against the depravity of Daesh–then an air campaign represents by far our best option.

I'll return to the subject of air power and strategy shortly. But before doing so, I need to address this conference's second inconvenient truth.

I refer to the apparently irresistible rise of joint warfare, of which 'multi-domain integration' is an aspirational extension. Plan *Jericho*, through which the RAAF will pursue the goal of multi-domain integration, has the potential to significantly enhance the application of joint force. But ultimately, *Jericho* can only be an enabling mechanism. The issue here is not one of technology, or networks, or even of information, but of purpose. Specifically–what do we want our joint force to do? And what kind of joint force do we want?

The late General John Baker, Chief of the Defence Force from 1995 to 1998, arguably has been Australia's most intellectually able senior military officer since World War II. In a seminal report on command arrangements in the Australian Defence Force published in 1988, then-Brigadier Baker stated that air power was 'the greatest complicating factor' in those command arrangements, and that it was 'air alone' that had given rise to the 'inexorable trend towards joint operations'. Unfortunately, Baker continued, the proper use of air power in contemporary conflict was not well understood.

Baker placed the blame for this on generations of Air Force leaders, noting that there were few RAAF scholars adding to the strategic debate. The only remedy, he wrote, was for the RAAF to provide exemplary support in all its forms, and to itself understand the importance of its contribution to success in land and sea operations. Of any of the Services, Baker concluded, it is Air Force 'which requires the greatest body of corporate knowledge of all forms of operations on land, sea or in the air'.[1]

Couched explicitly in terms of the future ownership of air assets, the *Baker Report* presented the RAAF with a disturbing institutional challenge. Since Federation, through two world wars and major conflicts in Malaya, Korea and Vietnam, Australian defence strategy had been dominated, initially by concepts of naval power, and then by the deployment overseas of large land forces. Although air had become increasingly important, its advocates struggled to make themselves heard above the noise of Australia's dominant military culture.

Now, it seemed, Army and Navy, via the *Baker Report*, were threatening the RAAF either to get on board the joint train or risk being thrown under the locomotive. In the years since then, the relentless push for jointness has been accompanied by a suffocating degree of political correctness, in which joint is 'good', single-Service is 'bad', and to say otherwise is to risk career death.

In any undertaking it never serves anyone's interests to avoid the hard questions. And at this juncture there are three to confront. First, the innate merit of exploiting all combat domains simultaneously–of conducting joint operations–is self-evident and is not at issue. But 'joint' means 'combined' or 'cooperative'. It does not mean 'ineffective' or 'sacrosanct'.

Second, when General Baker described air power as 'the greatest complicating factor' in the ADF's command arrangements, whose way of life, precisely, was air complicating? Not Air Force's, you might think. And finally, in reaching his conclusion, what kind of strategic prism had Baker looked through?

Insights into each of these issues can be gained from a review of some key moments in the Western way of war since the emergence of air power. That review must be necessarily brief but the broad theme is, I suggest, clear enough.

1 Headquarters Australian Defence Force, *Report of the Study into ADF Command Arrangements*, AGPS Canberra, March 1988

During World War I, air power's primary task was to assist surface operations. Land and sea were in command, air was in support, the apparent natural order was being served, and it seemed there were no 'complications' to alarm anyone.

But that was not the case with the two roles that have come to define air power–control of the air and strategic strike. On the contrary, airmen understood that if they were to give their armies and navies the best possible joint product, then they first needed to win control of the air. And while surface forces made a contribution with ground-based air defence systems, by and large, this was a discrete air force task.

There was even less scope for surface forces to contribute to strategic strike. Towards the end of the war, the United Kingdom established an Independent Bombing Force in France entirely separate from the other British services. The Independent Force attacked so-called 'strategic' targets inside Germany, such as railways, industrial centres, and airfields.

With those developments in mind, some observations on the war's broad strategic nature are pertinent.

Fighting on the Western Front started in August 1914 as an intended war of maneouvre on Germany's part via the Schlieffen Plan, which envisaged a rapid advance by hundreds of thousands of troops into Belgium and France. The only thing rapid about the Schlieffen Plan, however, was the speed with which it collapsed. Maneouvre of sorts also featured in the closing months of the war. Of particular interest to Australians was the successful early model of joint (air/land) warfare applied by the brilliant General John Monash at the Battle of Hamel in July 1918.

However, in the intervening four years, fighting was largely reduced to a static war of attrition. Immune to innovative thinking, generals constantly called for more men and, when that failed, more again. This wasn't strategy, it was arithmetic. It was not as though what happened should have surprised anyone. Fifty years previously, the American Civil War had vividly demonstrated that a broad-front advance against entrenched artillery and rapid-firing smaller arms would almost certainly result in slaughter. Yet for most of the war on the Western Front, that was exactly what both armies tried to do, often for little strategic purpose.[2]

During the interwar years, there was a persistent tension over the control of air power. In the maritime domain, the debate turned on whether or not aircraft could find and sink warships at sea, with trials in the United States and the United Kingdom indicating that they could and

2 Lessons from the American Civil War were also ignored by Japanese commanders during the Russo-Japanese War of 1904-5, when Japanese infantrymen were mowed down in their thousands while making massed frontal assaults against Russian machine gun posts. But because Japan eventually won that war, the conclusion reached in European academies was not that attacks against such odds and with such immense casualties were no longer acceptable, but rather that they had to be 'pressed harder, with more men'. Christopher Clark, The First Calamity, The London Review of Books, 29 August 2013, p. 5, viewed 4 April 2016, <http://www.lrb.co.uk/v35/n16/christopher-clark/the-first-calamity>

3 William Mitchell, 'Aircraft Dominate Sea Craft', Winged Defense, Dover Publications, New York, NY, 1988, pp. 56-76; also 'Night Torpedo Attacks made on the Fleet', Aircraft, 1 January 1935, p. 22

would.[3] World War II passed the final judgment, most dramatically on 10th December 1941, when land-based Japanese bombers operating from Indochina sank the great British warships HMS Prince of Wales and Repulse off the east coast of Malaya. Ever since then, surface ships operating without air cover have had to be considered at risk, and precisely how that cover might be provided has been an ongoing 'complicating' factor for navies, especially since aircraft carriers became too expensive for most nations.

Similarly, during the Battle of the Atlantic, Allied shipping losses to U-boats at one stage were so high that Winston Churchill feared the war might be lost. A turning point came when aircrews flying very-long-range, land-based patrol/bombers were able to extend the air cover overhead convoys. Of the 594 U-boats lost to direct Allied action, 264 were sunk by ships, 293 by aircraft and 37 to combined air/sea attack.[4]

Operations in the air/land domain mirrored that broad theme. The best-known example is the German Blitzkrieg, derived from the British strategist Basil Liddell Hart's theory of 'expanding torrent' warfare.[5] While the Germans may have introduced the technique, it's arguable that the air part of the equation was applied to best effect by British units, including a handful of Australian squadrons, in North Africa. That model wasn't confined to North Africa. In every theatre of the war, close attack, ISR and air manoeuvre were fundamental to land operations.

As to air power's independent roles, suffice to say that, on D-Day, the Allies flew 14 000 sorties and the Luftwaffe 300; while when the crew of the Enola Gay dropped their atomic weapon on Hiroshima, not a solitary Japanese fighter aircraft rose to the defence.[6] The strategic bombing campaigns remain controversial to this day, having been neither precise nor efficient. But they were effective. The Combined Bomber Offensive opened up a second front against Germany two years before D-Day, and by January 1945 had brought the Nazi war economy to its knees; while in August, Japan surrendered without a single Allied soldier having set foot on the home islands.

In its Post-War Plan, the Royal Australian Navy declared the aeroplane to have been 'the master weapon of World War II'; in similar vein, Joseph Stalin described his close attack aircraft as being 'as essential to the Red Army as air and bread'.[7] It had become almost inconceivable that armies and navies could mount any kind of substantial operation without air power.

However—and this is a critical observation—the reverse did not apply. While surface forces could make a contribution to control of the air, strike and ISR (intelligence, surveillance and reconnaissance), their participation wasn't essential. What that meant was that there was an inherent tension in the relationship between jointness and strategy.

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4 Uboat.net website, U-boat losses by cause, nd, viewed 2 January 2016 <http://uboat.net/fates/losses/cause.htm>

5 BH Liddell Hart, Strategy: The Indirect Approach, Frederick A. Praeger, New York:, NY 1954

6 James Parton, 'Air Superiority', The D-Day Encyclopedia, Simon & Schuster, New York, NY, 1994, p. 36

7 Department of Defence, The Royal Australian Navy Post-War Plan, National Archives of Australia, Commonwealth Record Series A5954, Box 1841; Marshal Joseph Stalin, quoted in John W.R. Taylor, Combat Aircraft of the World, Ebury Press, London, 1960, p. 572

This dichotomy was again exposed five years later in Korea. Close air attack was vital, notably during the battle along the Pusan Perimeter in August-September 1950, where the United Nations Command's (UNC's) air forces, including the RAAF's No 77 Squadron, saved their army from being pushed into the sea and losing the war.[8] After initially surging up and down the peninsula, in mid-1951 the opposing armies entrenched themselves just north of the South Korean capital of Seoul, where they've remained ever since. Meanwhile, the UNC's air forces embarked on a bombing campaign which was to all intents and purposes independent. Some 90 per cent of North Korea's power generation capacity was quickly dismantled, but fierce international protests against attacking allegedly non-military targets undermined the campaign's legitimacy.

It was Vietnam's misfortune to provide the next setting for this narrative. By the late-1960s, the US and its allies, including Australia, had become trapped in a catastrophe of their own making. Joint operations worked well enough, but no amount of inter-service cooperation could overcome the flawed theory of warfare. Known as 'search and destroy', that theory amounted to a series of large-scale, limited-duration operations into enemy-dominated territory, staged from vast, culturally isolated base camps. Its most telling effect was to alienate many of the South Vietnamese civilians whose interests it was purportedly serving.

Replicating the mentality of World War I, the US Army's response to the manifest failure of 'search and destroy' was to call for more boots on the ground. Between 1961 and 1968 the number of [foreign] soldiers in Vietnam grew from 2000 to more than half a million.

Desperate to imagine progress where none existed, analysts in the Pentagon came up with a variation on the theme of arithmetic as strategy when they began to use the daily count of enemy body bags as an indicator of success. Tragedies like the My Lai massacre exposed the true nature of the invasion and made it impossible for the US and its allies to 'fight amongst the people'.[9]

The air campaign against North Vietnam was little better. Planners repeated the mistake from Korea of thinking that First-World values could be applied to target selection in a Third-World country; also like Korea, the campaign attracted intense international opprobrium.

At the same time as the disaster in Vietnam was unfolding, 8000 kilometres away, the Israeli Air Force's spectacular victory in the 1967 Six-Day War signalled the beginning of the time of air power. The most instructive Israeli template emerged from the First Lebanon War from 1982 to 1985, which in many respects foreshadowed the West's military experiences from the First Gulf War in 1991 to the recent past. Prior to a planned invasion of Lebanon in June 1982, the Israeli Air Force [IAF] was tasked with neutralising Syria's powerful ground-based air defence [GBAD] system in the Bekaa Valley, the site of the Damascus to Beirut highway. In a masterful operation, the IAF destroyed Syria's GBAD within hours and then, when the Syrian Arab Air Force was

8 Matthew B Ridgway, The Korean War, Doubleday, New York, NY, 1967, p. 244

9 On 16 March 1968, a platoon of US Army soldiers murdered up to 500 unarmed Vietnamese civilians in the hamlet of My Lai. Many of the victims were women and children. Three years later, the US Army charged 14 officers with suppressing information relating to the massacre; most charges were subsequently dropped.

scrambled to contest control of the air, shot down more than 80 enemy fighters for no losses of their own.

The essence of what happened was that the Israelis fought with a revolutionary degree of situational awareness, and the Syrians fought blindfolded.[10] In that respect, the campaign anticipated the kinds of outcomes Plan *Jericho* is intended to generate. The IAF's campaign set new standards for ISR, and command and control. Also like *Jericho*, it drew on leading-edge technologies to sustain its strategic logic.

The six-day air campaign marked the high point for Israel in what became a three-year quagmire. As soon as the Air Force had cleared the Bekaa Valley, the Israeli Army crossed the border into Lebanon and quickly pushed on to Beirut. But the invaders were deeply unpopular with the occupied population, and incapable of controlling the sectarian forces their presence unleashed. Lebanon's fragile political equilibrium collapsed, and when the Israeli Army finally withdrew, Beirut had been reduced to rubble, the reputations of Israel and its Defence Force had been sullied, a new and dangerous enemy—Hezbollah—had emerged, and none of Israel's objectives had been achieved.

With due allowance for detail, much the same pattern has been apparent in subsequent Western-led campaigns. That is, brief, overwhelmingly successful air campaigns have been followed by protracted, disastrous land campaigns.

Before drawing together the threads of joint warfare and contemporary strategy, I want to comment on the relationship between technology and strategy, and the RAAF's force structuring initiatives in the 1960s and 1970s.

During the period the Israeli Air Force was constructing the intellectual and technological framework that would underwrite its Bekaa Valley campaign, Australia's defence posture was dominated by our involvement in the invasion of Vietnam and notions of counterinsurgency warfare. Despite having to function within that institutionally moribund environment, the RAAF managed to keep the ADF at the forefront of military technology.

Against sometimes vehement opposition from the Defence establishment, the Air Force managed to acquire the F-111, the B-707 tanker, Jindalee over-the-horizon radar, and precision weapons. These were capabilities that challenged the prevailing mindset, suggesting a defence posture based on information dominance, precision, strategic reach, and national independence. The implication was that perhaps Australia's defence posture could look less like Vietnam, and more like the Bekaa Valley.

In more recent times the linkage between technology and strategy has been similarly expressed through the acquisition of Growlers, KC-30s, P-8s, Tritons, Wedgetails, F-35s, C-17s, Gulfstream 550s, and so on. In combination, those are the kinds of capabilities that support the full spectrum

10 See Alan Stephens, 'The Arab-Israeli wars of the 20th century', in John Andreas Olsen (ed), Air Power History: Lessons and Prospects, Naval Institute Press, Annapolis, to be published in 2017

of 21st century strategies, from the containment of terrorism at one end to regional self-defence, coercion and compellence at the other.

But while advanced air forces have performed admirably in managing to assemble the hardware, software, and people needed to apply those strategies, they've been less successful in explaining their merits. There is a general community awareness of land warfare, not least through constant exposure to 20th century slogans such as 'boots on the ground', 'win hearts and minds', and 'the three-block war'. In Australia, those kinds of slogans carry even more populist appeal, and serve as some kind of dimly-perceived strategic belief system, because of their connection to the national obsession with the legend of Anzac and the myth of the digger.[11]

By contrast, there's little understanding of 21st century concepts such as control and protect, containment, degrading the enemy, the rapid halt, anti-access/area denial, and so on. This is not just a matter of public relations, it's a problem with serious implications for the formulation of strategy, and it needs to be fixed.

The foundations of 21st century strategy established by the Israeli Air Force were consolidated by two USAF fighter pilots looking for answers following the disaster of Vietnam. In what Professor John Andreas Olsen has described as the 'renaissance of American air power', Colonels John Boyd and John Warden separately constructed models which, when combined, created a compelling strategic framework.[12] Boyd's and Warden's work was distinguished by its emphasis on information dominance, decision-making superiority, a rigorous approach to targeting, and tempo. It was the antithesis of strategy based on mass, close-up fighting, the presumed need to hold ground, and implausible social engineering.

A similar approach was evident in an impressive concept for land warfare formulated in 2001 by the respected American soldier-scholar, retired [US] Army General Robert Scales, titled *Checkmate by Operational Maneuver*.[13]

Drawing on his analyses of the air campaigns in Iraq in 1991 and the former Republic of Yugoslavia in 1995 and 1999, Scales proposed a concept for the employment of highly mobile land forces defined by speed, precision, knowledge dominance, and a fleeting footprint. As Scales acknowledged, he wanted armies to replicate the characteristics of advanced air power.

It's a matter for regret that Scales' concept seems to have received little attention in Western military academies, with a survey of the US Army's professional journal *Parameters* and the

11 See James Brown, Anzac's long shadow: the cost of our national obsession, Redback eBook, Collingwood VIC 2014; and Marilyn Lake and Henry Reynolds, What's wrong with Anzac? the militarisation of Australian history, UNSW Press, Sydney, 2010

12 John Andreas Olsen (ed), Air Power Reborn: The Strategic Concepts of John Warden and John Boyd, Naval Institute Press, Annapolis, MD, 2015; Grant T Hammond, The Mind of War: John Boyd and American Security, Smithsonian Institution Press, Washington DC, 2001; John Warden III, The Air Campaign: Planning for Combat, National Defense University, Washington DC, 1988

13 Robert L Scales, 'Checkmate by Operational Maneuver', Armed Forces Journal International, October 2001

Australian Army Journal between 2002 and 2015 revealing not a single reference to *Checkmate by Operational Maneuver.*[14]

On the contrary, ignoring fifty years of failure, the West's generals decided to keep doing the same thing and hope for a different result. In 2006, the American Army issued a new manual of counterinsurgency warfare. Known as FM 3-24, the manual acquired near-mythic status among Washington insiders.[15] However, notwithstanding FM 3-24's façade of strategic sophistication, when in 2008 the situation in Iraq began to worsen, the response was, yet again, to call for more boots on the ground, in this instance 20 000. And in similar circumstances in Afghanistan four years later, history repeated itself, except that this time 30 000 extra troops were called for.[16]

But almost inevitably, political and social forces proved far more powerful than mathematics. The short-term gains of each of those so-called 'surges' proved illusory and today both countries remain characterised by extreme levels of violence, political instability, economic chaos and endemic corruption.[17]

Recent developments may, however, indicate that the lesson has finally been learned. Since early 2015, operations against Daesh have followed a fundamentally different model.[18] Large-scale fighting on the ground has properly been left to indigenous armies, whose soldiers actually can 'fight amongst [their] people'. Those indigenous armies operate jointly with advanced air power which contains and degrades the enemy; and also with Western Special Forces that make the kind of precise, high-value, fleeting incursion envisaged by General Scales.

I'd like to conclude by noting that the RAAF is one of the world's very best air forces. It's achieved that status, not because of expedient notions of joint warfare, but despite them. If Plan *Jericho* is to realise its ambition, it must be complemented by thinking that rejects archaic institutional and populist sensibilities, and accepts 21st century strategic truths.

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14 See Parameters, The US Army War College Quarterly, Strategic Studies Institute, Carlisle, PA and Australian Army Journal, Land Warfare Studies Centre, Duntroon ACT, both 2002-2015.

15 FM 3-24, Counterinsurgency, Headquarters, Department of the Army, Washington DC, 15 December 2006. An alternative assessment of FM 3-24 was given by Vietnam veteran turned academic, Andrew Bacevich, who wrote that FM 3-24 was so vague and self-serving as to be meaningless: 'Trafficking in the standard array of postmodern tropes—irony, paradox, bricolage, and sly self-referential jokes, [the] manual [says] next to nothing', he commented: see Andrew J Bacevich, Washington Rules: America's Path to Permanent War, Metropolitan Books, New York, NY, 2010, pp. 196-202

16 "Troop 'Surge' in Afghanistan Ends With Mixed Results", The New York Times, 21 September 2012; Ahmed Rashid, 'Kabul in Crisis', The New York Review of Books, New York, NY, 1 February 2016

17 For a celebrated observation on US policy in Iraq that has lost none of its capacity to shock 11 years later, see Eliot Weinberger, 3 February 2005, 'What I Heard about Iraq', The London Review of Books, pp. 3-11, viewed 4 April 2016 < http://www.lrb.co.uk/v27/n03/eliot-weinberger/what-i-heard-about-iraq>. See also Martin Chulov, 20 February 2016, 'Post-war Iraq: Everybody is corrupt, from top to bottom', The Guardian, London UK, viewed 4 April 2016 < http://www.theguardian.com/world/2016/feb/19/post-war-iraq-corruption-oil-prices-revenues>

18 Patrick Cockburn, 3 March 2016, 'End Times for the Caliphate?', The London Review of Books; Clive Williams, 4 December 2015, 'The Growing Special Forces', The Canberra Times; David Wroe, 31 December 2015, 'Australian troops' key role as Ramadi wrested from Islamic State, The Sydney Morning Herald.

HOW ASIAN STATES DEFINE STRATEGIC INTERESTS AND SUCCESS, AND WHY?

DR JOHN LEE

I have been asked to speak on the topic of what success looks like for many Asian countries, especially in a multi-domain context. This is daunting for two reasons. First, it is a complicated topic drawing in not just advances in military technology, but also political, economic and domestic capabilities of countries—all of which goes toward determining what success actually means. And second, I am speaking to hundreds of people in this room who know a lot more about military strategy than I do.

So I will begin from the premise that [a] wise man knows what he doesn't know. And keeping that in mind, I hope to offer something that may prove useful to you over the next two days and beyond.

We all know the direction in which high-end, high-intensity warfare is heading. This is the reason for this conference. Air, sea, land, cyber and space are becoming increasingly integrated. The better the integration across domains, the more formidable the capability of that military.

Each domain offers a new opening through which to gain an across-the-board advantage over an enemy and each domain also presents one way for your enemy to degrade your overall capability. This means that all domains come into play in the event of high-intensity conflict. This leads to the problem that some domains are easier to attack than others and can be done remotely—cyber being the domain I am thinking about. It also means that no domain can be completely ceded to the enemy if an integrated multi-domain strategy is to survive.

Then there are two other implications of this kind of multi-domain warfare. The first is that when engaged in such warfare, the enemy has a strong incentive to initiate military action with little or no warning, meaning that armed forces need to be in state of readiness to conduct high-end and high-risk operations at very short notice. It also means that traditional forms of deterrence through signalling, tactical positioning or posture may not be as effective.

Second, and in addition to the necessity for forward deployed forces to immediately engage in multi-domain, high-end warfare, reinforcements must be able to seamlessly integrate with forward deployed forces—adding an extra level of complexity and sophistication to what modern militaries are called to do.

As I said at the beginning, how a modern military goes about preparing for this emerging reality is better left to the people in this room rather than myself. Let me now get to what I have been asked to speak about which is Asia. And what I say will also apply to many other countries around the world.

One of the advantages of not being in government is that I can be blunt and honest in what I believe to be true. Of course, you should always feel free to disagree with me.

In my view, integrated multi-domain warfare will widen the capability gap in much of the region. I say this because the majority of Asian countries have made relatively little progress when it comes to genuine military transformation—everything from capability to the organisational, institutional and strategic doctrines that are needed to engage in modern, multi-domain warfare. Instead, what we are seeing is the upgrading of existing capabilities involving operations in one or two domains. So we are seeing improvements in capabilities for force projection and capability for operations in low-visibility environments. There are improvements in surveillance and reconnaissance.

But the factors preventing military transformation in much of the region are quite difficult to overcome for a number of reasons.

- There are budgetary constraints which won't be lifted to any great degree. Much of Asia is still relatively poor and focused on economic development rather than military transformation. And the latter doesn't come cheap.
- In some cases, organisational and bureaucratic resistance is considerable. There is the effect of legacy systems and pre-existing procurement commitments which cannot be broken because of the political, diplomatic and financial relationships built around these between arms vendors and purchasing countries.
- Moving toward multi-domain warfare requires a change in the way militaries are organised and structured. I am speaking at an air power conference so I can say this openly—many militaries in Asia are fairly hierarchical and usually dominated by the army for historical reasons.
- They tend to view disruptive changes to how the military should work with a lot of suspicion. And for those not fully convinced about the brave new world of multi-domain warfare, it's a lot more fun to buy a new and improved large weapons platform such as a battle tank than invest in command, control, communications, computers, intelligence, surveillance and reconnaissance or C4ISR systems as one example.
- Much of Asia is still in the process of economic development from low- to middle-income countries, with several possibly stuck in the so-called middle-income trap. Properly integrated multi-domain warfare requires an advanced military and civilian industrial and technological base which most countries in the region will not have for many decades.

Now, there is an argument that military transformations can speed up dual-use technologies that can be used by the civilian economy. But it's a chicken-and-egg argument; the technologies and innovations used for high-end multi-domain warfare are better integrated into already advanced economies with an established and world-class industrial base. The bottom line is that the economic payoffs for any developing country with a limited industrial and capital base will probably be underwhelming.

If what I say is accurate, then what can many of these countries do about it?

If you're an ally of a great power with considerable capacities yourself—and we all know which countries I mean—then the way ahead is fairly obvious. You find niche but important areas where you can fill or narrow some of the capability gaps of that great ally. You place enormous emphasis on interoperability. In summary, you ensure that your capabilities—in terms of hardware, institutional set-up and strategic doctrine—act as a force multiplier for both yourself and the great power ally.

If you're an ally of a great power, but you do not have advanced capabilities yourself, then it becomes a little trickier. You still aim for as much interoperability with the great power ally as you can manage. But fall too far behind the pace of required military, institutional and doctrinal transformation taking place and you become less and less important when it comes to future coalition operations. If you get to the point where you are not a force multiplier for the great power ally, you enter dangerous ground. Of course, there are other ways you can assist great power allies: offer your territory to assist in logistics, surveillance, troop rotations, positioning equipment and other technologies etc. Just make sure you don't call what you offer any great power a base!

If you're a security partner of a great power, but not an ally, you also have some options. If you have formidable networked capabilities yourself, then the objective is to ensure you have a flexible, resilient and rapid power projection and response capability against attack by a much larger and formidable power. The objective is not to be able to defeat that larger highly advanced power, as that is not possible, but to buy time to allow intervention by other great powers. Of course, this presumes that you can skilfully position yourself in the region such that it is in the vital interest of your great power partner to prevent your defeat even if they are not your treaty ally, and come to your assistance in the event of a major attack by an enemy against you.

And what if you don't have a great power ally and you have minimal or negligible capabilities when it comes to initiating or sustaining a high-end multi-domain military campaign? One possible way ahead is what some people call 'cross domain deterrence', or CDD, which involves using capabilities of one type in one domain to counter threats of another type in another domain. The most obvious is to develop one's cyber capabilities to be able to inflict heavy or prohibitive damage to the enemy's capabilities in another domain. Cyber is of interest because the barriers and costs to entry tend to be lower.

Yet, countries with poorly integrated multi-domain capabilities also tend to have poor cyber capabilities. Even if a relatively weak country could use cyber weapons to disrupt a more powerful enemy, the more powerful enemy is almost certain to be able to inflict enormous costs on you without using an elaborate multi-domain strategy.

Additionally, the whole concept of inflicting so-called prohibitive or deterrence level costs on a more powerful enemy is an inherently subjective standard and is very difficult to determine. How much disruption and cost to the enemy is truly prohibitive depends on factors such as what is actually at stake and the domestic politics of that country at any given time. All this is impossible to quantify. Moreover, if the more powerful enemy knows that we are prepared to pursue a CDD line of attack, it might actually increase the incentive of that more powerful enemy to launch an unannounced and pre-emptive attack to take out our CDD capabilities.

In short, small and weaker countries are playing with fire when they pursue any kind of asymmetrical prohibitive cost strategy. The reality is that for the majority of Asian countries, and I suspect for most countries around the world, a genuinely integrated multi-domain strategy across all five domains (or even four) might be beyond their reach for decades. So for the majority of regional countries which have a maritime focus, it will be about acquiring superior conventional capabilities in the air and sea over immediate neighbours—and attempts at better integration of air and sea power. Even then, force projection across these two domains is likely to be limited to their immediate periphery.

So for most Asian countries, superiority over their immediate neighbour is achieved NOT because they operate better across multiple domains that include cyber and space but because their traditional naval and air force capabilities are better, their militaries more professional and less corrupt, and their traditional strategic and tactical doctrines better thought through.

This is what success for them looks like. This not to say there won't be progress—just that fundamental transformation toward a fully networked force will be much more difficult to achieve. Meanwhile, most Asian powers will have little role to play if great power conflict occurs.

A small number of states in the region will do better. These will be states that have a few things in common:

- an advanced and innovative civil industrial and military base,
- a professional military,
- a highly skilled and well educated population,
- capacity to source advanced military technology from great powers or build it themselves,
- interoperability with a great power in specific theatres and contexts, and
- a national will or identity that wants to be a leading regional military power.

These states in the region (and you can count them on one hand) will push the boundaries of what is possible in a multi-domain context across four or five of the domains. In addition to

better raw capability in the air, sea and land, they will comfortably attain dominance over their neighbours even if the prospect of war with one's immediate neighbour is remote.

But defining what success looks like for these more capable powers is a little more complicated when it comes to the possibility of high-intensity conflict with another country with advanced capabilities. Does an Asian country aim for superiority over this potential enemy (that is, the capacity to defeat one's potential enemy in a particular theatre of war) or are we are happy with a workable military stalemate (a situation where both sides are able to catastrophically disrupt the networked military structure of the other by inflicting damage to the enemy in one or more domains)?

Whichever it is, nothing is enduring because technology never stands still—take changes in these areas, for example: cyber, directed energy such as microwave and lasers, nanotechnology, robotics and biotechnology. Advances are being achieved so rapidly that it is impossible to predict their future impact across all five domains. An emphasis on electronic warfare to disrupt an enemy's eyes and ears will lead to a counter-strategy based on new technologies, capabilities and doctrines. New vulnerabilities in one domain will have cascading effects on others. It is impossible to see advances in multi-domain warfare standing still.

You have heard the truism that any high-intensity conflict involving Asia's great military powers would be disastrous for all countries due to the economic relationship and integration between the whole of East Asia. Remember that all of Asia's great military powers are also great economic powers. High-intensity conflict would be made worse by the possibility that all five domains are targeted which could lead to enormous economic and civil dislocation.

So military success is one thing. But strategic success requires that these countries be able (whether standing alone or joining an allied action) to not just prevail in a conflict zone, but control and contain the pace, scale and geographical space of escalation across domains at every stage of conflict, especially cyber and space. This becomes more difficult when the battlefield is expanded across different domains, and countries with the capability might try and go for a devastating first strike in one of the domains.

But fail to control those three things—pace, scale and geographical space of conflict—and any victory may prove too costly. I said at the beginning that a wise man knows what he doesn't know. Well, I openly admit that controlling escalation is very difficult to do when it comes to networked capabilities.

So how we do that is a question for much smarter people than myself to work out.

MULTI-DOMAIN INTEGRATION – THE EUROPEAN EXPERIENCE

AIR GENERAL F JAVIER GARCIA ARNAIZ

All distinguished audience, generals, dear peers, thank you very much for inviting me and offering the opportunity to explain some of the views we can have on the multi-domain integration.

For me, it's a privilege to be over here with two hats. One, as it has been mentioned, as Chief of Staff of the Spanish Air Force, and the other as present Director of the European Air Group. This is a group of European air forces that have associated and established a headquarters in the United Kingdom at High Wycombe with a small staff, just 20 persons. They strive to coordinate our air forces and our staffs to better integrate and to obtain a real interoperability, not only in materiel, but in the doctrine, personnel and the ability to operate and work together. These countries are Belgium, Germany, France, Italy, the Netherlands, Spain and the United Kingdom. And I think that in the years they've been working, they've been very successful and are obtaining very good results.

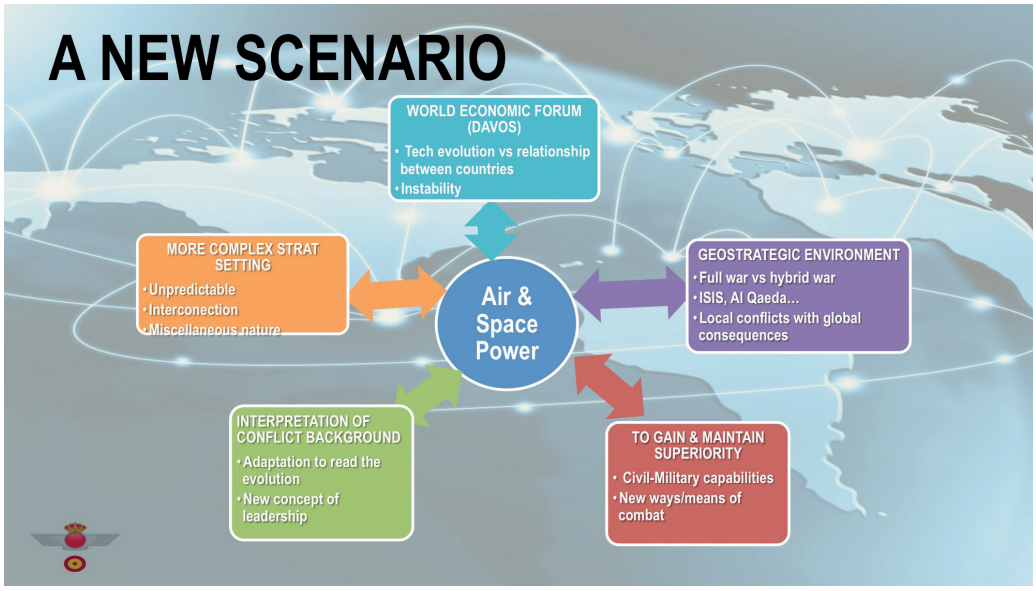


Figure 6-1: Current Influences on the Need for Air and Space Power

During the World Economic Forum in Davos, [Switzerland] social, political and business world leaders discussed the impact of the fourth industrial revolution on the international system, meaning how technological evolution might affect the relationship between countries and consequently Western security and defence systems. Artificial intelligence, automation, hyperconnectivity, robotics—this progress could lead to a more unstable world and transform

the environment in which the military air force takes place into an always more complex and strategic setting, more dangerous and unpredictable with increasingly interconnected threats of different magnitudes and of a miscellaneous nature.

In terms of security, and according to the current strategic environment, full war between countries is still unlikely. But rather, more frequent and small crises will take place – small local conflicts with global consequences shifting from wars of attrition to quick campaigns. Our security framework must adapt to correctly read the evolution and nature of the aforementioned environment, to modify it according to our goals and interests, because if we don't do it, the potential threats will.

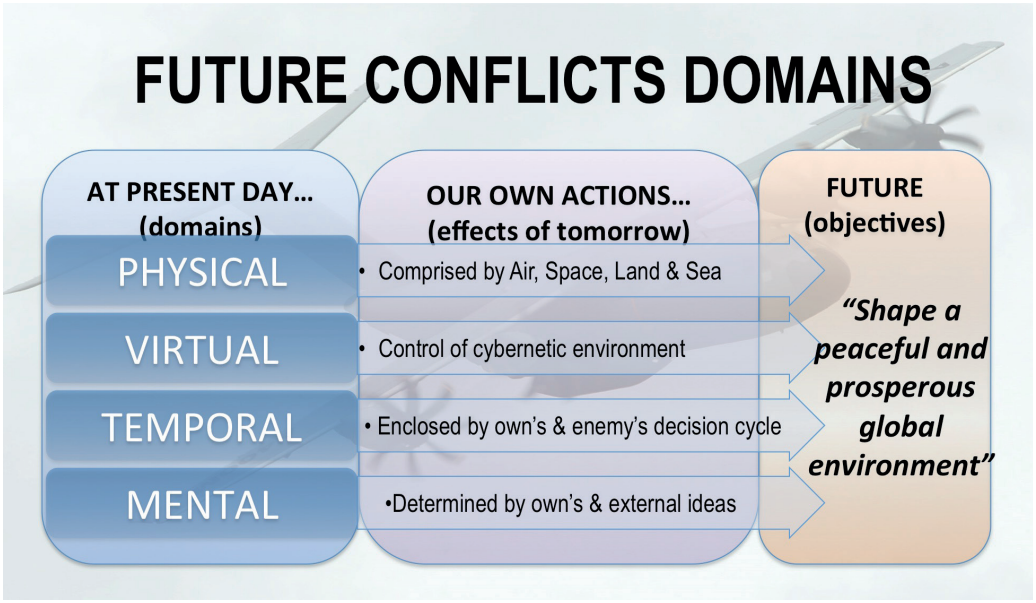


Figure 6-2: Domains with Potential for Future Conflict

The environment's nature, and where the conflict takes place, defines the domains in which the military force may act and drives the ongoing evaluation of whether our security systems match the risks, the threats and the general environment.

In the following minutes, I will try to reflect on the multi-domain concept, offering for discussion my point of view. First, I will define the domains involved in the future conflict; I will continue by describing the contribution of air and space power to gain and maintain engagement superiority; and finally conclude with the greatest competitive advantage of the air force's inventories, which is its personnel.

Domain could be described as the environment where military actions are executed, conditioned, limited or maximised to achieve the specific effects and objectives. In the past, we used to consider air, land and sea environments as the only domains. Down the line, the space domain was added, and recently the cyber domain has been included. Therefore, according to the nature of a current conflict, we can distinguish between the physical domain, which is comprised by the air, space, land and sea, and then the virtual domain consisting of the cyber environment. However, the success or failure of any military operation within the physical domain will depend greatly on the tempo and the perception. This is to say, when a decision is made, when a particular action is enforced, when the action produces the desired effects and the perception of it—in brief, how the action is interpreted and the effects achieved. Therefore, it seems appropriate, due to the relevance to the military operations, to consider another two domains—the temporal domain determined by our own and the enemy decision cycles, and the physiological domain determined by internal and external ideas, our own and external knowledge management and what we could call the bubble of the narratives.

Any modern conflict could be defined by these four actions already mentioned, whether by disputes between groups or organisations in any of the four domains or in one of them exclusively, or even in any combination of them. We could say that the absence of conflict occurs when every domain remains quiet, meaning when no agent would attempt to take control of it.

A clear example of the interpretation of a conflict to the domains, is what it is called 'hybrid warfare'. The NATO comprehensive report on hybrid warfare defines it as:

> a comprehensive strategy to achieve geopolitical and strategic objectives based on a broad, complex, adaptive and often highly integrated combination of conventional and unconventional means, overt and covert activities, military, paramilitary, irregular and civilian actors, conducted across the full spectrum of the elements of power to create ambiguity and targeted at an adversary's vulnerabilities.

Complicated, but anyway we have to deal with it.

But from the multi-domain's point of view, hybrid warfare could be understood as a combination of coordinated and synchronised actions across the four dimensions defined, normally oriented to break the enemy's decision cycle by means of deceit and deception.

The current conflict lies within the four dimensions, and there are threats which are able to fly faster than we do. They are more agile and efficient in their actions. The success of paramilitary operations will depend on the integration of proper actions in each of the domains using military, diplomatic, information and economic means.

According to the definitions previously addressed, the physical domain encompasses the traditional operational environments—land, sea, air and space. Our aircraft and satellites

operate in the air space domain. They fly out of the air bases and can attack targets in the air, on the ground or at sea. This is the domain we all master, because it is our native domain, the one in which we have operated so far.

Traditionally, armed forces, and air forces too, have focused on the physical domain—aircrafts, weapons, bases—but very recently we have identified cyber as one of the priorities. But the other two domains abovementioned—the temporal and the mental—are still at a different level. In spite of all of the above, the fact that operations in other domains gain in importance in the overall outcome of a conflict or crisis, does not imply that the physical domains are going to disappear as battlespace. They will continue to be one of the most important combat arenas, because even cyber wars live in the physical domain and they are vulnerable to physical effects.

The challenge is to be able to integrate the rest of the domains, especially the temporal and the mental domains, in future air operations. The document called *Joint Air Power Capabilities*, which has been drafted by the Strategic Allied Command Transformation, provides a strategic vision of the roles of the air power and identifies the capabilities required for 2030 and beyond. This document is not a multi-domain document, but in an effort to provide the strategic insight into capabilities required in the long term it clearly marks the need for 2030 air forces to operate in all domains. It clearly marks that the air power roles are going to be more or less the same at this time, and these will be the counter air—whatever you want to call it—attack, air mobility and ISR [intelligence, surveillance and reconnaissance]. Those roles are present across the full spectrum of the operations in the envisaged operations framework. The strategic guidance provided for the capabilities required can be summarised in prepare, project, engage, sustain, command and control, protect and inform.

Those conclusions regarding the future capabilities of joint air power will inform the next generation of weapons, armaments and materiel, and in this field, technology takes a very important role. The pace of technological advance is clearly much faster than the air forces' capabilities and materiel acquisition processes. So, trying to describe how aircrafts, weapons, command and control systems and the elements of the physical domain will look like in the future is a mere imagination exercise. But there are some technological strands that will significantly impact the way we will fight in the future.

I would like to highlight a couple of these possible strands. Technological proliferation severely produces a technological advantage. Connected to the above, proliferation increases the risks in the form of over-reliance, single points of failure, and the lack of traditional backup systems. So far, even in the most modern and state-of-the-art systems, there is a human element in the decision loop, more precisely, making the decision, but we are close to witnessing the tremendous leap forward of seeing interconnected machines or robots making their own decisions. Will we see a swarm of armed RPAs [remotely piloted aircraft] taking off, assembling their formations and pushing toward the targets? But what is really new to the new generation air forces is the

need to operate in the physical domain as well as in the rest of the domains. They need to produce effects in the temporal or virtual domains while operating from the physical or space domain. And they need to defend from threats originated in the other domains.

It is difficult to predict how air forces will be served by technology in this integration, but I would like to bring here examples that might disturb some thinking. Will we see cyber counter-operations? Today, the cyber component can be deemed to be in support of the air forces; it might also be seen that air forces may be in support of the cyber component, for instance, by destruction of the data centres. It is therefore important to understand, at every level, how to integrate cyber in air planning and targeting. Moreover, the involvement of air forces in the cyberspace arena is reinforced by the fact that the future vision of air power will probably be a combination of air power and cyber power.

Air-cyber. Dealing with this topic is one of the newest initiatives of the European Air Group that I mentioned before. Will we see cross-domain targeting, meaning preparing targets in different domains and searching for effects in one or more domains? As a consequence of domain integration, multi-domain situational awareness is a must. Regarding ISR capabilities, air forces will collect, process and disseminate information and generate intelligence in all domains. Will we see, as suggested by the European Air Group, a cyber-recognised picture or a strategic-communications-recognised picture added to the current recognised air picture?

In the future air battle, a three-day ATO [air tasking order] cycle will likely be too long. Nowadays, there are already indicators of this trend, such as dynamic targeting or time-sensitive targeting. Will we see a single, standing real-time air tasking order?

According to the cyber domain and its contribution to a joint military action, an infrastructure adapted to offensive combat is necessary. The hyperconnectivity of air weapon systems with all their components increases the efficiency of the cyber offensive actions. Similar to denial of enemy attacks or air superiority operations, counter air can be designed in a way to inhibit or neutralise virtual space computer infrastructures which unbalances the scenario.

Likewise, we can work in the virtual domain. This enables us, with low cost connections, for instance, encrypted internet connection, to have a future where a synergy of hundreds of operators, thousands even of operators, can contribute to exercise control over the air and space domains. The use of a multi-connected network will shorten the dead times in the decision cycle.

In the global network framework of our military operations, the involvement of the cyber world in the military air operations will lengthen the reach of any air headquarters to the farthest aircraft. The air and space power can be projected without physical or logistical limits that hamper the most important characteristic of the air power, which is its expeditionary nature.

The unstoppable growth of the virtual world would be exploited to the benefit of the air and space power.

A dilemma is created when it is necessary to resolve the actor's identity in the domain. We should translate this into the physical world and define the recognised cyber picture, acknowledging the difficulty of integration with other domains. Cyberspace is a part of the global commons—that is, common space without an owner or a ruler; difficult to control without a leader to put in place the security and defence structures. As for offensive use, how can we fight the cyber threats? And what is the contribution of the other integrated capabilities, including air power, to counter it?

Cyber defence is much more complex than cyber attack, with a dual-use technology where the offensive one dominates for better efficiency in the use of capabilities and its effects. The use of the 'cloud' concept improves interoperability between fourth and fifth generation aircraft and the transition between the productions of the two generations of air weapon systems. The problem results in effective management of the databases. It is necessary to incorporate cyber objectives in the targeting process and planning, not only to coordinate but to go beyond and seek correlation effects. The future vision of air power is a combination of the other domains to identify centres of gravity, CIS [communication information systems] media, servers, nodes and lines.

When discussing the physical and virtual domains, we often concentrate on platforms, materiel and equipment and put aside two critical items—organisation and personnel. Armed forces will have once more to react and adapt quickly to design and generate the structures and organisations that allow full multi-domain operations both at planning and execution level. Besides, as has been repeatedly shown in military history, the human factor will be crucial for success in what we could call the 'second revolution in military affairs'.

Education, training and leadership will have to evolve to guarantee that our personnel have the necessary knowledge and skills to understand the implications of the multi-domain battlespace. This is particularly true for the next generation of military leaders. First, in this multi-domain environment, what security model do we need? What strategy is better suited to the changes taking place around us? The common element to all domains is the individual—the combatant at all levels who uses, exploits or transgresses each domain, his mindset, his will to action and his level of ambition. In my opinion, we must evolve towards more proactive models, which in modern societies are known as innovative models, with a wish for commitment, with a good will to influence the world, to protect and preserve our values, more inclusive and, from a joint perspective, through a high-readiness, prepared force.

The element that actually confers a proactive nature towards strategic plans is the person responsible for designing and executing them. Ultimately, formulated plans are not as critical as the leadership model we decide to have and the talent of the people we want to attract and

retain. Our true competitive advantage against any threat will be to have leaders at all levels of our organisations. For that, we have to select them, train them, educate them and manage their careers.

Most experts agree that the factor that really characterises a leader is not so much their philosophy or their leadership, personality or management style. It is what could be called the 'logic of actions'. That is, how to interpret reality and the environment around him. And the leadership style that the armed forces of tomorrow will need is this:

- leaders with the ability to create visions shared by their whole organisation that help promote personal and organisational transformations;
- leaders who can anticipate incoming threats together with the most likely combat scenario, enhancing knowledge management and information;
- leaders who can question what is known about the environment, encouraging all staff to invest time and energy into a permanent learning;
- leaders capable of interpreting reality around them, to recognise common patterns in the complexities of every-day life;
- leaders who are able to decide for themselves, to make decisions from a proactive and responsible attitude, seeking opportunity and taking the consequences;
- leaders who can align themselves with the objectives of the other actors involved in their state's security, improving the strategic communication and relations both inside and outside the military environment;
- leaders capable of learning—future-oriented, enabling collective learning and incorporating the talent and the commitment of every soldier, of every airman.

So, concluding, to be well prepared to employ air power in an ever-more complex and strategic environment, it is essential to feed, exploit and share a cyber database that should be applied to the other domains. An effective management of these databases and the use of the 'cloud' concept will improve interoperability between aircraft of the fourth and fifth generation, and this will be a crucial tool to provide a powerful cross-domain-based air force.

The temporal domain may decide the success or failure of any military operation, whether any event occurred outside or beyond enemy decision cycles. The hybrid warfare is well aware that a change produced in the battle rhythm or in the perception has strong influence within the physical or virtual domain, and the core of the four domains is the human factor. Even in the most modern and state-of-the-art systems, there is a human element in each decision. We need to identify and focus on this element and must understand the implications in the multi-domain battlespace.

MULTI-DOMAIN INTEGRATION – A PACIFIC AIRMAN'S PERSPECTIVE

GENERAL LORI ROBINSON

Aloha. I want to say it's great to be an airman. I love being an airman and it's so wonderful to hear all these conversations. I'm going to talk to you not just about an airman's view of multi-domain operations; what I really want to do is talk about the Joint Force Air Component Commander's view of the Pacific for Admiral Harris, but I would be remiss if I didn't tell you that I don't do this by myself. I have two of my great brothers-in-arms here, Admiral Scott Swift from PACFLT [US Navy Pacific Fleet] and Lieutenant General John Toolan from MARFORPAC [Marine Forces Pacific]. I would tell you, it's a great team and, so while I'm going to provide the Air Component's view of multi-domain operations here in the Pacific, I have great brothers-in-arms that we do this together.

Let me begin by underscoring the importance of our alliances and partnerships as we face the serious challenges and uncertainties of this century. In particular, let me recognise the long and enduring alliance that has served the security interests of the United States and Australia so well.

Just recently, the Government of Australia put forth the *Defence White Paper*, which matches actions and words—no easy feat in government policy papers, as we all know. Along with joining the United States in building a revolutionary, multinational 5th-generation air power coalition, Australia in its White Paper announced the biggest expansion of its Navy since World War II, and a Defence budget plus-up of $21 billion. This is an extraordinary document, one that provides an unambiguous framework for Australia to transform its military, to become one of the world's most capable and agile, well into the decades ahead. The White Paper also reaffirmed the importance of the Australia-US alliance.

America, like Australia, is adapting to the new regional and global realities. When and where America will need air power next will continue to be unpredictable. Therefore, the nation needs a flexible, precise, and lethal force that can rapidly respond anywhere around the globe. Although US Air Force core missions have not fundamentally changed, how we perform them has radically changed. Instead of snapping black and white photos of enemy troop positions, airmen now control remotely piloted aircraft that capture thousands of hours of full-motion video every day. In 1947, we primarily operated in the air domain, while today, our five core missions are carried out in and through air, space and cyberspace.

Over the last few years, a series of guiding documents have been released to provide the US Air Force a strategic framework for the future. They describe who we are as a service and define us as a team of innovative airmen, grounded in our core values, and superbly trained to execute our five core missions. They describe how our missions of:

- air and space superiority,
- ISR [intelligence, surveillance and reconnaissance],
- rapid global mobility,

- global strike, and
- C2 [command and control]

are brought together to provide global vigilance, global reach, and global power.

Our Air Force's strategic vision for the future sets us on a path to building an agile, inclusive service that aggressively promotes innovative ideas and pursues game-changing technology to match the rapid pace of change. The Air Force enterprise has been given the strategic vector to pursue even greater multi-domain approaches to our five core missions, and given the foreseeable, strained fiscal environment, this approach is a compelling one.

From the Pacific island-hopping campaign of World War II to the success of coalition forces in operations against ISIL [Islamic State of Iraq and the Levant] and its allies today, air superiority has been and remains essential to successful military operations. Joint force and coalition commanders have come to expect air superiority, and the Air Force has given them ample reason. Not since 15 April 1953, has an enemy combat aircraft killed an American service member. Air superiority, however, is not a given in a contested and congested environment. It will be much more difficult to attain and maintain air superiority.

America's freedom to operate effectively across the spectrum of conflict rests not only on our ability to dominate in the air, but on our ability to leverage space and cyber. Each and every day, airmen play a role in ensuring agile information superiority, providing critical capabilities that enhance the military's ability to navigate accurately, see clearly, communicate securely and strike precisely. New options networked across domains, including non-kinetic reversible actions, are being developed to deter a wide range of actors and to address unpredicted operational challenges.

Traditionally, we have organised forces in Service components with a particular domain emphasis. While our component model remains valid and effective, the emerging global environment demands we strive for greater interdependence to achieve integration across multiple domains.

In the Central Command area of responsibility [AOR], there have been many opportunities for multi-domain integration among the US, our allies and our partner nations. From Afghanistan in 2001, to Iraq in 2003, and continuing today in Iraq and Syria, integrated operations across multiple domains have yielded changes to doctrine, tactics, techniques and procedures, as well as advances in interoperability. Our integration with coalition partners, such as Australia, Canada, Denmark, the Netherlands, Saudi Arabia, Turkey, UAE and many others represented here today, has created the foundation for expanding future multi-domain operations. These operations, however, have been conducted in relatively permissive environments. Future multi-domain operations must build on what has been learned, so that we can apply these lessons in a more heavily contested environment—an environment you'd possibly see here in the Indo-Asia-Pacific.

Having said that, let me speak for a bit on the scope of this dynamic and complex region. The Pacific Command area of responsibility is the largest of all theatres. It encompasses 52 per cent of the Earth's surface, includes 36 nations and sustains 60 per cent of the world's population. By the middle of this century, most projections estimate that seven out of every ten people will live in this region of the world. The implications for the world's food, energy and infrastructure requirements make the current rules-based international order essential to maintaining peace and prosperity. These projections not only point to opportunities for cooperation, they underscore the potential for conflicts as well.

Pacific Air Forces is composed of 46 000 military and civilian airmen. Additionally, we are the air component to US Pacific Command which is comprised of almost 400 000 military and civilian personnel. All of these folks work hard to maintain security and stability in the Indo-Asia-Pacific—a region with the world's three largest and five smallest economies. From a military perspective, the region has seven of the ten largest standing armies in the world and five nations with nuclear weapons. Russia, China and North Korea, respectively, have the largest missile arsenals in the world. Unlike the multilateral nature of NATO, the US has five defence treaty allies, which include Australia, Japan, the Philippines, the Republic of Korea and Thailand.

Above all else, what these statistics should tell you is that the Indo-Asia-Pacific matters to the United States—which has always been, and will always be, a Pacific nation and partner. Even as we confront other challenges around the globe, including ISIL's barbarism in the Middle East, we continue to make progress in advancing our enduring interests in this region. And while Pacific Air Forces work hard to maintain peace and prosperity, as a military commander, I must also ensure that our forces are first and foremost ready to defend our national interests. And, I think you'd agree that even in the last five years, the international security environment has become significantly more complicated.

Given North Korea's quest for nuclear weapons and a missile system that can deliver them throughout the region, including the United States, North Korea remains our most dangerous and enduring challenge. While the international community's condemnation of North Korea's latest nuclear test and satellite launch precipitated increased sanctions, this persistent threat is one of the reasons why strengthening our alliances with Japan and South Korea is so important. For decades, these alliances have been the foundation of peace and security in North-East Asia. In November, the Commander of US Pacific Command, Admiral Harris, joined US Defense Secretary Carter in Korea for the 47th Annual US-Korea Security Consultative Meeting, in which, among other things, we agreed to expanded cooperation in space and cyberspace.

Despite a priority focus on Europe and the Middle East, Russia is engaged politically and militarily in the Indo-Asia-Pacific. Russia's Pacific coastline, for example, exceeds the distance from Hawaii to California. Accompanying their destabilising actions in eastern Ukraine and mirroring the spike in its air activity in Europe, Russia has significantly increased its long-range aviation activity across the Asia-Pacific. Their air patrols to the coast of California and around Guam and the Japanese main islands have reached a frequency in recent years not seen since the

Cold War. Moscow also remains attentive to untapped resources in the Arctic which coincides with its increased militarisation there. In the authority given to me from US Pacific Command as the Area Air Defense Commander, I must view Russia's air activity from a theatre-wide perspective, adjusting force posture levels as necessary.

The political and military dynamic in the East and South China Seas is changing, and the calculations—or miscalculations—between claimants present threats to stability and security. As I meet with my counterparts in the region, almost all of them share a concern about the dangers of militarising outposts in the South China Sea. We encourage all claimants to halt land reclamation, the construction of new facilities, and the militarisation of their outposts in the South China Sea. And we strongly urge China and ASEAN [Association of South-East Asian Nations] to conclude a meaningful code of conduct as soon as possible, as it is in the interests of all to have all claimants follow clear, predictable rules-of-the-road in the South China Sea.

International seas and airspace belong to everyone and are not the dominion of any single nation. By matching our words and our diplomacy with routine freedom of navigation operations, we make it clear that the United States continues to favour peaceful resolutions to ongoing disputes, and that our military will continue to fly, sail and operate whenever we choose in international airspace and in accordance with international rules and norms.

Before moving to the next slide, I'll touch on one more shared theatre challenge, and that's natural disasters. Many of the developing countries in the Indo-Asia-Pacific are situated on the world's hazard belts and are subject to floods, droughts, cyclones, earthquakes, windstorms, tsunamis and landslides. Last month, for example, a monster cyclone (Tropical Cyclone Winston) hit Fiji. With winds reaching in excess of 180 mph, the storm battered the tiny island nation, killing at least 17, knocking out power, and causing heavy flooding. Thanks to the governments of Australia and New Zealand, humanitarian assistance and the use of military aircraft and ships were offered to the Government of Fiji to assist with aerial damage assessments and the swift delivery of relief aid.

In the last decade, this region has suffered 80 per cent of the world's natural disasters, affecting more than 2.4 billion people and causing in excess of $910 billion in property damage. Increases in population and urbanisation will only increase the impact of future incidents. Due to the frequency and intensity of these disasters, military involvement in disaster response has grown. In the past few years, Pacific Air Forces airmen have participated alongside our joint and coalition partners in humanitarian response and disaster relief operations in Japan in 2011, the Philippines in 2013, and most recently, in Nepal last year.

These theatre challenges highlight the requirement to effectively integrate multi-domain operations across the joint force and we do this by utilising the air tasking cycle to connect strategic guidance with operational and tactical tasks.

As the Theater Joint Forces Air Component Commander and Area Air Defense Commander, I meet regularly with my strategists from within the Joint Air Operations Center, also known as the

613th Air Operations Center, to approve the Theater Air Operations Directive for US Pacific Command. Through this process, guidance is passed on the use of joint air, space and cyber capabilities. It informs planning through our joint air tasking cycle and manages risk during the execution of the joint air tasking order. The directive is shared with our Marine, Army and Navy teammates to ensure airpower priorities are levied across the joint force. We also share it with our allies to inform their respective air component planning and to enable integration into our air tasking order, furthering interoperability. As the warfighting air component to US Pacific Command, we also distribute our guidance to functional US commands. Exercising my space coordinating authority, I share my space priorities with US Strategic Command, through the Joint Space Operations Center, which results in a space tasking order that directly supports our joint air tasking order. While we also continue to integrate non-kinetic operations into our day-to-day missions, our ability to plan and execute the joint air tasking order across multiple domains as well as integrate monthly with our joint and allied partners demonstrates the speed at which air, space and cyber power contribute to warfare.

In order to illustrate the complexity of our multi-domain and multi-lateral integration and coordination, let me walk you through the day-in-the-life of one of our bomber missions, as all of them require integration across multiple domains to achieve strategic objectives.

At the start of a B-52 mission, the aircrew receives a tasking from the Joint Air Operations Center via the Theater Air Control System which relies heavily on key cyber and space nodes throughout the Indo-Asia-Pacific. As the aircraft departs Andersen AFB in Guam or some other forward operating location in the Pacific, it may be required to talk directly to an allied air operations centre like the Australian Air Operations Centre to integrate with Royal Australian Air Force F/A-18s for the purpose of escort training. Due to the length of our bomber missions, KC-135s deployed to Andersen and permanently stationed in Japan, refuel our B-52s and other allied aircraft integrating with our bombers.

After receiving a dynamic tasking from an airborne C2 [command and control] aircraft like an Australian E-7A Wedgetail, which I flew on last week, the bomber may be redirected to participate in a multilateral maritime exercise to facilitate the development of tactics, techniques and procedures for air operations in support of maritime operations. After yet another refuelling, the B-52 might conduct close air support training with RAAF joint terminal attack controllers [JTACs] to facilitate a bilateral land manoeuvre exercise.

Before returning to base after a 30-hour sortie, the B-52 might participate in a small force employment exercise with Japanese F-15s and deployed F-22s to work on integrating 5th-generation fighter capability with our allies and partners. All the while, the entire mission is supported by ISR [intelligence, surveillance and reconnaissance] resources from both US and partner nations to provide our Joint Air Operations Center, aircraft and resources with the necessary situational awareness to effectively execute the mission. During the sortie, our Joint Air Operations Center might coordinate directly with a partner AOC to utilise foreign space assets to feed the common operating picture in order to inform my decisions. Simultaneously,

cyber airmen from over eight different US bases could be tasked to closely monitor the mission while actively protecting the cyber nodes from malicious threats that could impede the common operating picture at the Joint Air Operations Center and partner AOCs as well as impact our ability to transmit a dynamic tasking to our aircraft.

The multi-domain and multi-lateral integration and coordination which I have just described enables us to do in hours versus days or weeks. In the air, we can rapidly project power in any other theatre, when and where we want it. In fact, as of last week, as part of our Bomber Assurance and Deterrence Missions, we have B-2s in the theatre to do exactly that.

Following mission execution, we spend a lot of our time assessing how the mission contributed to our tactical, operational and strategic objectives. We continuously plan and evaluate the results of our air, space and cyber operations to ensure my boss, Admiral Harris, has the joint air component assessment necessary to inform his overall assessment, across all domains. Where we're able, we also share assessments with partner nations to inform their respective assessments and further our mutual planning efforts for follow-on air tasking cycles. Where we can do better in the future, as airmen, is to improve our assessment of non-kinetic effects, like space and cyber.

There is nothing more multi-domain, multi-service and multi-lateral than integrated air and missile defence [IAMD]. It is combined and joint from top to bottom. It's a joint service mission using the integration of capabilities and overlapping operations to defend the homeland and national interests, while protecting the joint force and our freedom of action. The pillars of IAMD are active and passive defence, attack operations, and C4I, or command, control, communications, computers and intelligence. Our active defence, for example, requires launch detection, cueing, engagement, and kill assessment—you can't do any of this without utilising all domains. It involves space tracking and surveillance systems, sea-based radars, AEGIS destroyers, Patriot batteries—all linked through C2 nodes. The same goes for each of the other pillars.

In my roles as the Area Air Defense Commander and Theater Joint Force Air Component Commander, I support Admiral Harris, when given the authority, to plan, coordinate and integrate all air and missile defence operations. This means providing timely warning and cueing information as well as timely and accurate track reporting; establishing identification and engagement procedures; establishing command and control and producing an approved Area Air Defense Plan.

Within the joint operation planning process, the combined force commander's strategic intent and operational focuses are fused with adversarial strategic and operational centres of gravity and our own centres of gravity. The area air defence staff is the steering committee for plan development and integration and ours includes, among others, a Pacific Fleet and MARFORPAC [Marine Forces Pacific] Liaison, and liaisons from the 94th Army Air and Missile Defense Command and 5th Battlefield Coordination Detachment, as well as coalition representatives.

As the Theater Joint Force Air Component Commander [TJFACC] and Area Air Defense Commander [AADC], I issue monthly strategic guidance and my priorities. Based on this guidance, the Joint Air Operations Center synchronises with US Pacific Fleet to utilise maritime resources to ensure sufficient theatre IAMD coverage. This synchronisation extends to our Japanese, Korean and Australian partners as we levy maritime, air, space and cyber resources to enhance our C2 and IAMD architecture. Luckily, we have liaison officers from each of those countries working on our staff and in our Joint Air Operations Center. The Navy Liaison Element coordinates directly with US Pacific Fleet regarding ballistic missile defence, or BMD, assets and the Army Battlefield Coordination Detachment executes day-to-day BMD C2. To facilitate better coordination between myself and the Deputy Area Air Defense Commander, an Army one-star, we integrated the 94th Army Air and Missile Defense Command, which is comprised of approximately 100 soldiers, into the PACAF headquarters staff and battle rhythm.

Missile defence also requires an interconnected web of capability across multiple domains. To support that, we've steadily increased our cyber defence capabilities over the past few years to conduct cyber reconnaissance and surveillance missions. Defending and maintaining our robust infrastructure of computers, routers, switches and virtual teleconferences is absolutely vital to the C2 of integrated air missile defence. In fact, they are the foundation of our C2 capability. Without cyber, I can't do my job as the AADC and TJFACC. There are dozens of airmen in Hawaii, Colorado, Virginia, Texas, and Alabama who are running cyber missions that maintain mission assurance.

I also rely on the space community for indications and warnings because they track domestic and foreign space launches, as well as long range missiles that pass through space. North Korea's space launch last month demonstrates the importance of having this awareness. And so, to track launches and objects in orbit, we often partner with our closest allies. For example, we've partnered with the Royal Australian Air Force to operate and maintain a Space Surveillance Telescope and C-band Space Surveillance Radar based in Western Australia. To facilitate information sharing among allies and partners, the US also has Space Situational Awareness agreements with eight countries, including Australia, Japan, and the Republic of Korea.

For the past two decades, the Department of Defense's primary space focus was to integrate space capabilities into all aspects of the joint fight. US Strategic Command, through the Joint Space Operations Center, designated the 614th Air Operations Center, has integrated these capabilities with great effect and today, we see this integration as a critical force enabler, providing tactical, operational, and strategic advantage. To provide assured space power, focused on the joint commander's need, the US stood up a joint Operationally Responsive Space Office in 2007. It develops, acquires, fields and employs affordable space capabilities in shortened timeframes. We've partnered with nine countries through a *Space Memorandum of Understanding*, to enhance warfighter responsiveness through the exploration of small, low-cost and rapid space-based solutions.

The 614th has more than 50 tactical units, and its planners, operators, and analysts simultaneously support multiple regional and functional combatant commanders, synchronising

operations to maximise the benefits space effects provide our joint force. Our Director of Space Forces and our Joint Air Operations Center coordinate through the 614th Air Operations Center to provide space support to US Pacific Command component operations. I rely on the Director of Space Forces to provide their senior space perspective so I can develop guidance for desired effects and space integration.

The whole world relies on satellites flying at approximately 20 000 kilometres above the Earth. It is amazing how precise navigation and timing signals that the US provides as a free service across the entire globe has truly revolutionised and innovated our world economies. And, this is why it's so vital we protect these space-based capabilities in an ever increasingly contested and congested environment.

And, how about cyber? We are just starting to develop warfighting doctrine, and coming to grips with maximising our capabilities in and through cyberspace. Our Twenty-Fourth Air Force was only activated in 2009 and US Cyber Command is even younger than that. It might be a surprise to some in the audience, but cyberspace has been a threatened domain for 30 years. In fact, 2016 marks the 30th anniversary of what was the first PC virus. A pair of brothers who owned a small computer store found a number of customers circulating unauthorised copies of their software. To punish these customers for pirating their software, they created the first PC virus. Of course, this virus is a far cry from the threats we face today.

So, what keeps me up at night? Do I have the ability to fight through a cyber-attack? What about a natural disaster that damages underwater sea cables, cell towers, and major internet nodes? To command and control forces, it is imperative I have the capability to pass information anywhere around the globe and at the time of my choosing. To distribute joint and coalition air tasking orders, network resiliency and redundancy are vital.

To ensure this connectivity, Pacific Air Forces has teamed up with the 624th Cyber Operations Center, to provide both cyber effects and mission assurance in support of joint operations in the Pacific. In fact, last year, to facilitate this coordination and synchronisation, we became the first Air Force Major Command to appoint a Director of Cyber Forces. Cyber coordinating authorities do not exist yet, so we're advancing the Air Force's concept for a Director of Cyber Forces role by documenting it and exercising it. Additionally, our Joint Air Operations Center will also be one of three global air operations centres to receive additional cyber personnel to bolster our own organic cyber capability.

The capabilities afforded us by the 624th cover the full spectrum of cyberspace operations, from offensive, to defensive, and protection and maintenance of the networks. We've also started integrating our Pacific air missions with cyber teams from around the country to conduct cyber reconnaissance missions on key USAF cyber terrain. As you would expect, over the last few years, we've invested heavily in defensive cyber capabilities. In exercises, we practice working in contested and degraded environments by denying ourselves access to certain networks. This provides us the opportunity to practice our PACE plan, which stands for primary, alternate, contingency, and emergency communications. I'll be the first to admit that we surprise ourselves

every time we practice, and we've taken away a lot of lessons learned when our primary network isn't available.

An airman's perspective on multi-domain operations is unique. In a single 48-hour span, we can fly 5th-generation aircraft from Alaska, to Japan, to South Korea, to Singapore. In 12 hours, a single GPS satellite being flown from across the world can circumnavigate Earth providing precision navigation and timing to every human on the planet. At the speed of light, cyber airmen are jumping onto networks in Europe, Africa, the Middle East, and the Pacific, enabling mission assurance and defending vital assets. And we perform these integrated operations side-by-side with our joint and coalition partners in exercises and real-world missions daily. Let me give you examples of how we apply this integration in our exercises with both joint and multi-lateral partners throughout the region.

Exercises like *Northern Edge* and *Valiant Shield* are joint training venues designed not only to simulate combat operations, but also test new innovations and improve interoperability of communications, and command and control in multi-domain environments. Planners and operators experience and fight through many of the difficulties in integrating air, land, maritime, space and cyberspace in a very tough and realistic operational environment.

Valiant Shield 14 involved more than 18 000 joint force service members from 30 units, including 200 aircraft and 20 ships in, and around, the island of Guam. In *Valiant Shield 14*, a PACAF-led demonstration team successfully demonstrated the deployment of extended range Quickstrike naval mines to bring aerial-delivered mining into the 21st century and to advance our nation's undersea warfare capability. The US Air Force delivers over 90 per cent of mines on behalf of the US Navy, and thus, we've teamed with US Pacific Command and Pacific Fleet to improve mining capability in the AOR by exploring precision mine placement and stand-off techniques and procedures.

Now, *Northern Edge 15* took place in Alaska, where the vastness of the ranges and the threat arrays available enabled outstanding training for the 6000 service members, 200 aircraft, and three naval destroyers who participated. The exercise demonstrated progress in several notable aspects of operational multi-domain integration, including the 'first ever' integration of specific live-virtual-constructive capabilities. The numerous virtual aircraft flown by pilots in simulators from locations throughout the United States added depth to the opposition force piece and provided robust training for our blue forces.

In the future, as F-35s will proliferate throughout the Pacific Region, future bi- and tri-lateral exercises will enhance 5th-generation aircraft interoperability and integration, as well as agile command and control across the full spectrum of coalition warfighter operations. The capacity for 5th-generation aircraft, like the F-35, using advanced technologies and sensors, in conjunction with other multi-domain systems to collect, fuse, and distribute information will lead to unprecedented battlespace awareness, survivability, and lethality in future highly contested environments.

This past July, more than 33 000 US and Australian joint service members, teamed up with personnel from the New Zealand Defence Force and for the first time the Japan Ground Self-Defense Force, to participate in *Talisman Saber 15*. The exercise featured 21 ships, including the aircraft carrier the USS *George Washington*, more than 200 aircraft and three submarines. Throughout the exercise, we made great strides in integrating air, maritime and land component operations. To address the tyranny of distance in this enormous theatre, effective command and control requires a multi-domain and multi-lateral approach.

During the exercise, 300 US personnel were joined by an additional 100 Australian personnel in our Joint Air Operations Center in Hawaii. On the operations floor, we had subject matter experts in space and cyber assisting in the planning and execution of the air tasking cycle. Maritime and land component liaisons were also represented and effectively translated the Maritime and Land Component Commanders' priorities for incorporation into the air tasking order.

The Combined Force Air Component Commander was an airman from the Royal Australian Air Force, Air Vice-Marshal Gavin Turnbull, who fortunately for me, is my escort this week. He managed and executed the joint and combined air tasking order for US and Australian air forces, naval air assets afloat and army units within the Joint Operating Area. Along with producing thousands of sorties which were monitored via a shared common operating picture between both countries, the Joint Air Operations Center commanded and controlled seven coalition C-17 aircraft loaded with 450 airborne soldiers from Alaska. Within a minute of their time on target, these soldiers were flown from Alaska to a range in Australia, where they successfully conducted airfield seizure operations for the rapid build-up of follow-on land component forces. This is a visible demonstration of the flexibility, speed, and range of air power.

In addition to cooperation agreements and operating the same military hardware, exercising multi-domain and multi-lateral operations enhances the critical interoperability and integration that is so important to our contingency response capability. From a contingency planning perspective, as the Commander of Air Force Forces, we spend a lot of time focused on humanitarian assistance and disaster relief planning and training so we're postured to support US Pacific Command and our partners in the wake of the next disaster.

As many of you remember, last April, Nepal was hit by a 7.8 magnitude earthquake, followed by another one just a few weeks later. As part of the HA/DR [humanitarian assistance/disaster relief] efforts, we deployed over 200 airmen in support of US Pacific Command's Marine-led Joint Task Force 505. These airmen became the eyes and ears for our Joint Air Operations Center. Because of the location of Nepal and the distances required for getting humanitarian assistance and disaster relief into the country, we established an air bridge from Thailand into Nepal. The forward presence of our C-130 fleet at Yokota Air Base enabled a quick forward deployment to Thailand to support missions in and out of Nepal. At our Joint Air Operations Center, planners worked day and night to integrate US Marine C-130s into the Joint Air Tasking Order to maximise airlift capacity in support of the relief efforts.

Additionally, along with our Contingency Response Group out of Andersen AFB, we sent a Joint Air Component Coordination Element to Nepal in order to effectively inform our planning and execution of the air tasking order in support of relief efforts. To establish a framework for improved air delivery with Nepalese transportation officials, this element assessed the airport and created an airlift operations plan for the Multi-National Military Coordination Center that ensured continued commercial operations while maximising relief throughput. As with most natural disasters, situational awareness of the affected area is absolutely necessary to support international relief efforts. Thanks to ISR resources throughout the theatre, we were able to garner imagery of Kathmandu to share with our allies and partners which informed overall operational level planning and tactical execution.

From a logistical perspective, a 33-person Airfield Logistics Team from the 36th Contingency Response Group at Anderson AFB deployed to Kathmandu where they established rapport with Nepalese authorities, built partnerships with various NGOs, validated the international airport's runway structural integrity, and received and helped distribute aid (in total, they attended 108 aircraft/5.2 million pounds of aid). In total, the US Air Force flew 148 sorties (770 hours), and airlifted close to 800 short tons of cargo and 770 passengers in and out of Nepal on C-17s and C-130s.

On a regular basis, operational-level planners and subject matter experts from my Joint Air Operations Center meet with their Australian and Japanese counterparts via virtual teleconferences to share information and pass priorities. These already established relationships provided quick and accessible coordination as both Australian C-17s and Japanese C-130s integrated into the airlift effort. Other key contributors to the success of relief operations included Bangladesh, Canada, India, Israel, Indonesia, Malaysia, Pakistan, Sri Lanka, Singapore, Thailand and the UK who either supplied aid and personnel or granted unlimited overflight access to supporting aircraft.

Into the future, we must continue to modify the way we think to further include the capabilities and contributions of forces from all domains—air, space, cyberspace, maritime, land and even the electromagnetic spectrum. This will not be easy and not without cost. The command and control, for example, needed to permit fluid transitions between supported and supporting roles and between centralised control and decentralised execution will require new levels of operational agility, in both planning and execution. I know that together, as a joint and coalition team, and together with our highly capable allies and partners, we can and will work through these challenges and prevail against the heavily contested environments of today and tomorrow.

WHAT DOES MULTI-DOMAIN INTEGRATION MEAN FOR THE ADF?

DR SANU KAINIKARA

Chief of Air Force, Air Marshal Davies, distinguished guests, ladies and gentlemen.

Multi-domain integration is an aspirational idea that is meant to create a new 'model' for the employment of military forces. In turn, the development of a new model for the employment of a military force clearly indicates two fresh realities. The first reality is an acceptance that there is an erosion of the holistic power projection capabilities of the force in question within the contemporary operating environment. This erosion does not have to be manifest in such a manner that the force is now unable to achieve its objectives, but only that there is a reduction in the capability and capacity edge that it had so far enjoyed, relative to potential adversaries. The second reality is also an acceptance that in order to be successful, modern military forces must retain the in-built ability to continuously adapt and respond to emerging situations faster than potential adversaries. This is a challenge that is particularly apparent in the dynamic 21st century environment where it is becoming difficult even to clearly identify the adversary. Military forces of the world will face this challenge well into the future.

In the context of this presentation, it is superfluous to go into the details regarding the global security environment and the role of the military forces of the 'free' world in ensuring international stability. However, it needs to be stated that the complexity of emerging challenges will require the military forces of the democratic world to continuously and critically analyse their own capabilities and concepts of operations. Such an analysis is necessary to ensure that the force is sufficiently agile, adaptive and resilient—qualities that are critical requirements for assured success. At the core of these essential characteristics is the ability of the force to connect to the overall national security strategy in order to achieve national security objectives in an uncertain global environment. In this scenario, a military force must be able to fight and win today's campaigns while concurrently developing the capabilities and a coherent model for their employment necessary to win future conflicts. This is strategic agility. Essentially, strategic agility is the ability to synchronise the two time-divided horizons—of the present and the possible future—in order to create a force that can truly become an element of national power.

There is an inherent and intimate connection between strategic agility and the model upon which the force is built. The model of the force will determine its efficacy through influencing the concept development process for the employment of the force-in-being as well as the force-in-development. These models should not be confused with the organisational structure of the military force. The models being discussed here are oriented towards optimising the employment of military forces. They are developed to solve challenges that military forces face through an optimised consideration of the military art and science, and are meant to achieve laid down strategic objectives. A military force must be able to meet the expectations of national security

imperatives within an accepted military strategy. The success or otherwise of a military force in achieving this fundamental requirement will depend on the model upon which the force is built.

In a generic manner, most modern military forces are structured as three domain-centric Services—the Navy, Army and the Air Force. These translate to land, maritime (including sub-surface) and air domains, which have been the traditional physical domains that military forces consider when joint operations are being planned. With the technological advances that have taken place in the past four or five decades, the domains to be considered in military operations have increased. Now there are four acknowledged physical domains—maritime, land, air and space. The Australian Defence Force (ADF) also recognises two non-physical domains—information, which also encompasses cyber and the electro-magnetic spectrum, and the human domain. The human domain can be sub-divided into the physical and the cognitive; with the cognitive domain itself being further divided into behaviour pattern and belief system. Since they function in the physical as well as the non-physical arena, the interaction between the domains have always been complex and at times even contradictory.

Of necessity, modern military forces are evolving entities. Although the fundamental responsibility of military forces have always remained the protection of the homeland, over the years the methodology to achieve this desired end-state has been continually changing. The capabilities and concepts of operations that combine to ensure optimum employment of military forces have undergone revolutionary changes, each driving the other in a cyclic manner. When extraneous factors such as resource constraints curtail the acquisition of the latest weapon systems in sufficient quantity, creating a relative loss of 'edge' in capability, the gap is normally compensated by creating innovative concepts and ideas. Multi-domain integration is such an idea—innovative and aspirational. Any new idea must be analysed through answering three fundamental questions—what is it; why is it needed; and how does it work?

What is Multi-Domain Integration?

The term multi-domain integration is not new; it has been used in the world of information technology for a number of years. However, its adaption into military parlance is relatively new and the term is used in the military with a slightly more nuanced meaning. However, before explaining and trying to define multi-domain integration in the military context, it is necessary to contextualise this idea itself and position it in its rightful place. The primary question that has to be answered is whether multi-domain integration is a force design initiative or an idea oriented towards creating a model for the employment of military forces. A majority of military practitioners broadly agree that single domain professional mastery, resident in the individual domain-centric Services, is the first step towards true integration of a military force. Therefore, the answer to the question is that multi-domain integration cannot be envisaged as a force design initiative. Purely by a process of elimination, it can then be reasonably concluded that multi-domain integration is an overarching idea aimed at creating the wherewithal for the optimum

employment of military forces.

From a historical perspective, the initial move towards creating joint forces and subsequently to achieving seamless jointness between the three domain-centric Services could be seen as precursors to multi-domain integration. In other words, the idea by itself is a progression of past initiatives. So what is new in this idea? The difference is in the nuanced manner in which the idea is conceived and the sophistication of its influence across all levels of war—and like all evolving ideas, multi-domain integration is difficult to define in precise terms. In such circumstances, it is easier to state what it is not and then arrive at an acceptable definition through an indirect understanding of what it actually means. Multi-domain integration is not about creating a single military force that clubs all domain-centric Services together; it is not about keeping the three Services tied to each other permanently; it is not about carrying out every single mission, operation or campaign as a unified tri-Service undertaking; and it is not about creating a force that dilutes single-Service professionalism. Multi-domain integration does not mean subsuming the distinctly different identities and operating ethos of individual Services into an unrecognisable single entity. Multi-domain integration is about optimising the potential of each Service and their domain-specific professional knowledge in a contextual manner to achieve the desired objectives.

Multi-domain integration can be defined as an idea that allows for the integration of capabilities resident in each domain into a flexible and reconfigurable whole in such a way as to ensure that the end-capability is greater than the sum of the individual parts in the mix; with the guarantee that the force design is tailorable to context. The focus here is on the ability to create a flexible design with the ability to rapidly reconfigure the existing force and design a force fit-for-purpose in a contextual manner. This is the fundamental difference between a joint force, and one that has achieved multi-domain integration.

Why is Multi-Domain Integration Important for the ADF?

From an Australian perspective multi-domain integration is important because the ADF is, and will continue to be, relatively small in size. This is a direct manifestation of the small population base of the country from which the force is derived. At the same time, security challenges that face the nation are broadening, making it imperative for the military forces to find more innovative ways to fight and win wars of necessity. Although the ADF will continue to be relatively small, the effective adoption of technological force multipliers have placed it in the realm of being a middle-power force. However, this acknowledgement of the ADF's enhanced capabilities come with enormous responsibilities. Further, and out of necessity, the ADF has to maintain an 'edge' over potential adversaries in order to be an effective deterrent, and when required, to be a credible coercive force.

Decades ago, the potent technological edge that the ADF possessed, provided it with the necessary assurance of success and was also its asymmetry. As this technology edge started

to erode with the open availability of high-end technology to most military forces and the geopolitical and global security environment started to become complicated in an ever-changing world, the ADF shifted to ensuring a concept and knowledge edge to sustain its deterrent and coercive posture. Over the years, the ADF has been continually innovative in order to maintain the 'edge'—in terms of technology, concept development, training, education, tactical agility—that is vital to its success. The idea of multi-domain integration fits into this sphere of activity. It provides an overarching strategic umbrella for the development of concepts at the operational and tactical levels for the ADF as a whole.

At the conceptual level, the idea of multi-domain integration is the one that creates a model which can be adapted to suit the requirements of a particular military force. The critical characteristic of this model is flexibility. Sufficient in-built flexibility within the model also caters directly to the need for the military force to be strategically agile. This model has to be developed at the highest strategic level of the force. The superimposition of the idea of multi-domain integration on the three levels of war—strategic, operational and tactical—through the model that has been created, clarifies the relationship between the idea and the realities of war.

At the strategic level, the idea translates to a model that must be designed within the policy directives that guide national security and aimed at creating strategic agility. In a practical sense, the model should get converted to a designed-for-purpose force structure grid that can provide the maximum options with the necessary strategic depth and breadth, dependent on the context. This is innovation with a capital 'I' at the strategic level. The force structure grid should also be sufficiently agile and flexible to provide guidance for the development of broad operational concepts from which functional tactical concepts can be developed. In the three levels of war, the operational level is the one that is responsible for the integration and alignment of tactical-level missions to achieve strategic objectives. In order to achieve this integration in a cohesive manner, innovation with a small 'i' at the operational level is needed to pick and choose the design and create a joint force from the strategic grid, contextually fit-for-purpose, to achieve the laid down objectives.

Multi-domain integration is important to the ADF to optimise its capabilities and to have the inherent ability to rapidly create a designed-for-purpose joint task force that will alleviate its numerical constraint and the disadvantage of small size.

How Does Multi-Domain Integration Work?

The starting point to initiate the process of multi-domain integration is for the force to have a clear understanding of all that joint operations entail and the innate ability to conduct them effectively. Although a joint operation is conceived and commanded at the strategic level, as the name implies, its execution is focused at the operational level. If a force has not been able to achieve the conduct of effective joint operations effortlessly, it will find it difficult to embrace

the idea of multi-domain integration. The ability of a force to be visibly joint in its operations is often referred to as being 'seamless'. Multi-domain integration as an idea is a step beyond achieving seamlessness in military forces. It is, therefore, necessary to understand the concept of seamlessness in order to come to grips with the higher level idea of multi-domain integration. So what does 'seamless' mean in the perspective of a military force?

At the outset, it has to be made clear that seamlessness in a military context does not mean totally and completely without the patchwork of seams. This needs further explanation. The concept of seamless joint operations can be explained with the analogy of the construction of a soccer ball. A soccer ball has many patches that are stitched together to make it into one entity. The various domain-centric Services of the military force can be equated to a combination of a number of patches and the stitching that hold them together to the seams that exist between the various elements of an individual Service as well as between the three Services that constitute the ADF.

Drawing on the soccer ball example, in terms of a military force, seamlessness only means that an external observer or adversary will not be able to distinguish or see the seams that are there. This presentation of a seamless force to the adversary is achieved by the various elements within a Service and the three Services working together, at times feverishly, to ensure that the seams between the patches are so completely supportive of each other that they are almost invisible from the outside. To the adversary, the military force is presented as one single entity with no seam that can be picked as the weak link. If the seams cannot be managed effectively, the adversary will be able to pick at the weak point in the seam and gradually unravel it. In military terms this would mean that the seamless joint force will gradually fall apart, becoming divided and even domain-centric, which in turn will certainly lead to loss of efficacy and the collapse of the joint force. When this happens, joint objectives will not be achieved at the operational level, starting a cycle of setbacks that would ultimately lead to campaign failure. Essentially the impact of the success or failure of seamlessness is focused at the operational level.

Seamless joint operations must become an infallible reality within a military force before it can successfully accept and implement the idea of multi-domain integration. This is so for two basic reasons. First, integration is an enterprise functioning at a degree higher than operating seamlessly since it involves all levels of war. Further, since integration involves all three levels of war, of necessity, the process has to flow from one level to the other in both directions. Second, the level of professional mastery resident in each domain-centric Service needs to be of the highest order, more than even being above the average, in order to successfully 'operationalise' the idea of multi-domain integration and create a working model.

Only after a military force becomes seamless, not only by its own reckoning but also in the eyes of the adversary, can it start the process of multi-domain integration. Going back to the soccer ball analogy, the patches and seams have now to be understood in a slightly more nuanced manner. In order to integrate, the group of patches, which represents a domain-centric Service,

must be designed to fit perfectly with its neighbour, must establish common protocols regarding the exchange of information across the seams within the group and the seams across the groups and, perhaps most importantly, know its place within the whole entity. In other words, the seams will start to manage themselves through a process of automatic and continuous interaction that transcends the physical domains. From a strategic perspective, creating the perfect soccer ball with individual patches, which then become groups of patches is theoretically feasible. The successful creation of such a military force can be equated to having climbed a stairway to heaven, or having reached the acme of military capability. However, it is an extremely difficult endeavour because of the large number of variables involved, especially resident in the two non-physical domains. Further, in order to retain the necessary versatility, the construction of such a force has to start at the lowest level, in this instance at the tactical level of war—success will depend on it adopting a bottom-up approach.

Returning again to the soccer ball, the tactical level can be equated to when the ball is in play. The fundamental requirement is to ensure that the ball retains its correct shape irrespective of the number of 'kicks' that it receives. In other words, the ball cannot spring a leak, either through a seam coming apart or a patch tearing. Translating this to the military force, it means two things. One, the group of patches that represent a domain-centric Service must not tear i.e. the Service must be able to function as one entity. Only professional mastery of the highest order can ensure this within a single Service. Two, the protocols that manage the connection and information flow between the groups of patches representing domain-centric Services must be robust enough to withstand immense pressure. The complexity increases because these connections have to be both linear, between immediate neighbours and also non-linear, going through the soccer ball or the military force to connect with a faraway 'patch' or military element through previously established networks. In turn, the protocols involved in these networks and their robustness become important centres of gravity for the entire force. What this means is that professional mastery of the domains at the tactical level is necessary to bind the military force together to start the process of multi-domain integration.

At the operational level, the success of multi-domain integration will be a direct function of the resilience of each domain. Resilience, the ability to resume the original form or position after being bent, compressed or stretched, is underpinned by agile professional mastery. While agility in the application of force is a critical asset at the tactical level, at the operational level it is more important to have conceptual agility based on an in-depth understanding of the domain and its relationship with other domains. This is at the core of agile professional mastery. In order for multi-domain integration to succeed, the inherent resilience of all domain-centric Services will have to be brought together as a whole in a seamless manner, while still retaining it within their own 'patches'. This would mean drawing on each other's capabilities, as required and contextually. When the ball is in play, the equivalent of the application of military forces at the operational and tactical levels, the weakest patch or the weakest seam will determine the force's overall resilience.

It is at the strategic level that the two non-physical domains— information and human—enter the integration pattern. The addition of these two domains exponentially increases the complexity of achieving multi-domain integration. The efficient functioning of a military force will depend on mutual trust and reliance in the capabilities of the domain-centric Service's strategic level. In this context, the overlap that exists between the Services will also have to be factored in, to create a stronger synergy. Trust is an intangible commodity and can only be developed through demonstrated commitment at the strategic level to knowing and understanding the strengths and weaknesses of each domain-centric Service. In order to build a resilient force, there has to be open acceptance of the constraints of each Service. If these drawbacks are to be effectively plugged and the domain 'patch' made sufficiently resilient, there has to be acceptance that the whole is only as good as the weakest patch. To achieve multi-domain integration, trust, reliance, understanding and willingness to draw on each other's inherent capabilities must come naturally. This cannot be created overnight merely through the articulation of a sophisticated idea and with the stroke of a pen. It will require painstaking build up from the tactical level and clear-eyed directives from the strategic to ensure that the process is continued. The litmus test, of whether multi-domain integration has been a success or failure—would obviously be at the operational level.

Creating and maintaining a military force that has achieved true multi-domain integration will require almost continuous integration of combat capabilities of the domain-centric Services, but in a contextual, designed-for-purpose manner. It has to be emphasised that this does not mean that all three domain-centric Services remain permanently connected or chained to each other. The necessary connectivity is contextual which requires the establishment of networks that have great flexibility and the ability to be rapidly activated, even from a cold start. The protocols necessary to ensure this will be extremely complex and by themselves can become a vital centre of gravity.

When all domain-centric Services within a military force, the group of patches of a soccer ball, have sufficient and equal resilience, the joining seams are being managed efficiently, and the linear and non-linear connection protocols are robust, the force will be more than the sum of its parts. Such an integration is particularly important for the ADF, which is a force without any fat on its bones. By the same token, it also does not have the cushion that could soften the fall if the enterprise fails. The ADF, by virtue of a number of its inherent characteristics, is a force that can only fail once. The one-time failure therefore will prove to be catastrophic; one from which the force will not be able to recover in time. Therefore, the process of multi-domain integration that it is embarking on is a double-edged sword and must be carefully treated as such.

Achieving Multi-Domain Integration

There is no doubt that multi-domain integration is a progressive idea and that, if implemented optimally, it will create a very capable, and in fact, a superior, military force. However, there are many challenges in the pathway to converting a joint force into a multi-domain integrated one.

Four critical challenges—innovation, quantum of available capability, professional mastery and networks—to the successful integration of the different domains are examined below.

First is the challenge of innovation, since multi-domain integration is underpinned by innovation at all levels. A conventional military force, with its autocratic decision-making mindset is more tuned to accepting a 'top-down' directions approach. This is a competent, and at times necessary, approach in steeply pyramidal organisations like traditional military forces. Unfortunately, in a multi-domain integrated force such an approach may not always produce the optimum results. Therefore, it has become fashionable now to talk about 'bottom-up innovation'. This is indeed a great concept, especially since multi-domain integration is most visible at the operational and tactical levels. However, the superimposition of a bottom-up innovation process on a traditional military force can only be achieved as and when the military force in question is able and willing to dismantle some existing hierarchies in the command and control structure.

In this situation, two factors become clear. First, agile decision-making is critical to the success of multi-domain integration and can be achieved only if a culture of bottom-up innovation can be inculcated and embedded within the force. Second, a conventional military force embarking on multi-domain integration will have to move out of the well-trodden autocratic and rigidly hierarchical command structure at the operational and tactical levels. Success or failure of the integration process will depend on the acceptance of this reality at the strategic level. The well-known and fundamental air power tenet of centralised control and decentralised execution assumes a more nuanced meaning and would need to be altered to centralised command, distributed control and decentralised execution. This could become a dictum for the multi-domain integrated force of the future.

The second challenge is the question of the quantum of capability available within each domain-centric Service. Multi-dimensional integration does not mean that domain-centric capabilities in the three physical domains remain integrated in perpetuity, but that such integration will be contextual. Therefore, it might become necessary for one domain-centric Service to integrate simultaneously with both the others. Small military forces may not have sufficient depth of capabilities to achieve this. They might find this situation difficult to contain and will have to make an operational level prioritisation regarding which of the other two Services it will integrate with first. In such a situation, the left-out Service will only receive the left-over capabilities, which may not be sufficient or fit-for-purpose. This will detract from creating the holistic capability that multi-dimensional integration is meant to bring about.

The third challenge—professional mastery—also doubles as a critical requirement. Professional mastery comes up repeatedly as a crucial element for a force to achieve multi-domain integration; it is the glue that binds the disparate parts that have to be brought and held together for the integration enterprise to succeed. If adequate professional mastery is not resident at all levels and in all three Services, this lack will very rapidly develop into a pitfall in the integration path. It

is obvious that the lack of professional mastery in one element will have a detrimental impact on the viability of multi-domain integration. In turn, this will manifest itself as the inability of such a force to create the desired effects and achieve its objectives. This becomes the weak link in the process that will lead to the failure of the entire enterprise. The professional mastery required in an individual domain in order to create multi-domain integration requires each independent domain-centric Service to be a seamless whole with sufficient agility to separate into sub-systems when necessary. Essentially, assured and high-calibre professional mastery in each domain is not a negotiable factor in implementing the idea of multi-domain integration.

The fourth challenge is the ability of all elements to connect within and across the domain-centric forces. Going back to the soccer ball analogy, each patch and group of patches must be able to connect with its immediate neighbour and also to a patch that may be diametrically opposite, while still functioning within the protocols of the established networks. At the strategic level, each domain-centric force must be able to connect with the other two; at the operational level, the connections will have to be contextual and at times simultaneous; while at the tactical level, the sub-systems of one domain must have the ability to connect directly to the sub-systems of another. Integration of any sort is completely reliant on the robustness of connecting networks. Further, effective integration cannot happen without connecting networks and the ability of the non-physical domains, human and information, to keep pace with the rapid and contextual changes that characterise emerging situations.

Implications for the ADF

From the four challenges that have been highlighted, it becomes clear that efficient integration of the physical domains is dependent on the ability of the force to superimpose and integrate the non-physical domains at all levels of war. The challenges are manifest to the highest degree in the information and human domains and therefore always carry an intangible element of the unknown, creating uncertainty within the process. The complexity of the process of multi-domain integration reaches a high-point when the information and human domains are overlayed on the three domain-centric Services simultaneously, especially at the strategic level.

Multi-domain integration is a noble vision—a vision for a bright future. However, transforming this vision into reality will involve a long and arduous journey. The fundamental requirements for a military force to create a model that is designed to achieve multi-domain integration can be listed as:

- being able to function seamlessly as a joint force at the tactical and operational levels;
- having the ability to create a strategic force-structure grid that is designed-for-purpose;
- the ability to devolve, as well as accept, operational and tactical innovation from and into this strategic grid;

- adequacy of the resilience inherent in each domain-centric Service; and
- the ability of the networks to withstand external and perhaps more importantly internal, buffeting.

The combination of all these qualities is not easy to achieve and once achieved, is even more difficult to maintain at the level required to be continually successful in the process of multi-domain integration. While the domains need not be functioning together at all times, the need is to have the built-in ability for them to come together rapidly and in a contextual manner. The creation of a designed-for-purpose model, which is flexible at the strategic level, is a tall order and absolutely critical for the success of multi-domain integration. At the same time it is also the most difficult to achieve effectively in practical terms. However, failure to do so will see the entire enterprise falling apart.

This is not to state that the future of the multi-domain integration enterprise is all doom and gloom for the ADF or any other force that is preparing to adopt this idea for the future. Multi-domain integration is an idea of the future, a great idea, which if well implemented will deliver more that it promises in theory.

There is no hesitation in accepting that the ADF is currently the best-situated military force to move into a holistic multi-domain integration mode. If any force can make it work, it is the ADF. That much is certain. At least at the operational and tactical levels, there is no other force that could carry this out with more aplomb. The challenge is to let this great idea spread across the three levels of war, with the strategic level becoming even more flexible to accept operational innovation and distributed decision-making. This will need concerted and long-term effort.

Conclusion

The success of multi-domain integration will depend on whether or not the vision can be transformed to reality, an arduous task, since the idea goes beyond being a mere vision for the future. Success will require the idea to become embedded in the day-to-day culture of the organisation; it must become naturally and intrinsically pervasive across the entire force from the strategic to the tactical levels. Achieving such an integration is the only way a military force can prepare itself to meet the challenges that have yet to be foreseen in what remains of this century.

MULTI-DOMAIN INTEGRATION – A JOINT SOLUTION

AIR VICE-MARSHAL MEL HUPFELD, AO, DSC

Good morning. I am Mel Hupfeld and I am currently the acting Chief of Capability Development Group. On behalf of the Vice Chief Defence Force [VCDF], my task today is to provide context around multi-domain integration, or more commonly referred to as the 'joint environment'.

In recognition of our American guests, some people may have an opinion that I have 'drunk the kool-aid' when it comes to joint. I don't agree with the notion that there is an inherent dichotomy between single-Service and joint. I believe that when I put on my Air Force uniform, I am already inherently joint and that this applies equally to the other Services. We are all here to provide the capability the Government requires to achieve Australia's Strategic Defence Interests. So, in that context, we are all joint.

The previous speaker proposed a definition of multi-domain operations which resonates with our plans to strengthen the joint foundations of the ADF. The future strategic context within which the ADF will operate demands our consideration of three key elements of multi-domain operations:

Firstly, **'Integration of Capabilities'**. We must strive to ensure that each and every capability that we bring into service has a robust consideration of its place within the joint whole and that its acquisition provides the linkages and resources required to operate effectively. We have not had and we do not have the resources for bespoke capabilities that are not aligned with our collective path forward. We will need to ensure this alignment through the application of the joint lens at the earliest stages of the capability life cycle. This lens will also consider how we will operate with the United States and our other key coalition partners.

Our second key element is **'Synergy'**. We must identify, examine and realise the benefits that arise when capabilities cross domain boundaries and we must exploit the synergy that arises when capabilities are fundamentally integrated and strategically aligned from the beginning of their service life. This means that we examine, analyse and experiment across all six capability streams to identify additional capacity, ability or optimisation that individual capabilities can offer when placed into a joint force context. This can only be achieved through the close cooperation of the Services and the enablers where the operational expertise remains.

The third key element is **'Context Adaptable'**. Our considerations of the roles and design of the future ADF cannot be slaved to a single scenario or threat. We must ensure that the ADF has an innate capacity to respond to the Government's needs across the range of operations required to achieve our Strategic Defence Objectives. These objectives reflect an assortment of tasks to meet a broad range of threats in a variety of environments. Each operation will require coordinated and coherent integration and application of ADF capability across domains and environments for success.

So, what of **'Strategic Intent'**? Our efforts to prepare for future operations across Service domains are guided by the *Defence White Paper* and *First Principles Review*. Our collective path forward is captured in the *Integrated Investment Program* and the *Defence Industry Policy Statement* and our key changes involve improved accountability and clear authorities across the organisation as a whole.

The critical strategic intent when considering how we realise our joint force vision is three-fold.

Firstly, **a Consistent Link to Strategy**. We have clear Strategic Defence Objectives from the Government and we need to build a force to achieve them. Our efforts to close our conceptual gaps to better inform our capability and investment decisions are ongoing.

Secondly, **a Strong Strategic Centre**. We are already in the process of adapting our higher organisation to meet the recommendations of the *First Principles Review* with a particular view to integrate the Defence enterprise, joint capabilities and the future force. The process by which we identify and resource capabilities is being improved through our governance/committee structures and life cycle development with each providing a holistic consideration of what is required to meet our objectives.

Thirdly and most importantly, **a Champion for Joint Capabilities and Force Design**. Our collaborative joint operations across domains will require particular capabilities that are not resident in a single Service or even within a single piece of equipment or platform. Under our new approach, the joint perspective will be well-represented and our examination of the force design required to achieve our tasking from Government will mature into a permanent component of our capability life cycle. Through two new functions—Joint Force Design and Joint Capability Management and Integration—we will focus our efforts to deliver the most effective joint capability supported by the requisite enablers.

The Future Joint Force

The future joint force needs to have a consistent link to strategy and an emphasis on bringing together the six capability streams outlined in the *Force Structure Review* and articulated in the *Integrated Investment Program* capability management prioritisation and integration matrix.

- **ISREW Space and Cyber**. ISR [intelligence, surveillance and reconnaissance], EW [electronic warfare] and C3 [command, control and communications] systems cut across war fighting domains and Service-specific capabilities.
- **Maritime and Anti-Submarine Warfare**. New maritime systems will introduce a range of important war fighting nodes that must integrate not only with coalition partners but with other related ADF systems.

- **Strike and Air Combat**. Air warfare is essential across the environmental domains and from high-end warfighting to counterinsurgency. New strike and air combat assets will need to be integrated both technically and conceptually with the full range of other new capabilities.
- **Land Combat and Amphibious Warfare**. Amphibious warfare is an inherently joint capability and the range of potential missions in which an amphibious platform might be utilised also implies a range of different integration and flexibility issues across the joint force.
- **Air and Sea Lift.** Air and sea lift identifies the ongoing need for capability integration where warfighting capabilities must be rapidly and flexibly deployable and sustainable for the duration of an operation.
- **Key Enablers**. These include health services, fuel, explosive ordnance, training support and simulation, combat service support systems, base operations and aircrew training.

What I am confident in is that the new force design will clearly identify how individual capabilities contribute to the cohesive whole and give joint and Service capability managers improved capacity to identify opportunities for synergy. Additionally, we are linking our Strategic Defence Interests and Outcomes to our Joint Force Objectives.

Our most recent effort to conceptualise how the ADF operates as a joint force is through the *Australian Joint Operating Concept*. This document fills the gap between our strategic guidance, military strategy and our operational planning by describing how the future ADF will operate as a joint force.

JOINT CAPABILITY AUTHORITY

As the champion for joint capabilities and as the accountable joint capability authority, VCDF is responsible for the design, integration and assurance of the future joint force in accordance with strategic and resource guidance.

Additionally, as the chair of the Investment Committee, VCDF, supported by Contestability Function, works with the capability managers and enabling and delivery groups to ensure prioritised, balanced investment decisions and potential trade-offs are made during the investment approval process to deliver an effective and affordable joint force by design.

VCDF is assisted in the Joint Capability Authority role by the following strategic centre functions:

- a continuous force-design cycle that reviews the current, planned and future force structure against applicable strategic guidance to evolve joint capability concepts and to identify capability needs underpinned by robust information governance;

- contestability advice to ensure Defence's force design, capability needs and requirements are aligned with strategy and resources; and
- an ADF-wide test and evaluation centre of expertise.

C4ISR DESIGN AUTHORITY

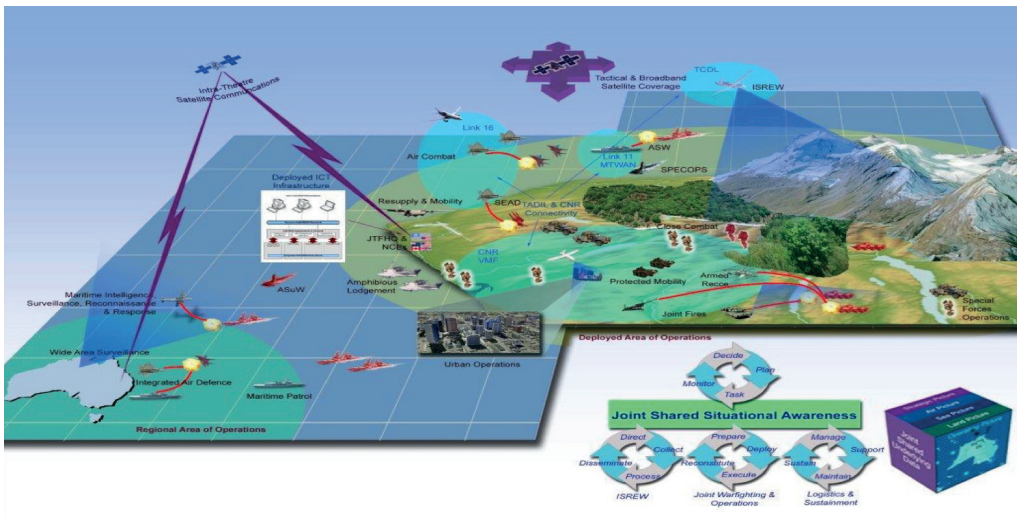


Figure 9-1: C4ISR design authority (Joint Battlespace Networked Environment)

As outlined in the *Defence White Paper,* Defence will strengthen existing capabilities in the command, control, communications, computers, intelligence, surveillance and reconnaissance (C4ISR) networks, communications and information systems. VCDF (as the C4ISR Design Authority) is accountable for defining the warfighting environment and the operational architectures, and setting and governing military interoperability and integration, including development and assurance of joint interoperability standards. VCDF will also govern development of C4ISR enablers (communications and combat systems) that are integrated and customer-centric, with greater use of cross-functional processes.

The C4ISR Design Authority will establish an endorsed, consistent and comprehensive reference for the capability life cycle in the form of a C4ISR Design Framework. This framework assists designers, decision makers, operators and coalition partners to better collect, analyse, understand and share information in the complex Defence C4ISR environment. In concert with the capability managers, the Design Authority will develop and promulgate endorsed joint operational, capability and mission platforms' systems (interoperability) designs. Importantly, VCDF will partner with the CIO [Chief Information Officer] in developing enterprise wide frameworks for information architecture, standards and master data management. The designs

will provide a consistent and interoperable design representation of the whole-of-force to allow for the following types of analysis:

- investigation of C4ISR interactions with a new capability and impact of decommissioning an existing capability;
- provide a baseline for modelling and simulation of system (and networked joint force [NJF]) behaviours through agreed joint force integration/interoperability guidance (from force design) including applicable joint and functional concepts; and
- provide defined interoperability profiles, conventions and standards in partnership with the C4ISR Technical Authority.

In conclusion, the *Defence White Paper* has made it clear that the Government is investing in a range of Defence capabilities across the capability streams. We expect, and the Government demands, that this investment realises a force that has the capability, agility and adaptability to do what the Government requires. Our analysis has shown that the future joint force will need to leverage advanced technology and have high levels of systems integration across our own force. Our span of objectives will require us to broadly interoperate with our partners, the United States, both as a contributing partner and as leaders in our own right.

The end-state to be achieved is one of delivering a more capable, agile and potent high-technology force, where the sum delivered is greater than the parts, and one that can switch tasks, cross domains and do so in all scenarios required by Government.

MULTI-DOMAIN INTEGRATION – THE MARITIME EXPERIENCE

VICE ADMIRAL TIM BARRETT, AO, CSC, RAN

Ladies and gentlemen, thank you for the opportunity to speak to you this afternoon. I would like to thank Air Marshal Leo Davies for the opportunity to speak. It is a real pleasure.

The question that I have been asked to address is how Navy looks at air power and the support that is needed in an integrated multi-domain operation. It is indeed an interesting question and one that has set me thinking about the overall dynamics of multi-domain operations. And if one poses the question slightly differently, what is it that Navy is looking for from Air Force? One could equally ask what is it that Air Force is looking from Navy in this domain? To answer either of these questions, they have to be taken together because the question is really about integrated, multi-domain operations rather than individual force components. What I hope to do this afternoon is to set out Navy's approach to integrated multi-domain operations and to provide a holistic view of the conduct of warfare in the 21st century.

Given that, I must admit a measure of trepidation in doing so because I think that one must necessarily take a one-Defence, three-Services approach. I am aware that Trinitarian thinking has not been universally accepted in the world of philosophers or theologians. But I take heart from the fact that as strategists and defence planners, we live in the world of combat realities rather than religious beliefs. The pragmatic world of warfare deals with what it is as distinct from what might be hopeful.

I welcome this conference theme because building the system that realises successful, integrated, multi-domain operations is what delivers both deterrence, in times of peace, and decisive and distributive lethality in times of war.

We all appreciate that the range and variety of threats we currently face are driving a demand for situational awareness and an ability to engage adversary or adversaries across an extended battlespace. In most circumstances, this will be a land-sea-air battlespace where success will depend on the quality of the forces we deploy and our ability to integrate them to achieve the fundamental purpose of strategy, that is, defence of the nation and its interests.

That strategy may require the application of sanctions against those who threaten us. As the *Defence White Paper* puts it, maintaining Australia's technology edge and capability superiority over potential adversaries is an essential element of our strategic planning.

To channel Andrew Gordon, who is the author of an outstanding analysis of the Battle of Jutland called *The Rules of the Game*, this might just be a blinding glimpse of the bleeding obvious. But in fact, technology superiority and the advanced operating skills that sound manpower planning provides in each of the land, sea and air domains goes to the heart of military success in integrated multi-domain operations.

If we are to maintain our technology edge and capability superiority, as was well defined in the recent White Paper, then we need to ensure that we are not just thinking and theorising about multi-domain operations. We need to turn it into reality by 'operationalising' our technology edge at both the capability planning and doctrinal levels. It is essential that we design this into our forces from the outset.

It can be argued that the key to military success now depends as much on our skills at the drawing board as it does on the battlefield. Now let me give you an example of this. The White Paper discusses a future submarine threat in very broad terms. If we were to view this as an underwater problem only, then we would be sowing the seeds of our own eventual defeat. Why? Because quite simply, modern submarines are not predicated on a single operating standard. They are not unidirectional platforms but rather they're complex multi-purpose systems that fit into a system of systems. Their strategic purpose varies across the deterrence-decisive-lethality spectrum, as do their operational purposes. Some carry torpedoes. Some deploy supersonic anti-ship cruise missiles and some ballistic missiles.

To me, this means the conduct of ASW [anti-submarine warfare] now, and in the future, encompasses multi-domain operations because the submarine system itself presents threats under, on and above the water, and their effectiveness is massively enhanced when they are strategically and operationally integrated into a joint and combined sea-air system.

During the past 12 months, I have stressed the importance of decisive lethality as a key element of sea power strategy, as it is indeed for air power strategy. I have also emphasised the importance of a rolling or continuous-build approach to both the submarine and surface force and the enormous advantages that this offers to Government, Defence and also to industry.

These capability development and delivery issues are also critical aspects of the why-and-the-how of Navy's contribution to meeting the challenging maintenance of Australia's technology edge. We need that edge across our entire force structure and our resultant force posture. The nation's industrial baseline will be the very thing that enables us to keep pace and stay ahead. Like Air Force, Navy is a materiel system that requires an innovative and agile industrial base to enable it to meet the ever-evolving challenges ahead. It's about future proofing.

For our armed forces to meet their mandated purposes, we need to be able to force an adversary to pause and to reflect. As I've said elsewhere, we need to be able to mess with the adversary's mind. We need to be able to generate uncertainty and to use that uncertainty to our advantage. We do this by being able to force errors of judgement and decision in our adversary because we are capable of deploying offensive lethal force at a time and a place of our choosing, as both joint and combined forces. The deterrence we collectively achieve is the consequence of holding the adversary's operating systems constantly at risk. To put this in a way that I know all of you in Air Force will know, we want the adversary to disappear up his own OODA loop [OODA = observe, orient, decide, act]. Uncertainty and ambiguity confuse the adversary in observing,

thwart any attempt at orientating, destabilise his deciding, and prevent his acting. We will always seek to leverage the ambiguity of our force disposition by forcing the adversary to ask continually 'Where the hell are they and what will they or won't they do?' The fact is we must be able to deliver lethal force if the adversary chooses to initiate armed engagement.

The key issue for Navy, in this area, is its ability to contribute decisive lethality across a distributed system; the ability to deliver distributed lethality across all three domains. This, I think, is what Douhet was really getting at in his seminal work on air power in command of the air. Strategic bombing is nothing if not distributed lethality.

I have discussed the theoretical foundations of the rolling and continuous-build approach to the Navy submarine and surface combatant systems. It is much more than an Australian industry jobs plan, important though that is. It both recognises and advocates the critical role that Australian industry will play in making this strategy successful. It also, I might add, transforms the Navy from a defence enterprise into a national enterprise.

Leveraging a continuous and evolving industrial backbone is the means by which Navy will maintain its technology edge and capability superiority, thereby providing the deterrent and war-winning effects that the Government requires. Deterrence and victory are the outcome of a force that is lethal, available, sustainable and affordable. A rolling and continuous-build strategy for both submarines and surface forces is the means by which we will achieve this.

This brings me back to the central theme of the conference—multi-domain integration—on which our ability to fight by means of increased situational awareness and collaborative targeting fundamentally depends. As we progress our build programs, we are quite consciously designing our next-generation fleet within a multi-domain framework leveraging the availability of real-time operational information. While we have had significant exposure to systems that expand situational awareness, Navy is just starting to see the potential for remote cueing of weapons with the introduction of cooperative-engagement capability in the Hobart class. The ability in the future to integrate the fleet with Wedgetail, JSF and other mission systems is essential if we are to achieve the capability dividend that this technology provides and ensure operability with comparable US systems will be just what is required if we are to achieve distributed lethality.

The recent release of open-source information and discussion regarding the US Navy's development of Naval Integrated Fire Control–Counter Air provides a guide to what is possible when the integration of specific system within a system of systems is successful. We are not likely to achieve distributed lethality in exactly the same manner as the US Navy, but we can work towards it. And what they are doing serves as an example of what can be achieved, noting the commonality of system and operational objectives between the USN and the RAN and between the US Air Force and the RAAF and between our national armed forces as a whole.

Air Force is implementing its component of this capability in Plan *Jericho*, a 5th-generation Air Force. Navy has Plan *Pelorus*, a plan that aims to launch the Navy onto its new trajectory as we recapitalise the fleet. As I've said before in many areas, I expect *Jericho* and *Pelorus* to coincide. As I have said earlier today, it is the continuous-build strategy for our fleet that will deliver the platforms and systems that maintain the technology edge.

So onto this new paradigm, how does Navy work with the RAAF to ensure we are designing for integration? This allows me to segue into a brief discussion of some of the challenges that multi-domain operations bring for both of us and how the Navy will ensure that our continuous-build strategy meets these challenges.

The first issue is the size of the battlespace and how we will achieve situational awareness and cooperative targeting required to counter a rising threat. This is a significant issue when we consider the sheer volume of data that can be generated by integrated multi-domain sensors. The task of collecting, managing, collating and distributing the data that is available on these systems and then transform it into the knowledge that the warfighter can use is significant. What we are talking about here is 'big data' and with that comes all the issues associated with trying to find the right signal to act upon against a backdrop of noise that is generated by the vastness of real-time data collection.

This is not a question of redesigning or modernising the methods and approaches used 20 years ago and applying them in a new battlespace. This is new data and requires innovative ways to manage and interpret it. This will be essential if the ADF is to fully utilise the advantage that the technology can deliver to operations in the 21st century. As a technology-based institution, we have no option but to do this.

The second issue is the life cycle of the technology edge. Under Moore's Law, the time a technology edge can be sustained before it needs refreshing is decreasing. It is no longer sufficient or efficient to allow ten years to acquire a technology or a system to defeat a threat, provide a mid-life capability upgrade and then use the system well past its design life. Again, rolling and continuous shipbuilding will profoundly change how our processes support the capability cycle. It will mean that refresh or redesign approvals and funding will work in a continuum. It will be intrinsic to the program, an expectation from the outset, not an ex-post factor leap-of-faith made in the face of delay and ultimately obsolescence.

With new technologies, current technology refreshes have a half-life of years, not decades. Indeed some changes in the cyber domain are measured in months and possibly in days. So as we insert and upgrade, we will know that we have already funded the next iteration. This is new for Australia. It is an innovation that is as exciting as it is daunting. The agility to maintain the technology edge into both new and existing platforms is as essential for the Air Force as it is for Navy if we are to bring value to our future operations.

We see this agility in our current submarine force through the integration of the USN combat system. We need to make sure the lessons learned from this approach are applied across our surface fleet as well so that the appropriate refresh cycle is supported by the continuous-build strategy.

Now the third issue is the hardening of networks. Not only do we need to protect the networks and systems that deliver distributed lethality, we also need to recognise that the protection of network enablers is just as important. As we become more reliant on distributed lethality to provide battlespace advantage, the hardening of Air Force and Naval platforms is indeed critical. This is important to Navy as our platforms consist of many different networks, such as administrative networks or platform networks that control hotel services and propulsion, all of which need to have their vulnerabilities mitigated or removed. The challenge here is one for the national defence enterprise to address. Note that I've said national defence enterprise because it is not just Navy or the ADF that is engaged. This is a challenge for Government, for Defence, for industry, and for the nation. We need to ensure that we have a naval enterprise that fits into the larger ADF enterprise to deliver the required effect and the naval operations across multiple domains, and this will not be easy.

To achieve the level of systems integration needed for the delivery of decisive and distributed lethality that expands the engagement window beyond any given platform's organic sensors is a constant and consuming task. But it is essential that we meet this challenge if we are to ensure a technological edge and the consequent capability superiority. My workload would be much less if indeed it was a Navy that was designed and structured to meet the more-limited purposes of just an exclusive-naval policy. But a go-it-alone Navy would also be sub-optimal. It would be a national albatross rather than a national asset.

By virtue of its history, its tradition, its doctrine and its culture, the Royal Australian Navy is well positioned to meet the demands of working within joint and combined operations with allies and partners. Cooperation and interoperability are, as it were, in our DNA within our Service. We must convert a hard-won, collaborative, operational experience and now use it to deliver a naval enterprise that will provide a continuous-ship-build approach to fleet management, thereby enabling us to fight and win together on, over and under the sea.

To conclude, the ADF is now, and will become, an ever-more capable, multi-domain force able to project power through integration and networking of capabilities and their transformation into systems. This will be a system of systems that will provide battlespace response and dominance where and when required. The ships, submarines and aircraft of the future fleet and the air capabilities of the future Air Force, not failing to mention the critical Army capabilities that are essential if we are to occupy and hold ground, will be integrated into this multi-domain force. This is how the future ADF will fight and win.

MULTI-DOMAIN INTEGRATION – THE LAND EXPERIENCE

LIEUTENANT GENERAL ANGUS CAMPBELL, DSC, AM

Good afternoon, ladies and gentlemen, I would like to acknowledge the Traditional Custodians of the land on which we are meeting today and pay my respects to their Elders, both past and present.

I have been invited to provide a perspective on Army's plan to integrate fielded and new capabilities, in my role as the ADF's land capability manager. I spoke late last year of my profound commitment to the value, indeed the necessity, of joint, interagency, coalition and allied operations, as the best and most sustainable way to pursue our nation's interests.

I cannot envisage any contemporary or future scenario where land capability will operate in isolation from the joint force. And this is especially true when considering the issue of air-land integration. Accordingly, I will frame my remarks today in the context of joint land combat capability—the Army's unique contribution to Australia's national capability.

Our experience in Afghanistan (and the wider Middle East area of operations), over the last decade has allowed considerable contemporary insight into air-land integrated operations. ADF members have gained valuable experience operating across the spectrum of the joint air-land battlespace. While often we were utilising ADF capabilities and assets, more often than not we operated within a construct provided or significantly enabled by coalition (US) assets and architecture.

Indeed, at the commencement of our involvement in Afghanistan, the Army (and the ADF) could not conduct such activity on its own. Yet, informed by our recent experience, and with the new capabilities currently being fielded or acquired, we are on the cusp of being able to routinely do so.

This is important, for more than the obvious reason that it enhances the joint force's battlefield performance. Our recent experience in the Middle East has confirmed the vitality of effective air-land integration in the contemporary joint battlespace. For the ADF to remain a useful alliance partner into the future it is essential that we can operate jointly, combined and with the right level of air-land interoperability.

Also important, will be the ability for us to generate effects independently, or as a lead nation, across these domains, if and when Australia feels compelled by our sovereign or common interests, to respond to any regional contingencies.

The enduring purpose of air-land integration remains to ensure delivery of the right effect in the battlespace, at the right place, at the right time. And to be able to keep doing so, gaining and driving home the initiative—and preferably setting the campaign by our own design rather than our adversary's.

We need to continue to improve the means and rapidity with which a situation is understood, decisions are made, resources assigned, tactical effects delivered and outcomes promulgated to commanders, capitals and communities. Recent decades have shown that a key change in the character of war is the speed of transmission of ideas (that is, information/data). This requires us to be more agile in our understanding of the battlespace and also in our ability to execute. Once again, suggesting the importance of integration.

Conceptually this is elegantly simple. Of course, in practice, it quickly becomes difficult as multiple actors and capabilities combine with environmental effects and the friction ever present in the battlespace. Clausewitz and many others have been telling us this for over 2000 years.

Network integration is challenging—not all information can be shared equally. It takes time to determine what information should be shared, with whom, to best enable the delivery of the right effect at the right place at the right time. The critical requirement from an air-land integration perspective is to be able to filter the necessary information for a commander, but at the same time make more of it available to the battle staff to process in order to make better sense of what is going on.

While digital systems and platforms make it easier to source information, they can also make it harder to make sense of it. As an example, the Army can generate an immense amount of data within a combat brigade headquarters. But much of this data is often of little sense or utility to a fused air-land picture in the conduct of operations.

Commanders need to be conscious of the paralysis of analysis that can happen to them as a result of these new systems and the large data flows they possibly generate. They also need to be alert to the electromagnetic signature we've created in our brigade headquarters, and the missile systems likely to be targeting them.

While C4ISR [command, control, communications, computers, intelligence, surveillance and reconnaissance] systems generate a lot of data, much of it can be regarded as the 'new normal'. A key challenge which then emerges is how to find the 'needle' in what may be 'a haystack full of needles'. The air-land integration work being conducted by the Army's Land Network Integration Centre (LNIC) with Air Force seeks to make sense of this through trial, experimentation, testing, and understanding.

The LNIC was established to provide myself, as the Chief of Army and capability manager, with a better understanding of the land network. Inherent in this is an understanding of how we conduct joint land combat, and what it means to move and present information and intelligence to commanders to support operational and tactical decisions.

LNIC has been given the remit to understand the networks, systems, applications, and therefore the means, to move information in the battlespace. To do this effectively means working closely with the Air Force to understand the new generation fleet, and the data it will generate.

We have a full-time RAAF officer within the LNIC as a conduit to Air Force, with which we share many connections. We are working very closely with Plan *Jericho* to understand the challenges shared between the two Services. Most recently, the LNIC has supported Air Force in:

- en route mission planning using C-17,
- wireless networks for air platforms, and
- airborne communications bridges linking air and ground systems.

We will see a trial of some of this work during Exercise *Jericho Dawn* at Puckapunyal later this week. A Tiger helicopter and a Super Hornet will demonstrate the exchange of positional data and free text using a Battlefield Airborne Communications Node (BACN). There is a lot of work being done on new capabilities which are coming that will enhance air-land integration. These are just a few examples.

The Army is already a connected and technologically advanced force. What is coming down the pipeline will exponentially develop the force. The objective of our efforts is to move as quickly as possible from what I describe as the 'divergence' of multiple systems, bearers, boxes, air-gaps and workarounds that currently characterise the technologically advanced but bloated Army brigade headquarters to the 'convergence' of small, data-assured, common-view, multi-function, universally connected digital networks, without becoming vulnerable to catastrophic cyber collapse.

In pursuit of this objective, the Army has a range of projects intended to progressively develop our capacity to, among other things:

- deliver a battle management system (BMS) and digital radio backbone to the force to address the needs of a joint battlespace communications system;
- provide new platforms and digital communications to Australian and allied close air support platforms;
- develop the land force's 'sense, warn and locate' capability; and
- enhance Army's ground-based air and missile defence (GBAMD) systems, which will also aid airspace surveillance to ensure friendly force deconfliction of artillery, mortars, fixed and rotary wing platforms and unmanned aerial systems.

The *Future Land Warfare Report 2014* assesses the battlespace will be a more lethal, crowded, connected, constrained and collective environment. (And we couldn't and shouldn't forget the other Services, agencies and partners in there as well). These 'meta-trends' support the case for acquisition of more autonomous ISR systems, capable of undertaking the 'dull, dirty and/or dangerous' work the joint force is often required to undertake.

Over the next decade, the ADF will operate a suite of autonomous aerial vehicles. Unmanned systems will augment an array of manned airborne sensors, including Army's Tiger ARH and the Air Force's Poseidon, Growler, Wedgetail and JSF platforms. Of course, we shouldn't forget the contribution that will be offered by the Hobart Class air warfare destroyers in building an ADF networked picture.

The amount of information our increasingly sophisticated ISR [intelligence, surveillance and reconnaissance] platforms will be able to collect will test our joint networks and analytical capabilities. A forthcoming paper written by members of Army Headquarters Modernisation and Strategic Plans Division notes:

> Since 1999, Army has binged on technology and has arguably overwhelmed its analytical capacity and in turn, decision making processes, with terabytes of raw data, across the full spectrum of sensors[1]

This is a truism across all Services and headquarters. The authors go on to describe a clear and present issue with what they term 'the collection / analysis imbalance'. The magnitude of this challenge brings into focus the need for common architectures, data formats and analytical functions across the joint force.

We are ready to capitalise on the decision advantage offered by new ISR capability. But we must also seek to address the wider integration and management implications of increased data collection and flow.

The final materiel capability piece I want to briefly mention this afternoon is the Houston Review. Some in this room may be aware that in October last year I asked the former CDF [Chief Defence Force], Sir Angus Houston, to conduct a review of Australian Army Aviation. His review will be complete soon. The terms of reference are broad. I am seeking a holistic review of the rotary wing capability in the Army, as an element of ADF aviation, to determine if and how it could be generated more effectively. This is an important study – the rotary wing aviation capability is an integral part of joint air and land combat. Army Aviation sits across the seam between land and air power. As the capability manager, I want to explore how we can utilise it to facilitate even better integration outcomes.

We live in an era where there is an implicit assumption that technology is good, therefore more technology is better. Given the cost and complexity of most of these new capabilities, we must be sure that the initiatives being pursued actually provide the utility we seek. This requires some critical thought about the measures of effectiveness (qualitative and quantitative) that would provide demonstrable evidence of the improvement in our systems and their integration. It may

1 Army Headquarters, *Under-estimated and over-utilised: Improvements and challenges for Army's ISR Enterprise*, unpublished paper, Canberra, 2016

also answer key investment questions such as whether we need to broadly improve everywhere or at specific touch points between air and land C2 [command and control] (the seam) at which information flow can be improved?

But the most significant challenge relates to our way of thinking about air-land capabilities and their employment. The Director of Army Research, Dr Al Palazzo, suggested in his recent primer *Forging Australian Land Power* (a pamphlet that I recommend to all present) 'investment in leadership intellect is the most important capability improvement'. I want to consider the implications of this against the context of the capability initiatives that I have outlined today.

The challenge for intellectual leadership is to imagine the use of new and emerging capabilities in novel ways, preferably before our adversaries do! Much of what we discuss as new 'capability' is actually new 'means'. We know that platforms or systems in isolation do not deliver new capability. How we use them, and think about their use, is important to realising capability. In fact, I think it is fundamentally critical. Until we innovate and adapt with respect to our 'ways' our capability investments efforts will not achieve their full potential.

The *Future Land Warfare Report 2014* identified 'how we fight' as a principal question.

> Is the Army willing to fundamentally change its traditional command, control and communication structures and processes, in particular the Army's unit and formation headquarters, to maximise the advantages of access to joint effects and the enhanced networking of digital systems?

This is a question that has been at play for many years. We must be willing to leave the relative comfort of the present and embrace alternative, credible possibilities. I will have a little bit more to say about this in a few days time at the Williams Foundation seminar.

If I might go back to where I started—with our recent experience in Afghanistan. While acknowledging the experience gained and lessons learned, we must also acknowledge the unique circumstance. There was no adversary air force. Similarly, the Taliban's use and integration of the cyber and space domains with the terrestrial conduct of their operations was limited to non-existent.

We are comfortably pre-disposed to imagine future war through the prism of recent experience. Instead, we should consider the impact of a future where the provision of air support directly to land force manoeuvre is necessarily limited. A future where we assume our adversary has 'useful' air, space and cyber capabilities, they are in play, and our headquarters had better be small, mobile and difficult to detect.

The *Future Land Warfare Report 2014* (page 6) identified 'constrained access to information domains' as one of the principal questions which Army must consider if it is to adapt to the future battlefield. It poses the question, 'To what degree can the Army adapt and ensure it is able

to operate effectively in a digitally contested and constrained environment without information assurance?' Not as well as we may like, I suspect, at the moment.

The answer to this question is fundamental to the future of our integrated air-land capability when one considers the purpose and nature of the capabilities I have previously outlined. We need to take what we have usefully learnt from our current experience while developing our capabilities for a plausibly different and more difficult future operational environment.

In my preface to the Army's modernisation plan, I wrote of the 'tension between solving contemporary problems and imagining the Army of the future', and noted that today's decisions will open or close off future opportunities. Naturally, we want to keep as many opportunities open as possible.

We will seek to balance the inherent tension between present and future needs with the aim of optimising the contribution of air-land integration to joint land combat. This is an objective wholly sympathetic to Air Force's Plan *Jericho* vision 'to develop a future force that is agile and adaptive, fully immersed in the information age, and truly joint'.

Army looks forward to working with our joint partners to realise this vision.

BUILDING THE WARRIOR SCHOLAR – AN IMPERATIVE FOR SUCCESS?

DR PAULA G THORNHILL

What a terrific opportunity and event to explore the warrior-scholar concept. I thought it'd be a richer experience for all of us if, rather than assert that the warrior-scholar was an imperative for success in the 21st century, to approach this as a question: 'Is the warrior-scholar imperative for success at all?' Simply adding a question mark quickly made me realise I was uncomfortable with hyphenated references like warrior-scholar or airman-scholar, even though I've used these expressions for years. Let's take the expression 'warrior-scholar' and I'll explain.

The first part of this expression, 'warrior', what does this mean? How do we determine who is and what makes a warrior? Is it a mindset that applies to anyone, including a civilian, who thinks like a warrior? Does it require donning a uniform but nothing else? Does it include deploying? Going into harm's way? Coming under direct fire? The mere act of trying to define it suggests that the broader the definition, the less consequential it becomes; the narrower the definition the greater the likelihood of excluding outstanding service personnel.

Similarly, what does is it mean to be a scholar? How do we determine who is and what makes a scholar? Is it a way of thinking? Does it require a postgraduate degree? Does it require a PhD, if so will any PhD do or must it be in specific disciplines? What's the difference between a scholar and a 'know it all'? Can I create the former without giving rise to the latter?

Third, how do we weight these qualities? If someone isn't a warrior then does it matter if they are scholars? Is a warrior lacking scholarly credentials reduced to being a terrific tactician, but unqualified to operate at the highest levels of policy and strategy?

As you can see, the more I analysed the expression 'warrior-scholar' and contemplated what it actually meant, the more perplexed I became. At its lowest common denominator, it seemed to be more about credentialing than anything else. In other words, the expression seemed to devolve into serving in the right career field and having a prestigious degree from a well-known university. Recognising all of us would be dissatisfied if I left my exploration there, I went searching for exemplars that clearly fit into this category, to see if we could discern some of the general characteristics we were looking for based on their specific traits. Because this conference is focused on airpower, and because of my years in the US Air Force, my first three exemplars come from the American Air Force. They also come from three different periods spanning the early years of flight to the first decade of the fight against global extremists. They had considerable experience in the Asia-Pacific, by all measure had extremely accomplished careers, but each in a unique way. Maybe their stories and experiences will clarify what is this imperative for success.

General James Doolittle

My first exemplar is General Jimmy Doolittle. A quick recap of his career is enlightening and humbling. Although one of America's earliest aviators, he was too late to the game to fly in World War I and he was convinced his military career would forever suffer because of it.

Fascinated by flying machines and flight, he entered the post-World War I era consumed by a big question that would guide his aviation career: 'What is this new invention, the aircraft, and what is it actually capable of in the military and civilian realms?'

He became one of the dominant aviation pioneers of the interwar years. He won multiple air races; learned how to crash airplanes, since, as he noted, they inevitably crashed and the key was to be able to walk away from the crash; he set numerous flying records; became an accomplished aircraft maintainer and travelled all over the world using airmanship to build ties and learn about other cultures.

He was also fascinated by the concept of flight and sought opportunities to learn as much as possible about it by studying and shaping a new academic disciple called aeronautics. He did this in part because he was convinced that the aircraft designers didn't have the experience to understand just how bad some of their designs were. He was one of the first students to study at the US Army Air Corps School of Engineering. He continued his education and ultimately he was awarded one of MIT's [Massachusetts Institute of Technology] first PhD's in a brand new academic discipline called aeronautical engineering.

He experimented obsessively, to include exploring the possibilities of using instruments to fly 'blind' in bad weather and at night; test flew every aircraft he could. When he left active duty and joined Shell Corp for most of 1930s, he experimented with best aviation fuel for an emerging class of commercial aircraft—the DC-2 and DC-3.

All of this experience, education, and experimentation came together for Lieutenant Colonel (notice the rank) Doolittle in one of aviation's most epic missions of World War II and maybe of all time—the 1942 Doolittle raid. This mission required Doolittle to rely heavily on his years of aviation experience; apply everything he'd learned about the theory and practice of his scholarly discipline—aeronautical engineering; and relentlessly experiment to ensure he could launch a group of B-25 bombers from the heaving deck of the aircraft carrier USS *Hornet* in hostile waters.

What we know now is that Doolittle's raid provided a huge morale boost to the Allied war effort. What's interesting is that in the immediate aftermath of the raid, Doolittle thought he'd failed because so many of his bombers had been lost. He expected to be court-martialed; he certainly didn't expect to be awarded America's highest military honour—the Medal of Honor—for leading the raid on Tokyo. No-one was more surprised than he when this happened.

Doolittle went on to use his experience, education and penchant for experimentation as the leader of Eighth Air Force in England. By end of World War II, he was well established as one of the iconic airmen of the 20th century.

General Bernard Schriever

The second exemplar I would like to offer is General Bernie Schriever. Some call him 'the most important military man of the Cold War that you've never heard of'.

Schriever earned his pilot wings in the interwar years, about 15 years after Doolittle. Early in his career, he served under the command of Lieutenant Colonel Hap Arnold, the man who went on to lead the Army Air Forces in World War II. The connection between these two men would persist until Arnold retired and it would be decisive in how Schriever's career unfolded.

Furloughed briefly in the 1930s as part of the Army's downsizing, he came back on active duty just prior to America's entry into World War II. During that war, he spent much of his time stationed in Australia and then around the western Pacific, first flying B-17s then overseeing aircraft maintenance and engineering operations. Fascinated by what it took to maintain, repair, and sustain an air fleet, Schriever developed a reputation for being able to tackle any logistical problem that threatened air operations in the Pacific. Indeed, this was where the Army Air Forces used and developed his experience during most of the war. This included developing expertise in how to recreate air bases on islands formerly occupied by the Japanese. In short, his experiences covered every aspect of air operations in the Pacific during World War II.

Schriever was also well educated. He had excelled at the same Army Air Corps engineering school that Doolittle had attended. General Kenney, his commander there and later in the Pacific, subsequently encouraged his application to Stanford to study aeronautical engineering in greater depth. The war broke out while he was at Stanford and he expected to be recalled from graduate school immediately. Instead, he was told the most important thing for him to do was to complete his master's degree. Before anything else, the Army Air Forces wanted to put his education to use.

After the war, the combination of his experience, education, and connection to General Arnold resulted in the assignment that would dominate the rest of his career and take him on a path distinct from his peers. Arnold told him to identity and focus on the work and leadership in the civilian scientific community that would ensure USAF research and development stayed on the cutting edge of technology. Arnold wanted the soon-to-be-independent Air Force to constantly be looking decades into the future to keep a competitive advantage over possible adversaries.

As part of this effort, he asked Schriever to lead the effort to elevate the importance of research and development in this new air force. Schriever became colleagues and later friends with some of the leading scientists of the 20th century, like Princeton's Dr von Neumann and Caltech's Dr von Karman. Von Karman in particular shaped Schriever's thinking. He was always looking far into the future and routinely reminded Schriever, and his boss General Arnold, that no problem has ever been permanently solved or has a universal solution. Ever mindful of this, von Karman argued the Air Force's long-term success rested on ceaseless and swift adaptation to new technology. Schriever took this to heart and focused on technological innovation for the rest of his career. He also looked to another accomplished educator, experimenter, engineer, and operator, Jimmy Doolittle, to mentor him in the post–World War II phase of his career.

As Schriever came to understand the new technologies that emerged during and after the war, especially those technologies resident in the atomic and hydrogen bombs, he homed in on a

big question that needed to be answered, 'Can an H-bomb be miniaturised sufficiently to be delivered by a missile and could that same missile launch something into space that would stay there and allow you to get the information back on earth?' As a senior colonel, selected but not pinned-on to brigadier general, Schriever was given the opportunity to answer this question when he was told to create an operational intercontinental ballistic missile [ICBM] and satellite launch capability in the shortest time possible.

As the future father of the USAF's ICBM force, Schriever had to become a master experimenter. He understood that ballistic missiles by nature where very experimental, reliant on the best minds in the scientific community to conceptualise and design them. As well, innovative, new industries were needed to engineer and build these missiles. The story of Schriever's road to an operational ICBM is littered with failed launches, bitter potentially career-ending exchanges with General Curtis LeMay and stunning successes that revolutionised the ballistic missile and space worlds.

He was always searching for solutions to big questions, and providing some huge solutions with the fielding of an operational ICBM and early satellite launch systems. Schriever, like Doolittle, the man who incidentally pinned on his first star, was a restless, curious, impressive mixture of experience, education and experimentation whose career took off as he focused on answering a big question.

Both Doolittle and Schriever made important contributions in their respective eras. Inspiring as their stories are though, are they still relevant? Is there a more contemporary airman exemplar—that shares their qualities, that helps us understand better what we really mean by the expression warrior-scholar? I think my former boss, General Dick Myers, is such an airman.

General Dick Myers

General Myers retired as America's senior military officer, the Chairman of the Joint Chiefs of Staff, about 10 years ago. He followed a pattern similar to Doolittle and Schriever in some ways but I'd argue that he wasn't consumed with addressing a large unanswered question until later in his military career, specifically beginning with the last weeks of his term as Vice Chairman. (As an aside, it might be of interest to know that one of the last military officers General Schriever spent time with before he passed away was General Myers.) In early September 2001, he was finishing his term as Vice Chairman and preparing to take the oath as Chairman on 1 October. With the terrorist attacks on 11 September 2001, he was violently confronted with the big question that would define the rest of his career—how does a nation successfully understand, confront and ultimately defeat the violent extremists that threaten America's citizens, partners and interests around the globe?

To answer this question in part, he looked to his combat experiences in Vietnam. A fighter pilot flying in the middle of a large, complicated insurgency, he drew on those experiences to try to characterise the new threat facing America, and ask a big question. 'Can the global violent

extremist threat best be understood as a global insurgency? If so, what does this mean for what America's military can, and cannot do, in order to defeat it?'

As part of this line of inquiry, he spent considerable time discussing this with counterinsurgency experts like General Abizaid, the Commander of Central Command. He also significantly leveraged his earlier educational opportunities. I'd like to highlight this for a moment because credential-wise his education was unremarkable—no Ivy League pedigree, no MIT, Melbourne or ANU, no PhD. Indeed, the most important educational experience this Air Force four-star relied on, as Chairman was his year at the Army War College. What most would consider an average educational experience at best, and I say this as a former dean of National War College, he turned into an extraordinary one. Not only did he dive into the world of strategic studies, he built an informal brains trust of gifted civilian academics that he could turn to challenge him, provide sounding boards for new ideas, and advise him. He cherished this group and continues to rely on it to this day. He might have lacked impressive academic credentials, but he was and is a serious scholar. He leveraged, to the extreme, the educational opportunities the military offered him—and used these skills to address the big question that faced him at the pinnacle of his career.

Indeed, when confronted with Al Qaeda's 1.0 version of global violent extremism on 11 September, he drew on his experience, his education and his scholarly brain trust to understand this daunting problem and what the military's role is (and isn't) in this fight against violent extremism. Moreover, this was far from an air power–unique problem. His responsibilities were much broader than the air domain. And he wrestled with what was the best role for the military in disrupting, destroying networks, or tracking down individual extremists? As a result, he encouraged experimentation within unique organisations like Special Operations Command, empowering JSOC [Joint Special Operations Command] in particular; organisational experimentation and adaptation by the Services and other combatant commands, and experimentation with whole-of-government cooperation and integration to help solve this wicked problem. It's worth noting also that even as he took this problem on in 2001-2002 timeframe, he knew it wouldn't be solved on his watch.

In fact, by the time he retired, General Myers assessed that this was the major struggle, the existential threat facing the US, its friends and partners for the first half of the 21st century. He continued to highlight it even as most of the world, at least temporarily, turned its attention to other things, like the great recession. Today, he continues to discuss, to teach, to educate, and to explore. And his proposed solution to this big question, to approach these violent extremists as the vanguard of a global insurgency still awaits validation, if for no other reason than policy options haven't coalesced around using this strategy to fight global violent extremists. Unlike Generals Doolittle or Schriever, who comfort us with the knowledge that everything will work out for the best, General Myers is an exemplar that reminds us of the risk and uncertainty associated with seeking solutions to daunting, dangerous problems—and reiterates the von Karman's maxim that no problem is every permanently solved.

Where does this leave us? Each exemplar is extraordinary, but is their commitment to experience, education and experimentation generalisable to something that resonates across air forces? Is there a prototypical exemplar—someone who calls us to look beyond the hyphenated scholar; who humbles us with his achievements; who inspires us with his knowledge of warfare, fascination with flight, mastery of multiple disciplines, ability to ask big questions and relentlessly look for answers across all those disciplines…and even invent new disciplines if necessary; someone who, in short, speaks not only across air forces but across cultures and generations?

Leonardo da Vinci

Following this line of inquiry led me to the person I argue is the original airman, even though he never flew. He also happens to be, among other things, one of history's greatest artists, scientists, mentors, and military engineers. Yet, he had little formal education and certainly no advanced degrees. Of course, the individual I'm describing is Leonardo da Vinci.

Leonardo embodies the spirit of airmen throughout the ages. Modern scholars who study him say that of all his amazing achievements, the one he'd be proudest of is his ability to imagine man flying. Leonardo himself believed he asked the biggest, most outlandish, fantastical of all possible questions when he asked: 'Could man overcome the challenges of weight, speed and power to fly?' To answer this question, he was the first in history to approach flight in a rational, scientific way even as he marvelled at it. Indeed, a quick glance at his notebooks reveals a love and fascination with flight. He studied birds for hours at a time, drew them, sought to understand principles of flight and how man might copy them. He even bought birds that were for sale in the marketplace just so he could release them and watch them soar. He designed a flying machine that he hoped to build one day, but simultaneously noted that even if man succeeded in successfully building such a machine, it would never be as beautiful as what nature had already accomplished. Indeed, scholars comment Leonardo would be thrilled to know man built a viable flying machine 400 years after he first envisioned it.

It's worth noting that as part of his approach to problem solving, Leonardo noted that true science and knowledge, whether applied to the arts or to warfare, depended on the same three qualities evident in our more contemporary exemplars:

- experience, which is the origin of our desire to know;
- reason and contemplation, or what I referred to as education, because it fosters understanding and wisdom; and
- experimentation and demonstration, which allows us to know what's possible today as well as impossible today but may be possible tomorrow.

Leonardo stressed that we must develop in all areas or as humans we will be out of balance. He commented, at one point, that those who fall in love with practice, with experience, without education and experimentation, are like the sailor who enters a ship without a helm or compass

and who can never be certain whither he is going. Not surprisingly then, Leonardo lived by the maxim 'study, study, study'. Never be happy with your answer. Look for answers across disciplines; expect your answers to change. Keep questioning, keep experimenting, never be satisfied…have the courage to pursue and to know. Von Karman clearly took a page out of Leonardo's notebook.

Leonardo is both the original and quintessential Renaissance person: experienced, educated, inquisitive, always seeking to know, understand, invent, and improve. He is the one who removed the hyphens between experience, education, experimentation and saw instead the importance of fusing all three.

Renaissance Airmen

As I near the end of my remarks, based on these four exemplar airmen, I'd simply offer the following. Rather than talk about the hyphenated scholar, we should consider instead an integrated conception of what it means to be an airman. Leonardo led the way for all of us, including Generals Doolittle, Schriever and Myers. He is the prototypical Renaissance airmen: fascinated by the horizons that flight opened up; steeped in and motivated by an amalgamation of experience, education and experimentation; and never satisfied with the answer of the day, always looking to improve, do things better, to understand.

In the 21st century, creating and retaining Renaissance airmen is imperative for a military's success. To produce and retain these Renaissance airmen, we can no longer send them off to apprentice with Leonardo; we have to do it through the institutions of our day, which means balancing assignments, education and opportunities for experimentation. Along these lines, here are some 'dos' and 'don'ts' to consider when balancing them. Starting with the 'don'ts', which are focused on the educational component a little more, since most air forces and militaries have the hardest time integrating it in a meaningful way.

Don'ts

- Don't send airmen to graduate school mainly to build credentials or networks.
- Don't go to graduate school because you want to set up your next, civilian career.
- Don't be an intellectual pedant; whether the topic is Clausewitz, air power, the F-35 or Gallipoli, education should be about developing intellectual humility not hubris.
- If senior, don't dismiss someone's ideas as irrelevant academic pontificating because they are better educated but are lower in rank; conversely if possessing graduate degrees, don't dismiss others ideas because they lack a similar academic pedigree.
- Don't be afraid of the unknown, whether it's about your air force, your military—have the courage to explore questions that make others uncomfortable—remember Leonardo trod where others feared.

Do

- Do have a plan to equip military officers with higher education, to include a PhD, which advances the air force's needs; use the degree to bridge communities, not widen an existing gap.
- Do understand that graduate education is hard work, and that it changes how graduates think about their institutions in ways that might make some uncomfortable.
- Do leverage teaching in developing Renaissance airmen. It is one of the best ways to delve into complex issues; as anyone who's led a seminar will attest to, it's also an excellent exercise in peer leadership.
- Do give Renaissance airmen latitude to explore, fail, succeed, surprise. This is an essential part of understanding that no problem is ever permanently solved.
- Do embrace the fascination, devotion to interdisciplinary exploration, experience experimentation, rigour that all the exemplars and especially the first airman, Leonardo da Vinci, brought to the marvel of flight.

Conclusion

In conclusion, I would argue that the military in the 21st century should look beyond creating the hyphenated scholar, and instead focus on nurturing the Renaissance airmen spirit. This requires encouraging airmen no only to excel in their jobs but to, first, ask big national defence questions and seek to solve big national defence problems. Second, rely on a balanced mix of experience, education and experimentation to answer them. That's where the best solutions to a nation's defence problems rest, otherwise the solutions will likely be too narrow, too theoretical or too impractical, and perhaps might even be dangerous. And third, accept that in national defence, no problem is ever permanently solved. The very solution you put forth today probably carries the seed of subsequent challenges for your successors.

Experience, education and experimentation—fostering and balancing—that's the imperative for an air force's institutional as well as operational success in the 21st century. The good news is this has been the imperative for success since the first airman, Leonardo Da Vinci, pointed them out to us 500 years ago. As he demonstrated, this is a lifelong journey. It is restless, inspired, fascinating. Could we, as airmen, ask for a better exemplar to inspire success than Leonardo da Vinci, the original airman, the prototype Renaissance man? I think not.

LESSONS LEARNED FROM THE NEXT WORLD WAR

MR AUGUST COLE

I'm going to begin my talk by reading an excerpt from *Ghost Fleet*. It's about a Marine aviator whose callsign is *Worm*.

> *Worm* banked the F-35B hard to the left immediately after take-off. The jet shifted smoothly into forward flight mode and he tried to gain some kind of situational awareness, just like they taught him in flight school. The AN/AAQ-37 electro-optical Distributed Aperture System fed his helmet with data from visual and IR sensors located around the plane, allowing him to see through the plane below, and what he saw was chaos. He'd once flown through a forest fire during a training mission in California's Sierra Nevada mountains and this was worse. All the smoke and debris in the air had created a swirl of darkness with patches of bright sun. Chinese drones darted in and out of the smoke at low levels, and on the deck, his squadron's fighters lay scattered about like puzzle pieces. He scanned up and around the sky and confirmed what he'd feared—his was the only US jet in the air. He started to check on the jet's other systems but no sound came over his radios. The fighter's GPS-coupled inertial navigation system was wrong. It showed him he was flying over Maui and he knew damn well this was at Oahu. Electronically-generated false targets flickered on the horizontal situational display and then disappeared. The plane, with its novel software systems and millions of lines of code, was designed to be its own copilot, capable of automation and interpretation never before possible in battle. But at this moment, *Worm* thought the 5th Generation fighter is having trouble getting out of its own way, electronically speaking.

So that's a crucial scene from our novel *Ghost Fleet*. *Ghost Fleet* is what we're calling useful fiction. It can be read on Sunday and taken to work on Monday to help reshape thinking in the national security community around core issues like cyber security, like the future of the Pacific. When we started four years ago, Pete and I wanted to use a novel, fiction, to talk about something nobody else wanted to discuss—Chinese military rise and the implications for American power in the Pacific—and we chose a tale that's both cautionary but also inspirational, because we do have it within ourselves.

The novel has 400 end notes, which is highly unusual in the thriller genre. And, make no mistake, it is an entertaining book but it's a serious one. Tackling a concept like the third world war requires different perspectives. We have everything from hackers in Silicon Valley; we have space pirates—essentially Blackwater mercenaries deployed to outer space; we look at it from the PLA's point of view, but a PLA [People's Liberation Army] that is quite different to today's [Chinese] Communist Party military.

When I recognise the unprecedented capabilities that Australia's Air Force and military modernisation is going to deliver, I want to have this discussion and use *Ghost Fleet* as a verb. And there's an Army general down at Fort Benning's Manoeuver Center of Excellence who's doing just that as a way to

liven up the lieutenants and captains who are writing policy and planning documents. Narrative has value in this world and in these conversations about the future of conflict.

The time is right for this approach. The impact in the US and Washington is real, because there's an appreciation, particularly in the strategy and defence technology communities, that status quo approaches to figuring out the future aren't up to the speed and complexity of the world as it will be, nor as we want it to be.

So, in talking about integrated cyber and space operations, it's important to think about the unthinkable, especially a great power war, and to think about Plan *Jericho* in that big war context. And I don't mean a Cold War redux, even though we are seeing, as we heard earlier, the Russians operating more flights in the Pacific than they have since the Cold War, as they're doing in northern Europe.

A great power war, particularly one with China, would be far different. For all the focus among today's policymakers on terrorism and insurgencies in the Middle East, a focus that also dominates the fiction section of the thriller market, the geopolitics of the 21st century will be shaped by a brewing Cold War between the United States and China, and along with its junior partner, Russia, who doesn't quite yet realise it. If these great powers were to go to war, one of the key ways it would differ from past conflicts, as we talked today, is that it wouldn't just take place in the waters of the Pacific, which would be different enough considering the US Navy has not fought a major sea battle in over 70 years and the Chinese Navy hasn't done so since the last time it was a great power hundreds of years ago. It would occur in the skies above, extending to two places that have never witnessed major battles before—space and cyberspace. The expectation of a contained conflict, which is behind a lot of the Chinese and US military thinking today, could very quickly unravel.

My co-writer, Pete, and I both work in and around the policy world exploring these technologies and trends of the 21st century. Over the years we have seen how, in war games, workshops and meeting the defence community, how narrative and storytelling do take a powerful role in illuminating real world issues.

Fiction abets official truth telling by asking tough questions that might otherwise be too complex, too contrarian or too uncomfortable to posit directly. Questions such as 'Has America and its allies spent trillions of dollars on weapons that may or may not be there for this, for us when we need them most?' and 'Could ubiquitous sensors and artificial intelligence utterly change the way we think of humanity's role, not just in the economy but also in warfare?' After all, this is the premise behind the Pentagon's Third Offset Strategy. And perhaps most uncomfortable of all, because no-one wants it but it must be evaluated as a real risk, 'What would the 21st century of full-out, great power, state-on-state war look like?' That's the question we felt compelled to dig into because it is crucial to how organisations like your air forces from around the world, consider the future of war.

Now, is such a war inevitable? We're asked this a lot. The answer is 'no'. But it is a risk. The Communist Party's official People's Daily has declared that a US/China war is inevitable if the US doesn't change its policies in the Pacific, while leaders in both the US and Russia have declared each other their number one threat. Since 1500, according to the Harvard expert Graham Allison, war has ensued in 11 of the 15 cases in which a rising power has confronted a ruling power. So, it is a possibility worth exploring—especially if it is to be avoided.

This leads to the lessons learned from *Ghost Fleet*, and the first lesson is about cyber. Understand your vulnerabilities; really know your capabilities. Consider that the city of Jericho stands as one of the world's oldest walled cities. The wall is one of the oldest forms of defensive systems known to man. It affords the advantage of height from a parapet; it's imposing with its own impact on the narrative of power and its image of strength; it blocks ingress of large groups more effectively than a line of soldiers; you add a moat, maybe alligators, an ironwood drawbridge or other technical features, and it becomes even more formidable as a defence. But a wall can be costly to build, create overconfidence and strength and security, and once an adversary is inside you are trapped in there with them.

We build plenty of walls today, particularly in cyberspace. Many of the same rules apply as they did hundreds and hundreds of years ago. The average dwell time of a hacker inside a system is approximately 200 days, and that's before the network's owner even realises it.

This approach is changing in cyber security, thankfully, to a more active defence, but the predominant way forward is still, in most organisations, to build a bigger and bigger wall, both in government but also in industry. And this matters to your air forces. To explain why, I'm going to pick up with our excerpt about a Marine aviator, *Worm*, flying a sole US military warplane over Honolulu in the minutes after Chinese forces launch an asymmetric attack.

> For a long time, defence analysts had worried about the notion of the kill switch, a chip that would shut down an entire computer system on command, but on *Worm's* plane, the opposite happened. In each of just 12 microchips, a tiny piece of technology inside a single block woke up. The F-35B was protected by shape and stealth materials that shrank its radar signature to a size smaller than a metal fist. But as the Directorate missile's radar washed over the plane, it activated a tiny antenna hidden in the 9th block of each of the 12 microchips that linked *Worm's* helmet display system to the plane's flight control system. Even if the helmet's manufacturers had performed a security scan when they bought the microchips, they still would have missed it. Each antenna was microscopic, hidden inside a one millimetre square and activated only by a specific frequency of an incoming missile. While each antenna had just a tiny amount of energy on its own, the combination of them sent enough power to broadcast what was, in effect, a homing signal. As *Worm* accelerated away, the Chinese quadcopters missile picked up the signal and pursued the fighter. *Worm* dove towards the palms of the Ulupau Crater in a bid to mask his plane from the missile's radar. He grunted as the g-forces pushed him down into his

> seat and then he jinked hard. He should have been able to shake it, but whatever he did made no difference today. The missile followed his every move. In his last moments, *Worm* glanced down at the watch his fiancée had given him for his 31st birthday—a Breitling Aggressor Digital Chronograph. It was as much to think of her one last time as it was like a physician to mark the time of death. The missile rode the giveaway signal like a rail and slammed into the side of the F-35, splitting the jet into two pieces that tumbled into the Pacific.

As this grim anecdote shows, one of the key lessons learned—your battle networks may be compromised on the ground months or even years before a conflict takes place. That may be entirely out of your control. It could be a network vulnerability that was left unchecked because someone was still running Windows XP … anybody? It could be a hardware hack tied to a microchip array. No matter the source, the consequences will still be borne by the air forces of America and its allies. This is a simple but crucial understanding—know your entire spectrum of network vulnerabilities; understand how the adversary will exploit them not only in peacetime and what that means for wartime.

This anecdote about *Worm* has been helpful, actually, within the US Department of Defense because it crystallises the risk of cyber vulnerabilities and hardware hacks, particularly around trusted sources of semiconductors, which is an issue that has concerned the defence community for a long time.

And one of the biggest things you also need to think about is that how often hacking is portrayed as a nuisance in peacetime, it is connected to wartime vulnerabilities. An example in the US is the hack of the Office of Personnel Management [OPM]. This is a 2015 penetration that resulted in the theft of more than 20 million Americans' personal information, essentially used on Defense Department security clearances. And this wasn't just the basics, but sensitive background checks as well were also part of the heist. And, moreover, security experts believe that interlinked databases within the intelligence community may have also been compromised through this hack. That means exposing polygraph results and other personal deep dives that security investigators performed over the last few decades. This impacts government but also industry, as many have government backgrounds as well.

Now, during the Cold War, it would have been quite a heist for the Soviets to lift this much information, let alone process it. Imagine the tractor trailers filled with boxes. It might have actually worked in the '70s when Washington's traffic wasn't so bad, but today I think the Beltway is its own moat. But with cyber spies and big data analytics, it's almost a strategic imperative to conduct espionage at this scale.

Now, the building blocks of a social engineering hack are made exactly of data like that which was stolen in the OPM heist. So what does a bureaucrat's background check have to do with operating an F-35 in combat? Everything. As a hacker and artist that I was recently interviewing put it, if something has a source code and is run by humans, then it has a vulnerability. To

see hacking as a purely technological thing is completely wrong. Most exploits rely on a huge amount of social engineering first to enable those later technological exploits. Backdoor software vulnerabilities and hardware hacks come predominantly through social engineering. When we sift through the open-source reports from the Homeland Security Department in the US or the Defense Department's own weapons testing officers, it's revealed consistently as a major vulnerability. This, along with the growing amount of code in major weapons platforms, equals greater complexity and therefore vulnerability.

In the context of Plan *Jericho*, consider this number—576 million. It's not a price tag for one of your jets. It sounds like it could be. What that is, is a reference to the nearly 600 million lines of code in the Australian Air Force's planned buy of 72 F-35s. Each jet has about eight million lines of code. Combine the tens, if not hundreds of millions of lines of code in current and future RAAF platforms like the Global Hawk or Triton, the P-8, KC-30s and other assets, it puts the challenge of operational supremacy in perspective, whether it's just software maintenance, updating systems or malicious cyber spies. As Plan *Jericho's* modernisation continues, America's problems essentially are your problems on this front. But its cyber and defence communities are also your allies.

I do want to step back for a moment because it's important not to give in to doom and gloom here, when you're thinking about the future and particularly the future of war. You know, the narrative we use when we approach these challenges is crucial and seeing problems as surmountable is important. We want to use our narratives to inspire creativity and confidence in our ability to prevail with innovation or to get around technological liabilities that are impeding us from achieving our objectives.

As the science fiction writer, David Brin, has said, it's important that you see science as helpful. And he's right, especially now that peril and promise are conjoined twins. So what do you do?

One of the lessons learned that we've taken away from the book is 'you train like you fight', not the fight from the wars of today but the wars of the future. It really matters here. The US Navy is actually teaching midshipmen how to navigate with tools not used in decades when they're in Annapolis. They're using celestial navigation again. We also need to work with partner nations in this denied context. Imagine if you held Exercise *RIMPAC* [Rim of the Pacific] and nobody was allowed to use GPS.

Policy matters, too. The 2011 changes to the Australian New Zealand US Security Treaty to include cyber operations is significant and it's important. But yet, people matter most—more than any one technology. That's a message you've heard throughout the day and it's one that can't be said enough. One of the ways to think about that truism is in the context of allies. I would encourage the Air Force officials in the room to think about finding new allies. Don't just think of super, empowered individuals in a negative context—Snowden or Bin Laden. Think about them in a positive context. In America, that means Elon Musk, Eric Schmidt at Google, Jeff Bezos.

You now have institutional progress towards the ability to reach and connect and sustain relationships with many of your nation's leading innovators. Australia's Centre for Defence Industry Capability and their virtual defence innovation hub seem to me to hold promise, it would seem, in drawing in these new allies. This is an opportunity to recruit, to inspire, to connect and to ensure that your vision of the future is aligned with theirs.

There's two reasons why this really matters, and it comes down to culture and process. The first is to create a culture of adaptability and resiliency within the air power community. It is a daily practice and it's also a bottom-up approach—something that you've often seen in the technology sector as well. I think establishing human connections to your cyber and network defence communities, both private and public, to help them now to understand the ongoing threat environment from your perspective, but to do so at a personal level, is imperative because that will be crucial during a crisis. Invite them along to watch a squadron exercise; put them in a simulator or invite them to an operational brief. Such outreach is not that expensive but it's very important because you create bonds that can't be broken when they're needed most. And do the same—invite yourself to see how they work. Don't be bashful about it. And break down the bureaucratic doors but leave them open.

Right now, South by Southwest Interactive in Austin, Texas, one of the pre-eminent gatherings of nerds and tech community in the world, is coming together for the next few weeks. It's also film, it's also health education. It's one of the best fountains of ideas in modern society. Could you imagine sending staff to watch and learn there, or to speak? Or how about RSA Conference in San Francisco, a major cyber security conference where Ashton Carter, the US Secretary of Defense, recently announced that Eric Schmidt, the Chairman of Alphabet, which is Google's parent corporation, will be heading up a new Pentagon Silicon Valley Board as the latest example of the Defense Department's outreach to America's tech innovators.

It's great to see that, because what we found in writing *Ghost Fleet* is that cyber resiliency comes down to attitude as much as technology. Networks will be up, will be down, changing speed and direction like the wind. The metaphor might be the wings of an aircraft adapting to the inflight physics of the moment.

The people who may be the frontline players could also be in the commercial world. In the book, we really had a lot of fun with this. We posited the Silicon Valley billionaires frustrated with the US Government's inability to move quickly and effectively to take on Chinese hackers, they would do so themselves, even in a barely coordinated way, so great was their frustration. Those kinds of allies can do things that are extremely important, like check blind spots and check all of them. The US Defense Department's weapons testers in a 2014 report found that much more realistic cyber testing was needed. So don't do this alone. Please draw in new experts.

At the *Art of Future Warfare* Project at the Atlantic Council, we are including the creative community—video game directors, science fiction writers, even graphic novelists as part of

the conversation about the future of war. What we're trying to say is invite people who don't belong; bring in people who have expertise and who bring seriousness and rigour to their craft, to their practice, that may be wholly different from yours but can be valuable in providing new perspective and checking those blind spots that I mentioned earlier.

Now I'm going to shift domains to space. Like cyber, space is a new battle domain that is crucial to all others—air, land and sea. Now, by treaty, space is not supposed to be weaponised, but there's plenty of military activity there that indicates how decisive it will be. If you want to just pause for a moment and think about how fragile a satellite actually is, the list of things that can knock it out of service is very, very long—ground-to-air launch missiles, energy weapons, solar flares, space junk. There was a collision between an Iridium satellite and a Russian satellite that put up a debris cloud that still threatens space assets. Satellites colliding with other satellites, either intentionally or not, remains an ongoing threat as the heavens become more populous.

So, when we built the *Ghost Fleet* scenario, which was in effect a massive narrative red team exercise with Pete and I alternatively playing heroes and villains, because no narrative, no hero is as good without a great villain, we set out to deprive the US of its ability to wage war on its own terms. Surprise, of course, is crucial in knocking down the space-based assets essential to the American and allied way of war. In fact, the book opens with that in its first pages.

We envisioned the Chinese secretly arming a future Tiangong space station, Tiangong-3, which is not yet built, in order to command the high ground, as part of a long term investment and vision for the importance of seizing the strategic high ground. It seemed possible. We felt like it was an important way to begin the book because it seemed like the most credible way, if we were the adversary, of how we would approach denying the US what it most wanted to come true.

Can you imagine what a future Royal Air Force [or] Royal Australian Air Force mission based on Plan *Jericho* modernisation might be like without access to GPS, space-based imagery and signals intelligence? Even the use of commercial communication satellites? A first strike in a Pacific military operation certainly will be in space, likely simultaneous with cyber, and why? For the reason as I said before, because we depend on it so.

So, what's on that target list? Well, military satellites certainly, but consider [that] the commercial networks are crucial, too. How much of Plan *Jericho's* network traffic will cross commercial satellites and, I would also add, undersea cables? There's something to be known and understood there, because it's closely tied to vulnerabilities that adversaries will exploit, if they're not already doing so or preparing for it.

We also have to realise that we can be our own worst enemy in our hunger for more information, more data, more insight, more speed. We're already running out of satellite bandwidth and the usage is only going to grow. Drones, command and control, automated logistics, real-time analytics, combat-cloud capabilities, and the list goes on, with amazing technologies that we are

putting forth without adequately provisioning for their bandwidth requirements.

In Operation *Enduring Freedom* and Operation *Iraqi Freedom*, US forces were using many, many times the bandwidth that they did during the 1991 Gulf War—as much as 30 times. Even a single Global Hawk or Triton aircraft uses five times the bandwidth of the entire US military during the Gulf War—five times. You can find that fact in articles going back to 2002, using the Air Force's *Air Power Journal*, and yet we're still struggling to keep up. Individual bandwidth consumption is rising at an unbelievable rate, nearly doubling from 2001 to 2004 from Operation *Enduring Freedom* to Operation *Iraqi Freedom*. It is 10 000 times higher from Gulf War 1 in 1991 to Operation *Iraqi Freedom* in 2004, according to *Satellite Today* [magazine].

Even something mundane, like email for the military, exemplifies this challenge. The US military's email rules are 512 megabytes as the storage limit for the Army that's been imposed by the Defense Information Security Agency for basic users. If you're a business user, you get four gigs [gigabytes], which is a little better. This is worth noting for a couple of reasons. The tyranny of the Inbox in wrecking strategic foresight has a new front, a very real one. Not just tasking orders, but email account management. And meanwhile, a free Google account gives you 15 gigs for free for its whole portfolio of services; as many as 30 if you're a big organisation or a university. And they have 900 million users.

Essentially, military basic user accounts stop receiving email above that threshold, which is low. So, what would I do if I were an adversary during a crisis, looking at this data? Shut down military comms networks with something as simple as a spam of relevant imagery and videos to the crisis of the moment, or maybe just videos of kittens, baby ducks. The lessons learned here are that space, like cyber, is a battle domain. The vulnerabilities are similar to cyber, but yet they're physical too, adding greater and greater complexity. It only serves to think about 2007 when Chinese anti-satellite tests showed the kinetic aspect and the consequences with space debris that have implications for the entire lower earth orbit.

Good news—and I think there is good news here—is that the latest Australian *Defence White Paper* highlights the importance of space assets for surveillance and communications and for launch. However, what we found when we war gamed *Ghost Fleet* is that the most important thing isn't the satellite you have in orbit; it's the next one that is on the ground ready to go to replace the one there, and then the one after that. So what's the implication here? You need to be thinking about how integrated battle management, C4ISR [command, control, communications, computers, intelligence, surveillance and reconnaissance], automated logistics will work, not just in the contested space environment but a denied one. And then we think about solutions. One is to be ready to launch your own satellites. It's not as much of a reach as you think, because of the small sat or cube sat movement. Some of the same concepts around swarming that we see with unmanned systems are, in effect, being applied in space. You could put three or four cube sats on this table right here that would be light enough to lift with your hand, based more or less on cell phone, mobile phone technology.

So part of this is considering that, even as an option; to embrace that kind of invention that's even beyond innovation. *Aviation Week* recently had a great summary of some of the concepts for Aircraft Assisted Small Launch. One of them is Altera, a French concern. The other is Virgin Galactic, which is also looking at this segment.

You also could think about your UAS [unmanned aircraft system] in a different category. The Triton or Global Hawk in that capacity can function as a node, and obviously so can an F-35. On Monday morning, I had the privilege of seeing two of the Royal Australian Air Force's hot air balloons flying over the lake here and it made me think about higher altitude aerostats also as contingency network nodes if Wedgetail, P-3s, P-8s, F-35s are not readily available.

When you think about the fundamental importance of cyber and space, it's important to never take them for granted. You'll be operating what are essentially cutting-edge platforms conceived during the flip-phone era when many of the assumptions about cyber security or electronic warfare had yet to be really put to the test.

And a final point, and it relates to not just the futuristic capabilities inherent within Plan *Jericho*, but it reaches further into the realm of science fiction—the Third Offset Strategy. Integrated cyber and space operations for the Royal Australian Air Force and allied nations need to be considered in the context of the technologies emerging from the US Department of Defense's Third Offset Strategy. So what is Third Offset? It's a quest for conventional deterrence in an age of proliferating commercial sector technologies, some of which will be invented in the next decades, that have direct military application. Others are pure-play military inventions like rail guns or directed-energy lasers.

It's often put in a historical context to the previous offset strategies the US has created but, in my opinion, this is a wholly new and separate way of thinking about the intersection of innovation, military technology and the commercial sector. We're seeing some interesting signs already with some of the innovations—new purposes for existing systems like using an SM3 surface-to-air missile as an anti-ship weapon. The challenges are big. 'Wave-breaking' is one of them. How do you manage wave after wave of high-accuracy, low-cost projectiles, or even PLA [Chinese People's Liberation Army] cruise missiles which have the potential from air, land and sea launchers to overwhelm current missile defences? Some of the Third Offset's investments are tackling this directly.

On another level, there's an intense interest in artificial intelligence and closer and closer man/machine teaming. What's important always to remember in these technological explorations is the human element. In *Ghost Fleet*, we paired conventional fighters with unmanned aircraft—essentially a version of the UCAS [unmanned combat aircraft system] unmanned system that is in another world within the US military's procurement process. We also employed missiles that had swarming capabilities for the ability to strike in an information-denied environment through creation of local networks. This is something to think about when you're training with existing

assets, these sorts of concepts or operations. It's also important to find ways to use simulators to explore this independently, and inexpensively, until the technology is ready.

In the Third Offset context, as advanced and ambitious as Plan *Jericho* is, do not let it be left behind if there's a step-function increase in US capability due to autonomy. You're already seeing a lot of open-source conversation about it occurring in cyber defence and offence, or even in unmanned teaming.

The open-source budget for the office within the Defense Department is focused on near-term Third Offset technologies, things that are innovative. And by innovative, I mean existing capabilities that are used in new and novel ways. We're spending around US$845 million, it looks like, in fiscal year 2017. Yet that's doubled from 2016, so you can clearly see the intent there. And we're spending it on everything from artificial software investment, long-range, unmanned autonomous underwater systems to swarming aircraft, UAVs. Also rail guns and directed-energy weapons, too.

One of the really interesting tests occurred off Alaska recently when they tested the deployment of micro-drones from flare dispensers on F-18s and F-16s. As operators of the F-18 aircraft here, that is the sort of program, called *Perdix*, that should be of interest to the Royal Australian Air Force.

Now, this budget is not a lot of money in a Pentagon context. It's almost $1 billion, but these are decisive dollars—I'll call them that—because of their support of game-changing initiatives where the investment yield is potentially disproportionately high. I would argue that if Australia is America's best ally in the Pacific, it is incumbent to insist on a place at the table in discussing the Third Offset. Do it now, not after the fact when many of these technologies are already in deployment or further in the development cycles when it's more costly and more bureaucratically difficult to integrate them into the foreign military sales and export context. Many of these technologies will also come from the commercial software sectors, engineering centres in Silicon Valley and other technology hotspots around the country, but to really be effective, they have to be shared. And that's one of the inherent tensions that's resident within the Third Offset Strategy that, in the Pacific, is incredibly important to resolve and to resolve with purpose, but also in synchronicity with modernisation programs like Plan *Jericho*.

Because what is the point of networked operations if the best capabilities are closely held? If they're so advanced that they can't actually be shared, who benefits then from the network? What good is a network that is self-limited? There are hints of this already that the US military has been struggling with. It's the simple ability of an F-22 Raptor and an F-35 to share data securely.

I think, in closing, I'm going to talk a little bit about my favourite technologies from the book, because we're often asked this. I might say that it's the respirocytes, which are small nanotechnology simulations of red blood cells that helped our US Navy SEALs swim underwater for literally impossible lengths of time, or the robot reconnaissance lobster nicknamed Butter which has become popular enough that I've seen some military officers put it on their T-shirts

as a logo. Despite never having seen it, they've imagined it, which is an important lesson of the power of narrative right there.

We also used brain interface technology, normally employed in the medical realm. We did so for interrogation, which was pretty horrifying. It was one of the harder parts of the book to write and to explore. We also looked at space pirates—private military contractors in space. We even bought the rights to use Alice Cooper's *Space Pirates* rock opera in the book as well.

But I think my favourite technology is actually its absence. It's the low-tech approach to war. It's bringing F-15Cs from the Arizona Desert boneyard and rigging them up with duct tape tablet computers and inflight local networks for a one-way mission. It's insurgents using thick wool blankets to hide from quadcopters with infrared sensors that are spotting for Exosuit-equipped Chinese commandos. It's a General Atomics Avenger drone essentially used as a stealthy passenger pigeon delivering a message. It's US Navy taskforce warships communicating by signal and flag or on local networks that are undetectable.

I'll wrap up here with a summary of the lessons learned.

- Understand your vulnerabilities to really know your capabilities, especially with cyber.
- In space, the important thing isn't the satellite you have in orbit, it's the next one that's on the ground and the one after that.
- Don't get tunnel vision around one specific program or capability; bring in new perspectives on both vulnerabilities and capabilities.
- Find new allies in the commercial sector, particularly in software and high-tech industries who understand and exist in a higher metabolic environment.
- Be ready to operate in information-denied conditions but with the confidence of success of an integrated force.
- Foresee a resilient OODA [observe, orient, decide, act] loop, for example, that can be carried out with independence.
- Have low-tech options. Maybe hold on to those F-18s that were returned or sold when the F-35s arrived, because technology, technological diversity through quantity on the battlefield, especially with air power, still matters in an era of cyber vulnerabilities.
- Lastly, get a place at the table in developing the Third Offset Strategy technologies that will be essential to major Pacific military operations, particularly as they relate to software and AI [artificial intelligence].

I'd like to thank Air Marshal Davies and Air Power Development Centre's Mark Green, Michael Spencer and Sandra Finney, for the invitation to speak. It's been a privilege to address the audience.

COMMANDER'S INTENT

AIR MARSHAL LEO DAVIES, AO, CSC

To the Service chiefs and their representatives, ladies and gentlemen, at the outset, I wish to thank yesterday's speakers for their presentations. There is a common thread running through the discussion concerning how to extract the best from military capability through integration, and that is, the human element. The technology may be cutting-edge, but no matter how sharp that edge, it is the people on the frontline and in the networked environment, working seamlessly with the other tactical operators and supporters, who create and sustain the effort. It is that dimension—the human dimension—that sits at the heart of my command philosophy.

Military aviation has a relatively brief but already distinguished history. In the decade after the Wright brothers' first powered leap into the third dimension in 1903, the potential for military effect from the air had only been imagined. By the Armistice of 1918, a range of relatively simply flying machines had not only been imagined, but fielded in a majority of roles immediately recognisable to a 21st century airman. The constant evolution of refining them through technological innovation, exploited by human ingenuity, had already begun. It is not by luck that we find ourselves here today as part of that journey.

The Royal Australian Air Force will mark its 95th anniversary at the end of this month. In less than a century of operation, it has continually, if not always consistently, exhibited the traits that have marked successful air forces—technologically driven, adaptable, responsive and innovative. The last three are human attributes, delivered by people who know how to exploit the technology, and develop and optimise operating procedures. Air forces thrive and succeed when their airmen are technically trained, are versed in air power and are capable, trusted and empowered to adapt, respond and innovate.

This is the type of air force I've been appointed to lead and one I intend to take further along a trajectory that organisationally and culturally entrenches adaptability, responsiveness and innovation; a trajectory enabled by trusted commanders who in turn trust their people to perform. My priorities outlined in my *Commander's Intent* should come as a surprise to no-one: providing Government and joint force commanders with the best possible air power options, primarily through technologically advanced systems, operated, adapted and optimised by a skilled, supported and air power–savvy workforce.

Mine is the Air Force's third commander's intent, the first having been released by CAF, Air Marshal Binskin, in 2008. There is a consistency among them. Clever people optimising the performance of technologically advanced equipment is an enduring characteristic of air power and air forces.

We—that's you and I—are expected to deliver. Smart people acquire, operate and sustain Air Force. But it's not just about a technician turning a spanner or providing air traffic services to launch and recover aircraft. Those, and many other aviation skills, can be equally found in a civilian world. We are an air force; a force of air power professionals, people trained in their specialisation and educated in what it means to create air power. That's what truly makes Air Force tick. I want them to strive to do their best. I will ensure they are entrusted, appropriately

trained and educated, supported and empowered; nothing less will suffice if Air Force is to deliver the full potential of the networked force it will soon become.

Delivering air power also requires the ability to advocate, argue and explain at all levels, to all levels, its undeniable value. In the past, air forces relied on spokespeople, being officers who developed an air power brain through their years of service. They've often arrived in those senior engagement roles without the opportunity to reflect upon that accumulated knowledge and hone it for use with best effect.

(Front row) Air Marshal Errol McCormack (Retd), Air Marshal Leo Davies and Dr Alan Stephens with the inaugural Sir Richard Williams Scholars (back row from left to right) Wing Commander Jason Begley, Squadron Leader Travis Hallen, Group Captain Steve Edgeley, Group Captain Phillip Champion and Wing Commander Jarrod Pendlebury

A number of officers with the potential to serve in roles linked to senior engagement and strategic shaping have been identified to undertake sponsored doctorate level studies with a focus on air power. This will represent the culminating point of their formal air power education. At last evening's reception, the Air Power Scholar Program, initiated in conjunction with the Williams Foundation, was announced. Today, behind me, you see that first group of Sir Richard Williams Scholars. I congratulate them on their selection, wish them well in their application to studies and look forward to their emergence as the key senior influences and commentators on air power.

The officer corps does not hold a monopoly on leadership. I also depend greatly on our warrant officers and NCOs [non-commissioned officers] to provide values-based leadership. Therefore,

Air Force will be implementing a Warrant Officer Employment Continuum, a framework that recognises, cultivates and exploits the value of our senior airmen. Air Force requires critical thinkers at every level, equipped with experience through greater and more diverse employment opportunities, along with honed, tailored professional development and education programs. This framework is intended for future application to the development and management of all Air Force warrant officers and airmen.

I am focused on the people who are Air Force. While the Air Power Scholar, Warrant Officer Continuum and other training and education programs put this into practice, we must be mindful of the tools, resources and systems they will need to build, evolve and maintain as an air force of strategic importance. Air Force now has the systems and capabilities to offer a balanced and truly capable force. Our ongoing contribution to Operation *Okra*, Australia's military contribution to the fight against Daesh, is testament to this. Detachments of Super and 'classic' Hornets—sustained on mission by KC-30 refuellers and made aware by Wedgetail AEW&C, and with a sustainment bridge, enabled, in part, by C-17s and C-130s—are making a significant contribution to operations, which are well beyond niche.

This integrated capability will be further enhanced in the coming decade when it is joined in service by Growlers, F-35 Lightning IIs, P-8 Poseidons—we have four more now—MQ-4 Triton UAS and Gulfstream 550 electronic warfare support aircraft. We'll also have transitioned to a new pilot training system, based on PC-21. We have, and will continue to build, in our ground systems, an environment fit for the purpose of supporting our air assets to their full potential.

By 2025, Air Force will be a truly 5th-generation force. Our oldest aircraft will be C-130J, and it's certainly not a legacy platform. Our systems will be world-class and in many respects, world-leading. This is the Air Force we are building. We have runs on the board through recent operations; we have established a reputation as a go-to option available to Government across a range of contingencies.

But we don't live in a blue vacuum. Increasingly, we are not constrained by the three physical domains of air, land and maritime. The cyber and space domains increasingly network the world. Fifth-generation systems will permit us to connect through these intangible domains to create enhanced joint effects encompassing the air, land and maritime environments.

The 5th-generation Air Force platforms do perform the traditional roles we have always associated with their predecessors. However in many cases, the modern solutions are multi-role, with the ability to conduct various roles in one sortie. Traditionally, this has meant finding your way to the target—in an air-to-air mode, perhaps—switching to air-to-ground to prosecute and then reverting for the egress. Fifth-generation combat aircraft will do this, and much more, and at the same time.

The F-35 will be our primary control-of-the-air platform but with innate strike capability. However, with its comprehensive sensor suite, it will also be an integral and essential element of RAAF's ISR [intelligence, surveillance and reconnaissance] network. It will contribute to, and draw from, the networked array of sensors present in the battlespace. It will largely accomplish this in the

background, leaving the pilot to concentrate on prosecuting the mission as the aircraft synthesises data and contributes to the campaign. The potential for the use of these platforms and systems will only be constrained by the imagination of our airmen.

Military history shows that the leaps of advancement have resulted from networking. The impacts they create have been felt most strongly by those on the wrong end of the stick; those unable to comprehend the art of the possible and either enact it or prepare to defend against it. Blitzkrieg, which enabled the conquest of vast tracts of Europe early in World War II, had been evolving in Guderian's mind since shortly after the armistice of 1918. Some might argue this was an extension of a concept first employed by Sir John Monash and Sir Arthur Currie in World War I. But as a concept, it took the systems then available, and to network them, with devastating effect. Notably, Guderian struggled against a hierarchy mired in tradition and process, to get traction for his ideas.

More recently, a similar effect was achieved by the networked and precision-enabled latter day blitzkrieg that was Operation *Desert Storm*, whose 25th anniversary was marked only recently.

Within the ADF, as in the militaries of many nations, the Services have evolved along different cultural lines, but increasingly have commonality in the abilities of their workforces. They share the human attributes of versatility and inquisitiveness. When we reflect on what a few men of foresight were able to achieve in the past, with relatively primitive technology by today's standards, then the future has boundless promise if we empower our people in uniform and our partners in industry. Air Force has already embarked down this path.

Plan *Jericho* is also demonstrating the art of the possible in developing ways in which to better integrate the elements of Air Force, drawing heavily on what the cyber and space domains add. It's only a year since *Jericho's* announcement and significant progress has already been made. For example, we have demonstrated the ability to stream remote sensor video into the cargo bay of C-17s. It was conceived by airmen and delivered by L-3 and ViaSat. Airmen saw the need for mIRC [Microsoft internet relay chat] chat on Wedgetail and Boeing said, 'Yeah, okay, we can do that'. Soldiers and airmen wanted to connect Tiger to Super Hornet and Northrop Grumman said, 'I think we can do that'.

The transformation of Air Force through Plan *Jericho* is not an end state; it is a way forward. We're discovering the art of the possible through empowering our people. These are two of the strong themes of *Jericho*: a plan that will forge the elements of Air Force into a fully integrated force and build upon its human capital to maintain the momentum. *Jericho* will sustain the journey in the short-term but it is more like a compass than a map. It builds upon the force-in-being and points us into the future, a future that becomes less certain the farther we peer into it.

In 2007, Air Force released the *Future Air and Space Operating Concept* to provide the vision for 2025. Circumstances have changed, however so have responsibilities for generating doctrine. Therefore, I have directed the Air Power Development Centre to bring forward a new vision statement, set in the 2035 timeframe, when we will once again be deeply contemplating force renewal. This document will guide Air Force and inform our sister Services and wider community of where we are heading. It will chronicle the potential threats, the challenges and opportunities we may face

along the way: technical, societal and economic. It will be a map, but not of the high-resolution type we are familiar with today.

While we are certain of where we are now, the cartography becomes less certain the further we project ahead. There will be unchartered areas along the way, which must be navigated cautiously if we are to arrive at our intended and preferred destination—a truly multi-domain fighting force. This document will describe that destination and detail those risks and opportunities we can conceive of as lying along our path and to inform those who will travel along it.

What is certain is that it is not a journey that we'll be taking alone. Air Force has been fortunate at being at the forefront of bringing into service the platforms and systems, which will enable the fullest exploitation of networking and integration, which in turn, are enablers for the joint force. As the *Defence White Paper* states, the ADF's future lies in 'jointery', permitting the rapid and more effective delivery of force when required. The benefits accruing will be equally applicable in operations other than conflict. Achieving a joint force will require the active participation of all elements of Defence: uniformed, civilian and our industry partners.

Thank you once more to those who have already spoken and today's focus will be on providing insight into our experience on the ways in which the Royal Australian Air Force intends to prepare for success in an environment where joint success is enabled and sustained by multi-domain integration.

PLAN *JERICHO* – THE STORY SO FAR

GROUP CAPTAIN JAKE CAMPBELL AND
GROUP CAPTAIN PETE MITCHELL, OAM

Group Captain Pete Mitchell: Good morning ladies and gentlemen, I'm Group Captain Pete Mitchell and together with Jake, we are the Directors of *Jericho* within Air Force Headquarters. We're not actually going to talk about the story so far because that would be perhaps looking rearwards. Instead, we'll start looking at how we've delivered and Air Force as a whole is delivering on *Jericho*. We'll cover very briefly a short history and some context. We'll then look at the last 12 months, the next 12 months, we'll then cover an acquisition methodology that we're proposing, and then finally we'll have a look at the future.

The *2016 Defence White Paper* is extremely clear in the Government's intent to provide more emphasis on a joint force that includes the intelligence, cyber and electronic warfare capabilities that will make us able to apply more force, more effectively and more rapidly when and where we are directed to by Government. The *Jericho* vision is therefore to become an agile and adaptive force that's fully immersed in the information age and truly joint with the ability to operate and win within a 5th generation–warfare context.

The vision is underpinned by three core themes:

- to harness the combat potential of an integrated force,
- to develop an innovative and empowered workforce, and
- to change the way that we acquire and sustain capability.

As part of the *First Principles Review*, the *Jericho* Plan and vision fits neatly into that One Defence construct and complements the *First Principles Review*.

Why we must transform. When I went to primary school we had blackboards. In high school, we might have seen a whiteboard and a computer was locked away in a particular room and we were allowed to go there perhaps once a week to play with it. My seven-year-old son is probably now going to be expected when he goes into Year 3 next year to take his own iPad to school and be fully immersed in the technology age. Obviously, that environment, and the strategic environment, is challenging the way that we need to stay ahead of our adversaries.

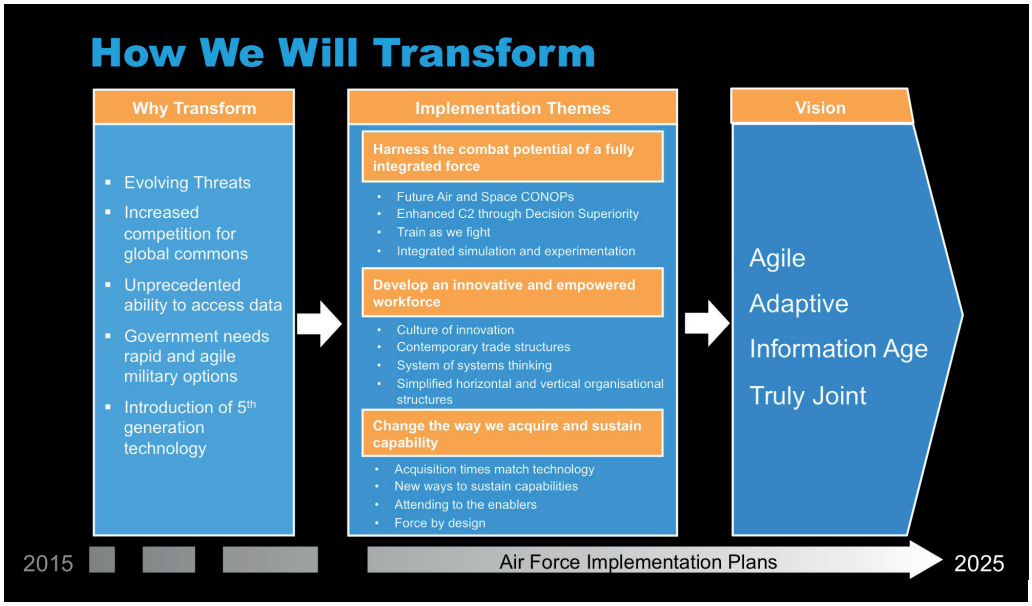


Figure 15-1: How Air Force will Transform under Plan Jericho

This slide here really is the Chief of Air Force's intent for *Jericho*. But why must we transform? There are evolving threats, both traditional threats, aircraft and missile systems, but we've also seen the emergence of threats in domains that are a lot harder to touch and feel and understand, in particularly, the cyber domain. There is an increased competition for the global commons and, as an example, around 80 per cent of Australia's petroleum now comes by sea through the South China Sea. In order to maintain fuel security, we have a particular interest in maintaining access to various global commons but we are not alone in our desire to access those commons.

There is an unprecedented amount of data that is available and we have a hunger for that but we cannot be, as Chief of Army yesterday said, be paralysed by analysis. With the amount of data that JSF, Wedgetail, P-8 and Triton alone will provide to the organisation, how do we decipher that amount of information and where do we put it? How do we pick out the veritable needle in the haystack of needles?

And finally, the introduction of 5th-generation technology. By the end of this year, we'll have P-8 on the hard stand at Edinburgh. By the middle of next year, we'll have Growler on the hard stand at Amberley, and within 24 months we'll have the first lot of JSFs on the hard stand at Williamtown. Whilst those 5th-generation platforms will be here, we need to ensure that we have a 5th-generation air force that can hold together at the seams to be able to provide and support those platforms. Platforms alone will not make us a 5th-generation air force.

Under the *Jericho* themes, we have three. Harness the combat potential of a fully integrated force, and that has required us to develop a more robust CONOPS [concept of operations]. That was done last year and there will be continued work on the CONOPS that will look out to 2025. It's about how Air Force will, as part of the Defence team, transform. We have a requirement to improve our decision superiority and one of the key enablers for that is an

advanced command-and-control system where we understand how and why we're going to do business and how we are going to get the decision out to the warfighter to make the tactical decision in a timely manner against a threat that may not allow him to have minutes or even days to consider. Obviously, we're going to implement the integration of simulation and experimentation into the way that we train and fight.

The second theme is to develop an innovative and empowered workforce. A culture of innovation that allows those leaders out in the field to have the skills, the understanding in the temporal space, and the mental agility to make those decisions and deal with the challenges that they'll face. We also need to have a look at the workforce, how it's balanced and the types of capabilities we will need. In particular as an example, what do we do with network designers and managers that enable a C2 [command and control] system that allows the warfighter to make those decisions with some clear guidance but the freedom and autonomy to go and operate and act against a threat that, again, may have him extremely time compressed.

And finally, we're looking to change the way that we acquire and sustain capability. We have a proposal that we'll dig into a little bit later that will fit into the new capability life cycle and the One Defence methodology that we are proposing. It will allow us to acquire technology and implement that technology at a rate that allows us to deal with the change in technology but also the application of that technology as chosen by the adversary when they develop their threats. So we need to be able to react to that.

The future force will require a lot more than just the top-down design. There have been a number of principles in the implementation of Plan *Jericho*. Top-down design and our strategy need to meet bottom-up innovation. We can't have a monopoly of good ideas in Air Force Headquarters. Certainly, as the Chief has highlighted, the number of ideas that have already come from the field to fix or address a problem or a capability gap, have come up with an innovative solution that with some dedicated resources actually delivered significant capability increases in a short amount of time.

The Chief also mentioned that we are going to be strategy-led and we're going to take a compass versus a map approach. So we need to take a vector out towards 2025 where we can see where we need to go but we have not plotted a route on a map or been confined by terrain or obstacles that we might find. We will have the ability to shift and adapt to those obstacles, develop solutions and continue on our vector out towards 2025.

Finally, we need to ensure that we are combat-mission focused, that we are actually about delivering localised tactical effects in the battlespace. A shiny pamphlet developed at Air Force Headquarters does nothing for delivering a laser JDAM [Joint Direct Attack Munition] onto a member of Daesh in a trench, it does nothing for a guy or a girl in the back of a Wedgetail trying

to develop a common operating picture, or nothing to a new airman that's trying to deliver a network cyber effect that enables follow-on capabilities.

Group Captain Jake Campbell: Good morning everyone. The map says this is about looking forward but we will take time to look over the last 12 months and what *Jericho* has achieved in its first 12 months.

Really, the first iteration over the last 12 months was about planning. It was about understanding what Air Force needed to look like in 2025 to 2030, and then the mechanisms that were needed to be put in place to enable that. Last year, we spent a lot of time considering the concept of operations for Air Force. We pulled together a team of experts from right across Air Force at various rank levels under a program we called *Jericho Spring*. That was a wargaming activity. It wasn't quite as disruptive as the Arab Spring but it was important to us nevertheless.

It was really having a look at operating concepts where we fight as an integrated force and in doing so, that allowed us to develop the Air Force CONOPS. It was really a surprise to me at the start of last year that we didn't have an Air Force CONOPS that covered the whole of our force. We had various force element group [FEG] CONOPS and some of those, in fact, most of those were quite complex and sophisticated and really important to the FEGs but there was nothing there that said how we were going to fight as a combined Air Force. So it was important that we pulled that together and we did that last year. That was signed off by the Chief of the Air Force in June of last year.

Once we had that CONOPS, it became a little easier for us to understand where our capability gaps were in realising an integrated force. We pulled together all the gaps, we applied them across all of the fundamental inputs to capability. In that sense, we didn't just say that the answers to all our problems are new technology and new widgets. We knew that we might solve some of our gaps through the application of new tactics, techniques and procedures. Well, we might solve some of our gaps through better training systems or through different ways of sustaining our force, or perhaps even through our application of fighting at an air base level. So we looked at all the fundamental inputs to capability and then we produced the glossy brochure that [GPCAPT Mitchell] was talking about there, which is the *Program of Work*.

The *Program of Work* is on the Air Force DRN website, you can go through the *Jericho* link for the Air Force folk. It's worth a read. It outlines the 15 projects that are top-down design piece of *Jericho*.[1] Those 15 projects are the means to remediate those gaps, so that by 2025 we will have an integrated force that knows how to fight together and regularly trains together, and that's fundamental to the success of *Jericho*. Two of the most important projects in that *Program of Work* are the first two—enhancing our air-land integration capability and enhancing our maritime-operations capability.

1 The Plan *Jericho Program of Work* published in September 2016 increases the number of Jericho projects to 16.

At this point, I have to disagree slightly with Dr Stephens from yesterday and say that joint operations are not just a politically correct term. They are fundamental to the way that we are thinking in terms of Air Force's response under *Jericho*.

So those are the first two projects. There are other projects in there, including remediation of the common operating picture [COP]. Air Force's recognised air picture and the way it contributes to the COP has some fundamental flaws, largely due to technology, not due to the quality of information that's sitting in EASTROC [Eastern Regional Operations Centre]. But we need to address that information flow so that it is getting to the operational commander in the time and with the quality that he demands.

There are projects in there that deal with our logistics approach. How do we integrate logistics into the battlespace and what new logistics methods and techniques are needed to enable our integrated force and sustain it? There's a project in there about defending the air base. Clearly, the air base remains fundamental to any air force and that's no different under *Jericho*. What is different is that with the evolving threat and the quality of the threat that we're facing, we have to be able to move our air bases at fairly short notice. We need to establish air bases forward at fairly short notice and then we need to be prepared to move them again at fairly short notice. Our ability to establish those air bases, to protect them, to have the logistics that feeds them, and then be able to move them is fundamental to a 2025 to 2030 fight.

There are 15 projects in there altogether. That's just a snapshot of them and I encourage you to have a read of the full *Program of Work* so you understand what it is we're doing and why we're doing it.

In addition to the *Program of Work*, we wanted to make sure that we could get some quick wins and really start the workforce on the path to understanding the need for change and actually seeing some change. *Jericho Dawn* activities were fundamental to that. We had in *Jericho Dawn*, as the Chief mentioned, full-motion video into the back of a C-17. From a Heron, that was sitting overhead Woomera, its full-motion video was piped through the Defence Secret Network and then via satellite into the back of the C-17. That now gives ground forces the ability to have updated situational awareness all the way to their insertion point—not just a snapshot taken eight hours before they actually land at their target. That project was implemented in about 63 days and got us off to a really good start.

Jericho Dawn has had some spectacular successes like that one. We've had some failures and what we're saying is that failure is actually okay. It helps us to learn, evolve and improve. We did a Wide Band HF trial. Now that Wide Band HF is going to be important in a space denial environment, and we're doing a lot of work in that area. The initial trial that we did was really successful in terms of the way industry and the whole-of-Defence came together to put the trial together but it didn't give us quite the outcome that we had hoped for. We have learnt a lot and we'll continue to evolve that capability.

We've enhanced AP-3C communications, we've done some forward arming refuelling capabilities and trials and so forth. This afternoon, you'll hear a little bit more about what's happening in terms of bottom-up initiatives but *Jericho Dawn* has been important to enable some of that thinking.

Other things we've done to enhance the *Program of Work* is that we've recognised that broader Defence needs some capacity to be able to help us deliver *Jericho*. So we've put some resources into CIO [Chief Information Officer] Group and resources into CISO [Chief Information Security Officer]. We've had a lot of discussion with industry about how we can work more closely together to enable some of these capabilities. Of course, we've had a lot of discussion with our strategic planning folk so that *Jericho's* not just a one-off and then in ten years we're wondering why our strategy hasn't turned into capability. We want to make this 'business as usual' and that's what we're doing.

Over the next 12 months, *Jericho* will focus on delivering those three transformation themes that Group Captain Mitchell outlined. This is the second iteration. Last year was about planning; this year is about delivery. And delivery in the context of a White Paper that's been published and the context of a First Principles Review that is now starting to lay down the Department's understanding of how it's going to operate. There will be deeper consideration of the threats, evolving threats, and how we need to respond to those threats through some more CONOPS work. The one-star officers who own those projects in the *Program of Work* will develop and produce their implementation plans and start delivering those plans. We'll synchronise that work with the Government intent in accordance with the *White Paper* and we'll make sure that we update the *Program of Work* so it doesn't become a static document but continues to evolve as Government intent changes and our understanding of the threat changes and our ability to deliver it changes.

A heavy emphasis this year is on joint outcomes and making sure that we continue to engage the other Services, including intelligence organisations, to achieve joint outcomes under *Jericho*. As Group Captain Mitchell mentioned, we want to get faster acquisition times to enable all of that. Our threats aren't encumbered by a Defence bureaucracy that takes sometimes ten years to deliver capabilities. We want to make sure that we're not either. It doesn't mean that we're going to spend more dollars, but it does mean we need to have a different approach and a different relationship with industry. Group Captain Mitchell will talk a little bit more about that later.

The other thing we want to do is make sure we maintain our understanding of technology and our technological edge. We want to make sure that we've got a mission-focused experimentation framework and activities that enable us to continue delivery of air and space power effects that are leading edge and able to defeat our adversaries. This year, we are looking at some force-level electronic warfare [EW] experimentation and geolocation capabilities. We're doing that with the US under [Exercise] *Storm Force 16*. So that will give us some global EW capabilities.

We're looking at an airborne gateway demonstration. That was talked about yesterday. On Friday, there's a firepower demonstration in Puckapunyal and we'll be demonstrating the ability to integrate Tiger's Eurogrid with our Link 16 system and with the AFATD [advanced field artillery tactical data] system for Army. That should significantly speed up our ability to conduct air-land operations and clearly, we're quite excited about that.

Other things—quantum cryptographics, open system architectures, and live, virtual and constructive [LVC] capabilities are being progressed this year through various studies, experiments and other initiatives and they again are fundamental to our capability. With LVC, for example, we've got to understand what it means to have a white force, to have a red force and what they look like. How do we train a 5th-generation force, where security is a massive issue, in the ability to go and release weapons live?

We're going to look at all of that, we'll study all of that, we'll leverage off some of the work that's happening around the world with the US and the UK who are also looking at this problem. We'll try to land on something that is suitable for our scale but gives us the training outcomes, not only in Air Force but across the broader joint force.

There are a number of activities that are happening this year and I encourage you, if you're involved with them, to help us to progress those activities.

Group Captain Pete Mitchell: As I mentioned earlier, theme three within *Jericho* is to look at the way that we acquire and sustain capability. The Jericho team have been developing a process of looking at prototyping innovation in the way that we acquire and sustain capability in order to maintain our air power advantage.

Generically, if you have a look at the way that our current acquisition environment is operating, it is often a process that lags behind the threats, and that's not a slight on the team or even necessarily the process, but just the rapid increase in the available technology and the evolving threats. We obviously need an acquisition environment that is responsive, that can identify the need and acquire, through innovation, a capability that can address those threats.

Our relationship with industry is largely contractual. We may or may not hide behind a 4000 page requirements document that says that we need X, Y and Z. We'll pass that to industry, industry will assess their ability to respond, and then when we have any disagreements, we bring in the lawyers and again add time to that process. What we're about is trying to develop a Defence-industry partnership. The Centre for Defence Industry Capability that has just been announced, is obviously one way where we can look at developing those true partnerships and the innovation hub is another area.

We often have military-off-the-shelf, commercial-off-the-shelf solutions that are somewhat tailored, but only in a limited sense, to provide us with an answer to a capability need. What we

believe is that we need to start looking at exploring how we can use innovation and prototyping to develop truly unique and responsive capabilities that can have a military application.

We're often largely crippled by risk or at least trying to mitigate the risk down to an acceptable level, but that again drags out the process. Where we need to be risk aware, and in particular a concept that I'll talk about on the next slide, is the potential to provide upfront investment into innovation, into industry, for prototyping and innovation. The figures from that NASA study, if you invest zero to 2 per cent upfront, then you have the potential of a cost overrun and schedule overrun of between 50 and 200 per cent. If you invest at the 8 to 14 per cent upfront, then your cost overrun and schedule is a lot less likely to blow out. Potentially, by putting some upfront dollars and taking some risk early in the process, we can take advantage of the innovation through that.

We often do big upgrades, block upgrades to platforms, where we could consider more spiral upgrade capabilities that can address those rapidly emerging threats.

Finally, the acquisition process can be rapid via necessity. For example, recently we've purchased C-17, KC-30 and Growler rapidly. But that's probably more by necessity, where an opportunity is going to close and we need to take advantage of that, as opposed to being consistently rapid by design.

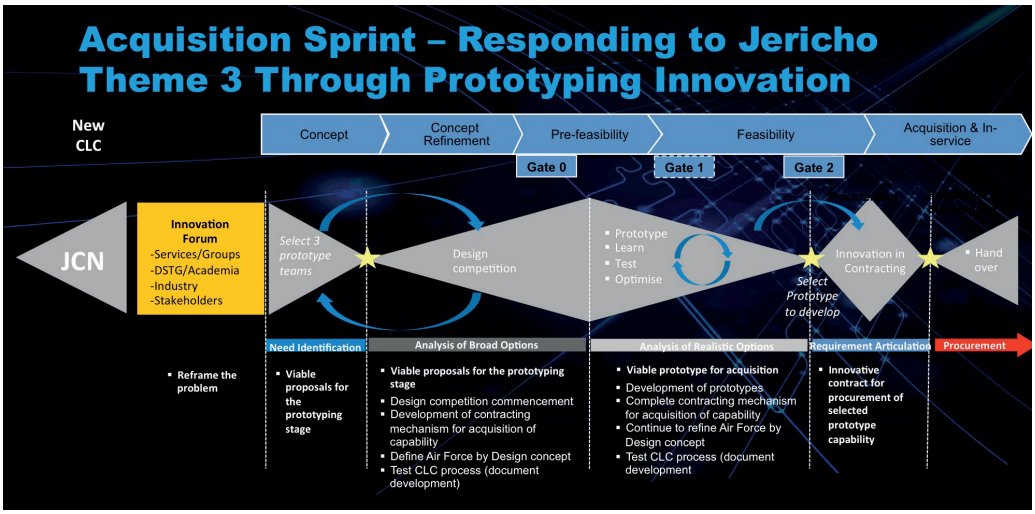


Figure 15-2: Plan for New Acquisition Strategy

The innovation methodology that's been developed does sit within the new capability life cycle. The capability life cycle sits across the top generically there, and a new term there is the 'joint capability narrative' that has come out under the capability life cycle.

First, we have a problem statement. The intent is that an innovation forum of the Services, the various groups, DSTG (our science and technology group) and academia, along with industry and stakeholders look at reframing or shaping the problem, bringing industry in to get some concept development and context to put that into an operational context. From that, we look to down select, in about two weeks or so, three prototype teams that have presented their concept for addressing our capability need. Then we start the true innovation piece where the Commonwealth proposes to provide seed funding to work with the three prototyping teams and provide each of those teams with funding to allow them to start developing their concept and prototype. Initially, they'll start by looking at the analysis of the broad options and having a design competition, and from there, doing realistic analysis of the options. They will need to address with the Commonwealth the fundamental inputs to capability—the major systems, the sustainment, people and training—to ensure that we end up with a realistic solution.

The timeframe for this is between nine to 12 months. We have looked at the One Defence team and the capability life cycle issues of how do we share collective IP [intellectual property] and how do we protect the three prototypes teams' individual IP. That is a challenge but we need to look at how we address that so we can all be in the tent together to develop the concept and then allow those three prototyping teams to develop their solutions.

Once we get down to the analysis of the realistic options, we need to select to a single prototype and then, with innovation in contracting, within six months set the requirements and start the delivery and handover of that capability. This is the methodology that has been developed in consultation with a large number of people in the Defence organisation and with the academia that have specific innovation methodologies. It's our proposal to test this process through an acquisition sprint. There'll be more that will come out on that in the next couple of weeks.

Group Captain Jake Campbell: Looking forward before we wrap up, we're committed to transforming Air Force. The *Program of Work* remediates a lot of our current gaps and gets us thinking about integrated operations as a normal way of doing business. But it's never going to be enough—we still need to continue to look for new ways and better ways to come into the fight and particularly with an emphasis on understanding the threat and how we need to mitigate the threat. It's clear to us, certainly from the CONOPS work and it should be clear from a lot of the speakers we've had in the last day, that for Air Force, air control remains a fundamental part of what we do, but, equally now, information control is important and fundamental to our operations. We're going to be putting a lot of effort into understanding what information control means. What does that mean in terms of the way we manage the electromagnetic spectrum? How does Growler contribute to that fight? What does it mean for cyber? You'll see a project in

the *Program of Work* where Air Force is growing our cyber capability to support the Defence cyber capability. We need to understand how that's evolving and how we can bring both of those domains together—cyber and electromagnetic—to generate a cohesive, coherent information fight.

We need to do that so that we can ensure that for an air force of our size, we are always coming first in terms of decision superiority and we always have the information we need at the tactical level so that we can deliver superior local tactical effects that are more lethal than an adversary. At the same time, we have enough information and systems in the battlespace that mean that our forces have the maximum chance of surviving the fight. But it also means we need to get our head around these things that you hear quite often, like 'big data'. What does that mean? What does that mean to us? We'll be looking at tools, methodologies, academia, and thinking about what that means, how we respond to that.

Another thing I want to talk about is open-systems architecture. Open-systems architecture, in theory, is a way that you can have systems onboard your platforms that mean you're no longer tied to a prime provider. In other words, you can put a box on board, link it to a software-definable radio and an antenna array that can give you whatever wave form you need to come out of that box. And then through changing your applications that are on that box and tapping into the local mission systems, you can continue to outfight the adversary.

Open-system architecture was first thought of as a way of improving cost and availability in terms of sustainment of capability. We're looking at it in the context of what it actually means to the fight and how it helps us win and integrate our force. We'll be doing a lot of work this year on understanding open-system architectures, how we can apply that in the battlespace and what sort of tail it will bring with it in terms of industry's ability to provide all the software engineers that we might need, for example. Our ability to sustain those kind of capabilities, configure manage them, and then have something like Army's LNIC [Land Network Integration Centre] capability where we can test them all as a whole-of-Air-Force system. A lot of work is happening on that this year.

As for 'big data', we need to understand our network, our system, how to fight with it, how to visualise it. This is not our command-and-control system, but I can tell you it looks a lot like it. This is an unclassified version I found on the internet that looks very similar. You look at that and you go 'man that is complex, what have we done to ourselves?' Now, there's a lot of reasons why we've got to that point but you look at that and you go 'well, there's a lot of critical nodes in there'. We need to protect that, we need to fight with it, we need to have operational commanders who can visualise it and understand what's important and what isn't important. So we're going to look at concepts that can do that.

Before we wrap up, I want you to imagine joint combat where every decision-maker has access to every bit of data on the planet, not just intelligence data but every bit of data on the planet.

He has the tools, the experience and the skills to find what's important from that data and use it to make faster decisions. What you're seeing running in a loop, which is going to really bug you after a little while, but that's an example of Microsoft's new HoloLens capability. There are other technologies out there that look similar.

Instead of the football team, imagine that's your air combat capability on the battlespace. And instead of the line showing where the ball is going, that line is showing where your networks are connected. Imagine how much simpler it will be for an operational commander to visualise what's happening in the battlespace, make decisions about the battlespace, and then implement change.

We're looking at new technologies that might help us to get through that sea of data and make faster decisions. We want to get to a point where every sensor in the battlespace is sharing its information with every other sensor in the battlespace, every weapon is connected. We get to a point where we've got intelligence agents on the network that are making a lot of decisions that we currently have humans making so that we can deliver an effect as quickly as we possibly can. To be honest, that's the only way we're going to defeat a contemporary threat, particularly in our region.

What does that mean? Well, we need to understand what that means for rules of engagement [ROE]. What does that mean for rules of engagement where a machine is making some of those decisions and what does it mean for rules of engagement where not only is the machine making those decisions, but the network doesn't just include Australian forces, it includes coalition forces. So our ROE are different depending on the source of the sensor, the source, the weapon and the decider in the battlespace. We're looking at that for this year.

In wrapping up, you've seen what we've achieved in 12 months—just imagine what we can do in the next ten years. That's really what *Jericho* is about—having that top-down design but really importantly having everyone in Air Force and across the joint force thinking about the bottom-up initiatives that can kick us along more quickly. Our ability to win will depend on the success of *Jericho* and this team working together to deliver it.

COMBAT MISSION FOCUSED

AIR VICE-MARSHAL GAVIN TURNBULL, AM

Chief of Air Force, distinguished guests, ladies and gentlemen, thank you for the opportunity to speak.

What I'm going to do is talk about the operational level of Plan *Jericho* and how we are responding at the operational level to the requirements of *Jericho*. I'll stick with the theme of multi-domain integration but I am going to look for the combat-focused way of doing business. I'm going to start with a little historical perspective, and it's probably a little early for the Staff College guys and girls in the room to groan at that but I'm not going so deep that it will hurt. I'm going to talk about the current state of Air Command, and Headquarters Air Command in particular, and then run through some of the operational level responses and the structures that we are putting in place to respond to *Jericho* and to take the command where we need to be over the next 10 to 15 years.

Let's first explore where we were. In the 1990s, we were individual and isolated capabilities deploying in support of our allies. Transport was provided by some Australian forces, and you'll see the venerable, old 707 and the C-130H there on the pictures. We did some air-to-air refuelling in the '90s out of Kuwait and our combat elements were unable to deploy at that period due to coming out of the decade of 'fitted for but not with'. The risks involved in us actually getting involved in combat operations was considered, at the time, a little too great.

As we move through the noughties, we deployed capabilities that needed to integrate into a larger operational command-and-control structure. Essentially, it was provided by the US. We needed help—we needed help to get there; we needed help to operate in the theatre; and we needed help to sustain ourselves. In 2001 when operations commenced in Afghanistan, RAAF provided air defence at Diego Garcia. It's a very pretty place. In the 2003 Iraq War, Air Force deployed three C-130s, two P-3s and 14 Hornets to the MEAO, or the Middle East area of operations. For our combat capabilities though, this was the first time that we had deployed in 50 years and the learning curve was steep. We had lost track of how our allies had developed over the intervening 50 years and some of the things came as a bit of a shock.

Now we have a different story. In 2014, we self-deployed multiple capabilities under a joint headquarters construct and integrate into coalition air and space C2 [command and control]. We joined established coalition networks and we operated the way that we train, in the main. It's a noteworthy turn around for an Air Force that can now self-deploy itself and sustain itself halfway around the globe. So what have we done to get there?

First, we learned some lessons. And I know that's really strange for the military people in the room. We wrote them down but we actually decided to learn some. We paid more than lip service to some of those lessons, particularly the bit about 'train as you fight'. We applied

resources to the outcome, again unusual, and into our raise-train-sustain systems to make it so. We developed habitual positions in our coalition command-and-control organisation—the command-and-control architecture and the organisations behind it, to both support our forces and supplement the training requirements. This is where we put effort and we've provided in this, a strong basis for the future.

Now, we are at the operational level. People will recognise the joint headquarters out at Bungendore—it used to be a sheep paddock. It's got a bad name but I can tell you, having worked in there, it's a great place to work—it's full of motivated people. At the operational level, we are a high-performing, small Air Force with stovepipes of excellence and they are held within our force element group [FEG] structure. Each of the force element groups though, are developing at different rates. They are innovating based on the platforms that they have and whatever phase of transition that they might be in at the time. They are doing upwards innovation from the bottom within their FEGs, or in some cases in response to who might be paying attention to what they're doing.

Each of these force elements though are getting on with the business of raising, training and sustaining jointly enabled, combat forces. They're applying their intellect and professionalism to everything that they do and they're full of smart professional people. But to integrate we need more. We need a means to lead that effort. Future operations and threats will require us to think beyond the 5th generation. We need to be able to operate in the information age and that will demand high levels of integration of our sensing and awareness enterprise—and I use those words very deliberately—the platforms that we fly and the C2 [command and control] that they operate within.

Now these are not new thoughts and we've already heard some of them yesterday and we will hear them again. They're difficult to define though without time to think and we're a busy small air force and we need to take the time, on occasion, to sit down and think.

Let me get down to where the rubber hits the road. Headquarters Air Command. How did we respond at the operational level? Well the first thing that I'd need is a headquarters to help me lead the transformation within the command and the first thing that we needed to do was to give it a mission. We needed to drive that headquarters to think differently, to understand its role in doing so, and this is what we came up with 'An operationally focused headquarters that supports the Air Commander by planning, coordinating and executing Air Command raise-train-sustain activities to deliver the capabilities as directed by the CAF Preparedness Directives'. What we needed underneath that, as most would understand, is a concept of operations and lines of operations. The Army are starting to wax lyrical about the Air Force guy up here talking about lines of operations now, but it is useful inside our headquarters context to do this.

Importantly, the lines of operations that you can see are aligned upwards to the Air Force operating model so that I can critically, along with the Deputy Chief, align everything that we

are doing in a budgetary sense, so that I can justify what I'm spending and why I'm spending it. As you can see, we have strategic planning, capability planning and transition management, and capability management. The first two are primarily operating up toward the strategic level. Capability management is squarely down at the operational level with a long-term hand at the strategic level. Then there's operational planning and execution, and importantly governance, which we cannot avoid and must do.

The CONOPS [concept of operations] describes the effects required. It describes the lines of operation. It annunciates which staff are responsible and it annunciates also the integration requirements of those staffs both upward and downward to make sure that we are coordinated.

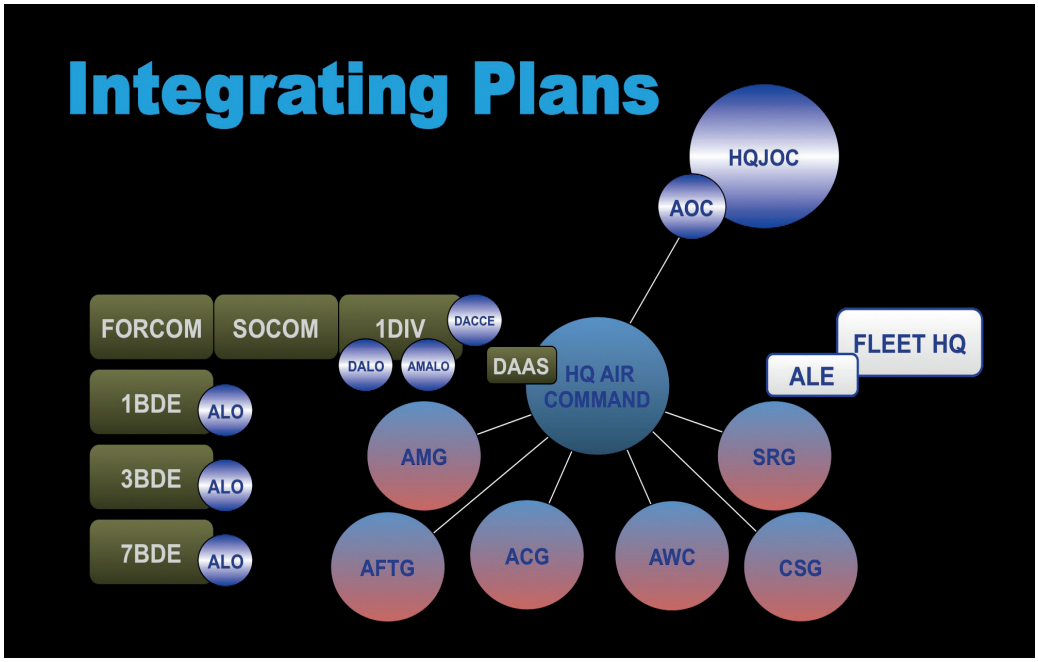


Figure 16-1: Headquarters Air Command's Relationships with Other Services and Headquarters

In integrating plans across Defence and across the command, Air Command staff are clearly aware that they remain responsible for joint collective training and operations planning undertaken within Headquarters JOC [Joint Operations Command], Headquarters One Division in Army, Headquarters Special Operations Command, Headquarters Forces Command and Fleet Headquarters.

Embedded within all those organisations is an air liaison officer network to help us achieve what we need to achieve in that operational space. Embedded within 1st Division, the manoeuvre brigades 1, 3 and 7, and the Amphibious Task Group are liaison officers who are integral to both the planning and execution. The Divisional Air Liaison Officer at the division headquarters and the brigade air liaison officers coordinate RAAF support to Army force generation and they also augment the planning into Deployable Joint Force Headquarters when required. We have an Air Mobility Liaison Officer who is embedded within the Amphibious Task Group staff and in a reciprocal arrangement, the Forces Commander, through his G3 organisation, has a voice inside my headquarters through the Director of Army Air Support. We integrate that Director of Army Air Support into our planning workshop and our Plans Directorate. And I have physically moved them into the building because they were hiding over the road and that was a little bit of kicking and screaming. I also have an officer dedicated to liaising with the Fleet Headquarters Air Liaison element as well.

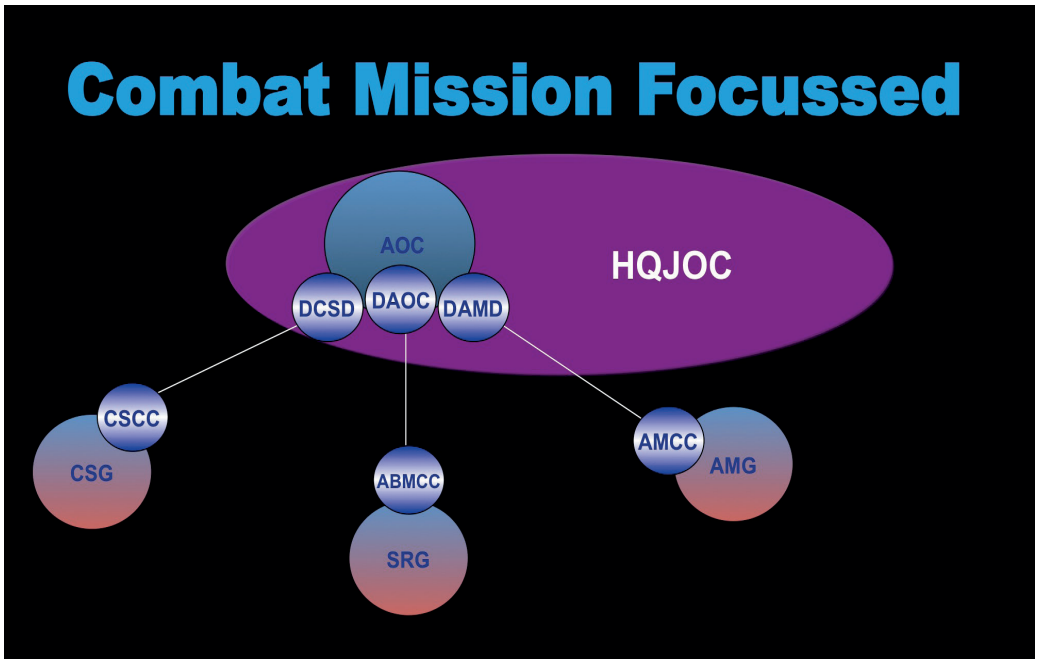


Figure 16-2: Air and Space Operations Centre's Relationships

In 2013, we added to the Air and Space Operations Centre the Director of Air Mobility and that was learning some blatant lessons that we stole from operating in USAF air operation centres about the importance of integrating the air mobility into the cycle inside the air operation centre. This year, Combat Support Division will stand up within the Air and Space Operations Centre. Again, this is

a lesson that we've learnt inside the joint headquarters in that having Combat Support Coordination Centre dislocated is just a little too far away and we needed, at the O6 [group captain] level, support to the Director General Air. Inside Headquarters JOC, that Combat Support Division integration makes sure that we know where our resources are going, how much of that resource we have left, and integrating it into the way that Headquarters JOC, in particular, does their long term planning.

Under this construct, Headquarters Air Command delivers a broad range of planning activities, from supporting deliberate long term planning, to capability transition, future operations and immediate crisis response planning, development, coordinating collective training, mounting forces, deploying and sustaining forces, for short term or long term requirements. The planning activities require synchronisation and coordination of discreet plans to achieve the desired effects and the collective training undertaken is substantial.

In calendar year 2015, Air Force led or supported 160 exercises. Forty five of those were Air Force–led as our core training requirement for the raise, train, sustain of our professionalised Air Force. Twenty Joint Operations Command–led exercises, 22 Forces Command–led exercises, 25 Special Operations Command exercises, 35 maritime exercises including six amphibious exercises, and we supported 13 exercises in Australia from our coalition partners.

The constructs are not all new but they are gaining traction as we seek to support and integrate both Plan *Pelorus* for Navy and *Beersheba* for Army. Providing a vector from coordination to integration though for us, as you've heard, is Plan *Jericho*. We are focused under Plan *Jericho* on developing a fully integrated and seamless force to train, fight, and win in the information age. Our deployment of the Air Task Group, as you have heard, has become an important step forward in gaining operational experience with a combination of forces. We deployed as fighters, tankers, and surveillance assets and we are slowly learning in that theatre how to integrate those three stovepipes of excellence in an operational theatre. We're evolving these operations in light of the relationships between those three platforms. We continue to explore innovation and enhance the ability of each of those platforms to participate in the targeting, sensing and awareness networks under an enterprise construct. We're part way there in some areas but we're a long way from where we would like to be and *Jericho* is going to help us get there.

Whether through *Jericho*-sponsored activities or under the auspices of directives that represent the initial caseload of *Jericho*, as the team mentioned earlier on, the key to Air Command operational integration lies in the Air Warfare Centre. The Air Warfare Centre officially came into being in January 2016. It was officially opened on 25 February this year and we had our Air Force Senior Leadership Team in attendance because it's a significant event. The Air Warfare Centre was created from the basic building blocks of what used to be Aerospace Operational Support Group, the commander is in the room today, but it is already becoming much more than that.

So why build one? There are two statements that drove the creation of the Air Warfare Centre.

- 'Systematically generate solutions in response to current capability deficiencies'. The *Jericho* team alluded to those deficiencies in the 15 programs that are running to fill them.
- 'Our ability to enhance our key relationships, particularly with the UK Air Warfare Centre and the USAF Air Warfare Center.' As a small Air Force, we've been looking at those air warfare centres for more than ten years wondering how we can collaborate and how we can get inside the doors of those organisations. Well, it was simple. We had to have one to be part of that network and now we have one. It's already paying dividends for both, and pretty soon for the trilateral arrangement with the UK and the USAF air warfare centres.

The required outcomes from the Air Warfare Centre are:

- a focal point for bottom-up innovation at the tactical and the operational levels,
- coordinated integrated tactics procedures development,
- live, virtual and constructive environments to do testing (a little bit more on this shortly), and
- coordinated and integrated enabling functions across all the force element groups.

The Air Warfare Centre is already making some of the FEGs [force element groups] uncomfortable. We're in the right place. We're rubbing shoulders inside the hierarchy of those force element groups and there's a little discomfort. There's a little shuffling and that's going to continue. That's about the right level of integration for an air warfare centre. It should not be 'in your face' but it should be there as part of what you're doing all the time—coordinating science and technology research and development across Air Force. They are located in South Australia with a lot of our Defence Science and Technology Group. We need to test future or proposed concepts of operations against our force structure and the higher Defence guidance. We need to collate lessons and actually continue to learn from those lessons and to change our TTPs [tactics, techniques and procedures] in response to them. And we need an optimised structure promoting the exchange of ideas across the ADF.

What is it going to look like? The implementation team travelled to the air warfare centres of the USAF, the UK and Canada. Let me tell you the Canadians were very candid about what didn't work with the stand-up of their own Air Warfare Centre and it was much appreciated. We've built a structure that blended what suited us across the organisation and we outrageously stole a lot of the construct from the UK Air Warfare Centre to get a running start. We looked at the USAF Air Warfare Centre—they've got more people in their Air Warfare Centre then we have in our Air Force and we decided that that structure probably wasn't going to work for us. We then imposed an aggressive schedule to achieve a stand-up of the Air Warfare Centre and the challenge has been accepted. The Air Warfare Centre is now the prime driver for integrating across force element groups. It's 'operationalising' innovation and generating rapid, cogent and integrated

capability solutions in response to our gaps. You'll hear about some of the tactical successes later on this afternoon. It's going to support our raise-train-sustain system, integrating force and produce professional integrated forces for assignment to joint operations. Our ISR [intelligence, surveillance and reconnaissance] enterprise, and again I use the ISR enterprise very deliberately, is refocusing on supporting commanders and responding to command requirements with much gnashing of teeth and grinding.

We are redefining the roles of the Air Warfare Centre Intelligence Directorate and we're changing them from an 'oh look what happened' to 'mmm, so what, what now, what next?' It's a significant cultural change for some of our organisations in the intelligence community but they're starting to embrace it and we're starting to see the results.

Instead, we are now focusing on raising awareness, and I know that sounds reasonably easy to say but it is not easy to achieve and we have a long way to go to get there but it's exciting nonetheless. Where we can really make a difference with our Air Warfare Centre is as we move into live, virtual and constructive [LVC] in the management of our [weapons] ranges. We have very deliberately placed LVC with our Ranges Directorate to make sure that the synergies that we can achieve there, are achieved. It's a key requirement for the 5th-generation, integrated force to be able to have a robust, live, virtual and constructive environment in which to train. LVC cannot and will not be solely focused on the platforms. Again, [that is] why we've put it in with the ranges. It must include the glue that keeps all of our capabilities together with C2 space and cyber capabilities integrated as well as the current and future Navy and Army capabilities.

Our ranges must not only be able to support emerging weapons but critically they need to support LVC test and training. The fidelity required to actually do LVC testing is significantly greater than just having an operating environment and it's going to cost a lot more. Our ranges and future LVC capabilities will provide the operating edge we seek, facilitate experimentation, and allow the testing and employment of advanced capabilities in a secure environment. If you look at the photo down there—for those that don't know, Woomera test range, just north of Adelaide, it's bigger than the UK, it's bigger than Texas. There's not a lot out there right now but it's got a lot of potential. As a nation with space, and we have a lot of that, the air kind—not the non-air kind, we have opportunity but we also have a plan to take advantage of that opportunity.

In the first half of 2017, Air Command will execute the first integrated air warfare instructors course. And again, this is a really big step for us. In the original plan we were thinking that this might work in 2019. No, the team innovated and they said we can do this in '17 and we're going to make this work. The course will bring expertise developed from fighter combat instructors courses, fighter combat controllers courses, fighter intelligence instructor courses with around about 65 years of pedigree and we're going to produce air warfare instructors. Or in the USAF parlance, we're going to produce our patch wearers across a much broader and more integrated course. These air

warfare specialists, with their 62-year history, will accelerate the integration efforts not just within the command but across the Air Force and across the ADF.

The challenges we are facing and overcoming have seen engineers step up and innovate and actually become excited again about innovating. We've seen the emergence of energised staffs that are not afraid to leap into the unknown and find a solution. But we are also developing a system that is tolerant of mistakes—Jake referred to a failure of some of our testing last year. We can't be afraid to fail and we can't be afraid to manage those risks, knowing that we may fail occasionally. We can't punish those that fail. We have to move on, learn from the failure and continue to innovate and bring up new ideas. Our operational deployments have created a cadre of engineers and operators who can see the benefits of trail blazing. Ultimately though, the command at the operational level must focus on producing an integrated force that is agile and responsive.

Air forces must be raised, trained and sustained within the context of government direction and the evolving strategic landscape, and maintain an operational focus. Air Command needs to be led at the operational level, enable innovation at all levels, accept some innovation comes with failure, and seek to exploit that till it sets us apart. We are a small professional air force filled with professional people, and I liked the term 'the Renaissance airmen', and we love a challenge.

HOW INDUSTRY INNOVATION SUPPORTS PLAN *JERICHO*

MR KENNETH A SHAW

Good morning everybody. It's a great honour and privilege to stand up here today to talk on behalf of industry. We've had this great privilege of listening to our uniformed leadership talk about the plans, the strategies; the Minister, and others. And when they asked me to speak on behalf of industry and what we're thinking about, relative to innovation and supporting Plan *Jericho*, I wanted to start with an event that many of you in the audience would resonate with.

Back on 12 December of last year, I had the opportunity to attend operational conversion graduation for Hornet pilots and to be the industry participant there, and to watch the vibrancy, the enthusiasm, the passion of these young pilots as they got their awards and then to sit there and watch the video they put together of their time going through conversion. What I took out of it was that when we as industry are doing our bit, it needs to be focused on the customer. It's easy for us to always say that, but when we think about innovation and *Jericho*, one of the things that all of us in industry need to think about first and foremost is what is innovation and what is value in the eyes of the customer? We've heard earlier today of the successes to date on *Jericho*, some of which we participated in, some of which we did not. But what's important is how all of us in industry think about the customer first when we're thinking about our products, our services, our technologies, as we bring them forward.

As we're talking about people, I want to start with how industry needs to think about the people side of this. We have been fortunate in our organisation that we've been going through some pretty large growth lately and it's mostly in systems and software engineering. When you go walk around our building, you get to see the 22-, 23-, 24-year-olds that are recent uni graduates. But more importantly, when you start to listen to them and their ideas, the way they think, they're a different culture. And when you think about this 5th-generation air force, many of these platforms have their heritage back in the 90's, the 2000's, and they're just now coming into service. And yes, they're the best out there, but how do we innovate them continuously? So I'll talk about that.

As we think about the young men and women of industry, what is industry's obligation? I want to start with STEM [science, technology, engineering and mathematics] because when you think about the *2016 Defence White Paper*, you think about Plan *Jericho*, we're talking about a ten-year vision. So what are we doing in industry, partnered with Government, to ensure we have the talent? Group Captain Mitchell talked about his seven-year-old—how do we make sure they're excited at that age about science, technology, engineering, mathematics, because I would submit [that] the Air Force and the ADF that have been discussed in the last day and a half, and those around the world are in the information age. These kids, whether they be in elementary school, primary school or university, how do we tap into that because they learn differently. And how do we take advantage of that diversity?

The Minister talked yesterday about the Services being at 18.5 per cent female—on their way to 25 per cent. I would submit all of industry is on that same journey. So what are we doing about diversity? And in this case, it's gender, but it's also background, it's colour of skin, it's experience. What are we doing to pull that through so that we have a sustainable industry to innovate, not only tomorrow, but for the next 10, 20, 30 years as these platforms and these fighting forces will be relevant until the next generation of capital acquisitions happen?

How do we partner with universities to do deep research, to take research and information that needs to be the core of the industrial strategies? How do we partner with the Defence Science Technology Group, and people like that, to do what is happening both between the Department and those in industry and those that sit in between? What are we doing with the small-to-medium enterprises [SMEs]? You heard the stories this morning on *Jericho*, how do small-to-medium size enterprises play into the future? We talk a lot in industry about best of industry. We, especially those of us that are large corporations, we need to do our part of pulling the SMEs into the discussion because they have wonderful technology. You know when crypto was talked about earlier, we're partnering with an SME. We actually went across the Boeing company, we went across industry, and the best technology that exists that we can tap into in the world is in SMEs here in Australia. So how do we go and partner and help them along their journey? And that's going to be important as we sustain this momentum.

Then how do we as large companies work together? We often at times talk about the term 'competimates'. The large acquisition decisions have been made. Where Boeing sits, where Lockheed sits, Raytheon, Northrop; those big decisions have been made. So how do we partner with Lockheed Martin to create even more value across and within the battle management domain that serves all the Services? How do we work with Northrop? How do we work with Raytheon? But also, how do we work with the non-traditional aerospace companies—the Googles, the Apples, the Microsofts? And how do we pull them in and take advantage of HoloLens, to name one that was shown earlier? Because when we think about things like 'big data', many of these companies have solved this problem in a different dimension. So how do we take advantage of it? And then how do we learn from what others around the world are doing? Because we need to have that common objective focused on the customer, in this case, today's discussion around the RAAF; but across the whole ADF and across the whole coalition forces.

As industry, we need to start thinking our way through that. We think about locally and there were discussions earlier around acquisition, around risk. We as industry need to start thinking about those types of things because what we're going to have to do in these prototyping environments, in experimentation, is think about how we contract differently where failure is an option if it's controlled, if we learn from it. Because the last thing we want to do is fail in a big way that causes a monumental problem. But just as importantly, we don't want to fail if we don't learn. So how do we create the vehicles to do that? How do we in industry think about reducing risk with our own investments?

We now have a strategic roadmap for the next decade as it comes to the ADF, in terms of the Defence *White Paper*, when it comes to what CAF talked about earlier as far as the RAAF, what we've all heard about on *Jericho*. So there's no reason that we, as industry, cannot now focus our investments in the places where we think we can make a difference for the customer. How do we do that in partnership with the acquisition community? How do we do that in partnership with the Services? The First Principles Review will help greatly. The culture changes that are going on within CASG [Capability, Acquisition and Sustainment Group] will help many of us greatly as well, over time.

Then how do we do this agility with speed? How do we do things in terms of minutes and hours, days and weeks, not months and years? We have all been through acquisition programs where it's taken, from the customer saying they need a capability delivered to getting under contract, that takes years. We have one that we talk about publicly in our organisation that took nine years to go through a competition and then we have another few years of doing the program off record. Was that really necessary, especially when we're doing rapid prototyping, when we're trying to deliver effects for a force that's in harm's way?

So we need to think about, as an industry, how can we be transparent? When do we tell the customer [when] we don't have something, and be intellectually honest with ourselves, especially those of us in the big companies—that's hard to do? Who do we partner with, whether it be small-to-medium size enterprises or the large industries or with universities? Or when do we just tell the customer we're here to support you, whatever you need, but we're probably not part of your ultimate solution and here's why? But here's some ideas that we have from lessons learned elsewhere, either in our company or in the industry.

As we think our way through this, it also takes into account sustainment, and it's been briefly touched on. But these platforms that are just being introduced, have recently been introduced, or will be showing up here later this year, early next year or later the year after, they're going to be in service for decades. How do we put in place a spiral development program that takes advantage of innovation, investment and customer need? And how do we do that quickly so we get the needed capability proven out, whether that be in the laboratory, whether that be a prototype that we fly in an aircraft to prove it out a little bit harder, or how do we get it fielded very quickly through a sustainment program?

We, as industry, need to come to grips with [the fact that] not everything is going to be a big program of record. Often times, these things are going to be many, many small programs to get very effective capability in a very short amount of time.

This whole notion of interoperability—we, as industry, need to think about our own interoperability. We need to look in the mirror sometimes, as an industry, and say 'how do we interoperate' so we can take this collective knowledge, this collective experience, all of our kit, and bring that to the customer and say 'here's a solution that we've worked together on that we

think is better than if we did it independently'? That would be a different way of doing business. And we tend to do that on these large acquisitions, whether it be the long-range strike program where we teamed with Lockheed Martin. Talking about a gut check for two companies, right—two 'evil empires' working together. Now, we didn't win but we still picked the right partner.

But when we're doing spiral development under *Jericho*, how do we do it quickly? And when we put a piece of kit on an aircraft or we connect with a network, do we really care who's providing it or how we deliver the capability?

I, too, really like this notion of the renaissance airmen that came up yesterday and around education, the STEM tie, when you talk about experimentation, when you talk about experience, but just as importantly is passion and innovation. That's what industry needs to come to bear to help with *Jericho* and help with this whole interoperability situation.

What are we trying to do as a company? I talked about what industry needs to do—now let me give you a little bit of a lens into what we are trying to do as a company. We just had a team that spent the last three weeks canvassing the Boeing company trying to figure out what capabilities we either have ourselves or [have] access to across our broad network. They've come back now and that's starting to help inform our decisions on where we invest. We've added considerably to our investment funds focused around interoperability. Not only just *Jericho* but interoperability across all the Services, across the ADF, because that's a space where we think we can play. Certainly, when you look at the platforms that we have that are in the air domain, the space domain, but also in the land domain with network programs we have going on and the Army domain with our platforms, we have to take a serious role in interoperability. Then, how do we connect with the right people? How do we bring the right people in if we don't have the capability around cyber? We have the largest hack network in the United States as a company. We do a little bit around cyber internally, but how do we bring that to bear? We have our CIO [Chief Information Officer] coming out in a couple of months to really help us think our way through cyber. Have we got it right here in the application domain?

Big data. We had our 'big data' leader, Dewey Houck, in last week spending time with the team thinking through how we should do it. Also thinking through how we partner with small-to-medium size enterprises in that domain and then where we, as a company, make investments that are broader than just Australia. Should we be doing things in Australia that are exportable back to the United States and to the allied countries because we might have the right workforce here, we have the right cost structure, and we have a pull from a customer that we can immediately demonstrate an opportunity?

I say that because we're trying to be as transparent as we can which is hard for industry sometimes, right? Because we all worry about our business plan, we all worry about our financials, we all think everything is double top secret, but everybody in this room knows what everybody else is doing right? How do we just put it out there? And we now have a roadmap

from the customer, from Defence, from the Prime Minister, of where we're going. So how do we take that roadmap? How do we get to the next level of interoperability integration? And then how do we do it quickly? How do we take advantage of rapid prototyping and what are we doing across industry? That's an area we're trying to figure out ourselves in certain domains but it's also an area where we've done programs, as has everybody in industry, in months or a year or two that sometimes have taken five or ten years because we've taken a different approach to what needs to be fielded. We need to get it out there. What do we need to do collectively, from the user, to the contracting organisation, to the provider, to get focused on one objective? If we can all come together with one common objective, the power of industry to support the RAAF, to support the ADF, and to support the coalition forces, is very, very powerful.

I would like to end as we in the Boeing Company are actually in our centennial celebration—we're in our 100th year of existence. The Chief talked yesterday about the RAAF coming up on its 95th year, so we're a little bit ahead.

To close, I'd like to show this one quote from Bill Boeing, our founder; 'No-one is to dismiss any novel idea with the statement that it can't be done'. For us in industry, the question I ask you is 'why can't we work together?' Why can't we focus on value in the eyes of the customer? What are we doing to get it done to support not only Plan *Jericho* but interoperability across the Services, multi-domain? You heard it in spades, from sea to air to land to cyber to space. And then how do we fold in the human element which is going to be the sustainability of how we do this for the next generation and the generation yet to come.

REFLECTIONS FROM CURRENT OPERATIONS – OPERATION *OKRA*

GROUP CAPTAIN STUART BELLINGHAM, CSC

Good afternoon distinguished guests, ladies and gentlemen.

It was a Friday evening at about 1800 hours in early September 2014 when I was sitting at my desk in Headquarters Joint Operations Command wondering why the usual Friday afternoon crisis hadn't arrived, when my phone rang and the Deputy Commander Joint Operations (DCJOPS) summoned me to his office. DCJOPS informed me that an Australian air task group was to depart Australia in just over a week, headed for the Middle East. The mission was to conduct strike, airborne command and control (C2) and air-to-air refuelling (AAR) as part of the US-led coalition that had been formed to disrupt, degrade and destroy Daesh. The Joint Operations Command (JOC) Air and Space Operations Centre (AOC) led the response. Eight days later, the Air Task Group (ATG) was wheels up and on its way as directed. It was established in its forward operating base within 14 days. The ATG was conducting initial flight operations within 21 days and conducting effective close air support, strike, airborne C2 and AAR operations over Iraq within 28 days. The Air Task Group has been deployed on operations since September 2014 and is engaged in combat operations as I speak to you today.

It is a privilege to have the opportunity to talk to you about my experiences and associated reflections from current operations. My involvement in recent operations has been from two perspectives: as Director of the Australian Air and Space Operations Centre (DAOC) within Joint Operations Command from January 2014 until July 2015 and as the Commander of the Australian Air Task Group on Operation *Okra* from July 2015 until January 2016. Operation *Okra* is the name for the Australian Government-directed mission to disrupt, degrade and destroy Daesh as part of the US-led coalition. It is more broadly known, within the coalition, as Operation *Inherent Resolve* (OIR). My deployment as Commander of the ATG was, without reservation, the highlight of my career. One of the reasons it was such a positive experience is that we, as an Air Force and as the Australian Defence Force (ADF), are extremely good at what we do. We make the complex appear simple and the difficult seem easy. My intent is to provide you with a basic understanding of the ATG structure and roles, to review the success of ATG operations and briefly examine some of the reasons for that success.

It is important to note that Headquarters Joint Operations Command at Bungendore and the Australian Joint Task Force based in the Middle East Region, are a key part of the ATG success. However, I do not intend to address these headquarters in my discussion today; rather, my central point of discussion will be the ATG, air power and Air Force.

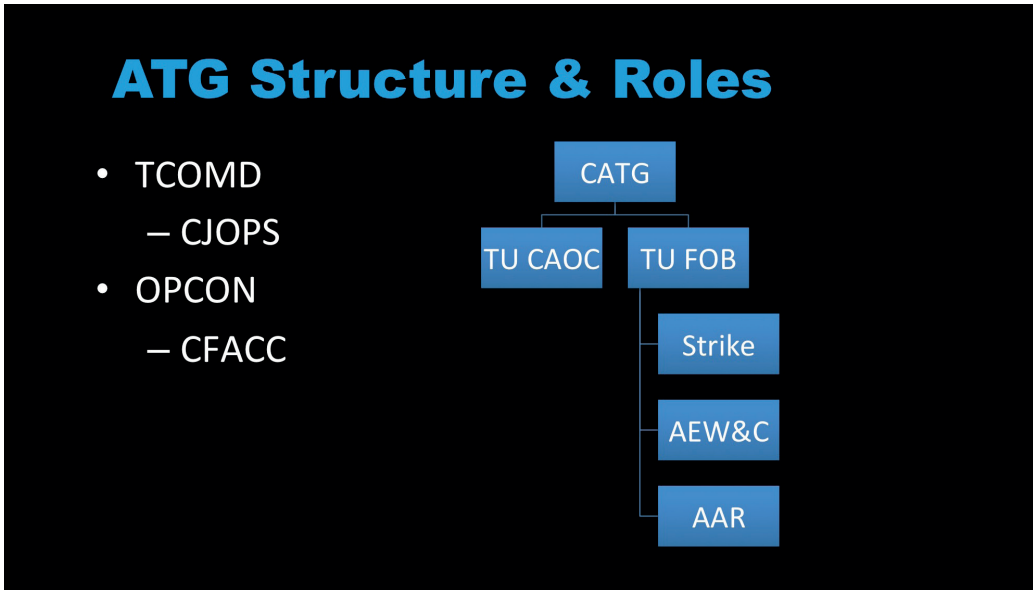


Figure 18-1: Air Task Group Structure, and Command and Control

The Air Task Group operates under theatre command of Vice Admiral (VADM) David Johnston, Chief of Joint Operations (CJOPS) JOC, and under operational command of the US Central Command (CENTCOM) Combined Force Air Component Commander (CFACC), General C Q Brown. The Air Task Group contribution to the CFACC's air order of battle are the F/A-18 Hornet (six aircraft), the Wedgetail E-7 airborne early warning and control (AEW&C) aircraft and the KC-30 multi-role tanker transport and air-to-air refuelling (AAR) aircraft.

The ATG consists of approximately 300 personnel who perform duties spanning, command, planning and liaison, deliberate and dynamic targeting, legal, engineering and logistics, intelligence, administration, current operations and communications. These functions are performed across group, wing and task element levels. I would liken the ATG, in US terms, to a mini–expeditionary air wing.

Since deploying, the Air Task Group statistics, up until the end of January 2016, are:

- F/A-18: sorties 1179, hours 8748, munitions 867,
- E-7: sorties 185, hours 2267,
- KC-30: sorties 534, hours 4255, fuel 43 million pounds.

Mission success rates sit in the 95–98 per cent mark across all three platforms. The statistics are impressive but they don't tell the whole story. Some factors that are worth considering include: this is the first composite air task group that we have deployed on combat operations in a long time; the initial deployment saw the first operational employment of Super Hornet, Wedgetail

and the KC-30; the transition to operations was rapid; the battlespace is dynamic and complex; the deployed force is 10 000 miles away from the national support base; the enemy is adaptive and does not operate under any recognisable rules; and the summer was brutal. In addition, the ATG has operated in a constantly evolving environment and has managed an evolving mission. During my deployment, the area of operations (AO) transformed with the arrival of Russia into Syria, and Turkey into the coalition with the subsequent 'shoot down' of a Russian aircraft. Also, during my tenure as Commander ATG, the ATG mission transformed with the Australian AO [area of operations] extending to include operations over Syria. We were definitely challenged in many areas.

I remember one conversation in particular with my Senior Intelligence Officer (INTELLO), during which he remarked upon the fact that no scriptwriter could have dreamed up the level of complexity and daily 'excitement' in which we found ourselves. Reality is truly stranger than fiction.

The ATG is making a difference in the fight against Daesh. Even though the ATG provides only a small portion of the coalition air power in the Middle East Region, the ATG makes a useful and critical contribution to CFACC's daily Air Battle Plan. The ATG continues to perform at an exemplary level and whilst small, it has established an excellent reputation within the coalition across fighter, airborne C2 and AAR operations.

The ATG's rapid, successful transition into Operation *Inherent Resolve*, highlights a number of aspects that are worth examining. The initial deployment of the ATG was an extremely challenging and complex task but it was successful, and more significantly, it was made to appear relatively simple and easy to the casual observer. The ATG met all of its directed milestones as it transitioned into combat operations and all platforms and crews executed their initial missions successfully. One of these initial missions stands out. It stands out not just because I am now the Officer Commanding No 42 Wing and responsible for the outstanding capability that Wedgetail AEW&C represents, but because it demonstrates that as an Air Force, we have developed outstanding capabilities that are primed and ready for complex combat operations with little additional preparation required.

The first airborne C2 mission by the Wedgetail was meant to be a 'shadow and monitor' flight to enable the crew to fully understand the complexity of the OIR battlespace prior to 'going solo'. As it turned out, the USAF E-3 went unserviceable and the Wedgetail picked up the ball and ran with it straight away. My intent was to have one of the original crew from that flight provide this conference with a 'war story' but he was unavailable. My understanding is that on flight one, in an extremely complex environment controlling coalition aircraft across Iraq and Syria, the Wedgetail seamlessly integrated into CFACC's Air Battle Plan and made it work. A reflection by one of the crew who was on that flight was that 'it was just like a mission from the Red Flag playbook only it lasted for 12 hours without a break'.

To further highlight the success of the ATG, and the ease with which it appeared to achieve its mission, at one point during my deployment I had the distinct impression that some people felt that the F/A-18 mission was fairly rudimentary and simple. The following is a typical profile of one of these F/A-18 flights.

- Transit two hours to get on station in all weather, day and night.
- Operate in congested airspace with coalition aircraft, Iraqi aircraft and others.
- Maintain constant vigilance above a hostile enemy who engaged coalition aircraft with surface-to-air fires on a regular basis.
- Release weapons against an enemy who were in close proximity to Iraqi Security Forces, often in a troops-in-contact, dangerously close situation.
- Target an enemy who routinely operated from within LOAC [Law of Armed Conflict] protected entities or from within areas that presented significant collateral-damage issues and ensure that the weapons effects aligned with CFACC Special Instructions, LOAC, ADF Rules of Engagement and the ADF Targeting Directive.
- Extend on station by up to two hours and then transit another two hours home to land safely, sometimes having completed 6–7 AAR plugs along the way.
- Finally, deal with an inflight emergency that required an engine to be shut down and the aircraft to divert into a suitable safe airfield.

There is no doubt that I have actually understated the complexity and intensity of the ATG operations in my attempt to describe a typical F/A-18 mission, but hopefully, you can agree with me that this is a demanding and challenging mission and not simple in any respect. That some people believed it was a simple role is really quite a flattering perspective because it demonstrates what a superb job the ATG was, and is, doing.

So why is the Australian Air Task Group successful? It is my belief that the foundation for the ATG deployment in September 2014, the subsequent rapid transition to operations, and the ongoing success of the ATG is underpinned by how we, as airmen and airwomen, understand our business and how we translate that understanding into effect. I believe it is the professional mastery of air power that we have developed as an Air Force, and the application of that understanding, which has underpinned the success of the ATG.

Dr Sanu Kainikara, in his working paper titled *Professional Mastery and Air Power Education*, published by the RAAF Air Power Development Centre in 2011, provides the following insight into professional mastery of air power:

> An overarching and critical factor in the generation and application of air power is the professional mastery of its practitioners, which will determine the success or otherwise of all air operations. Air operations must be carefully tailored and integrated into the joint campaign, which in turn should be guided by national security strategy. This can only be achieved by an air force with sufficient professionalism and resident skills that enable it to adapt rapidly to emerging and dynamic situations.

Whilst it is the professional mastery of air power that I believe has been the source of ATG success, in my subsequent analysis of some of the elements that contributed to the ATG success, the themes of Plan *Jericho* are evident. Listed below are the themes of Plan *Jericho* for those who are not familiar with this Air Force plan:

- harness the combat potential of an integrated force,
- develop an innovative and empowered workforce, and
- change the way we acquire and sustain capability.

I should point out that the aim of my discussion was not to address Plan *Jericho*. Equally, I did not set out to espouse how masterful we are as an Air Force in our understanding and application of air power. However, when I began to plan my paper, their inclusion became a natural association. This tells me that Air Force is on the right track with its current force generation and onto something quite significant in Plan *Jericho*.

Some of the areas that I consider critical to ATG success that reflect the application of the professional mastery of air power by airmen and airwomen are as follows.

- **ATG Command and Control (C2) construct**. The bottom line is, that when the ATG C2 model and structure was designed, it was by people who had an advanced understanding of the application of contemporary air power. From a C2 perspective, the focus point for successful integration of the ATG into the coalition was, and is, the combined air operations centre (CAOC). Those who designed the ATG structure, understood C2 of air power and set the foundations for success through their design of the ATG team within the CAOC. Some aspects of the C2 model worth noting are:
  - **Commander ATG**. Commander ATG (CATG) is positioned within the CAOC under OPCON (operational control) of CFACC. Of note, the CATG position was established as a one-star (air commodore) so whilst I am now wearing group captain rank, I did have my six months of glory. The location of the Commander of the ATG was a pivotal

aspect for success. As a one-star CATG operating from within the CAOC, I had direct access to the CAOC Director, Deputy CFACC, CFACC (sometimes) and I had a voice and influence within coalition discussions in the CAOC that directly impacted on ATG operations.

- **The ATG Team in the CAOC**. The team within the CAOC consists of a dynamic-targets red-card holder, a command legal officer, a command senior intelligence officer, an intelligence (INTEL) team, a dynamic-targeting team, liaison officers for [each of] the ATG aircraft, ATG representatives within the CAOC Target Effects Team and the CAOC Dynamic Targeting Team plus essential communications, logistics, and administrative personnel. The design of this team provided the foundation for successful integration into the coalition. The team that I had within the CAOC ensured that the ATG was connected with the right elements of the ATG, CAOC, CJTF-OIR, CENTCOM, JTF633 and HQJOC such that I was able to successfully conduct the flying/fighting aspects and, concurrently, keep commanders' situational awareness at the right level most of the time.

• **The selection of innovative and empowered people to fill key positions within the ATG**. One of the themes of Plan *Jericho* is to encourage innovation and empower the workforce. In terms of our people and their suitability to translate commander's intent into a successful mission, the Air Force personnel who I served with were extraordinary and a very positive manifestation of the Air Force culture, the personnel model and our training systems. Combined and joint organisations that I have been involved in have been successful due to the ability of people within those organisations to understand commander's intent and translate that into outcomes. My team were constantly seeking ways to innovate and improve our operations and I can unequivocally state that there is not an area of the ATG that did not excel in their ability to do this. These are a few examples.

- **Information processing**. My INTEL team had their capacity to process information severely tested by the ever-changing environment. My INTEL team was not designed for the scenario that we found ourselves in, but through determination and innovation, they rose to the challenge, adapted their processes and continued to over-achieve.

- **The environmental conditions**. I can unequivocally state that they were extreme. Actually, a more appropriate description is brutal and oppressive heat. In a deployed environment, the ATG implemented innovative and effective environmental controls to ensure that personnel were protected and mission success rates continued to remain unaffected through the summer.

- **Daesh tactics**. The tactics, techniques and procedures (TTPs) of Daesh exploited collateral damage concerns and, where possible, exposed civilians and protected entities. The ATG implemented mixed-weapons loads, incorporating low-collateral weapons

when appropriate to minimise possible collateral effects. These low collateral weapons were employed on numerous occasions with good effect.

- **The foundation for joint and combined integration**. Another theme of Plan *Jericho* is joint and combined integration. One area that I was acutely aware of as a source of ATG success or possible failure was our ability to integrate into both coalition and joint organisations. A few notable aspects that were key to this integration were:

  - **Coalition training and tactics, techniques and procedures** (**TTPs**). I provided an example earlier highlighting the success of the first Wedgetail flight over Iraq. One of the important factors contributing to the successful integration of Wedgetail on this first mission was that the crew was effectively just flying another Red Flag mission. We like to think of it as Red Flag mission number 11. They had previously experienced the same complexity and workload (albeit for shorter durations) and they understood how to employ their weapon system at an expert level within this environment. All of the ATG aircraft were equally successful in this regard due to previous opportunities to exercise with coalition partners.

  - **Relationships.** The 'relationship factor' was essential to success on initial transition into operations and arguably more important to the ongoing sustained integration of the ATG. Relationships that cannot be built in a few days and relationships that have enough depth to survive the stress, fatigue and confusion of combat operations are vital. They are relationships which have been developed and strengthened through years of close cooperation— built from exchange postings, international engagement forums, postings to joint organisations such as Joint Operations Command and involvement in exercises and training across the globe. The overall effect of the Air Force programs that are in place to support the generation of RAAF air power through involvement in exercises, exchanges, joint postings and international forums is that we are prepared to deploy at short notice and integrate quickly and effectively.

  - **Doctrine.** This may appear to be an obvious consideration but again the ATG succeeded with a rapid transition into operations and effective sustainment of operations because we knew how to work with our coalition and joint partners. As I alluded to in my opening personal perspective of the rapid transition, there was no time to work up crews and conduct extensive mission rehearsal exercises. However, despite this, we still transitioned quickly and integrated seamlessly into the coalition with very little fuss.

  - **Hardware, software, platforms, communications and weapons.** Another seemingly obvious aspect for successful integration was the compatibility of the ATG's aircraft, communications standards and weapons. The aircraft fused very easily into the coalition battlespace and were clearly able to value add to the CFACC's Air Battle Plan from Day 1.

- **Ground Liaison.** In my position as Director Air and Space Operations Centre (DAOC), when the ATG first deployed, I advocated the requirement for ground liaison personnel to be embedded within the ATG. As a result, two positions were established within the ATG for ground liaison personnel. Without these two positions, the ATG would not be able to integrate into the coalition as effectively as it did. They provided an essential line of communication and understanding into the Combined Joint Task Force–OIR agencies which ensure ATG command and aircrew have the best possible understanding of the battlespace and how to operate optimally within the battlespace.

Improvements and the way ahead

I have provided my perspective on why I think the ATG is successful. Largely, I have glossed over the indomitable spirit of my colleagues who have served in the ATG from day one through to today. What I mean by this is that the ATG path has not been perfect and the success of the ATG has only been possible through a lot of 'blood, sweat and tears' from a lot of dedicated and highly professional airmen and airwomen.

My deployment as Commander ATG was a positive experience and the pinnacle of my professional career. The success of the ATG reflects Air Force's professional mastery of the generation and application of air power and reflects the main themes of Plan *Jericho*. There is always scope to improve, but my experience as Commander ATG tells me that we have the right foundations for that improvement, and Plan *Jericho* is an excellent initiative that is ideally focused to deliver this improvement.

TOP–DOWN DESIGN MEETS BOTTOM–UP INNOVATION

GROUP CAPTAIN JAKE CAMPBELL

Thanks everyone. I'm not going to take a lot of time because I really want to get to the presenters. I just wanted to weave the thread, if you like, of where this fits into the broader *Jericho* program.

This morning, you heard a lot about the top-down design element of *Jericho*, the *Program of Work* and how that's coming together from Air Force Headquarters, the Air Command Headquarters and down. But there's been a lot happening across the field in the bottom-up side of the house—people getting on with business and helping to improve their foxhole, if you like, by themselves.

You've also heard though, plenty about empowerment and innovation, and how that is so important to operations. Group Captain Bellingham's brief before lunch was a fabulous way to weave that part together.

But what we want to show really is what can happen while you're not on operations. We don't want to have to wait until combat operations begin before we start innovating and changing capabilities so that we can meet that operational requirement. We want to start it happening as normal business across the organisation. So you're going to hear from reps from across a cross-section of our force element groups (FEGs). They'll give you their experiences in delivering bottom-up initiatives through a 20-minute snapshot from each of those FEG representatives.

While you're listening to them speak, I ask that if you're in a leadership role across the organisation, think about how you can help empower your people to deliver innovation and capability upgrades while you're not on ops; not only while you're not on ops, obviously while you're on ops. But again, normal business; get this to normal business.

If you're a worker, think about how you can support your leadership in coming up with innovative ideas, thinking about better ways of doing business and then flowing those ideas to your leadership so that they can then empower you to get on with innovating.

SYNCHRONISING PLAN *JERICHO* WITH A CAPABILITY TRANSITION–NO 92 WING EXPERIENCE

GROUP CAPTAIN PHILLIP CHAMPION

On the screen, you can see a live FMV [full motion video] feed from a P-3 currently on station in the vicinity of Seymour, Victoria. We tested this recently with South Australian Police as a multi-agency *Jericho* initiative. This line of effort fits into the command and control (C2) theme in the *Jericho Program of Work* which encompasses unclassified connectivity with other Government agencies and non-government organisations. This was all driven bottom-up within No 92 Wing (92WG).

Firstly, the 92WG *Jericho* experience is centred on understanding the context of the moment. We were undergoing a capability transition from the AP-3C [Orion] to a P-8 [Poseidon]/ Triton family of systems. However, for a period of 2–3 years in the interim, we will have P-3 and P-8 as a mini family of systems. To understand and capitalise on the context of the moment, you also need a solid understanding of the end-state. We understood that while Project Air 7000 would deliver us the hardware, it would not deliver the organisational culture and innovative mindset required to enable it—*that was No 92 Wing's challenge*. No 92 Wing needed to be a faster and flatter organisation which networked and informed our people. We needed to generate capability with a qualitative edge by empowering our people to lead and to make decisions at all levels. An innovative and empowered workforce will then naturally exploit opportunities and drive connections and improvement. While understanding the laws of physics associated with the quantitative aspects of project delivery, *Jericho* inspired a qualitative dimension where, through innovation and experimentation, we could exert influence over capability inflection points.

Secondly, the thing you may notice is that I am not going to talk up-front about technology and new capability. Through necessity, the 92WG *Jericho* experience during transition has principally centred on empowerment, innovation and collaboration. The FMV 4G feed you see on the screen all occurred as bottom-up innovation. The appetite for a large amount of dollars to be exhausted in P-3 space on new technologies as the platform's planned withdrawal date approached was obviously low. Therefore, we quickly realised that targeted initiatives for the P-3 must be focused on areas that can enhance current capability at relatively low cost and can assist the introduction into service of P-8. A resource-constrained environment is not always a bad thing and can be quite empowering. In No 92 Wing's case, it allowed innovation to foster and prevented any temptation to instinctively outsource innovation or to confuse it with existing lines of effort within established capability roadmaps.

Thirdly, the synchronicity of Plan *Jericho* with our capability transition has been beneficial. Our capability transition required transformational change across all areas of our organisation and *Jericho* provided a qualitative roadmap. Just focussing on the quantitative project elements would deliver us a more reliable P-3 with two jet engines. Although there is often a natural temptation to focus innovation on technology, our innovation strategy by virtue of transition needed to be more far-reaching and integrated across all elements of the fundamental inputs

to capability. For example, we needed to introduce contemporary Air Force practices such as a co-operative capability management program with the US Navy and more emphasis on an industry-integrated workforce. Although essential to our future success, some of this was going to challenge the wing's traditional paradigms. Deliberate change management and effective communications are essential.

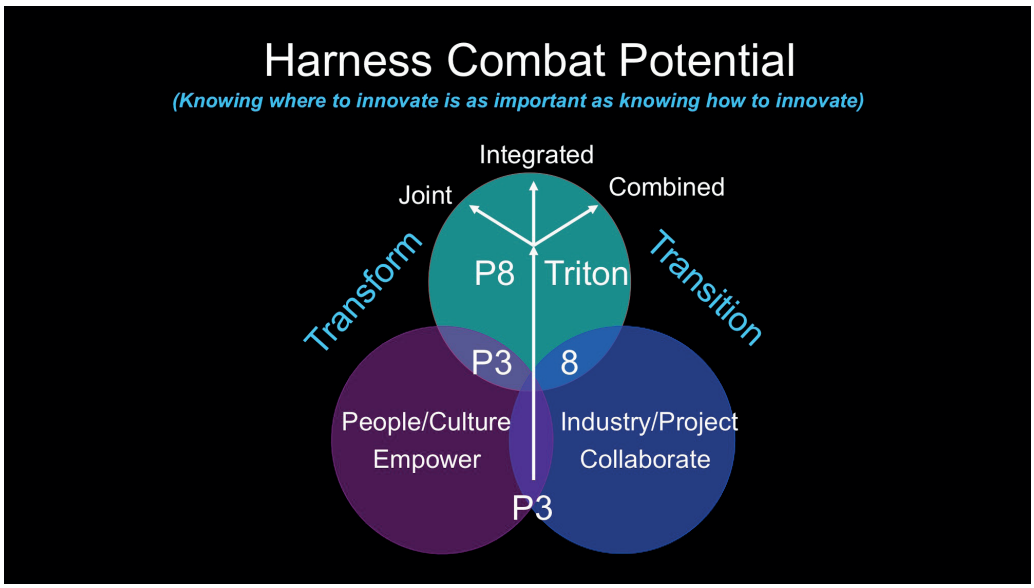


Figure 20-1: No 92 Wing Innovation Strategy

If I could summarise all of the above with a *Jericho* 'so what', it would be: You need an innovation strategy which reflects your moment in time, ie, innovation for what purpose? You need to know where to innovate, as this is just as important as knowing how to innovate. You need to balance the three *Jericho* themes as they mutually reinforce each other and you need some formalised change management and a communication plan.

No 92 Wing re-badged 'improvement' to 'innovation' and developed an innovation strategy. The 92WG strategy is all about the context of the moment. With the P-3 now out of the MEAO [Middle East area of operations], agreed flying hours reductions to accommodate transitional overheads and planned withdrawal date approaching, I was presented with latitudes and opportunities that previous management were not. Breaking it down into plain language, 92WG's innovation strategy is about aggressively leaning into P-8 operational assimilation, while continuing to internally build resilience and capacity in P-3 space as the fleet reduces for as long as it is necessary. There are innovative options available as a fleet reduces that would not have been available a few years before and I will go into some of these soon. Independent of the terms IOC [initial operational capability]

and FOC [final operational capability], it is about challenging pre-existing assumptions and exerting influence over the capability inflection points where P-8 takes the mantle from P-3, role by role.

We recognised 2017 as a risk year. We were digging deep into transition with overseas training in full swing in 6-month blocks. The efficiencies of the new platform were yet to be fully realised and the P-3, as an ageing and maintenance-intensive platform, was running hard on operations. Therefore, we needed to quickly develop smart and innovative options to build resilience on operations, while not necessarily pulling back the 'raise, train and sustain' throttle too far, as this would atrophy crew proficiency in the lead up to the transition. Many advanced warfighting skills are platform generic, so what we did in P-3 space would transition into and enhance P-8 space. So what did we do?

Firstly, we drove empowerment by flattening C2 [command and control] structures. As an ageing platform, maintenance is the P-3 limiting factor. We chose to flatten structures in maintenance by devolving the wing approved maintenance organisation (AMO) down to squadron level. We needed to do this in preparation for the P-8, but I would have done it anyway as it simplified a convoluted C2 structure, empowered squadrons and provided the commanding officers with the resources they required to deliver capability. The squadron-level AMO generated ownership and we yielded almost immediate serviceability and availability dividends, which have been sustained.

Secondly, from one of our recently retired aircraft, we introduced a non-flying static aircraft, maintained by industry. In the past, approximately 1600 hours per year were being apportioned to ground static aircraft against otherwise flyable/line aircraft. This initiative allowed these statics to be apportioned against a dedicated static training aircraft, thereby preserving valuable line aircraft for flying duties. The static aircraft is oversubscribed for aircrew and maintenance with important tasks such as heavy weapon loading qualifications, et cetera. It has also been utilised as a *Jericho* test bed for things such as wide-band HF trials and open system architecture trials. This has been a high-dividend initiative and reinforces the importance of understanding the context of the moment, as there are opportunities when retiring an aircraft that may not have been thought possible just 2–3 years prior.

Thirdly, we embarked on a program aimed at exposing the workforce to modern technologies and practices. Industry collaboration became more robust and we explored opportunities to leverage 'white space'. We viewed the interim-sustainment support contract (ISSC) which was under negotiation for P-8 introduction as an opportunity for experimentation. Importantly, we ensured that Logistic Branch was fully engaged in the ISSC process and the subsequent transition to the through-life support contract. The aim was that by the time we get to P-8 FOC, we would have already experimented. We would have a common organisational sight picture with Air Force Headquarters and Logistic Branch and would know where efficiencies could be leveraged.

In conclusion, the three areas of:

- flattening C2 structures to generate empowerment,
- P-3 static aircraft initiative, and
- a tighter coupling with industry, particularly the use of 'white space'

have all coalesced and together have led to increased resilience in P-3 space, while setting us up for both P-8 transition and broader transformation.

AIR MOBILITY CAPABILITY ENHANCEMENTS – ACQUISITION AND SUSTAINMENT IN THE SMART PHONE ERA

GROUP CAPTAIN STEWART DOWRIE

Chief of Air Force, Air Marshal Davies, distinguished guests, ladies and gentlemen.

As introduced, I'm here to talk about what Air Mobility Group has been doing over the last 12 months, and indeed, stretching back even further, 24 months in the pre-*Jericho* time. And while the bulk of my presentation is aimed at providing that information to you, I also want to provide a few lessons learnt at the end; perhaps some thoughts, some reflections, even some questions about what it means to be conducting acquisition and sustainment in the smart phone era. Our experience in AMG [Air Mobility Group] has been that there's a lot of analogies that we can draw between the spiral type of technologies that exist in our pockets every day, and what we need to do to transform Air Force in line with the intent of Plan *Jericho*.

Certainly, it had been clear throughout 2015 that *Jericho* was driving, not just a lot of different work, but also providing a lot of opportunities in our business at Air Mobility Group. When combined with the other transformational activities that had been occurring over the previous three to four years under SRP [Strategic Reform Program], through improvement programs and innovation programs, it became necessary to draw those threads together and to express them as a single narrative so that the members of Air Mobility Group could clearly understand and articulate where we were going as a FEG [force element group].

Figure 21-1: Air Mobility Group Jericho Activities

This diagram is a very high-level view of that particular narrative, with a number of lines of effort that we are currently undertaking. Today, I'll take you through a very small cross-section, a very small sample, of what those activities look like. And the first one that I want to touch on is LVC [live, virtual and constructive simulation], which the Air Commander Australia alluded to earlier, was one of the key activities under *Jericho* and where there's some very exciting opportunities lying ahead.

Last year, the C-130J participated, for the first time, in Exercise *Coalition Virtual Flag*. The pictures you see on the screen are in fact the crew at about two or three o'clock in the morning, flying as a virtual aircraft on that exercise, which, for those of you who are familiar with it, meant flying as a synthetic target amongst 100 live aircraft on Exercise *Red Flag* in Las Vegas, Nevada. That trial worked very well and No 285 Squadron are currently doing the work to seek permanent accreditation, along with our industry partner in this particular event, CAE [CAE Australia Pty Ltd], to ensure that we can repeatedly participate in that exercise. And I'm aware there's many other aircraft types across Air Force that are seeking to do the same.

We've also been working with Northrop Grumman, another industry partner, to see if we can access the United States Air Force Mobility Air Force's Distributed Mission Operation (MAF DMO), which is another LVC network that may be available to AMG to participate in a range of different (simulated) training opportunities and activities.

In [Exercise] *Talisman Saber* in 2015, the C-17 mass formation airdrop was rehearsed by all the USAF aircraft through the MAF DMO. There was only one aircraft and one crew that didn't participate in that rehearsal and that was the Australian C-17. So we're investigating in partnership with Northrop Grumman to see what we can do to get access to that training environment. Unlike *Coalition Virtual Flag*, which runs a handful of times per year, the MAF DMO is online 24-hours-a-day, seven-days-a-week; and we hopefully will get the opportunity to participate, and not just with our C-17s. Indeed, we are also working with CAE again with both the C-130 and with the KC-30A to use the MAF DMO; because one of the exciting opportunities that that environment offers us is to do things like virtual air-to-air refuelling. Again, another exciting activity with lots of opportunities.

The next area I'd like to hit is also another training line of effort, our Air Mobility Mastery work stream. Again, there is a long way to go with the professionalisation and integration of our workforce (across Air Force) as a whole. But before Air Mobility could truly step into that domain, there was the need to critically look at our C-130J training, which had been languishing in a late '90's and early 2000's method of delivery. Along with some very long-needed syllabus redesign, we now have the latest in CBT [computer-based training] hardware, offering something a little bit more than just the basic PowerPoint click through a presentation. Working with CAE, its parent company CCC back in Canada, and with Lockheed Martin, we're in the process of delivering something that finally looks like it belongs in the second decade of the 21st

century for contemporary Air Force training. The net result will be C-130 pilots and technicians who come off course far quicker, far better equipped to be able to deliver the effects they need to now and better positioned to be able to deliver the next level of training that will be needed into the future.

Capability development has been a very busy part of AMG's business across all of its fleet; a small sample of which you've seen demonstrated in the foyer out here and in the foyer of R1 [Russell Offices] over the last week. It's also been demonstrated in a live sense on various C-17 sorties over the last year. This is the AirView 360 planning system; and in combination with wideband and narrowband SATCOM [satellite communications]—wideband having been fitted to two of our C-17s now and we're hopeful the rest will get done over the next few years—and the extant L-band narrowband satellite communication system, which through a Viper terminal, has allowed for encrypted DRN [Defence Restricted Network] and DSN [Defence Secret Network] communications. This provides the opportunity for our embarked forces, and by embarked forces, I don't mean just Army—I mean anybody who travels in the back of a C-17—to be provided with the latest in situational awareness. This means they can make the best decisions they possibly can and be provided with the opportunity to plan and execute missions airborne, such that when they step off the ramp, they are able to do their job to the absolute best of their ability.

In Air Mobility Group, that's what it's all about. The people that we carry are our weapons system. It's our aim to make sure they can do the best job that they can, when they leave our aircraft. AGAP [Airbus Group Australia Pacific], as you heard from the previous presenter, have been another important partner in that regard as the TLS [through life support] contractor for the C-130J. They have been fantastic in helping us get to a point where we can have the first beyond-line-of-sight SATCOM system fitted to an Air Force C-130J, from concept to incorporation, in less than 12 months. And we now have four or five aircraft modified with that system. In parallel, we've been progressing the design of a Link 16 system for that aircraft. The picture on the left is the first production aircraft, which has completed ground testing and is about to undertake its first flight test; again, about 12 months from concept to delivery. A fantastic outcome which has been reflective of a bunch of people working very hard in both the SPO [system project office] and within industry to realise new capability for AMG.

Enhancing air-land integration. Commander AMG has been given the task of coordinating that particular *Jericho* program across Air Force. But for today, I'm going to constrain my comments to the Air Mobility side of that particular work stream. For a lot of AMG, Army is our key partner. They're the reason why we exist. We are here to ensure that they can go into battle fit, ready and able to execute their mission. So for us, partnering with Army is a very, very important part of our business.

On the left, you can see the picture of a Black Hawk touching down alongside a C-130J. This is from a set of trials conducted earlier this year for FARP—for those who aren't familiar with the term it means 'forward arming and refuelling point'. It was leveraged out of the work already done by the Army's CH-47 for the Black Hawk. Now we have the capability to allow a C-130 to effectively act as a fuel tanker at a forward airfield for Black Hawks, providing all sorts of range extension options and force multiplication effects for Army. It's the next best thing to an air-to-air refuelling capability for that type of helicopter.

On the right-hand side of the screen, you can see a pallet that's being cross-loaded from a CH-47 into the C-27J. The C-27J is coming into service; we now have four of them on the state register—two here in Australia with two overseas. Many people when they first see the aircraft will be tempted to think of it as the twin engine Herc. And while that's not untrue, it may be more useful to think of the aircraft as a fixed-wing Chinook. And indeed, that's the level of partnership that we are seeking with Army. No 35 Squadron are in the process of establishing a close working relationship with 5 Aviation Regiment up in Townsville to ensure that we get grassroots cross pollination of operational concepts, battlefield tactics and (joint) capability systems development.

We are already familiar with the benefits of such relationships down at Richmond; notably between AMTDU [Air Mobility Training and Development Unit]— a joint unit comprised of RAAF and Army personnel which certifies loads for airdrop and airland—and Army's 176 Aerial Dispatch Squadron [176 AD] which prepares loads to be dropped from AMG aircraft. The picture at the bottom of the slide looks like just another airdrop load right? Well, it is actually another great example of enhanced air-land cooperation. In mid-2014, Army soldiers from AMTDU and 176 AD first recommended using time expired parachutes to create a cheap, readily disposable, system for HA/DR [humanitarian assistance and disaster relief] airdrop loads. It was Air Force engineers and aircrew in AMTDU who then rapidly realised that capability for the ADF before the 2014/15 Christmas disaster season; including airdrop trials from a C-130. It was a great example of teamwork from across the (joint) airdrop community, showcasing innovation and continuous improvement from the ground up (in every sense of the word).

Why are we doing all of this? What will the *Jericho* 2020 strategy mean for AMG? Well, to realise a vision that might look something like this for the ADF. This next slide shows a possible future of connectivity and air mobility effects over a theatre of operations. On the left, a KC-30 is anchored over a part of the battlefield conducting air-to-air refuelling. But the size, weight and available power on the aircraft means it is capable of doing much more—from acting as a network node and 'Babel fish' for a wide variety of air and ground stations, to the use of remotely controlled sensors collecting a wide range of information in the battlespace and feeding that back to various agencies through space-based assets. In the meantime, a C-130J equipped with an EO ISR [electro-optical intelligence surveillance reconnaissance] capability is

conducting reconnaissance of the landing zone for a C-27J insertion and then the drop zone for its own resupply mission, whilst in both aircraft the embarked forces are in direct contact with ground parties to prepare for arrival. The C-130 then goes on to provide overwatch to troops-in-contact before handing off to a fully ISR equipped King Air 350 for targeting, which cues fast jet ingress and egress for close air support. The C-17 in the meantime has embarked a Special Forces element finalising mission briefings and determining optimal insertion locations to distract and confuse the enemy. With the E-7 and space-based assets providing further connectivity and building a comprehensive picture of the battlespace, all ADF and coalition assets are able to see what they need to see, and talk to whom they need to talk to, to win the fight. A compelling picture of a future that we can realise if we seize the opportunities being put in front of us.

So how do we do that? I am assuming just about every one in the room has a smart phone, right? These things have revolutionised our lives in ways we probably don't fully understand. We buy them knowing they are generally a good thing to have, use them for two or three years in ways we couldn't really have imagined when we bought them, and then we go out and get the next model and do it all over again. Compare that with our traditional Defence acquisition practices: spending years to define what we think we need [the requirements definition phase], then years acquiring the system [acquisition] and a few more years bringing the capability into service [realisation]. The intent behind this rigorous process, which we tend to apply even to minor projects, is to achieve the best value-for-money, right? Well here is what I do know: introducing obsolete technology is never going to represent value-for-money. I think it fair to see we have rightly been accused of doing just that in Defence from time to time—failing to achieve value-for-money in the misguided attempt to achieve value-for-money.

How do we speed up our processes to overcome that problem? The *First Principles Review* concept of streamlining higher headquarters interactions will be part of the answer. But I would like to address the things we can all do for the smaller acquisitions we have been doing in AMG. First, take a lean approach: don't write briefs, papers or any other documents that don't actually add anything to a decision (the decision to acquire is what we are seeking, the process itself has no other value). Be flexible; understand what is dead-end waste and just don't use that part of the process. Second, think carefully about the benefits of competitive tenders; they certainly have their place. But if you bring your preferred industry partner into the tent from the start you will find cost and schedule risk is driven down very quickly. For almost all spiral upgrade technologies, an integrated project team approach is the way to go—industry, Air Force and CASG [Capability, Acquisition and Sustainment Group] working in partnership to set requirements and then rapidly acquire them. What I am suggesting is the need to manage big system risk. Each process we have is designed to retire individual (small system) risk, often to people who may not even be involved in the final decision. The biggest risk we have, in this the smart phone era, is introducing obsolete technology—which is never value-for-money.

The smart phone analogy also has many parallels in new ways of managing sustainment. We tend to do a lot of sustainment modelling upfront which generally soaks up a lot of time and doesn't necessarily lead us to a better decision at the end of the day. Here again, I'm talking more in the spiral development case. I wouldn't care to comment on major capital acquisition—that's not my *forté*. That's not what HQAMG has been doing.

But we do need to critically ask ourselves questions with these types of devices [holding smart phone up]. Do we even bother with a sustainment system? Do we look at just a warranty period and then take some risks from there? What we are discovering is that our sustainment contracts, if we enter them, are almost the same value over five years as the actual system itself. This begs the question: 'Do we just buy a new system in three to five years' time, rather than be locked into something that we won't want or need anymore in that timeframe?' You must do the work to understand what that all means at some point, and I'm not advocating any sort of cowboy approaches here. It's just when we do that sustainment modelling, when do we understand it well enough to put the contracts in place? Before we acquire it, or after we have been using it for a little while?

And just finally, the AMG experience in innovation is about exploring possibilities and about exploring opportunities. You've heard it said today, I'll reinforce it again, it's about being willing to fail, or at least honouring the chance of failure, learning from that failure and then moving on again. But if you don't take that risk upfront, you'll end up with a culture that just doesn't innovate, and that's not going to do us any good.

We have mitigated that in AMG largely by leveraging proven technologies. The AirView 360, the Wi-Fis—none of these things are particularly cutting-edge, although we're hoping to use them in cutting-edge ways. So while the USAF has been one of our main organisations to look at to see what type of systems are available, the fact that we are a much smaller and much better integrated force, means there's opportunities to use that technology in ways that perhaps our big coalition partner hasn't yet explored. And that's where we hope to really unlock the possibilities of *Jericho*.

As I said, SPO and TLS contract partnerships are absolutely essential. Know which process to use, think lean and please, focus on achieving value-for-money. At the end of the day, that's what the *Financial Governance Act* is all about. Processes themselves help us but they don't get us there at the end of the day.

AIR BASES *EN ROUTE* FROM SYDNEY TO CANBERRA

WING COMMANDER DAVID HOWARD

Chief of Air Force Air Marshal Davies, distinguished guests, ladies and gentlemen.

The topic of my presentation is air bases *en route* from Sydney to Canberra. But, as all the locals will know, there's about 350 kilometres of highway between Sydney and Canberra and there's no air bases on that road. So what am I talking about? What I want to talk about is what Combat Support Group is doing to ensure that our air bases maintain relevance and capacity to support our emerging 5th-generation Air Force and in order to do that, I want to contextualise it with a naval analogy.

This is the HMAS *Sydney II*. She was purchased by Australia in 1947. She's one of two Majestic class carriers to serve in the Royal Australian Navy, the other being the more famous HMAS *Melbourne II*. *Sydney* operated successfully off the coast of Korea during the Korean War in 1950/1951 and she's the only Royal Australian Navy carrier to have seen wartime service. However, HMAS *Sydney* did not evolve to accommodate the transition of aviation from the propeller age to the jet age. She didn't have the necessary design features, such as an angled flight deck and the catapult, and wasn't capable of sustaining the weight of the heavier jet aircraft.

So when HMAS *Melbourne* arrived in 1955, some eight years later, *Sydney* was relegated to being a training ship and later placed in reserve. She was recommissioned in 1962 as a fast troop transport. Between 1965 and 1972, she ran 25 missions from Australia to Vung Tau, Vietnam, carrying troops and equipment to support the Vietnam conflict. And that's how she earned her nickname 'The Vung Tau Ferry'.

HMAS *Sydney* was left behind by the jet age. The effort within Combat Support Group is that the implementation of Plan *Jericho* is focused on making sure that we're not left behind by the arrival of the 5th-generation Air Force.

This is HMAS *Canberra*. I've got to say, I think we can learn a lot from how Navy operate the *Canberra*. I was involved with the amphibious development when I was at Headquarters 1st Division. But like HMAS *Canberra* and other naval platforms, air bases need to be developed, maintained and operated to provide a capable 4th-generation sustainment and projection base for 5th-generation platforms to effectively interface between multiple domains and to support the achievement of joint outcomes. Therefore, that's the title of my presentation: Air Bases *en route* from Sydney to Canberra.

Now just to stick with the naval theme for a second, this is a picture of the USS *George Washington*. Now that's an impressive air power projection platform. The platform itself is a complex system of systems and all of those systems are designed and honed to integrate seamlessly to launch, control, recover and replenish air missions like a well-oiled machine.

But to most aviators, we tend to focus on the air power on the flight deck and maybe the intricacies of the platform that's supporting that might not be so obvious most of the time. But when the supporting platform loses its operating integrity, the platform comes clearly into focus. Now the air power on the flight deck is really only noteworthy because of its vulnerability. Those combat aircraft on the flight deck of that carrier won't be flying any more combat missions. They've become ineffective.

This is the HMS *Ark Royal* after being torpedoed by a submarine and subsequently sunk on 10 November 1941. The subsequent board of enquiry and court martial determined that there were issues of design and there were operating issues, both in terms of training and operational command deficiencies that led or contributed to the loss of that platform once its defences were penetrated. We want to make sure, within Combat Support Group, that our future highly capable and highly valuable 5th-generation platforms are not made vulnerable due to shortcomings in air base design or operation.

Now our air bases may not be as photogenic as aircraft carriers, or even LHDs [landing helicopter dock ships]. And if you go to the front gate [of any air base], it might be hard to distinguish it from any other Defence estate or garrison. But I think the key is that air bases aren't garrisons. They are fighting platforms. They are quite complex. And they are essential to the generation, projection and protection of air power. To provide effective support to the 5th-generation Air Force, we have to transform and evolve all of the air base systems. And that's beyond just the pavements and the hangars.

The 5th-generation fighting force. Plan *Jericho* proposes the 5th-generation fighting force will deliver greater effect through shared awareness and integration with enabling capabilities. Now that leads to two considerations for Combat Support Group. The first consideration is: 'What do we need to do to effectively host and support 5th-generation systems?' The second consideration is: 'How can we actually incorporate the attributes of a 5th-generation system into our air bases to improve our air base warfighting capability?'

First of all, we'll look at hosting 5th-generation systems. Last year within Combat Support Group, we conducted a foundation analysis of what we need to provide to support our Air Force platforms across the national and expeditory domains and what we need to provide to support the mounting, deployment and sustainment of joint forces and most often, land forces.

It's been clear from the outset, as we looked at Plan *Jericho* and its *Program of Work*, that because Combat Support Group is an enabling force, everything we do will affect the rest of the Air Force. Looking through our plan of attack, we recognised that there were direct relationships with all of the other projects across the Plan *Jericho Program of Work*. As I bring up the activities we're working on, you'll see some additional text comes up, which just keeps us honest in terms of the bottom-up innovation meeting the top-down design and linking what we're doing to the other projects.

Our foundation analysis has resulted in a revised preparedness directive and that preparedness directive now matches our combat support elements directly supporting platforms and supported forces for specific missions. Subsequently, Commander Combat Support Group has raised a directive to the CSG wings, asking the officers commanding to conduct further analysis to determine how we're going to provide that support.

For the first quarter of this year, we've been working with the Combat Support Group wings to examine and adjust both our operation and enabling force structures and looking at the capability system requirements and the equipment requirements and what resources we're going to require to generate the future force. Now that's a substantial task and it's ongoing and it will be iterative and a deliberate re-examination in light of what's changed, at least annually.

From the second quarter of this year, or next month, we will start reviewing and developing our tactical doctrine to support training and standardisation, and developing a 4th-generation plan to provide assurance that all of our elements are either operating at the required level of performance or they're being held at the required readiness notice to support future operations. We're going to work closely with the A58 at Headquarters Air Command and with the Air Warfare Centre to ensure that all of our training requirements and all of our mission essential tasks are completely integrated into the Air Force and broader joint collective training program.

Now once we go through this analysis, we expect to see a considerable number of capability proposals and capability development activities commencing as we identify deficiencies or opportunities within the future force that we require. So I would expect that that will start to show itself as minor capability proposals that will flow into the Air Force Minor Procurement Program and probably put pressure on that in the forward years, and particularly from 2017. We also want to go through our equipment entitlements and make sure that for all of our particularly deployable elements, we have appropriate levels of equipment holdings, either within our standing units or, for deployable units, held within the joint logistic system at the appropriate readiness notice.

Following on from this, we will start actively generating the future force from 1 July this year. Now, will we get it right first time? Clearly not. There's a lot more analysis to do and we're going to learn by doing. We will go through a nine-month cycle and then we'll go through a deliberate re-examination in the second quarter of next year to see how we need to test and adjust as we go forward.

That's about hosting the 5th-generation systems. What about being a 5th-generation system? We had a look at the generic characteristics of a 5th-generation capability with a view to looking at how air bases could take on some of those attributes.

So the first characteristic of a 5th-generation platform is that they are stealthy. But air bases—not so much. It's pretty hard to hide an air base. But if you look at what stealth achieves for a 5th-generation platform, we can look at electronic warfare, passive defence, counterintelligence

and operational security activities to achieve for air bases part of the outcome that's achieved by stealth for a 5th-generation platform.

Fifth-generation platforms are considered to be highly manoeuvrable and they have multi-role capabilities. Now this was touched on before. We need to make sure that not only are our deployable air bases held at high states of readiness, but they remain agile so that we can change locations or change missions quite rapidly. And that will go into our deliberate design.

We inherently have multi-role capabilities. An air base can function variously as a main operating base, air point of embarkation, forward operating base for one or more platforms, intermediate staging base, air point of disembarkation, evacuation point, reception point or landing zone. And in most instances, a particular air base will operate as a number of those functional elements at once.

Now we get down into the key areas that we're going to look at in the next few months in terms of our implementation of Plan *Jericho*. And the first is the advanced avionics piece. Now avionics don't apply to an air base but we can interpret that to mean the use of distributed decision support tools to deliver the functions within an air base, and I'll touch more on that in just a moment. And the other aspect, and the utopia for us, is network data fusion. That's about fusion of those federated systems across the air base into a single common air base operating picture.

In terms of advanced avionics, you can see that this links into a large number of other *Jericho* activities and it's all about, as I said, acquisition and development of distributed decision support tools to support the air base enabling functions. Now to explain that, all of the different functions on an air base—there's some indicative ones here—we call them enabling functions.

This list is not exhaustive. There's some existing air base enabling functions there. There's some emergent functions in there that we're starting to consider. Now for each of these functions, to execute them, we will have one or more decision support tools feeding into that.

Okay, so a bunch of acronyms there. It doesn't really matter what they are; suffice to say some of these systems we have in service but we haven't implemented them effectively. Some of them, we just know, are out there and we may need to use them in the future. I'm sure there's also a number of functions on the air base that don't have any decision support tools used within them at the moment and we will need to go out and identify what's available and what we can employ.

Now critically, a number of these decision support tools go across domains. So if we're starting to play in the space where there might be an integrated air and missile defence capability on or close to an air base, and we need to know what that's doing so that our recovering and launching and circuit aircraft aren't put at risk; then we will have to use a system that goes across domains.

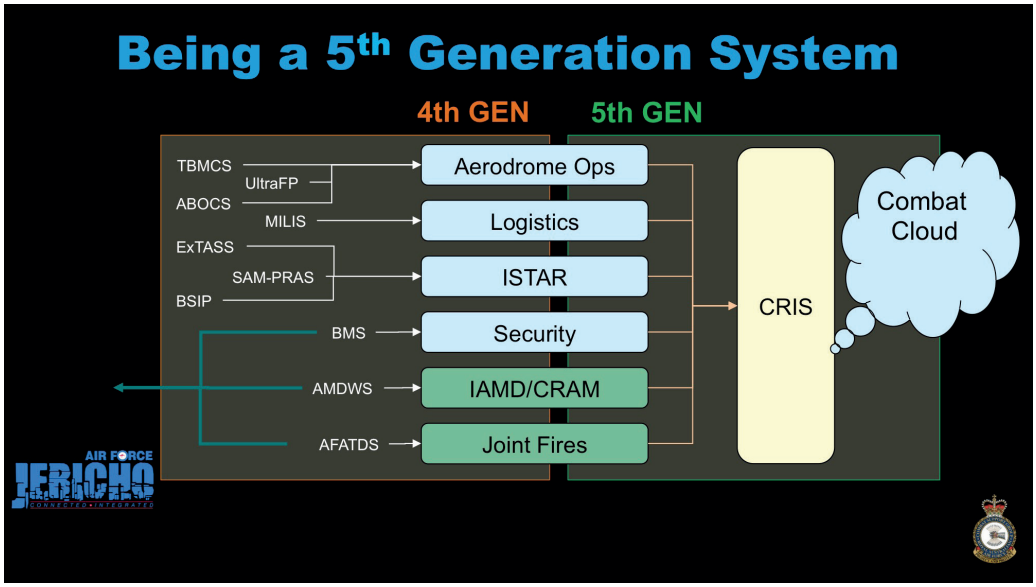


Figure 22-1: Air Base Enabling Functions

So we want to actually roll out and better implement decision support systems and that activity will really start as we, as I said, learn by doing from July this year. But I think the key is, that even if we get that to a good state of maturity, we're really only looking at a 4th-generation capability. A bunch of different decisions feeding into different areas within an air base command post, and then you still get an air base commander that's going to have to make decisions based on a bunch of disparate advice.

So as I said, the utopia for us is getting to the 5th-generation style of capability. And we will achieve that if we can achieve network data fusion across all of those federated systems into a common core air base operating picture. Now why is that important? It's important because the air bases don't operate on their own. The air bases are just an enabling capability for Director General Air or for a Designated Joint or Combined Force Air Component Commander. So, not only will we want to use that core system within the air base for our own business, but we need to feed the relevant information up into the combat cloud and into the newly established Combat Support Division of the AOC [Air and Space Operations Centre].

So how are we doing this? We are attempting to achieve this through development of our in-service capability reporting and information system, which we call CRIS. Now CRIS is our version of an application called Harvest, which is produced by DPRA. It's a US-based company and they have an element in Australia—DPRA Australasia. It's an asset management application and we've had this in use within the FEG for a number of years. It's currently hosted on the Defence Secret Network.

Up to this point, this system has primarily been used as an asset reporting system where people have to come in, open it up and put a bunch of information in for periodic report and it's just an

additional management overhead for them and they don't really use it for anything constructive on the air base.

However, last year, Air Commander Australia said that he wanted real-time reporting of air base capabilities. So we had a look around at what options we had for providing that and decided that our best way forward on achieving the Air Commander's intent was to develop CRIS. Now CRIS, at the moment, provides a dashboard-type interface where all the assets on the air base are grouped under the enabling functions they contribute to and you can run reports on various functions; you can link deficiency and capability issues associated with those functions and you can roll-up reports based on a function within an air base or a function across multiple air bases.

The next version of CRIS is close to delivery now and what we've done with this version is we've added DPRA's TALIRA mapping module. What that primarily does is it gives every asset we have a geographic location. So with Version 2.2, we will have a graphical user interface with customisable views at any zoom level from global to local. Within the Combat Support Division of the AOC, they'll be able to have a look at an overview of, for example, fuel holdings across our air bases or network status across our air bases or munitions holdings on our air bases. Or they can just look at air base capability overall. And if something goes wrong, an alert will pop up, that will be the flag. They can click on the graphical interface and they can drill right down, through the dashboard, into the specifics of that air base capability and see what's going on.

Now at the local level, we can use it to look at where the assets are on our air bases. Now initially we won't be able to do this because we don't have any automated position reporting and the location of the assets will only be as good as data that we've manually entered. But in the future we hope to improve that and I can foresee a time when we go to an expeditionary air base and you'll be able to sit in the AOC, or at any DSN desktop, and you'll actually be able to see the air base grow as assets come in place and go online within that air base boundary.

So we intend to use this application across our strategic network, where it's hosted at present, and also roll it out into deployable networks and importantly, the training networks, so that we can truly fight as we train.

Version 2.2 of CRIS also introduces enhanced asset reporting in that it has an issues entry wizard, so any problem you have on the air base, you put it in, it will flag straight up to higher headquarters. It will also guide users through generating operational incident reports and then distribute those incident reports and it will also introduce email alerting for people that might not be looking at CRIS at the time something happens. As I said, it adds the asset tracking function but to get good information out, we will have to develop the capacity within our air base command post to keep CRIS appropriately informed.

So the enabling activity around the organisation design with this is actually bolstering our air base command post capabilities and we've already done some work within Combat Support

Group to introduce an Information Manager, working under our Staff Officer Information and Knowledge Management to manage the configuration of this and other systems.

Now once we go to version 3—we're developing the concepts of this—the key things we would like to see come into Version 3 are assets reservation and commitment module. That will allow tasking of combat support assets. It will allow users to come in through an e-port or an online shop and actually request combat support and it will also enable planning so that we know if we take all these assets away from Edinburgh, Williamtown and Pearce to support a deployment, how that's going to affect our raise, train and sustain [functions] across those bases?

But then again, the utopia you see in that future version is that air base data fusion, decision support, will bring all the federated systems in so that they report into that central system. That will enable automated reporting of our asset location and status and roll-up the impacts of that on our capability. So it's a big ask and we don't know how far we'll get with it but we're certainly going to try.

The key here is to set the architecture so that all those federated systems that are there now, where we can, we'll feed them in and we'll have a requirement that any future systems that come in have to be able to feed into that architecture. And at the other side of it, make sure that it can feed out the required information up to the Combat Support Division and the AOC, and more broadly, into the combat cloud.

So that's an overview of some of the Plan *Jericho* related activities currently being progressed within Combat Support Group. There are other concurrent activities going on but I don't have time to cover them all today.

I don't have any whiz-bang gadgets to show you just yet, but we do have a solid body of work going on within the group. I think that by this time next year, we should have some real developments that we can show off and I think that should become apparent because the air bases affect pretty much everybody in Defence. Certainly with the introduction or the roll-out of the new module of CRIS—and that should roll-out by 1 July, depending on the time required to get it integrated and hosted on the DSN—I think we'll start to see a significant positive change in capability coordination across the air bases.

So in summary, we're continuing to innovate to effectively support the generation, sustainment and projection of 5th-generation air power and to incorporate 5th-generation concepts into air base design to improve air base warfighting capability and integrate effectively with the combat force.

JERICHO PRE–DAWN AT AIR FORCE TRAINING GROUP–*JERICHO* PREQUEL

GROUP CAPTAIN STEPHEN LONGBOTTOM

Chief of Air Force, visiting and retired chiefs, dignitaries, Senior Leadership Group, ladies and gentlemen, I thank Air Commodore Harland for the privilege of presenting the topic '*Jericho* Pre-Dawn at AFTG–*Jericho* Prequel'.

A prequel is a form of history. We humans turn to history to find answers to important questions and to build a better future. My previous colleague was speaking about the building of Utopia. To important questions like the meaning of life, the *Hitchhikers Guide* answers that for us—the number 42 is clearly that answer. I regret to tell you that, as individuals, Utopia has come and gone for us. It started with the invention of novocaine, which made painless dentistry possible and it ended with the invention of computers.

This is the agenda for this afternoon's presentation. The focus will be far more on how capability was produced and how that process may inform *Jericho* for Air Force's future.

Our history has a very clear starting point. At the end of 2008 then-Commander Training Group (now Air Vice-Marshal Watson) tasked me to study ACO [air combat officer] training issues at RAAF Base East Sale. In February 2009, he stood up the first team and those teams have continued within Training Group over the past seven to eight years. The names indicate the subtle changes of remit but the rules that run our group have not changed since Day One. There are principally two rules.

- Firstly, form follows function: technology and process are very valuable in their own right, but they are only useful to the Air Force when they generate capability.
- Second rule is the Pareto Principle. If we aim to target more than 80 per cent of an ideal outcome, then we are at high risk of time-consuming and expensive failure. Far better to get it 80 per cent right and then, with pre-approved and pre-funded spiral upgrades, keep it robust and relevant for the Air Force's future.

Here we see two outstanding weapon systems, each in their own era. The Lancaster, perhaps the highpoint of the kinetic-electronic era of World War II and the Growler, well embedded into the information era of 5th- and 6th- generation warfare.

As the Air Force transitioned its navigator training from the Lancaster days towards the modern Air Force way back in '06, '07, '08, we merged the navigator and air defence categories to form the air combat officer category. Similarly, Navy replaced the observer with the aviation warfare officer.

Here we see examples of the older weapon systems and, as many speakers have commented here earlier today, pre-5th-generation weapon systems not acting in the network-centric warfare.

As a result, at the unit, formerly known as the School of Air Navigation then the School of Air Warfare, and in February of this year became No 1 FTS [Flying Training School], Air Force has been training both ACOs under the Air Combat Officer Training System, or ACOTS, and also training AvWOs [aviation warfare officers] for the Navy.

Information, as previous speakers have highlighted, is driving all of this and it just goes without saying that this statement is so true: 'We have the power but also we have the risk of saturation and confusion'. In other words, we have to get it right and we have to get it right in our training, in our undergraduate training, in the IET [initial employment training] space, which is where our FEG [force element group] stands up.

These are some of the weapon systems that you are aware of in the 5th- and 6th-generation space for Air Force and Navy, which will collect and disseminate that information. Commander [Training Group] saw that something had to change so with then-SAW [School of Air Warfare] being established, the focus started to transition to information processing. Everything we've done in Training Group is to produce a robust air warrior, aircrew of the old mould. But these aircrew also have to have mission skills and they have to be able to absorb almost unlimited information, to filter that information, prioritise it and select the right pieces to support correct mission decisions.

Figure 23-1: Components of Air Combat Officer Training System

What do you get for your dollar with the ACO Training System? It's a combination of hardware, firmware and software under Air Force Minor Project 1029, which will stand up on 20 June this year. It will deliver to the airborne platform—the Super King Air—either in the front right-hand seat or in the cabin, a tablet that has the ACO training software on it. [The tablet] can also be used on the ground and in the Part-Task Trainer.

The sensors are all emulated and simulated. In this slide, we can see the electro-optic family of sensors that ACOTS will provide: TV and IR [infra-red], B-scope radar, ISAR [inverse synthetic aperture radar] and tactical situation displays.

The Part-Task Trainer is a unique capability, we believe, in the world. Most part-task trainers are adapted from pilot training. This capability was, from the ground up, developed for non-pilot mission training. It has all those features embedded in it so that the focus can remain squarely with non-pilot mission training. When the mission has been flown and the training has been conducted, the aircraft is recovered to land via an ILS [instrument landing system] autoland.

The Part-Task Trainer is focused on the student. Our intention is that, for the most part, this trainer will be used by students in their own time—weekends or after hours—to improve their skill sets in those areas where they know they are deficient. On the trainer, where you see red, that's the B-300 cockpit faithfully replicated but it doesn't respond because it doesn't need to.

Figure 23-2: ACOTS Part Task Trainer

The areas that are in black are responsive. You'll note they include areas like the FMS [flight management system] with its control panel and the mode control panel for the aeroplane, things that are something of a mystery, almost throughout the entirety of their training at Sale.

The left-hand seat is there for an instructor, if that's deemed appropriate for whatever reason. The visuals, because of some excellent cooperation from the mapping agency, permit the very highest standard of visual navigation training.

This is why we believe the ACO Training System is delivering to the ADF a world-leading solution. Commander Training Group, back in '08, may not have known that *Jericho* was arriving when it did. It's just a happy coincidence that network-centric warfare targets, which he passed on a tactical level from a bottom-up, growing process, have arrived at the right time to deliver to the Chief an unclassified, generic, ISR [intelligence, surveillance and reconnaissance] training engine, something I'd like to christen as a *Jericho* engine.

Right now, it's going to be used for the training of ACOs and AvWOs. But it has applicability in other areas, if there's merit to that being done. It's simple to use, yet it provides infinite training possibilities. The practical principles that come with this will stay with the students for the rest of their careers. Training Group isn't trying to muscle in on operational conversions. There's nothing in this that is classified. It is entirely generic. It's simply that network-centric warfare is replacing the sextant that was used in the HS748 days, to test capacity and build skill sets amongst navigators.

It's probably the 'how' that represents the most potential value that Training Group has done in this space for *Jericho*. The teams were built light and tight, agile and powerful. They consisted mainly of Reservists with the appropriate contribution of Permanent Air Force personnel. Every single element on that slide meant something to us from day-to-day. They were more than just glib words. Without them, we could not have achieved our capability output. It's been my great privilege to lead these teams for the last seven years and the individuals who have worked on these teams are truly inspiring members of the ADF.

We started with an RPDE [Rapid Prototyping Development and Evaluation] process that enabled us to select a supplier, through all normal governance competitive processes. Air Force Minor [Project] 1002 then came underway and produced the first result. To make it more robust and relevant, a project approval variation was conducted and then when [Project Air] 5232, the major project suffered a major time delay, Air Force decided it needed the Air Force Minor 1029. As I said, that stands up under full operation on 20 June this year and is consistent with the way we've done business. It's going to be ahead of schedule, under budget and it's going to exceed its target capabilities.

Where to from here? If there is merit in what we have done, then the Commander will place all of our work, our process in the *Jericho Dawn* space, if it can help. The acquisition principles

that we've used over the last seven years, hopefully may be meritorious for considerations of acquisition reform under First Principles Review. Essentially, Training Group stands ready to help if that help is deemed to be of merit.

The Air Force and Navy values on this slide are well known to all of us in the room. The point of putting them up here is that they were more than just glib words. Without the application of all of those principles on a day-to-day basis, the team could not have functioned; it could not have generated the capability that it did in the short time and with the small amount of resource that is was given. And it proves the point, that as members of the profession of arms, we have to stick to our guiding principles and apply them and apply them fervently and with passion.

That's the Air Force side of the equation. Cirrus was the firm selected. It's full name is Cirrus Real Time Processing and they are, as our Boeing colleague said this morning, a small to medium firm, located in the heart of Sydney, [made up of] about 14 people. They came to the partnership, which delivered the ACO Training System. And a true partnership is what it was. The quotation there from their CEO, Mr Peter Freed, has turned out to be absolutely true in execution. To deliver cost effective implementation, you have to have that combination within the partnership.

What did we bring? We brought the obvious things; things that you would expect from professionals within Air Force and within Navy. We looked for the right Reservists to [engage], the B-cats [experienced B category instructors] with the passion to see the capability get produced with the desire to pass on that knowledge to the contractor who is going to help us build that capability. What Cirrus brought to that partnership was their extensive engineering and R&D [research and development] capability. Both were required to achieve the outcome. But this cannot and will not happen without genuine partnership.

How do you get genuine partnership? Respect for each other, each party being responsible and empowered—now isn't that a word we've heard a lot of today, empowerment—and cooperation and collaboration with the ultimate outcome of the capability being what drives you. In practice, it means that there's no second-guessing going on [regarding the] functionality that the Commonwealth brings to the space. The Commonwealth refrains from telling the contractor that everything is priority one and we don't second-guess the engineering calls.

Early in the [project], I had a thought that we might want to import some technology, a proven asset, into the Cirrus space and I was told, politely, to leave that alone. 'You've given us a job, we'll get on and do it.' And they did it far better their way than the way that I thought could have happened.

This requires trust, not terms. And trust is a very scarce and difficult commodity. How do you build trust? Well it's not paid for, it's earned and it's earned over time by consistent behaviour. An example: rather than just giving bare-bone statements of requirement, the Commonwealth

provided Government-furnished information [in the form of] SMEs [subject matter experts] going up there with the company for a couple of days and working through with the R&D people, exactly what we mean by this point or that point. What does it look like on that radar? How does it look on a TV sensor image? From Cirrus' perspective, we had a lot of legacy hardware from the old HS748 days. They helped us get over those technical issues that could have turned our capability into a nightmare.

But I think it's the last point that is probably the most important. Instead of just defining the capability you want at the outset and then having to leave it alone, as this capability is matured and focused, you get a much better view of what you want to make your training as effective as it can be. And you get those subsequent bites at the cherry.

What this allows is detailed requirement setting, progressing in an evolutionary way, not set and forget. We don't get just one chance to get it right. And we learnt as we went and we came up with ideas and so did they. Genuine partnership provides the customer that real opportunity and the full range of issues do become visible.

As an example, the workshop became an invaluable tool for us. Various SMEs from the various categories spent time with the R&D folk at Cirrus and they came up with options that were then considered and decided and absorbed by Cirrus to get the job done and get it done well. Features emerged that were well beyond what we specified at the original point. This wasn't a problem for Cirrus and it certainly wasn't a problem for us.

Let me give you a classic example of how this works. This graph shows you your initial statement of requirements. The large dots came out in coarse resolution at that time, and that's all you can see. Some of them are high utility, low cost; some are at a greater cost. And if that's where you lock it in, that's what you're stuck with. But as you get into the process, this workshop thing develops ideas between the two parties and you start to see the emergence of much finer detail. We saw ideas forming here and here that were not there at the outset of the process. The workshops continued and at the end of it, you can see that we got a much better value by going for this range of options than we could for what we might have at the start. The outcome is what the taxpayer and the Chief would want—a far more powerful capability, quickly and within budget.

I go back to history to end my presentation. This is the lead slide from the package that led the Air Force Minor 1002 presentation back in '09. That committee meeting was chaired by DGCP-Air Force [Director General Capability and Plans], then Air Commodore Davies, now our CAF. So here we are. History has placed us with a *Jericho* engine as a result of a process that in and of itself may be of value to *Jericho*. Air Force Training Group stands ready to help and assist as required.

AIR WARFARE CENTRE INNOVATION–NEW TECHNOLOGY SAVES TIME FOR FLIGHT TEST

GROUP CAPTAIN TOBYN BEARMAN

Good afternoon, Air Marshal Davies, distinguished guests, ladies and gentlemen.

Today, I'll describe how the Air Warfare Centre is developing the use of integrated teams from diverse domains to deliver the comprehensive and innovative solutions required by our future joint force.

My presentation will cover two parts. I'll briefly recap the Air Warfare Centre organisation, its functions and approach to innovation, as described earlier by the Air Commander. I'll put this into the context of a current innovation project that is delivering tangible benefits for Air Force. The example I'll use is coming from the flight test perspective, but I'd ask you to think about how the previous presenters and this presentation describe the power of the technique of innovation and pulling together of integrated project teams and how this can be applied across all of the domains of the Air Warfare Centre. That's what we're seeking to do and you'll see that in a moment.

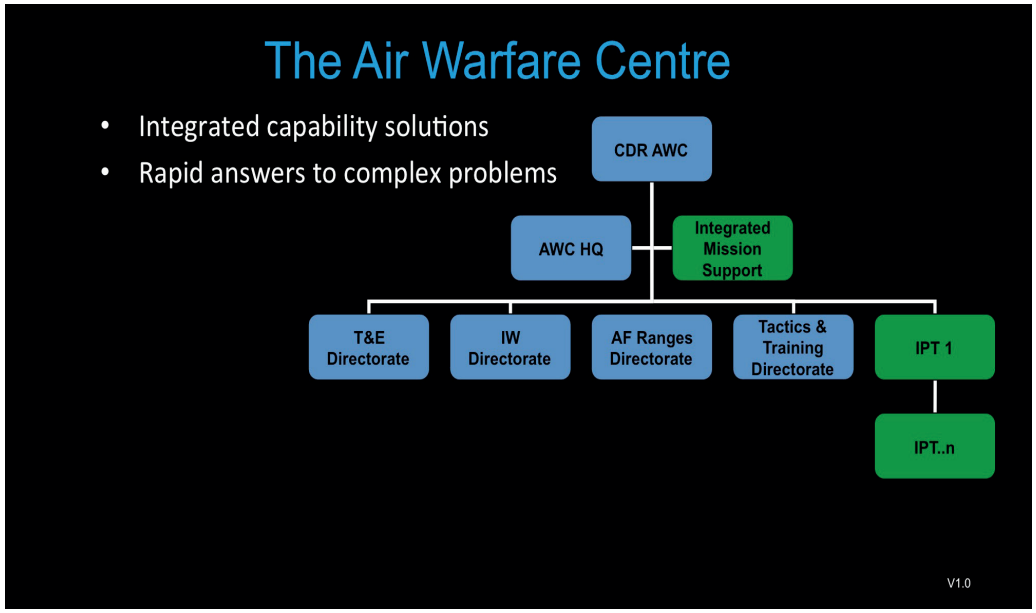


Figure 24-1: Air Warfare Centre Structure

Before the Air Warfare Centre, Air Force lacked a framework to generate truly integrated capability solutions. The Centre evolved from the Aerospace Operational Support Group. The Air Warfare Centre itself retains the foundation roles of test and evaluation, information warfare and a management of weapons ranges but its capabilities are now expanding to include the development of live, virtual and constructed expertise and the development of an integrated

tactics and training capability. These functions are delivered across the domains you can see. The four separate directorates are in blue.

The Air Warfare Centre is now able to deliver expert support from each directorate but its real strength comes from its ability to simultaneously access subject matter expertise across those domains to address air power problems and provide truly integrated solutions. To determine which directorates and subject matter expertise to engage, new requests for Air Warfare Centre support are reviewed by the team you can see in the green box to the right there, the Integrated Mission Support [IMS] system. The IMS can be thought of as the enabler that helps the separate domains of the Air Warfare Centre work together.

In response to a request from the field, a task is raised via our IMS and either assigned as the sole responsibility of a single directorate if the task is that discrete, or as a task that requires coordinated input from multiple SMEs [subject matter experts]. For the latter, an integrated project team will generally be established. It's the IMS that's the key for Air Warfare Centre to bring together these teams. It's about bringing the right team together to solve the problem.

The Air Warfare Centre is about the delivery of innovative solutions. Tasks are accepted and analysed for opportunities to innovate. Complex tasks are tackled through integrated project teams drawn from diverse backgrounds who come together and seek out innovative methods and solutions.

To support these outcomes, the Air Warfare Centre has also established what we call the Innovation Hub. The Hub has two key roles. The first and most important is to work alongside the integrated project teams as an innovated engine, if you like, assisting teams to explore new ways of thinking and empowering those individuals to embrace change, identify alternative techniques to solve problems and deliver solutions; to help them think up, identify, or even exploit better ways of doing business.

The second role is to provide some training on innovation. It's not innate. We need to support our teams and our staff to unlock that capability that's within them as skilled individuals. This second role is a significant long-term undertaking but will help to up-skill Air Force in the use of tools and methodologies useful in that innovation. Not to forget, that the people that work in the Air Warfare Centre at the moment, and in the future, come from Air Force and will return to Air Force. Just as importantly, it will help foster Air Warfare Centre's bottom-up approach to cultural and behavioural change. So I'd like you to think of our Innovation Hub as the key to developing the 'how' within the Air Warfare Centre. We've got the IMS that brings the team together and we've got an Innovation Hub that helps to unlock that 'how' factor.

I can provide an Air Warfare Centre demonstration of the potential for small IPTs [integrated project teams] to develop effective solutions to difficult problems through an active initiative. By collaborating with Defence Science and Technology Group [DSTG] and Australian industry, the Air Warfare Centre is developing a non-intrusive flight test instrumentation system—we call it NIFTI for short—that significantly reduces the historically unattractive overheads of

instrumentation and improves the Air Warfare Centre's ability to help deliver rapid capability solutions.

Instrumenting an aircraft is sometimes critical to the delivery of air power. The test community uses instrumentation to produce the quantitative data required to underpin the development of an aircraft's operational flight envelope and mission capabilities. During initial certification, this data is collected to verify such things as an aircraft's handling qualities and performance. These might include, for example, confirming take-off distances in hot weather, flying qualities with an engine shutdown or the performance of a weapon management system.

In a military-specific context, instrumentation is also used to support the expansion of an aircraft's roles, such as determining the limits for operating a helicopter from a ship, the compatibility of an aircraft or two aircraft to refuel in-flight or the compatibility of the aircraft's mission systems with other systems in use across the joint force.

Instrumentation is also useful for the investigation of issues not easily predicted by analysis, modelling or previous experience. This short video shows an event that occurred on an Australian Hornet during a test program. If you look out to the missile on the wingtip, you can see the oscillation starting to increase. This configuration had been in service for more than a decade with no reported issues.

By analysing the information collected using the instrumentation system that was fitted to that aircraft, the team was able to identify a latent error in the aircraft's flight control system. Clearly, if that error had been encountered during normal operations, that type of event could have caused catastrophic results and mission failure.

Traditional instrumentation systems temporarily or permanently modify small numbers of aircraft with bespoke systems designed to collect the data required. The system on the left there, is installed on one of our F-18 aircraft. That's a good example. This approach provides a responsive capability development support tool, but it comes at the expense of operational availability. That aircraft is a bespoke flight test aircraft at the Air Warfare Centre and you can see from the complexity and the size of the instrumentation that's fitted to that aircraft, that it's offline as a line weapon system. But it's very useful as a flight test system for capability development and for other problem investigation.

The other method is to install instrumentation on an as-required basis. The P-3 on the right of the screen is an example. This approach has the advantage of maximising operational availability but at the expense of responsiveness for problem solving.

Both methods required the aircraft to be hangar-bound for long periods of time and ongoing servicing. This limits the capacity and the willingness of operators to devote specific test aircraft or to undertake projects that require complicated instrumentation, with potentially negative influences on operational capabilities.

Our NIFTI system is designed to reduce or remove the bottlenecks created by conventional instrumentation by providing a generic system that can be rapidly installed on any aircraft in any configuration.

The time to install a conventional flight test instrumentation system, as I've just described, is determined, in part, by the complexity of that system and the complex routing of electrical wiring that's usually required. Typical installation times can be as short as two weeks but they can be as long as two or three months.

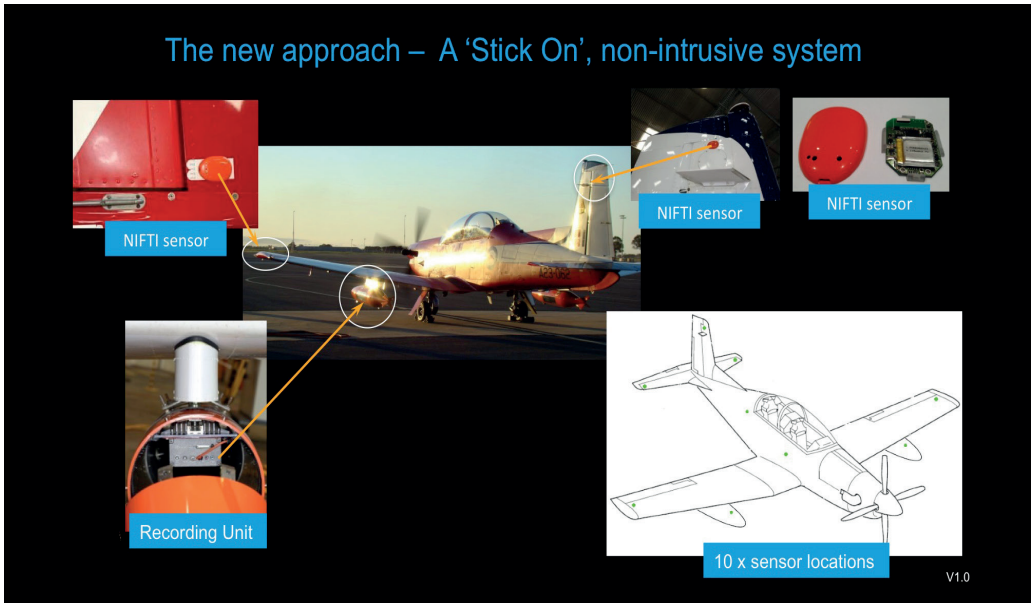


Figure 24-2: Non-Intrusive Flight Test Instruementation System

Our NIFTI system uses battery powered, wireless sensors. These are mounted temporarily on any external surface and this reduces the installation time to a matter of hours.

The initial prototype NIFTI system was developed in eight months and flown in a series of concept demonstrations in September last year on the PC-9 aircraft, you can see pictured. The prototype system included ten sensors mounted externally, as well as within the cockpit and baggage compartment, and a wing-mounted cargo pod for system control.

The trial successfully demonstrated how an integrated team can develop a prototype and then rapidly configure an aircraft to collect flight test data. Once the prototyping was complete, the trial installation of the ten sensors that were fitted to the aircraft was completed in 15 minutes.

So the innovation I'm talking about with this system, or that I'm bringing to your attention with this system, spans several different domains. We used commercially available glue, if you like, or

those temporary glue strips, to fit the sensors to the aircraft. The sensor uses a version of Wi-Fi to communicate with itself and to collect the information.

We also sought to exploit the principle of agility that *Jericho* promotes. So there's a new approach to flight instrumentation that we're exploring here. We don't have to take an aircraft offline for long periods of time to instrument it to get the result. That may be for a problem investigation or to collect some data that's required for certification or to confirm the performance of a system for an air-worthiness purpose.

The technology that enables NIFTI is founded on Australian industry intellectual property, which was developed for the telecommunications, mining and medical applications. The effort to take the technology and optimise it for flight tests was accomplished by a small IPT consisting of Air Warfare Centre engineers, pilots, DSTG scientists and design engineers from Australian industry. The activity represents a great example of the Air Commander's challenge to bring together diverse teams of skilled people and optimise the performance of critical systems.

The Air Warfare Centre is now discovering the success possible using this approach, not only for test, but also for the live virtual and constructed environment and the teams that have been using it for developing tactics. It's not too hard to think about how if you then blend all three of those environments together, we can truly deliver on that *Jericho* objective of integrated solutions from the test, through the training, into the tactics and then into the operations domain.

The PC-9 concept demonstration completes Phase One of a three-phase capability development program, which will produce a system we expect can be used on any aircraft type. The concept demonstration results have been combined with evolved objectives to create a specification for Phase Two. The Phase Two program will be demonstrated during an air-to-ground weapon clearance activity on the Hornet in October of this year. That system will be capable of capturing high accuracy strain and vibration data and include improved ability to monitor system health and control system parameters from within the cockpit. And in parallel, the team in the Air Warfare Centre is looking ahead for Phase Three and how we might integrate that system or how we might apply that system to the Joint Strike Fighter environment.

So in summary, to meet the future challenges posed by the rapidly evolving technical landscape, and the constraints that come with some of the truly complex and evolved systems that we're introducing into service, the Air Warfare Centre is adopting the principles of Plan *Jericho* to help transform the way we develop and acquire capability. We're doing this to help create the future combat capability that is highly adaptable and one that is able to deliver decisive effects, despite the context.

Bringing together the right people with the right skills in the right areas is critical for our Air Force to achieve an environment where responsive and innovative capability development is the norm. And the Air Warfare Centre right now is working hard to provide this environment and deliver these outcomes for Air Force.

TOP–DOWN DESIGN MEETS BOTTOM–UP INNOVATION

GROUP CAPTAIN PETE MITCHELL, OAM

The last five presenters have provided an indication of what they are doing out in their various FEGs [force element groups] to embrace innovation and improve their individual capability and with the resources and the people that they have. There are other examples, and I'll bring a couple of those to your attention.

One of those that Stu Bellingham indicated but didn't expand on, was heat management within Operation *Okra*. He gave an indication of how troops and junior officers could look at a risk and work out a way to achieve the task through innovation. The environment that we faced was 52 degrees in the shade with aeroplanes that were not under shelter and a mission launch time of about three o'clock in the afternoon in the Middle East. That was providing us with temperatures of 67 degrees on the flight line itself. And when we applied the normal heat management process to that, the answer came down that we could have troops out there, working on and launching those Hornets, for [a maximum of] 15 minutes.

Now, that's not going to work for an hour-launch cycle. So how are we going to put these people out there in harm's way? It was the corporals, LACs [leading aircraftman] and the flight lieutenants that came up with the solution. They explored the option of getting a cool vest, a knitted vest with capillary tubes, ice water and battery packs, that would allow them to get out [on the flight line] and operate in those temperatures for the hour without exceeding any sort of health and safety regulation. Without that innovation, I either (a) needed a lot more people, four times the number of people to launch that aeroplane, or (b) I just couldn't get the job done. But they looked at it, they problem-solved, innovated and came up with a solution to achieve the mission.

Within Air Combat Group, there are a number of activities that are happening and one of those, in particular, is within No 4 Squadron. Four Squadron flies the PC-9. They fly with a Winjeel smoke grenade launcher trying to deliver a simulated JTAC [joint terminal attack controller] training capability to combat controllers, Special Forces and land forces who will later employ high-end air combat capability in the field as JTACs. As a bottom-up initiative, they've now identified a wireless and self-powered pod that can be attached to the wing that can provide a video downlink to simulate rover-like capabilities without the requirement to have integration with the platform with wiring and testing. It also provides feedback into the cockpit or down to the ground to provide a capability that can simulate a more expensive capability that you might see on a Hornet, Super Hornet or P-3. Again, this was bottom-up innovation where they looked at breaking through the long, perhaps traditional, testing or integration process. They found a battery-powered pod, put it on a PC-9 and now we can do JTAC training using video data link without the need for an expensive platform to sit over the top of them.

Furthermore, we looked at how we are going to integrate forces in the future. Certainly, the 'classic' Hornet and Super Hornet have been looking at how they can interact together as they explore the integration problems, or at least explore the integration opportunities that are available when we start blending various 4th- or 5th-generation aeroplanes or platforms with others.

The integrated tactics that have been developed within Air Combat Group, where multiple 'classic' Hornets can be enabled by a single Super Hornet using its advanced radar and data link, can actually increase the lethality of the whole force. This starts stepping up the tactics and techniques that are going to be required for the current generation of fighter pilots to transition to the JSF [Joint Strike Fighter], Super Hornet and Growler. As they start moving forward, they will already have some of those key skills and knowledge to do that.

Bottom-up innovation doesn't just sit within ACG [Air Combat Group]. Just recently, Super Hornet and Wedgetail units have explored means to start developing interoperability that is truly a 5th-generation capability. The outcomes of a recent exercise in the United States have been extremely promising in how those two capabilities can work together.

And that has not been led from the top down. It was the mission commanders on Wedgetail exploring and engaging with the fighter combat instructors within Air Combat Group. They had a look at how those systems will work together and how they could develop the TTPs [tactics, techniques and procedures].

And that leads into the Air Warfare Centre and how, not only ACG and SRG [Surveillance and Response Group], but now Air Mobility Group and others, can develop those integrated tactics. All of that comes from the bottom-up innovation that we are seeing from the tactical leaders and the troops on the ground.

Finally, as we look at the power of bottom-up innovation, we need to accept that there'll be some risks in having bottom-up innovation. If you're a commander, you need to try to support those troops and those junior officers as they explore those risks and provide them, perhaps, with some guidance. But ultimately, you need to take a risk yourself in that the reputation of your command could have a chance of being in jeopardy. In the end, if we don't start exploring those boundaries, and accepting some risks, we will never be able to push to innovate, perhaps to the level that we should.

Certainly as senior commanders, we need to support the COs [commanding officers] that may try to step forward. Every now and again, they will overstep the line, they may spend money they're not supposed to but it will be our behaviour as to whether they get punished or a lesson-learnt-and-move-on approach that will really foster a culture of bottom-up innovation.

RECRUITING AND MANAGING GEN Y–HOW TO DEAL WITH THE WORKFORCE OF TOMORROW

MR BERNARD SALT

I have a very simple proposition and that is that the Australia you have known over the last ten years, the work force that you have known over the last ten years, is a vastly different proposition to the Australia that you will know, to the work force that you will know, over the next ten years. I think it is more than a simple shift in the generations, from Baby Boomers to Generation X to Generation Y. I think it is also a cultural shift, an ethnic shift and a settlement shift of the Australian people, which impacts the work force.

I want to start by taking a big-picture perspective and make an observation about Australian culture. We are told that we are extraordinarily innovative. I want to show you two slides to make an observation about that statement that we take as a given; that we are as a people, as a nation, as a work force, extraordinarily innovative.

We need innovation to create the jobs of the future

	United States	Year	USbn		Australia	Year	USbn
1.	**Apple**	**1976**	**522**	1.	**BHP Billiton**	**1885**	**110**
2.	**Google**	**1998**	**508**	2.	**Commonwealth Bank**	**1911**	**94**
3.	**Microsoft**	**1975**	**412**	3.	**Westpac Banking**	**1817**	**72**
4.	**Exxon Mobil**	**1870**	**321**	4.	**National Australia Bank**	**1893**	**51**
5.	**Facebook**	**2004**	**311**	5.	**ANZ**	**1835**	**50**
6.	**Berkshire Hathaway**	**1955**	**310**	6.	**Telstra**	**1901**	**48**
7.	**Amazon.com**	**1994**	**298**	7.	**CSL**	**1916**	**35**
8.	**Johnson & Johnson**	**1886**	**283**	8.	**Wesfarmers**	**1914**	**33**
9.	**General Electric**	**1892**	**266**	9.	**Woolworths**	**1924**	**22**
10.	**Wells Fargo**	**1852**	**250**	10.	**Macquarie Group**	**1970**	**18**

Source: Bloomberg Terminal Data as at 26 January 2016; KPMG Demographics

Table 26-1: Ten Largest US and Australian Companies and Their Years of Founding

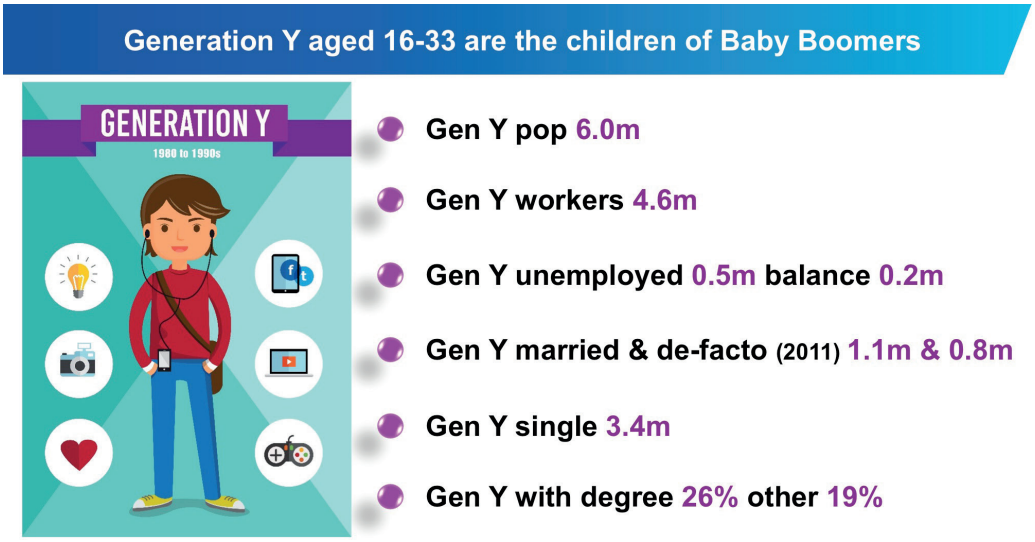
Let's have a look at the ten biggest businesses in the US and compare that with Australia. Here is the top ten businesses in America based on market capitalisation and this is the share price. Multiply it by the number of shares—and you'll appreciate that this bounces around from day-to-day and certainly from year-to-year. The biggest company in America, in a private sector sense, is Apple, of course, at $522 billion. If you want to buy it, it's about half the Australian GDP [gross domestic product]. Then of course, Google and Microsoft, Mobil, Facebook,

Berkshire Hathaway, Amazon, Johnson & Johnson, General Electric and Wells Fargo. I've also included the year in which each of these extraordinarily large businesses was founded.

Now let's have a look at Australia, innovative Australia. Let's see how we compare effectively with the world's best innovators, if you like. America is ten to 12 times the scale of Australia, so the size of the businesses reflect this. BHP Billiton is $110 billion in market valuation, formed in 1885 in Broken Hill. Then there's CBA, Westpac. The [important] column is the year in which these businesses were formed. If you exclude the Macquarie Group, show me the company that has been formed later than 1924.

Are we an innovative people? We project that sentiment, to the rest of the world and across Australia. No we're not. We are an absolute mile from innovation. We do not take risks at a national level. We need to be more entrepreneurial, more enterprise-driven. We need to cultivate a culture of entrepreneurship, of enterprise. Not necessarily like the Americans, but we can certainly see what innovation can do. Boldness, a culture of admiring enterprise, delivers an economy like this where six of the top ten were formed, in fact, within the last generation.

Figure 26-2: Generation Y Statistics



Of course, that all plays out in terms of the work force that Generation Y is moving into. Here is Generation Y. These are people who are now 16 to 33 years old. Between 33 and about 52 is Generation X, 52 to 70, the Baby Boomers. [There are] about six million Gen Ys on the

Australian continent. There's only 24 million people here; about 25 per cent of the Australian population form the Generation Y cohort, if you like; 4.6 million workers, half a million unemployed. 1.9 million are married or de facto and a lot of them [3.4 million] are single. A lot of them [are] highly educated. Highly educated, well travelled, global, digitally connected and vast in number, forming the broad, fat base of the Australian work force pyramid today. And the purpose of this presentation is actually to explore their values, their society, the community into which they are evolving over the next decade or so and that you will be recruiting from.

Let's have a look at the big picture of Australia; 24 million people on the Australian continent. I want to identify the top ten tribes, the largest communities by ethnic origin on the Australian continent. Here is the top ten.

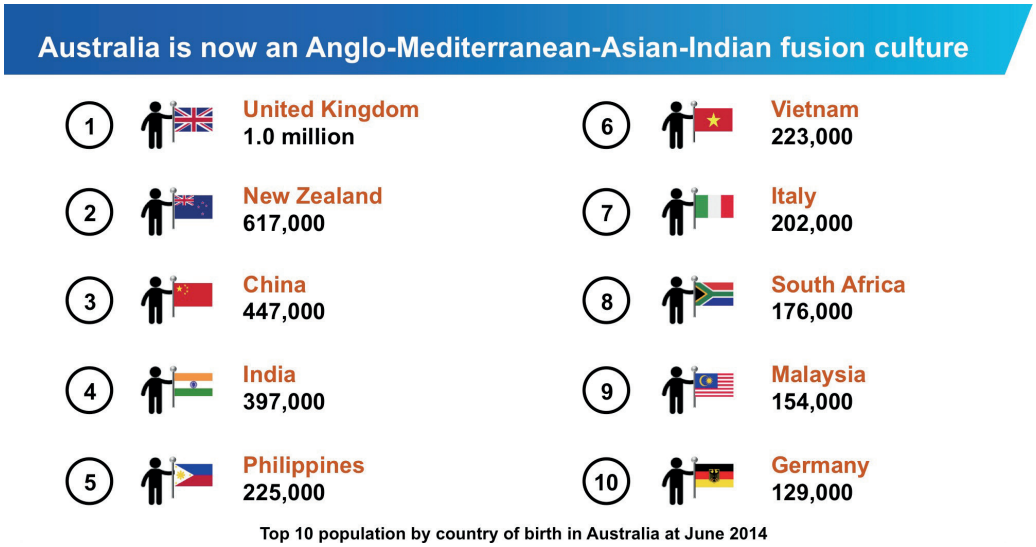


Figure 26-3: Australians by County of Birth in June 2014

Out of the 24 million people on the continent on the continent, one million were born in the UK, ten-pound poms that arrived here in the 1950's. Six hundred and twenty thousand people living on the Australian continent were actually born in New Zealand. There's only 700 000 on the South Island of New Zealand, and this number's growing more rapidly. Then of course, the Chinese—let's say half a million Chinese; then 400 000 Indians; then the Filipinos; then the Vietnamese and the Italians. The Greeks are down at about number 12 or so.

There is a story behind these numbers. When I see a chart like this, I see an Anglo, Mediterranean, Asian, Indian and rising Arabic fusion culture. Is this not the story of the Australian nation and people? Seven million people out of 24 million were actually born overseas. That is 30 per cent. No nation on earth that has a higher proportion than 30 per cent born overseas where the critical mass is more than 24 million people. Canada is 20 per cent; the US is 13 per cent; the UK is 12 per cent; Germany is eight per cent.

We are multicultural at a scale that is unmatched anywhere on the planet. Forty-two per cent of Sydney's five million people were actually born overseas. If you put in one parent born overseas, it will be up around 55 per cent to 60 per cent. In New York, 29 per cent born overseas; in Paris–18 per cent born overseas; in Melbourne–37 per cent; in Perth–41 per cent. We are multicultural at a scale that is simply unmatched by other countries that we do business with, certainly certainly those that are our cultural peers, in fact, it makes us different. So I actually think that we are a fusion culture.

Back in the 1950's or '60's when there were Greek and Italian migrants, when the Greeks, the Italians arrived here in the 1950's, we regarded their food as wog food. But by the 1980's, we realised, 'Actually, your food is better than our food'. By the 1990's we started to eat out on the pavement, as they did, as they did in the piazza or the plaza. It took us 30 years–1950 to 1980–but ultimately there was a cultural fusion. Out with tea, in with coffee, in with arugula, olive oil and pasta. Men and women started to kiss each other on the cheek. This is a continental affectation that we have absorbed as a consequence of the Mediterraneanisation of our culture, from that 30 per cent of the Australian population, and more, that was not Anglo heritage. We are a vastly different people and culture to what we were ten, 20, 30 years ago, in fact.

Even our sense of style has shifted. If you had bought a fashionable terrace house in Sydney's Paddington or Melbourne's Albert Park in the 1980's and you wanted to put on an extension, it would have been one in a Victoriana style. By the middle of the 1990's, that extension would have been done as a glass and concrete minimalist cube, very Milanesque, when you think about it.

Our affectation, our sense of design, our palate reflects the reality of our demographic. The demographic that is rising is Asian and Indian. What does this mean for Australian values, behaviour and thinking by the middle of the 2020's … 2025 or so? The Greeks and the Italians Italians arrived as labourers, worked damn hard and prospered over the course of a generation. The Chinese and the Indians are coming in through university. They will find their way through to middle-class prosperity very quickly. They will reshape Australia; fuse Australia in a different perspective and a different direction going forward.

Here are the top ten tribes. You can't be in the business of demographics and not have cool acronyms like Yuppies and DINKs [Duel-Income-No-Kids]. Here's some of the coolest acronyms which describe the latest tribes of Australia, starting with the PUMCINS, and I suspect that everyone here is a bit of a PUMCIN which stands for the Professional-Urban-Middle-Class-In-Nice-Suburbs. You can tell PUMCIN men on a weekend; they wear polo shirts,

chinos and boat shoes. PUMCIN women wear their active wear absolutely everywhere. And you can tell if you come from a PUMCIN household if there's goat's cheese in the fridge. I have this theory that households that eat goat's cheese do not eat McDonald's. They are mutually repellent. I think that Melbourne, Sydney and increasingly Brisbane, have what is known as a goat's cheese curtain. It's about five kilometres out from the CBD and you're either inside or outside the goat's cheese curtain.

Then of course you have the NETTELs. This is the young power couple, 35 to 45, kids under the age of 15, both partners working, household income of more than $180 000 per year. The NETTEL hotspot in Melbourne is Albert Park; in Sydney it is Paddington and in Brisbane it is New Farm. NETTEL stands for Not-Enough-Time-To-Enjoy-Life and you can tell if you come from a NETTEL household if after the evening meal, you and your partner get out your iPhone and coordinate the next day's activities. And if you email the schedule to your nanny, then you're an uber-NETTEL. I have seen that done.

My personal favourite however, are the KIPPERS. These are the young 20-somethings, generation-wise, that live at home with their 50-something mum and dad, K-I-P-P-E-R-S, Kids-In-Parents'-Pockets-Eroding-Retirement-Savings. I have a couple of KIPPERS myself. And then of course, everyone knows some LOMBARDs, L-O-M-B-A-R-D, Lots-Of-Money-But-A-Real-Dickhead.

Talking about the work force over the next ten years, in strategic thinking, my logic is, never look forward until you first look back. Let's have a look at the last ten years in terms of the Australian population. Over the last decade, we have added 3.6 million people. We've gone from 19 to 23 million and here is where the demographic has changed. We've added 250 000 extra kids: the baby blip; the baby bonus; Gen X, Gen Y jumping on the baby bandwagon. The kid business was a good business to be in, in Australia, over the last decade.

Then up here in the 20-somethings, the cafes and restaurants and the generation going to university. You should have got into student accommodation about 2002. And then up here is the Baby Boomers in their 50's and their 60's and they're sea changing and tree changing and superannuationing. Has this not been the story of Australia over the last decade? Absolutely fascinating but completely irrelevant because it is the last ten years.

Over the next decade, Australia will add not 3.6 million, but in fact, 4.2 million. Australia is a good place to do business in building building, construction, retail, and infrastructure. But if you look at the demographic and say, 'Well actually, we're not going to lift the birth rate any further'. In fact, we've lifted the birth rate from 1.7 to 1.9 births per woman. We won't lift it to 2.1 because that's the equivalent of the American birth rate and that's underpinned by the black and the Latino population. We won't compare with that going forward.

But all those babies born in the last decade pop up now in primary school and junior secondary schools, suburbia and sports activity. Junior Auskick would be would be a [good] business. And remember that student accommodation business that you got into over the last ten years? Get

the hell out of it in 2010 because the demographic rolls out of their 20's, into their 30's. What do 30-somethings want? They want affordability, they want a career, they want surety, and they want a lifestyle. How can you build your business, how can you configure your proposition to fit into the ascendant demographic of the Australian people over the next decade?

I'm very sorry to say Baby Boomers, but there's not enough Generation Xs coming along behind to compete for your residential property in suburbia. You won't get the price tension in the next decade that you got in the last decade. All those Baby Boomers now move out of the work force, into early, active retirement. It's not old people. You can bleed to death in business waiting for a demographic.

Show me an ascendant demographic right here, right now that is shaping the Australian consumer market, work force, consumer spending culture, and I would say, ten to five to 15 year olds, 30-something's and 60's into the 70's, Baby Boomers. Hips and knee replacements would be a business to be in. Financial planning, succession planning would be a business to be in.

I don't know whether you've noticed Saturday mornings in tabloid newspapers. For about the last two years in the travel sections, there's been advertisements and photographs for what I call 'Rhine River Cruises' and you see a photograph of a Baby Boomer couple, clinking a champagne glass as they glide past Budapest Castle. Exactly the right product at the right time aimed at an ascendant demographic, in fact, volunteering as a business. How can you be a fan? How can you volunteer? How can we marshal those resources to build a community, to build resilience into the community? Big picture questions; big picture observations.

Again, I never like to look specifically at individual figures. I like to get really, really high and make observations.

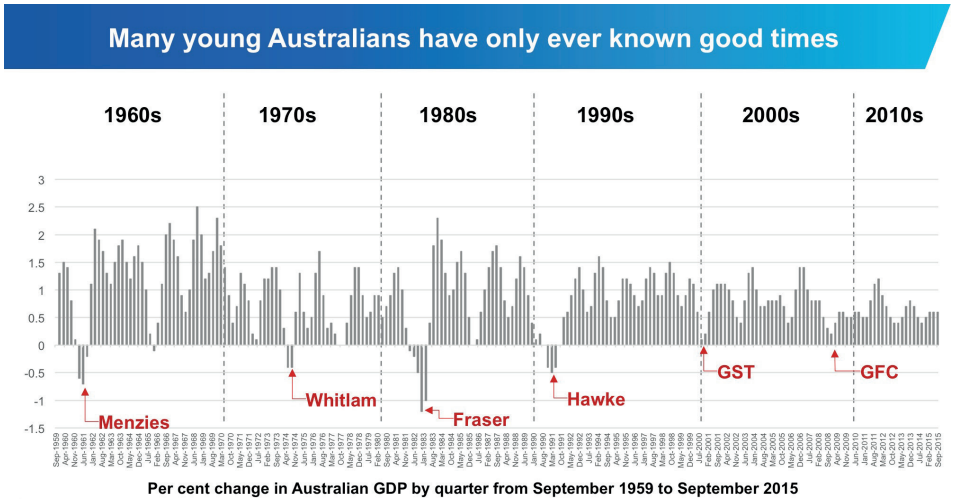


Figure 26-4: Australian Gross Domestic Product Change by Quarter

Come with me across Australia over 60 years, from September 1959 through to December last year, 60 years, in fact. Figure 26-4 is a chart showing GDP [gross domestic product] growth quarter-by-quarter for 60 years. Don't look at the individual numbers. I'll walk you though it.

When you have two negative quarters together, you have a recession. If you had a choice to be a 25-year-old entering the work force for the first time, or starting a business for the first time, in any year of Australian history for the last 200 years, what year would you choose? I would choose that year, 1993. I would have been born in 1968, and be 25 years old [in 1993]. I would not have known it at the time, but I've got 25 years of economic prosperity [ahead of me]. So you're 55 years old today, you look back and you say, 'I've been pretty damn successful in my career'. Maybe you should have been pretty damn successful in your career because you have had a dream run.

Imagine, for example, if you had have started a business in 1959. You probably remember the Great Depression. You might have even fought in World War II, in fact. And the type of people you're selling the product to, they remember the Depression. Don't get ahead of yourself; don't take out credit; save for a rainy day.

This is where Generation Y differ, the people that you are recruiting, this is their space, this is their time in history, this is the planet from which they come. 'There is no recession. Why would I save for a rainy day? I can max out my credit card. I can toss my job in. I can go to London. I can come back, live with mum and dad. I'm not committed to marriage or mortgage or children or career. I can live in the moment. Why would I plan for the future?' I would be living in a particular bubble. It is only Generation Y at this time in history that could possibly have invented a concept called YOLO–You-Only-Live-Once. 'Why would I plan for the future?'

The other point that I would make is that there is no-one in business, no-one in Government, maybe no-one in the Air Force that is in management positions today, was in a management position at the time of the last recession. We have lost that corporate memory. What would be the impact on Australia, on consumer confidence, on recruitment, on defence forces generally, if in fact there was a recession? Or is the proposition that we have eradicated the recession virus from the Australian continent, [really true]? Because I think it's sitting out there somewhere and when it comes, I think the impact will be significant. What would you do? I reckon there would be retreat to security. Who offers security at some point in the future?

I've actually put this chart to the leading bank economists in Australia. None of them want to talk about when the next recession is. No-one can predict it. It might be next year; it might be ten years. I'm simply saying, probably one, two, three, four [years]–there's probably one sitting out there and it will reshape consumer spending and thinking and attitudes to security, going forward.

What does it look like in Australia back at this time in history? Here is a house in 1950. It was the absolutely quintessential Australian lifestyle. A quarter-acre block, 1000 square metres, three

bedrooms, one bathroom, a Baby Boomer family, maybe four, five or six kids. Mum and dad– dad worked, mum was a housewife. This was the model that attracted a million UK migrants to Australia at that time.

Let's have a look at what Australia looks like today at the end of that 25-year period of economic prosperity, unmatched in Australian history until the second half of the 19th century during the gold rushes. Here it is. So the house block has gone from 1000 square metres to 500 square metres; three bedrooms is now four bedrooms; one bathroom now two bathrooms. Instead of one income earner, there's two income earners. Instead of six kids, there are two kids.

Come with me into the [1950s] family home. So you come into the porch, into the lounge room. The lounge room is the good room, the parlour, if you like. This is the room where you showcase wealth and prosperity of the family, the social status of the family. There might be a mahogany hallstand, sideboard, with a silver tea service.

Come into the modern house, in through the portico, not the porch, the portico. Into the family/dining room/kitchen room, if you like. And then you think, 'Well it's indoors … what's this space called? Alfresco.' Where did that come from? The Greeks, the Italians arrived here and said, 'Why are you Australians living in an English house? You have a Mediterranean climate.' And just as they shifted our palate, our behaviour, our sense of design, our affectations, they changed the way we live; indoor/outdoor, there is now an island bench. And if you entertain people in front of that island bench, then the island bench needs to be a marble bench-top, waterfall style. And in the centre of that will be a silver gooseneck tap. It's the new silverware. The tap ware is the new silverware. And the cupboards behind will be bespoke, minimalist, in fact. And they'll have either Austrian or Danish closing mechanisms, soft closing. And we try and weasel that comment into the discussion to showcase our globalness, if you like. This is how we showcase wealth and prosperity in Australia today.

Let's move forward to look at how the life cycle has changed in Australia over 80 years. In 1936, the average Australian lived for 63 years. You qualified for the aged pension at 65 so you promptly dropped dead two years before you got a pension, back in 1936. The other thing to note, in 1936, you're a child for 14 years and then you're an adult. The life form we know as a teenager did not exist in 1936; [it was] childhood, adulthood, old age and death. That's the way it worked. No need to save for retirement because everyone expected to drop dead in the workplace. That's the way it worked.

Forty years later in 1976, life expectancy is now 71. Six years in retirement. And the term 'teenager', an invention of the Baby Boom generation, suddenly emerges. And you probably need it because the type of work we're doing needs more education. You need to complete secondary school and you're now not old until well into your 60's. But basically, you get six years of retirement. We can sort of manage that.

Here is 2016. Life expectancy is now 82–that is 17 years in retirement. Although the most common age at retirement for an Australian is not 65, it is 58. That is 24 years in retirement. What are you going to do? Sit at home and babysit the grandkids for 24 years? Baby Boomers will not do that–I think they'll reinvent that space. I think we will see the evolution of a 55 to 75 lifestyle stage in the life cycle; work five days, then four days, then three days, then two days, then one day.

I want to resign my commission; I want to resign my engagement and come back as a tutor, as a counsellor, as a director, as a volunteer, as a coach, if you like, life coach, whatever it is. Is there a role for that? How can you harness that energy? This will come from Baby Boomers going forward, looking to actually reinvent that 55 to 75 stage in the life cycle.

This idea of a generation reaching in and changing the way life is lived over a decade has occurred before. Gen X and Gen Y picked up the teenage phase in the life cycle invented by the Baby Boomers. They've picked it up and they've stretched it. I think you're now a teenager between the ages of 13 and 29. All of the measures of the transition into adulthood that Baby Boomers made at 21, 22, 23–commitment to marriage, mortgage, children and a career–has been kicked out by Gen X and Gen Y to 28, 29 or 30.

And in fact, the driving force behind that, I think, is a postponement of commitment to marriage. In 1971, the average age at first marriage for an Australian woman was 21. She was a Baby Boomer born in 1950. She would have announced her engagement on her 21st birthday otherwise she thought she was going to be left on the shelf. Today, the average age of first marriage for an Australian woman is 29. Eight years–it's opened up cafes, bars, restaurants, gap years. Who had heard of a gap year ten years ago? This was an invention by Generation Y, paid for by Baby Boomer parents, designed to extend that period of adolescence. And in fact today, if you were to announce your engagement on your 21st birthday, you would be regarded as a loser. You should have completed tertiary education, paid off HECS and travelled overseas. The narrative of life has shifted. We're not making commitments–marriage, mortgage, children, career–at 30.

Baby Boomers want to create a lifestyle stage in the life cycle between 58 and 75. What is the product? What is the service? What is the marketing? What is the configuration of business that will capture this fluid, mobile, agile generation who don't want to make commitments, going forward?

Let's have a look at each of the generations. The Baby Boomers, born 1946 to 1964, deeply hierarchical, raised by that frugal generation that touched the Great Depression; one of four, five or six kids. If you're one of six kids, you understand concepts like deference, hierarchy, waiting your turn and hand-me-down clothes. If you're a single kid raised by rich parents in prosperous times, you wait for nothing. 'I want it and I want it now.' How does that fit with a military organisation or a professional partnership? Also, the Sandwich Generation, they're dealing with their 20-something kids as well as their 80-something parents.

Then of course, you have Generation X, today's 30-somethings and 40-somethings, always in the wrong place at the wrong time. I regard the Xs as the 'pissed off' generation. They are sick of Baby Boomers. They're sick of Generation Y. Baby Boomers got fee-free tertiary education, 1972 to 1987. When did Xs go to university? Late 1980's, in came HECS. When did Xs go into the work force? Early 1990's, unemployment peaked at 12 per cent. Then they went into the work force, waiting to get their hands on the top job, working to Baby Boomer management.

Just after the Year 2000, into the work force came young Generation Y, and Baby Boomer management's focus went straight to the Ys. 'Are we paying you enough, Generation Y? Is anyone being mean to you, Generation Y? Can I get you a pillow, Generation Y?' 'Bugger Generation Y. You didn't do that for me when I started in the work force.' The good news for Xs is that you've now got your hand on the top job and now you can wreak your revenge on Generation Y.

Then you have Generation Y—in fact today's teenagers and 20-somethings. This is the 'special generation'. From the age of five, they've been told they are special by their parents, by their teachers, by their employers, which is all well and good, but what happens when this 'special generation' wakes up at the age of 35? They're married with a mortgage and kids, looking straight down the barrel towards middle age. They wake up one day and they realise, 'I'm not rich; I'm not famous; I'm not a celebrity; I've been lied to all my life'.

Of course, it will all be someone else's fault. How can their middle age possibly live up to the expectations of their youth, not necessarily as a consequence of society's cultivation but maybe just the time in history? Twenty-five years of economic prosperity, 'I'm entitled to a certain standard'. There'll be big expectations of what I expect life to be in my mid-30's. And if it's not delivered, how do I get out of it? How can I? What is the pathway going forward? Very entrepreneurial, digitally connected, and globally travelled.

Then of course, you have Generation Z. These are the children of Generation X. In fact, the Americans call this the 'Millennial Generation', I think because they can't pronounce the letter Z. So the Zs are the children of Generation X women, the second generation of women who went back to work. They carry absolutely no guilt about this. 'Look kid, I work, get over it. You're not special, that's the way it is.' No-one steps out of line in a Generation X household. Different generations.

Generation Y is the Peter Pan generation, raised to adulthood in this extraordinary period of economic prosperity by two parents. And indulged because there are only one or two kids per household.

Generation Z have a different mindset altogether, maybe they will be your recruiting targets in the 2020's. These are people that have been raised in a post-GFC [Global Financial Crisis] world: rising unemployment, rising taxation, rising uncertainty, the pragmatists looking for security, perhaps, going forward. You are recruiting at an extraordinary time in history. Generation Z–an

extraordinary generation at an extraordinary time in history. Maybe Generation Z, raised in a different world, will have a different attitude to working in the military.

I want to talk about the perfect global corporate citizen. I ran a conference in Washington six years ago. It was just after the GFC. And I had the HR [Human Resources] Directors of KPMG's global businesses in the room and I went through what were the attributes of the perfect global corporate employee. And in fact, here is what they came up with. It was just by discussion.

If you are recruiting for a senior position who could ultimately go into the C-suite—so this might be a Deputy CFO [Chief Financial Officer], for example—the ideal is around about 38 to 42, because you reach your career peak at 42 to about 48 in the corporate world. They have a partner that's agreeable to move, a law degree or a business degree or an MBA, for example. You need two degrees to compete in this space. You need a second language. And in America it was English, the second language was in fact Spanish; that they may have lived abroad in their youth. They may have worked on a World Vision campaign in Tanzania, experience of running a division.

This guy put up his hand and said, 'Possibly been involved in the military'. The entire room stopped, said, 'What … why is this?' And he said, 'Well I have found that people in the military are used to working for a global organisation. They take orders, they move around and they get things done.' And everyone said, 'Yep, I get that, accepted'. And [they] have a global mindset.

Let's compare this ideal global corporate employee with Generation Y—today's 16 to 33. No relationships, not committed to marriage, mortgage, children or career. They can be shuffled around much more easily, perhaps, than previous generations. No mortgage, no debt, widely travelled, possibly have a second language. They did backpacking years or gap years. The New Zealanders talk about their OE [overseas experience]. In fact, possibly involved in volunteer work. All of this is tick, tick, tick, tick, tick. Everything [is] going really quite well until this idea of actually committing to an organisation. The first time that you come up against a blockage, do you toss it in and head off to London or do you stay in that organisation and work through? And that's the great challenge for Generation Y.

Let's move through this quite quickly. Here is job growth in Australia in the 21st century. From November 2000 to November 2015, the number of jobs added on the Australian continent is 3.3 million; full-time, part-time, good jobs, bad jobs, high altitude demographics. We have lost 300 000 jobs. For every job we lose on a car assembly plant, we create ten jobs. Ten to one, that's a pretty good ratio. It's not a bad outcome; three million in net terms.

Where are the happy jobs? What parts of the work force are expanding at a rapid rate? Where should I actually look to recruit skill sets? And it's up here–healthcare and social assistance. Seven hundred thousand net out of three million over the last 15 years; professional services, construction, education. When you look at the jobs that are contracting, it's manufacturing and

agriculture. Never look at the numbers. What is the common denominator between the left-hand and the right-hand side of the chart? And I say, in order to share in the prosperity of modern Australia, you need either a university degree or technical training. These are knowledge workers, in fact, or people with capabilities and skills, technical skills. The sort of skills you would get in the military, you would think.

Down here, what happens to these people? Well these are unskilled, low skilled, barely skilled people. Where do they get a job in the back half of this decade if all those sectors that once absorbed that labour have off-shored that to Guangzhou? Well they don't get a job. Does this set up an Australia where there is a 'them' and 'us'; a community that's disaffected, disconnected, feel they do not have a chance to participate in the prosperity of the Australian people and economy? Does that lead to radicalisation? How would you mitigate against that–volunteer programs, engagement programs? Is there a role here that we can play in the military and beyond? I would certainly suggest that would be the way forward.

And finally, a couple of key points: forces shaping the work force of tomorrow [should] focus on education and training, continual learning and to inspire Generation Y in the workplace. Develop workplaces that are collaborative, flexible, innovative, diverse and that engage workers. Recruit soft skills. We cannot predict what the technical skills will be required in 2025, let alone 2035. But I think that what you can do is create fluidity, flexibility.

'You know your job as a welder has now been retrenched because we've got this new technology. We don't need welders anymore. But if you introduce yourself to those people over there, then I think there is a job going in some other sort of fabrication.'

'I'm a welder. I will wait till a welding job comes up. And besides, I don't know those people.'

If you are fluid, if you are flexible, if you are self-confident, if you are articulate, you have future-proofed your career. How can the military, how can KPMG, future-proof the careers, the skill sets of its young Generation Y workers? Fluidity, flexibility, mobility, adaptability, learning on the job. I don't know what the jobs will be, but I have a mindset that embraces change, that looks forward to change, that is not threatened by change. That is how you future-proof a work force going forward. Create a culture of innovation. We proudly proclaim this in Australia. We do not have the evidence. The Americans have the evidence. We've got a long way to go.

How can we actually create; how can we actually harness ideas? I've suggested we need a festival of entrepreneurship, of enterprise at a country, city and town level, in order to cultivate this idea of admiring and emulating people that actually create a business going forward. And then finally, provide opportunities for global engagement and to expose a work force to [the] word's best practices, and I would certainly think the military is best able to do that.

And finally, just two more minutes, I want to introduce you to some new research that I've done on the results of the most recent census. I've scanned every suburb, every neighbourhood, every town and every precinct across the Australian continent using the census in order to find

Australia's bachelor hotspot. Where is the highest concentration of eligible young bachelors across Australia? And by young, I mean 25 to 34, five years either side of prime marriageable age; and single, separated, widowed never married or divorced. These boys are on the market.

Where is the highest concentration of eligible young bachelors relative to eligible young women? I've run the numbers and the highest concentration is to be found in the South Australian township of Roxby Downs. In fact, technically–according to the census–there are 1.88 young single men per young single woman in Roxby Downs. Clearly the Roxby Downs pub on a Friday night is the place to be.

I have in fact done this analysis for every major city in Australia, including my hometown of Melbourne, and the bachelor hotspot in Melbourne is in a suburb known as West Footscray. And I have been told that the odds might be good but the goods are odd in [Footscray] … I would never say that, but I've been told that.

You can, in fact, do exactly the same analysis for eligible young women. The highest concentration of eligible young women, relative to eligible young men right across Australia, is to be found in the New South Wales town of Mullumbimby, inland from Byron Bay. Technically, there are 1.63 eligible young women per eligible young male in Mullumbimby. Mullumbimby is actually joined to, or connected with, Roxby Downs via the Barrier Highway, which I think should be renamed 'The Highway of Love'. Bring together the boys of Roxby Downs with the girls of Mullumbimby.

STRATEGY LED–DELIVERING *JERICHO* FROM THE STRATEGIC HEADQUARTERS

AIR VICE–MARSHAL WARREN MCDONALD, AM, CSC

Chief of Air Force, distinguished guests, ladies and gentlemen, I'll talk to you about some of the challenges of innovation inside the Royal Australian Air Force and why it is difficult for an air force that has a rather rigid structure to make it all come together, because there are certain challenges in there.

I would say, in opening, that out of about 1000 ideas, about three come to fruition. In a resource-constrained environment—and we all are in that—it is sometimes difficult to get a very good idea forward. Not just that, you also need the right people. Bernard has obviously taken a good view of Australia and there are no good people there to assist us on our journey. But indeed, when you look at some of the generations, there are some very impressive people that are inside Air Force, and indeed, inside Defence, in all Services and all those agencies that support Air Force.

But it is a structure, like I said, that doesn't necessarily like someone who lies on the outer, someone who is disruptive, has a very intelligent mind and can cause tensions inside. That's a point that Dr Thornhill picked up on, that these disrupters are sometimes difficult to contain and not always necessarily embraced by the Services.

I had some experience with that when I met a very intelligent person at a junior rank. Some people would say that's not really an aberration; it's more a reflection on myself. But this person was a member of Mensa and a very capable, intelligent person, but sometimes had trouble connecting with others. I think that's fairly reflective of some very brilliant people on the planet.

His trouble was interpersonal skills and he was the squadron leader that sat above me. We were in a small unit and above him was a wing commander. His trouble was highlighted in his annual report by the wing commander, quite brutally laid bare, so much so that the squadron leader, not to litigate his annual report, but to understand more, packaged it up in an email and sent it out to his subordinates. Now I think we're aware of 360 degree reporting, but this put an edge on it. And he was asking for feedback. So when it came up on the computer screen, I thought of one word and that was 'brave' and then I thought, 'How many people are going to actually sit down and talk to him?' So I thought with the honesty that it had been delivered, that it was my duty to do so.

I made an appointment and sat down with him. He had the annual report on the desk and he asked me, 'Am I the person that is in this report?' I answered the question with a question. I said, 'When you see me walk in on Monday morning, up the corridor, do you think, "How on earth am I going to talk to this person? What will I say? Why can't that person connect at the level I am at? Why do I have to have a rather mundane conversation?"' His response was, 'Yes'. Then we talked a little bit more, obviously over that point.

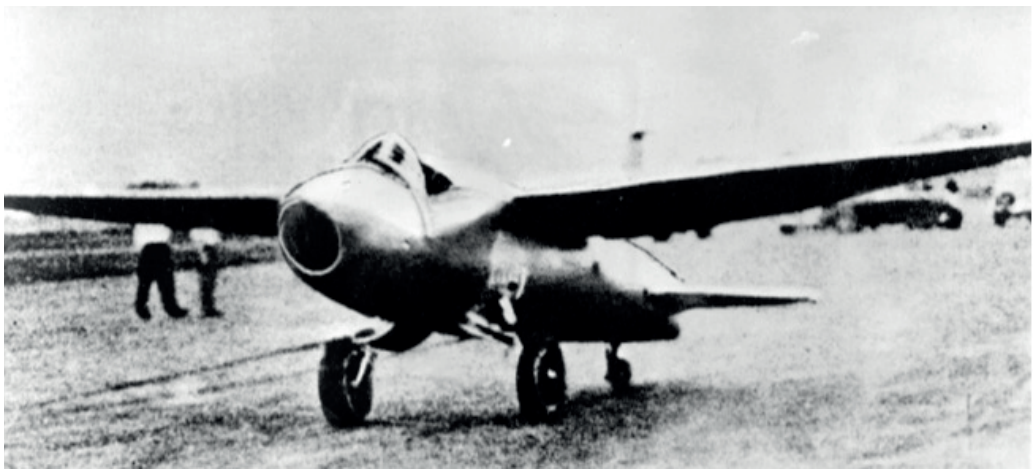
He went on to be highly professional. I went off with a little understanding of what it must be like for someone like that, trapped in a framework that does tend to bury people who have that type of intelligence. And that's a challenge for the Royal Australian Air Force. That's a challenge for Defence. If we start to get into the innovation space, we're going to have to become comfortable with those people.

You look at Alan Turing who cracked the *Enigma* code. He must have been difficult to manage. You look at other people in history that have brought forward innovations and have put up many ideas; they must be difficult to deal with, and you need a framework around them.

So a part of our challenge inside Air Force is to build that framework and that framework comes from the *Jericho* team inside Air Force Headquarters and it comes from the Air Warfare Centre. And it comes from an understanding that we need to manage these people very carefully and very cleverly because they do exist inside the organisation.

I was fortunate enough last Monday to travel across to Adelaide, to go inside the Air Warfare Centre and talk to some people in the cyberspace [section]. They were junior. They'd just come out of ADFA. And we all sat around and wondered, 'Do we have the right training systems in place?' Well I can say to you, 'We absolutely do'. They were breathtaking. I got in there at about seven o'clock or 6:30 at night. They spent their time till about 9:30, sitting down, talking to me about what they've been doing and just how far they had got in their search for answers and their search for understanding. Very impressive.

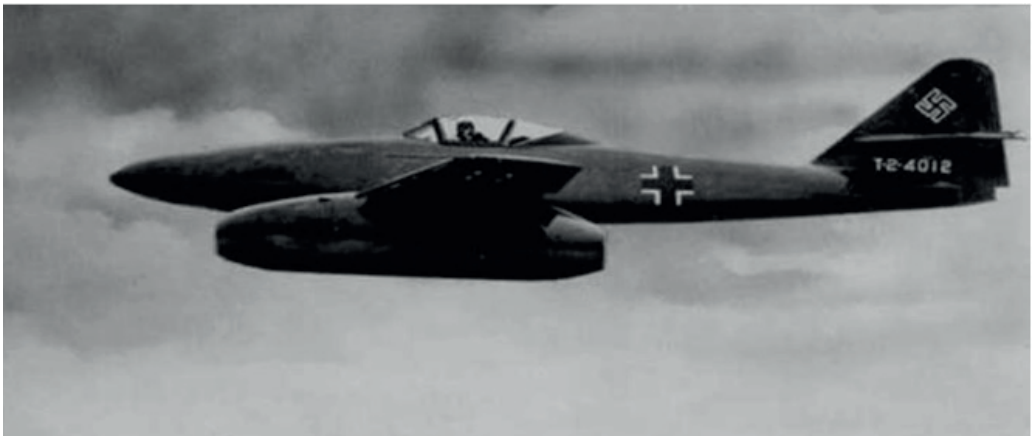
The other thing I would like to talk to you about, is history. It is instructive. It teaches a lot about some of the challenges we face.



Heinkel He 178

Now I'm going to take you back to 1939. It shouldn't be hard; you are in Canberra. And I want you to think, 'What about that? What is that?' Well, it's the 178 jet aircraft developed by Heinkel and flown in 1939. It flew at about 600 kilometres an hour. But can you imagine the frame of reference you would have when you looked at that? Most likely you'd come out of a propeller-driven aircraft. Biplanes were still flying around, and then someone showed you that. You may think it won't fly. How on earth can I make that into a capability?

And look where Germany was at that time. They were on the cusp of war. And many looked at it and said, quite rightly so, 'It's going to be a short war—1939 to 1940'. Pretty well on the mark and there were very few who could test that. But others may have looked at it and thought, 'I can't 'productionise' it. We don't have the metals. We don't have the understanding for the engines. How can I convert that into a machine of war?'



Messerschmitt Me 262

Well obviously, someone else was doing some work in other areas inside Germany. The Messerschmitt 262—in 1944 entered the fray. What framework did they have in place that enabled that? What forward-thinking people were contributing to building something like that?

Innovation is not easy. Some good examples for that aircraft were that they had to change their tactics. They realised that the 30-mm cannon wasn't accurate enough. The sight picture was so brief, they had to revert to a more accurate weapon to deliver from that platform. And how complex is that, in the middle of a conflict, a world conflict, to be able to produce something like that to the standard that it was?

I'm not sure if many people know of Captain Brown, Royal Navy. He flew that aircraft after World War II and his summary word was 'superb'. How did Willy Messerschmitt develop something like that inside the context that Germany was in in that time?

And obviously, in wartime, the war provides focus. But there are also resource constraints, similar to what we have now. We are resource-constrained but sometimes without focus. And that's up to the leadership inside Air Force, to provide the focus for the team to develop these types of capabilities that are a little far right, that are challenging. I'm not saying developing aircraft, as you see here, but what I am saying to you is, develop those capabilities that will contribute to Defence in the future, and that is the challenge that is before us.

How do we do that? Like I said, we have to establish frameworks. We have to invest in the intelligence that sits inside the Royal Australian Air Force. That is why Chief of Air Force has kicked off the Williams Scholar program. That's a part of it. Army is well ahead of us. They do invest in their people and their education and I admire them for it. We needed to do that, and that is why the Chief has supported that through the Williams Foundation. It's an important start, a small start. And I do believe it will deliver dividends into the future, because they are the people that will lead the new Air Force forward.

So in closing, whilst we talk about innovation, we talk about structures, talk about frameworks, I want to widen up the aperture and I want to talk to everybody in the room. I ask that each and every one of you assists us in our journey.

There are many instructive lessons from the air forces that sit here. General Mubarak from the UAE Air Force, whilst we may talk about what we're doing in the Middle East, it's very instructive to see what they're doing in Yemen. Their rate of effort is fourfold ours. How they combined their air force together and got into Yemen and doing what they're doing—very instructive. Incredibly well led and we should have a good insight to how they're operating over in that area.

Narrowing my focus back down now, I'll talk to industry. I ask that you assist us, that you engage with us and help us deliver the capabilities we need into the future. Many of the speakers have been very generous in their criticisms of the past, both inside Defence and inside industry, how we haven't necessarily played well together. But I do say the environment is ripe for us to move forward in a much different context. The *Defence White Paper*, the IIP [*Integrated Investment Program*], resets, as the Minister of Defence said, that relationship with industry. And it's ours to lose and I ask that we do not do that.

I narrow the focus now down to the Air Force personnel sitting in this room, to the junior members. In your hands, you hold the future of Air Force. You have the ability to shape it. Inside your minds, you have the ability to build relationships with our sister Services. I strongly encourage that you do. You have the ability to set up the strategy for the future as you move through the ranks. And it will be quick because Air Force and life moves on very quickly. So I ask that you think ahead, plan ahead, keep an open mind and start widening your focus on your responsibilities.

Air Force in the past has been quite small. It is not that anymore. And when you grow in size, you have the ability to scan further in your environment. You have the ability to reach out to the other Services and contribute to them, not pull them back. And that is the frame; that is your aperture from which you must look. You must reach out and you must support because without that, we could only be open to criticism, and rightly so. We have a duty to our Air Force; we have a duty to Defence and we have a duty to this nation and we must not fail in our endeavour.

CLOSING ADDRESS

AIR MARSHAL LEO DAVIES, AO, CSC

Ladies and gentlemen, it was about two years ago that I actually served my apprenticeship at one of these conferences, in closing the conference, as then-Air Marshal Geoff Brown had been unavoidably detained. He did however, return in time to hear me finish, so I must have done a reasonable job because now I'm the Chief and I'm here to close the 2016 Royal Australian Air Force Air Power Conference.

I don't intend at all to pull apart all the presentations we've heard over the last two days. I don't think I could really do them justice, and we will get a chance to get those proceedings published so that you can read them in slow time. And that will serve as an enduring reference to the time you spent here in Canberra.

I'm sure you would agree that each presenter has clearly and eloquently voiced his or her perspective, giving us much to take away and much to consider. I thank them all for their effort and their time in preparing, travelling and presenting to us all over the last couple of days.

Of course, below the smooth conduct of a conference lies a lot of frantic activity. Many people have worked long hours over many months, however I wish to particularly recognise the tireless efforts of Sandra Finney, of Debbie Fisher and their teams, who did indeed fret over a lot of the detail to produce, what I'm sure you'll agree, has been another successful production. So I'd ask you to please join me in congratulating the organising team, and Air Commodore Steve Osborne, our MC, in delivering the professional and solid platform on which this conference has been anchored. Thanks very much team.

To the members of the Australian Defence Force, we have recently been given very clear direction from Government in the form of the *Defence White Paper*. Operating jointly and with deepened integration is how we will best meet those requirements. Air Force is well advanced in exploring and implementing integration initiatives and we've heard many of them today. And we are keen to more closely engage with Army and Navy in building the joint and integrated force necessary for our future.

To our international guests, I thank you for your participation and wish you safe travels home. This conference has provided an opportunity for the exchange of ideas and experiences. It is imperative that we continue to explore and implement a wide range of engagement opportunities to further build upon our established relationships. Bilateral and multilateral training and exercises, staff exchange programs and contact at all levels, must feature in our interactions. In these ways, we'll continue to work collegiately in developing new ways to interoperate and to allow us to seamlessly respond together when crises call for an international response.

Finally, I'd like to thank our principal sponsor Boeing, as well as our other sponsors Rolls-Royce, L3, Defence Health and Defence Bank. Without their sponsorship, this conference would not be possible.

With that ladies and gentlemen, I would like to close the 2016 RAAF Air Power Conference and I thank you very much for being with us.