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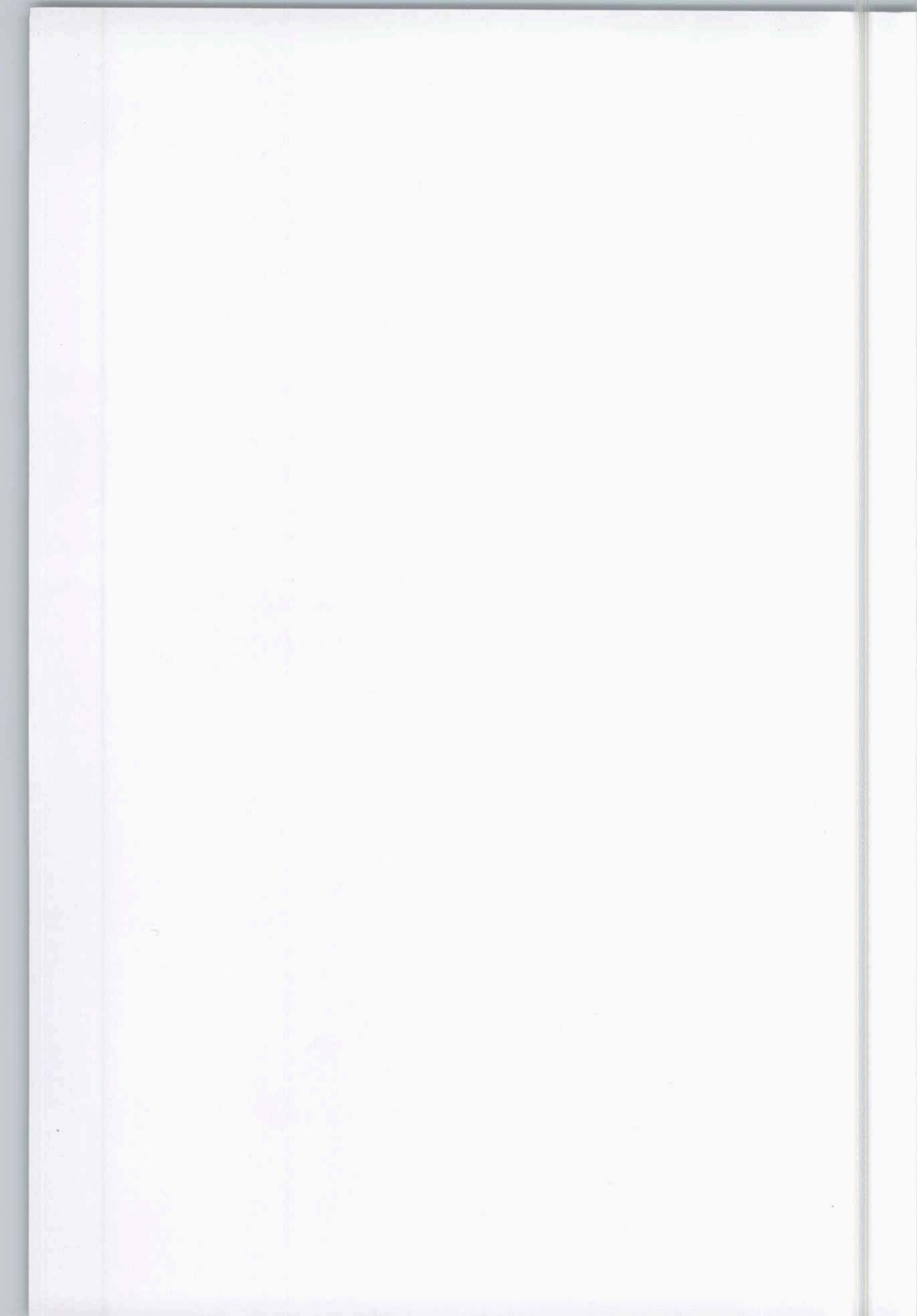# the
LIMITS

Edited by Shaun Clarke

TESTING THE LIMITS

THE PROCEEDINGS OF A CONFERENCE HELD BY THE ROYAL AUSTRALIAN AIR FORCE IN CANBERRA

MARCH 1998

EDITED BY SHAUN CLARKE

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PREFACE

Papers have been printed as presented by the authors, with only minor changes to achieve some consistency in layout, spelling and terminology. The transcripts of the discussion which followed papers have been edited for relevance, clarity and brevity. Copies of the edited transcripts were sent to authors for comment before publication.

Special acknowledgement for the style and quality of this publication is due to two people in particular: Dr Alan Stephens who played the 'chemist' in drawing the particular combination of speakers and topics to the one venue, and therefore into the one publication; and Mrs Sandra Di Guglielmo who once again provided outstanding editorial assistance.

WGCDR Shaun Clarke, RNZAF
Air Power Studies Centre
Canberra
June 1998

NOTES ON CONTRIBUTORS

AIR MARSHAL L.B. FISHER, AO, FRAeS joined the RAAF in 1960 completing navigator training in 1961 and later pilot training in 1965. He has had numerous operational flying tours on Nos 10 and 11 Squadrons (maritime patrol), holding all executive positions on 11 Squadron and accumulating over 5000 flying hours in total.

Air Marshal Fisher has held a variety of staff appointments in Headquarters Air Command; Air Force Office; and Headquarters Australian Defence Force. His command appointments include Officer Commanding RAAF Base Townsville in 1986, Commander Tactical Transport Group in 1987, Commander Maritime Patrol Group in 1988, and Commandant Australian Defence Force Warfare Centre in 1990. In addition, through an exchange posting in 1976, he has served with the USN at Moffett Field, California as the Plans and Readiness Officer for Commander Patrol Wings Pacific.

Air Marshal Fisher became Assistant Chief of Defence Force (Operations) in 1991, Deputy Chief of the Air Staff in 1993, and Chief of the Air Staff (later retitled Chief of Air Force) in 1994. He is a graduate of Joint Services Staff College. He was appointed a Member of the Order of Australia in 1987 and an Officer of the Order of Australia in 1993, and he was awarded the United States Air Force Legion of Merit in 1996.

THE HON IAN MCLACHLAN, AO, MP is the Federal Liberal member representing the electorate of Barker in the Australian Parliament. Barker is a country electorate in South Australia.

Mr McLachlan was President of the National Farmers Federation for four years relinquishing this position in May 1988. He is personally involved in one of Australia's largest export industries as a wool grower, with wool and cattle growing interests in South Australia, Victoria and New South Wales.

Mr McLachlan was director of several companies and Deputy Chairman of the South Australian Brewing Company before being elected to the Federal Parliament in 1990. Following the election of the Coalition Government in March 1996, Mr McLachlan was appointed Minister for Defence on 11 March 1996. While in Opposition Mr McLachlan was variously Shadow Minister for Industry and Commerce, Shadow Minister for Infrastructure and National Development and Shadow Minister for Environment and Heritage.

Mr McLachlan is a graduate of Cambridge University and has represented Australia in cricket. On Australia Day 1989, he was made an Officer in the General Division of the Order of Australia for his service to primary industry.

GENERAL MICHAEL E. RYAN is Chief of Staff of the US Air Force, Washington, D.C. As chief, he serves as the senior uniformed Air Force officer responsible for the organisation, training and equipage of 750 000 active duty, Guard, Reserve and civilian forces serving in the United States and overseas. As a member of the Joint Chiefs of Staff, he and the other service chiefs function as military advisers to the Secretary of Defence, National Security Council and the President.

The General entered the Air Force after graduating from the US Air Force Academy in 1965. He has commanded at the squadron, wing, numbered air force and major command levels. He flew combat in South East Asia, including 100 missions over North Vietnam. He has also served in staff assignments at the major command level, Headquarters US Air Force and the Joint Staff. As commander 16th Air Force and Allied Air Forces Southern Europe in Italy, he directed the NATO air combat operations in Bosnia Herzegovina which directly contributed to the Dayton Peace Accords. Before assuming his current position, the General was Commander of US Air Forces in Europe and Commander, Allied Air Forces Central Europe, with headquarters at Ramstein Air Base, Germany.

MRS NATALIE CRAWFORD was educated at the University of California, completing a B.A. in Mathematics (1961) and later completing Graduate Study in Engineering and Applied Mathematics (1966-67). She has worked for RAND since 1964 in a range of positions and has held three Project Air Force Directorships including those of the Force Modernisation and Employment Program, the Force Structure and Force Modernisation Program, and the Theatre Forces Program.

Mrs Crawford's areas of expertise include conventional stand-off weapons; night/adverse weather attack capabilities; tactical aircraft; aircraft survivability; munitions and targets; tactical air requirements; avionics; aero performance; electronic combat; weapons effects; off-board sensor support to combat operations; power projection force structure and assessments; theatre air defence; force modernisation and space systems.

Mrs Crawford in currently Vice President and Director of Project Air Force and also holds positions as Co-chairman of the Air Force Scientific Advisory Board (since 1996), and as a member of the Air Force Scientific Advisory Board (since 1988). Recent honours and awards include the Air Force Decoration for Exceptional Civilian Service (1995), and the title of Woman of the Year conferred by the Santa Monica Chamber of Commerce Women's Business Council (1997).

DR RICHARD BRABIN-SMITH holds an honours degree in physics from the University of Nottingham and a doctorate awarded for experiments in low temperature magnetic resonance. He joined Australia's Defence Science and Technology Organisation (DSTO) in 1973.

Dr Brabin-Smith's subsequent work experience includes: operational research with particular emphasis on air defence and anti-submarine warfare; policy and force structure analysis with the Force Development and Analysis Division (FDA); four years as Assistant Secretary Project Development; one year in the Pentagon as an analyst in Program Analysis and Evaluation; a tour as senior adviser to Paul Dibb for the 'Dibb Review' of Australia's Defence Capabilities; and posts as First Assistant Secretary Force Development and Analysis (in FDA), Head of Strategic Policy and Coordination Division and First Assistant Secretary for International Policy. As First Assistant Secretary for International Policy, he had wide-ranging responsibilities for Australia's strategic and international defence interests, including alliance relationships and the Defence Cooperation Program with regional countries.

Dr Brabin-Smith was appointed Chief Defence Scientist in 1993. In this position he is head of DSTO and Program Manager of the Science and Technology Program. For a period through 1996 and 1997 Dr Brabin-Smith was a member of the

Senior Review Panel of the Defence Efficiency Review - a Portfolio-wide review initiated by the Minister for Defence to map out future directions for the management of the Australian Defence Organisation.

DR GRAEME CHEESEMAN gained a BSc and a PhD from the University of New South Wales and is a graduate of the Royal Military College, Duntroon (1968). He is currently review editor of the *Australian Journal of International Affairs* and senior lecturer in Politics at the University College, University of New South Wales. Before joining the University College in 1992, he was a senior research fellow in the Peace Research Centre at the Australian National University and, before that, served as the Defence Adviser to the Parliamentary Joint Committee on Foreign Affairs, Defence and Trade. He has also served in the Australian Regular Army and Department of Defence. Dr Cheeseman has written widely in the fields of Australian defence and security. His latest publications include *Preparing for Australia's 'Military After Next': The Price Report and the 'New Model' ADFA* (co-author, 1997); and *Discourses of Danger and Dread Frontiers: Australian Defence and Security Thinking after the Cold War* (co-editor, 1996).

MR JOHN A. WARDEN III is an executive, strategist, planner, author, and motivational speaker with a worldwide reputation for innovations in military, political, educational and commercial endeavours. Within military circles he is most noted for having written *The Air Campaign: Planning for Combat*; and for having articulated the radically new concept of parallel war. Generals Schwarzkopf and Powell have credited him with creating the air campaign that defeated Iraq in the Gulf War.

Other posts in which Mr Warden has gained attention as an innovator have included: Special Assistant to the Vice President of the United States; head of the Air Force's Air Command and Staff College; and commander of the 36th Tactical Fighter Wing in Bitburg, Germany. He has over 3000 flying hours in aircraft such as the F-15, F-4, and OV-10, incorporating 266 combat missions as a forward air controller over Vietnam and Laos in the Vietnam War.

Mr Warden retired from the military in 1995 and started his own company, Venturist Incorporated, specialising in corporate strategy development, team building and innovation, and multi-media design and gaming. He has a BS from the United States Air Force Academy, an MA from Texas Tech University, and is a graduate of the National War College.

AIR CHIEF MARSHAL SIR JOHN ALLISON, KCB, CBE, ADC, FRAES, RAF entered the Royal Air Force College Cranwell as a cadet pilot in 1961 and was commissioned in 1964. After two tours on Lightnings he was posted in 1970 on exchange with the USAF as an instructor flying Phantoms in the ground attack role at Luke AFB, Arizona. This began a 22 year association with the Phantom, which included command of 228 OCU (1977-79) and RAF Wildenrath (1982-85). His tour in command of 228 OCU also saw him complete two seasons flying Spitfires and Hurricanes with the Battle of Britain Memorial Flight.

He was posted to MOD in 1985 as Secretary to the Chiefs of Staff Committee and then in 1987 as Director of Air Forces Plans and Programmes. Following the Royal College of Defence Studies course in 1989, he took up appointments as

Assistant Chief of Defence Staff Operational Requirements (Air Systems) and, in September 1991, as Air Officer Command No 11 Group.

In June 1994, Air Chief Marshal Allison was appointed as Chief of Staff and Deputy Commander-in-Chief, Headquarters Strike Command, and in March 1996 assumed the position of Air Member for Logistics and Air Officer Commanding-in-Chief Logistics Command. Air Chief Marshal Allison returned to Strike Command in July 1997 to take up his present appointments as Air Officer Commanding-in-Chief and Commander Allied Air Forces Northwestern Europe.

DR ANDREW C. BUTFOY is Lecturer in International Relations, Department of Politics, Monash University. Dr Butfoy has been a Research Associate at the International Institute for Strategic Studies in London and a lecturer at the UK Royal Military Academy (Sandhurst). He has also tutored at the London School of Economics and the Australian National University (ANU). Other degrees held are an MA in War Studies from Kings College (London), and an Honours degree in International Relations from the University of Sussex.

Dr Butfoy has published a number of journal articles in Australia and overseas. His most recent publications are *Common Security and Strategic Reform: A Critical Analysis* (1997) and 'Offence-Defence Theory and the Security Dilemma', *Contemporary Security Policy* (1997). Current research interests include: the strategic implications of common/cooperative security; the evolving political, strategic and conceptual framework for arms control; and the role of nuclear weapons in international relations.

MR RICHARD SZAFRANSKI is a Principal of Toffler Associates - the strategic planning and business advisory firm run by Alvin and Heidi Toffler. Dick Szafranski retired from active service in the United States Air Force as a colonel in July 1996. In his last assignment he was the National Military Strategy Chair at the Air War College, Maxwell Air Force Base (AFB), Alabama and the study director for Air Force 2025, an inquiry into the capabilities required for air, space, and information power in the next century. While serving, Colonel Szafranski commanded B-52 units at the squadron and wing level, including an assignment as Commander of the 7th Bomb Wing, Carswell AFB, Texas, from 1991 to 1993. As a multi-engine jet pilot and instructor pilot he has flown over 3000 hours. He was also the Base Commander of Peterson AFB, Colorado.

Mr Szafranski travels extensively, presenting to conferences and lecturing to staff colleges around the world, and has a wide range of written works to his credit.

AIR VICE-MARSHAL PETER NICHOLSON, AM joined the RAAF in 1968, and after pilot training served at Butterworth, Malaysia, flying the Mirage in the tactical fighter role. In 1973 he attended the Empire Test Pilots School at RAF Boscombe Down where he won the McKenna Trophy as dux of his course. He subsequently flew as test pilot, Flight Commander and Squadron Commander with the RAAF Aircraft Research and Development Unit and has amassed over 3000 hours on 40 different aircraft types.

Air Vice-Marshal Nicholson's command appointments have included Base Commander of Tindal, and Commander Northern Command. He has held staff appointments in the Air and Engineering Staff of Air Force Office, as the Director of

the Office of the Chief of Air Staff and as the Director of Project requirements for the Jindalee project.

Air Vice-Marshal Nicholson is a graduate of the RAAF Staff College, the USAF Air War College and the National Defence College of Canada. He holds degrees of Bachelor of Engineering and Master of Public Administration. He took up the position of Chief of Operations at Air Command in 1995 and was promoted to the appointment of Air Commander in 1996. He was appointed a Member of the Order of Australia in 1995.

AIR COMMODORE BRENT ESPELAND, AM joined the RAAF in 1966 and after academy and pilot training was posted to No 36 Squadron flying C130A aircraft. Subsequent flying posts have included Central Flying School tours as Chief Flying Instructor in 1980, and Commanding Officer from 1986 to 1988. He has also flown with and led the RAAF aerobatic team, the Roulettes.

Air Commodore Espeland's staff appointments have included posts with the Directorate of Personnel - Officers, and as Military Secretary and Comptroller to the Governor-General. Other appointments have included leadership of the Pilot Training Design Team (Support Command) with the introduction of the PC/9A, Director of the Air Power Studies Centre, Officer Commanding RAAF Fairbairn, Commandant RAAF Staff College, and Deputy Director of Studies at the Australian College of Defence and Strategic Studies.

Air Commodore Espeland is a graduate of the Canadian Forces Command and Staff College and the United States Air War College. He was appointed a Member of the Order of Australia in 1989 and assumed his present appointment as Air Officer Commanding Training Command in 1995.

AIR VICE-MARSHAL ERROL J. MCCORMACK, AM was commissioned into the RAAF on completion of pilot training in 1963. His flying experience includes tours on Sabre aircraft in Malaysia and Thailand with Nos 3 and 79 Squadrons and, after bomber conversion, on Canberras in Vietnam with No 2 Squadron. He converted to the F-111 in the US in 1968 and later was posted on exchange duty with the USAF flying RF4C aircraft with the 363rd Tactical Reconnaissance Wing at Shaw Air Force Base, South Carolina.

Air Vice-Marshal McCormack's command appointments have included Commanding Officer No 1 Squadron, and Officer Commanding No 82 Wing (strike/reconnaissance), both flying F-111s at RAAF Amberley. His most senior staff appointments have included Director General Operational Requirements at Air Force Office, Director General Force Development (Air) at HQADF, and Air Attache Washington. Air Vice-Marshal McCormack was appointed Commander Integrated Air Defence System under the Five Power Defence Arrangement for Malaysia and Singapore in 1995. He took up the appointment of Deputy Chief of Air Force in Canberra on 12 May 1997. Air Vice-Marshal McCormack is a graduate of RAAF Staff College and Joint Services Staff College. He was appointed a Member of the Order of Australia in 1993.

ABBREVIATIONS

AAMOUR	Anglo-Australian Memorandum of Understanding on Research
ABCA	American British Canadian Australian
ACTD	Advanced Concept Technology Demonstration
ADF	Australian Defence Force
ADHQ	Australian Defence Headquarters
AEW&C	Airborne Early Warning and Control
AFB	Air Force Base
AI	Air Interdiction/Interception
AIDS	Acquired Immune Deficiency Syndrome
ANZAC	Australia and New Zealand Army Corps
ANZUS	Australia, New Zealand and the United States
AO	Area of Operations
APC	Armoured Personnel Carrier
APEC	Asia-Pacific Economic Cooperation (forum)
ASCC	Air Standardisation Coordinating Committee
ASEAN	Association of South-East Asian Nations
ASRAAM	Advanced Short-Range Air-to-Air Missile
AUSCANZUKUS	Australia, Canada, New Zealand, United Kingdom and United States
AWACS	Airborne Warning and Control System
BHAG	Big Hairy Audacious Goal
BVR	Beyond Visual Range
C2	Command and Control
C3I	Command, Control, Communications and Intelligence
C4I	Command, Control, Communications, Computers and Intelligence
C4ISR	Command, Control, Communications, Computers, Intelligence, Surveillance and Reconnaissance
CAOC	Combined Air Operations Centre
CTDs	Capability Technology Demonstrators
CCIB	Command and Control Interoperability Board
CEO	Chief Executive Officer
CJTF	Combined Joint Task Force
CNN	Cable News Network
COMAO	Composite Air Operations
COMAST	Commander Australian Theatre
CPX	Command Post Exercise
CTAPS	Contingency Theatre Automated Planning System
DARPA	Defense Advanced Research Projects Agency
DoD	Department of Defense
DFAT	Department of Foreign Affairs and Trade
DFM	Design for Manufacturability
DRP	Defence Reform Program
DSTO	Defence Science and Technology Organisation

ESM	Electronic Support Measures
EW	Electronic Warfare
FAA	Federal Aviation Authority
FAC	Forward Air Controller
FEBA	Forward Edge of the Battle Area
GATT	General Agreement on Tariffs and Trade
GDP	Gross Domestic Product
GPS	Global Positioning System
HF	High Frequency
HUD	Head-up Display
ICAO	International Civil Aviation Organisation
ICCS	Integrated Command and Control System
IDM	Improved Data Modems
IFF	Identification Friend or Foe
IMF	International Monetary Fund
INAS	Integrated Nav/Attack System
ICBM	Intercontinental Ballistic Missile
IO	Information Operations
IPT	Integrated Process Team
IR	Infra-red
IW	Information Warfare
JFACC	Joint Force Air Component Commander
JORN	Jindalee Operational Radar Network
JSF	Joint Strike Fighter
JSSC	Joint Services Staff College
JSTARS	Joint Surveillance Target Attack Radar System
JTIDS	Joint Tactical Information Distribution System
LOCAAS	Low Cost Autonomous Attack System
LPI	Low Probability of Intercept
MA	Master of Arts
MEMS	Micro Electromechanical Systems
NASA	National Aeronautics and Space Administration
NATO	North Atlantic Treaty Organisation
NCO	Non-Commissioned Officer
NCTR	Non-Cooperative Target Recognition
NDU	National Defense University
NRO	National Reconnaissance Office
NSC	National Security Council
OECD	Organisation of Economic Cooperation and Development
OSE	Open System Environment
PC	Personal Computer
PSAB	Prince Sultan Air Base, Saudi Arabia
RAAF	Royal Australian Air Force
RAF	Royal Air Force
R&D	Research and Development
RDT&E	Research, Development, Test and Evaluation
RF	Radio Frequency
RMA	Revolution in Military Affairs

S&T	Science and Technology
SEAD	Suppression of Enemy Air Defences
SIGINT	Signals Intelligence
TM	Trademark
TUAV	Tactical Unmanned Aerial Vehicle
UAV	Unmanned Aerial Vehicle
UCAV	Uninhabited Combat Aerial Vehicle
UCLA	University of California at Los Angeles
UK	United Kingdom
UN	United Nations
US	United States
USA	United States of America
USAF	United States Air Force
USMC	United States Marine Corps
WP	Warsaw Pact
WWII	World War Two
Y2K	Year 2000 (Bug)
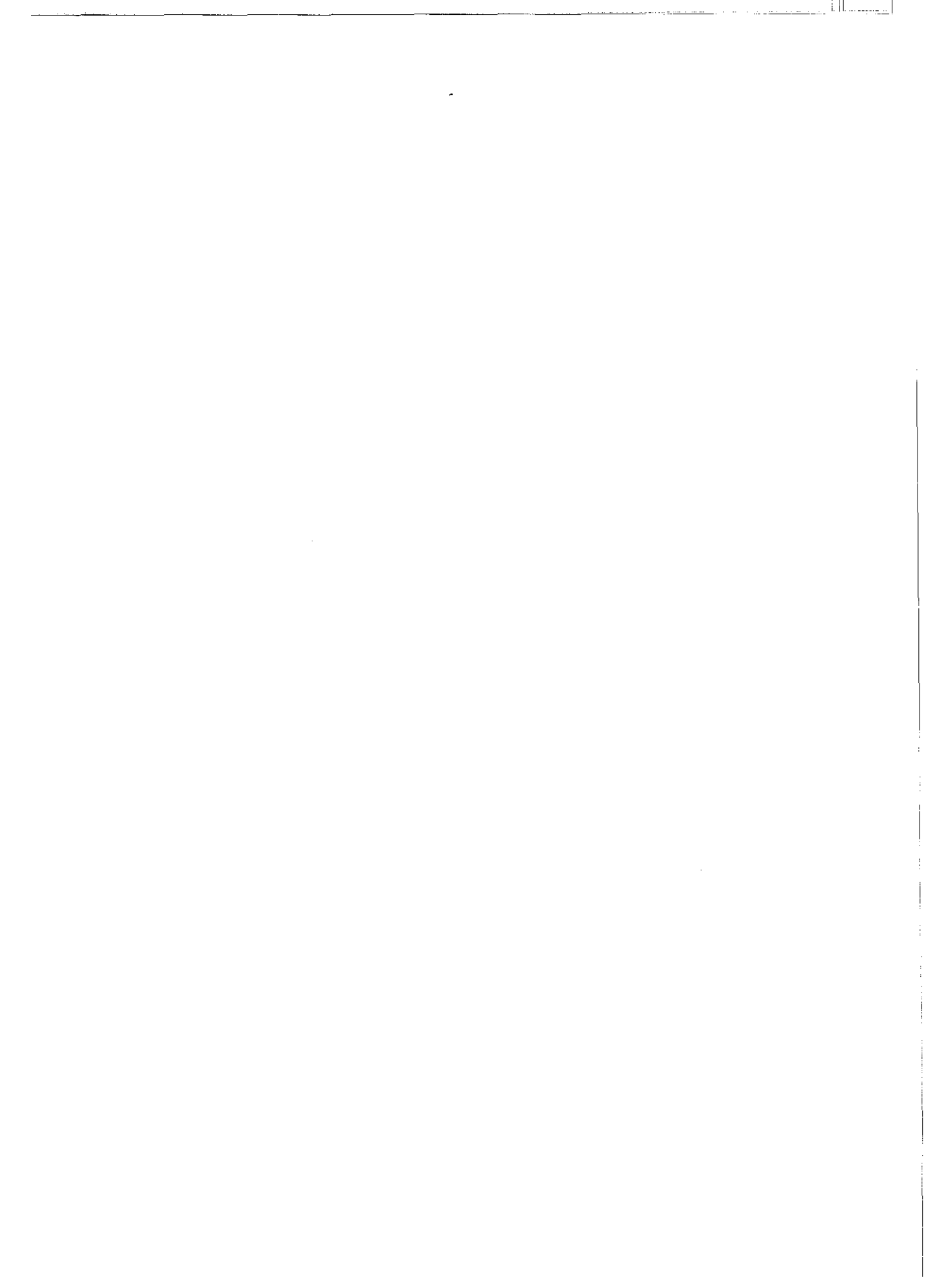
OPENING ADDRESS

AIR MARSHAL L.B. FISHER

Welcome to the Royal Australian Air Force's 1998 Air Power Conference, 'Testing the Limits'. The RAAF is honoured by the presence of so many leaders from the political, defence and aerospace professions.

As Chief of Air Force, let me also say how personally pleased I am to see so many members of my own service - as well as Navy, Army, and Defence civilians - here today. This is an important event for the RAAF and, indeed, for the Australian Defence Force.

The rise of air power during World War I represented the twentieth century's first Revolution in Military Affairs (RMA). I believe it is now accepted that we are currently experiencing another RMA, this time driven essentially by the microchip, which is making possible quantum and continuing advances in the knowledge, precision, quality and speed with which we can go about our business. It is also accepted, however, that like all technology, the microchip is merely a tool; and unless it is accompanied by the right doctrine and the right organisational arrangements - that is, by the right ideas - there will be no genuine RMA.

That is why we're here today. 'Testing the Limits' is the RAAF's fifth major biennial conference; a series which started in 1991 at the initiative of one of my predecessors, Air Marshal Ray Funnell. Successive conferences have examined a variety of topics. In 1991, our first conference coincidentally took place only weeks after the Gulf War. During that conflict, we saw for the first time the knowledge dominance, precision, sustained tempo and parallel operations which, in combination, are now recognised as an essential characteristic of any advanced defence force.

Our 1992 conference examined the place of air power in regional cooperation. Distinguished military and civilian leaders from the Asia-Pacific region looked at the way in which we collectively employ our air forces to promote regional security. There was general agreement that one of the keys to the constructive development of regional air power is to work together to achieve and maintain a qualitative edge.

In 1994, the history of the war in the air from 1914 to 1994 proved to be an exceptionally interesting and professionally rewarding theme. It is noteworthy that the published proceedings from that conference have since become a standard text at many military academies and universities throughout the world.

Most recently, in 1996, we listened to, and talked about, concepts of 'New Era Security' - that is, security in the post-Cold War era, a period characterised by strategic uncertainty, the Revolution in Military Affairs, and the information revolution. Those of you who were present will recall, I am certain, the challenge presented to air forces by Professor Martin van Creveld. I will be disappointed if similar challenges do not emerge in the next two days, as we seek to 'test our limits'.

Immediately following the Minister's Keynote Address, I'll be officially releasing the third edition of the RAAF's most important doctrinal publication, The Air Power Manual. At this stage, let me simply make the point that, to a considerable extent, the new Air Power Manual is very much a product of the discussion, debate, arguments

and, in the end, consensus, which has emerged from those previous conferences. In other words, everyone who participated in those events has, to some extent, contributed to the development of RAAF doctrine.

This year's conference will build on, and extend, the ideas which are presently guiding the RAAF's course. Against the background of the profound changes currently affecting many advanced defence forces around the world, I want to encourage the speakers and all delegates here to push the boundaries of conventional thinking on national security, defence, and air power; and to challenge the RAAF's conventional wisdom and institutional comfort.

I fully expect the ideas that emerge from this conference to have a major influence on the way in which the RAAF seeks over the next twenty-five years to achieve its Mission - to 'Prepare for, conduct and sustain effective air operations to promote Australia's security and interests'.

In addition to the formal proceedings, delegates will be able to hold informal discussions with some of the world's pre-eminent strategic thinkers. I urge all of you to take full advantage of this valuable opportunity.

While a great many people have worked long and hard to organise this conference, in the final analysis, the crucial contribution is, of course, the one made by the speakers. Any conference can only be as good as the ideas put in front of it. On behalf of everyone present, I would like at the outset to thank our presenters, a number of whom have travelled halfway around the world to be here today. And as Chief of Air Force, let me say how personally gratified I am that the RAAF has been able to attract the support of such a distinguished group.

While on the subject of support, I want to acknowledge the generous assistance of our major sponsor, British Aerospace Australia, who have now had a long association with these conferences. They have been ideal partners: always supportive; never intrusive. My thanks also to our two minor sponsors, Qantas and Rolls Royce; and to the other organisations which have contributed to this event.

Again, let me welcome all of you to the RAAF's 1998 Air Power Conference, as I now start the formal proceedings by launching the third edition of the Air Power Manual.

OFFICIAL RELEASE
THE AIR POWER MANUAL - THIRD EDITION

AIR MARSHAL L.B. FISHER

It is a truism that any organisation can only be as good as its ideas. Consequently, basic air power doctrine is an ideal subject to raise at this early stage of a conference which aspires to test the limits of our thinking.

The third edition of The Air Power Manual, a copy of which you have all received this morning, represents a response to significant, complex and rapid change within the environment in which the RAAF conducts air operations. There are a variety of issues driving and featuring in this change. First, there is the shift in global and regional politics which has occurred in recent times, especially since the end of the Cold War. Second, there are the strenuous and on-going initiatives to make the defence organisation more effective and efficient in its functions, organisations, processes and outputs - noting that Air Force's output is air power. Third, there are the emergent forms of force employment. The threat or use of armed force is no longer confined to conflict between states. Air operations must address all of the applications of military force, through a spectrum of activities ranging from emergency relief to peace operations to major war. Fourth, are the emergent methods of conflict. Air Force's conduct of operations *must* reflect the Revolution in Military Affairs (RMA), and the advent of information warfare. Fifth and finally, we are experiencing radical shifts in the way in which organisations conduct their business, away from traditional hierarchical command and control arrangements, and towards networks which share information across all levels. Each one of these issues presents a formidable challenge to our thinking; and each one strongly influenced our recent review of RAAF doctrine.

There are four features of the new Manual I particularly want to highlight this morning. Those features include the nature of the Manual; the core air power capabilities; the vital enabling functions; and the place of single-service doctrine in the *joint environment.*

First, the nature of the Manual. This third edition of The Air Power Manual presents *basic* or *fundamental* air power doctrine. It establishes the fundamental philosophy for the employment of air power by describing what the RAAF believes to be both true and in the best interests of Australia's security. Unlike the first and second editions of the Manual, the third edition does *not* present the 'how to' of air power doctrine. That is, the operational aspects of doctrine have been removed in the interests of presenting our basic philosophy as clearly and concisely as possible. I might add that I have tasked Air Commander Australia and the Air Power Studies Centre to produce a new and separate manual of operational-level doctrine, and that work on that job is underway.

The second and most obvious change I want to highlight is the establishment of five Air Force *core air power capabilities*. Those core capabilities, which describe *what* air power can do - that is, what air power can bring to the joint planning table, and what

air power can offer the Joint Force Commander - are control of the air, precision strike, precision engagement, rapid force projection, and information exploitation.

And that leads to my third point, which concerns *vital enabling functions*. The five core capabilities rely on much more than aircrew in cockpits, and clearly reflect Air Force's Goal One: 'One Air Power Team'. No longer should we discuss air power capabilities separately from vital enabling functions. Often previously described as 'support' activities, vital enabling functions are an integral part of the RAAF's war-fighting structure, and are essential to the success of air operations.

It is noteworthy that, when this Manual was being drafted, one of the most frequently asked questions was, 'Why isn't there a separate chapter on logistics, or engineering, or RDT&E?', and so on. The answer is, none of the five core capabilities can exist without those and other vital enabling functions. Indeed, to regard those functions as a separate component of basic air power doctrine is both to misunderstand the holistic nature of air power, and to diminish the efforts of those members of the RAAF whose contribution is made outside the cockpit. Without maintenance, or refuelling, or clever planning, or effective personnel management, or quality health care, or effective and safe air bases, and so on, there will be no control of the air, no precision strike, no precision engagement, no rapid force projection, and no information exploitation.

Let me repeat, the vital enabling functions are an *integral part* of RAAF war-fighting; and that is why they are inferred from, and integrated within, our five core air power capabilities, rather than being treated as something separate and distinct, as was previously the case.

The final aspect of The Air Power Manual I want to highlight is its place in the joint environment. It is the RAAF's responsibility to aspire to the highest standard of professional mastery that we, as members of the Australian Defence Force (ADF) team, are capable of attaining. The Air Power Manual is the start point for meeting that obligation. The complexity of modern warfare demands a great deal of interdependence between the services. Combat operations in any one environment - namely, aerospace, land or sea - may facilitate or provide direct support to operations in the other environments. While major operations will invariably be joint or combined, the contribution of the single services is the foundation on which the success of those operations will depend.

The roles each service performs, and the environment in which each operates, require fundamentally different sets of skills. In other words, the development of specialist, single-service war-fighting skills remains a prerequisite for the conduct of joint operations in the ADF. And that is why The Air Power Manual represents an essential start-point in the RAAF's pursuit of professional mastery.

I want to make one last comment on the nature of The Air Power Manual. In defining five core air power capabilities, the RAAF is not laying sole claim to those proficiencies. On the contrary, in my opinion, it would be a strange army or navy which did not also seek professional mastery in, say, precision engagement and information exploitation. The Air Power Manual simply sets out the beliefs and qualities the RAAF considers should be reflected in any modern, advanced air force - no more, no less. And it defines those beliefs and qualities squarely within the context of joint ADF operations.

So, let me declare this third edition of The Air Power Manual officially launched. It is to be taken as authoritative guidance by every member of the RAAF and, I would hope, will be carefully studied by the many other members of the ADF and the broader Defence community who have an interest in the application of Australian air power. I commend an understanding of the Manual's contents to all of you.

Testing the Limits

BUILDING TO THE RAAF OF 2020

HON IAN MCLACHLAN

This conference offers an opportunity for participants to discuss the issues, strategies and doctrine shaping the Royal Australian Air Force into the future. The theme of the next two days - 'testing the limits' - should be both practical and provocative. All of us (but some more than others) can only benefit by having our favourite beliefs and pet prejudices vigorously challenged.

I would like to talk this morning about a number of issues central to the future of the Air Force. They are: the impact of changes in technology, replacing our current fighter aircraft, and personnel and training challenges.

CHANGES IN TECHNOLOGY

Current and prospective changes in technology are challenging traditional thinking about how armed forces go about their business. Among the key changes are the increasing accuracy and lethality of weapons; the distances over which force is projected; and the speed of information processing and computing. The implications of these developments are producing a vital debate about the roles of defence forces in the future. We cannot *know* the future. But there is no excuse not to understand the direction of fundamental trends - in particular the impact of new technology.

Certainly, there have been earlier 'revolutions in military affairs.' The use of air power brought about one of the most profound changes in warfare this century. Not everyone saw it that way at the start. General Douglas Haig, for example, was not a supporter of air power. He said to his senior military colleagues in July 1914:

> I hope none of you gentlemen is so foolish as to think that airplanes will be able to be usefully employed for reconnaissance purposes in war.

I use that quotation not to belittle Haig, but to point out how easy it is to misjudge the power of technological change.

'PRECISION' AND CHANGING TECHNOLOGY

Precision is one of the key aspects of developing military technologies. But, in thinking about the future of military forces the term 'precision' has a wider meaning than just the accuracy of bombs and missiles. Everything a defence force does must be marked with precision - of thought, intent and action, and precision in the application of force. That is why the key to a highly capable defence force is *knowledge*. Intelligence information has always been an important factor in military success, increasingly it is the *essential* key to victory. To dominate the battlefield, defence forces must have advanced means to collect and analyse information and a command and control system to transmit the right knowledge to the right people in the right place.

THE 'KNOWLEDGE EDGE'
It is for that reason that the Government's Strategic Review,[1] published in November last year, identified 'the knowledge edge' as priority one for ADF development. The RAAF operates vital elements of our information collection system on behalf of the ADF. Foremost amongst these will be the Jindalee over-the-horizon radar network (JORN), which is becoming a crucial element of our surveillance system. We still have a few problems to iron out, but when it is fully operational, JORN will provide exceptional coverage. It will be a unique capability in our region. Complementing JORN within a few years will be the fleet of airborne early warning and control (AEW&C) aircraft which this Government will order. I suspect AEW&C will come to be regarded as the most significant technology to enter RAAF service since Menzies ordered the F-111 in 1963. As noted in the Strategic Review, newer capabilities, like space-based surveillance, will become more important. Long-range and long-endurance unmanned aerial vehicles (UAVs), carrying different sensors, will be important in providing a surveillance capability for strategic areas. We are working on demonstrating the capacity of UAVs to operate in Australia's harsh environment.

Our second priority for defence development is to have the capability to defeat threats in our maritime approaches. Air superiority is the key to dominating these approaches. I will return shortly to the question of the choices facing the Government about replacing our F/A-18 Hornet fighter aircraft.

STRIKE OPERATIONS
First, however, let me address the air power aspects of the Strategic Review's third priority for force development - strike operations. It is now seven years since the Gulf War, and a great deal has been done to develop capabilities since then. In 1991, only a small number of USAF aircraft were able to conduct precision strike. Today, the USAF has increased the number of precision strike aircraft to about 450. That total continues to grow. Because the numbers of ADF platforms will always be restricted, mission survivability and precision are crucial. The RAAF has a strong precision strike capability with its F-111s, F/A-18s and P-3Cs. Each of these aircraft is undergoing a program to enhance its precision strike effectiveness - either through a systems upgrade or new weapons buys, or both. This triad of strike aircraft is the foundation for the ADF's capability to undertake proactive operations in the defence of Australia, air superiority and maritime air operations.

HORNET REPLACEMENT

I want to talk about the need to address a replacement for the fighter. While this decision will not be taken for some years, we have already started to examine the options. Since World War II, the RAAF has been the pre-eminent air force in our region. This has strengthened our position as a defence partner and ally. We want this situation to continue. The decision on a replacement for the fighter is highly important, both for our own defence needs and for our standing in the region. As I said in the Parliament late last year, we must decide the correct balance between upgrading the sensors and combat systems of the F/A-18 and acquiring a new replacement. An upgrade of the F/A-18 will be needed, whatever the outcome of these studies, as a first step in modernising our air

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[1] *Australia's Strategic Policy*, Department of Defence, Canberra, Australia, 1997.

capabilities. Upgrading means we can maximise our return on the investment in the aircraft by upgrading the avionics, sensors and weapons. But the Hornets will eventually have to be replaced and on current planning this will happen between 2010 and 2015.

EFFECTIVENESS AND COST

Two issues to consider when deciding on this new investment are effectiveness and cost. Effectiveness in a multi-role fighter aircraft can be measured by two attributes - survivability and lethality. For a weapons system to be effective, it must be able to survive to get its payload to the weapon release point. It must deliver that payload with precision to ensure maximum effect and minimal collateral damage. Survivability for manned platforms must include return from combat so that the weapons system can be re-armed to fight another day. While effectiveness is the prime consideration, cost will always be a factor. Two attributes are relevant - affordability and sustainability. As the price of owning and running high technology weapons grows, our consideration of life cycle costs must get closer attention. Let me list some of the technologies we must consider.

NEW TECHNOLOGIES

One of the most striking developments of the late 20th century is the growing power of microelectronics. The performance of microprocessors and the size of memory continues to double every eighteen months. Fusing advanced sensors, microelectronics, agile platforms and advanced propulsion creates small, smart, deadly weapons. Increasingly, offensive force is being projected by unmanned aerial vehicles such as missiles, glide bombs and, in the future, recoverable weapons platforms called 'Combat UAVs'. Low observability or 'stealth' has received much deserved attention and again, there is a choice of technology for the fighter replacement. The F-117 and the F-22 use a revolutionary stealth strategy, while the Eurofighter, Hornet E/F, Su-27 and MiG-29 families represent an evolution of existing systems.

DIFFICULT POLICY CHOICE

Put together, this mix of needs, technologies and costs will make for a very complex and difficult selection process. For example, should we buy high cost, reusable stealth platforms to defeat enemy sensors? Or would a better option be lower cost weapons projecting force at great distance? That lowers the risk of losing aircraft and crew. Could a single platform effectively replace both our F-111s and the Hornets, or will a mixed fleet still be needed?

So far I have just talked about the level of technological capability we need but, of course, cost is also a major consideration. During World War II fighter aircraft could be made for the price of a luxury car. Today's fighter aircraft cost anywhere between 50 to 150 million dollars each. Not surprisingly options with a low price tag can be attractive. But a 'cheap' aircraft - if one can use that word - may not have the edge in combat. It is becoming more important to look at the cost of operating the aircraft through its whole service life. This is a more accurate measure of the real cost to the country. I note the increasing rate at which suppliers are being contracted to maintain equipment, thus giving them a vested interest in high levels of reliability and maintainability. Higher levels of reliability may also reduce the total number of platforms needed to keep the necessary number fully ready to go. Looking at all these

factors, deciding on the Hornet replacement will be one of the most costly, complex and important defence decisions we will ever have to make.

I cannot say what will replace the Hornet at this stage. I do not even want to prejudge whether it will be a piloted aircraft - remember what I said earlier about challenging pet prejudices. Whatever the system, it will probably have to operate to the year 2050. It will cost billions and be a key weapons system for the ADF. So, the potential cost of making the wrong choice would be very high.

HORNET REPLACEMENT DISCUSSION PAPER

It may not be this Government which makes the decision. But this Government has a duty to set the groundwork for the Hornet replacement by explaining to the Australian people why it is necessary to devote the effort and resources to such a project. I have therefore asked my Department to produce a public discussion paper on the Hornet replacement. The paper will discuss the strategic reason for the project, as well as the technological, force structure, industry and budget issues. The paper will not itself announce a contract winner, but it will help shape the terms of what should be a public debate about a highly important public policy question. And it will show how the decision making process works to come up with a solution over the next few years. I hope to release this document in three or four months time.

PERSONNEL AND TRAINING

I want to turn to some of the major personnel and training challenges facing the RAAF.

No task is more important to the future of the RAAF than improving the quality of the training we provide our people. As a small, advanced-technology force, the RAAF must maintain a highly skilled workforce able to master technological advances and changes in strategies and tactics. In the context of our Defence Reform Program (DRP), the challenge to Air Force training is to preserve and enhance our competitive edge in a small, highly skilled organisation. Experience shows this is best achieved by keeping a constant training base, and by using strategies to limit separation rates. With a smaller workforce, releasing people from their workplace for formal training may no longer be the best approach. We must plan to increase use of distance learning, computer aided learning, and embedded training techniques. Future training must take greater note of different skill levels which reserve personnel bring to their service roles, and of the limitations their civilian employment puts on access to military training.

INTEGRATION OF SERVICE TRAINING

A key part of the Defence Reform Program is the greater integration of service training through rationalisation of schools. Our national reforms in vocational education and training and a more mobile workforce see an increased linking of ADF training with the civil community. There needs to be greater use of external training to provide more cost-effective solutions for the ADF. Our approach to training must be complemented by the right personnel management strategies.

PERSONNEL MANAGEMENT STRATEGIES

In an increasingly competitive environment, we will have to work hard to ensure that we attract and keep the right people. As a result of various reviews and restructures, over the last ten years the ADF has reduced personnel numbers by twenty-five per cent without

cutting defence capabilities. The DRP will result in further personnel reductions as we make more efficiencies in support areas so we can re-invest in combat areas. To meet DRP goals, the Air Force will reduce personnel, from about 16 300 at present to 13 000 by mid 2001. This can only be done by shedding many non-core support functions and re-directing more personnel into combat and combat support. We will have 60 to 70 per cent of service people in combat, or related units. Currently the figure is around 42 per cent. Managing these changes, while at the same time attracting and retaining the right people to sustain a highly trained, professional and motivated force presents a challenge.

PERSONNEL MANAGEMENT INITIATIVES

Let me mention two of the initiatives we are using to good effect to improve personnel management in the ADF. The Flexible Career Management System is shifting from the idea of a 'job for life'. It recognises the different needs of individuals and a shift in societal norms. The ADF needs some people to serve for the majority of their working careers, but not everyone. Similarly, only a minority want to spend an entire career in the ADF. The aim of Flexible Career Management is to provide the means for both better management of separations, and keeping these people who are essential to operational capability.

The ADF Pay Structure Review is moving the forces away from the 'all of one company' rank-based concept for pay, especially for officers, towards a system based on work value. This will allow us to include, in some cases depending on skills, pay features designed to respond to wider market forces.

CHALLENGES OF THE DEFENCE REFORM PROGRAM

Let me acknowledge that the changes introduced by the Reform Program are big - and demanding of the all the Defence establishment's skills and intellectual resources. But we must be able to show the country that we are using our annual $10 billion budget in the most efficient and effective way.

It is essential to do this for a number of reasons. First, it is the obligation of all Government funded organisations to operate in this way. Second, we know that it is essential to make these changes if we are going to be able to afford projects such as the Hornet replacement at some time in the future. Last, it is a healthy exercise to re-focus on core functions - in our case the defence of Australia and our national interests. Some of that focus had been lost in the decade preceding the election of the Howard Government. It is important that we have a clear link between our day-to-day peacetime activities and our most important function: to be a highly capable combat force.

I am confident that the Air Force and all the other elements of Defence accept that the Reform Program must succeed. It is the only way for Defence to meet its core goals into the future.

CONCLUSION

To conclude, I encourage everyone here to participate energetically in the debate over the next two days - to join in and test the limits. The biennial Air Power Conference has become an important international event in the Air Force calendar. It is important that the professionals get together to exchange views, try out ideas and stay at the cutting edge of thinking in their areas. I wish you well in your deliberations.

NEW WORLD VISTAS: USAF AIR AND SPACE POWER FOR THE 21ST CENTURY

EXPEDITIONARY AEROSPACE FORCES: A BETTER WAY

GENERAL MICHAEL E. RYAN

We in the US Air Force believe we are truly 'testing the limits' of air power by becoming an Expeditionary Aerospace Force - what we need to be today and we must be tomorrow.

Why are we in this transformation? Because world circumstances demand it and our nation expects it. Our conviction evolves from the premise that, in the end, our armed forces exist to fight and win America's wars. And that we are entrusted with the awesome responsibility of putting our precious young men and women in harm's way to accomplish it. Because of that, we must insist that we win decisively - not by a score of 51-49. We want assured wins, no close calls. That doesn't just happen, it takes a lot of hard work and patience. And we must not only be prepared today, we must invest to meet the challenges of tomorrow. We believe the best way to meet these challenges is to transform our Air Force into an Expeditionary Aerospace Force.

That belief has its theoretical basis in documents such as *Joint Vision 2010* and our own service vision of *Global Engagement: A Vision for the 21st Century Air Force. Global Engagement*, among other things, lays out the core competencies of the United States Air Force. I cannot overstate how important our Air Force views these core competencies. They guide our doctrine, our employment concepts and our procurement. And they contribute directly to our national military strategy.

Succinctly, that strategy has as its objectives, to promote peace and stability throughout the world and, when necessary, defeat adversaries. The three elements of the strategy focus on shaping the international environment towards peace and stability, responding effectively to the full spectrum of crises and preparing now for an uncertain future.

The US Air Force contributes to that strategy in many ways. I'd like to explain how we help shape, through forward presence and global reach; how we are able to respond to halt crises and win conflicts; and how we are preparing now for that uncertain future by balancing the readiness needs of today with modernisation - our readiness for tomorrow.

In many respects, all of us in this room help shape the character of our world. We in the United States military unabashedly admit that we must be involved, up front, in helping to preserve peace and build stability through forward presence and global reach. Efforts to shape peace and stability are more than noble in and of themselves. They are critically important to those of us in this room who will be called upon to deal with the often terrible consequences of instability and conflict.

Shaping is why the United States has stationed forces abroad on the territories of our allies, at their invitation. It is why we must continue deployments and

exercises with friendly nations and reach out through military-to-military contacts to those nations who wish to be friends.

With the end of the Cold War came a decrease in the strength of many of our uniformed forces. The US Air Force decreased its men and women in uniform by one-third and cut in one-half our forward-stationed force. But in an unstable world, we have had to increase our contingency deployments by a factor of four.

And while we have consolidated our forward-stationed forces from many Cold War locations, we have remained in substantial numbers at key locations, and have opened eight additional contingency bases to deal with Bosnia and Iraq. And we have continued to adjust our forces to deal with our extensive global commitments that challenge us today. For instance, in 1997 we had deployed forces in almost every country in the world. Air power's involvement in shaping a better environment for stability is not just a localised effort, it's truly global.

I would summarise this discussion on shaping by noting that the US Air Force is no longer a Cold War garrison force focussed on containment. We no longer have the massive preplanned bed-down bases with the fixed infrastructure of the past. The paradigm has shifted to a world that requires rapid and tailored engagement in many regions and many situations. We must partner with friends and allies to help keep regional stability. We have realised that if engagement fails we must rapidly respond at many levels of crisis or conflict. That paradigm shift necessitates restructuring our mind-set, our concepts, our organisation, our equipment and our training to meet the challenge of being an Expeditionary Aerospace Force.

We are equally convinced from history and our recent experience that air power has an inherent capacity to respond effectively to the full spectrum of crises at every level of operations, and can contribute mightily to halting crises and conflicts or winning victories.

The 'Halt' concept of rapidly applying power to seize the initiative is not new, but it is becoming much more meaningful for all air forces as we enter the 21st century. With the advent of global awareness, it seems that the fog of war has lifted somewhat. Little that happens in the world today goes without notice, and even less so in the future. Suffice it to say that this increased awareness enhances our ability to be better informed and to respond more rapidly with the right tools for the mission. And air and space power is increasingly capable and increasingly preferred. Our ability to rapidly employ with precision, while applying asymmetric strategies - strength against weakness - has increased significantly in this decade. We know we must get inside an adversary's decision cycle and force him to fight on our terms. To that end, we submit that we will be able to find, fix, track, target and engage anything of significance in near real time early in the 21st century.

Also, the idea of winning will have a broader meaning in the 21st century because of those capabilities. With information superiority and precision engagement, opportunities for creating and exploring options to force rapid compliance have been and will continue to be increased. I know [retired Air Force Colonel] John Warden [former commandant Air Command and Staff College] will talk on the subject of winning later in this conference, but I'd like to make a point about the direction that halting with air power can take us. If used properly it can often free us from pitting surface forces against each other in large battles of attrition. It provides commanders other options where manoeuvre can support fire rather than

vice versa. I'd like to briefly demonstrate how these concepts have evolved across the spectrum of conflict with a few examples from history.

Air power can be decisive at sea. In the Battle of the Bismarck Sea, Australian and American air forces halted the advance of Japanese forces hoping to resupply New Guinea. They accomplished this by sinking a large convoy of eight transports and four destroyers. This early use of air power alone to halt surface combatants was one of the critical turning points in winning the Battle of New Guinea. Throughout World War II air power was a decisive factor in halting enemy advances and winning campaigns in both the Pacific and European theatres.

Air power can be decisive against oppression. The Berlin Airlift was a classic use of air power to halt the land blockade of Berlin by the Soviets. British and American airlift literally fed a city for almost a year until the Allies won this early strategic confrontation, and the Soviets lifted their siege.

Air power can be decisive on land. The fact that coalition air power set the conditions for a quick and relatively bloodless victory in the Gulf War should not be forgotten or undermined. It was coalition air power that was first on scene to deter Iraqi advances beyond Kuwait. It was coalition air power that fought first, for well over a month before the conditions were set for land forces to engage. And when the Iraqis attempted an attack to goad a land battle before its time, air power halted, routed and won that tactical victory. It has been the use of air power or the threat of the use of air power that forced Iraqi compliance with UN Security Council resolutions over the past eight years. Even as we speak an allied air armada is poised in the Gulf area enabling the UN to inspect for the most heinous of weapons. That's an air power halt and win in my book - one with minimal friendly casualties.

Air power can be decisive against starvation and suffering. In Rwanda, ethnic clashes between Hutus and Tutsis left thousands of refugees scattered and stranded without food and shelter. The death toll exceeded 5000 per day from the devastating effects of deplorable sanitation, rampant disease, and lack of potable water and medical care. Friends and allies using the power of airlift rapidly brought the crisis to a halt. By airlifting massive amounts of food and medical supplies, and setting up water purification and distribution systems in a matter of days, these efforts reduced the crisis to a point where local governmental and non-governmental agencies could deal with the tragedy. A triumph over starvation and suffering is every bit as gratifying as victory in war. Rapidly responding to humanitarian needs through air power is a winning strategy for humanity.

Air power can be decisive against aggression. In Bosnia, after years of carnage and impotent attempts at peacekeeping, after embarrassment and atrocities, the UN, less than enthusiastically and only with the staunchest stand by allies and friends, allowed the effective use of air power. After the slaughter of civilians in downtown Sarajevo, an air campaign against Bosnian Serb military capability began. Within 14 days, the Bosnian Serb leadership realised that continued aggression was useless. Air power halted the carnage and violence in Bosnia and led directly to the peace accords in place today - clearly a halt and win.

These are only a few success stories, but across the spectrum and at every level of conflict, air and space power has relevance and has made our world a better, safer and more secure place to live. And to secure that peace, we in this room are obligated to prepare now to maximise the potential of air and space power for the future.

The 21st century will be an era of unprecedented growth in population, in knowledge, and in the capability to both influence and disrupt peace and stability through both conventional and asymmetric means. In short, it will be an uncertain and dangerous future, but one for which we must prepare well. The US Air Force prepares for this future by emphasising readiness and modernisation of our equipment, our people and our concepts. We believe we must focus our efforts on improving our core competencies. They are the aspects of air and space power that we, as a service, must nurture, integrate and properly apply in the 21st century. In the United States, no other service brings these capabilities to bear across the spectrum of peace and conflict.

The first core competency is information superiority - the ability to collect, control, exploit and defend information while denying an adversary the same. The efforts we have undertaken in the 1990s simply could not have been as effective without orbital, atmospheric, and land-based information collection and distribution systems. Joint STARS was critical to the success at Kafji, by alerting us to an Iraqi offensive movement. Today we are exploring moving the capability resident on Joint STARS to space to give us constant global coverage. Furthermore, unmanned aerial vehicles such as Predator have proven invaluable to peace enforcement in Bosnia, and we are now testing high-altitude, long-range, long-dwell systems such as Global Hawk and Dark Star to supplement our information, surveillance and reconnaissance capability.

While information superiority is the key to anticipating and characterising evolving crises, air and space superiority, our second core competency, is that vital control over the vertical dimension that allows the success of all other military operations. We are investing in space and atmospheric systems that should guarantee dominance of the ultimate high ground. Our centerpiece for ensuring air superiority is the revolutionary F-22. The stealthy Raptor's integrated avionics will maximise the effect of its advanced precision munitions, carried at supercruise speeds, which allow it to range rapidly whenever and wherever it desires, providing incomparable first look, first kill capability. The airborne laser is also 'on track' for a live demo in 2002. It is a developmental system that will be our nation's best near-term hope for providing boost phase intercept capability against the theatre ballistic missile threat.

When combined with improved early warning from our new Space-based Infrared System and underwritten by a robust space launch capability embodied in our expendable launch vehicles, we will be able to reach and exploit space economically.

While our expendable launch vehicles should provide more efficient space lift into the future, we'll need efficient airlift to meet deployment and sustainment needs on Earth. Our third core competency is rapid global mobility. The versatile C-17 has already demonstrated the ability to rapidly respond to needs across the spectrum of contingencies in areas previously inaccessible to large airlifters. The CV-22 will give us a new dimension to vertical lift. Improvements to our vital air refuelling aircraft as well as our en route support structures around the world will increase our global reach capacity.

But we are also committed to building on our capability to project power rapidly at global ranges, with precision, without the need for that en route support structure, as represented by our fourth core competency: global attack. Global deployment and employment missions are becoming routine. Conventional

munitions upgrades to our bomber force will increase its lethality and stand-off capability nearly ten-fold within the next few years. And they will be integrated into our air expeditionary forces.

All of our air expeditionary deployments must have the ability to reliably and selectively apply power precisely with minimal friendly casualties, as indicated in our fifth core competency: precision engagement. The ability of our platforms and weapons to know exactly where they are at all times has indeed revolutionised the precision of warfare. The Joint Strike Fighter will employ the next generation of stand-off, precision munitions, all underwritten by our constellation of global positioning satellites.

But we do not only need precision in force application to become more effective and efficient. We need precision in supply and sustainment, as represented by our final core competency: agile combat support. All elements of our combat support team must also strive to be more lean and efficient. Based upon an integrated and up-to-date information and tracking system, our 'lean logistics' concept strives to send the right part to the right place with the most reliable, high-speed transport available, and we know where it is at all times. We can and have, reduced our forward footprint from large mountains of mass material to small hills of essential supplies with rapid *reach-back* capabilities for those things we need right now.

Of all the activities to prepare that we do, there is none more important than how we prepare our people for this uncertain future. They will help shape the environment in a world that is less than congruous. It is they who will respond to the crises of the future with innovative concepts and uses of equipment to win battles, campaigns, and wars. And they will set the cornerstones for readiness and modernisation for the future. They truly are the strength of our past and the leadership of our future. It is they who will lead our expeditionary aerospace forces in the future.

And what is an Expeditionary Aerospace Force? It is a force that is tailored to mission success with the right combination of capabilities and people to match the challenge. It is rapidly deployable to any part of the world. It is light and lean with the smallest possible footprint forward. It is globally connected to reach-back for worldwide information and support, and it can command and control the assigned forces in near real time. And it is led by a schooled and seasoned air commander who can decisively apply the gamut of air and space capabilities across the spectrum of crises. That is where the United States Air Force is headed.

But the United States Air Force will seldom engage alone. As we have seen in the past 50 years of this millennium, it has been allies and friends who have given strength and resolve to coalition actions. Whether it is shaping the international environment, responding to crises or conflict, or preparing for a more secure tomorrow, we here in this room must have the capability and the trust to work together toward a more stable and peaceful world - for it is when peace and stability fail that our air forces will be called on, and expected to be first to respond, first to fight and first to win.

DISCUSSION

Air Commodore D. Bowden: All of those things are possible provided you have the warning and readiness and industry support to bring it to the point of focus you need at the right time. For smaller air forces following that trend, if you don't have the warning or the preparedness, then going back into the supply chain to get those weapons that you need just when you need them, can carry some risk. You control or influence, through some very large organisations (some here today), that supply line. Are we running into the case where the ability to make these new concepts work is actually going to go right back into industry: who controls it? and who's got it?

General Ryan: For us in the United States Air Force there are certain classes of equipments and supplies that we must have forward; that are critical to the operation; that we cannot allow to be interrupted; and therefore, that must be controlled and sustained by military forces. There are other classes which will only marginally affect the operation if we don't get them there just in time, but which take huge amounts of resources forward in a *forward footprint* to sustain and maintain. We're trying to optimise this in several different ways including designing right up front - in weapons systems, our communications capability and our supply system - the ability to not have to rely on large amounts of stuff forward.

In the interim, we are trying to wean ourselves away from the insatiable appetite of our commanders to take things forward that are not necessary: the belt and suspenders. But we have to remember that we pay our commanders to make these decisions of what they need to take forward and we also pay them to win decisively - no 51-49 as I discussed before - and so their driving rationale is *do not fail*. So it's this balance between those two that we have to make.

We also have to partner with industry. We need industry, and in the future we will need the right kinds of commitment from industry that, during times of crisis, they will be there for us and they will do what we need done. That is a great challenge for us right now as we look at out-sourcing and privatising - just as the Australian Air Force is doing from what Les has explained to me. There are some things you do not want to out-source and privatise; that you shouldn't, even if they don't deploy.

Martin Dunn: You say that the new US expeditionary Air Force needs to win decisively. However, in modern warfare we have two sorts of factors that are increasingly being evident. The first involves governments using the ambiguity of the political circumstances to avoid your strikes by taking advantage of the UN mandate or your national rules of engagement so that you cannot use air power effectively where it hurts. The second factor involves when such governments themselves exploit the urban areas or the civil population to make their combatants *indistinguishable* from the civil population, so that you can't use force there either. I was wondering how the expeditionary Air Force might be able to cope with these situations?

General Ryan: On the first question, I think it is absolutely essential that all who wear uniforms and all who are involved with defence make sure they define what winning is right up front. Winning must be connected to a political outcome and an end state that everyone agrees upon. If you cannot get agreement on what the application of power

will lead to with respect to an end state, then you do not have a definition of winning and you probably shouldn't engage. That is a responsibility of the people in uniform and those who are directly involved in the defence side, to make sure that our governments are educated to the fact that when you throw your hands up in the air because you have no other options, the military is not necessarily the answer. You must define the objective and define what winning means in terms of that particular engagement, and only then use the power you need to use.

Urban warfare brings about a whole new dimension for air power. I do not claim, and never will claim, that air power is the be-all and end-all for all military operations. It is a *joint* environment we're in and every piece of our forces needs to be used. They need to be balanced: some lead at some times and some follow at others, and some will be *supported* and some are *supporting*. In the cases of urban warfare, the application of air power (other than in urban renewal), probably has its limitations and that is why we have ground forces. There are, however, air applications that have to do with information, with reconnaissance and with precision strikes that *are* relevant in urban warfare. Of relevance, the United States Air Force is pursuing munitions that are small and useful in those kind of environments.

I don't think there is any operation out there which is an exclusive domain of one service or another. We are so small now, not only in the United States military but across the world's militaries, that we need to rely on each other and on all the strengths of each of our services to get the job done.

Group Captain M. Lax: As the US Air Force adopts and adapts the new high technology in future warfare, your allies are going to find it much more difficult to remain interoperable with you. What does that mean then to the USAF in terms of running the risk of going it alone, and the complexities of modern coalition warfare. What will change?

General Ryan: I've heard that argument often, but I don't believe it. None of us moves so fast that we lose the capability to integrate; even if in a reach-back kind of way. I will give you a Bosnian example from when we ran the operation there. We used every manner of ally that we had and we put them into the niches where they fitted best and helped the most. Throughout all the years where people have said they're falling behind in technology, interoperability and connectivity, we have always been able to make it work. I see that as the case in the future.

It will always be an important matter for all of us, to make sure that the kind of capability we have to offer in coalition operations is something that will fit in with the capabilities of the lead nations. That's why we have these conferences; that's why we have exchanges; that's why we have conventions to bring together our technologists; that's why we have exercises; that's why we forward deploy; that's why we work together on a day to day basis to ensure interoperability occurs. The United States is very knowledgeable of the things we need to do to be sure that we continue to interoperate with our allies and with our friends.

Group Captain R. McLennan: General Ryan, in the answer to your first question you mentioned industry involvement. I'm asking if you can expand on that a little, particularly to the extent of your move towards the expeditionary force and how that affects the use of contractors (or indeed of *any* civilians) in the AO. What do you see as

the advantages or the limitations on their use and how do you propose to address those issues?

General Ryan: It will depend on the conflict and the location. I'll begin with the premise that in very few situations will you be able to rely on contractor support in the AO at the point of engagement, or in the first part of any conflict. It takes international organisations a long time to gear up to provide that support. It did not happen in Bosnia, for example, although there are those who will look back and suggest to the contrary, that we were easily able to get Brown and Root in to do the things they needed to do. That is absolutely not true. It took us a long time to get Brown and Root set up, including the hiring of the local nationals they needed for some of their functions. In fact, the United States Air Force had to use our heavy construction engineers to put down the tent cities for the US Army because they'd put that into the guard and reserve. They had no capability to do it themselves in this instance in that location in Europe.

We must have a residual capability in our forces to be able to take care of ourselves when we go in. And it's not just an issue of cost; it's an issue of force protection. When you go in, you will not be sure of the environment you're in and you must be very sceptical of the kinds of folks that you bring in to be your support for food service, for hauling gas, for all of the things that could bring asymmetrical kinds of attacks against your forces. So I'm a great believer that we should not step too far down this road in trying to contract out support until you're into an established theatre. Every force, I believe, who wants to deploy and come forward must have an organic capability to take care of themselves for the initial stages of any engagement.

Wing Commander R. Owen: In your presentation you mentioned that one of the core values was *service before self.* I'd like to question that in terms of the current change in defence forces throughout the world where we're moving away from people that are institutionally orientated; where it's now no longer a full time or life time career perhaps. Is the US, and in particular the USAF, finding a conflict in being able to recruit the right sort of people with that notion of service before self?

General Ryan: Absolutely not. We have no end of people who would like to serve in our armed forces and particularly in the Air Force. We have in our enlisted force, retention rates that are sustaining our force at levels that we think are about right. We have some downturns in our second term enlistments as a result of the economy, and the way we've targeted that is with bonuses that go against those particular enlisted specialties. For all air forces, I think, the seasoned NCO is the one that makes the force operate, and we're not seeing a great downturn there.

Our main concern is with our pilot force. Looking at the domestic United States and at the hiring that will go on over the next five to seven years by the 13 *major* airlines (and this doesn't count the commuters), the United States Air Force and Navy and Marine Corps could allow every one of the pilots who have finished their service commitment to go and still not half fill the demand for the majors. If you throw in the commuters, we make up not one quarter of the demand that's out there. So we see no end in the opportunities our folks will have to leave us.

I have to say that I don't call that a lack of *service before self.* In the USAF we're talking about people who have been with us for nine years. We've probably sent them back to the desert or to Bosnia four times. They have served their country and done

a marvellous job in taking care of the security of our nation. They are wonderful people and they have served their duty to our country. If we can't keep them, that's our fault not their fault.

Dr Alan Stephens: You now describe the United States Air Force as an 'air and space force', and you say that in the coming years it will transition into a 'space and air force'. I appreciate that you've been working on the doctrine and ideas to affect that transition, but I wonder if you've started any *more tangible* programs to facilitate what would appear to me to be a profound change. Air Forces, I believe, have always been defined by the man in the cockpit. It would appear that that won't be the case in the space and air force. Do you have any education, training and organisational programs in train now to facilitate that profound change?

General Ryan: Let me first talk to the notion of an air and space force proceeding to a space and air force. First of all, there those who would want to separate the two, to recognise air and space as separable entities. I argue that that is not the case: that it is a vertical dimension that's integrated; that it's one medium with both air and space in it. It's just the further up you go the further apart the air molecules get.

Transitioning to a space and air force will not occur for a very long time. It is our vision for the future a long way out. Right now the uses of space we have are terrestrially focussed and will remain terrestrially focussed until man goes 'expeditionary' to space. We have not done that and will not do that for the foreseeable future. It's when man starts exploring planets and stars that we see ourselves transitioning to a space and air force. Until that time, we will remain an *aerospace* force - and we're starting to use that terminology more, putting an 'o' between 'air and space' instead of the conjunction 'and'. Our future vision is that when we do go extraterrestrial, it will not be a *Captain* John Picard but a *Colonel* John Picard and he'll be in the United States Air Force.

The other aspect of your question was about the systems we're using. If you look at the United States Air Force budget you can see the transition of our dollars, particularly in our R&D (research and development) and S&T (science and technology) migrating slowly to space. We are funding things such as space-based laser, and the applicability of the airborne laser also has some spill-over into the technologies we need for space-based laser. We are funding technologies for *aerospace plane.* We are partnering with NASA and our NRO in ways we never have before to make sure that the capabilities we put in space are applicable.

The biggest issue in space I think will be the commercialisation of space. We must be on board with the commercial sector because in the next year, they will surpass our investment in space and then triple it by the end of the first decade of the next century. Space will be a place that is important to the economies of all nations within the next five years and we will realise with that time that we must figure out a way to protect it because of its impact on earth.

Dr Alan Stephens: Could I follow up your comments with a question more on the *ethos* of the air and space force becoming a space and air force. Accepting that it's decades down the track - and I apologise if I'm misinterpreting you here - I still infer from what you were saying that the transition in terms of training, education and programs is primarily *reactive* - that people train on these new space-based systems, lasers,

information sensors, etc. as they come into service rather than through some kind of pro-active program developed to change the Air Force's mind-set towards these different capabilities. Could I ask you to comment on that please?

General Ryan: I would disagree with the premise of the question. We need to remember what militaries are for: we're not for new science and we're not for the exploration of our solar system. We in the military (in the uniformed services) are here to use space in such a way as to affect the security of our nations. We are not into space for space's sake. We are into space for the things it brings to military capabilities and the application of power on this earth. Our forward vision is that when we have the technology, the policy and the capabilities to migrate things to space which are applicable for projecting power on earth, then we will do that. We have very substantial research programs in those areas that are not commercial, that are not being done by others, to affect that change.

Dr Adam Cobb: Looking to the future, to what extent do you anticipate conventional military forces to be inadequate in the face of the threats identified by the President's commission on critical infrastructure protection?

General Ryan: I'd like to answer that with a story. We had an attack on the United States Air Force's information system. Our 108 major installations, State side and overseas, are protected by a capability we have that monitors the inflow of information into the networks used on our bases to pass information around. About a couple of months ago we were under severe attack and the Air Force were the first to pick it up, because we have a system that can tell us this is occurring to us. It was during the time that the Gulf was becoming a flash point and we didn't know where it was coming from. It involved assaults on the system like trying to get into and change passwords and get access to different areas. These were not our secure systems; they were not our command and control systems; they were our information systems at the unclassified level. We fought back in the best way we could, and then we started shutting down.

     We have an organisation (almost a task force) in the United States Air Force to protect ourselves from this kind of attack. It's resident in San Antonio in Texas and some of you have probably been there and seen it. We geared up our task force and started shutting down the various ports and entry points that these attacks were coming through. We are prohibited in the United States Air Force from attacking back in the information sphere because of constitutional restrictions on the military. So our best defence was 'rope-a-dope' - get them against the ropes and find out who was attacking us. It went on for a week with us slowly shutting down, rerouting and laying in traps.

     We were able to trace it back to two 16 year olds on the West Coast aided by a third country national. All of them had call signs. These were the people who had us under attack and we thought it may have been connected to the Gulf. It was not, but it shows how vulnerable all of us are as we become more dependent on information systems to do our business.

     It's not only the military, but also the commercial sector that must be very careful about how defences for these kinds of attacks are set up. It will increasingly be a problem that we must learn how to deal with as individual institutions, as governments, as government and civil authorities, and as nations - even internationally as many of our companies have international sprawl. We have to consider its effect on the people we

subcontract with because their systems interface with ours. It's a huge problem that we have got to put a lot of brain power and a lot of organisational capability into solving. It's one of the big threats of the future. It's also, however, an opportunity. That is, offensive information warfare is not the preserve only of those who attack us.

Air Commodore Ray Perry: As we enter this brave new century with RMA and lots of other things that are going on, in particular the structures of air expeditionary forces et al, are you currently happy with the organisational structure that you have for managing that? Or do you perceive that there may a need to change the way you do business, particularly through numbered air forces down to wings etc?

General Ryan: We have looked at (and in fact have a study going on right now) how to organise ourselves into sustainable expeditionary entities. I can tell you we made some mistakes. Coming out of the Cold War paradigm, what we had done was have our operational forces capable of deploying forward very rapidly, but we had never worked the sustainment issue. That is, that when we opened up Tusla and Brindisi and PSAB (Prince Sultan Air Base) and all of the bases that we've opened up, we never budgeted for the infrastructural costs that go with them. So, what we have found is that the forces on our bases back home are being thinned out through folks being brought forward onto the support side of these bases. The people back home are working 12 hour shifts and the people who are forward are working 12 hour shifts, and then we switch them. This is a cockamamie way to do business and we have to fix it. The first way to fix it is to throw people at it, and we're going to do that.

But it is also an organisational issue. Our draw downs with our base closures and realignments were based more on what we wanted to divest ourselves of than what we wanted to set ourselves up to be. We found ourselves spread very thin on many bases for many reasons; political, economic and social. We are now calling for another round of base closures and realignment: not to downsize our force, but to size it in the right places with the right infrastructure and with the right access, so that we can sustain these overseas operations that are expeditionary.

We're attempting to change but it'll take a while. We can fix the first part fairly soon. The second part on reorganising ourselves into structures for support will take a little longer. We do not see, however, any change in our structure as it exists involving major commands, numbered air forces and wings. Those structures we reorganised back in the early 1990s. They serve us very well regarding our expeditionary forces and how we integrate them. We've just written doctrine on what this will look like and what we'll call them when we do send them forward in an expeditionary manner.

Air Commodore D. Chipman: You mentioned a developing concern with pilot numbers. Can you say something about your dependency on reserve pilots and how that's going to change in the future, and perhaps expand on how difficult it is to get reserve pilots and keep them current?

General Ryan: We have not had difficulty in getting reserve pilots who want to be part time. About one third of the reserve structure is full time. It isn't all part time: one third is full time and two thirds are part time. Many of our people who get out want to join the reserves, but they don't want to join the *full time* reserves: they want to be part time and pursue other careers. So, our problem in the active force is very similar to the reserve

problem that we have today: maintaining the kinds of individuals that want to stay on full time. The advantage in the reserve, of course, is stability for families. We have no end of folks who want to join us on the part time reserve and we use them very effectively. We have pushed our reserves to the limit of their capability. About ten percent of our operational tempo is on our reserve side, which is about all they can give and still expect their civilian employers to allow them to go. So our major concern right now is with the full time guard and reserve personnel who we want to keep. We may have to throw some money at it. I'm not sure what the answer is.

With respect to our pilot training side, we've already thrown money at it. We doubled the bonus for our pilots: it went from about US$12 000 to US$22 000 a year, for five years after they reach the nine year point. That had about a four percent influence on the retention rate; it only affected four percent. I have to tell you that that four percent paid for the bonus and retraining, but it was not a substantial jump. Also, there is a division that occurs in the force when you start paying the pilot of an aircraft a huge bonus when, say, the navigator gets nothing. Suddenly you have a unit disparity that is very difficult to deal with.

We've done other things to try and help this operational tempo problem and sustainment problem including down time when personnel come back: organisational changes that allow them more time to deal with their families. We have changed our exercise schedule to cut back on operational tempo where it was self inflicted. We've changed our inspection systems so we're not constantly inspecting whether they can do their task when they're *constantly* doing their task by deploying to the desert and Bosnia and other places. We rely very heavily on our reserve forces, but they are in a similar situation to the active force with respect to pilots.

THE IMPACT OF TECHNOLOGY IN THE NEXT QUARTER CENTURY

NATALIE CRAWFORD

INTRODUCTION

Air Marshal Fisher, distinguished guests, ladies and gentlemen. To say it's an honour to be here is an understatement. I am delighted to be here and I hope that my remarks will fit the bill and live up to everyone's expectations. I have been associated with the United States Air Force for 34 years. I am very fortunate in that regard. I have grown up with a lot of the people who are here today and that means a lot to me. I hope that I have earned their respect and have some credibility with them; I believe I do and I certainly hope I will with *you* by the end of today.

I'm going to talk part philosophy and part technology. I want to start out by echoing remarks that were made earlier today. We are not alone, the United States of America. None of the countries represented here today are alone. Everything we do today and in the future will be joint, coalition and a combination of the two. The circumstances will include training, operations and every other facet of military involvement. So that's number one. The second thing is one we talked about this morning - the fact that there are enabling parts of our forces - the logisticians, the communicators etc. - who support our forces and their activities, and whom we could not do without. You can't give them up. It's like asking a person, 'Well, what do you want me to take out, your heart, brain or lungs?' You can't live without any of them and that's the case with those enabling components of the forces that we have.

It's not technology that we seek: it's capabilities. We don't just do technology for the sake of technology. There is a level at which we do that but when we think about technology applied to military problems we're thinking about capabilities. The technologies we seek represent those catalytic agents which enable us to build military systems that will deal with the enduring needs or provide enduring capabilities for the armed forces - be they Air Force, Navy, Marine Corps, Army or whatever.

We are witnessing unprecedented growth in many areas, as has already been discussed today, and I think by the end of tomorrow you're going to have heard that as many times as there are speakers; but that's not all bad. It was mentioned this morning about the rapid growth of commercial space capabilities and, initially, that's in satellite communications. We're seeing it also in imagery and perhaps soon in launch. It's making access to these services available globally and affordably to both the people we *want* to have them and the people we *don't want* to have them. That's an interesting point that I'll come back to later on. It gives countries, entities, and individuals access to the capabilities that are provided by vast satellite communications systems and very precise imagery capabilities without any investment in infrastructure. Now think about that. The United States of America has invested in space infrastructure since the 1950s. We've probably spent trillions of dollars on this - I don't know what the number is, but it's a lot of money. But now anybody out there can subscribe (just as we do to a utility) for communications and imagery (and eventually imagery that will be very precise)

without making those investments. That's something to be mindful of, to be worried about and, for we in the free world military, to understand how to exploit so that we can make our small military investment dollars go farther than they would if we had to build and field all of those capabilities within our own military budgets.

Air Marshal Fisher this morning mentioned the rapid growth of computing power. It's Moore's Law I believe which says that every 18 months computers go twice as fast, weigh half as much and cost half as much. Now we talk about having the capability to store a teraflop of information on a sugar cube. As somebody jokingly said the other day, 'If you don't like it you can eat it'. But this has important ramifications with respect to weaponry, with respect to vehicles and, eventually, with respect to processing imagery and signals intelligence information on satellites in the future.

One of the most troubling trends that I see today in the world of technology, is that industry is not investing in long term R&D. 'Long term' for industry is the next shareholders' meeting, or it's the next product. That's three years or five years, it's not 30 years. TRW Inc. has invested for 30 years in the development of laser technology which has enabled us to have the airborne laser today. If TRW were faced with an investment like that today, I don't think they'd make it. What this means for military R&D establishments, and for the militaries of the world in general, is that we must understand what capabilities we need to have, for the future, to make the weapons systems that we have today viable forever. We're going to have 100 year old aeroplanes: we just won't retire things as we currently do.

How do we make the systems we have viable through their lifetime and then improve the capabilities we have in the next generation? For the military to capitalise on commercial technology development we have to pay attention to it, we have to work with industry as General Ryan said earlier, and we have to be a partner in those investments. Motorola with the Iridium Satellite Communications program came to the United States Air Force and said, 'Tell us what we can do to help you'. But, with all due respect, by the time we were able to answer that question we were inside lead time - it was almost too late. That's because it was a paradigm that we'd not faced before. We have to face it now. We have to face it not just in the technical sense, but in a business sense. So, one of the challenges I put out to you is that we need businessmen in our military in the future. That's people who understand options; people who understand how to write contracts; people who understand how to be able to exploit the rapidly changing technologies that the commercial sector can provide to us in a way that's affordable and that provides us the capabilities we need without being terribly disruptive.

MILITARY TECHNOLOGY OR ENGINEERING?

I ask you this question: is it really military technology we're talking about here, or is it engineering? My view is that it's at least 50 percent engineering, and maybe more. It's often not a single technology that gets us a revolutionary capability. You *evolve* to a revolutionary capability, and an example of that is the Intercontinental Ballistic Missile (ICBM). The invention of the nuclear weapon in the 1940s was an amazing and revolutionary thing. But the revolutionary capability was not the nuclear weapon, it was the invention of the ICBM. That came from an evolutionary process within which the weapon was changed to weigh less, to have a higher yield, to incorporate an inertial navigation guidance unit for accuracy of delivery, and to be coupled with a booster that

would propel that weapon intercontinentally in a *very* short period of time. *That* was revolutionary and *that* changed the world. It wasn't a *single* invention.

Another example is the transistor. The transistor was invented 51 years ago. It was an amazing invention. But what it did was enable modern computing technology to *evolve* and give this Moore's Law effect that we see today in information systems development. The first report on orbiting satellites was in 1946. In the mid 1950s the first satellite was launched. I probably couldn't have said that two years ago, but I guess I can today. The point is that these things take a long time to happen. They don't just suddenly occur as a revelation - they take a long time to happen. That's why I asked the question: is it technology or is it engineering? You need both.

THE EXPLOSION IN COMMERCIAL TECHNOLOGY

We're experiencing another revolution today on the commercial side, and that is the revolution to be able to adapt quickly. Look at the acquisition system in particular. There's a lot of inertia in the acquisition system. We're trying very hard in the Air Force to change that, and we *have* made significant changes. However, the difficulty is, given that we have institutional inertia (and that's not a criticism, it's just a fact), how do we *now change the time constant and the mentality so we can incorporate the technologies* that the commercial side develops, to give us a new capability or a significantly improved capability. How do we get *agility* in to the acquisition system? I don't know the answer, but we're a long way away from it. Although you may have technologies that turn over every 18 months, you can't modify your weapons systems every 18 months. More importantly though, you can't afford to field the next millennium's fighter with 20 year old technology, and we wish we didn't have to do that. This is something that we need to seek to do better than we can today. I don't have an answer, but in finding one we do need to work with the commercial side as well.

NEAR-TO MID-TERM OPPORTUNITIES

There are many near- to mid-term opportunities with respect to technology and technology applications. I want to list and go through some of these.

INTEROPERABILITY

One important opportunity is that of interoperability through communications, command and control and information systems. Someone asked a question earlier about interoperability. I think it's absolutely critical.

As the United States of America continues to operate as we do today - worldwide with our allies and coalition partners - those operations will only be as effective as our ability to communicate with each other and apply our forces to their best use. This means that we have to have common air and ground pictures, so everyone knows who's where and what's what. It means being able to communicate via voice and data - sensor-to-controller-to-shooter, sensor-to-shooter and, maybe some day, sensor-to-shot. For the most part this will occur through modifications to *existing* weapons systems, and this will be the case for some time. Changes will gradually occur with *new incoming systems*, but we're going to have a lot of the force structure that we have today for years to come. Maintaining viability in this aspect of communications, especially for interoperability, is very important.

But the issue is not just interoperability between Australia, New Zealand, Singapore, Malaysia and the United States of America, for example; it's also about the United States of America doing it with Army, Navy and the Marine Corps. It's the interoperability of old weapon systems with new weapon systems, and it's interoperability with commercial systems. So this is a big issue; it will take partnership and hard work, but important potential is there.

PRECISION GEOLOCATION

Another important and emerging capability, as was mentioned earlier, is precision geolocation worldwide. We are rapidly reaching a point where we will be able to locate any stationary or slow-moving thing, of any significance, with incredible accuracy very quickly. The things that don't move at all we'll be able to fix accurately all the time; so, concealment won't keep us from attacking them. We'll watch them being built or we'll otherwise monitor them with various types of sensors. Non-stationary things that don't move too rapidly will also be able to be targeted with great precision and speed in the future. That's GPS.

An unexploited part of GPS is the timing accuracy that it possesses: nanosecond timing accuracy. I don't think we know what to do with that yet. We use it in JTIDS in our communications, but I don't think we really understand how to exploit it. Where I think it might be most exploited soonest is in the financial world where, in regard to financial transactions, time is money. I think that has some interesting implications for how we protect such systems in the future and whether or not we want to give them up to a commercial, out-sourcing, or privatisation kind of concept. We really need to think about this issue very hard.

REACH-BACK COMMUNICATIONS

The importance of 'reach-back' communications lies in not having to forward deploy massive amounts of command and control and other information infrastructure. It's the ability to be able to order a part from Ogden or Warner Robins, for example, and have it quickly delivered through airlift, whether that be commercial or military. We are exploiting that capability but, again, we will come face to face with a concern about protection of the required communications links. We are all so excited about GPS (I'm a real fan of it and have been for 20 years), and we're excited about the explosion in commercial satellite communications capabilities, but one of the things we want to be sure we understand (as General Ryan mentioned with respect to the *hacking* that occurred a couple of months ago), is what the vulnerabilities are. Can we have robustness through diversity? Will we have enough satellite communications capability so that through some 'big switch in the sky' we'll get survivability through being able to route effectively and efficiently? We need to think about these things to avoid unintended consequences. I think that, in the rush to save money and in the rush to exploit capability that's new and fascinating, we want to be sure that we don't bring about unintended consequences that will ultimately work against us in ways that may be difficult to counter.

One of the cautions of reach-back communications is that, if we get really good at reach-back, then somebody in the seat of government is likely to think they can run the war, and they probably already do. But my goal is not to have a war run remotely. The idea here is to be able to pass information efficiently and quickly to the right people

at the right place so that they're able to send out the unit - whatever that unit might be - to attack the targets and achieve the objectives.

THE GPS SYSTEM

Precision navigation and geolocation will eventually reduce the need to deploy landing equipment for adverse weather conditions. Now I'm *personally* not there yet: I have a problem with free flight to the extent of flying all the way over here (although I realise it's a big sky) believing that everybody's GPS is going to work so reliably and accurately that no one is going to crash into anyone. Maybe some day that will happen. It's very important, however, to be able to reduce the amount of airlift required to deploy our forces into any kind of a contingency, and landing equipment is one of them. We will also, as I mentioned earlier, be able to locate (very precisely) targets of interest that are moveable or stationary.

RAPIDLY AVAILABLE INFORMATION

I mentioned the rapid availability of information before, but the key concern here is our agility to exploit that information. The cheap availability of information to potential antagonists - people who worry us even today - through space and over the Internet is going to empower a lot of second tier or disadvantaged groups with knowledge about our operations. Whether or not such a group could do something frontally with such information may be unclear, but they certainly could be able to do something asymmetrically. That's something that we have to worry about and it's something that's much less easy to predict ahead of time.

WEAPONS WITH TAILORED EFFECTS

Some people refer to weapons with 'tailored effects' as 'non-lethal weapons'. There is no such thing as a non-lethal weapon - everything is lethal at some level. I prefer to use the term 'tailored effect', and I'm sure that you'll indulge me here. The world we live in today places the military more and more in the position of being an instrument of political policy as well as national policy and international policy. These situations are often likely to amount to less than war, where the rules may place one or two hands behind your back such that you may not be completely in charge of what you're supposed to do. Bosnia is an example of that. There are likely to be casualty-intolerant situations with intense media coverage. A premium is going to be placed on minimising collateral damage, and minimising casualties to whatever extent we can. As a result we have to develop weapons that can quickly subdue these antagonists without resulting in large civilian or military casualties. It's also important, however, to build these weapons to have a *variety* of tailored effects. This may include anti-personnel weapons, which to my knowledge have seen very little development since Vietnam.

This is not just a military issue. There is tremendous potential for technology transfer from the military to the civil law enforcement agencies of our society. In this regard also, we need to deal with the inter agency problems that were alluded to by General Ryan earlier. When we had the incident involving computer hacking against the defence system, for example, and I believe this is true, the action was eventually stopped by the Justice Department. Where do you draw the line? When problems occur, somebody has to stand up there and take control. I guess the Chief of Staff of the Air Force is not necessarily the person to do that, but somebody has to. Working out these

inter agency issues ahead of time is really important, because when the time comes you're going to have to act immediately.

SMART BOMB SYSTEMS

The small smart bomb system is something that has a tremendous amount of promise. We are developing small, inexpensive, accurate weapon guidance systems which, when coupled with improved detonation processes and improved explosives, will produce bombs which, for example, might weigh 250 pounds but have the same effect as a 1000 or 2000 pound bomb would today. This means that, given proper integration into our aircraft and appropriate targeting systems, the larger weapons payloads will enable us to attack more targets per sortie. It also means that we may, some day, be able to carry these weapons on unmanned aerial vehicles (UAVs) for target attack.

The LOCAAS (Low Cost Autonomous Attack System) is an example of a weapon that uses a smart sensor to detect vehicle type targets. The system can determine whether a particular target is a tank, a truck or an APC, for example, and it passes information to a detonation system which is capable of producing different effects. Thus the warhead is detonated according to the specific target. What's great about this is that you get one and a half weapons instead of three. It's tempting to say 'three for one' but I'm not sure exactly how effective these things will be.

Think about the logistics implications of this kind of system. Think about what the implications are for the way you buy war reserve materiel and store it. Think about the implications for transporting these sorts of weapons to the place of intended use. There is not a big sorting problem if you can ship one weapon instead of three. This is a very important concept and it *is* coming.

UNMANNED AERIAL VEHICLES.

Everybody loves UAVs. They are not new: we have had UAVs in the United States of America for 40 years. We had supersonic ones; we had reconnaissance ones; we had ones that dropped bombs and shot missiles; we've *done* all this. What is new is that it appears that UAVs can be acquired and operated at a cost which is competitive with manned aircraft for some missions. Reductions in defence budgets means we are looking at the opportunity to replace some manned weapon systems (and I include in that surveillance, reconnaissance and intelligence) with unmanned options. The Advanced Concept Technology Demonstration process which produced Predator and is producing Global Hawk and Dark Star has not (by design) produced supportable well understood systems. This does not say that Predator hasn't done a good job, only that it is not supportable. This process, however, has and will continue to force us to experiment with aggregates of technologies to produce 'system' prototypes quickly and relatively inexpensively. Also however, as is the case now with Global Hawk and Dark Star to a greater extent than Predator, the receiving service has to be involved so that we get supportable residual military capability.

While the promise of UAVs is great in my belief, we've got to be realistic about it. I believe that a 'walk, run' strategy is prudent. We don't know how to do autonomous flight yet. We should not ignore (nor be offended by) the FAA and ICAO concerns about operating UAVs autonomously in the presence of manned aircraft, whether they be military or civilian. We are not certain about manning or sustainment yet. We're not certain about the life time of a UAV (but I can guarantee it won't be 50 years). However, on all this, we are learning.

We should learn from our experience. We should move ahead first with applications we understand (in terms of performance, product and cost); for example in the areas of surveillance, reconnaissance, SIGINT, and communication relays. Great capability can be achieved affordably, I believe. However, careful definition of program 'off ramps' has to be done so adjustments can be made if we succeed or if we fail. We need to be able to change direction easily if there are any surprises.

SUMMARY

All of the capabilities and technologies that I've discussed (and there are more) are important and even critical to success on today's battlefield and the future battlefield. Furthermore, many of them are key to maintaining the viability of the weapon systems and fighting forces that we have today and will (in many cases) have for decades to come. Unlike airlines the military can't just sell off ageing aircraft and adjust the route structure. We just don't have that opportunity.

THE LONG TERM

As I said earlier, industry is not going to do long-term (20 years plus) R&D in the future. The government laboratories have to focus on militarily unique R&D and on those systems and interfaces that permit easy integration of commercial technologies. I'd like to go through a list of longer term investment areas which I believe are important and necessary. We need to develop each of them before we can know whether they will offer us any ability to do something we can't do today, or to do something we can do today more effectively and affordably.

First of all, as a fairly revolutionary capability, consider the prospect of a 'phased array laser'. Semiconductor diode lasers which are currently being developed both in commercial industry as well as at the Air Force Research Lab at Kirkland AFB will some day enable us to build a phased array of lasers that we'll be able to direct (just like RF energy) for defence or offence. A few years ago the Air Force Scientific Advisory Board undertook a look at technology for the future and one of the concepts which came out of that investigation we called the 'photo fighter'. It was to use these phased array laser systems. Related systems are actually being applied in commercial industry today, although not as phased arrays.

Another important area for research involves hypersonic propulsion for weapons and vehicles. This will enable very rapid responses to international crises - power projection globally in minutes for reconnaissance or for attack, for example. I can't write you a treatise on this: I just know it's right. We have *subsonic* flight. We've got *supersonic* flight. Well; what's the next one? - it's *hypersonic* flight. The concern that I have is about testing facilities. We know we need them, just like Von Karman and Arnold knew in the 1940s that they needed to build a facility in order to develop supersonic vehicles. They knew there were applications, they just didn't know exactly what they were. Testing for development purposes is a very critical part of the acquisition process. Sometimes it takes as long to build a test facility as it does to build the stuff you want to test. We need to get ready. The hypersonic facilities we have today simply aren't up to the task. Some of our facilities were brought in from Germany by Von Braun after World War II if I'm correct.

Somebody needs to start working on engines with no moving parts. We need something that is to the turbine engine today what the turbine engine was to the

reciprocating engine. I don't know what it's like for people in this part of the world, but high cycle fatigue is really a big problem in the United States Air Force and probably in the Navy too. We wouldn't have a high cycle fatigue problem (though we might have other problems) if we didn't have moving parts in our engines. The prospect is a long way off, but somebody needs to be working on that now.

We talked about processing earlier. We need processors that are small, lightweight, fast and inexpensive that can enable onboard satellite processing so we can take advantage of all of the multiple 'INTS' that are going to be up there collecting information. We need to be able to use such processors to enable smart guidance on weapons and resolution enhancement of imagery.

Another important area involves MEMS - *micro electromechanical systems* as small as a hair that can go undetected into denied places and send back information. I recently saw a presentation by a professor of engineering at UCLA where they're actually applying this kind of technology neurologically in conjunction with the UCLA School of Medicine. These are amazing technologies that we don't know how to exploit. We need to be thinking about them because they can provide us enormous capabilities.

We need detection systems to enable the location of chemical and biological agent production and storage (perhaps MEMS could help us with this). We then need weapons to attack these facilities while containing the effects. We *are* going to see somebody use weapons of mass destruction - particularly chemical and biological weapons (not to minimise the nuclear problem) - and we need to be able to deal with that.

Real and rapid sensor fusion that correctly integrates information provided by various sensors (multi/hyperspectral, SIGINT, etc.) will, when coupled with precise geolocation and a common battlespace picture, offer profound effects. There is much science yet to be done on fusion. We don't have the mathematical basis for this yet and that needs to be worked on. The potential power in this capability is incredible.

The autonomous operations of UAVs need to be developed (including MEMS UAVs).

We need to work on reusable launch vehicles (call them 'space planes') that enable rapid launch and/or recovery of space vehicles on a routine basis at relatively low cost - just like sortieing aeroplanes.

CONCLUSION

There are many things that we have to think about in these areas. In the United States Air Force we have a large science and technology budget. However, that budget will no doubt continue to shrink as the money gets tighter. It is of key importance to realise that, for your country as well as mine, these funds are the 'seed corn' of future military capability. We need the commitment of our people and the passion to stay the course. I know of no more committed people than those in the United States Air Force, but we do have problems out there. As General Ryan said, they've been to Bosnia four times in nine years and perhaps they don't want to do that any more. We can't abuse our people because in the end, even with all the technology in the world, without the people and the commitment of those people we can't do anything.

Space looms out there as an environment in which exciting things can happen. As more and more of our commerce occurs via space systems, and as our military becomes increasingly reliant on products delivered by space systems, we're going to be confronted with a need to protect those space lines of communication and/or deny access

of others to it. We've got to prepare for this. I don't care what the policy is, we've got to prepare *now* using the appropriate technologies. We've got to write the doctrine and understand the laws and the treaties so that when the time comes we're ready. To ignore this need could be tantamount to national suicide in the worst of cases.

As the world becomes more complex and competitive and troubled in spots, and as free world military forces continue to be cut in size, coalition operations are becoming the day to day norm rather than the exception: nobody can go it alone. It is critical that we exploit all technology to maximise the interoperability of our forces, while at the same time minimising the cost and the time it takes to do this. The key technologies are those that facilitate the passing, sharing and displaying of information, and the command and control of joint and coalition forces. Such interoperability requires common interfaces, data formats and nomenclature. It provides the key to maintaining current weapon system viability into the future. Most importantly, it will be the capability that enables all of our forces to exploit and act upon information quickly and decisively - before the adversaries - and in the end prevail. As the availability of commercial satellite communications and imagery becomes common, fast and relatively cheap our main challenge is the one I mentioned before - to use information more quickly and decisively than our foes. They too will have access to much the same capability. It will be the ability to be more agile than the enemy and exploit total battlefield awareness that will determine the victor.

These are very exciting times we live in. We all tend to wring our hands and think about the problems we have, but there are tremendous opportunities out there. Great changes are occurring very fast but they shouldn't be feared. Rather, we should confront them: we should recognise the opportunities and exploit them together in the true coalition and allied situations that we currently live in and hope to live in for the future.

DISCUSSION

Dr Andrew Butfoy: I have a comment, a guess and a question. The comment is that the United States does retain a very strong unilateral military option and has consistently demonstrated its willingness to go the unilateral route. The guess is that the next time a nuclear weapon is used, it will not be used with an ICBM; it will be used with some other delivery system. The question is: if the United States goes full speed ahead, so to speak, with hypersonic delivery systems, will it not, in fact, be engaged in an arms race with itself and would that not, in fact, be the quickest way to make its current comparative advantage obsolete?

Mrs Crawford: First of all, this is not something that's going to happen overnight - I guarantee that. It's going to take years to develop the propulsion, the materials and the integrated systems that are required. Second, you would go into an investment like that based on a *need* for the capability. As United States forces continue to be withdrawn to the continental United States (as opposed to peacetime bases overseas), and as necessary response times for certain circumstances increasingly involve minutes rather than hours or days, the options for getting to the scene are becoming less adequate. One way to improve that situation is through a hypersonic vehicle; be it a weapon or a returnable

delivery system. I guess it's possible that that could result in an arms race within the United States, but the pressures of the purse mean there are very careful decisions about where to spend the money. Your concern is noted, but my experience is that we're far too conservative to let that happen.

Squadron Leader D.G. Millar: You very well addressed the *what*, *where*, and *when* in the matters of global reach, speed of weapons delivery and knowing where in the world the target is. But I was wondering how you might address the *who*, in the matter of mistargeting. The likely impact of that on world opinion and United States domestic opinion is such that you can't afford to get it wrong. How could you see that being addressed?

Mrs Crawford: Technology alone can't solve that problem. The Gulf War taught us a bad lesson. We fought that war with relatively few casualties, so now everyone expects that that's the way it's going to be in future. I hope to heaven it is, but there *will* be casualties when we go to war and when force is used, whatever we do. To make a mistake and have it on everybody's news at night when they're eating their dinner is a serious problem. It is one that cries out for better intelligence capabilities than we have, and the ability to locate a target of interest and produce only the desired effect when weapons need to be placed near to a sensitive location.

What this begs for is an understanding of the people and the cultures in those areas where we may have to use these weapons. Unfortunately I'm Western, and I regret that I am not a student of other cultures. But in saying that, I recognise the fact that I don't know what makes other people tick. In order for us to be able to use very precise weapons (whether they arrive quickly or slowly) and produce the desired effect (which is making the adversary quit doing what we want him to quit doing, or otherwise do something we want him to do) we have to understand where the pressure points are. That is a capability I think we are short on. Improvement is going to take a tremendous investment in intelligence and cultural understanding - I think we may not have enough of that today.

Mike Hall: I wanted to take issue with something you mentioned early on in the piece which related to the strategic nature of required investment and the suggestion that industry tends to think no further forward than perhaps the next shareholders' meeting. I expect that that's true. There's a second element which relates to politics, where we know that the political environment may change and that that may indeed bring about changes of philosophy. What is the United States doing to address this very important area of strategic planning? How do you go about it? And what parallels are there for nations which have perhaps less funding than yourselves to set up long term plans of this order?

Mrs Crawford: I can speak best with regards to the Air Force. The United States Air Force, through its research laboratory, has a long history of partnering with industry and universities. Many of the technologies that have been developed have involved significant interaction with industry. One of greatest note is perhaps engine technology which has been basically developed at Wright Paterson and then transitioned into the commercial sector. It was the commercial sector that mainly got the price down and the performance up; not the lab itself. There has been a move in the last two years to make

that interaction more intense. The push has been to partner with industry where appropriate but at least to be wise consumers and smart buyers of commercially developed technology, and also to let the contractors understand what the Air Force capability requirements are so that, to the extent that the industry is willing and able to make longer term investments, they can. But there's nothing that the United States Air Force can do, short of promising a national emergency or guaranteeing a return on investment for involved companies, to make investment happen. There is, however, a great deal of communication, and let's call that the strategic partnership that I think it is. Industry can't know and plan if you don't communicate with them and I think we're doing that much more effectively today.

Also in the past couple of years the Air Force has written a strategic plan which laid out for the first time (and it's just a first iteration) what they believe the required capabilities are for 25 or 30 years down the road. That is an unclassified document: several of the strategic planning documents that the Air Force has written are unclassified and openly available. Conferences are held from time to time to talk about these things and I think that provides fairly good information flow back and forth.

I know what I said was pejorative and it was intended to be that way. A recently retired president and CEO of a *very* large United States aerospace company said to us as we were doing the 'New World Vistas' project in the Scientific Advisory Board a few years ago, 'I am embarrassed to say that my company is no longer doing long term R&D.' I understand that, but we have to be able to live in that environment and continue to keep them informed.

Air Commodore D. Bowden: My question is really about interoperability and how much that relies on standards. We understand how over the years in aviation the ability to have aircraft refuel across different air forces has been a product of technical standards on equipment interoperability. We understand everything from railroads to communication protocols and also how information systems initially got their standards through defence. The latter is, however, no longer the case: they're coming through industry. Is it still important that defence influence those standards because they *will* impact on interoperability? To put the question in an unusual way: should we make Bill Gates' Microsoft Word the standard for communications interoperability so at least we can talk to our own Army who are currently using a different product? Is that the key to interoperability for the future?

Mrs Crawford: Your point is well taken. Let's take '1553' data busses, for example: there were good standards there, it was worked on hard, it had backward compatibility, etc. Now let's take the '1760': we still don't have standards and we still don't have backward compatibility. Interfaces are critical, you're absolutely right.

If I'm not mistaken, Bill Gates has been very interested in talking to the military. I think the military needs to take the lead. If these kinds of systems are going to be used for military purposes then you've got to be pro-active about going to the guys who produce them. It's like the Motorola/Iridium story. They came to the Air Force and said: 'What can we do? What do you need? How can we help you?' And we couldn't answer the question. It wasn't because we were stupid; we had just never thought about it. Standards are even more important because you can't afford to make wholesale modifications of weapons systems - be they aeroplanes, tanks, trucks, submarines or

weapons - you've got to be able to do it at an interface. To build a good interface which is affordable and enduring, you've got to understand what's on either side of it.

This is the key to interoperability in the future. It's going to demand communications between the military and industry and, in ways that we may not have done before, across services and across countries. It's going to take pro-activeness and maybe a little bit of risk, but it has to be done.

Dr Adam Cobb: Technology does have a down side from time to time, and in both the ADF and the commercial sector in Australia we're having big difficulties with the 'year 2000' (Y2K) bug. I was wondering if you could explain to us the US Air Force experience in coming to grips with this problem, particularly with regard to strategic nuclear forces?

Mrs Crawford: I can't answer that question. General Ryan would you like to? I don't know the answer.

General M.E. Ryan: We started a process several years ago to address the year 2000 problem. We went initially to our operating systems to make sure that they were the ones cleared first. We have a plan that takes us through 1999, by which time we should have been through every one of our systems; both from an identification stand point and a clean up stand point.

As far as the strategic capability goes, I'm not terribly worried. We looked at that system very early on and very quickly and made sure that we had the patches in it. What is of greatest concern to us is not our internal systems. I guarantee the United States Air Force is going to fly on the first day of January in the year 2000. What I am worried more about are our interfaces with our other partners in industry who have not been as diligent as ourselves in cleaning up the Y2K bug problem. We are connected with so many of those folks out there - in our information systems, in our acquisition systems and in our reporting systems - that we're worried about how that might pollute or affect our main systems. So that's our focus right now. We've done, I think, a very credible job in working our way through the problem but, like everything else, what you don't know you don't know. When the elevator doesn't work or the toaster doesn't work or whatever doesn't work in the year 2000, we're going to have a lot of cleaning up in those areas. But for our major weapons systems and for our command and control systems, particularly on our nuclear side, we're in pretty good shape.

Air Vice-Marshal R.V. Richardson: I wanted to raise the issue of cost escalation in emerging technology, especially as it relates to the importance you placed on interoperability. It does seem to me that Moore's Law almost seems to be applying, in the inverse, to the leading edge of aerospace technology in its cost escalation. You pointed out that the key capabilities for interoperability are the passing, storing and processing of information. It does seem to me that for smaller countries - perhaps especially those even smaller than ourselves - interoperability in those key areas is becoming almost impossibly expensive with what I see as the great advances being made in your country in terms of those information development areas. Could you comment?

Mrs Crawford: You may not be able to afford to *develop* information capabilities; you may be able to afford to *acquire* them, but all you actually need to be able to do is *receive*. What I want you to have is communications systems, whether they're data links or whatever (Link 16, JTIDS, etc.) so that you can have passed to your aircraft (or any weapon system) information that can be displayed to give you a common picture with whatever other aircraft are operating in your environment. It's the communication part of it that to me is absolutely critical. You can't possibly replicate the industrial infrastructure; I know that. Sometimes we can't either but the commercial side is what keeps it going. The essential investments are in data links and communication, and in displays. Those are not free - they're expensive - but they're not as expensive as if you had to invest in the whole infrastructure itself.

Let's say the United States of America is involved in some place and that it has systems present like AWACS, JSTARS, Rivet Joint, etc. - something up there that can pass information. We want to be able to pass that information to *you* so that the component commander or joint force commander knows that your aeroplane has the same picture on its scope that every aeroplane does, so that there aren't any surprises. That's what I was referring to primarily on the interoperability side. However, it requires what we talked about before - interfaces - whether they're on the communications side or the display side or whatever. You've got to have interfaces so that you can pass exactly what you want to pass, receive what you want to receive, and display it. That's where I think the leverage lies personally.

Squadron Leader N.M. Connell: Given the incredible advances in conventional weapon technology which are forecast over the next couple of decades, do you see the low yield nuclear weapon becoming increasingly irrelevant and of no utility?

Mrs Crawford: Absolutely not; I believe in nukes - did I say that? I think that we've been through this. One of the problems of being around as long as I have is that you see all this stuff come and go as though it were on a sine wave. There was a period, years ago, when people said that precision conventional weaponry would render nuclear weapons of certain types obsolete. I don't think that's been the case: if for no other reason than for their deterrent value. It's a really scary thing to think somebody could unload a nuclear weapon on you, whether it's a tenth of a megaton or a hundred megatons. I don't think the conventional weapons that are forecast could take the place of nuclear weapons for certain targets and for deterrence.

There are, however, an increasing number of targets that we are able to attack conventionally. We saw this in the war in 1991 in Iraq. We could previously never have attacked some of those targets without small yield nuclear weapons - deeply buried targets, for example - but now we can. That's a good thing, but I don't believe *conventional weapons will ever replace nuclear weapons, at least for deterrent purposes.* That's my opinion.

Squadron Leader J.R. Brown: I've just been reading with interest the book *The Icarus Syndrome* in which Carl Builder talks about the USAF having an institutional affection for aeroplanes to the detriment of the development of missile systems. Would you like to comment on that as someone who's been closely involved with the USAF, but as an outsider and not actually as part of the organisation?

Mrs Crawford: I'm not sure that I'm so far removed. We have the people of the past, the people of the present and the people of the future. I'm not as pessimistic about the so called 'cultural change' that's required. There is a lot of concern about the fact that the leadership of the Air Force is a fighter pilot leadership, but they didn't get there by accident. The preponderance of the force, since the strategic era, has been in fighter aircraft and those leadership positions have resulted in the leaders we have today. There is nobody in the United States Air Force that cares more about moving to the next paradigm than General Ryan, or General Fogelman before him, and probably whoever succeeds General Ryan in three years - they understand it, they know about it and they're trying to deal with it.

I don't know how there got to be *outsiders* and *insiders*, but there are, and I say that with regret. I think there are more people who feel like *insiders* than feel like *outsiders*. I have known lots of Air Force people in my years. I know some who are genuinely unhappy and concerned about their status. I know there are some who are chronic malcontents who complain. The problem is that one bad apple can spoil a barrel. This is not a problem to be ignored.

One of the problems with the space people - which is the missile force if I can make that leap - is that that group of people has never been part of the Air Force. There are more people from the Air Force than any other service in the National Reconnaissance Organisation (I believe that's correct). They go and they never come back. That's OK except that they are not part of the operational Air Force. By that I mean those people who generate forces, the people who support forces, the people who go out to attack targets, the people who lose their buds, and the guys that never come home. They've never been part of that. So I'm not so sure the cultural problem lies with the guy that wears the wings as much as it does the people that have been a part of the missile force or the space force who have never really integrated into the Air Force.

Now that's not their fault; that's the way it was designed. So the challenge I see is with the assignment process, which is going to take something other than voluntarism to work. It's going to have to be by direction where you move people - the space folks, the missile folks - into positions where they can learn to understand what the Air Force *is* and what it really means. We also we need to take people who have an understanding of what the Air Force is minus space, and let them see what space can contribute. We need to homogenise the milk. I know that General Ryan is trying as hard as he can to do that, but the problem is an historical artefact. It does not exist because people are mean or trying to do bad things to people. It's just a fact that that part of the world was so segregated through the classification of the operations they were doing, that they became two separate pieces divided by the 'green door'. It is changing: everybody who matters understands it and a lot of us are working hard to try and change it.

THE IMPACT OF TECHNOLOGY:
AN AUSTRALIAN DEFENCE PERSPECTIVE

RICHARD BRABIN-SMITH

INTRODUCTION

Air Marshal Fisher, thank you very much for the opportunity to speak to your conference and, in so doing, to risk joining the pantheon of highly senior people who over the years have tried to make predictions and have not got it all that right. I refer to the likes of the following:

> *Heavier-than-air flying machines are impossible.*
> Lord Kelvin, President, Royal Society (1895)

> *As far as sinking a ship with a bomb is concerned, it just can't be done.*
> RADM Clark Woodward (1939)

> *Space travel is utter bilge.*
> Sir Richard van der Riet Wooley, The Astronomer Royal (1956)

> *There is no likelihood man can ever tap the power of the atom.*
> Robert Millikan, Nobel Prize in Physics (1923)

> *The bomb will never go off - I speak as an expert in explosive.*
> Admiral William Leahy, US Atomic Bomb Project

> *I think there is a world market for maybe five computers.*
> Thomas Watson, Chairman of IBM (1947)

By coincidence, sitting at my desk one day earlier this year, I had a package dropped on it which turned out to be the official history of an organisation that until recently dared not speak its name - namely the National Reconnaissance Office (NRO). I'll just bring this panoply of the perils of prognostication and the difficulties of getting support for new ideas a little more up to date. Let me read from the first page of this history of the NRO.

> In 1946 the US Army Air Force's project Rand published a speculative essay which called for a multistage experimental world-circling space ship. At the same time the US Navy proposed the construction of a single stage earth satellite vehicle. With no apparent military application, these proposals fell on deaf ears ... Even after the creation of a separate US Air Force, a new Department of

Defence and a Central Intelligence Agency in 1947, proposals for the development of satellites continued to languish. No one was interested.

So you can see I'm pleased to be standing here this afternoon trying to assess the future and get support for it.

STRATEGIC FUTURE

I'd like to start the talk with a little speculation on the strategic context that will develop over the next few years. I'll talk a bit about technology itself, and its influences. Then I shall use the framework coming out of the Government's 1997 Strategic Review[1] to try and put the two together. From this I hope to distil some priorities for force development. Then I will summarise.

Clearly I'll be talking about some global factors - laws of science are universal after all - but I'll bring out aspects that relate specifically to Australia. I shall clearly not be covering everything, but focussing on some of the more important areas in which I believe the future will be different from the past.

Now, I need to start with some assumptions about our strategic circumstances. I see continued economic and therefore defence growth in the East Asia Pacific. I see the current 'crisis' as being somewhat ephemeral. Therefore, there are going to be continuing demands, as the Strategic Review points out, on the levels of capabilities which we need in our Australian Defence Force. This will also come through the widening focus of our strategic policy. It takes, as the bedrock, defeating attacks on Australia, but it also then enlarges that to give a greater emphasis than in the past on defending our regional interests and supporting Australia's global interests. There are going to be considerable demands on the levels of capabilities that are appropriate for the ADF.

My first speculative conclusion rises from the question: to what extent will our future strategic circumstances make it *inappropriate* for Australia to lag the leaders in capability? We have been able over these years to wait until our great and powerful friends have made the initiatives, have got new systems in service and have ironed out most of the bugs. But I speculate that we're going to have less of a luxury in that respect in the future. Inter alia, we're going to have to manage risk a bit more cleverly. And I allow myself the slightly ironic thought that the future is going to be a field day for the Public Accounts Committee and the Australian National Audit Office.

A further speculation is that our Defence funding is not going to be that much radically different from what it is today. It might go up, say, 10 percent or 20 percent but I certainly don't see it going up by a factor of ten without the outbreak of very serious deterioration in our strategic circumstances. I see, therefore, a need for continued rigour in our priority setting, sharper tools of analysis, better operational research and cleverer use of simulation in helping us understand the future, as part of this priority setting process. I might add, having been part of previous decades of analysis, that historically the tools we've used have been quite crude.

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[1] *Australia's Strategic Policy*, Department of Defence, Canberra, Australia, 1997.

Here are some more assumptions about the base case extrapolation (and I will leave it to others to think of more radical futures). I believe that the alliance between Australia and the United States will endure and, indeed, could well become even stronger, as we in Australia see that it is to our advantage to exploit (in the nicest possible way) the kind of leadership that the United States is going to give, not just in global security, but more specifically in the East Asia Pacific. Slightly more speculative on my part is to wonder whether we will not see a continued strengthening of an 'English Union alliance'. That is to say, it's not just ourselves that wants to be a close ally with the United States, but also Canada and the United Kingdom. I should include some reference to New Zealand here also, but as we all appreciate there are some difficulties in that relationship at the present time. Let's just reflect for a moment that those countries which have sent forces to the Gulf, in this most recent series of events in support of the United Nations through the United States, comprise Canada, ourselves, the United Kingdom, New Zealand and the Netherlands. Where is everybody else? Behind my speculation is also the thought that, at the end of the day, even in a post-modernist deconstructionist world, shared language and shared cultures actually do count for something.

I will speculate further and say that I see strong prospects for greater interdependence. This will come from two main drivers: a political predisposition which derives from the kinds of factors that strengthen the alliances anyway (including for coalition operations), and also, importantly, cost imperatives. I see the potential for greater interdependence with intelligence, interoperability (leading to more shared doctrine and a shared approach to C3I), more actual coalition operations, and perhaps a greater interdependence in some aspects of the development of defence materiel (and I shall amplify that shortly). Maybe there's going to be a role here for the other democratic countries - Western Europe and some of the countries in Asia - but I have to say I'm not so sure there, and I don't think that it affects my basic thesis anyway. Finally, I see that the United States will continue to be a dominant locomotive for advances in technology as applied to defence, although Europe will continue to be competitive in many areas.

Let me mention in passing ANZUS, Deutch-Ayers, AAMOUR, CCIB, AUSCANZUKUS, ABCA, and ASCC as some of the enormous privileges which we have in Australia in terms of a high guarantee of access to the United States, the United Kingdom and Canada, which, sometimes at our peril, we take for granted.

TECHNOLOGICAL FUTURE

So much then for some speculation on the strategic future. Now let's turn a little bit to the technological future: Moore's Law. And let me just remind you what Moore's Law is; Moore's Law says that the number of lecturers who refer to Moore's Law doubles every 18 months, while their comprehension of what it means halves. In fact, Moore's Law and the trend for computing power at constant cost is shown here at Figure 1.
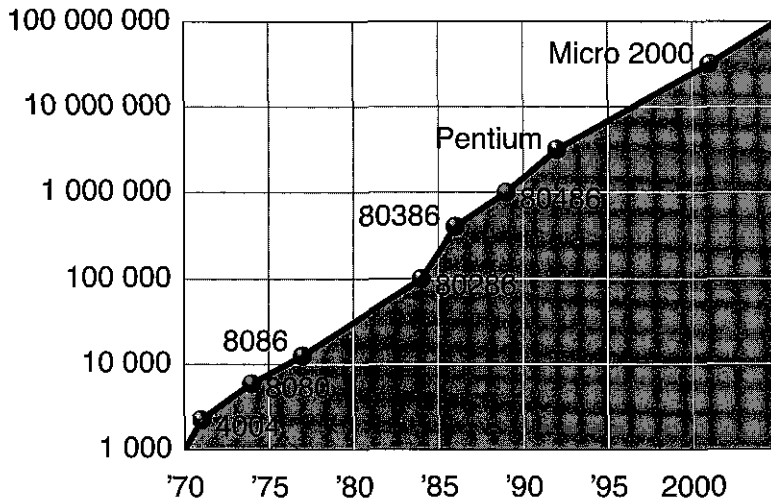
Transistors per chip

Figure 1.   **Moore's Law**

Technology continues to advance, and it seems to me it is useful to differentiate between the fields which are moving slowly and those which are moving much more quickly. It seems to me that the highest rate of change is at a rate which, as far as I can see, is without precedent, and I really wonder sometimes whether we've got the point. I think our minds have got the point, but it's not entirely clear that our hearts have really caught up with a deep comprehension of what it means.

As I've written in my notes here, electronics touches everything. Now that's a bit of an exaggeration, but it certainly touches one hell of a lot of things. As Figure 1 allows you to conclude, the rate of advance is simply terrific. By the year 2020 we're looking very realistically at the prospect of 10^9 or 10^{10} transistor equivalents per chip, and I think that is phenomenal. Just think where we were 20 to 25 years ago and now exponentiate that into the future.

Let me give you another couple of examples. Nulka (the decoy for anti-ship missiles) started about 20 years ago; computing power at constant cost has gone up by a factor of 100 in that period. Jindalee (the over-the-horizon radar) started 25 years or so ago; computing power has gone up by a factor of 10^5. I'll return to the point of what that means for system design later on in this talk.

So there's a lot of science that's going to be pretty exciting stuff. I'm talking about systems science, not just the basic science but the application of existing knowledge spurred on and made phenomenally exciting by this rapid rate of advance in anything that electronics and the associated computing software touches. In addition to that, there will be new science coming along: for example, biotechnology and some aspects of material science including MEMS (Micro Electromechanical Systems).

Let me speculate some more. Let's just think of some of the consequences of this rapid rate of change. The first thing is to emphasise that we're talking about the application of technology to war-winning capabilities: not just capabilities that might some day be useful, but capabilities that will win wars or alternatively lose them. I believe, therefore, that this has quite significant consequences for our culture and our general approach within the Defence organisation. My first point, that not everybody

will welcome, is that the rate of change is so rapid that I believe the usefulness and relevance of individuals' knowledge in science and technology is going to decay quite rapidly. Therefore there's going to be a greater need to harness the expertise of those in the Defence organisation, and more broadly, whose job it is to know where the leading edge is. If you think that's a bit of an advertisement for the Defence Science and Technology Organisation, you would be right in so thinking.

I believe also that we need to foster much more the culture of risk management rather than risk aversion. I believe that within the Defence organisation (and within the public service more generally) we've gone a long way in this respect over the past ten years or so, but there's one hell of a way further to go.

I believe that we need to continue to take seriously the program of Capability and Technology Demonstrators (CTDs), as part of the response to how to take advantage of the rapid rate of advance in the technologies that underpin war winning. The parallel of our CTDs is the ACTDs (Advanced Concept Technology Demonstrators) program in the United States.

There will be more exploitation of *commercial-off-the-shelf* products, because a lot of these war-winning technologies are being developed at this huge speed by the commercial sector for application in civil areas. There will be less reliance on *military specifications,* and there will be more evolution in capability once equipment is in service.

I believe that there will be a need to go back to basics: to thinking about what warfare is and is not, and to be less constrained by current doctrine. Let me make a sweeping statement and risk being shot down for the same. Let's remember that current doctrine itself, in many cases, has been the result of adapting to the way technology has developed. Therefore we need to make sure that the doctrinal context in which we think about how to apply new technology is the relevant context and not an inhibition based on yesterday's technology.

Summarising some of these aspects: we need to continue to reform our acquisition processes and to do more to put in place a culture of *seeing* - that is to say, *recognising* - and then *seizing* opportunity. These changes need to apply across the board within the Defence portfolio: ADHQ, the ADF more generally, my own organisation (DSTO) and the acquisition organisation. What I'm looking for is a positive culture of exploiting science and change, including in the fields of capability planning and acquisition.

What does this mean for how we interact with industry? Four issues emerge:

- International collaboration
- Self-reliance and globalisation
- Partnership versus competition
- Parent service challenges

I have to admit that the speculation continues in this list and that there is some unfinished thinking in my mind. In any case, it would be unfair and improper of me to pre-empt what Minister Bishop might say in her upcoming industry statement. But I do believe that there will be more international collaboration in materiel development, being pushed by at least two different factors: one is the sheer cost of it, and the other is the strategic political environment which will encourage more coalition warfare and therefore more interdependence. It's too early to speculate to any great consequence on

what this means in practice, but I do see that there will be cases where the development will be from scratch (which is, after all, what the collaboration with the United States was with the Nulka decoy) and others where it will start once an initial product is available (as we are seeing with the Evolved Sea Sparrow Missile, and as we will undoubtedly see with the ASRAAM Within Visual Range missile that was announced recently).

There will be challenges, and you might like to speculate on some of the matters that arise. How, for example, do we get the balance in Australia - given the relative fragility of our national industry base - between self-reliance on the one hand and globalisation on the other? A second point is that early commitment to collaboration with other countries means that we will be making an early commitment to picking winners; and not everybody will be happy with this because how do we demonstrate that we've picked winners and not losers? I believe it *can* be done, by the way, to a sufficient degree of confidence.

We will need to get the balance between the partnership of Defence and specific companies on the one hand, and the benefits of competition on the other. Competition brings the benefits of efficiencies and exploiting new technologies, but if we do that at an arm's length it also means we sacrifice the benefits of partnership.

Again, as we develop more equipment in Australia to meet our own unique Australian needs, there are going to be what I call the 'parent service challenges', where a platform and its in-built systems are going to be configured in a way which is unique to us; therefore, there'll be no one to run to when things go wrong. I speculate here that we will see a new class of relationships develop, as we go down this path, between the major players: between industry, the ADF and my own organisation.

To sum up for this part of the talk, let me turn briefly to a bit of technology. DARPA (Defense Advanced Research Projects Agency) in the United States tends to be one of the central locomotives in thinking about the future of Defence technology. The following is a list of what DARPA sees its top ten military priorities in which progress has a good prospect of getting significant leverage:

- Comprehensive awareness
- Real-time dynamic planning, replanning and C3
- Information system survivability
- Biological warfare defence
- Early entry force enhancement and Small Unit Operations
- Unmanned or minimally manned warfare (for example, arsenal ships, tactical air)
- Micro-robots and micro-systems (for example, micro UAVs)
- Logistics information systems
- Detection of unexploded ordnance
- Radical new concepts (for example, buried targets)

I will not go through all these in detail, but let me say that a lot of them relate to knowledge warfare areas. Note also the issue of defence against biological warfare (which I'll return to later) and the matter of micro-systems.

Let's turn now to DARPA's underlying top ten technology priorities, as listed here:

- Biomimetics and biomolecular materials
- Micro Electromechanical Systems (MEMS)
- Information survivability technology
- Very large, high-speed networks
- Information usability (for example, visualisation, collaboration, intelligent agents, semantic interoperability)
- High energy-density power sources
- Environmental energy - 'perpetual power'
- Techniques for complex system development and testing
- Very high data rates into large dynamic databases
- 'Seedlings' (for example, IR artificial dielectrics, ultrascale computing, virtual reality)

To note just a couple of these; the first one relates to materials and structures. What can we learn from nature about how to develop materials that are more flexible, lighter, stronger etc? The second one of these is Micro Electromechanical Systems - looking at the fabrication of three dimensional mechanical devices using techniques and tools of semiconductor production. We're looking at an entire new class of micro devices allowing direct computational access to the physical world via sensors and actuators. MEMS component dimensions measure in microns and number from a few to millions, and the applications are so huge as to be immeasurable. It seems to me that MEMS in the future are going to become as ubiquitous as the transistor and also, therefore, as the very large scale integrated circuit.

Turning closer to home and being slightly more parochial, Australia is not the United States. We have to be less ambitious on the size of the canvas on which we draw, and below are some central themes for DSTO which we developed in the context of the 1994 White Paper[2] but which, I'm pleased to say, have enduring value:

- Support for intelligence
- Surveillance
- Electronic warfare
- Communications
- Information technology
- Exploitation of environmental information (including acoustic and electromagnetic propagation)
- Signature management
- Operational research
- Human factors
- Modelling and simulation
- Systems and systems integration
- Advanced materials (especially for through-life support)
- Understanding the strengths and weaknesses of key weapons and sensors

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[2] Defending Australia 1994, *Defence White Paper 1994*, Australian Government Publishing Service, Canberra, November 1994.

We felt that these themes were important for defence and self-reliance and therefore important for us in DSTO, supporting our national defence effort. These are areas where other countries will not be able to provide the desired information because they simply won't know it, or if they do they won't share it with us because it's too sensitive. Therefore, we will have to do it ourselves. Indeed, one of the enduring themes that I find myself referring to time and time again in taking part in the Defence policy debate here in Canberra, is the final bullet here: understanding the strengths and weaknesses of key weapons and sensors. There's a lot of semi-coded thinking behind that bland statement.

TECHNOLOGY AND THE STRATEGIC REVIEW:
THE PRIORITIES FOR FORCE DEVELOPMENT

Let me now take the framework of the Strategic Review and try and map what I've just been saying, plus a few other things, onto this framework.

PRIORITY ONE: THE KNOWLEDGE EDGE
Priority number one in the Strategic Review is getting *the knowledge edge*. The side headings for this priority in the Strategic Review include:

- intelligence,
- surveillance of our maritime approaches, and
- command arrangements and command support systems.

We're talking about a very complex system of systems. Several of the factors that I've alluded to already come into play in thinking about the knowledge edge and the steps we need to take to ensure that we achieve it and then retain it. Just to emphasise the point, we are talking about key war-winning technologies, and, in effect, these technologies equal electronics.

So what are we going to see here? We're going to see in perpetuity - arguably, and certainly for the next couple of decades - a huge rate of advance. We're going to see spin-in from industry, and therefore our approach to the knowledge edge and knowledge technologies have to take that into account. There are going to be problems for individuals involved in this process, keeping up to speed with what is today's technology and tomorrow's technology, as opposed to the technology of three or four years ago.

We're looking at immense complexity, as I've already mentioned. Once we get our seamless interconnected C3I system in place in Australia, I don't think there's going to be a single system in our country that will come close to it in terms of complexity.

Interoperability with coalition partners is going to be a challenge, and all of the above factors are going to increase the pressures to reform our acquisition process. I therefore see some major management challenges in anything to do with acquiring and maintaining the knowledge edge.

Intelligence
One of the delights about intelligence is that you can't talk about it. However, the points made in the unclassified version of the Strategic Review include:

- collection (more imagery)
- fusion (all-source)
- analysis (computer assisted)
- distribution (to the field)

Yes, we will improve our collection systems, through a variety of means, and we recognise that there is a major opportunity, but also a major challenge, in fusing and distributing all-source intelligence to forces in the field. We also see the growth of what is technically feasible in all-source, open source intelligence and commercial imagery. This raises the issue (and it's a difficult one to address): how do we get the balance right between self-reliance in intelligence, and partnership agreements (while at the same time, in the business of finding needles in haystacks, the needles are getting stealthier and the haystacks are getting bigger)?

Surveillance
Surveillance emerges in many ways from aspects of intelligence - in some senses they're not that easily distinguished. Yes, there will be commercial satellites used in imagery, but I believe some aspects of differentiation between military and civil applications will remain, which means that those countries that have or have access to military satellites will retain an edge. Nevertheless, the challenges and opportunities even within the military sphere are going to be significant. Payloads are getting smarter and lighter and there's going to be a greater variety of them. The range of sensors is going to include visible, infra-red, synthetic aperture radar, and we're also looking at multi and hyperspectral imaging. By the year 2020 (and some people would say earlier than that) it will be possible to direct your surveillance assets to cover any part of the globe, randomly, to get continuous and richly textured surveillance information. We heard that from General Ryan earlier.

Our Australian challenge is, of course, not the global one; it's much more parochial. One of the things we need to look to is whether our more 'equatorial challenge' - because that's where our key interests tend to be - can make it easier for us to exploit what technology is making possible. Here is some speculation for you. Given my views on the way the English speaking nations will come closer together - is it sensible to talk about an international coalition surveillance architecture? It's a nice thought.

Current advances in sensors can of course go into both manned aircraft and unmanned aerial vehicles. Also in surveillance we are looking at through-life upgrades of the Jindalee radar and the Jindalee operational radar network.

All of this raises a challenge: once we get all this information, how are we going to handle it? Even in our relatively small part of the globe, we are going to have major problems in communicating it and fusing it all together. So that brings me onto communications.

Communications
What a revolution there is in communications! And how many of you here today really think that we in defence, in our thinking about communications, are keeping up with the revolution that's going on in the civil sector? Essentially we're talking about spin-in from the civil sector, and I think that the possibilities are enormous. We are going to see competing constellations of low earth orbiting (LEO) satellites - Iridium, Teledesic, and

I suspect many more in the future. We're looking at the prospect of global broadcast in which soldiers in the field can quite easily pull down huge quantities of information, almost at the push of a button. Others wiser than I believe that the bandwidth will be there. Certainly there'll be more bandwidth than at present, but I suspect that we'll rapidly find ways of using up that bandwidth, and therefore control of access to bandwidth is going to be one of the problems that we have to deal with.

With communications comes the issue of interoperability. How can we make sure that we can communicate both for joint operations and for coalition operations? This, since we're looking to the year 2020 or 2025, allows me to speculate even further: if we're going to have (as we do) an intelligence partnership; if we are potentially going to have a surveillance partnership; then maybe we're also going to have a communications partnership.

C3I Systems

Well, we have to bring it all together. I could stand here for the rest of the afternoon talking about the problems and the challenges that this brings. Let me just touch on a few. At least in theory, there'll be so much information available that it becomes sensible to start talking about 'no doubt' warfare. The key decision makers will have a high degree of certainty about what's going on and what they should do to handle it. But we're not there yet. We do need to make sure that commanders are not swamped; that this huge amount of information is presented to them in a *commander-friendly* form.

Which introduces the fascinating subject of human factors. How do those of us who are designing these systems see inside commanders' minds, to know how they think, so that we can make sure the information is presented in a style consistent with how they want to see it?

I touched on the issue of complexity before and I mention it again in this context. The complexity involved in C3I means that we need an integrating function somewhere within the Defence Organisation. Project Takari provides this. Takari started off as a DSTO research project to make sure that our research was integrated in this most complex of endeavours. I'm pleased to be able to say that Takari has become much more than that. It is now the device through which Defence as a whole is taking an integrated approach to the conceptual development of capabilities in C3I, the acquisition process, and the underlying R&D. Takari might have started off as being DSTO's, but it now belongs to ADHQ as well. It belongs to Chris Barrie (Vice Chief of Defence Force) as much as it does to me.

Other aspects of C3I's future which are worthy of note include speech recognition, battle rehearsal, interoperability and information operations. I think we can take it as read that there will be advanced speech recognition. C3I will facilitate for commanders the ability to plan, replan and replan again through simulation. There will be issues of interoperability, but I'm pleased to say that it seems to me that, on interoperability with the United States, both the US and ourselves have recognised that if we do nothing about this it will become a problem. Given that both sides have recognised that it could be a problem, I think that we can start to get some degree of reassurance that the problem will be managed in a very constructive way. Reliance on C3I brings with it the need to make sure that this reliance is not going to be undermined by information warfare of both the discrete variety (cyberwar) and the not so discrete variety (namely non-nuclear electromagnetic pulses, and so on). There are some non-

trivial issues here. I come back to the notion that we have to use Takari as the vehicle through which to make sure we get it right.

PRIORITY TWO: DEFEATING THREATS IN OUR MARITIME APPROACHES
Priority number two from the Strategic Review comes under two headings: air superiority and defeating ships.

Aircraft
I was in a sense delighted to hear the Minister and others talk about the cost of combat aircraft because I too have speculated on this. I remember, in the late 1970s and into the 80s, it became fashionable to read lugubrious articles saying that by the early years of the 21st century the United States would be able to afford only one aeroplane - it would be solid gold but that's all that would be affordable. Indeed costs *are* going up and we need to do more than speculate, we need to put our thinking caps hard on to think about whether, in the decade 2010 to 2020, we really will be able to afford a hundred or so new aircraft to replace the hundred or so combat aircraft that we currently have (that is, the F/A-18s and the F-111s). If we believe that we have to be able to do this, then it'll be important for us to take advantage of the initiative the Minister announced earlier, of going public to explain why it is so important that this figure of thousands of millions of dollars actually be spent.

There will be less of a choice of possible solutions. I remember 20-25 years ago when we were looking at aircraft to replace the Mirage, there was quite a large number of potential replacements. But as we look into the future we can count on the fingers of one hand what the potential replacement aircraft will be: the Eurofighter, F/A-18E/F, Rafael, the F-22, the Joint Strike Fighter, and maybe if you really want to push the limits there are even some Russian contenders.

This leads to an issue that we're currently looking at: should we offer to become involved in this early stage of Joint Strike Fighter? I don't believe for a minute that we are going to get into the business of designing and developing, in this country, fast combat jet aircraft, but the principle is a useful one to keep in mind. There is going to be less choice in the future; less choice for us to go to the shelves of the major arms supplying nations and say 'We'll have one of those and six of those'. In the future we will face the prospect of having to make a commitment up front, not just for political reasons, but also to make sure that what's coming off the production lines really does meet our key requirements.

We'll continue to need to keep old aeroplanes flying for longer. I was delighted to hear Natalie talk about aeroplanes flying for a hundred years. That is an interesting challenge. One of the consequences for us in Australia is that we will need to understand the strengths and weaknesses of the new materials out of which these new aeroplanes will be made.

Systems analysis is going to be very important. We will have to analyse the capabilities of not just the platform that replaces the Hornet, but also the Hornet as a system itself (obviously including its avionics and missiles), and the broader system into which it fits. Indeed, if we're going to take the Joint Strike Fighter seriously we will need to take a very broad ranging systems approach. Fortunately a lot of the tools that we need for this kind of systems analysis are becoming available - not least through our contacts with the United States and the United Kingdom - through very advanced simulation and modelling.

Into this, in a way that is not yet clear, we need to factor UAVs. Let me leave you in no doubt on this point. Certainly while we have our present Minister, and I suspect for all follow-on Ministers, we will not get away in the Defence Organisation with saying 'No Minister, our professional judgement says that UAVs are not on'. The Minister won't accept that as an answer. We will need to conduct the relevant analysis.

Several other issues arise in the context of fighter aircraft. The key one comes back to bite us: we need to understand the strengths and weaknesses of the key sensors and weapons. For example, we need to understand the strengths and weaknesses of the air intercept radar (including NCTR [Non-Cooperative Target Recognition] aspects), and, to the extent that access to NCTR remains difficult, we will have to take more seriously other options or broader options for getting this capability. That applies to other aspects of electronic warfare as well, especially as we see the battle developing between radar designers on the one hand with low probability of intercept (LPI) radar features, and ESM designers on the other with far greater equipment sensitivities and new techniques for EW self protection.

We need to think through - right from the word go - through-life updates. If I may beat a drum that I have beaten, it seems, every day over the last ten years: we do need reliable access to source code including for regionalisation. That is to say, we need the source code to make sure that what we're buying as something that's vital for national defence actually meets our needs in our strategic environment. I'm pleased to say that there is some indication of movement in some of these areas; for example, the Project Agreement signed with the United States only last week for collaboration on EW self protection.

I've made a note to myself here to mention 'navigation war', picking up Natalie's point on GPS. The more that GPS becomes important, the more confident we will have to be that we can overcome any attacks on the accuracy of GPS.

Missiles

I've broken out missiles as a special case. We need to think very seriously about how missile development is going to change the nature of the air-to-air war. They're going to become increasingly intelligent, highly lethal and capable of incredibly long ranges. This all means that a lot of the thoughts we've had about reduced vulnerability for aircraft which are clear of the FEBA are now becoming obsolete. Other possibilities for missiles include cooperative engagement where one platform does the designation and another actually fires the missiles. Energy management of missiles - of the propulsion systems - is also going to become a lot cleverer, increasing the probability that no one will escape. Missiles are going to be highly programmable. You'll be able to program them on the flight line for the specific mission that you're on the point of conducting. Such complexity makes it more and more important that we understand how the missiles work, and that has some quite significant implications for the capabilities we develop in Australia - in the ADF, in DSTO and in industry - to support them through-life. Let me just say that countermeasures to such missiles are going to be a particular challenge. Maybe our salvation will lie in non-nuclear electromagnetic pulses, but that is far from clear to me.

Ships

The other part of the air/sea gap - defending our maritime approaches - involves ships. Now I realise this is an air power conference, not a naval conference, but ships are an

integral part (as is the air force) of our maritime strategy. We need to look very closely at the trade-offs and the relationships for the survivability of the kinds of ships we can afford. What is the relationship between detection and identification of ships by UAVs, by satellites, by long-range maritime patrol aircraft; and the extent to which the ships themselves can detect LPI radars? Then you can raise a similar set of conceptual questions with respect to the missiles that such platforms might fire off against ships. Again it needs a systems approach at the operational level.

Submarines, of course, get a big mention in the Strategic Review. I am pretty certain that, within the time frame that we're looking at here, Air Independent Propulsion in non-nuclear submarines will become commonplace. For us the question is: when do we do it?

Then there is the *virtual* submarine concept. The technologies behind combat systems and combat data systems are moving so quickly that there becomes something here to exploit. You can construct electronically - through simulation - a virtual submarine in which everything is either simulated or emulated. You can do a lot of land-based testing and development of new concepts for combat data systems and this offers enormous leverage for through-life development.

Then there's the old chestnut to keep the ASW (anti-submarine warfare) people happy, that one day perhaps there really will be submarine-launched air defence missiles.

PRIORITY THREE: STRIKE

In many ways the same issues arise for precision strike weapons as for air-to-air weapons. We need to understand their strengths and weaknesses and put in place the mechanisms for through-life upgrade and through-life support. Signature management applies as much to air defence aircraft as it does to strike. As signature management is one of the more sensitive areas, we in Australia are going to have to understand most aspects of it ourselves, and at least some aspects of stealth.

With regard to through-life support, the year 2020 - the time frame of this conference - will arguably see the final F-111 leave service. That is going to pose quite a problem for us. Again, we will not get away with overlooking the application of UAVs in the eventual replacement of the F-111s.

Table 1 shows the forecast schedule of RAAF aircraft retirements by type.

Number	RAAF Assets	Year Of Withdrawal	Age On Retirement
73	F/A-18 HORNET	2017	30
21	F-111 (with Pave Tack)	2020	47
15	F-111G	2020	47
19	P-3 ORION	2020	42
24	C-130 HERCULES	2003	33
21	CARIBOU	2000	37
10	HS-748	2015	43
4	DAKOTA	2000	55
45	PC-9 TRAINER	2006	14
10	MACCHI TRAINER	2000	32

Table 1. RAAF Aircraft Retirements

None of the aircraft on this slide is yet looking at being a hundred years old when it's retired but the Dakotas, if they last to 2000, will be half that age.

Finally, we need to mention Special Forces. What we're looking at here, in terms of leveraging the capabilities of Special Forces, again comes most from the knowledge based technologies: communications, LPI technologies and so on.

PRIORITY FOUR: LAND FORCES

Briefly on land forces, it seems to me that the technologies that will allow the Army to get the most leverage for the future are again the knowledge based technologies: all-source C3I, better surveillance, UAVs, synthetic aperture radar and seamless C3I systems. As in C3I more generally, complex 'system of systems' issues will arise. Importance for the Army is going to lie in things like battle labs, synthetic theatres of war and simulation more generally.

One of my longer term concerns is, in many respects, parallel to a concern of the United States: defence against biological weapons. As we are seeing in the Gulf at the present time, the fact that there are international agreements and conventions to inhibit the proliferation of weapons of mass destruction, doesn't mean that these conventions actually work. It seems to me that the way biotechnology is going makes it important that we, sooner or later, should position ourselves to be able to deploy forces against the spectre of attack by biotechnologically modified diseases in biological warfare.

CONCLUSION

There are many ways of thinking of how the future will be different from the past. What I tried to do here is pull out some - what you might call - policy principles. The increased influence of coalition warfare will come from both *our* policies - our national policies here in Australia - *and* the policies of our allies. For that and for other reasons, our capability development of the ADF will need to lag less behind that of the leaders. Hence, we're going to have to manage risk in our acquisition process in a much more sophisticated way. There is going to be more sharing between allies and coalition parties, both through political factors and cost pressures. I believe that we are faced with the prospect of greater interdependence, not only in intelligence, but arguably also in surveillance, communications and some aspects of materiel development.

Increasingly, knowledge technologies will represent the war-winning edge, bringing in train increased challenges but also opportunities in interoperability. These challenges come not least because the rates of advance in these technologies is unprecedented, amplified by the spin-in from the civil sector. I believe that the effect on war-fighting will be profound. There will be a need for clear top-down thinking about what *Revolution in Military Affairs* means. We need to ensure that we avoid being constrained by yesterday's dogma and doctrine. Maybe a good place to start is to see war as an extension of politics rather than the summation of individual tactical encounters. If you think I'm being slightly rude about some aspects of the way we go about thinking within Defence at the present time, then you would be right.

Finally, we need to find ways to ensure that we keep up with knowing where the leading edge is, because the knowledge of individuals and the relevance of that knowledge is going to become out of date very quickly. There's going to be a need for systems thinking and, there's going to be a clear need to exploit possibilities coming from advanced simulation. We need a more flexible and evolutionary approach to capability acquisition and to through-life development.

DISCUSSION

Colonel D.J. O'Neill: You mentioned knowledge dominance in your presentation. As somebody who is now to embark on developing some knowledge management concepts and strategies for the ADF, I'm interested in what you mean by *knowledge dominance* and its relationship to a term we've had in the past of *information dominance*, both of which I think lead to a business outcome of *decision superiority*. What do you see as being the difference between information dominance and knowledge dominance, and what will be the key indicators for achievement of knowledge dominance? How will we know what's needed to achieve it?

Dr Brabin-Smith: I think that you can see some kind of progression from data to information to knowledge, and I guess that to some extent you can see knowledge as being information which has been internalised and adapted to the frame of reference of the decision maker in a way that allows maximum use to be made of that information.

How will we know when we've got there? I don't know. I think probably one can differentiate between the way commanders at various levels would believe or feel that they've got the knowledge - having absorbed the information, having understood what it means, and having a clear view on what the consequences are and what do you do next with it.

Warrant Officer I.A. Kuring: Sir, in your presentation you used the term C3I. Why aren't we using C4I?

Dr Brabin-Smith: I think that it's just through an historical accident. There's a whole string of these things which you can use: C3I, C4I, IO, IW. I think the latest thing coming out of the United States is to throw in intelligence, reconnaissance and surveillance as well (C4ISR). The key thought here is that we're seeing a potentially enormous system of systems in place in which all kinds of information are going to be fused and turned into something that's useful. We have yet, I believe, to get a lexicon (or an agreed concept) that everyone finds is useful. I don't feel particularly strongly about which term is used. My own wish is that people realise that the opportunities that are coming out of C3I are there to be exploited, and to get on with thinking about it.

Dr Andrew Butfoy: I have two questions. The first question is: can you see any dangers of the further development of an English speaking coalition? Here I'm talking about perceptions of something like 'the West verses the rest' emerging. I'm thinking about the sort of situation where the English speaking world, some weeks ago, was going to get involved in attacking a country that had not attacked Australia or any of its allies.

The other question concerns the use of the word 'interdependence' which suggests a degree of symmetry in relationships, and the dangers of interdependence. Is the term interdependence being used as a euphemism for dependence?

Dr Brabin-Smith: On your first question: I was speculating in that direction without making a value judgement on whether, overall, it would be good or bad. Although, in a narrow sense, to the extent that it did foster coalition forces that were stronger rather

than weaker, it would be a good thing. But yes, there are the broader political contexts in which it might look bit old fashioned.

On interdependence, I'm not sure that I can answer that question. It does get to the matter that we debate quite frequently within Defence: what precisely do we mean by self-reliance? It depends on how you define it. I think that if Hugh White were here he would define it in perhaps starker terms than I do. That is to say, you have a combat force which can go and fight very successfully without the support of anybody else at the combat level. I tend to use it a bit more broadly than that. There's a classic example in intelligence: at what stage do we say 'Well OK, we've got the intelligence partnership, but we need something that looks distinctly Australian as well'. So these things are looked at case by case, and they need to be.

ALTERNATIVE FUTURES

GRAEME CHEESEMAN

The Cold War ended in 1989 and we are now, in the view of many commentators, entering a new era in international politics. Our sense of changing times is heightened by the variety of terms being used to encapsulate the essence of the ongoing transition - post-industrialism or post-Fordism, post-militarism, post-statism, post-capitalism, post-(western) civilisation, post-internationalism, post-modernism, and so on.[1] What this new era will end up looking like is a matter of considerable debate where opposing visions of the future are shaped as much by the theoretical leanings of the commentator - whether he or she is a realist, neo-realist, liberal internationalist, marxist, idealist, feminist, and so on - as by what is actually happening around us.

Rather than try to describe and synthesise these various 'isms' and their multiple characteristics, I will attempt to locate them within the broad historical framework developed by Barry Buzan in an article published in the *Journal of Peace Research* in 1995. Buzan suggests that we are at the conjunction of the end of three important and overlapping eras: the Cold War, the twentieth century, and the period of western global dominance (extending from the late 15th century to the present). He goes on to suggest that each era has witnessed the demise of certain basic ideas and understandings and the continuation or 'triumph' of others. 'Knowing what ideas go forward', he argues, 'gives some ability to anticipate the future into which we are moving'.[2]

According to Buzan, the 'main losers in the war of ideas over the past five hundred years' are absolute monarchism, empires, fascism and communism. The main winners, which are 'now taking on the status of universal ideas' are those shown here:

- *War prevention amongst the great powers*. This has been gathering strength since World War I, was decisive with the advent of nuclear weapons, and is drawing strength from the spread of democracy.
- *Market economics*. This has been gathering strength since the 19th century, and was triumphant by the end of the Cold War.
- *National self-determination*. This has been gathering strength since the late 19th century, and was dominant by the end of World War II.
- *Science and technology as core social values* (some describe this as modernity). This has been gathering pace since the 16th century, reaching full flower by the 19th.

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[1] See for example Anthony Giddens, *The Consequences of Modernity*, Polity Press, Cambridge, 1990; Martin Shaw; *Post-Military Society*, Polity Press, Cambridge, 1991; Alvin and Heidi Toffler, *War and Anti-War: Survival at the Dawn of the 21st Century*, Little, Brown and Company, Boston, 1993; A. Amin, *Post-Fordism: A Reader*, Basil Blackwell, Oxford and New York, 1994; James N. Rosenau and Mary Durfee, *Thinking Theory Thoroughly: Coherent Approaches to an Incoherent World*, Westview Press, Boulder, 1995.

[2] Barry Buzan, 'The Present as an Historic Turning Point' in *Journal of Peace Research*, 30(4), 1995, p. 392.

- *The sovereign territorial state.* This has been gathering strength since the 16th century and was dominant by the 19th.

Buzan adds that 'a possible half winner is democracy, whose position is entangled with that of market economics.' He argues that these basic ideas will serve to define the 'general character of the future', at least for the immediate future. He also notes, however, that the ideas 'contain a variety of contradictions within and between themselves' which will also go forward into the new millennium and will affect the detail and prospects of both the system of world (dis)order we will inhabit and the role of military force and military forces in that system.[3]

In this paper, I will sketch out some of these contradictions and uncertainties and where they could lead us; I will outline a range of strategic futures that could confront us in the years ahead and the role of military force and military forces within these, and I will talk briefly about the Australian experience asking, 'Where are we heading?' What might Australia's 'military after next' look like? And can we reasonably expect the Australian state, society and armed forces to adjust to the changing times?

First, some precautionary notes are in order. One, much of what follows is highly speculative and contested, but it does reflect debates which are going on in the literatures now. Two, time frames are important for our analysis of different worlds. Some are more likely in the immediate future; others are unlikely before decades or even centuries have passed. Three, we are not entirely at the mercy of changing events or circumstances. Where we move to will depend, to some degree, on decisions we make now. Four, the future world could be both malign and benign depending on who and where we are. And finally, with regard to the notion of perception versus reality, we need to appreciate that these visions of the future are simply that - visions or models which, perhaps, at times oversimplify the complexity of what we are trying to describe.

So let's look at some of the contradictions and uncertainties associated with Buzan's variables. They can be considered to include:

- tension between national self-determination and state sovereignty,
- tension between state and market economics,
- uncertainty of technological and scientific change, and
- contradictions over the future role of military force.

Some of these contradictions and concerns are fairly obvious. As witnessed by the wars in the Balkans and elsewhere, there is a clear *tension between the ideas of national self-determination and state sovereignty.* Ethnic groups are seeking either to secede from existing states, or to overthrow what they regard as repressive or illegitimate regimes. As Buzan notes, there are currently some 200 states and around 6000 ethno-national groupings in the world today. 'The nation-state fusion has been achieved by only a small minority of existing states' and non-conflictual multinational states are 'extraordinarily difficult to achieve [especially] where long-resident and diverse peoples are gathered together within an essentially arbitrary state boundary'.[4]

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[3] *Ibid.*, pp. 392-393.
[4] *Ibid.*, p. 394.

Ethno-nationalism and ethnic violence within states are seen by many as the principal source and type of conflict respectively in the post-Cold War era.[5] These 'uncivil wars' as Donald Snow describes them, are taking place largely within rather than between bordered states, and in relatively remote regions on the periphery of the developed world. They make little sense from either traditional Clausewitzian or Cold War (counter)revolutionary perspectives. They usually have little relevance much beyond the immediate vicinity of the site of the violence - unless they are taken up by the international media - and are extremely difficult to manage from outside. While ethno-nationalism and ethnic conflict are important features of the post-Cold War world, it needs to be noted that they are merely one manifestation of a broader process of disaggregation and dissatisfaction with traditional political structures and sources of authority. As Martin Shaw has noted, the final years of the twentieth century are witnessing a range of competing claims to identity based not just on ethnicity but religion, gender, race, class, profession, lifestyle and other grounds.[6]

It is noteworthy that there is a tendency in the West to demonise these remote conflicts and their participants. The belligerents are often painted as the new barbarians, and the factions as the repository for terrorists and terrorism. Yet violence and anarchy are not the exclusive province of developing or failed states. As the Report of the Commission on Global Governance noted, *a disturbing feature of the contemporary world is the all-pervasive culture of violence which tends to see force as the answer to all kinds of political and social problems.*[7] This culture is evidenced in Hollywood action films, in the bullying behaviour of powerful states and their leaders, by police brutality towards minority groups within society, and by widespread domestic violence towards women within all cultures and polities.

A second set of tensions and contradictions are those that operate between the *sovereign territorial state and the emerging system of market economics.* As Buzan describes:

> The logic of liberal economics knows no natural boundaries and is fundamentally directed at the achievement of a global market. Pursuit of it means that states should not only create open markets within themselves, but also open their borders to economic activity so as to reap the...[alleged] benefits of competition and efficiency internationally.[8]

The difficulty, however, is that a globalised economy also poses two broad kinds of problems which can have major political and military ramifications. First, while it may increase wealth overall, it also creates the prospects of systemic

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[5] Martin van Creveld, *The Transformation of War*, Free Press, New York, 1991; Daniel Moynihan, *Pandaemonium: Ethnicity in World Politics*, Oxford University Press, New York, 1993; Donald M. Snow, *Uncivil Wars: International Security and the New Internal Conflicts*, Lynne Rienner, Boulder, 1997.

[6] Martin Shaw, *Global Society and International Relations: Sociological Concepts and Political Perspectives*, Polity Press, Cambridge, 1994, p. 8.

[7] *Our Global Neighbourhood, The Report of the Commission on Global Governance*, Oxford University Press, Oxford, 1995.

[8] Buzan, 'The Present as an Historic Turning Point', p. 395.

instability of the kind we are currently witnessing in Asia and saw in the debt crises of the 1980s (they could even cause the economic system as a whole to collapse).

Second, economic liberalism can also serve directly to challenge the autonomy and legitimacy of both the state and the nation in a number of ways. Firstly, by requiring states to open their borders to economic and related global activities. It is largely agreed that, in the face of 'quicksilver capital' and other international transactions, the idea of a 'national economy' is losing most of its force. In the area of economics at least, the state is generally seen to be 'condemned to tinkering around the edges'.[9] Secondly, by threatening local customs and cultures or introducing market reforms that create domestic poverty and insecurity. And thirdly, in creating alternative sources of power and authority (IMF, World Bank, APEC, etc.).

A BIFURCATED WORLD

In spite of these potential problems and concerns, the ideology of market economics now commands an almost universal following throughout the world where, ironically, states and state elites are key agents in its spread. They promote domestic economic activities that make local firms competitive in international markets, and promote a 'web of transnational regimes and other linkages which have increasingly been developing the capacity to operate autonomously of the state'. The place of the state in international affairs and the way it works, in short, is moving away from the earlier notion of the 'strategic state' and towards what Philip Cerny calls the 'competition' or 'residual state' which simultaneously:

> ... maintains itself and undermines itself by focussing on one central public role - promoting competitiveness - while downgrading or shedding many of its other traditional public roles'.[10]

As a result of these broad changes, the state-centric system which has operated since the Treaty of Westphalia of 1648 is undergoing bifurcation (division) into two increasingly autonomous worlds. On the one hand we have the traditional world of territorial states that continue to focus on the traditional geopolitical concerns of balance of power, stability and order, self-defence, spheres of influence, and alliances. On the other hand we have a complex, increasingly interconnected and globalised *international political economy* which operates in accordance with the premises of market economics, has porous or no borders, and is dominated by a range of non-state entities, norms and transactions.

A WORLD OF TIERS

A second feature of this emerging global economy is that it is 'more or less coterminous with the Western alliance system': that group of leading capitalist powers that won the struggles against both fascism and communism.[11] In addition to the change in the relative nature of power - from geopolitics to geoeconomics - the rise of

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[9]   Philip G. Cerny, 'What Next for the State?' in Eleonore Kofman and Gillian Youngs (eds), *Globalization: Theory and Practice*, Pinter, London, 1996, p. 127. See also Peter Drucker, 'The Global Economy and the Nation-State' in *Foreign Affairs*, 76(5), September/October 1997.

[10]   Cerny, 'What Next for the State?', pp. 124, 133.

[11]   Snow, *Uncivil Wars*, p. 5.

this kind of 'economic security community' is said to represent one of the defining features of the post-Cold War which, in contrast to earlier eras, is likely to offset some of the potential hazards seen to be associated with the concurrent shift from a bipolar to a multipolar geopolitical power structure. The emergence of regional economic communities has led some scholars to propose a tiered or centre-periphery approach to international relations.[12]

This sees the contemporary world not in terms of a collection of autonomous states but broader regions or zones which are differentiated along economic, industrial and political rather than territorial or military lines. Within this schema, the 'centre', 'core', 'first tier' or 'zone of peace' comprises the globally dominant group of capitalist economies - roughly those belonging to the Organisation of Economic Cooperation and Development (OECD). These countries are distinguished by:

- their 'participation in the global economy';
- the fact that they have 'entered the Third or High-Technology Revolution, which is increasingly the driving force behind their economic growth and prosperity';
- their demonstrated commitment to democracy; and
- a broadly shared consensus that conflict, and more specifically war, between them is 'essentially unthinkable'.[13]

The 'periphery' or 'second tier' encompasses the rest of the world and, as such, embraces a vast array of states and conditions. Because of this, they are sometimes further divided into 'subtiers' such as: relatively advanced economies, which includes countries like South Korea, Singapore, Taiwan, Israel, Argentina and Brazil; partially developed economies, such as China, India, Egypt, Bolivia, and Poland; undeveloped or developable economies and, finally, resource-rich countries. In contrast to the first tier, the second tier is much more fractious and conflict-ridden although most of the conflict is restricted to the least developed states and to 'areas that lie principally outside the growing global economy'.[14] Most countries in the relatively advanced and partially developed tiers tend to aspire to be part of the core and so seek generally to follow the example set by the first tier at least as far as economic policies and prescriptions are concerned. Whether they will (and need to) adopt more open and democratic political structures is less certain and, if the proponents of the democratic peace thesis are correct, could have an important bearing on the prospect of military conflict within the core itself in the future.

The core-periphery approach is well suited to the more complex and dynamic circumstances of the 1990s. It incorporates both the liberal international model of world order, which broadly describes the circumstances found within the 'First Tier',

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[12] Barry Buzan, 'New Patterns of Global Security in the Twenty-First Century' in *International Affairs*, 67(3), 1991, pp. 431-451; James M. Goldgeier and Michael McFaul, 'A Tale of Two Worlds: Core and Periphery in the Post-Cold War Era' in *International Organization*, 46(2), Spring 1992, pp. 467-91; Max Singer and Aaron Wildavsky, *The Real World Order: Zones of Peace/Zones of Turmoil*, Chatham House, New Jersey, 1993; Steven Metz, *Strategic Horizons: The Military Implications of Alternative Futures*, Strategic Studies Institute, US Army War College, Carlisle Barracks, Pa., 1997; Snow, *Uncivil Wars*.

[13] Snow, *Uncivil Wars*, pp. 11-13.

[14] Snow, *Uncivil Wars*, pp. 13-19.

as well as more traditional, realist approaches which are seen to be 'relevant for understanding regional security systems in the periphery'.[15] The key issues that concern proponents of this approach include the continuing relationship between the core and the periphery, and how the system as a whole is likely to change over time. Will we see the conditions and values that underpin the core continuing to spread? Or will, as the proponents of the 'new medievalism' thesis suggest, we see a gradual return to the kind of situation that existed before the Treaty of Westphalia - a world of spreading chaos and anarchy as portrayed on the screen by the Mad Max movies and as we find in reality in places like Rwanda?

But the model also has its limitations and problems. It associates progress with the spread of western structures and ideals and, as such, can be said to be guilty of ethnocentrism and cultural (and economic) imperialism. It also tends to divide states into either core or periphery. Yet in many places, in the mega-cities of the world for example, the conditions of the periphery can be already found within the core. A more appropriate metaphor for a divided world may be the one advanced by Robert Kaplan in his article 'The Coming Anarchy'. According to Kaplan, we need to view the world in terms of:

> ... a stretch limo in the potholed streets of New York City ... Inside the limo are the air-conditioned post-industrial regions of North America, Europe, the emerging Pacific Rim, and a few other isolated places, with their trade summitry and computer-information highways. Outside is the rest of mankind, going in a completely different direction ... a run down, crowded planet of skinhead Cossacks and juju warriors influenced by the worst refuse of Western pop culture and ancient tribal hatreds, and battling over scraps of overused earth in guerrilla conflicts that ripple across continents in no discernible pattern.[16]

A third set of tensions and contradictions stems from Buzan's fourth variable or 'universal idea' - continuing *developments in science and technology*. These have provided means for increasing national and international wealth and prosperity and for greatly enhancing individual well-being and lifestyles. But science and technology, combined with market economics and its associated political ideologies, have also spawned nuclear and other weapons of mass destruction; the progressive militarisation of the globe; and a process of industrialisation and economic restructuring that is leading to massive internal migration and urbanisation, to the impoverishment of much of the developing world (creating, in Richard Falk's words, a 'system of global apartheid'),[17] to the continuing depletion of non-renewable natural resources and to growing global environmental pollution. Advanced satellite-based communications and facilities such as the Internet are also making people all over the globe more knowledgeable and assertive, and is providing them with the skills and techniques needed to translate these feelings into concerted political action. Indeed, the capacity

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[15] Goldgeier and McFaul, 'A Tale of ...', pp. 469-470.

[16] Robert Kaplan, 'The Coming Anarchy' in *The Atlantic Monthly*, 273(2), 1994, pp. 60, 62-63.

[17] Richard Falk, *On Humane Governance: Toward a New Global Politics*, Polity Press, Cambridge, 1995, pp. 49-55.

to view the same events simultaneously on television or personal computers is inducing a 'reflexive' approach to life whereby 'inhabitants of the planet subconsciously orient themselves to the world as a whole'.[18] We are witnessing, in short, the emergence of an international civil society which sits alongside the system of territorial states and the growing international political economy.

As a result of these developments, governments and their militaries are having to deal not only with international and transnational economic actors, but with increasingly powerful and globalised social movements. They are being constrained by emerging international structures and norms, and are facing a range of new sources of insecurity - such as nuclear oblivion, global environmental pressures of various kinds, international crime, and AIDS and other pandemics - against which they are relatively powerless. Finally they are less and less able to fully meet the growing material expectations of their constituents who, as Charles Moskos and James Burk have described, are fast losing faith in all forms of authority and what they purport to stand for. Increasingly across the globe:

> Old verities are [being] questioned, rather than accepted. There are [now] few if any overarching authorities to which people are willing to defer. There is a shrinking consensus about what values constitute the public good, nor even much confidence that we know how ... to determine what the public good might be. The eighteenth century's faith in reason, the nineteenth century's faith in the nation-state, and our own century's confidence in science and technology have all lost their hold on our imagination, despite their considerable accomplishments.[19]

Under increasing pressure from both above and below, states are ceding authority upwards - towards international organisations like the United Nations and the European Community - and downwards to various ethnic, religious, cultural, single issue and political groupings which have links and expectations that increasingly transcend traditional boundaries and cultural identities.[20]

SYSTEMS OF GEOGOVERNANCE
These various integrative tendencies are said to presage the emergence of a system of global governance or *geogovernance* which is seen by some commentators as the most likely model for both describing and managing international politics in the next century. As the Commission on Global Governance noted in its report, *Our Global Neighbourhood*, there is no single form of global governance, although all systems recognise that the key issues of human survival, security and prosperity are systemic

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[18] Malcolm Waters, *Globalization*, Routledge, London and New York, 1995, pp. 62-4.

[19] Charles Moskos and James Burk, 'The Postmodern Military' in James Burk (ed.), *The Military in New Times: Adapting Armed Forces to a Turbulent World*, Westview Press, Boulder, 1994, p. 143.

[20] For a discussion of these processes, see David Held, 'Democracy and the New International Order' in Daniele Archibugi and David Held (eds), *Cosmopolitan Democracy: An Agenda for a New World Order*, Polity Press, Cambridge, 1995, pp. 100-101. See also Malcolm Waters, *Globalization*, chapter 5.

in nature and so can only be dealt with holistically and cooperatively. As was noted by the Commission:

> Effective global decision-making ... must build partnerships - networks of institutions and processes - that enable global actors to pool information, knowledge, and capacities, and to develop joint policies and practices on issues of common concern.[21]

Such systems of geogovernance encompass a range of possibilities including the 'society of states' or 'system of mature anarchy' favoured by neo-realist scholars, notions of 'transgovernmentalism', and various forms of world government.[22] As Richard Falk argues, while world government could be achieved 'through radical reforms to the United Nations or as a result of a global constitutional convention', it is more likely to arise 'through pressure brought by global market forces ... to complete the work of building a viable world economy of optimum efficiency' (an extension of the Eurofederalism concept).[23]

THE TECHNOLOGICAL IMPERATIVE AND ITS IMPLICATIONS FOR MILITARIES
Continuing advances in military and associated technologies are also 'revolutionising' the battlefield and serving to reinforce the Clausewitzian notion that war, or the use of military force, can be readily employed to protect or extend political and national interests.[24] But just as military power is being maximised, the state's monopoly over the use of organised violence is also changing, as are the social and political contexts within which military forces operate and military force is able to be used effectively. There is a growing, although not universal, consensus among scholars and commentators that major war between developed states, certainly those within the core or 'first tier' of industrialised economies, is becoming increasingly unlikely.[25] This view is said to be heightened by certain developments which distinguish the present era from earlier ones. These include:

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[21] *Our Global Neighbourhood*, p. 4.

[22] See Rick Fawn and Jeremy Larkins (eds), *International Society After the Cold War: Anarchy and Order Reconsidered*, Macmillan, Houndsmills, 1996; Anne-Marie Slaughter, 'The Real New World Order' in *Foreign Affairs*, 76(5), September/October 1997, pp. 183-197.

[23] Falk, *On Humane Governance*, p. 6.

[24] Benjamin S. Lambeth, 'Technology Trends in Air Warfare' in Alan Stephens (ed.), *New Era Security: The RAAF in the Next Twenty-Five Years*, Air Power Studies Centre, Canberra, 1996, p. 135. See also Eliot A. Cohen, 'A Revolution in Warfare' in *Foreign Affairs*, 75(2), 1996, pp. 37-54; and David Gates, 'Air Power and the Theory and Practice of Coercion' in *Defense Analysis*, 13(3), 1997, pp. 239-254.

[25] See, for example, John Mueller, *Retreat from Doomsday: The Obsolescence of Major War*, Basic Books, New York, 1989; Carl Kaysen, 'Is War Obsolete? A Review Essay' in *International Security*, 14, 1990, pp. 42-69; and James L. Richardson, 'The Declining Probability of War Thesis: How Relevant for the Asia-Pacific?' in Stuart Harris and Andrew Mack (eds), *Asia-Pacific Security: The Economics-Politics Nexus*, Allen & Unwin, St. Leonards, 1997, pp. 81-100. For a contrary view, see William R. Thompson, 'The Future of Transitional Warfare' in Burk (ed.), *The Military in New Times*, pp. 63-92.

- the appearance of weapons of mass destruction, which changed forever rational war calculations at least among nuclear players;
- increasing economic interdependence which serves to increase the number of stakeholders in international disputes as well as the potential costs of military conflict; and
- the so-called 'triumph' of liberal capitalism in the wake of the end of the Cold War and the continuing spread of a modern, democratised and globalised culture.[26]

The decline in the prospect of war between industrialised nations does not mean that armed conflict will disappear completely, for the foreseeable future at least. This is the central message of those who see ethno-nationalist and intra-state conflict dominating the security landscape of the future, albeit largely within the periphery of the emerging 'new world (dis)order'. But, as Donald Snow argues in the case of the United States, it is not altogether clear whether the high-technology weapons and forces flowing from the RMA are relevant or appropriate for most of these conflicts or, indeed, whether and why the United States and its allies would become involved in them in the first place.[27] While high-technology forces might be needed for defence against a major second tier power, such an eventuality is again thought to be unlikely given, first, that most advanced second tier states are seeking to become part of the core, and second, the clear and growing technological ascendancy (so evident in the Gulf War) of first tier forces and economies. Those developing states or other organisations that are in conflict with 'first tier' countries, are more likely to seek to attack the latter's societies and sophisticated economic infrastructures than directly challenge their overwhelmingly powerful armed forces.

These developments have led a number of commentators to raise important questions about the future role and functions of the armed forces of the industrialised world. Martin van Creveld believes that traditional Clausewitzian strategies and structures will be of little use for either understanding or responding to the situations governments and their leaders will face in the future, and that defenders of the state will start to look more and more like existing police and civilian security services than the militaries we know today. In their book *War and Anti-War*, Alvin and Heidi Toffler see an increasing need for special forces or special operations units to deal with low-intensity conflicts - defined as 'hostilities constituting limited war but short of a conventional or general war' - as well as conduct such missions as 'feeding villagers after a disaster', clandestine raids for intelligence gathering, sabotage, hostage rescue, assassination and 'anti-terrorist or anti-narco operations'.[28] They further argue that western militaries need to become smarter and more attuned to both the problems and possibilities of 'Third Wave' civilisation and warfare. They argue the need to mobilise the almost limitless potential of the silicon chip and interactive software to not only enhance existing weapons systems but also to develop a new and perhaps more

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[26] Robert Jervis, *The Meaning of the Nuclear Revolution: Statecraft and the Prospects of Nuclear Armageddon*, Cornell University Press, Ithica, 1989; Francis Fukuyama, *The End of History and the Last Man*, Free Press, New York, 1992; Bruce Russett, *Grasping the Democratic Peace: Principles for a Post-Cold War World*, Princeton University Press, Princeton, 1993; and Edward D. Mansfield and Jack Snyder, 'Democratization and the Danger of War' in *International Security*, 20(1), Summer 1995, pp. 5-38

[27] Snow, *Uncivil Wars*, p. 7.

[28] Alvin and Heidi Toffler, *War and Anti-War*, pp. 91-92.

appropriate (and effective) range of non-lethal and other technologies; to extend their own protection against computer viruses, 'info-terrorists', 'have-gun-will-travel fanatics' and other postmodern threats; and to develop a 'brain' rather than 'brawn' based structure and corporate ethos within the armed forces themselves.[29]

Carl Builder of the RAND Corporation has argued that while there will be some requirement for the United States armed forces to continue to structure and train for major conventional wars, this role will become less and less important. In his view, the size of active forces required for such war-fighting roles will almost certainly decrease, whereas missions and associated forces 'involving the rapid projection of infrastructure (transport, communications, surveillance, rescue, medical, humanitarian assistance, civil emergency, and security) are likely to increase disproportionately'.[30]

Technological change is also fundamentally altering the nature and shape of civil-military relations, at least within developed countries. According to Moskos and Burk, western militaries in particular are beginning to undergo a transition away from the permanent, 'high-tech' forces-in-being that characterised the Cold war era, and towards a 'postmodern' form. Postmodern militaries will, in their view, be smaller in size, they will rely increasingly on civilians and reserve force components, and will need to be led by 'soldier-scholars': well-educated 'officers skilled in handling the media and adept in the intricacies of international diplomacy'. In line with the views of van Creveld and others, they also suggest that armed forces in the future will less and less be organised around sovereignty defence and more and more required to conduct 'non war-fighting military missions'. They are likely also to enjoy less public support than in the modern period and will need to be more responsive to the broad social and other changes taking place around them.[31]

Compounding these 'pressures from above' is what James Rosenau terms as the 'disaggregation of the concept of self-interest' within the ranks of militaries themselves. Already in places like the former Yugoslavia and Algeria, corporate and national loyalties are being replaced by familial, ethnic and religious affiliations, while service men and women everywhere are beginning to place their own welfare and interests above those of their service or nation.[32] These kinds of pressures are, Rosenau continues, leading militaries in many countries to begin to move out 'from behind closed doors into the public arena' and act 'not as agents of the state but as claimants on its resources, much like other subgroups that populate the multicentric world'.[33] They may also be responsible for what Kaldor and Schmeder have termed the 'reprivatisation of violence': the proliferation of private armies, the 'mercenarisation' of former soldiers

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[29] See also Chris Hables Gray, *Postmodern War: The New Politics of Conflict*, Routledge, London, 1997.

[30] Carl H. Builder, *The Icarus Syndrome: The Role of Air Power Theory in the Evolution and Fate of the US Air Force*, Transaction Publishers, New Brunswick and London, 1994, p. 255.

[31] Moskos and Burk, 'The Postmodern Military', p. 154.

[32] James N. Rosenau, 'Armed Force and Armed Forces in a Turbulent World', in Burk (ed.), *The Military in New Times*, pp. 25-62 For an interesting discussion of how these kinds of forces are affecting the place of military families in the British and United States' armed forces, see Christopher Jessup, *Breaking Ranks: Social Change in Military Communities*, Brasseys, London, 1996.

[33] Rosenau, 'Armed Force and Armed Forces in a Turbulent World', p. 43.

and defence scientists, increasing black and grey market arms sales, and the 'privatisation and contractorisation of defence manufacturers and defence services' generally.[34]

FUTURE IMAGES OF THE WORLD

As we approach the new millennium, we are confronted by a world in transition, one characterised by rapid change, growing uncertainty, and contradictory and contested trends in military, political, social and international affairs. While there is no dispute over the fact that the world as we know it is changing, the likely end-point(s) of these ongoing transitions remains hotly contested. The following lists various future world images:

- 'coming anarchy' or 'new medievalism'
- unipolar dominance
- multipolar balance of power
- multi-bloc neo-mercantilism
- 'clash of civilisations'
- 'zones of peace' versus 'zones of turmoil'
- liberal international order
- 'global village'

Some see a continuation of existing state-centric structures based around either realist notions of balance of power or a form of liberal international order that emphasises multilateral security arrangements rather than competing alliances, and the language of assurance rather than deterrence. Others suggest that future fault lines will occur primarily within rather than between bordered states, or between civilisations, or so-called zones of 'peace' and 'turmoil'. Still others offer visions of an increasingly globalised world, with prospective systems of geogovernance ranging from the neo-realist's 'society of states' through various forms of 'transgovernmentalism' to the fully integrated 'global village' and other, less harmonious, forms of world government.

These different visions of the future have different implications for the meaning of security - in particular who or what is being secured and against what - as well as for the future roles of military force and armed forces. Traditional balance of power prognoses - whether stressing unipolar, bipolar or multipolar geopolitical structures - represent a continuation of existing priorities and mind-sets. These would continue to privilege the state as the key actor in international affairs and the use or threatened use of military force in the pursuit of national interests. Military conflict would still be posited as the single-most important issue affecting national and international security, armed forces would continue to be structured and trained for traditional war-fighting roles, and national strategic postures would continue to emphasise sovereignty defence, power-balancing, coalition warfare and the management of alliances.

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[34] Mary Kaldor and Genevieve Schmeder, 'New Issues' in Mary Kaldor and Genevieve Schmeder (eds), *The European Rupture: The Defence Sector in Transition*, Edward Elgar, Cheltenham, 1997, pp. 23-42.

The conduct of warfare and the organisation of military forces within this realist model would continue to evolve to accommodate technological change and emerging social pressures and expectations, but not radically or evenly across the globe. State-based forces would also be required to take part in UN peacekeeping, humanitarian assistance and other non-military operations, but these would be of secondary importance and would usually not determine military force structures or basic doctrine. This future vision of international politics may be of comfort to those who fear or wish to control change but it will also continue to invoke unchecked security dilemmas, continuing militarisation and conflict, arms racing, and the prospect of wars between major powers and their respective friends and allies.

Those who see the next millennium dominated by geoeconomics rather than geopolitics, suggest that the place of both the state and military power in international affairs will become much less relevant although they will continue to have a role. Increasing economic interdependence, the rising power of transnational corporations and the so-called 'triumph' of liberal capitalism raise questions about the importance of sovereignty and territoriality in security calculations. They also hold out the prospect of slowly expanding 'zones of peace' or democratic economic communities within which there would be no expectation of major war and no need for either state-based sovereignty defence forces or the maintenance of internal military balances of power.[35] Military forces will still be required for a degree of internal reassurance; to protect those in the 'zones of peace' against threats emerging from the surrounding 'zones of turmoil' and, occasionally, to intervene in these latter areas to safeguard peoples and resources or to help protect or resurrect failed or failing states or communities. Given that the 'zones of peace' will be inhabited by highly advanced, 'third wave' economies that are able to capitalise on the ongoing 'Revolution in Military Affairs', it is unlikely that they will be challenged militarily by the large, but technologically inferior, conventional armies located in the more advanced parts of the 'zones of turmoil'.[36] Rather, for 'first tier' countries, the key security issues are likely to be non-military rather than military ones - such as population movements, pandemics and trans-boundary environmental pressures - although the various postmodern threats described by the Tofflers and others will cannot be fully discounted.

Proponents of a globalised world foresee the expansion and eventual overlap of the 'zones of peace', the replacement of nation-states by regional or global communities, the expansion of international regimes and associated norms, and increased global governance through either a system of world government or some form of transgovernmentalism. Such a system of geogovernance could be inequitable, unjust, unrepresentative, and, for many, profoundly insecure; marked by structural inequalities and conflict 'between the forces of globalisation and the territorially-based forces of local survival seeking to preserve and to redefine community'.[37] Or it could be both enlightened and humane - in Richard Falk's words:

[35] Max Singer and Aaron Wildavsky, *The Real World Order*.

[36] Steven Metz, 'Which Army After Next? The Strategic Implications of Alternative Futures' in *Parameters*, XXVII(3), 1997, pp. 18-19.

[37] Robert Harkavy, 'Images of the Coming International System' in *Orbis*, 41(4), Fall 1997, p. 585. For a discussion of such a world order, see Noam Chomsky, *World Orders, Old and New*, Pluto Press, London, 1994.

> ... an imagined community for the whole of humanity which overcomes the most problematic aspects of the present world scene ... [and where] difference and uniformities across space and through time are subsumed beneath an overall commitment to world order values in the provisional shape of peace, economic well-being, social and political justice, and environmental sustainability.[38]

However structured, systems of global governance are likely to be much less warlike. The key security issues and associated dilemmas will be largely non-military in nature and either transnational or local in focus. Traditional alliances will be replaced by common security arrangements. Society will become progressively demilitarised. To the extent they exist at all, military forces will be collectively organised and will tend to be employed in security rather than traditional defence roles. These roles might include the management and protection of planetary resources, the policing of UN or other global norms and conventions, and the provision and maintenance of infrastructural and other forms of support to areas or regions of need.[39] Some collective traditional military actions or interventions might still occur although, within a system of humane governance, it would be generally viewed 'as a failure of "security" not as its embodiment'.[40]

It is impossible to tell at this stage which one or combination of these models of the emerging international system, and their implications for the use of force in world affairs, will prevail. While the models differ quite markedly, they all provide important insights into the nature of our changing world. None can singly describe where we are or where we are heading although, depending when and where we look, some models may be more valid than others. Certain parts of Africa, for example, seem closely to fit the 'new medievalism' thesis, while western Europe is a clear exemplar of the economic security community postulated in both the liberal internationalist and zones of peace/turmoil models. As Robert Harkavy notes, some of these models (the geoeconomic and zones of peace/turmoil models for example) are not necessarily mutually exclusive while others (such as the global village and balance of power models) are almost impossible to pair.[41] Many of the models can also be located within a broader strategic futures domain (or planning space) which can be defined in terms of common underlying tendencies or characteristics such as (un)development, (dis)aggregation, and propensity for (non)conflict. That domain and the placement of alternative futures within it is depicted in Figure 1.

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[38] Richard Falk, *On Humane Governance*, p. 243.
[39] Mel Gurtov, *Global Politics in the Human Interest*, Second Edition, Lynne Rienner, Boulder, London, 1991.
[40] Falk, *On Humane Governance*, p. 70.
[41] Harkavy, 'Images of the Coming International System', p. 586.
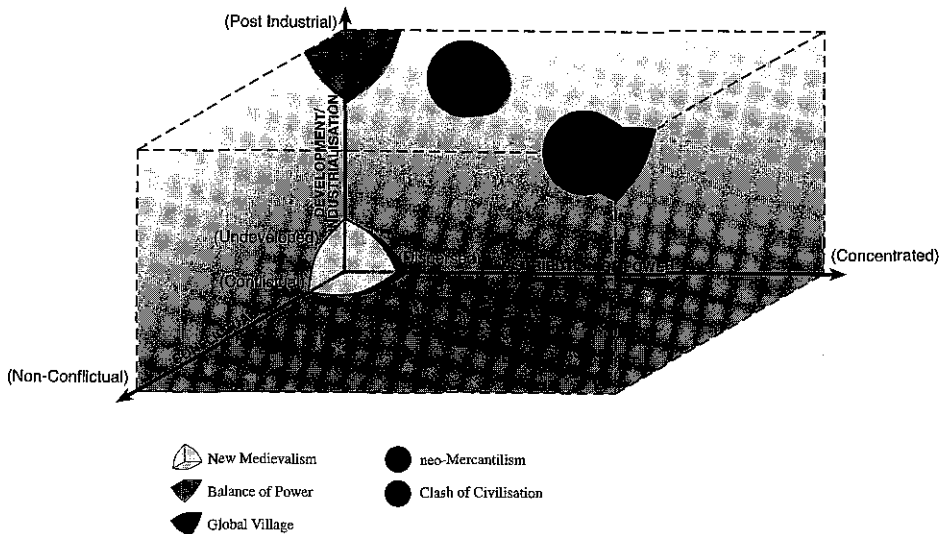
Figure 1.   **Alternative Futures Planning Space**

Such a domain defines not only where we might be heading but the normative question of what kind of world we would like to see emerge.

What is clear from this is that the realist balance of power model and its underlying assumptions are inadequate for fully describing (and responding to) the complex world we see around us today.[42] As Jan Pettman notes, it is possible to (re)imagine the world in a range of other ways (and ask what security implications follow):

> ... as a global web of movements of people, goods, ideas and social relations that crisscross state borders; or as a world society, with vulnerable but growing global norms, rules and international organisations; or as an international political economy in which multinational companies and international banks may be far richer and more powerful than states, and

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[42] The assumptions that underpin the realist view of international relations are: 1) the modern international system is based on a collection of sovereign states that are unconstrained by any higher authority (so-called anarchical system of states); 2) the state's key concern is maintaining security from military threats which is achieved through armed strength and, if necessary, alliances; 3) the nature of the state itself is immaterial. States are unitary, indivisible actors which act in a rational way to maximise their power relative to other states; 4) priority is given to maintaining order and stability within the system as a whole (maintaining the *status quo*) primarily through power balancing (achieved through alliances).

the global structure is one of profound inequalities, of exploitation and dependence.[43]

Given the trends and detailed changes described above, it would also seem reasonable to conclude that we may be in the process of moving away from traditional geopolitics and geoeconomics towards some form of geogovernance - in a sense we are moving outwards on all the axes of Figure 1. Whether, how quickly and how uniformly we complete this basic transition and what kind of system of geogovernance we end up with will depend on the actions and decisions that we take now.

WHITHER AUSTRALIA AND THE ADF?

Since the early 1980s, Australia has been steadily moving away from the welfare or social democratic state towards Cerny's 'competition' state. Successive governments have opened the Australian economy to outside market forces, followed strategies aimed at making Australian firms more competitive internationally, privatised more and more public goods and services, and strongly supported the establishment of both regional and international trading regimes and institutions such as GATT and APEC. Under Labor and especially during Gareth Evans' time as Foreign Minister, Australia sought to extend this trend beyond economics and trade into the field of regional and international security where these latter initiatives were motivated, on the surface at least, by concepts of 'international citizenship' and cooperative and human security.[44]

While maintaining, and extending in some areas, Labor's liberal economic and trade agenda, the Howard Government has tended to resile from Evans' expanded foreign policy focus, cutting international aid, refusing to cooperate in reducing greenhouse gas emissions, adopting a neutral position on international human rights, and tacitly, if not openly at times, criticising the role of the United Nations and some of its agencies. To the extent that they consider strategic futures at all, it would seem that the Howard Government, and perhaps Labor as well, would be most comfortable with the emergence of a system of geogovernance which is dominated by elite interests and which places economic development above ecological sustainability and human well-being both at home and abroad.

In spite of some allusions to the emerging world economy and the multidimensional nature of security, Australia's defence policy makers and their advisers have continued resolutely to view the post-Cold War world in realist terms. Successive strategic reviews and defence white papers have continued to:

- express concern over regional hot spots and prospective external threats (measured in terms of existing or extant regional military capabilities);
- remain obsessed with the geopolitical balance of power and how this is changing;
- equate security with military strength and the use of alliances or other collective military arrangements;

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[43] Jan Jindy Pettman, 'National Identity and Security' in Gary Smith and St John Kettle (eds), *Threats Without Enemies: Redefining Australia's Security*, Pluto Press, Leichhardt, 1992, p. 54.
[44] See Gareth Evans, *Cooperating for Peace: The Global Agenda for the 1990s and Beyond*, Allen & Unwin, St. Leonards, 1993; and Gareth Evans and Bruce Grant, *Australia's Foreign Relations in the World of the 1990s*, Second Edition, Melbourne University Press, Carlton, 1995.

- express concern over the continuing US military withdrawal from the region and the possibility of regional hegemons rushing to occupy the ensuing vacuum; and
- insist that the role of military force and military forces are unchanging and all to do with the defence of the state against external aggression (this in spite of the fact that the ADF has been involved almost exclusively over the past decade in a range of largely non-military security operations).[45]

The continued reliance on a realist approach for understanding and responding to our changing international and regional environment means that the Government and its advisers are seeing the world in only one dimension and planning their strategies and responses accordingly. In practice this means that the ADF continues to be structured, equipped and prepared for a basic role - conventional warfare in the defence of the Australian state and its interests - that it may not be required to carry out. This basic disconnect between planning and reality is being compounded, I would argue, by the current interest in the 'Revolution in Military Affairs' and associated developments which continue to feature in our professional military journals and are the subject of numerous conferences and studies.[46] This interest remains largely focussed on operational and equipment concerns and may be driven too much by the perspectives and interests of our American ally. Entranced by pictures of high-technology weaponry at work in the Gulf War and by continuing US debates over the prospects of 'third wave' or cyberwar, we are tending to focus on means rather than ends, and preparing to engage in conflicts we would prefer to fight in rather than ones we might have to.

While an analysis of emerging technologies and their implications for conventional warfare is reasonable in itself, it needs to be extended beyond purely operational and equipment concerns to consider contexts as well. This is something that our planners and policy makers seem to prefer not to do. Yet, as we have seen, some of the alternative strategic futures I have canvassed could have significant, even revolutionary, implications for how the ADF may be used in the future - perhaps to prop up transnational economic institutions and interests, protect diminishing planetary resources, intervene in failed or failing states, protect the 'residual' state and its comprador classes against internal anarchy, and so on - as well as how it is structured, equipped, trained and led.

The ADF itself and civil-military relations in Australia generally will also need to change, perhaps fundamentally, in the wake of the continuing transitions in social and political affairs. While the organisation has undergone significant and important adjustments over the last decade in particular, I would argue that:

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[45] See Graeme Dunk, 'Security or Defence? Force Development in the Absence of a Direct Military Threat' in *Journal of the Australian Naval Institute*, May/June, 1994, pp. 5-10; and Desmond Ball and Pauline Kerr, *Presumptive Engagement: Australia's Asia-Pacific Security Policy in the 1990s*, Allen & Unwin, St. Leonards, 1996.

[46] See Alan Stephens (ed.), *New Era Security: The RAAF in the Next Twenty-Five Years*, Air Power Studies Centre, Canberra, 1996; and Keith Thomas (ed.), *The Revolution in Military Affairs: Warfare in the Information Age*, Australian Defence Studies Centre, Australian Defence Force Academy, Canberra, 1997. The need to take account of continuing changes in technology and move beyond the 'strategic perceptions of an earlier era and [the] outmoded views of the nature of warfare' informed the recent study of 'An Australian Army for the 21st Century' (Army 21) and the subsequent reorganisation of its combat components. See 'An Australian Army for the 21st Century', http://www.adfa.oz.au/DOD/SSA/C21ARMY/bookful. -htm.

- its basic identity continues to reflect a 1950s Anglo-American monoculture rather than multicultural Australia of the 1990s;
- its current structures, work practices and institutional cultures remain grounded in the early modern era, and associated notions of warfare, rather than the coming postmodern or postindustrial age; and
- as evidenced by the continuing incidents of harassment, it has still not come to terms with the changing place of women in society.

Even if we don't think these various changes will eventuate, it is important to study and think about the possible implications of what is going on around us as well as the continuing circumstantial changes themselves. Flexibility - the planners' current buzzword - needs to operate at the conceptual and strategic levels as well as in the areas of budgeting and equipment procurement. Why don't our military and political leaders try to think and act beyond the realist paradigm? This is a paper in itself but I will end with a few brief thoughts on the matter.

There are a number of factors underpinning why we are not actually testing the limits. These include:

- the current hierarchical nature of defence planning and policy making (this tends to produce the 'next military' rather than the 'military after next');[47]
- poor or compromised advice (too many people in power have a vested interest in implementing the existing defence program and do not wish to look at the assumptions which underpin it);
- generally conservative and introspective political, strategic and popular cultures (we find it difficult to think and act for ourselves); and
- inadequate education and training systems (which relate to the modern rather than postmodern military).[48]

DISCUSSION

Dr Andrew Butfoy: This is not really a question; it's just a note of agreement. With regard to the last point that Graeme mentioned, certainly in the university where I come from certain orthodoxies like commercialism, economical rationalism and so on are stifling the education sector and there is less and less space for this basic questioning and 'testing of limits'. That's one of the welcoming things I find about this conference. In fact, it might sound ironic to some of my academic colleagues that there seems to be more scope for introducing basic themes and basic questions in an environment like this than in some of our universities.

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[47] For a discussion of these terms in the American context, see Paul Bracken, 'The Military After Next' in *The Washington Quarterly*, 16(4), 1993. pp. 157-174.
[48] A detailed discussion of this issue is contained in Graeme Cheeseman and Robert A. Hall, *Preparing for Australia's Military After Next: The Price Report and a 'New Model' ADFA*, Australian Defence Studies Centre, Canberra, 1997.

Captain B.R. Brown: Earlier in your talk you used the phrase: '...unless taken up by the media', and then you didn't come back to that. It seems to me that graphic images of horror from Rwanda in 1995 galvanised world action. Each day in Bosnia-Herzegovina we get a score card of who's the good guy and who's the bad guy from the media. We have a senior military leader who's on record as saying that the most important thing he does each day is find out where Christiane Amanpour is so he knows where the action is going to be. Could you speak a little to the importance the media plays in the determining of alternative futures or the shaping of alternative futures?

Dr Cheeseman: I think a major part of the development I've tried to describe is the emergence of a kind of *international media* - one which has enormous capability now to report issues (in real time) that go into every home; not only in the countries that are directly involved in an incident, but right across the globe. This, I think, is a measure of the changing balance of power away from *states* and towards other *non-state* actors. The international media is clearly a very powerful, major non-state actor which influences policy and affects policy makers. I gather that during the Gulf War, policy makers everywhere got their information from CNN as much as from their own intelligence sources.

 The international media is performing a major political role. It informs public opinion everywhere and that feeds back into the policy making process. In many ways, no matter what we think of the media and particularly some of the media in Australia, it is I think adding to the questioning nature of young people and peoples everywhere. They're not prepared to simply accept the kind of traditional positions that governments have put to them. Led by the media, they're beginning to question these even more. So I think the media do play a key and growing role in the changing developments of international society generally.

Colonel D.J. O'Neill: I'd like to pick up on the technology issue a little bit further. You mentioned technology and I'd like to focus on *information* technology. In the Revolution in Military Affairs we understand the underlying part that information technology plays, but there's also a parallel concept of a revolution in security affairs which I think impacts on what you're saying. It seems to me in the options that you put up as possible world outcomes, that some are favoured more than others by the fact that we are in a period where we're using information technology more. Therefore, for example, the idea of falling back into medieval type concepts seems to me less likely than a global village. Similarly, now the spread of English through the availability of the media and so forth works in favour of a global village approach. Would you like to comment on that?

Dr Cheeseman: Essentially I'd agree with that. As I mentioned in my talk, I think, for various reasons, that we are moving towards systems of global governance. How long that will take and what form of system that will involve are matters of debate at this stage. One of the factors, however, is information technology or communications technology. It has promoted the formation of civil society, and it has developed a kind of reflexive approach to world affairs where people no longer see their loyalties to the state, but increasingly see themselves as world citizens. So I agree with you.

 Of course, the role of technology in a globalised world or in a system of global governance could provide either a negative or a positive incentive. We could have

George Orwell's world where communications technology - information technologies of various kinds - are used to control us all in various ways; whether it be through monitoring how long we're on the keyboard or following our cars, for example. So there is a potentially negative side which undermines civil rights and democratic societies and so on. Alternatively, it could also foster, as we discussed in the previous question, a more democratic, more pluralist, and much more humane system of geogovernance. Again, which system we move to, and the role of technology in that, depends on the decisions we make now. It's largely a political question and not necessarily a straight technological question.

Group Captain S. Peach: In your future images you looked at a number of transnational trends and spoke of the UN, and perhaps we could mention other international organisations. In Europe, of course, we've seen NATO adapt to the changes of the last few years and indeed expand and enlarge. Do you see the need will arise for some form of Asian security organisation, however softly focussed, as we start to test those limits and perhaps look at challenging the long standing alliance type ties - perhaps building on some form of ASEAN type model for security issues for the future?

Dr Cheeseman: Certainly Europe is, as I mentioned, the exemplar of the kind of development of a regional economic community where traditional borders and traditional ideas of sovereignty are declining, and where military forces (whether individual or collectively organised as you mentioned) are changing - and I suspect changing fundamentally. I think too, we are seeing that trend in the Asia-Pacific. At the moment it's largely in the economic and trade areas of security and less so in the traditional military security areas, but I suspect we *will* see a movement in the Asia-Pacific towards a European model.

A lot of people argue that that's too optimistic; that there are all sorts of tensions that operate in the Asia-Pacific. That's true, but I think that attitude really sells short developments that have already occurred in the Asia-Pacific: in ASEAN and other areas. In some ways the nations in the Asia-Pacific don't have the same baggage that Europe carried with them to try and divest themselves of in forming a community. So, if we're into predictions, I do think that we will see a trend (again, over time) towards a regional economic community in the Asia-Pacific, not unlike Europe.

Certainly it will have the same economic variables that Europe does - there'll be an embracing of market economics and we're already seeing that - but the key question is whether an Asia-Pacific community will be based on pluralist democratic values. That is a more open question than in the European context, and it might be a crucial question. If the proponents of the future of war are correct and the lessening of the prospect of war between industrialised states also depends on the development of pluralist democratic regimes, then that may be a crucial variable in the future of the Asia-Pacific regional community, however we define it.

These sorts of changes will take time, but will also depend very much on the kind of initiatives that are started now. It seems to me that most regional leaders and their advisers do share the belief in the need to move towards some kind of community based approach to the region, and that's very positive.

Squadron Leader R.D.S. Rintoul: You touched on the ADF's ability to change to meet the sociopolitical and economic changes in the world. How do you see, and how do you consider the Australian public see, the ADF's willingness and ability to make these changes?

Dr Cheeseman: That's a huge question, but an interesting one. My own view is that the Australian public see the ADF in very traditional terms; as a kind of extension of the Gallipoli legend. That's useful for the ADF in that it can paint what it's doing in traditional terms and the population, to the extent they look at defence, will say 'That's fine, yes, we have a maintenance of the old myths and approaches'. So in a sense the ADF can use that to do what it wishes. The problem though (that you've inferred I think in your question) is that if the ADF decides, for whatever reason, it needs to change radically away from the kind of basic myths that underpin modern force, or the forces of the First and Second World Wars, it will have difficulty selling that politically and to the people at large. Part of the problem for Australia generally, is that firstly, there's no real debate within the political parties over these issues, which is disappointing. Second, the political parties are too willing to use *any* debate, or any move away from these kind of traditional myths and approaches to militaries, to politically point-score - which makes it very difficult for leaders (either military leaders or defence leaders), if they want to make significant change, to do so. So there is a cultural dimension to this whole issue that we mustn't lose sight of: that we can argue logically that there needs to be moves in the direction that I've suggested or in some other direction.

Wing Commander M. Toia: You spoke briefly towards the end of your talk about where the ADF has failed to test the limits and, perhaps it's just my perception, but it seemed distinctly negative. I was wondering if there is anything positive that we're doing, in your view, to test the limits?

Dr Cheeseman: I did mention that, especially over the last decade or so, the ADF has made enormous changes: from someone who has been studying the ADF for a number of decades, there has been significant change. There have been enormous changes organisationally including the move from single service structures to joint force structures; the move towards more integrated headquarters with, for example, the formation of Headquarters ADF; and the changing and improved civil/military relations within Russell Hill itself. There has also been a recognition of the need, on the part of the services generally, to adjust to *some* social changes; to take into account, for example, the need to move towards a more multicultural force - that the force and its various officer and other corps need to reflect more Australian society generally. So, I don't wish to sound overly negative, but the conference is to test the limits and I thought it important to try and push you by saying as I did that it seems to me, as an observer, the strategic identity of the ADF and defence generally has not changed fundamentally. It's still about the preservation of Western ideals (and Western interests) against non-Western ideals. That's contrary to the whole idea of engagement. Essentially what it does is set up a kind of duality - us versus the rest or an English speaking world versus the rest - and I think that's inappropriate. We haven't been decolonised in our thinking in that regard.

The second broad issue that I raised was really flowing from the Revolution in Military Affairs and its information revolution and other things, on the way that the

ADF does business. It seems to me that the basic structure of the ADF, the officer and non-officer classes for example, is located back in the 19th century - inherited from the British class system - and that it needs to be fundamentally changed. We can see that there are already significant problems in trying to differentiate between officers and others when some of the others are more skilled, more important, and deserve to be recognised much more than officers. The way to portray this in a simple way is to suggest that the structures, work values and approaches remain associated, largely, with modern militaries (that is, militaries of the modern era). That might be fine right now, but we're moving into a *post*-modern era (a post-industrialised age) which is going to be significantly different in a whole range of ways and I've tried to show some of those. The ADF needs to really think a lot more about how it might be structured to meet this new post-modern era.

Air Vice-Marshal M. Weller: Following on from the last question: might it be that the defence forces *are* changing and *are* reacting in a flexible way? It seemed to me this morning that General Ryan was indicating that his service was structurally changing in response to the challenges of Bosnia and Rwanda and the like. Secondly, might it not be that, if there's a change in social order towards anarchy, that the military will have to retain some traditional values; that the things it would need to bring to that order would be organisation and discipline at the very least.

Dr Cheeseman: I agree that there's a role for the kind of tradition that militaries operate and the kind of traditional roles that they've had. The point I'd make is that, it seems to me, the presentations that we've heard to date assume, explicitly or implicitly, that the current system of world politics and the assumptions that underpin it will continue, and that it's simply a matter of managing ourselves better to deal with the changes in technology or other system changes. There is no allowance (or perhaps there is but it hasn't been apparent in the presentations) for the impact of these system changes on the nature of the political system itself; that in the future, the state will become more problematic, and hence the key agents of the state will become more problematic, or fundamentally change. Some areas of the state might even disappear altogether, so what does that spell out for the military?

Really it's time, I think, for military planners and defence planners to think about those issues. They might not occur until the middle of next century but they're going to occur and I don't think it's enough to ask how we are going to improve the military without looking at what are important prior questions about the context the military will operate in. Will the context change? If it's going to change, what implications will it have for roles, methods of leadership training, and so on? That's really what I'm pointing to. I'm not suggesting that the military *at the moment* isn't properly structured or isn't changing to meet today's needs. It's really the needs into the next century that they have to think about a lot more.

PLANNING TO WIN

JOHN WARDEN

INTRODUCTION

Ladies and gentlemen, it's an enormous pleasure to be here in Australia. I feel as though I have an affinity for Australia because one of the earliest things that I can recall my father mentioning was that, when I was born, he was on a troop train going from Brisbane up to some port of debarkation in the northern part of the country preparatory to taking part in the invasion of Lae. And about the same time I had an uncle who was one of the last airmen to leave the Philippines - at about the same time that General MacArthur left. He spent a good chunk of time down here in Australia while the counter offensive was building up, before subsequent moves into New Guinea and then on back to Tokyo. So it's a real pleasure to be here and especially to be amongst a group of people who are as committed to air power as you all are, as is evidenced by the amount of time and effort that you put into thinking about it.

I want to talk today about planning to win. Obviously the hypothesis here is that it's desirable to win and that if you are going to do so, you've got to do some planning. I'd like to start out with a question: as an organisation - as a military organisation, as the Royal Australian Air Force, as the United States Air Force, as a company - do we really exist in our own minds to fight or do we exist to win?
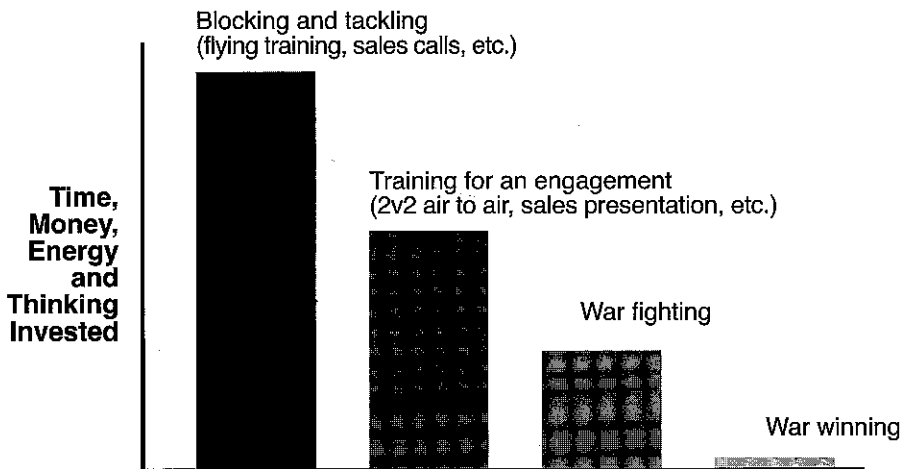
Figure 1. **Exist to Fight or to Win?**

Let me suggest how we might look at this question. We might look at the amount of time, money, energy and thinking that's invested in various aspects of our trade. And we might look at something like Figure 1 and see that we spend a lot of time on the basics of flying - as we say in the US in the basic blocking and tackling; sales calls in the

business world. We spend a little bit less time, probably, thinking about how we are going to bring more than one tactical engagement together - two versus two in air-to-air; or making some kind of a sales presentation as opposed to a single sales call in business. We spend less time than that, I would argue, in thinking about war-fighting - issues including improvements to logistics systems, etc. Then, at the very bottom we spend, I would argue, very little time, especially at the command and management levels of companies or of our military, actually thinking about winning.

As I was doing a little bit of research for this presentation, I did an Internet search of the joint documents - joint doctrine including the dictionary of military terms and so on. In that Internet search I could find not a single primary entry for the words 'winning', 'to win' or 'victory'. There was a whole lot of things in there about how to do tactical things, but almost nothing about the final end states that were supposed to be the result of this action. Now what I would like to suggest is that, at the highest levels - and perhaps moving down to a fairly low level - we ought to be reversing the scheme in Figure 1. We need to spend a whole lot of time thinking about *winning* and what that really means.

WINNING

Now to think about winning, it probably helps to start out with a little bit of a definition of what *winning* is. In Figure 2a, the shaded circle is merely a representation of an opponent or some system that we want to change. We'll define winning very simply by saying we have won when the opponent - or the opponent's system - is in the state we want it to be in and when it can only do what we want it to, or *will* only do what we want it to. Now, how we are going to go about measuring that is interesting and we might think about it in terms of the *energy* that exists within the system - pre-hostility. Now our next thought might be to say: well, how much energy does that system need to be nasty - to do things we don't want it to do? That perhaps would be represented by the striped area. Winning then, in many senses, is probably nothing more than energy management aimed at reducing the overall energy level of an opponent's system to where it is less than what it needs to do things that you don't want it to do (as shown in Figure 2b).

Minimum energy opponent needs to conduct aggressive operations

Minimum energy opponent needs to conduct aggressive operations

Pre-hostility energy state of opponent

Post-hostility energy state of opponent
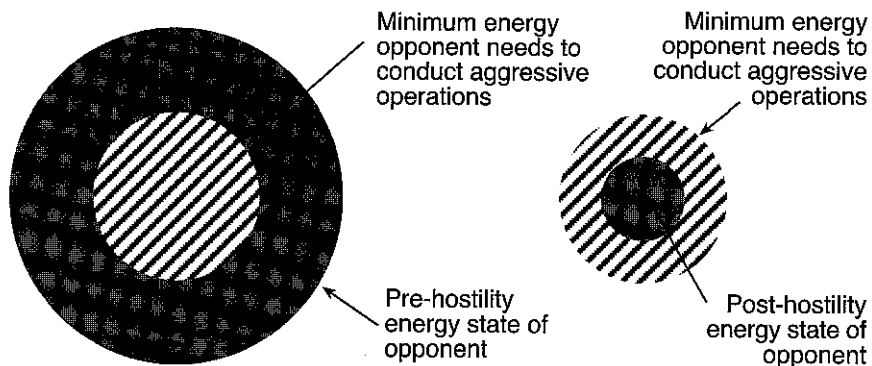
Figure 2.   **Winning: Energy States and Crisis**

We'll talk about this as a system and we'll go into a little bit more detail, but our real thrust here is not thinking about the opponent's aeroplanes or his ships, but thinking about the opponent as a system and changing his overall energy level as required. That's an example of *negative energy.* As we all know, in the years to come as militaries, we're all going to be involved in a lot of operations that are not traditional war. Disaster relief is an example, but this in my mind is nothing different at all from normal war. It's simply that the end state is somewhat different. In this particular case we might use the little spotted circle in Figure 3a to represent the amount of energy that a country perhaps has after a disaster. In the shaded area is the minimum energy needed for that country to survive, prosper and grow. So our operation then becomes one of changing the energy except, this time, putting *positive energy* into the system in such a way that it has enough for it to do what we want it to do (as shown in Figure 3b). A bomb is a negative energy weapon and a can of beans is a positive energy weapon. (And really there was no pun intended in that - if I'd thought about it perhaps there would have been.) We all need to think more about it in this way because more and more we are talking about changing energy states.

Minimum energy
needed to survive
and grow

Minimum energy
needed to survive
and grow

Energy state
immediately
after disaster

Energy state
after successful
disaster relief
operations

(a) Before Disaster Relief   (b) After Disaster Relief
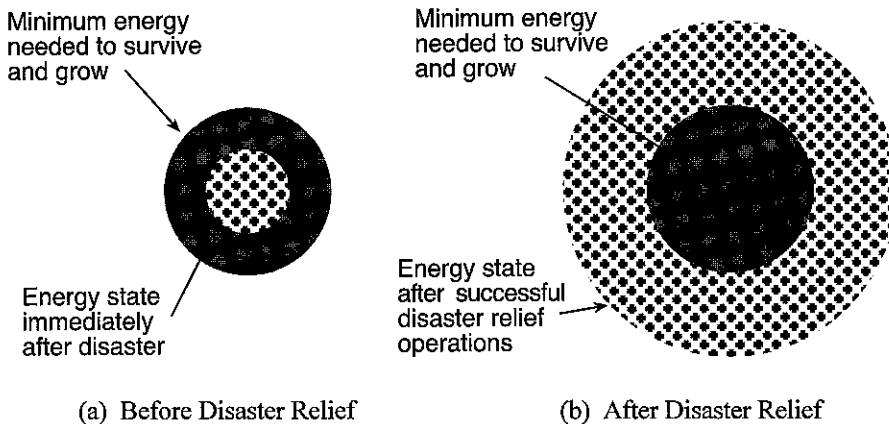
Figure 3.   Winning in Disaster Relief: Positive Energy and Crisis

Now if we're going to talk about winning, we need to be talking about the environment in which we're going to be operating. I don't want to be redundant about what's already been said here today, but I would start out by arguing that, in fact, the environment in which we're all going to be operating in the future is significantly different - revolutionarily different, completely different - from anything which any of *us* have experienced or, indeed, anything within *human* experience.

I think it first came clear to me how different this world was and how differently we needed to think when I was down in *Checkmate*, almost seven years ago on 16 January 1991. It was 1830 hours Washington time, the Secretary of the Air Force was there with us, along with the Director of Plans and a lot of the other people who'd been involved in the planning. And what were we doing? In real time we were watching on television what was going on in the heart of the enemy capital we were about to bomb -

quite an experience in itself. It was a little bit disconcerting because there was some heavy artillery or anti-aircraft fire going on at that time and there shouldn't have been any because there weren't any aeroplanes over Baghdad at 1830, or there certainly shouldn't have been. Although we were watching, we had an inability to do anything about it.

The next thing that happened was, I think, in many ways even more dramatic. At 1900 hours CNN reported, 'Yes, there are some bombs going off around the city'. We could see where they were going and had a pretty good idea that, in fact, the bombs were hitting where they were supposed to. So there's a nice *input* measure; again within seconds of the start of the war we had this information, without precedence. But more important was that a few seconds after that I remember turning to the Secretary of the Air Force and saying: 'I'm a little bit worried here. It *is* 45 seconds after the war's start and the electricity isn't off. Why isn't the electricity off?' - after all, that was the initial target for the operation. I had no sooner said that than the CNN picture went black. The CNN guy said, 'Baghdad has just gone black...maybe the Iraqis turned out the lights'. And we all said, 'No they didn't!' I'll admit it was a little bit hyperbolic but I rolled back in the chair and threw my arms up and I said: 'The war is over; we won. There is nothing now that the Iraqis can do that can prevent us from exercising our military will upon them'. You may argue with that but I would maintain that it was a *reasonable* statement to make, and after only 45 seconds.

The key issue here is that things move at a velocity which is simply incredible. And if we are not thinking and moving with that velocity, we're going to be in big trouble. It is a really different world. How different is that world? Well, to me it's probably the most revolutionary period in the history of mankind - a period that requires substantial new thinking and an enormous amount of agility. Within this revolutionary period, I think there are three huge revolutions going on at the same time: an information revolution, a military technological revolution (and I don't think of the term RMA here in quite the same way), and a geopolitical revolution. I'd like to talk about the first two of those a little bit.

INFORMATION REVOLUTION

We could describe the information revolution in a number of ways, but perhaps more than anything else it's characterised by the extraordinary velocity of information dissemination. Information moves at a great rate and because it moves quickly, by definition, it moves widely, to every place, very soon after it comes into existence. This, for practical purposes means that your customers (if you're in business) and your opponents (whether they're military or business) are going to know everything that is going on. Likewise, this speed of information dissemination means that information has a very short life span - it's very valuable when it first comes out but it rapidly loses its value. This says to me that we can no longer think about hiding information - that the energy expended on trying to keep secrets is counter productive - and that one is instead successful as an organisation, or indeed perhaps as an individual, by exploiting information *faster* than the other person.

Information speed is also leading to a significant reduction in product cycle times. We deal with some industries where product cycle times are down into the weeks. *Most* product cycle times in most industries are down to a year or two or three. There exists only one counter trend to this in the world, that I know of, and that's the product cycle times of military systems. These are going in exactly the opposite direction and I

would argue that that is a divergence that cannot and should not be allowed to stand. A little bit more on that later.

There are some interesting impacts from this information revolution. As an example, the impact on new types of technology. In the old era - ten years, 50 years ago - we would get a new technology (gunpowder or the machine gun for example) and it would take a fairly long time before it was perfected enough to where it would begin to have a serious impact. Then, once it had achieved a serious impact it might last for another 50 years or so. Sailing ships in the Royal Navy were once in service for a hundred years. That, I don't think, is the case any more. What we have today is a situation where new technologies arise - for example, the F-117 stealth fighter - that have a very rapid impact, but whose impact is short lived; fading very quickly away because everybody learns how to deal with it. This is the key to wealth in the semiconductor and integrated circuit industry, and a lot of other industries besides. Bring out something, bring it out rapidly, have a high impact and then start driving the price down on it. To me what this says is that the very concept of a 50-year aeroplane is one that is totally out of consonance with the age in which we live. In fact, the life spans of aeroplanes must become significantly shorter or we will be doomed to live with technology which is utterly irrelevant by the time it even comes out.

The next impact of the information revolution is this: the number of smart people available to do any particular job is falling rapidly. This isn't because there are fewer smart people in the world; just the contrary. It's because the number of opportunities that are attracting smart people are expanding at such a huge rate that they simply get diffused. When I say *smart* people I don't mean geniuses either; I mean *relatively* smart people - the kind of people that we've historically thought we needed to have in the officer corps (especially in a technological force like the Air Force). Tomorrow there will simply be fewer people available to do the kinds of jobs that we are doing today. We might be able to get more if we're willing to pay a whole lot more for them, but it's not going to be just a little bit - it's going to be a lot. We need to take that into account.

MILITARY TECHNOLOGICAL REVOLUTION

The second huge revolution is the military technological revolution which is a combination of tremendous computational power, increasingly unlimited bandwidth and a number of other technologies - the key one of which is precision. Those things came together for the first time in the Gulf War where we were able to see what they could actually do as we watched F-117s flying over Baghdad dropping single bombs and hitting exactly what they were supposed to. This, in my mind, is not *a* revolution in military affairs but is *the* first genuine military technological revolution ever because for the first time we now have a *conceptually* different way to wage war. We can now wage war in *parallel* as opposed to the *serial* operations that constrained us in the past.

Let me illustrate just one aspect of this, and that's the aspect of *precision*. We can ask ourselves how many bombs it takes in order to have a 90 percent probability that one bomb will fall on a target about a third the size of a football field (a fairly large target), or about a third the size of this room. As short a time ago as World War II, to have a 90 percent probability to put *one* bomb on such a target we needed to drop over 9000 bombs and fly over 1000 B-17 sorties which meant putting 10 000 men at risk over a target. It was too expensive. If this room had been a target in World War II we would have sent people to go and bomb Canberra in the hope that maybe something

would fall in this particular area. It changed in the Gulf War because, for the first time, there was precision available en masse which allowed one aeroplane with one bomb to provide that same probability.

Now take a look at the photo in Figure 4. This a photo of an Iraqi airfield. You can see there are several aircraft shelters and some maintenance complexes in the centre. The maintenance complexes are obviously destroyed. What you can't see is that there is at least one hole in each one of the aircraft shelters and that they are no longer functional. If you look closely you can see doors blown off the back. I ask you, looking at this picture: what do you *not* see in this photo that you have seen in every picture of artillery and aerial bombardment since the advent of photography? There are no craters in this picture.

Figure 4.   **Iraqi Hardened Aircraft Shelters After Precision Strike**

I remember in Vietnam, as many of you here will also remember, that when you were assigned to hit a target that had previously not been hit, you would go out and you would find the target - it could be a bridge or a building or whatever - and you'd often find it sitting in perfect splendour; untouched yet surrounded by a moonscape of craters. In the past, war was defined by *misses*. This war with precision (the Gulf War) was defined by *hits*. The whole experience of war - from rock throwing to dropping bombs - was suddenly inverted in *this* war. This is an extraordinary change that we have not really begun to grasp the full meaning of.

There are, for example, important logistical effects. Think about supporting one aeroplane and one guy, as opposed to 1000 aeroplanes and 10 000 guys. There is the cost factor, and we'll get to that in a second. There is the time factor - the weeks or months required to plan a 1000 ship raid substituted by just hours required to plan a single F-117 raid.

What else does it do? It drives you towards *precision of effect*. This means bombs fall not only where they're supposed to fall, but do only what they're supposed to do. If the target is this laptop computer, it does laptop computers; it doesn't do speakers unless it intends to do speakers.

We certainly try to store fewer platforms; simply because we can do with one aeroplane what it took a thousand to do in World War II. And that trend is continuing downwards. There is now more capital intensity because we need to start thinking about aeroplanes and other delivery systems not as expendable (as we have thought about them in the past) but instead as production machinery in much the same way that the company *Intel* thinks about spending two billion dollars to build a new chip factory which will be used for two or three years and then go into obsolescence. That's the kind of world that we're in. Platforms have got to be faster; yes, they must be hypersonic. The reason they've got to be faster is that they've got to keep up with the flow of information. If our physical delivery means are hopelessly behind the movement of information, we are defeated before we even start.

Let's talk about cost. The old era cost of, say, a B-17 put in 1997 dollars is somewhere in the vicinity of a half a million dollars. An F-117, on the other hand, costs about 100 million dollars. We say, well, if we have to make a decision as to which one of those we'll buy, we'll simply buy a bunch of those B-17s because they're so much cheaper. This was absolutely true when we were looking at it on a unit cost basis, and that is a reasonable basis for judgement when you're talking about attrition of systems and having to throw away a whole lot of them in order to achieve anything. However, it's not the case any more. What we need to be doing is measuring effect based on the outcome for the opponent; not on the unit cost. When we do it that way the ratio changes rather dramatically. The cost to put that single bomb into this room with the F-117 is a fraction of what it would have cost to do it with the B-17s. We need to have a completely different measure of how we are costing things and what we are willing to spend for them. Instead of the prices of aeroplanes going up I would argue that they are going down, if you measure at the right level. The right level to measure is not at the unit cost, it's at the systems cost and it is on the systems level - it's the effect that you are having on your opponent. We need to get on this curve and follow it religiously and not try to be following a curve that was built in an industrial age which is no longer here.

I said this cost saving was related to the military technological revolution. Let me give another quick illustration using the Gulf War. My overview of that war is simple: that Iraq started out in the summer of 1990 as a regional superpower, and that a few months later in the spring of 1991 it was in pretty sorry shape (and it's still in that sorry shape), and that the cost to defeat Iraq was amazingly low by historical standards. I would argue that a new standard was set at that point, but that now we've got to drive well below that new standard. This was probably the first war in the first true military technological revolution and, as imperfectly as it was executed, it is still the data point on which we must operate. You don't get chances in today's world to have multiple data points so that you can be convinced there is a curve out there that you're going to follow. You've got to go with what you have or otherwise you're going to be in trouble.

We could go into lessons learned in great detail here, but let me instead suggest some simple key ideas. First, the military technological revolution offers incredible opportunities, but you've got to do a complete rethinking of war itself. Second, precision redefines mass and concentration completely. We saw (and it was already mentioned today) that air power in fact can defeat land power. It's really a matter of moving power up into the third dimension to the high ground and then moving that high ground around and then exploiting it. You don't need to seize territory in order to win. In fact, seizure of territory becomes a very poor measure in military operations. Third and finally, when we are talking about saving money, we're actually talking about finding the greatest economy and the greatest efficiencies out of air and space forces; about measuring them against the effect that they are going to have on the opponent and about reducing the number of people that are needed in order to use them.

PLANNING TOP-DOWN

With all that as a preamble, how do we plan to win? As shown in Figure 5, we need to go through a fairly rigorous process which begins by thinking in terms of grand strategy. This is nothing more than identifying the objectives that we want. What do we want the peace to look like after we have conducted our operations? Next we think about centres of gravity or the opponent as a system. We have to set about finding centres of gravity which, when we affect them, will take us through to the grand strategy solution. Note that we are not paying any attention so far to what tools we are going to use to affect the centres of gravity. I can tell you that *every* centre of gravity in the world can be affected, or is vulnerable, to *something*. That's an absolute statement. Next we put together a campaign - an orchestration of the forces that are available to us. They may be information forces; they could be of all the services - it doesn't matter; together they form campaigns. And we need to think a lot about how we're going to terminate the operation. We need to make sure that we are giving the people who sit at the peace conference the sort of instructions necessary for them to get the best possible results from that process. Then there's the execution shown at the bottom of the figure. Why did I stick that down there at the bottom? Because when you get right down to it, there's not a huge difference in execution capability between pilot A in one country and pilot B in another country. If we think we're going to get huge leverages by concentrating all of our thoughts on improving executions, it's not going to happen. I would argue that we were superior to the North Vietnamese at an execution level during the Vietnam War, and we lost. We lost simply because the North Vietnamese had a much better grand strategy. They understood the centres of gravity against which they were operating, and they had a pretty good campaign. It was terribly expensive in human lives, but from their stand point it was a good campaign.

Our point really is that the right grand strategy, strategy, and campaign will accommodate a multitude of tactical errors and omissions. Conversely, great tactics in the absence of a good strategy and campaign are likely to win neither battles nor wars.

What is the object of war? It's really simple; it's to win the peace, and that's *all* it is. We can define peace in a lot of ways. As an example, in the work that we were doing with General Schwartzkopf right after the Iraqi invasion of Kuwait, there were specific things that we used to define the sort of the peace we wanted to see following the war. These things included Iraq no longer being in Kuwait, the government restored and, then more complex, a more stable region. When it was accepted that part of the grand strategy was to make the region more stable, what that drove us to was reducing

the energy level of Iraq down to a level where it could no longer be a strategic threat to its neighbours. At the same time we were going to have to be careful *not* to drive the energy level down to zero where it would create a huge vacuum which, in turn, would create waves of instability that could conceivably have lasted a century.
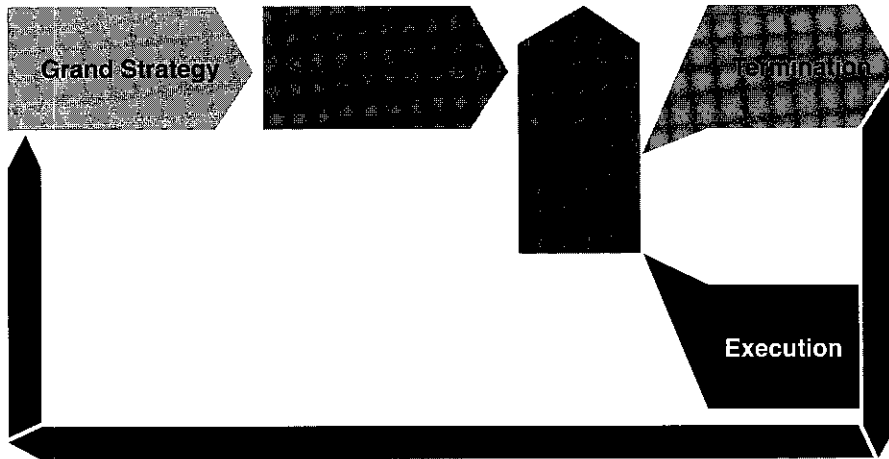
Figure 5.   **The Path to Success**

We need to think about outcomes carefully and we need to have some measures. When we're thinking about the measures, we've got to keep in mind that winning engagements, battles or wars is irrelevant unless we are better off after the event than we would have been otherwise. We need to keep in mind that wars are part of a process and that the kind of war that you are going to be able to execute is going to be very much a function of the peace that preceded it. Also, we need to keep in mind that the way you execute the war (at any level, whether that be a Bosnian style operation or a Gulf War operation) is going to have an enormous impact on the subsequent peace. We all pay lip service to this, and rarely actually demonstrate it. War is a means to an end; it's not an end unto itself. Finally, we need to be aware that our ultimate measure of success is the value of that peace which follows. This is so important that, as a planner or as a commander, you ought to be able to tell what each bomb has got to do with the peace that you want to follow the war. If you can't tell how a given bomb relates to the peace that's going to follow, then you probably haven't done your homework well and you probably shouldn't drop that particular bomb.

Let's take a quick look at another area of measurement. How do we decide whether we're doing well with regard to our force structure development process? Looking at Figure 6, we have a largely hypothetical line running across the bottom of the graph which shows the improvement in US defence capability over time. Sitting here as we approach the 21st century we can look back and say, 'Gosh, we've got two or three times the capability we had 10 or 15 years ago'. Another way of checking progress is against other militaries and we can say, 'Gee, we're better than they are', and then all pat ourselves on the shoulders. However, this is a trap that company after company has fallen into; they've used the wrong benchmarks.
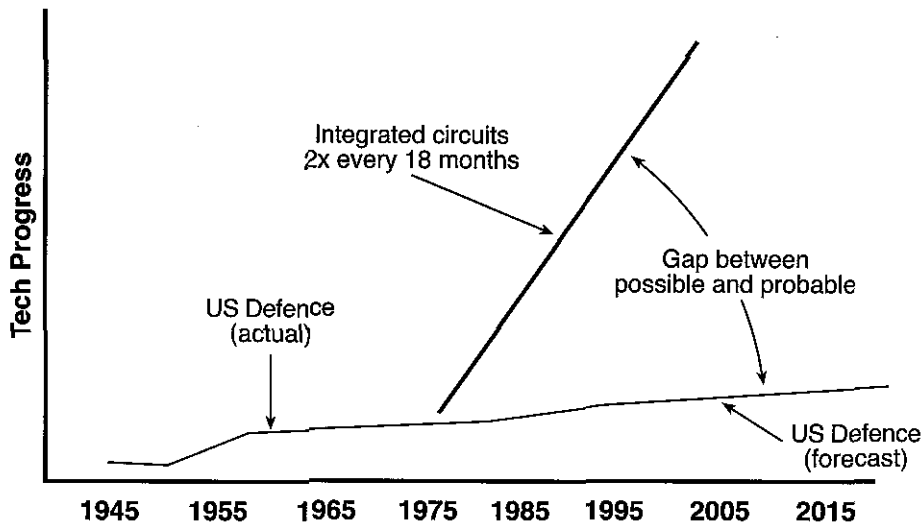
Figure 6.   **Self Measurement**

Let me suggest the possibility of another benchmark at the risk of being another one of these lecturers referring to Moore's Law and decreasing the overall understanding of it. If we go back to roughly 1975 (or to a little earlier than that and the advent of Moore's Law), the curve represents roughly the kind of progress that we had seen in integrated circuit technology and products associated with it. My question is: if that can be done in that industry, why could it not be done, at least theoretically, in the defence industry? Second, if in fact there is this huge gap between what we have achieved and what might have been achieved, is this not a gap that somebody else might fill in one way or another? In other words, what we're looking for are some absolute ways to benchmark ourselves; to not rely on comparisons with other people in our own industry (an industry which is not moving anywhere near as quickly as the most successful industries of this world).

SERIAL VS PARALLEL WAR-FIGHTING

The old way of fighting was *serial*. It had to be; not because of incompetence on the part of commanders, but simply because the curse of imprecise weapons and poor communications demanded it. You had to get all of your aeroplanes, horses or men together in one place in order to break through the defences, or in order to have any hope that any of your missiles, rocks or bombs might actually hit something important. In serial war, every attack attracts a response. Blue attacks, red responds; blue attacks, red responds and so on. Target by target we make our attacks. We've got to do A before we can do B, we've got to do B before we can do C, and every time we do a new serial operation our opponent has learned something so we are actually going into an entirely new war. Individual successes may not change the overall energy level of the enemy system and, in fact, you may well find yourself confronting a more difficult situation

after what appeared to be an initial success. The probability of being successful when you have to tie a lot of serial operations together is simply very low. This is not the way we want to go about waging war.

If we're going to be successful in today's world we simply have got to have an understanding of the enemy as a system in order to find centres of gravity. There may be multiple ways to understand the enemy as a system. The one that we used in the Gulf War was the five ring system (shown in Figure 7) which seemed to work out pretty well. We have also applied this with great success in a number of commercial market areas for the analysis of companies as well as entire markets. What this indicates is that enemy A is not significantly different from enemy B. Everything (military or commercial) is organised in about the same way: it has a brain function; it has an energy conversion function; it has infrastructure; it has some population; and it has something to defend it. Everything is organised that way and with that in mind we can differentiate down to the detail, and we can do so very rapidly. In the Gulf War, that differentiation process led to a second level of centres of gravity (or target systems if you will), which then required just one more differentiation to produce specific targets.

- Leadership
- System Essentials
- Infrastructure
- Population
- Fielded Forces
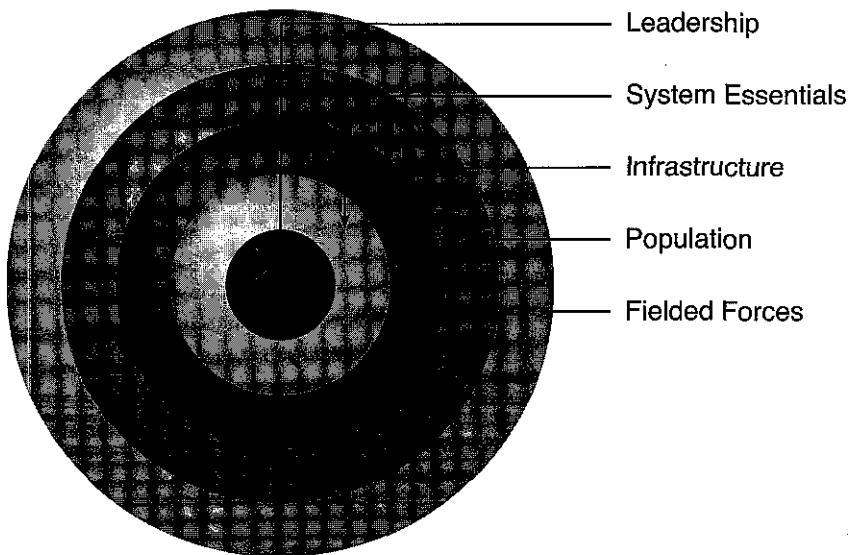
Figure 7.   **Systems and Repeating Patterns: Five Ring Model**

It's very easy for us to apply this process more broadly, whether we're talking about a market situation, guerrilla warfare or something else. Organisations are all the same and when we want to change them we find centres of gravity. With the tools available to us from the military technological revolution, and with the comprehension that we are dealing with an opponent as a system, we no longer need or desire to make our attacks dangerously in serial. Instead we bring the enemy under parallel attack, creating a very rapid reduction in the energy level of the opponent and putting it in a position from which it simply cannot react.

Many of you will say, well, this is all great if you have a very large force structure. The things that drove the Iraqis into the state of paralysis, literally in a matter of a few minutes (or hours if you want to take the most conservative view), for practical purposes amounted to about 100 aeroplanes - around 40 F-117s and around 60 F-111Fs - and probably, in that first 24 hours of the war, around 100 cruise missiles. Now those are not small numbers but, on the other hand, they are not huge numbers either. In fact, even with a *smaller* force we could still have imposed that paralysis, simply because there are not very many targets at operational and strategic system levels. It doesn't make any difference what the size of the country is, or the size of the opponent. In essence, you need to be thinking about parallel operations.

We can illustrate what we're talking about here with an example from World War II (see Figure 8). The United States Air Force began the strategic daylight bombing of Germany in January of 1943. Because of limitations on aeroplanes and the necessity to concentrate them all, we were able to attack one target a week, and that was all. In all of 1943 we ended up attacking about 50 targets. The Germans were able to deal with that situation. It still cost them, but they were able to deal with it and at the end of 1943 the Germans were functioning well. Conversely, within the first 24 hours of the war against Iraq we were able to hit 150 targets of greater significance. This represented a one thousand-fold time compression over what had happened to Germany and it simply put the Iraqis into shock. It was not because the Iraqis were incompetent, but simply because there was no reasonable way to deal with this sort of a problem. Had *we* been defending Iraq and been attacked in the same way, the outcome would have been precisely the same.
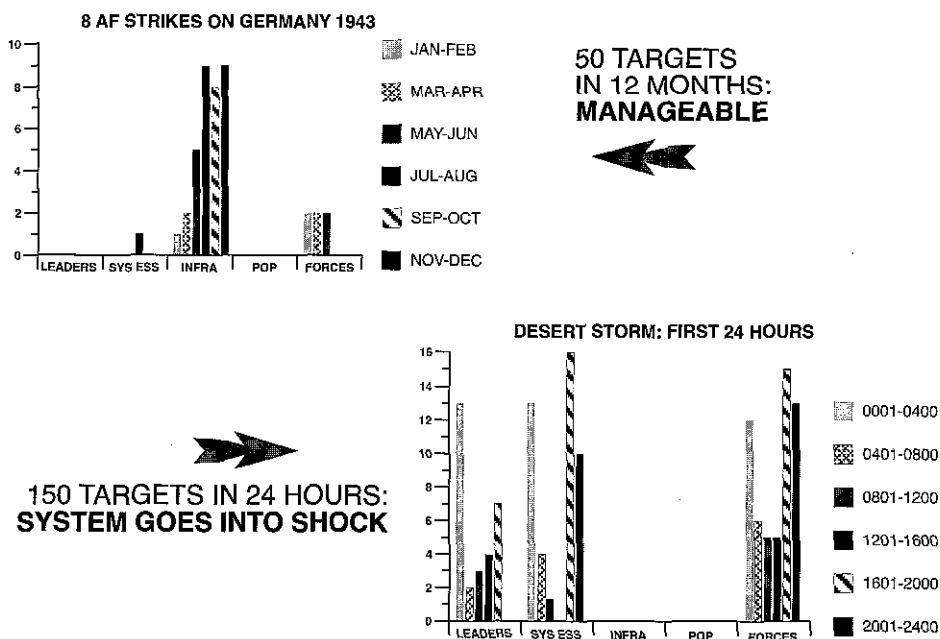
Figure 8.   Serial versus Parallel War (World War II vs Desert Storm)

OFFENCE AND DEFENCE

Let's just think a little bit about a couple more basic ideas. Are we going to be defensive or offensive? One of the things that I found very interesting when we started trying to look for solutions to the Gulf problem was that almost everybody was primarily in a *defence* mode. The reason for this was actually entirely logical. All of us had spent our careers dealing with tasks like *defending* central Europe and *defending* South Korea. To the best of my knowledge (and somebody might be able to vouchsafe me) there existed not a single plan for a counter-offensive in Europe. What we hoped to do was *hold* at some point, and if it didn't look like we could then we'd simply go nuclear, which everybody said was simply giving up. It was considered quitting because both sides were going to lose. So, our thinking had become very defensive.

We made a couple of observations about defence and those were these. First, that only an offence changes an environment. If you've got a situation out there that you *need to change, you've got to change it with an offence.* The offence in today's world is far more powerful than the defence. If Clausewitz was ever right about anything, he was not right about this - about the superiority of the defence - and especially not in today's world. Second, when you're on the defence you are at your opponent's mercy and the best outcome you can hope for is that you don't lose. You would normally not want to expend a lot of energy when the best possible outcome is that you won't lose.

SEIZING INITIATIVE

Now, we're talking about planning to win. Let's make this point. If we're going to plan we ought to make a plan that allows us to impose what we want on our opponent. The best plan is obviously the one that seizes the initiative and never lets it go. The worst plan is the one that deliberately cedes the initiative to the opponent and then becomes reactive. You might say, nobody would ever make a plan like that. Yet I would argue that virtually every plan made in the military and *almost* every plan that's made in business is exactly like that. People say we're going to make 'move one' and then we're going to sit back and see what the other guy does. In fact, we even drag out an old Prussian saying something to the effect that no plan ever survives the first contact with the enemy. Ladies and gentlemen, it is pure mental laziness if you believe that kind of stuff. The best plan is the one that seizes the initiative, does what is necessary and *never* allows your opponent to react. Now, you say, you need a lot of force structure to do that. I would argue this is not the case. You need to spend a lot of time *thinking* about what it is you're going to do and how you are going to make it happen.

You need to change the rules and let me give you an example of what I mean by that. I will tell you with utter certainty - I'll bet everything I have - that I can beat any grand chess master in the world. All I need are two conditions. Condition number one is that I get to be white so I move first. Condition number two is that I get to make the first twenty moves before my opponent can make a single move. This, I would argue, is the essence of planning and of winning - simply figuring out a way of making those twenty moves before the other guy can do anything. It's doable and it's not a matter of size; it's not a matter of numbers; it's a matter of sitting back and thinking about it and being willing to change the rules, if you will.

TIME VALUE AND WAR

I said before that we're in a very fast moving world. How fast is it moving? Figure 9 illustrates the time value of war. Something which is increasingly true is that the faster I bring key enemy strategic and operational level targets or centres of gravity under attack, the higher is my probability of winning because I have this parallel shock effect when I bring lots of things under attack in a very short period of time. Conversely, if I take a longer time to bring these things under attack, certain inevitabilities of the serial world will reduce the probability of my success. It doesn't mean that you can't win over a long period of time. It simply means that your probability of winning goes down because of all of the adverse things that are certain to happen. The rule then is very simple: it's to make things happen as close to simultaneously as you possibly can.
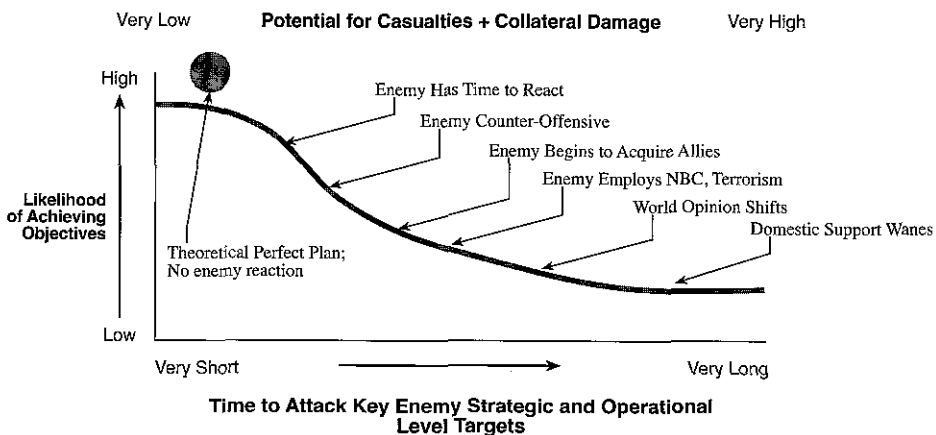
Figure 9.   Time Value of War

Now, a question that might reasonably arise is: how fast do you have to do these things? My thought for the United States, as an example, is that we ought to have the ability to be able to impose strategic and operational paralysis on an Iraq-size state within a maximum of 24 hours from the time of decision, and to do so without any pre-deploying. I would say that's probably a satisfactory time frame for the next four or five years. In six or seven years I'm thinking (and I'm sorry about the second reference to Moore's Law) that it ought to be possible in 12 hours, and then six, and then three. With the options that are increasingly going to be available to people (for example, biological attack) we can simply say that if we don't do things quickly, and if we're not successful quickly, then we're not going to be successful at all. That's not what we want. We want to plan to win.

None of this is exclusive to the military world. In the business world we make the same point (as illustrated in Figure 10). If you want to be successful at introducing a new product, your highest probability of success comes when you keep it to the

minimum amount of time - the time that's required for you to do your research and development, manufacturing, product introduction, marketing and advertising. The faster you do it - the more parallel you make the processes - the more shock you impose on the market and the more likely you are to be successful. The longer you take, more adverse things can happen. There will be more and more reaction by the competition until, finally, you get out to x number of years and your product name will be irrelevant, even if *nothing* else has happened.

NEW PRODUCT INTRODUCTION EXAMPLE
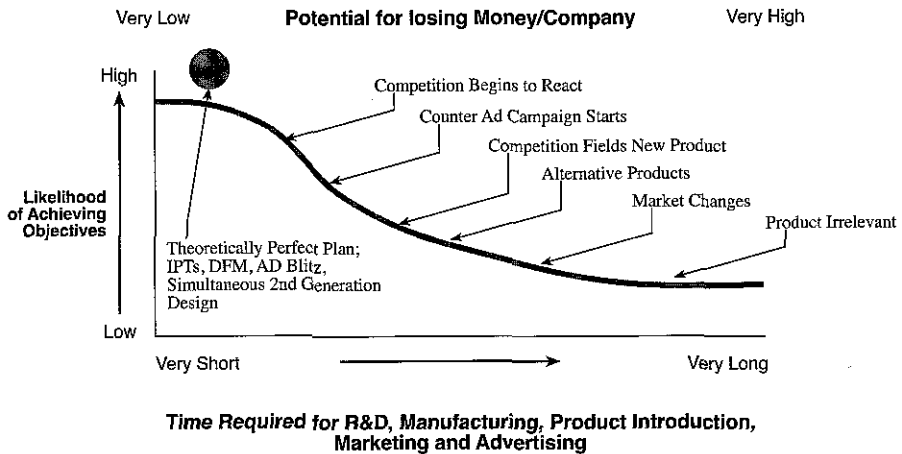
Figure 10. **Time Value in Commerce**

I would argue that, in many ways, this is the kind of problem we have run into in the United States with programs like the B-1, the B-2, probably we're going to run into it with the F-22 and we ran into it with the C-17. By stretching these things out we have allowed our enemies (the opponents of the program), for good reasons in some cases and bad reasons in others, to get enough strength to start making these adverse things happen. Our probability of success in bringing the project out as originally envisioned simply went down, down, down.

So, whether we're talking about a new military system or a new commercial system, we need to make things happen as rapidly as we can. In a theoretically perfect plan things happen quickly. They are probably going to involve IPTs (integrated process teams), DFM (design for manufacturability), advertising blitzes and simultaneous development of a second generation product before the first generation product is even off the drawing board. This is a fast moving world; the world of the computer. Anything associated with the computer world (which is almost *everything* else now) is down to life cycles of months or a few short years at most. We've got to think seriously about how we're going to change the life cycles of weapon systems for the military. I would argue that, in fact, there is a very economical way to do it - to get more power for less money on the technological edge - instead of planning for obsolescence the way that

many of our programs force us to do right now. However, that's a different subject and a different talk.

REORGANISATION

The next idea is this: if we are presented with a new objective, a new situation or a new technology, we simply have got to change our organisation. We have two options. We can try to make the old organisation work or we can create a new organisation. We've seen examples of people trying to do both. I think probably the best example was with the Germans and the French in the 1930s. In a comparison between German technology and French technology for the tank and the aeroplane, the French were probably a little bit ahead of the Germans. The French decided to take the new technology of the aeroplane and the tank and spread it out in the existing organisation. The Germans, on the other hand, recognised that new technologies, new situations and new objectives probably demanded a new organisation. They developed air armies and tank armies and when they applied that new organisation against the French in 1940, the French organisation was simply incapable of dealing with it. It wasn't a matter of individual incompetence on the part of the French soldiers or a lack of technology; it was a matter of organisation.

We have in the military this kind oi organisation. I believe, and somebody can correct me if I'm in error, that we have about 17 layers of command from the four star level down to the basic airman or the private. This is pretty much the same organisation that Frederick the Great had when communications and precision were somewhat different than they are today. I would argue that, for cultural reasons (as previously suggested) and for efficiency reasons, this is simply not an organisation which is viable any longer. It needs to be changed and changed fairly dramatically. Now, exactly what it should change into nobody knows, but it's probably something much flatter. It's probably something that has far fewer walls than we have been accustomed to having - where there's much more contact between people and between things that are *inside* and what we used to think of being *outside* our organisation.

CONCLUSION

I want to finish with this point: it's not your father's air force. I don't care how old you are; it's not your father's air force. It's a different world out there. We really have moved from an old era of attrition warfare - which was an era of very low probability warfare with individual bombs unlikely to hit *anything* - into an era of precision where things are significantly more predictable than they have ever been in the past.

Let me give you another couple of analogies in this regard. We have moved from an era of Newtonian physics to an era where our world is increasingly affected by quantum events. Also, we have moved from the old era of the vacuum tube to the era of the integrated circuit. The transistor and the integrated circuit have simply changed the world. However, the transistor didn't change the world simply because it was a slightly better vacuum tube, or because it was a cheaper vacuum tube. It changed the world because it enabled entirely new concepts of operations: global positioning systems, laptop computers, and a myriad of other things that have changed everything we do and the way we go about doing it.

The point that I'd really like to make in closing is this: that as we get these new technologies - whether they're information technologies, whether they're individual weapon technologies, platforms or whatever - the last thing that we want to do is to try

to use them to do the old B-24 and B-25 missions ten percent better. Ten percent better is simply *uninteresting* in a world where the power of the chip is doubling every 18 months. What *is interesting* is to get results that are 10x, 100x, 1000x greater than anything that we could conceivably have achieved with the old technology or with the old concepts of operation. Increasingly we need to think about reorganising ourselves and creating these new concepts of operation *every* time we end up with some new technology, or *any* new thing (even a new organisation) in order to allow us to get results.

With that I'd like to close and say, again, it's been an enormous pleasure to be with this group. I very much enjoyed the sessions today and I'm looking forward to tomorrow. For everyone on the e-mail, if anybody has any questions that don't get answered here, throw them on and we'll get back to you in an *asynchronous* way.

DISCUSSION

Squadron Leader I. McKenzie: A very quick question: when you don't have an identifiable enemy, how do you actually go about planning to win?

Colonel Warden: We don't need an identifiable enemy if we understand that *any* enemy is going to have some kind of system attributes. Now, I'm not talking about enemies against which we have no intention of ever using any military force; and clearly there are ones of that sort. But if we are envisioning the use of military force it will, by definition, be against an *organisation*. And if it's going to be against an organisation and we understand organisations in general, then we simply put together the kinds of plans that are necessary to deal with organisations in concept, and then when it gets a name we can very rapidly move into putting target names etc. on it.

In reality, that's exactly what we ended up doing with the Iraq situation. Nobody had been spending any time, that I know of at any rate, really looking at Iraq seriously as a system and how to take it apart. The group that I had in the Air Staff had been spending a lot of time thinking about centres of gravity system warfare. So when somebody announced 'Iraq', it was merely a matter of getting out the Iraq map and conceptually imposing the system model over the top of it, and then going through that rapid differentiation process to come up with the *details* of what it was that we wanted to do.

Martin Dunn: Pursuing that issue a bit further: what about the Somali clans or other irregular forces. And what about the strategy from the Iraqi perspective. Did they have a solution? Was there an asymmetrical challenge of some sort which was viable? Or did *they* need an Air Force that could strike US system targets quickly and early?

Colonel Warden: You have two or three very interesting questions there. Let me take them in reverse order. Iraq - Iraq made a couple of errors. Although, we have to realise that Saddam Hussein got awfully close to being successful with the invasion of Kuwait and keeping it. Remember that there was only one vote in the United States Senate that stood between him being in Kuwait today and him not being in Kuwait today. So it was a real risk. What he had to do was to approach the problem, I would argue, from a

systems stand point; he had to understand the United States as a system. He had to understand that he could not take it on symmetrically, and his asymmetric approach basically had to be one in which he did whatever was necessary to convince the United States not to go to war. Now, let me give you a sort of a trivial example of one way he might have approached it. If, in June of 1990, he had sent one of his trusted operatives to Madison Avenue in New York with a good cheque from a Swiss bank for a billion dollars and that guy had walked down the street saying, 'I'm looking for a good ad agency that would like to convince the American people that the Iraqis ought to own Kuwait and that Saddam Hussein is a good guy - anybody interested?' This guy would have been overwhelmed. Somebody would have grabbed that cheque and I'll guarantee you that they could have conducted a campaign that would have changed at least one vote in the United States Senate. Using that asymmetrical approach he would have been successful.

OK, back to the Somali thing. Frequently people say, well this stuff is only good against a big power like Iraq. Now, for everything that's out there - Somalis or whatever they happen to be - there is organisation. Now it may not be a single Somali organisation - there might be multiple clans - but those clans are defined in the same way we were describing. You bring pressure of one sort or another (positive or negative) against centres of gravity in order to change some or all of those clans to the point where you are going to achieve what it is you're intending to achieve.

Now, the last point that I would make on that is that, if we were forced to use military weapons against those people, would you rather have a real high tech, very precise and perhaps non-lethal or minimally lethal approach (depending on the terminology you want to use) that's delivered from the air with only a handful of people, or would you rather send some people into down town Somalia - your own Army, the Australian Army, the United States Army - to fight hand to hand through Mogadishu? I think the answer is pretty clear.

Squadron Leader D.G. Millar: You said aircraft would have to have three year turn cycles. Is it not the avionics and the weapon system that form the critical path? I would put it to you that if we'd had B-17s and AGM-142 with Data Link pods we could have had quite a different outcome in Germany.

Colonel Warden: This is an interesting question and, of course, the argument for an aeroplane that's going to last 50 years is frequently based on whether we'll simply change the weaponry as we go into that 50 year period. But what I would argue is that, as soon as you have established the outward appearance of the aeroplane, you have also (in rough terms anyway) identified the radar and visual cross section of the machine, and you have also within fairly narrow limits established its speed and its altitude. In other words then, what you are doing is giving people 50 years to figure out how to deal with an aeroplane that's going to work in a defined particular environment. What I would argue is that that might have been OK for sailing ship design in 1650, but it's not appropriate for aircraft design in 2000, because we know that the technology to deal with aeroplanes and space things operating in a particular environment is going to develop significantly. So what we would like to do is not curse ourselves with aeroplanes, or space things or unmanned air vehicles that are going to be with us for 50 years. Instead, we would like to have smaller numbers of very high productivity things that don't cost the same as a large number of aeroplanes, so that we can continually be

bringing fresh technology into our force and have something new out there on a fairly frequent basis. I would argue that, in fact, this is a significantly cheaper and significantly better approach than the old industrial age approach with which most of us are still dealing.

Dr Graeme Cheeseman: You mentioned at the beginning, I think, that there are three revolutions, the third being a geopolitical revolution. You didn't talk about that and perhaps you might briefly do so. The second aspect of my question is that, I can see the logic of the model in terms of when we're faced with a conflict, and the task of bringing a conflict to a halt very quickly, but what about an absence of conflict circumstance? Is not the logic of this model very similar to the flaws that operated for *extended deterrence* - that essentially what you're building up is a capacity for a first strike, an overwhelming first strike, against someone else in the event that there is a conflict. In a sense, if that occurs, the strategy to win, means you lose (or *could* lose unless you're the United States). If you're up against someone else, then you could end up *precipitating* a conflict. So, is it reasonable to build up this kind of model in a non-conflictual circumstance? Isn't this a recipe for arms racing and, with other people watching what you're doing, for a repeat of some of the old problems of the Cold War?

Colonel Warden: That's a very complex question and I'd like to take about an hour to answer it. Let me see if I can do it in 30 seconds. I think that with the march of technology the potential is there for someone else to do exactly what I'm talking about, and there's nothing whatsoever we can do to stop it. What I would argue is that to us, the people in this room - and I think 100 percent of us see a *good* future as one being based in stability and one that's not interfered with by somebody bent on destabilisation - it's better that we've *got* this capability than to stand by and just hope that somebody else doesn't develop something that could do some serious damage to us. So, on the one hand I don't think that it does necessarily generate an arms race. On the other hand, if it does, then sorry about that but it may be the world we live in - if that's the world then we have simply got to go for it.

Your original question was about the third revolution which I didn't address in detail - the geopolitical revolution. Again, without going into a lot of detail on that, what I basically think is that we are in a period that is absent great power competition, and that we are going into a period of general global stability that has the potential to last several hundred years if we manage it correctly, but that that global stability does not mean there will be no local disturbances - some thunder storms such as another Rwanda or the like. The global environment in this geopolitical revolution has become so basically stable that situations like five years of pretty nasty conflict in Bosnia have had no serious impact on the world system. Just some 70 years ago a relatively minor guy got shot in Sarajevo and it plunged the whole world into war. That's the essence of my view on the geopolitical revolution.

Wing Commander J.D. Thynne: Information is available at a rate that perhaps exceeds the ability of a single commander to absorb. How do we make sure that all the *right* information gets to the commander, if we're planning to win?

Colonel Warden: Human beings are extraordinarily good at seeing changes in patterns; they're extraordinarily terrible at seeing changes in detail. So, if you give somebody a

very complex financial spreadsheet and say, 'Find the anomalies in the spreadsheet', they might look at it all day long and not see anything. On the other hand, if you plot it into a graphical representation where you've got some contours and hills and valleys, somebody will be able to look at it and say, 'There's an anomaly right there'. I think the essence of the answer is - and this is easy for me to say, I'm not a mathematician - more and more driving towards presentation of information in patterns so that it can be understood. It's the anomalies in the pattern which are of interest, not all of the information which is not anomalous.

Group Captain S. Peach: As a European I don't wish to leap to the defence of Clausewitz. But, of course, if you accept, Colonel, that war is a continuation of politics by other means, then how do we get that *very rapid* planning to win into reality? To continue with the previous question, how do we get through the inter-agency process to get the political decision making to react quickly enough to concentrate the force we need?

Colonel Warden: Historically, governments - even aggressive governments - have been reluctant to go to war, and it always takes a good deal of time before they make a decision. This, in general, is *good* because wars in the past have been pretty nasty things and a lot of people get hurt. I believe (and I recognise that this may really be 'testing the limits' with a military group) that we need to stop thinking about war as, necessarily, a bloody and destructive thing. In the past they have been, simply because that was the only way you could do the job. What I would maintain now is that there is a potential to think about simply changing the energy level of an opponent and doing it in a way which does not involve a lot of casualties, on either side. And maybe not only in such a way as to avoid many casualties, but in fact, also in a way which may be reversible. I think that that comes through really driving down into the production of these weapons that have precision of effect, or as *I* still call them (imperfectly perhaps), non-lethal weapons.

Now what's the relevance of this to your question? Suppose somebody could have gone to President Bush in the end of July of 1990 and said, 'Mr President, we're fairly sure that the Iraqis are going to attack into Kuwait, but we're not certain. We think you ought to pre-empt'. Given the tools that were available to President Bush at that time, he would have said, 'I can't do it and it's too dangerous; I'm not going to do it'. On the other hand, had he had available to him a series of weapons with precision of effect - non-lethal weapons - which could have, let's say for simplicity, done nothing more than incapacitate the tanks of the Iraqi Army, I believe that he would have been *very* willing to go ahead. This is because he could have done so without significant risk to his own forces and, of almost equal importance, without doing things to the other guy that were bloody and would have been seen as intolerable acts of aggression. So, this is about new technology and new concepts of operation. Weapons that have precision of effect - non-lethal weapons - ought to drive us not only to new *military* concepts, but they ought to enable or drive us to entirely new *political* concepts of operation as well.

Wing Commander N. Tesch: My question perhaps relates to an earlier statement you made which was that one of the revolutions was due to the amount of information that's available, and that that revolution was that commanders can now better view the battlefield. I would like to suggest that perhaps the information that is now available

takes us back to how the battlefield was viewed before. Even if we look at Napoleonic times and back to Caesar, the picture I have is that the commander stood over the battlefield and *had* the information. And in fact what's happened is that, with the improvement in *military* technology, it is only now that *information* technology has caught up so that the view is again now available to the commander. Perhaps you could comment on the idea that it's only a cycle that's repeated itself and not a revolution in military technology.

Colonel Warden: I think that the concept of what you're saying is more than interesting. But I would have to take issue with it and would have to say that the battlefield has always been a place of huge uncertainty - and, in fact, our friend Clausewitz wrote about the 'fog' and the 'friction' of war. When you think about it, even as great fellow as Alexander sat on his horse and looked out into battle, wherever other guys were sitting on horses he wouldn't have been able to see what was on the other side of them. It was only very rarely that a commander could get himself up on top and have a genuine view of what was going on.

      I'm not sure that it's so important that we have a precise view of the battlefield today. But rather I think it's important that we have a very good understanding of the system that we are trying to affect. And, in fact, I would take that one step further and say that, as we are trying to think about the future we need to start redefining some of our vocabulary. We may even wish to redefine the use of 'battle' (or 'battlefield') because this is really a sub-optimising concept that may simply not be particularly applicable or relevant in today's world. It drives you towards a sub-optimal focus, taking away the ability to focus at a larger level where the same input of energy can have a significantly larger effect in leading you to where you want to go.

FUTURE OF AIR POWER - A EUROPEAN PERSPECTIVE

AIR CHIEF MARSHAL SIR JOHN ALLISON

I have been asked to give you a European perspective on the future of air power. However, I hope you appreciate that what I shall offer is *a* European perspective because it would be incorrect of me to speak on behalf of other European partners other than in the broadest of terms. Also it is inevitable that my comments will reflect my current perspectives as the commander of the operational arm of the Royal Air Force.

In addressing this subject, the starting point must be that the security environment in Europe has changed dramatically since the military certainties of the Cold War era. Prior to 1989 the operational environment could be best described as 'fortress Europe'. Our forces were positioned for forward defence; we had a clear and in-depth understanding of the threat; and we were poised to counter Warsaw Pact (WP) aggression with massive conventional and, if necessary, nuclear force. We were equipped and stocked to operate from home bases with hardened facilities to enhance survivability. The air environment in the anticipated area of operations was extremely hostile, with a vast and densely populated array of threat systems. Our task was to conduct operations at maximum rates of effort and to deliver a maximum weight of ordnance against opposing forces. Targeting, therefore, was a comparatively blunt instrument and political constraints were limited.

Of course all that has changed dramatically and our new roles demand, not just the defence of the UK and the support of NATO, but rapid and flexible force projection to protect British interests and promote stability worldwide.

We also find ourselves operating in what I like to call a 'minimalist environment'. To start with, we now have *minimal funding* with a defence budget set at just under 2.8 percent of GDP, the lowest share since the mid 1930s. Indeed, since 1990 the UK's defence budget has fallen in real terms by 22 percent and the present trend in defence spending is certainly not upwards. If we consider the defence expenditure of the UK, France, Germany, Greece, Italy, Spain, and Turkey as a whole, it still amounts to less than two-thirds of the US expenditure. To take another grouping, the 'five power' nations, their total expenditure comprises less than 20 percent of the US.

The deduction is obvious. Certainly no European nation (and I venture to suggest no nation on the planet other than the USA) has the requisite combinations of economic muscle and political will to field armed forces that can exploit the full range of war-fighting capabilities that technology can now offer. Thus only the USAF can speak realistically of 'full spectrum dominance'. The rest of us do what we can. Thus the theme of my talk is the rather prosaic one of what small to medium sized air forces, such as you find in Europe, can expect to do in the future; and I shall resist any esoteric flights of fancy as to what we might do if only we had the resources.

Coming back to the UK (and returning to my minimalist point) we now have *minimal force levels*, accurately sized to meet Defence Planning Objectives. The strength of the UK's armed forces has reduced by 32 percent since the Cold War. In

1990 the RAF had a front-line strength of 27 fast jet combat squadrons, of which 12 were based in Germany. The total figure has now fallen to 20 squadrons, and none will be based in Germany after 2002. To preserve these remaining forces in combat we must *minimise our attrition* and ensure that every mission counts against the achievement of our military and political goals; a theory which I believe the USAF refers to as 'strategy to task'. Political imperatives and public concerns also demand that we *minimise casualties* amongst both civilians and our own troops. Finally, we are expected to apply force with precision to *minimise collateral damage*. The latter two factors are or course critical if we are to avoid fuelling the 'CNN factor'.

In essence we are being asked to do more with less and we have to choose what we can and cannot do and who we do it with. The challenge of these rapid changes has been considerable.

A paradox of the Cold War was that most of our Armed Forces were not actually engaged in operations. Their main role was to deter all-out war in Europe. Since 1990, however, they have been committed to a series of actual missions, of varying size, duration, and intensity. The main examples are well known: the Gulf conflict and Bosnia. Yet, in addition, the UK has conducted a range of smaller but still significant missions outside the European theatre.

Of course, the Cold War's heritage has left us with many legacy systems, be they equipment or procedures, which are not necessarily suited to the new challenges which we face. For example, the Tornado GR. Mk 1 was optimised for low level, all weather offensive operations in the European theatre. One of the primary roles of the Tornado GR. Mk 1 was to attack WP airfields with the JP233 runway cratering and area denial weapon system. This weapon was optimised to be effective against known WP runway construction characteristics. However, when used during the Gulf War, analysis showed that the effects against Iraqi runways (built to quite different criteria) were disappointing.

The moral is again obvious. All our systems and weapons must be as multi-role and flexible as possible, and deployable and employable world-wide. Over time this is achievable through the forward equipment program, but in the meantime we have had to adapt equipment that was in many cases point-designed for specific Cold War tasks.

You may also recall that during the Gulf War we initially operated at low altitude partly because the aircraft was optimised for that environment, and partly because our weapons demanded overflight of our targets. Once air superiority had been established we were able to move to medium altitude to deliver precision guided munitions with devastating effect. This change of tactics did not signal a failure of our low level *modus operandi* but it did herald the start of our adaptation of Cold War legacy systems, tactics and procedures to match today's more diverse operating environments.

Current security challenges, with their broad span of risks, pose major questions to medium sized and smaller air forces as to how best to use air power to achieve political and military aims. Clearly, in a minimalist environment we cannot do everything. Therefore, we must choose carefully where to focus our effort and resources to achieve optimum effect.

In other than exceptional circumstances (and the Falkland Islands springs to mind) the UK is unlikely to go it alone. Coalition or combined operations are therefore the preferred option for sound operational and practical reasons, and I think it is fair to assume that this applies to many, if not all, European nations. NATO was of course the

bedrock of our defensive posture during the Cold War period and, following adaptation and re-orientation, the alliance still forms the same function. However, we are beginning to see a willingness for NATO to become involved outside its traditional area of operations, and it is clear that we must be prepared to operate as part of a coalition comprising both NATO and non-NATO nations.

It is perhaps reasonable to assume that the majority of coalition activity would be led by the United States, but Europe is gradually developing the capability to form coalitions from within and the RAF must be prepared to play its full part, and indeed take the lead, in a European coalition if necessary.

This background poses a number of key questions when considering how best to develop the RAF's operational capability.

First, *what* may we be asked to do? It is easy to say that we must be prepared to participate in the full spectrum of air operations from peace support to armed conflict. Thus we must train and equip ourselves accordingly. We are clear that if we can cope with the aggressive end of the scale then we should be able, with suitable training, to modify our activities to service less intense operations. On the other hand, it is these lower scale operations which frequently place considerable demands in terms of their duration and, perhaps, concurrency.

For example, we have been policing the northern no-fly zone in Iraq since September 1991 and the southern no-fly zone since September 1992, and these operations have been running concurrently with our efforts in Bosnia which commenced in June 1992. Cumulatively, over the last six years, the RAF has amassed some 100 000 flying hours on these three operations alone. There is currently no foreseeable end to these or any other of our operational commitments.

Second, *where* might we be expected to conduct our operations? The chances are it will be at some distance from the United Kingdom or Central Europe. Therefore, deployability and sustainability are high on the list of priorities, reflected in the objectives of the current defence review.

The third question is warning time. Assumptions on readiness states, which are linked to both scale of effort and concurrency of operations, is another subject which has been attracting particular attention in the UK. Maintaining forces at high readiness is of course expensive and demanding. We therefore need to ensure that we have the right forces at the right levels of readiness for the security environment - and the ability to change readiness levels if that environment changes.

Strike Command maintains forces at comparatively short readiness states for potential deployment as part of a national expeditionary Joint Rapid Reaction Force or NATO's Rapid Reaction Force. The trick is to get the balance right between holding a viable operational posture for immediate use, and maintaining the overall preparedness of our forces at a credible level. This could lead to a two tier air force with all its ramifications for morale and operational capability - a situation we would wish to avoid (and in that we have so far been successful).

Finally, *who* might we be operating with? Without doubt the United States has the military power and political will to go it alone in most circumstances and, indeed, as I suggested earlier, it is the only nation on Earth that can think in terms of *full spectrum dominance*. But the impact and value of the involvement of a willing coalition partner (or partners) in political terms cannot be underestimated. In some circumstances it may be that US forces will have to operate at a sub-optimal level in order to gain the benefit of allied participation. Moreover, to make a coalition effective, they will need to

exercise their wisdom and generosity in the sharing of capabilities and, in particular, information.

To take but one example: the ubiquity of space systems. Military activity is now almost unthinkable without the exploitation of space-based systems for surveillance, navigation and targeting. Of the 35 satellite channels used by NATO in Bosnia, 33 are US owned. Any air force that wishes to be taken seriously needs as a minimum to be able to connect with space-based systems. But extended exploitation of space could prove to be beyond the means of most European nations. However, America's allies should be able to continue to offer useful niche capabilities in return for access to their space systems. For example, the RAF has retained and developed a good mix of manned tactical 'recce' aircraft with state of the art sensors, whereas the USAF has largely moved on from this approach and our 'tac recce' assets have proved most valuable in recent crises.

The danger, of course, is that unlike the NATO alliance, which had a clearly defined threat to counter, coalitions tend to be rather fragile and the integrity of such forces forms an obvious centre of gravity for an opponent to undermine, thereby weakening international resolve to support the cause. We cannot afford to disregard this point.

While on the subject of weak points, developed societies are becoming accustomed to a safe and comfortable world. In Europe we even have legislation, such as the Health and Safety at Work Act, which engenders the idea that life should be risk-free. This is certainly not the mind-set of the warrior, and the Armed Forces have the problem of sustaining a warrior culture against a background of increasingly divergent values. Developed societies are now very squeamish about casualties. At the military level this is now a policy driver and, at the political level, it can lead quickly to defeat via the media. This factor makes air power a preferred tool, not only because it can shape the operational environment (as in the Gulf War) to yield a virtually bloodless victory on the ground, but also because in so doing only a limited number of our own combatants are put at risk. We are now seeing the beginning of a debate as to whether the ever-increasing application of social and employment laws has the potential to eventually undermine the ethos and military effectiveness of our Armed Forces.

To return to my theme, I would now like to look at the key drivers which, in my view, underpin the utility and effectiveness of coalition operations.

To be effective, coalition partners must develop doctrine at the operational and tactical levels of warfare which is compatible with, but not necessarily identical to, that of other nations. A common approach to C2 (command and control) is essential to the optimisation of planning and execution to ensure that every sortie counts towards achieving the objective. Like many other nations, the UK has embraced the JFACC concept as the fundamental architecture to execute it. From a UK perspective we are well advanced in our efforts to establish a C2 structure with approved joint doctrine on the JFACC concept, training for our potential component commanders and their battle staffs, and an operational CAOC equipped with mission planning systems which are compatible with both NATO and US systems - that is, CTAPS (Contingency Theatre Automated Planning System) and ICCS (Integrated Command and Control System).

The point is, that where regional organisations exist, we can exploit existing C2 structures to plan and execute campaigns. However, if such regional structures do not exist we need to avoid *ad hoc* arrangements wherever and whenever possible by exploiting our proven doctrine and C2 structures.

The next step is to engage with our most likely coalition partners to breed understanding, cooperation, and mutual respect at all levels. It is inconceivable that a coalition force could be fully effective if the first time that the member nations make contact is in the theatre of operations.

Interoperability is more than having the same (or even interconnectable) kit. It is about culture, language, methods, trust and mutual confidence. NATO has been working at such togetherness for 50 years and the approach is to train together in representative and realistic scenarios. This was bread and butter activity for NATO forces during the Cold War and this we continue to put great store by our training. We have a cascade of major exercises to test the CJTF concept and embrace new members and partners. The tactical leadership program, born in the 70s to bolster Cold War interoperability, remains a 'jewel in the crown' of NATO's training program. We have invested in computer-assisted war games, command post exercises and military education programs. We also believe in maintaining and, where we can, extending meaningful exchange programs for key people, not just aircrews.

In the UK we have cast aside our historical baggage and created a Joint Services Command and Staff College with no fewer than 90 overseas students from all over the globe. At the higher level, we have the Joint Higher Command and Staff Course; increasingly a pre-requisite for anyone going to a high level command or staff appointment. And as I have said, within my own command, we have developed a JFACC course which is now being expanded to encompass all three services, our friends and allies.

I have rather got off my theme of coalition operations. Once deployed, it is vital that coalition forces have both tactical and technical connectivity to ensure that they can operate collectively as part of 'Composite Air Operations' (or COMAOs).

I recall that during the Gulf War the RAF had to acquire, at short notice, Mk 12 IFF and *Have Quick* jam resistant radios to allow our forces to integrate into the composite air campaign. My concern is that our primary coalition partner, the United States, now exploits technology beyond the reach of others who are being left behind and increasingly lack key enablers for coalition operations. Looking to the future, it is looking more and more likely that the minimum entry ticket for a seat at the table will be compatibility of mission planning equipment and procedures plus possession of JTIDS equipped air platforms. We must ensure that we do not allow technological barriers to develop which will inhibit collective action.

While on the subject of constraints, we often hear commentary on the limitations of air power regarding the need for forward basing to support expeditionary operations. I would not disagree that acquiring host nation support is a difficult and often time consuming problem. However, I would also suggest that if we are unable to gain access to airfields and some degree of host nation support within a realistic air refuelled radius of action (say 600 to 800 miles) then we must seriously ask ourselves whether our presence and involvement in the region is wanted or warranted.

Our dark blue colleagues are keen to point out our reliance upon forward basing and offer up carrier based air as an alternative. They have a point, but that is only part of the picture as we will still need bases for our tankers and other support aircraft, and we must have the requisite penetration to reach an opponent's centre of gravity.

Coalition operations entail risks for air power as well as opportunities. We saw this in Bosnia in the frustrating years prior to the highly successful Operation Deliberate Force in 1995, up to which time air power looked impotent because it lacked clear

unified direction and it was used sporadically and ineffectually. From this we can see that it doesn't matter how good, how comprehensive, or how overwhelming the technology; for it to be effective the human decision on its employment must be clear and correct.

I hesitate to offer to so erudite an audience a summary of the self-evident prerequisites for the effective employment of air power, but I will do so anyway because events continue to indicate that the lessons are all too easily ignored in the heat of the moment. The guiding principles are that there must be:

- a clear mandate,
- a defined strategic end state,
- clear national guidance,
- proper resources to match strategy to task,
- a clear exit strategy, and
- an unambiguous coalition command structure.

So far I have banged on rather about working together in coalitions (I intended to) but I want to turn now to something I alluded to at the outset - the technology choices and strategies facing nations of modest means.

One obvious approach to procurement is that of new wine in old bottles. Much of the cleverness, and the inherent operational capability, of air systems now lies in the software. Airframe and engine development, while not entirely on a plateau, is certainly not rampant in the same way as progress in computers, sensors and communication equipment. Thus it is possible to keep an aging airframe operationally viable by updating its mission systems. We see this trend the world over. For example, the Israelis have given their ex-Romanian MiG-21 fleet a useful upgrade with fitment of a modern INAS, a HUD and a weapon control system compatible with modern missiles. In the UK, we still run one squadron of Canberras in the strategic reconnaissance role. As an aircraft, the design will have seen 50 years of continuous front line service next year, but the sensors are state of the art and the aircraft was used to excellent effect during recent operations in Zaire. I understand that the USAF has contemplated an even longer run-on for its remaining B-52s and, of course, Australia is running on an F-111 fleet. Software, sensor and missile development can also be used to overcome inherent airframe limitations. Take the Tornado. It is a fine *offensive* aircraft - the role for which its design was optimised - but it is no secret that, as a fighter, the F3 variant has considerable limitations of turning performance and of specific excess power other than at low level. To correct this, we have steadily developed the weapons system - radar, missiles and defensive aids - to a level sufficient to offset airframe performance constraints, and the aircraft now achieves highly credible results in dissimilar air combat training with our allies.

But our equipment is only as good as the people who operate it. Which brings me to the person in the cockpit, a subject which a senior military pilot such as myself simply cannot duck in an address such as this.

First, there is no doubt that technology now promises to create an air environment which is increasingly hostile to humans, owing to the manoeuvre demands for survival and other objectionable factors such as eye damage lasers.

This is a particular problem for medium sized and smaller air forces because one of the ways the RAF and others have sought to compensate for lack of technological

edge has been through attention to selection, training and ethos, with the aim of yielding an aircrew community of exceptional quality. The second problem is that we are most unlikely ever to be able to afford the generations of remote-controlled UCAVs (Uninhabited Combat Aerial Vehicles) and their essential world-wide C2 systems now being presaged by the current generation of UAVs. Indeed, we do not even possess that first enabling step. However, the technological problems yet to be overcome before UCAVs can undertake the more demanding tasks such as air fighting and deep attack suggest that, even for the USAF, manned fighting aircraft will be around for a long time to come. As for other nations, the proliferation of fielded equipment will be slow indeed, and if the US is the only nation possessed of such automated capabilities, why should her long-term friends and allies feel threatened?

Another area where no nation other than the US has made other than half-hearted investment is *stealth*. Lacking the prerequisite of all-out stealth to defeat modern surface-to-air defences, and lacking also a fleet of UCAVs, the only other obvious method of enhancing survivability is to use stand-off weapons. Indeed this could prove to be the most affordable development path beyond the next generation of offensive aircraft for European air forces.

Survivability (of people *and* machines) is obviously of particular importance to smaller air forces. The obverse of survivability is destructive power and equipment must be optimised for the best ratio of the latter to the former. JTIDS, I suggest, has transformed the potential for in-cockpit management, employment and coordination of tactical formations, and for enhancing situation awareness. In terms of putting BVR information directly into the cockpit, it is at least as significant a step as was the invention of AI radar. Not only does such technology confer a 'seat at the coalition table' but it also acts as a force multiplier and a force protector - both vital considerations for air forces of moderate size. It is such consideration that will influence future investment decisions.

We are tending to get rather hooked on soft kill techniques and even non-lethal weapons. These techniques do have tactical utility and humanitarian attractiveness. But ultimately warfare is about attrition. A famous quote, attributed I believe to Ron Fogelman, said it best: 'We drop bombs. We kill people and break their stuff'. Denial and disruption operations, designed to impose temporary inconvenience on the enemy may have short term tactical utility but, if carried out repetitively at high risk of loss of one's own equipment, they are unlikely to yield a favourable exchange ratio of attrition. Once combat is joined, the side which has the most efficient and sustainable ability to inflict casualties and damage will win. Returning to my minimalist theme, this is a key issue for smaller air forces. Every mission must count, and in targeting the risk/benefit equation must be carefully weighed.

I have one last point about future technologies. Not all the advantages always lie with the high-tech protagonist. We saw, with the American experience in Vietnam and the Russian experience in Afghanistan, how a less well equipped but determined and united society that was prepared to soak up casualties could endure and inflict attrition upon a much more sophisticated force. In the Gulf War we saw the political leverage exerted by the Iraqi Scuds - a weapon hardly more sophisticated than Hitler's V2.

The only truly satisfactory defence against such weapons with their potential for delivery of chemical or biological agents (apart from pre-emptive attacks) is to destroy them in the launch phase or at the apogee - yet, again, only the USA can afford such an investment. In Europe, we just study the problem! An unsophisticated force may also

hold other societies at risk through guerrilla warfare and urban terrorism. Why bother, therefore, with the acquisition of missiles and delivery systems? In short, countries that cannot play the high tech game still have some cards to play. The power of unsophisticated attacks was demonstrated graphically when sarin gas was released in the Tokyo underground, and the point was reinforced recently by scare stories in the UK press about rumours that Saddam Hussein might be planning to release anthrax in countries he regards as unfriendly.

What I am suggesting is that technology is not the answer to everything. Indeed, deployment of the full panoply of air capabilities will not always be appropriate or even beneficial. To take an extreme example, whither *information warfare* against an enemy who passes orders by word of mouth? Lower scale operations, such as peace intervention or non-combatant evacuation, can often be effected by the judicious flexible and limited application of military capabilities, and here small air forces can have much to offer in their own right.

To conclude, I fear I may not have been sufficiently daring and I may have fallen short of the injunction to 'challenge conventional thinking and institutional comfort'. What I have tried to offer, however, is a European perspective on the way ahead for air operations which is founded in the practical realities - drawn from experience of coalition operations - and a more restrained view of our means to exploit technology and the means of others to circumvent it. If you agree that there are real limits (especially of resources) in these areas, then I hope you will agree that I have attempted to test them.

DISCUSSION

Squadron Leader B. Anderson: Coming back to your point about the potential for the formation of a European-specific coalition and noting the disparate political will between the UK and France on the recent plan for strikes in Iraq, do you see additional challenges for such a coalition in the larger bureaucracy of Europe whilst trying to maintain the initiative?

Sir John Allison: I don't see any immediate prospects of a coalition of any particular sort, obviously because it depends on the circumstances. What I was referring to were movements to strengthen the Western European Union in various ways, and the formation of the Franco British Euro Air Group which was very much designed to put combined air capabilities further on the map in Europe and to exploit new mutuality in procedures and capabilities. I don't anticipate, at present, that there will be a European interest without there being an American interest as well. But nevertheless, there are little strands within Europe that suggest a will and a determination at least to try and strengthen our defence identity and that was the only point of the reference.

Dr Alan Stephens: Your point about the Royal Air Force identifying a niche market for its tactical strike jets leads me to suggest that the logical extension of that is that air forces, as we've known them for 70 years, are not going to exist in 20 years time. I'd like you to speculate on what happens when your niche market either doesn't exist or conditions continue to remain very difficult for small and medium size air forces.

Sir John Allison: I didn't refer to that niche capability - and tactical reconnaissance was my example - in the sense that we retained it or developed it because we perceived it as a niche capability; quite the opposite. We've actually retained that capability across all our offensive fast jet aircraft, in one guise or another, because that was the kind of reconnaissance that we could do and we perceived the value of. The fact that it happened to produce quite a useful fit within coalitions was a spin-off that wasn't designed in. It was simply that we had a capability that was useful. We have tried (and I'm talking about the Royal Air Force now) to maintain an overall balanced Air Force which covers the spectrum of air power capabilities: airborne early warning, air-to-air refuelling, strategic transport, tactical transport, support helicopters, maritime patrol etc. We are involved in most roles in one guise or another, and that remains our objective as long as the resources permit, rather than trying to design specifically for fit with other nations. It's very tough to speculate way into the future, but as resources get tighter and we're occasionally faced with force restructuring and the question of whether we should drop a role, we're always most reluctant to do so. It's an uncertain world. You never know what's around the corner and for as long as we are able to keep a role going, even in quite a modest way, we try to do so. Multi-roling of aircraft is obviously a tremendously important way ahead for us, and I suggest this is so for all small air forces. I mean, don't have tankers, have tanker transports for example. That is the way to maintain a broad spectrum of capabilities, by having multi-role platforms.

Flight Lieutenant C. Ward: You alluded to some social or human rights based legislation impacting on maintaining a warrior ethos in the United Kingdom. Would you comment or give us a couple of examples on that please?

Sir John Allison: I'll give you two examples. One is the Health and Safety at Work Act which now produces so many constraints (expensive constraints too, on the design of things and what people are allowed to do) that, at least theoretically for example, if somebody's invited to do work more than six feet up in the air, they could refuse, or we have to build in safety nets and other precautions at great expense in order to allow them to do that work. Now, you could say in one sense that's all very laudable. But on the other hand, if you're not prepared to do something so simple as climb a ladder more than six feet, then you're probably a pretty risk averse sort of person and that's not the ethos that one is looking for in people who are expected to go to war, or to go into operational situations.

Similarly, difficulties arise in terms of social legislation: the application of law on equal opportunities for example. I make no complaint about that, but in the anxiety to ensure that this is reinforced, alternative routes by which people can complain or draw things to the attention of authority are provided - that is, alternative routes other than the ·command chain.

Now both these things weaken the ability of commanders to give orders and expect them to be obeyed, and they weaken the essential confidence of those under command in their commanders because they postulate that there should be alternative methods for getting things put right. I would advocate that neither of those things is good when it comes to the need to command people to do things in battle.

Air Marshal Fisher: Another issue not completely unrelated to your last remarks concerns the employment of civilians in an area of operations; and what I'm alluding to here are contractors. There has been considerable discussion on this matter in Australia. How far forward do you take contractors in a contingency?

Sir John Allison: Our basic premise is that we will not rely on contractor support in deployed operations. We've done our manpower planning on the calculation of the requirements for maximum contemporaneous deployed operations and we sized our armed forces to meet that deployed support requirement, with the ability to do *roulement* as well - to rotate people to meet that maximum anticipated load.

There are, nevertheless, examples of a contractor's personnel being employed in theatre. It certainly happened in the Gulf War because there were already contracted personnel in theatre. There are also examples which go way back in history to where dockyard personnel were used on naval ships (and still are for all I know) during the ship's work up and quite often into combat, and that was really part of their employment. So, it is by no means unprecedented that civilian contractors are involved in a theatre of operations. Indeed, we recently sent specialist personnel out to support newly fielded equipment in the Gulf. These people were volunteers, they knew what they were getting into and they were very well paid for it. But the point is, in terms of our planning, we should not *rely* on such arrangements because there's no capability to *order* people to do that sort of thing. If on the other hand somebody has taken, as we say, 'the Queen's shilling', then you *can* rely on it because (and this comes back to my other point) you can still give orders.

Squadron Leader I. McKenzie: You alluded to the fact that we're all working under shrinking resources. You also said that we need to work towards maintaining interoperability. My question is: in a country such as Australia where our force development processes are based on our own defence and structuring our defence force to suit *our* needs, how much should the drive to maintain interoperability affect the desire to actually satisfy our own requirements?

In the European context, you were recently able to adapt current aircraft that were for use in Europe to operations in the desert. However, when you start to move towards your next acquisition of aircraft, or your replacement aircraft, that may in fact be more suited to operating purely in Europe and Europe alone, how do you maintain that interoperability? In other words, how do you maintain your own focus while satisfying the interoperability question?

Sir John Allison: Increasingly our focus is now on interoperability and on multi-roling and the multi-applicability of aircraft. As I said in my talk, our aircraft and air systems have to be employable worldwide in coalitions, or *go it alone*, but they have to be able to be used in a whole variety of ways and situations. To acquire systems that have very narrow limitations is simply not an option in my view for a nation of modest means. Therefore, I would argue that to have systems that are inherently interoperable with those of obvious potential allies is a basic requirement. If you have specific key national needs - presumably for defence of the homeland - then that obviously is a fundamental requirement. However, I would not have thought in most cases that would prevent the systems involved being also capable of being used with allies in coalitions. You simply can't afford, from a modest budget, too much *national only* equipment.

TESTING THE LIMITS -
ALTERNATIVE PERSPECTIVES

ANDREW BUTFOY

INTRODUCTION

As you all know, the theme of this gathering is pushing the boundaries on thinking in national security, with a focus on challenging both conventional wisdom and institutional comfort. I have read this as an open, and refreshing invitation to both act as a devil's advocate and to work through some key defence-related issues from first principles.

I have opted to attempt this challenge by reflecting on two interconnected dimensions of Western strategic debate. The first of these concerns military means - particularly the putative value of the 'Revolution in Military Affairs' (RMA).[1] The second dimension is military missions - especially concerning world order rationales for military operations.

At heart this paper is an exploration of some of the problems and pitfalls that can result from over-emphasising high technology in the formulation of national security policy. Central to my paper is the argument that this topic needs to understood in terms of broad issues of international politics - rather than simply in terms of the evolution of military science. This, in turn, suggests that the sort of exploration undertaken here requires the illumination of the often unstated and taken-for-granted assumptions which seem to be common in Western defence and security analyses.

Before I continue with this theme, it may be useful to spell-out two things that the paper does *not* do. First, I will not consider the idea of 'cyberwar' aimed at disabling civilian infrastructure through such things as computer viruses and the bloodless sabotaging of data management.

Second, the paper does not assess the technical claims (and associated costings) of particular weapons-related technologies. Such a task is beyond my area of competence as a political scientist.

The approach I adopt here is to generally assume that technology can work 'as advertised'. Thus, for the sake of the following argument, I will naively accept that, given sufficient resources, (a) nearly every militarily significant target can be located, (b) nearly every thing that can be located can be destroyed, and (c) this can be done

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[1] I take the RMA to encompass the following overlapping and mutually reinforcing factors: significant improvements in the gathering, coordination and utilisation of military intelligence (including target identification and the near instantaneous dissemination of information to relevant military units); the communications revolution; stealth technology; dramatically increased weapons accuracy and range; a magnified ability to rapidly focus firepower on carefully selected fixed and mobile targets; and the commensurate adaptation of training and doctrine, especially with regard to high tempo, all-weather, joint service operations. All of this is said to dramatically enhance the effectiveness of military force while reducing the prospects of large scale unintended casualties. In addition, the RMA is believed to have transformed the nature of war and opened up a massive gap between the 'haves' and the 'have-nots'.

quickly, with relatively few losses, and with little unintended damage. Further, I will accept that, *other things being equal*, in open warfare a side that embraced the RMA would have a decisive advantage over an opponent which did not. The point of this paper is not to dispute such arguments - rather, the aim here is to ask 'So what?'

This paper is an exercise in critical reflection rather than detailed planning recommendations. It is divided into three overlapping parts. Part one deals with relatively abstract strategic issues. It suggests, in a fairly general way, the risks and costs involved in viewing security through technological lenses. It also raises the questions of where the threats are, and how high technology forces might be countered. Part two discusses the pivotal role of the US in the debate on the evolution of the international security environment. Part three speculates on the implications of all this for Australia.

PRELIMINARY ABSTRACT REFLECTIONS

VIEWING SECURITY THROUGH TECHNOLOGICAL LENSES CAN BE INAPPROPRIATE AND WRONG-HEADED

Security is, at heart, a political matter. Over-focussing on tools can lead to blurred vision when looking at goals (which centre around politics). As a corollary of this, it might also lead to some unintended and dangerous outcomes.

If our concepts of security become reduced to considerations of military technology, two overlapping sets of problems could emerge. First, there is a danger of misreading the political dynamics of a particular confrontation or conflict. Political problems might be approached in terms of the military tools available, rather than in terms of underlying cause or alternative policies. This, arguably, is just what happened with the US intervention in Vietnam. Moreover, the more overwhelming the military advantages seem, the greater the temptation to militarise policy. Highly sophisticated military technology, married to a 'can-do' ethos, especially if underpinned by expectations of low casualties, can provide leaders with seductive options. This is all the more likely if the opponent is easy to demonise, and if national political culture is rooted in a high level of self-righteousness.

Second, the temptation to utilise superior military capabilities to seize the initiative in a crisis might lead to unintended (and unwanted) political consequences. An operation might achieve a narrowly defined military success and yet create disastrous political spill-over effects. It might be useful to provide a hypothetical example here. Some weeks ago the USAF was gearing-up for what promised to be a successful attempt to destroy a range of targets in Iraq. However, one consequence of such an operation may well have been an anti-Western revolution in Jordan. In such a scenario the political costs would probably have out-weighed the military gains.

WHERE ARE THE 'THREATS'?

The challenges to world order relevant to military planners can be seen as either intra-state, inter-state, or some kind of hybrid of the two. Intra-state challenges include ethnic conflict, secessionism, and failed states. Here military solutions can appear elusive, conceptually messy, and morally awkward (if not dubious). However, this sort of challenge does not drive the RMA. Although the latest available military technology might be useful for intervening forces (and for repressive regimes) dealing with states in crisis, its impact would probably be marginal. This seems especially true of air power (although I would accept that the experience with Bosnia represents a partial exception

here). In any case, despite the fact that intra-state conflict is often seen as the more probable form of future military operations, preparing to meet these sorts of contingencies does not generate most of the pressures for the ever more sophisticated weaponry appearing on the market.

The RMA is, for the most part, driven by more traditional notions of international relations in which threats are seen as coming from governments. The easiest way of rationalising and advertising the most expensive new weapons is to place them into this traditional security paradigm. However useful a high performance combat aircraft or tank might be for intra-state contingencies, their primary rationales continue to be a closer fit with inter-state models of world politics. Indeed, at the risk of over-extending the point, I would argue that the newer and more expensive a weapon is, the more it is likely to be useful for old forms of war.

But inter-state war has not entirely disappeared from the international scene. This raises the question: why would any state want to go to war in the face of the Western (particularly the US) technological edge in strategic capabilities? The obvious answer is to challenge the status quo. Such a challenge might, in theory, be motivated by one or more of six factors:

- Aspirations for global hegemony.
- Aspirations for regional hegemony.
- Territorial claims and expansionism.
- 'Gangster' regime politics.
- Hostility toward Israel.
- State-sponsored revolutionary/ideological pressures.

Clearly, there could well be considerable overlap between these categories. Each of these possibilities can, with differing degrees of plausibility, be used to help rationalise continued investment in the RMA. In each case, with the possible exception of revolutionary war, the RMA looks set to provide the West with significant advantages.

However, the RMA is clearly not a panacea - the full exploitation of its strategic advantages would require both a political context conducive to effective military action and the identification of a target set which, if destroyed, would lead to predictable and desired political objectives.

COUNTERING HIGH-TECHNOLOGY MILITARY CAPABILITIES

A hostile government which could not match a Western opponent armed with the RMA would have considerable incentives to look to other means to achieve its objectives. At least four such means may, in theory, be available. The first is the adoption of less expensive and less demanding technology. One obvious path here would be to acquire biological weapons to deter Western intervention. If proliferation pessimists are to be believed, within a decade or so nuclear munitions might also fit into this category.

A second would be what might be called 'niche' targeting. Here, relatively little investment in a specific weapon system might have a disproportionate impact on a particular confrontation. Rather than focus on the acquisition of the full range of technologies implied by the RMA, a hostile state might focus on targeting critical nodes in a technology-dependent enemy's strategy. For example, AWACS and satellites (along with their infrastructure) seem to be obviously attractive targets for this sort of

thing. Presumably, the development and proliferation of missile technology will open-up a range of possibilities here. Indeed, over time we may be compelled to re-define the distinction between low-tech and high-tech weapons. The increasing sophistication of relatively cheap civilian technology which can be incorporated into military systems can be expected to increasingly blur this distinction and change our sense of just what 'low-technology' means. As a category, *low-technology weapons* is both moveable and elastic - a fact which obviously has implications for arms racing and arms control.

The third option open to a hostile government is the adoption of a low-level conventional or guerrilla strategy. Depending on political factors, a hostile regime might be unable to win in open battle, but may nonetheless be able to deny victory to a more technologically advanced foe. Both the US in Vietnam and Israel in the Lebanon have had experience of this sort of thing.

Fourth, there is always the option of terrorism.

The natural response of some military planners to these challenges will be to call for 'more of the same': the application of more/better military technology tailored to combat these specific threats. Indeed, in some situations there may seem little in the way of alternatives. However, unless one is clear about what is driving an opponent in any of the directions just outlined, one could well miss the big picture or fail to see the wood for the trees. For example, chronic insecurity in the Middle East will not be solved by Western military superiority. At best this strategic edge can be used to hold the line while political solutions are worked out. At worst Western military muscle will be seen as helping to perpetuate injustice. Unless we are very careful, military threats could fuel anti-Western sentiment and further destabilise the region - especially if these threats continue to be paralleled by turning a blind-eye to what many people see as creeping Israeli colonisation in the West Bank.

THE PLACE OF THE US

Why does the US have such a dominant role in this debate? It is not simply because it is the leader in the RMA. Equal, if not more important, is the broader place of the US in questions of world order. This, in turn, is difficult to disentangle from interrelated questions of US values, American self-perception, and the manner in which the international community views the place of Washington. In other words, some mention must be made of Washington's place in the broad pattern of international relations.

As a way of moving further into this discussion, it is useful to remind ourselves of the major features of the international strategic context as seen from Washington. What sort of world does Washington see itself in? As I have argued elsewhere,[2] the international context is marked by three key themes. The first of these themes is optimism and enhanced scope for cooperation. Hopes have been raised by a series of interlocking developments. The growth of democracy since 1989 is said to be of primary importance here - the assumption being that a more democratic world will be a more peaceful place. In addition, more states seem pre-occupied with the pursuit of economic growth. This puts a premium on open economies and trade which, like the spread of democracy, is also assumed to provide an important basis for a more peaceful world.

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[2] This page draws on a paper I delivered to the Australian Defence Studies Centre conference in November 1997.

Last, but not least, compared to ten years ago, there appears to be a much greater appreciation of the degree of interdependence in world affairs.

The second theme which helps define contemporary international relations is the idea that, following the break-down of the putative discipline provided by the Cold War balance of terror, we have entered an age of uncertainty marked by dangerous forms of instability and a diffuse range of threats and problems. These are said to include:

- 'failed states',
- an alleged 'clash of civilisations',
- rabid nationalisms,
- religious fundamentalism,
- proliferation,
- 'rogue' states, and
- the 'China question'.

So, just at the very moment when it looks like we can build a more benign and secure international political environment, we appear to be faced with a series of dangers and challenges. For many people, these challenges are sufficiently worrying to spoil hopes for a world order marked by peace, economic development, the rule of law, and significantly deeper levels of disarmament.

As frequently noted in the international relations literature, we seem to have a system of overarching cooperative international relations (especially in the industrial core) paralleled by a diffuse range of perceived threats (especially in the developing periphery). This mix helps frame Western military power. More particularly, it is seen as providing an extra point to the rationalising of military options in terms of their insurance and fire brigade functions.

Increasingly, the use of military power is being justified by the West, at least implicitly, in terms of protecting the evolution of a more mature form of international political culture. Two paths seem to be open here: protecting the core from the periphery, and expanding the core into the periphery. This perspective seems to shape many American pronouncements on the legitimate functions of armed force. Further, this way of looking at the international political environment is helping to shape our perspectives on the RMA. It helps explain why so many analysts seem to view the RMA as an essentially benign, even virtuous, development. After all, it is the good guys who are leading the way.

This brings me to the third theme characterising the context for the use of force: the fact of US primacy in the international strategic system. This primacy operates on a number of levels; including the following:

- Defence spending.
- Arms sales.
- The general (although far from universal) belief that the US is the ultimate international security guarantor. So strong is this view that, even as we enter the 21st century, Western Europe is unable to shake off its psychological dependence on Washington - even though it has the most evolved system of international institutions, and is perhaps the world's most heavily armed and richest region.
- US domination (although not full control) over the international security agenda.

America's international 'weight' is compounded when one sets its massive military capabilities alongside the prevailing US ideology of active, if qualified, international activism. Moreover, as I have argued in the past, American activism frequently infuses the debate on the use of force with a can-do, self-righteous, and (sometimes) crusading tone. And, despite constant references to the power of isolationism, there is no sign that the US is willing to abandon the driving seat when it comes to setting the direction of the international security debate.

Given this context, what can we say about the appeal of the RMA to Washington? Four points seem obvious enough. First, the US clearly has a significant comparative advantage in the area. This advantage takes on particular salience for those who believe that the international security environment is dominated by 'the West against the rest'. This sentiment echoes Cold War notions that technology, in this case nuclear weapons, provided an appropriate counter to the barbarian hordes from the East.

Second, in contrast to previous eras, high-technology weapons are now more likely to be viewed (or at least presented) as offering a relatively humane approach to war.

Third, the RMA promises to help construct a political climate which allows greater military permissiveness. This is partly because the prospect of relatively clean war points to notions of more useable force. As during the 1960s, the proliferation of flexible military options can be seen as enhancing the range of tools available to decision makers in Washington. In addition, of course, providing the President with military options which promise minimal American casualties has a number of political advantages for the White House. In particular, other things being equal, it becomes easier to marginalise isolationists, calm Congressional nerves, or even circumvent Congressional powers.

Fourth, the US lead in the RMA reinforces the image of Washington as a global sheriff. The metaphor is, of course, strengthened by the willingness of allies like Australia to fall into line and by the constant description of particular anti-US players on the world stage as 'rogue' states.

IMPLICATIONS FOR AUSTRALIA

I now want to reflect on how Australia fits into this discussion. The first thing I would say is that there seem to be no compelling reasons why Australia, as a medium military power which faces no direct threat, should be leading the way in the adoption of high cost defence technologies, especially if this is done to enhance options for military adventures. Favourable geographical factors, and generally benign perceptions of Australia, make it sensible for Canberra to stay within relatively clearly defined strategic limits - in terms of both military missions and capabilities.

Unfortunately, this point has often been obscured due to a tendency to conflate notions of defence with somewhat open-ended notions of security. To take this discussion further, I will look at two questions: (a) what principles should drive Australian defence policy? and (b) why does debate in Australia so often confuse, rather than clarify, the overlap between defence and security?

WHAT PRINCIPLES SHOULD DRIVE AUSTRALIAN DEFENCE POLICY?

I will start here by making two points - one descriptive, the other prescriptive. My descriptive point is that Australia has unique strategic circumstances, limited resources, and no immediate enemies. My key prescriptive point is to agree with official rhetoric that the core task of the ADF should remain the defence of Australia. Furthermore, I would argue that the manner and degree to which Australia embraces the RMA should be determined by this core task.

Many analysts will argue that this position is nonsensical: if Australia faces no direct threat, why focus on the defence of Australia? Surely, it might be argued, the lack of direct threat means we should be looking elsewhere for the action. In particular, it will be said, the ADF has a role in support of broad notions of security, including the enhancement of world order.

My response to this sort of counter-argument is two-fold: (a) it is sometimes based on confused logic, and (b) there is a danger of it pointing towards inappropriate policy.

At the heart of the issue is muddled use of the term 'defence'. Confusing defence with world order, or with the security of the international system, is unhelpful here - especially for a small power like Australia. Yes, world order is important; yes, it is sometimes related to national security; and yes, it is sometimes appropriate to employ military forces to enhance world order. But, for Australia, it does not assist clear thinking to treat world order as synonymous with defence. I would suggest that allowing world order rationales to occupy a larger part of defence thinking would bring into question both the defence budget and the ideological direction of Canberra. Here I will simply note the Defence Minister's references to the importance of Northeast Asia to national security. Coming from a US Defence Secretary, or even from an Australian Foreign Minister, this would be unremarkable, but including it the presentation of Australian defence policy sets my alarm bells ringing.

In addition, the fact that there are few threats close to home does not mean we should look for them further afield. Theoretically, the paucity of threats to Australia may be a reason for reducing defence spending; it should not be a spur to job creation, nor does it mean Canberra ought to embrace military adventures in order to keep elements of the ADF 'up to scratch'. The idea of living in a low threat environment might be a problem to a few defence bureaucrats and analysts, but this should not be confused with it being a defence problem.

Of course, Australia does have non-defence objectives which may call upon military resources, but (at the risk of sounding repetitive) these should not overshadow defence planning. There are two problems with allowing non-defence objectives (such as beating-up third world states in the Middle East) to shape defence policy: it is difficult to know where to draw the line; and it encourages muddle in our thinking on the nexus between defence and security. This last point needs more careful analysis.

THE OVERLAP BETWEEN DEFENCE AND SECURITY

As I have already noted, the relationship between defence and security in contemporary Australian debate lacks clarity. Indeed, it is sometimes suggested that they are synonymous, rather than overlapping. How did we get to this situation? There are at least five reasons; or perhaps it is best to see it as arising from a cloudy convergence of five factors.

First, critical academic debate (particularly on the Left) has, for years, called for a broadening of the concept of security. A useful reference point here is the advocacy of common security which became especially fashionable in anti-establishment circles during the early 1980s. This advocacy included the argument that security should be less narrowly defined, and that it should break-free from the sense that it was coterminous with deterrence and defence.

Common security was offered as a dissident voice challenging Cold War orthodoxy, especially in Europe. It was argued that the military dimension of our understanding of security was over-bloated to a dangerous degree. This was said to fuel a ruinous arms race and a risky policy of deterrence. Real security was said to require scaling down the obsession with military balances and re-focussing on other issues - particularly economic development and environmental protection. Concepts of security, it was argued, had to be humanised, rescued from the abstract world of military planners, and related to the more day-to-day concerns of average citizens.

One unfortunate consequence of this line of thinking was that the concept of security became very fuzzy - so fuzzy, in fact, that it became very difficult to differentiate some ideas of security from broad notions of human welfare.

Second, the end of the Cold War required an adaptation of security concepts. Here, some of the thinking behind common security became accepted as orthodox wisdom. This was especially true in Europe where the idea of deterrence all but disappeared from the debate - although the shift in thinking went beyond that continent.

In general terms security did indeed become seen as less state-centric and more people-centric. This both reflected and reinforced the trend towards a post-Cold War strategic culture of interventionism for essentially humanitarian and state-building objectives.

A third reason for conflating defence with security can be viewed as somewhat less elevated and more self-serving. This was a desire to provide military thinkers with a more permissive conceptual framework in which to work. It was argued that, in a world of diffuse security problems, military policy needed to move even further beyond traditional notions of defence of national territory.

While earlier efforts to broaden our understanding of security were motivated by a desire to emphasise other instruments of policy and, indeed, to rein in the role of the military, these latter efforts looked like giving military thinkers an intellectual blank cheque. Now that everything can be given a security label, it is easier to slip into the habit of thinking that the potential occasions for utilising defence assets can be magnified.

Fourth, the Australian historical experience has tended to fuse notions of world order with the requirements of national defence. To take one anecdotal example: last year I asked my MA students what ANZAC day was all about. The response was that it commemorated sacrifices made in the defence of Australia; these sacrifices were said to be epitomised by the tragedy at Gallipoli. The fact that the landing at Gallipoli represented an invasion of another country was seen as an irrelevant matter of detail.

In addition, the sense that Australian national security requires the support of 'great and powerful friends' is used to reinforce, at least implicitly, the idea that Australia might have to be 'defended' in the form of alliance down-payments in far away places - such as the Middle East. Moreover, it might be added, this sentiment goes way beyond the need to meet formal alliance commitments. A relatively new twist to this phenomenon was illustrated in the recent Gulf crisis. Here policy driven by support

for Washington was presented as required in support of the UN - despite the fact that the projected war lacked UN endorsement.

Fifth, sloppy thinking which muddles the relationship between security and defence can be reinforced (or disguised) by employing the rhetoric of 'national interests'. Loose or excessively broad notions of the national interest make it relatively easy to tie defence thinking to questionable ideological goals. Certainly some people would say this is precisely what happened in the case of Vietnam.

Once the concept of national interest is invoked, it is relatively easy to short-circuit debate. This is especially so if national interests are seen to converge, or are presented as converging, with a bigger picture. To take a recent example, some weeks ago elements of the ADF were preparing to make war on Iraq - despite the fact that that country had attacked neither Australia nor any of its allies. I am not sure about Canberra, but the only debate that occurred in Melbourne came after the decision to commit forces had been made - and what a cursory debate it was. At the risk of pushing institutional comfort too far, and while recognising that Australia is a fundamentally decent country, I would suggest that our self-perceptions here could stand some reflection - that the country almost sleep-walked into a Middle Eastern war; that Australian notions of appropriate use of 'defence' forces encompass the possibility of attacks against other states; and, that the relationship between security and defence is frequently blurred, suggests that Australian political culture is more militarised (if only sub-consciously) than many believe or would be comfortable with.

It is obvious that developments in military technology have not caused this state of affairs. However, it may be that the gathering of military options that are more usable for international expeditions could reinforce this condition. All of this suggests we should review the orthodox list of criteria applied when deciding to commit defence forces. The following sort of list is standard:

- Adequate political support (domestic and international).
- Compatibility with national interests.
- Clearly defined objectives.
- An 'exit' strategy.
- Acceptable command arrangements.
- Reasonable chance of success.
- Acceptable costs.
- Reasonable time frame.
- No excessive intrusion on the core tasks of the ADF.

To this list I would suggest adding:

- the promotion of 'an international environment in which the use of force is discouraged'.

This is, of course, from the 1997 *Strategic Review*.[3] Given the recent crisis over Iraq, it seems to me that some people may have lost sight of this idea. On a similar theme, one

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[3] *Australia's Strategic Policy*, Department of Defence, 1997, p. 3.

might also note the following sentence from the latest *Air Power Manual*: 'Australia will not use armed force except in response to the use or threat of force by others'.[4]

CONCLUSIONS

I have five conclusions. First, there is no point turning our backs on technological advances, especially in the area of defence policy. The question of whether or not to exploit leading edge technology, as well as introducing commensurate reforms in areas of organisation and doctrine, ought not be answered in simple 'yes' and 'no' terms. This is not an 'all or nothing' issue. The practical question is: to what extent should innovation be embraced? When answering *this* question, decisions regarding defence planning should obviously be driven by considered political and strategic requirements rather than the stretching of technological limits for their own sake.

Second, we need to place the RMA into a broad context that recognises the nexus between strategic thinking and international political developments. While it makes little sense to reject the RMA, it is necessary to avoid being seduced by the narrowness of thinking that sometimes accompanies the phenomenon.

A particular worry is that an uncritical acceptance of the technical merits of the RMA, along with the seductive military options it offers, could lead to a loss of focus on the underlying political factors shaping international security. This, in turn, could lead to gratuitous arms racing and the possibility of smart weapons encouraging dumb politics.

Third, the US lead in the RMA, married to its broader position of strategic primacy, is a cause of both comfort and concern. The comfort comes from a sense that, if any country has to have strategic primacy, it is difficult to think of a more suitable one than the US. This is largely because the US political system is shaped by a set of values which are, in general terms, motivated by a degree of idealism not matched elsewhere.

The concern springs from how these values might be translated into practice. This translation is sometimes shaped by a level of triumphalism and moral or ideological self-righteousness which is inappropriate to the development of a more mature international society. The dangers of overactivity might be magnified if the availability of tools leads to a subversion of core goals, or encourages an over expansion of goals. This could lead to the tail wagging the dog.

US calls for military action can be both refreshing in their problem-solving directness and alarming in the way they dismiss complexity, moral ambiguity, and the need to base international society on a broad consensus. While the RMA is obviously not a cause of this phenomena, it does promise to reinforce it.

Fourth, the critical issues about Australian defence policy obviously concern ends, not means. The key question is: what should be the goals and missions of the ADF? Once this question has been addressed, gathering the tools becomes a second-order issue. Of course, one potential problem here is that the RMA is so appealing that gathering the tools can overshadow the question of goals. More subtly, seductive military technology could help to re-shape goals. An indication of how this could happen was provided last year with some of the debate over whether Australia should seek to acquire Tomahawk cruise missiles.

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[4] *AAP 1000: The Air Power Manual (3rd Edition)*, Air Power Studies Centre, Royal Australian Air Force, 1998, p. 15.

Fifth, rather than pushing the boundaries to military thinking, especially with regard to military activism, it might be better for Australia to draw-back a little. This does not mean abandoning such things as the idea of good international citizenship, but it does suggest that more care ought to be given to drawing limits to the role given to the ADF.

I, for one, would see little merit in costly efforts to turn the ADF into part of an American-led posse for maintaining world order. Maintaining a focus on the defence of Australia might be less exciting, but a state which has an unexciting strategic environment is indeed a 'lucky' country.

SUMMARY

From time-to-time we should step back and look at the nexus between technology and security in terms of a broad overview of world politics. Among other things, this paper is an expression of concern regarding the conceptual and strategic costs of conflating technological prowess with security. It is also a call to rein in, rather than push the limits to, some of our thinking on military planning. A failure to do so could open the door to militarisation of foreign policy; this, in turn, could open the door to folly and barbarism.

DISCUSSION

Wing Commander M. Toia: During your talk you raised the old chestnut of defence spending, and later you moved onto the idea of defence being confused with security. I would agree that, if we're going to have a comprehensive security policy for Australia, it should involve more than defence. I'd like to hear your views on, firstly, if the political will or organisation or process in this country will enable us to have a comprehensive strategy that includes defence, foreign affairs etc. Secondly, I'd like to hear your comments on the attention that defence funding gets, compared to other areas in the budget, such as DFAT (Department of Foreign Affairs and Trade) and others that also relate to security. Why is it, do you think, that Defence gets so much focus in the media compared with the other areas in regards to budget and spending?

Dr Butfoy: First of all, I'm not advocating cuts in the Australian Defence budget. I think the Australian Defence budget is quite low. What I am suggesting is that if people are going to argue that there are no direct threats to Australia, you could extrapolate from that argument a case for slimming back.

Secondly, what are the prospects for - and I'm not quite sure what this means - a *comprehensive security strategy*? I think Australia does have a more or less comprehensive security strategy. I think people in Canberra do realise that defence is a subset of security. And I think they do realise that it should mesh in with the work of Foreign Affairs and so on. I think there is a recognition that things like trade are integral to the big picture. Where perhaps Canberra has gone backwards, concerns the environmental dimension of security. There I think there has been a reluctance to face up to the, shall we say, holistic picture.

Why is defence expenditure more of a political issue than expenditure on DFAT? I don't really know. I suppose it's easier for the media to latch onto. They can

point to shiny new aircraft and say, 'Look what the taxpayer's money is being spent on'. That makes better news, better pictures than filming an embassy.

Squadron Leader D.G. Millar: Perhaps I could follow that on, and say that one of the reasons why Defence does fill an inordinate amount of that strategic picture is perhaps because the Department of Foreign Affairs and Trade abrogates the department of *Foreign Affairs* in lieu of the *Trade,* and that that area has been filled by Defence by default?

Dr Butfoy: One thing I would say is that, for all the fuss that was being made in DFAT when Gareth Evans was Foreign Minister, regarding cooperative security with the *Blue Book* and so forth, from speaking to some of my former students (who are now in Defence) they would say, 'Well look Andy, DFAT talk cooperative security and Defence *do* it.' So I take that point.

Lieutenant Colonel P. Faber: I thank you for your comments in highlighting the potential dangers of conflating definitions of defence and security. However, I do worry that your hand-ringing demonisation of the United States as a self righteous, moralising and zealous bulwark against non-Western hoards is perhaps a bit over the top. It is a tad self lacerating and a tad neolistic, which oftentimes seems to be a problem in academic circles today. If we work our way through your characterisations though - and let's face it, characterising the United States as a sheriff leading a posse is emotion laden language, so let's just take a more neutral approach - I regret to suggest that you miss a slew of social science studies that illustrate that there are overt and obvious positives and benefits in having a global hegemon. And although it is politically incorrect in the United States to suggest that we are a global hegemon, much of our post-Mogadishu strategy seems to recognise that point. So there is perhaps a level of maturity in our foreign policy that perhaps you're unwilling to recognise. Quite simply if you aspire to a 'mature international order', wouldn't having a hegemon midwifing that process - based on historical example - in fact be a good thing rather than the overtly negative thing that you characterised it as being?

Dr Butfoy: Thank you very much. Of course you have caricatured my caricature of the United States, which is fair enough. The term 'global sheriff' is not my term, although I think it does bring together a lot of the perceptions of what's going on. The term is, in fact, from Richard Haass (ex-NSC, ex-adviser to Bush and so on) and he is not just using this term descriptively, but prescriptively.

Regarding hegemonic stability literature and so forth: yes, having a hegemon can enhance the prospects of international stability, particularly if it's a hegemon of the type that the United States is. That is to say, one that doesn't have territorial ambitions; one that puts, as a high priority, the furtherance of decent human values; one that, with a few glitches here and there, basically supports democracy; and one, in fact, that makes considerable sacrifices in order to achieve those ideals. I agree with the thrust of your argument, that this enormous power can be an enormous asset to the international system. I just think that there is a certain amount of hubris in Washington and I think that there is very little in the international system that deters the use of American power. What constrains American power is public opinion in the US, Congressional opinion, and the degree to which it both creates international regimes and can be enmeshed in

those regimes. I'm saying that we have to think about how we can better utilise that power for the common good. Of course the problem there, as you well know, in the United States is that this evokes all sorts of outrage regarding foreigners getting a free ride and freeloading. Hence the visceral anti-UN sentiment that sometimes surfaces. But I agree with the basic thrust of your question.

Dr Michael Evans: I have some problems with your representation of the RMA. I think you've oversimplified it. It's a *process* in the US. You have several groups contending for policy influence. You have platform modernists, you have information radicals, you have air power theologians; all trying to get a little bit of the Defence budget. And I think you have to be a little bit careful the way you represent it, but that's an observation.

I also have a question on China. I'd like your views on China. Some of the RMA advocates look at China rather as we looked at Japan in the late 19th century. You probably know that Japan was a feudal society governed by Bushido and the long sword. It leapfrogged forward in a matter of a few decades to become a major world power. There are some who say that, with the RMA, in the 21st century, that's the very danger we face with China - that it will leapfrog forward, take selected technologies and become a major threat to the West. It behoves us in this situation to keep our lasers ready.

Dr Butfoy: I note your comments on the RMA and it being multifaceted, unfolding and so on, but I had to work on the basis of an abbreviated notion of what it was.

I don't really know much about China at all. I know, of course, that it figures large in the literature. Let's assume that various countries to our north, as it were, hang together as political entities. Then the future attitude of China is the biggest single question. And here, of course - to link this to the previous point - the United States has a fundamental role. This fundamental role involves balancing some kind of existential deterrent power with encouragement for integrating China into international regimes, international values, and so on. I think it's probably true that the United States has a key role here. What are the implications of that for Australian Defence policy? Well you probably can guess my views on that from what I said earlier. I remember at a conference last year saying that - depending on the scenarios you're talking about of course - it would probably be reckless for the ADF to put itself in the way of the People's Liberation Army in, say, the South China Sea. I think that would probably involve sending critical units into areas where they would be at great risk. I think also (and this is what I said at the earlier conference), that there are times when a country like Australia has to realise that it is not a mini United States, that it's not a scaled down United States, and there are times when it should keep its head in. There are times, if you're going to get to real worst case scenarios, when it should keep its powder dry.

Martin Dunn: Just pursuing you on your prescriptions for Australian Defence policy, the things you seem to describe struck me as being a restatement of the orthodoxy for the last decade. As we go through the force development process, we look at our equipment purchases and the standard mantra is that defence of Australia is the force structure determinant. And similarly, when we look at technology - and this goes back at least 25 years - we've always taken a selective view. We recognise that there are advantages in certain key technologies, but we recognise in other areas that we will lag

behind the forefront. What is it that we've actually been doing with our force structure that you think is so wrong?

Dr Butfoy: I'm not sure that over the last several years, or this year, Australia has made force structure decisions that I would disagree with. What I *am* suggesting is that what you call 'the mantra' may be circumvented by poor political judgments. There are signs of that - if you look at some of the statements from the Minister, or a comment yesterday that Australia would be very interested in producing an expeditionary aerospace force, for example. There is this notion that Northeast Asia is an area of defence interest; not just security interest, not just Foreign Affairs interest, but that somehow it could be an area of Defence interest. And of course the Minister himself has said that what he is interested in doing is shifting the emphasis, *within* that mantra. So I suppose it's a concern for tomorrow's structures, rather than how they are today.

THINGS MAY PLAY OUT DIFFERENTLY - THE INFOSPHERE DEFENCE FORCE

RICHARD SZAFRANSKI

INTRODUCTION

> *Of course it is not meant to be implied...that the limit of an infinite sequence or of a function always exists. In particular cases it may happen that there is no limit of an infinite sequence ...* [1]
>
> > Alonzo Church

> *Unless soldiers and statesmen, diplomats and arms-control negotiators, peace activists and politicians understand what lies ahead, we may find ourselves fighting - or preventing - the wars of the past, rather than those of tomorrow.* [2]
>
> > Alvin and Heidi Toffler

Let us test the limits of our thinking about the future of air power with a *koan*: if manned aeroplanes created air power and air forces, will manned aeroplanes destroy both? My distinguished colleagues have shared a variety of visions, paying particular attention to the role that technology might play in the future of air power. While there is much meritorious in what they have said, since many of them ought to be - in one way or another - in a position to help chart a course for air power, we need to consider another possibility: *Things may play out differently.* The course I wish for you to consider is that in the information rich Third Wave[3] states and groups of the future that seem to be emerging, manned atmospheric attack platforms may have very dim prospects. In fact, their prospects may be as dim as the ability of today's atmospheric air forces to contribute to combat and conflict resolution in the far future. It may be romanticism, not realism, that binds air forces to the atmosphere.[4]

The highest and best use of military air power has always been to help political leadership and military surface forces meet their objectives. Attack operations in the atmosphere probably will be necessary in the future, but these operations need not use manned aircraft, need not use aircraft, and may not even require 'air forces' as separate services. The next evolution of air power may not be the further exploitation of manned flight through the atmosphere or space. Rather, what follows today's air power may not

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[1] Alonzo Church, in Dagobert D. Runes (ed.), *Dictionary of Philosophy*, Littlefield, Adams and Company, Totowa, NJ, p. 169.

[2] Alvin and Heidi Toffler, *War and Anti-War: Survival at the Dawn of the 21st Century*, Warner Books, New York, 1993, p. 268.

[3] Alvin Toffler, *The Third Wave*, William Morrow and Company Inc, New York, 1980.

[4] I am grateful to Dr Libicki for allowing me to adapt our co-authored work. These remarks were derived, in part, from Richard Szafranski and Martin C. Libicki, '... Or Go Down in Flame?', *Air Power Journal*, 10:3, Fall 1996.

be built on the linear extension of the species 'aeroplane', no matter how fancily or expensively evolved the breed, but on information. Thus, things may, and perhaps ought to, turn out much differently than we envision today.

How can I say this? I can say it because it should be as obvious to the air power theorist as it is to the gambler that 'the future' is as unknowable as it is beyond our ability to control. This is disappointing for those steeped in the old science who would clarify, simplify, and bound the genuine complexity of the real world with the cold and artificial theory derived from the science of times past.[5] One's linear projections, another's trend extrapolations, and someone else's immodest imaginings ultimately may have the same validity, the same predictive power. That is, accuracy residing somewhere in a sequence that runs from none, or zed, all the way to zip. It is a delusion, no matter how comforting, to believe that one can forecast where air power will go 20 or more years hence. It is self-deception, and in large and generously funded organisations, self-deception on the grandest scale, to believe that since air power's platforms reify air power, the future of air power can be 'planned' and 'managed' year by year far into the future merely by managing the acquisition of platforms.[6] Rather, we must consider the possibility that there are a number of plausible futures wherein complexity creates all kinds of disequilibrium, and disequilibrium drives us off the comfortably charted linear path.

AIR POWER IS ABOUT WARFARE, AND WARFARE IS EXTREMELY COMPLEX

We airmen should begin by listening more closely to our critics. Armies and navies and naval infantry fault air power's advocates for forgetting what air power ought to be about. It ought to be, these critics assert, about helping resolve conflict on the surface, at the seat of purpose on our planet. Air power began because of problems on the surface, and air power atrophies, they chide us, when it becomes so detached from the mud, blood, and complexity of operations on the surface that it promises the ability to resolve multi-layered and multi-attribute conflict by simple, bloodless, technological, and remote control. Douhet begot Mitchell and Mitchell begot Harris and Harris begot another, who begot yet another, in a long line of fragile theorists whose air power promises never seem to quite be fulfilled.[7]

Air power theories, distilled to their essence - and we have heard them repeated here - assert that methodically breaking things and killing people from the air, whether deep in the enemy rear or at the point of invasive intrusion, can reduce surface combat. This is so obvious as to be as unarguable as it is unremarkable. But do they do this by

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[5] See Ralph D. Stacey, *Managing the Unknowable: Strategic Boundaries Between Order and Chaos in Organizations,* Jossey-Bass Publishers, San Francisco, 1992; James Gleick, *Chaos: Making A New Science,* Penguin Books, New York, 1998; and Gary Zukav, *The Dancing Wu Li Masters: An Overview of the New Physics,* William Morrow and Company Inc, New York, 1979.

[6] Air power's platforms do not, of course, reify air power. This fallacy and its implications are thoroughly examined in Carl H. Builder, *The Icarus Syndrome: The Role of Air Power Theory in the Evolution and Fate of the US Air Force,* Transaction Publishers, New Brunswick, NJ, 1994.

[7] John A. Warden III, *The Air Campaign: Planning for Combat,* National Defense University Press, Washington DC, 1988. See also John A. Warden III, 'Air Theory for the Twenty-first Century', in Karl P. Magyar (ed.), *Challenge and Response: Anticipating US Military Security Concerns,* Air University Press, Maxwell AFB, AL, 1994, pp. 311-318; and Warden, 'Employing Air Power in the Twenty-first Century', in Richard H. Schultz, Jr. and Robert L. Pfaltzgraff, Jr. (eds), *The Future of Air Power in the Aftermath of the Gulf War,* Air University Press, Maxwell AFB, AL, 1992, pp. 64-69. See also Lewis Ware, 'Some Observations of the Enemy as a System', *Air Power Journal* 9:4, Winter 1995, pp. 87-93.

fracturing the mechanical integrity of the enemy war-fighting machine or 'system'? Can they even end the war? There are 'pre-hostility' and 'deterrence' variants of the theory, of course, but the many children have the same lineage. The true test of theory is not merely explaining what happened, but the ability to accurately suggest or even predict what might happen. Air power reduces surface combat, but more elaborate theories understandably seem to have trouble both explaining and predicting.

When challenged, air power's advocates have historically responded that the fault lies in other's failure to perfectly understand or perfectly apply the air power theory of the day. We failed to bomb the power grid and went after submarine pens, so production did not decline. We went after the coastal and inland transportation network, so production of war material increased. We failed to centralise control of air power, so the enemy exploited us. We failed to bomb the capital or the sanctuary, so the war raged on in the jungles and on the trails. We failed to complete the elements remaining in a master attack plan, so a big bad actor endured. And so on. As an aside, it seems to me that the confusion, especially in Washington, regarding the utility of bombing this miscreant or that has never been higher. The confusion always seems to pivot on the question: 'After the bombing, what?' Neither teleological nor mechanical air power theories provide answers. Vindication of one air power theory after another eludes us because events in the real world of warfare always seem to inhibit us from following this or that piece of theoretical advice. And so we move from theories of pressure, and control, and coercion into the mumbo-jumbo of paralysis, and aerial occupation, and halt, to whatever comes next. All the while, the sailor and the soldier find this pre-occupation with theory as self-serving as it is silly.

They find it silly because conflict and warfare seem to be rather complex, messy and permanent features of the human condition. They find it silly because many airmen do not seem to comprehend that humans live and work and fight on the planet, and that they usually fight about something relating to the planet. They find it silly because people have always fought on the surface of the planet and these critics of air power theory have no evidence that people will not always fight on the surface of the planet in the future. Fighting, Keegan tells us, is viewed as being full of 'moral consolations,' including 'the thrill of comradeship, the excitements of the chase, the exhilarations of surprise, deception and the *ruse de guerre*, the exaltations of success, the sheer fun of prankish irresponsibility'.[8] Sad as it may be, people seem to like to fight.[9] And these people need not be organised into states. They can be brigands or terrorists. There seem to be a nearly infinite number of ways in which humans can organise to hurt one another.[10] Theory is fine if it enables us to explain and predict better, but the evolutions and revolutions in warfare are not easily predictable. Warfare is about humans. Humans are wonderfully creative and innovative. Their fighting has never depended on the tools they choose to employ. Thus, specific and formulaic defeat mechanisms are hard to envision. It seems to take a combination of things, and the application of air power's *Mors ab alto* is only one thing in the formula.

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[8] John Keegan, *The Illustrated Face of Battle: A Study of Agincourt, Waterloo and the Somme*, Viking Penguin Inc, New York, 1989, p. 285.

[9] Robert L. O'Connell, *Ride of the Second Horseman: The Birth and Death of War*, Oxford University Press, New York, 1995, pp. 82-83, takes a different view. See also his *Of Arms and Men: A History of War, Weapons, and Aggression*, Oxford University Press, New York, 1989.

[10] We should ask the air power theorists whether or not the Hutu and Tutsi were engaged in warfare.

If this is so, then we must accept that air power may be unable to stop people on the surface from fighting, and that air power alone cannot deter, resolve or terminate the fights that will occur. To promise that air power can prevent surface forces from having to be engaged or to shed their blood is an intriguing promise but, I think, an empty one. Adhering to it also carries three embedded penalties. First, it may consume much more treasure in promising that less blood will have to be consumed. Air power's tools have never been inexpensive. Said another way, because the markets for B-2s and F-22s are somewhat limited, production runs necessarily will be smaller and costs higher. Investment in these kinds of tools, if they are not demonstrated to be necessary, may prevent us from making some necessary investments in the modernisation of surface forces and the tools they employ directly or indirectly. Second, if warfare is becoming transformed, to use van Creveld's words, then the same transformation that erodes the geographical distinctions between front and rear and the operational differences between regular and irregular, may also deny attack air power its focus and purpose.[11] The third penalty, and the one to which we must now attend, is that 'the air' is no longer the operational high ground of our forebears.

Air forces were founded on the belief that mastery of the technology of manned flight would allow a nation to leap over World War I's bloody stalemate and strike a crippling strategic blow deep into the vital cogs and gears of the enemy's war-fighting machine. Air - the atmosphere - became the high ground. Command of the air, the nascent theorists promised, made victory everywhere else only a matter of dogged will and time. In the first interwar period, and we are in another, this technology was reified in manned aircraft. Manned, because only the human body had the physical strength, sensors and computing power to manhandle flying machines and accomplish air power's chores. Technology has evolved in 70 years. The slightest fingertip pressure can move flight control surfaces. Moreover, sensors, computers, energetic materials and the means to transport them no longer require that a human body be present in the air over the fray. The technology of operating in the air was the old problem. The air no longer requires the presence of humans to attempt to assert control. The need for humans on the surface, however, remains.

If we look more closely at air power theory, we find that implicit in it is the belief that it is better to strike some things on the surface than others, and that striking the right things can achieve more profound effects than striking the wrong ones. Information has always been at the heart of the problem. Information also is the new and future problem. In the baldest terms, if you have more and more unimpeachable information about the enemy than the enemy has about you, then only modest applications of precisely aimed, correctly timed force suffice to affect the surface battlespace. To the degree that air forces were or are about operating in, or attempting to control the high ground, then the new high ground is not the air or space or even aerospace, it is cyberspace. Understood in its broadest sense, cyberspace is the confluence of all the various bits and information streams which, taken together, generate the strategic topsight prerequisite for the effective operations that lead to success on the surface. By history, predilection, and structure, topsight is the natural - but not automatic - domain of air forces. For an air force to stake its claim to operations affecting tomorrow's high ground, that air force would need to redefine itself as an

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[11] Martin van Creveld, *The Transformation of War*, The Free Press, New York, 1991, pp. 196-205.

infospheric institution rather than an atmospheric one.[12] This redefinition, of course, is problematic and, to today's airmen, paradoxical.[13]

Understanding the implications of this proposed transformation requires returning to first principles. The mission of air forces is not merely what they do - tending toward air and space operations - but what they contribute. What they contribute is what they originally and always contribute: vantage and topsight. It is vantage and topsight that allow air power to determine how to operate for strategic effect. Knowing how to transport mass or energy to targets - plinking tanks, sinking ships, or flattening cities - has its time and place. Yet these operations are, *and always have been*, a subset of *knowing* how to get and efficaciously use knowledge to confound or terminate the production, distribution, and, increasingly, the enemy's ability to control its sources and methods of creating and applying its military strength. Technology permits ends - temporary strategic superiority - to be achieved using many tools: space-based, atmospheric, ground-based, and maritime systems, both manned and unmanned. If a separate air force exists for strategic purpose, then the knowledge or information derived from vantage, rather than any one attack method, becomes central. 'Central' to the degree that it is a rationale for an air force to drop its atmospheric orientation in favour of an infospheric one.

Just as air forces were born to exploit the technology of flight, they must now evolve to capitalise on the technologies of sensing and knowing. Our notions of the 'high ground' must change as air power theorists begin to accept the *coup d'oeil* as the peer to and enabling means for the long-cherished *coup de grâce*. I am not arguing here that air forces adopt the trendy profundity and modernity of 'information warfare' as their primary mission. The full gamut of information operations may work well against high-end foes, but enemies with no infrastructure to disrupt would leave an information warfare air force without the ability to contribute much. I am, however, arguing that vantage and topsight to harvest information are so much more important to air power than merely overleaping the trenches that all air forces will move in this direction. Denying an adversary vantage and topsight in cyberspace is a critical future mission, but not the sole mission, of the 'air forces after next.'

THE NEED FOR CLEAR THINKING

How does the vision of operating in, even seizing and controlling, the new high ground of cyberspace harmonise with the vision of the surface forces? There are at least two problems: vision and complexity.

VISION

Vision today is part of the problem. In the United States, *Joint Vision 2010* was designed to scan the strategic horizon, define ways for the smarter application of joint force, and thereby inform the still-separate 'visions' of the separate services. It aimed for a modernised understanding of unchangeable aspects of fighting. Yet, if one acquires an *electronic copy of the document from the web and edits it to remove the adjectives and*

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[12] This is the soul of the air power 'manifesto' that Dr Martin Libicki and I wrote two years ago.

[13] It is neither problematic nor paradoxical to the cohort upon which the future of air power depends. See Don Tapscott, *Growing Up Digital: The Rise of the Net Generation*, McGraw-Hill, New York, 1998, pp. 231-234 and 255-305.

adverbs, *Joint Vision 2010*'s lack of vision is astounding. Will there be precision strike in the future? Yes. Will one side strive to have greater awareness than the other? Of course. Would it be efficacious if joint forces could envision and engineer the dominating manoeuvre? Absolutely. Do focussed logistics facilitate resupply in ways that unfocussed or defocussed logistics do not? Unremarkably so. There is nothing really new here: Alexander, the Great Khan, and Napoleon would applaud these attributes, finding them familiar.

What is left unsaid, though, may matter more. Technology has increased the range of weapons and the precision with which they can be applied. Thus, *any* force, unless arbitrarily and unnaturally constrained, can strike deep. Any force can operate manned or unmanned aircraft.[14] Today, neither legislation nor downsizing makes jointness necessary as much as does the tendency of every service's or force element's target acquisition and prosecution systems to overlay and overlap. Since everyone can seize a piece of the action, everyone seizes a piece. Armies and navies purchase remotely piloted vehicles to be operated by sergeants and apprentice seamen. Smart cruise missiles, dumb and numb to the threats posed by air defenses or capture, go fearlessly into the fray. A consequence of technology is that the battlespace has become as indivisible as the cyberspace. It can no longer be divided into neat domains and parcelled out to each service to fight its own war - navies in the littoral, armies in the fields, and air forces high and deep. They just keep getting in each other's way. A future air force, if we conclude there are to be air forces in the future, is obligated to add its value by envisioning how operations can be conducted best in the totality of the battlespace. Anyone can strike things. Who will take responsibility for knowing which ones need to be struck, or modified, or ignored?

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[14] *PR Newswire*, 'First Student Military Operators Conduct Flight Demonstration of *Outrider* TUAV', 3 March 1998.

> The first student military operators of Alliant Techsystems' (NYSE: ATK) *Outrider*(TM) Tactical Unmanned Aerial Vehicle (TUAV) conducted a flight demonstration of the *Outrider* air vehicle for approximately 200 Alliant team members, government officials, and representatives from the U.S. Army today in Hondo, Texas.

James Wilson, regional director for U.S. Senator Phil Gramm, R-Texas, reaffirmed the importance of the *Outrider* system to U.S. combat forces:

> 'In the battlefield of the 21st century, combat information systems will prove to be pivotal in determining the outcome of conflicts,' said Wilson. 'The *Outrider* TUAV will provide our military forces the necessary tactical and strategic edge, without risking a single American life. Senator Gramm is very proud that operator training for the *Outrider* is being conducted in Texas, continuing this state's historic commitment to our national defense.'

> Speaking to the student military operators, B.J. Blanks, assistant district director for U.S. Representative Henry Bonilla, R-Texas, 23rd District, said the *Outrider* TUAV holds the promise of revolutionising the battlefield.

> 'It will give us the capability to see the enemy when the enemy cannot see us,' said Blanks. 'Each of you will play a vital role in making this a reality. Our congratulations for all you have accomplished, and our thanks for all you will do to make the *Outrider* a key part of tomorrow's military. America's military forces are number one because of dedicated soldiers and Marines such as you.'

At the heart of a vision for the air forces of the future must be awareness of the need for a vast, interconnected, interoperable, and ultimately integrated information system, *the arteries and capillaries of an 'organism of organisms.'*[15] *This would be an* information system to which all forces contribute and from which they all draw. Air forces need not and indeed cannot populate the entire organic construction of various pieces being built, tested, used, refined, reused, swapped out, and retired in their turn. What air forces can and must do, however, is envision what this information organism must do and the organic architecture that enables it. Anybody can own a long range cruise missile or a remotely piloted vehicle, and many non-air force entities (including criminals and terrorists) will. But, stewardship of the brains of the organism of organisms is the aspect of controlling and exploiting the high ground that differentiates next-generation infospheric air forces from today's air forces. Today's air forces, I fear, may be slowly yet inexorably petrifying themselves in the amber of much more expensive, slightly faster, slightly stealthier atmospheric operations. An infospheric air force possesses capabilities which lock out most would-be competitors to the degree that it makes their air and surface forces much less competitive with ours.[16]

Weapons for this infospheric variant of today's air forces do not disappear. An 'armed' force with information but no means to convert it into striking power is pointless. An infospheric air force must have faster means of energy delivery. The weapons of an infospheric air force will be real-time engagement weapons ranging from lasers to neutral particle beams and high-powered, focussed microwaves. Today's sensor-to-shooter paradigm is hopelessly outmoded for an infospheric air force. Such an infospheric force will need a sensor-to-warhead model and speed of light command and coordination for speed of light weapons.[17] A vision that sees next year's fighter as a line extension of last decade's one, and consumes nearly every penny of its dole to get it, may be a poor vision indeed. But clear thinking illuminates complicated challenges and clear opportunities.

COMPLEXITY
The new sciences illuminate how incredibly complex the real world is, in spite of our best efforts to bound the complexity. Single things seem to be part of one or more systems, and systems are vast and interconnected organisms that defy mechanical analogues. They have emergent properties that can neither be predicted nor controlled.

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[15] This organism-of-organisms description is meant to underscore the differences between this notion and the somewhat more mechanical one of 'system-of-systems'. It is the fact of organism that renders this construction so complex and so dependent on trying to capitalise on its emergent properties.

[16] An earlier version of this piece read 'makes their air and surface forces noncompetitive with ours'. Lieutenant Colonel Leonard A. Blasiol, USMC, wrote 'Whenever I hear absolute terms applied to warfare ('lock out *all* competitors') I start to twitch. We'll never lock them ALL out. The pesky old enemy, who is a thinking human (whether he's wearing a steel helmet, a fez, a straw cone hat, or a wool fedora) has a way of surprising us and challenging our dominance in ANY sphere. My favorite historical example is Dien Bien Phu, where an army which represented a nation without a state, which *possessed not a single aircraft or pilot, managed to gain and maintain air supremacy over the one* strategically critical portion of the battlefield, for the duration of the strategically critical period. Their feat of arms changed the world'.

[17] To really test the limits of thinking, technology, and concepts of operations, envision what it would take for a self-serving target system. That is, a system so vast and fast that to misbehave was to have a weapon or engagement system automatically allocated and applied.

Thus, it is impossible to change only one thing.[18] To change the orientation of an air force or an army requires changing many, many things. Thus, we should not be surprised that the United States 'Army After Next' is beginning to look like the United States Marine Air Ground Task Force of today, albeit more technologically marvellous. Nor should we be surprised that an air force oriented on operations in the cyberspace requires different organisation, training, and equipment.

Airmen and sailors put on terrible parades. Why? Because in air forces and navies the ability to march hither and yon in ranks and files merely is an artifice for instilling teamwork and discipline. Marching has nothing to do with what airmen or seamen contribute to warfare or security or national power. Young airmen and sailors realise this, but the hierarchies that control them do not. These hierarchies, adopted from the army, have their roots in autocracy, mass, and the phalanx, with 'modern' embellishments provided by Frederick, Napoleon, and the pre-World War I German general staff. All these guys are dead, but we keep them alive in air forces still timidly struggling for the acceptance and legitimacy that we believe only the ground forces can grant. We seem to be unable to envision and generate the alternative forms of training and education in the particular kinds of teamwork needed for the airman's art. Why can we airmen not have all-officer air forces? The Norwegians do.[19] Why can't enlisted airmen 'fly' satellites or aeroplanes or stand alert with ballistic missiles? Why can we not envision organisational structures that look more like Information Age networks than Industrial Age armies? Yet, it may be that even the United States Army accepts that its vision of 'Force XXI,' the next Army, will require soldiers and a human resources system that:

> ... emphasises risk-taking and participative decision-making behaviours in order to engender adaptability. Similarly, it relies more on self-managed soldiers, requiring them to assume greater responsibility.[20]

Likewise, the United States Marine Corps understands that the Marine of the future must be more empowered than the Marine of today. The Marines assert that networks, implicit communications, and intuitive or naturalistic decision making will change today's notions of 'command and control' and differentiate tomorrow's Marines from today's.[21]

There are opportunities embedded in testing the limits of our own thinking by squaring up to these challenges. One of the opportunities is that we could greatly expand the recruiting base for air forces. Carl Builder suggests that in democratic states the ability to serve the state in the armed forces is, at its heart, a social issue.[22] Thus, in the

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[18] Robert Jervis does a superb job exploring the implications for scholars and political scientists. See Robert Jervis, 'Complexity and the Analysis of Political and Social Life', *Political Science Quarterly*, 112:4, Winter 1997-1998, pp. 569-593.

[19] Alan Stephens pointed this out in a recent discussion.

[20] US Government, 'Rewarding, Organizing and Managing People in the 21st Century: Time for a Strategic Approach', *Executive Report of 8th Quadrennial Review of Military Compensation*, Office of the Assistant Secretary of Defense for Force Management Policy, Government Printing Office, Washington DC, 30 June 1997, p. 71.

[21] Working USMC draft tentatively titled 'Beyond C2: A Concept for Comprehensive Command and Coordination of the Marine Air-Ground Task Force', 3 March 1998.

[22] Conversation with Carl Builder.

United States, for example, more and more minority groups are integrated: first blacks, then women, then homosexuals. The armed forces always seem ill-ready for these natural expansions of democratic inclusion. Builder envisions that the next group to press for integration will be the physically challenged. It is not the mission of air forces to run at or away from the enemy. Thus, the physical standards for airmen need not be the same as those for soldiers. Tomorrow's air forces could capitalise on the wealth of human talent that casting a broader recruiting net would allow. If organisation and training do not change in tandem with vision or equipage, then transforming the valuable contributions air forces can make is unlikely or impossible.

THE CONTRIBUTIONS THAT AN INFOSPHERIC AIR FORCE MAKES

What contributions? Martin Libicki and I suggested that technology and today's need to deter and defer major power rivalry would cause three new missions to emerge over the next quarter century: extended information dominance, global transparency, and strategic defence. While I think that information dominance and global transparency must be goals, they will remain goals, BHAGs, that cannot be attained assuredly.[23] Nonetheless, to pursue some lesser goals would deny us the chance of meeting greater ones. Technology both enables and requires that the information dominance sought by the United States be extended to its friends. Apart from rare, expensive, and always incomplete 'stealth,' tomorrow's battlespace will be far more transparent to both sides than today's. Everything creates a signature of some kind - be it sound, odour, contrail, pressure, movement, or twitches in the geomagnetic environment. Every new bit illuminates the battlespace - whether discovering the tank in the weeds or the aircraft in the clouds - and, thanks to Moore's Law, the number of bits per buck has been doubling and will continue to double every 18 months. The more bits, the more illumination. Given a sufficiently dense covering of bits and the odds that enough of them will land on everything worth identifying increase. This is not purely a military phenomenon: indeed the most powerful forces for generating and disseminating information include the World Wide Web, the Internet, cheap and plentiful video cameras, commercial satellites, and the nearly do-it-yourself unmanned aerial vehicles (UAV). Exactly which capabilities appear when can always be debated, but the pattern is clear and may even be accelerated by fortuitous discoveries in the United States, in Europe, in China, or here.

We have only, for example, exploited a portion of the knowledge that we can exploit for sensing. Carl Sagan and Ann Druyan write:

> Bumblebees detect the polarisation of sunlight, invisible to
> uninstrumented humans; pit vipers sense infrared radiation and
> detect temperature differences of 0.01°C at a distance of half a

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[23] James C. Collins and Jerry I. Porras, 'Building Your Company's Vision', *Harvard Business Review*, September-October 1996, pp. 65-77. A 'BHAG' is a 'big, hairy, audacious goal.' The term is used in business to describe 10- to 30-year compelling visions for the firm. On page 73, Collins and Porras write:

> A true BHAG is clear and compelling, serves as a unifying focal point of effort, and
> acts as a catalyst for team spirit. It has a clear finish line, so the organization can
> know when it has achieved the goal; people like to shoot for finish lines. A BHAG
> engages people—it reaches out and grabs them. It is tangible, energizing, highly
> focussed. People get it right away; it takes little or no explanation.

> meter; many insects can see ultraviolet light; some African freshwater fish generate a static electric field around themselves and sense intruders by slight perturbations induced in the field; dogs, sharks, and cicadas detect sounds wholly inaudible to humans; ordinary scorpions have microseismometers on their legs so they can detect in pitch darkness the footsteps of a small insect a meter away; water scorpions sense their depth by measuring the hydrostatic pressure; a nubile female silkworm moth releases ten billionths of a gram of sex attractant per second, and draws to her every male for miles around; dolphins, whales, and bats use a kind of sonar for precision echo-location.[24]

Our technology already captures some of the capabilities and survival-enhancing sensors of other species. Why would we not wish to learn more about the micro-anatomy that makes these capabilities possible? Submarine sonar is big and bulky and already whale-like, but might we not reduce its size and weight along the bat's or the dolphin's model? Are we not good enough scientists and chemists and engineers to steal and incorporate this knowledge? Asked another way, why clone a whole sheep? Perhaps we need only clone the sensory apparatus of other species? Consider this: In eighty years, there has been a *trillionfold* decline in the cost of calculation. If this rate of improvement were to continue into the next century, the 10 teraops (trillion operations per second) required for a humanlike computer would be available in a $10 million supercomputer before 2010 and in a $3000 personal computer by 2030.

But can this mad dash be sustained for another 40 years? Easily! The curve is not levelling off, and the technological pipeline contains laboratory developments that are already close to my requirements.[25]

Consider the environment that would or will exist if the world were populated with 'humanlike' computers. Why stop with humans? Should we not apply better and better instruments and information technology to suck from nature all knowledge and discover all the ways that all the species sense and know? Knowledge *is* power in the Third Wave, and our *hubris* suggests that we can unlock all the important secrets of nature. The computer, long the paradigm for understanding the organic processes of the brain, probably will lose its favoured place as a model in the next 20 years and the organic processes of living sensors and processors will fuel the next level of advances in intelligent tools.

Thus, there is no great risk in asserting that in the future to be present is to risk being sensed by one phenomenology or another. The attendant revolution in precision guidance means, likelier than not, that to be sensed is to be engaged or even killed. Thus, to linger transparently is to court death. All this seems to favour defence over offence, since movement creates more and more easily discerned signatures than hiding creates. Whether the infospheric air force is defensively inclined until it seizes the offence or not, the future most definitely favours those who can integrate the various information flows into a coherent picture of the battlespace rather than an opportunistic

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[24] Carl Sagan and Ann Druyan, 'What Thin Partitions...', in Robert L. Solso, *Mind and Brain Sciences in the 21st Century'*, The MIT Press, Cambridge MA, 1997, p. 31.

[25] Hans Moravec, *Mind Children: The Future of Robot and Human Intelligence,* Harvard University Press, Cambridge, MA, 1988.

series of isolated appearances. Why shouldn't this be the infospheric air force that follows the atmospheric one?

In this environment, today's platforms simply cannot pass unnoticed en route to or when engaged in tomorrow's major fights. This fact, plus the current and apparently growing aversion to casualties in democratic and even in democratising states,[26] suggest that sending large numbers of young men and women to war against secondary enemies need no longer be the expected behaviour of the armed forces or the states that control them. Secondary enemies are those who the citizens rightly or wrongly believe cannot possibly directly threaten the country. More and more frequently, greater leverage may come from empowering allies to do 'it' themselves, particularly when aided by the knowledge of an infospheric air force armed with the capability of over-the-horizon applications of energy. Empowering is a key concept; telling friends the location of enemy targets to within the blast radius of their ordnance permits them to defend themselves against larger foes tied to Second Wave parameters of force. The means by which friends are so empowered are the same bitstreams that feed the organism of information, whether information be packaged for delivery or ingested organically. Hence, the first mission: extend to friends the information advantage enjoyed by possessing an infospheric air force. Should they cease being friends, they can no longer drink from this font of information. Without information, they must fight without the advantage of topsight.

The pursuit of a global transparency mission naturally follows. The surest deterrence to any nation aspiring to hostile great power status may be the certain knowledge that it is under continual watch. Let a miscreant so much as contract for biological research, buy a fermenter, open a small factory in the desert, and somewhere, somehow, some part of the information organism knows. Anyone can then instantly train their boresights on the offender. This knowledge need not always be converted into engagement; its demonstration alone may dissuade. Police, for example, find that merely illuminating an armed robber with an aiming laser encourages instant, albeit episodic, disarmament. Thus, the second new mission of the armed forces: to instrument the world to transparency so that no country can misbehave in the dark. The evil that lurks in the hearts of humans may hide still a few more decades, but not the means to convert evil thoughts into evil deeds.[27] Add the instant or extremely rapid wherewithal to denude will of means, and ill will becomes an aggravation instead of a threat.

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[26] Eric V. Larsen, *Casualties and Consensus: The Historical Role of Casualties in Domestic Support for U.S. Military Operations,* RAND, Santa Monica, 1996.

[27] Steve Connor, 'Science Finds Key to Beating Fear,' *The Times Newspapers Limited,* February 22 1998. If one can treat fear chemically, other opportunities present. As biochemistry and neuroscience develop, it may become possible to deter by inducing fear in an adversary. Connor notes:

> Scientists found that the emotion of fear is biochemically manufactured in tiny
> pathways between nerve cells in a small, almond-shaped structure within the brain
> called the amygdala, which is thought to be central to the processing of other primal
> emotions. A key finding is that certain connections between the nerve cells within
> the amygdala become strengthened when someone learns to fear something. This
> raises the rate at which nervous signals can flow through the brain's fear centre, and
> so increases the intensity of the emotion. In this way the scientists have shown that,
> emotionally, the brain can learn from experience. Patricia Shinnick-Gallagher,
> professor of pharmacology and toxicology at the University of Texas, who led one
> of the two research teams, says it is the first time anybody has shown that the
> experience of fear has a physical impact on the wiring of the brain. 'I guess you

The third mission, strategic defence, flows from the second. Over 90 per cent of trying to stop a ballistic or cruise missile is finding it. The same organic system that can arm an ally with information and make large parts of the planet transparent also can sweep the skies for air and space threats and dispatch their coordinates to whatever means are chosen for their engagement. If attack becomes pointless because it is doomed to be detected and defeated, then the defence apparently remains stronger than the offence.

THE SUMMONS TO INFOSPHERIC AIR FORCES

Those who would hold the new high ground need to attend to three activities that must become the *raison d'être* of tomorrow's air and space forces: (1) operating militarily in a transparent world, (2) understanding space, and (3) defending homelands from aerospace threats. Taken together, we may consider these needs as the inescapable facts of any plausible future. They are facts, not problems. A fact is something that cannot be changed. Problems arise from ignoring or trying to alter facts. Air and space forces must focus on the facts of the future and use them advantageously.

In a transparent battlespace, big things make more kinds of signatures than smaller ones. Encasing a human in the life support systems necessary to operate in the high atmosphere or in space requires plenty of weight and cube and even then may be frustrated by the high G-loads necessary for maximum agility. Remove the human body from the flight deck and combat air vehicles can surge ahead. The bandwidth to put 'space-derived data into the cockpit' can be redirected to contribute more effectively to other parts of the system. Data need to go to warheads, not task-saturated humans who also have to worry about staying straight and level, breathing, temperature control, urination, and, perhaps more importantly, capture and exploitation. Once the human is removed, small vehicles can quickly become very, very small and very, very fast and pose new problems to defenders. Once pilots are understood as information-processing components - and an infospheric air force would accept that naturally - the rational allocation of these functions between carbon and silicon can proceed more intelligently.

Central to a redefinition of air forces is what it means to be an 'airman.'[28] In World War II, a high percentage of airmen were subject to risk as air crewmen. Today's

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could say we have described the seat of fear in the brain. We can now determine the actual mechanisms underlying fear and can specifically design drugs to treat patients who cannot exert control over their fears,' she said.

[28] Although problematic to many reviewers of an earlier draft, 'Airman' is a good word. It anchors air forces after next to their roots, does not - like 'info-man' - sound goofy, and is superior to 'operator,' a word that connotes 'snake oil vendor' to many. 'Operator' is a problem. Colonel Charles J. Dunlap Jr, USAF, 'Organizational Change and the New Technologies of War,' unpublished manuscript, raises an important question about 'operators.' Dunlap writes:

Likewise the Air Force, probably unaware of the implications of its statement, has openly announced its intention to use civilians operationally. In *Global Engagement: A Vision for the 21st Century Air Force* the service states that 'combat operations in the 21st Century' will broaden 'the definition of the future operator.' It goes on to state that: 'In the future, any military *or civilian* member who is experienced in the employment and doctrine of air and space power will be considered an *operator*.'

aircraft are far fewer and more efficiently manned. No more than a very small percentage of any nation's air force can be in the air at any one time. Upon how thin a base of pilots at risk can an air force rest? Yet, what would substitute as self-definition in an infospheric air force? How have other services coped with similar requirements for change?

Armies, heavy and difficult to move, have no choice but to stay with the 'getting ready to get ready' template for combat consistent with the traditional cycle of initial response, build-up, counterattack, and consolidation. Perhaps a digitised army converts tanks into interactive simulators for 'virtual mission rehearsal' during the long, slow ride to 'build-up,' or perhaps the short work transparency makes of tanks may be too frightening to contemplate. Either way, armour constitutes the skin rather than soul of armies. At its heart is its self-definition as the will of its citizens made manifest in force.[29] This force, in turn, is expressed by being on scene-today in a real context, but over time also in a virtual one. In the United States, the Marines have gone further than the Army in shedding weight: tanks are a burden that light, lethal, agile forces may aim to shun. United States Marines plan to ride into the future on a self-definition that draws on the chaotic and complex context in which they ply their trade. A Marine is a human transformed into the transcendent rifleman. A Marine strives to be nothing more or less than a Marine. Similarly, navies will come to understand what transparency can do for the surface fleet. Yet, navies are wedded to the sea before they are wedded to any instrumentality of mastering it. To command the seas and engage adversaries 'from the sea' is not necessarily to exert power with mass but to exert discrimination with energy - the medium remains the message for navies.

What then of air forces? Air forces everywhere are habituated to being the wilful, rebellious little siblings of their nation's army. They just cannot be unshackled from the ground or escape the fact that the surface is important. In the United States, the Air Force found it difficult to change without clinging to the instrument that won it independence. Then came ballistic missiles and what some viewed as the shotgun wedding of aero and space. Will the even greater evolution to cyberspace - it is really nothing more than that - create a fuss, even though it is absolutely faithful to the vision of air power's founders? Of course it will create a fuss! The combat airman is the last and emotional vestige of knighthood, the product of the warriors' quest for one-on-one combat. Air forces breed cranky individualism because their best and brightest believe,

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> Once civilian technicians or contractors become involved in operations in a way that exceeds what was traditionally understood as mere support of the fighting forces, they risk being characterized as 'unlawful combatants' under international law. Among other things, if captured unlawful combatants can be tried and punished for their hostile actions, even for the same things for which a uniformed combatant would be immune. It is very doubtful that many of these 'surrogate warriors' are cognizant of their new status or comprehend the ramifications of it.

Dunlap cites: George C. Wilson, 'Special Ops: Bosnia's Best Hope', Army Times, January 8, 1996, p. 31 and Dennis Steel, 'The Human Touch: Civil Affairs in Bosnia', Army, April 1997. He notes at p. 21, US Special Operations Command has specific statutory authority to conduct training in foreign areas. See 10 U.S.C § 2011. Some of these missions are 'medical capability' exercises that essentially provide basic medical services in less-developed nations. See also 10 U.S.C § 401 et seq. (humanitarian and civic assistance funding authority), and Susan L. Marquis, Unconventional Warfare, 1997, p. 239.

[29] In the United States, our Army sponsors, among other popular television shows, 'The Simpsons.' In its advertisements the US Army defines itself not only as the world's best army, but the 'smartest' one. Would not the world's smartest army re-think the contributions that tanks and artillery could make in the future?

when all is said and done, that warfare really is about LeMay being superior to Khrushchev, or Horner being superior to Saddam. An atmospheric air force that seeks a personalised 'right stuff,' but limits the attainment of right stuff to aviators, risks an exploitable schism among its various communities. An infospheric air force must and would be based on the teamwork inherent in the construction of the networked information organism that defined it.

The air force apex always will be defined as the masters of the medium, but in an infospheric air force, the medium of air can yield a bit to the various space media. And if it is risk that defines the apex, consider that as processing power grows and the spectrum remains fixed, the ability to illuminate, command, and control the battlespace inevitably will reintroduce the essentiality of physical presence. Air forces likely will leave the air for space and cyberspace, only to find the nakedness of space as vulnerable as the air. Fortunate for them that they also moved to cyberspace.

So, how should air forces proceed? If air forces understood themselves to be organised around not the aging technology of flight but the nascent and growing technologies of topsight, they might be able to play continuous roles and missions debates in a far more constructive manner. Like any shrewd firm, an infospheric air force would cast off low-information missions in favour of high-information ones, strengthen its competence to capture, handle, and move information, and position itself for vigorous institutional life well into the next century, all the while contributing to fostering jointness without risking its own identity. The current division of services by media is problematic for air forces. Take any given mission. Step one in the democratic roles and missions dance is to assign each service responsibility for weapons emerging from their particular medium: ground, sea, or air. Step two, which breeds the grossest hairballs, is to argue that systems emerging from one medium are, of course, superior (better, faster, cheaper, etc.) to systems emerging from another. Service prestige is put on the line in defence of technical characteristics that play more or less randomly across the face of combat. This is a way to build litigious bureaucracies, not institutions. Air forces, by virtue of their need for theory rather than sentiment as their organising principle, wind up defending not what they contribute, but how they do it, as a means of preserving their end-strength. Inevitably this tactic puts their coherence on the line every time such issues arise. Sadly, their end-strength and coherence may both suffer.[30]

What should theory say about an air force's strategy for allocating missions? Consider the tedious recurring debate over the 'three' or 'four' air forces in general and close air support in particular. Declaring in the United States or elsewhere that there is but one Air Force and three other services also possessing air arms is to deny the facts and fuel continuing disputation whenever the embers of fact are fanned. Even so, 'one' atmospheric air force may disdain every other service's use of aircraft in general, and when it feels like it, jealously guards the close-air-support mission in particular. So the one institutional air force may do close air support, even without making it a special competence. Done with great personal skills and courage, but still with little institutional enthusiasm. Meanwhile, the army struggles along with antiquated coordination mechanisms and puts all the organic close air support capabilities it needs in the

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[30] A review of appropriations indicates that congressional cuts levied on DoD and the services between 1991 and 1995 resulted in average percentage reductions of 2.4 per cent for DoD, 2.9 per cent for the Navy, 0.2 per cent for the Army, and 5.5 per cent for the Air Force. Thus, during the interval of post-Desert Storm air power euphoria, Air Force cuts were 27 times greater than cuts taken from the Army and exceeded cuts to surface manoeuvre forces by a wide margin.

helicopter, since The One Air Force allows it no other choice. The answer for an infospheric air force is obvious: let this mission and its associated equipment go. And why not? In the United States, the Marines prove a ground force can supply its own jet-powered air power organically. Close air support is a necessary but low-yield and low-information component of warfare, one which contributes little to topsight, and rarely, if ever, provides the satisfaction of achieving strategic effect. As long as armies fight armies, close air support will be necessary. But it is nowhere written in stone that an air force must fulfil this responsibility.

A similar debate entails long-range missiles, both those for air defence and those for ground attack. Air defence is an Army bailiwick in the United States, sometimes contested by the United States Air Force as an unwarranted intrusion into the deep battle. Here, the Air Force strategy should be obvious: acquire the radars, the fire-control internetting, and the communications that glue the system together. Offer the missiles to whoever wants to drag them around the countryside. This keeps the role of preserving topsight over the increasingly non-linear battlespace and yields both the bullets and the trigger. What about deep attack ground- or sea-launched missiles? The same solution. Any force element ought to be allowed and able to pinpoint and hit static targets. Since static targets present lower information challenges and missiles are just more mass, an infospheric air force would relinquish these to surface forces. An infospheric air force armed with speed-of-light engagement systems and corresponding concepts of operations, economises mass to optimise energy. Thus, an atmospheric tasking order of the future would neither become an 'air and space' order nor an air force responsibility to produce. An infospheric air force would provide the information systems by which it is produced and the bandwidth by which targeting is accomplished. Today's divisions are notional because fire control and guidance are intimately connected to specific missiles or engagement systems. Such union is precisely the wrong way to establish missile guidance in the future. Ultimately, it is the infospheric command which informs the firing control mechanism, and an air force, if it is smart, will put first claims on these operations in the cyberspace to become the core of the military's information machine. An infospheric air force is, among other things, the battle- or engagement-management organism.

Today's roles and missions debates seem to hearken back to solving the surface and air targeting and coordination problems brought to a boil the last few days of February 1991. Instead, today's air forces ought to look ahead and make claims based on what 2015 or 2025 portends: a global battlespace reapportioned by the micro-second. It is a short hop to extend an air force's acknowledged claim to tactical missile defence battle management to overall cognisance of the entire complex information flow required to shoot down another missile. Moreover, the airborne laser is a fine speed-of-light weapon, albeit on a less than equally modern platform, and an infospheric force needs weapons. While an atmospheric air force jealously guards its claim to the right firing platform; infospheric air forces go for the jewels: engagement speeds as fast as information speeds.

If an atmospheric air force wishes to contend with other services over platforms, the way to do it is not to waste time arguing over one or another medium, but to lay claim to the information-rich components. An infospheric air force also can take the lead in maturing our understanding of information operations. An infospheric air force realises that A-2 (intelligence) and A-6 (computers and communications) no longer can reside in their own little stovepipes separated from A-3 (operations). The transition from

an atmospheric to an infospheric air force also will give long-term planners in A-5 at least five years of work, examining every aspect of the force and seeing where it fits into the new structure.

A related issue entails what an air force posturing for the future should keep organic and what it should moult to the private sector. An atmospheric air force retains its air base orientation, and a result is the retention of ancillary functionality and the footprint that goes with it. Consider ancillary functionality: in the United States Air Force there are far more nurses than aviators, with nearly 20 percent of the total Air Force in the health professions. This is ludicrous. The military's ability to command large forces in single-minded pursuit of worthy aims must be retained. Yet, an infospheric air force would ask which elements need to be 'military' to ensure continuity of information and command operations under stress.[31] It would carefully review the current practice of out-sourcing its technical magic or buying it off the shelf.[32] An infospheric air force is a BHAG, and BHAGs require more focus and single-minded leadership than doing the same old things better, faster, and cheaper, or more stealthily.

CONCLUSIONS

The leap from an atmospheric to infospheric 'air' force is the next logical step, as paradoxical as it may seem. Air forces have capitalised on the speed, range, freedom of manoeuvre, and vantage their medium provides. Yet, nothing travels faster than information. Nothing impedes the distance knowledge can travel. Nothing makes movement more intelligent, economical, and fruitful than information. And nothing less than an infospheric entity would provide the vantage that engagement systems of all kinds will require. Atmospheric solutions sufficed until technology permitted multiple solutions from any medium. We are not almost there, we *are* there. We must fully expect that change and divestment will be tortuous and torturous, but we also know that without vision, the people perish. Air forces stand in a transitional zone, pulled by the lure of the future even while still shackled by the comfortable past. To affix their affections, theory, and force structures exclusively to aircraft transporting mass to targets is to remain behind. Only by boldly moving forward can the air forces of the planet's democracies revitalise and rediscover themselves and their value. The lure of the romantic past provides a Siren-like seductiveness to those hardy handfuls of aviators in modern nations everywhere who are struggling to retain control of their forces. But other services broke their bonds to horse and sail.

Will air forces go forward, or will they stop or tarry? With so much to gain, to tarry or stop seems folly. If folly is chosen, however, count on it being proclaimed wisdom. Yet, it seems to me that the inexorable march of contingency only can lead to one of two outcomes. In the better outcome splinter groups arise, chipping off air force missions piece by piece and leaving the institution a withering core. The worse outcome is for the ideology of the atmosphere to withstand all challenges, alienating those within and outside an air force who see elements of the future with clarity. Then, someday within the next one or two decades, the old air forces will awaken to find the revolution

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[31] See Colonel Charles J. Dunlap Jr, USAF, 'Organizational Change and the New Technologies of War', unpublished manuscript.

[32] The problem grows. See, for example, Martin Wolk, 'Hacker Crashes Thousands of Windows Computers', 5 March 1998, Reuters Ltd, and 'Five-Sided Cyber-Attack: Hackers breach the Pentagon', *Time Daily*, 25 February 1998.

grasped firmly by those with few tears left for the old atmospheric air force. Either way, if the air forces of democratic states fail to do their states and their allies the favour of succeeding, we will have twisted Churchill's description of real tenacity and valour in a perverse way. It would be most unfortunate if historians of the next century looked every one of us here in the eye and recorded that 'Never have so few done so little for so many.' We can only hope and strive to make things play out differently.

DISCUSSION

Martin Dunn: I think I know how warfare is going to be fought in the next century. I can see it now: the bearded Air Force officer in the Pentagon rolls his wheelchair up to a control panel, presses a button and a millisecond later in Ghana in the defence headquarters, both the IBM XTs crash - and it will only have cost you a billion dollars for this capability. The obvious question with all of this is: is all this technology going to be relevant and can we afford it?

Mr Szafranski: Martin, those are the two killer questions. Let me answer the relevance question first. Yes, I think that technology will be relevant. It's the means by which we know things; it informs warfare with its ability to change the world. By that I mean that, absent knowledge and absent direction we don't have armies; we have bands of thugs that roam around and do things indiscriminately. That's not a happy vision of the future. Therefore we need organised armed force. What will organise the armed forces in the future are the means of communication and co-ordination, and the knowledge to act with great precision, with all the elements of precision. These go beyond precision in strike. They go beyond precision in resupply, precision in movement, and precision in planning and thinking - so they will be relevant.

      Will we be able to afford them? Yes. I believe that the cost is coming down. If we accept that they don't have to be 20 g tolerant (that is, if we don't lay on specifications that industry is unwilling to provide because there's no commercial advantage to doing it); if we change the stuff out at a great rate; in many cases if we lease rather than buy - it's all going to be there. That issue is not as important as the one of whether it will all be properly interlaced and stitched together. Absent some way of agreeing as to how that will work with our friends and allies, because these have become de facto global industry standards, then it isn't going to work very well. It is a sad thing when the lack of a radio causes coordination or communication problems between forces who are friendly. We are all fearful of friendly fire incidents. In the battlespace of the future, unless there is some kind of *integration* - in some holistic sense - these things are all likely. I think we will be able to afford them. In order to afford them we've got to get rid of some of the vestiges that we've been toting around.

Squadron Leader N. Connell: I'd like to invite your comment on a couple of naive observations. Firstly, are we not in the position or approaching the position where the action which a superpower like the United States could take, would be precipitous and wrong because of the speed of the capabilities? And secondly, we've heard a lot about

information - knowledge is everything, information is power - but where's the analysis in this? Are we intending to take the man out of the loop and, if so, how do we justify that?

Mr Szafranski: I think there *is* the risk that speedy operations might not manifest the reflection that's required for the weight of the action being taken. My observation though, about the government of the United States (and this is not unique to any particular seat of government), is that it's involved in a very slow and deliberate process - that actions are only taken with great reflection. The deliberations are as weighty as the aim of the discussion. I don't think you're going to see the ability for the system to act as speedily as my remarks may have suggested. I was trying to suggest that when the execution order is given by a legitimate authority, *then* we can act that quickly. But the lead-in to that situation, and all the debate, will be much slower and more reflective. The United States is going through the nail-biting hand-wringing period where we do have all this awesome power and we want to be a good friend and we want to be a good sheriff, and we spend a lot of time thinking, talking and debating about what is the best way to do that. So I would count on the inherent friction in democratic systems to slow things down sufficiently.

On the question of analysis, much can be done by machines. John Warden spoke previously about the importance of pattern recognition. There is software today that can look at a scene and tell you what's changed. These are used for inspection of manufactured components to see if there are any flaws in the component. The same kind of software can be used to look at a parking lot and note that there are five more cars today than there were yesterday. Humans will not, however, be out of the loop. I see humans in the future in an inhibitory role. That is, the challenge is not so much getting data to the cockpit for an overloaded human being who has to worry about staying straight and level, breathing, urination, capture by the enemy, and so on. Rather, the data needs to go direct to the warhead (in the nature of *sensor-to-shot* mentioned previously by Natalie Crawford). What the human will do is inhibit a launch when all the parameters are otherwise correct. This has been incorporated into systems before and it works quite well. You have the authority to stop an action. The events leading up to that action are assessed and analysed for you, and you're pre-positioned to take the action, but you can stop it at any moment. If you have data that indicates you shouldn't do this, or if it just doesn't feel right, the technology is overridden - I think that's where you're always going to need humans.

Dr Michael Evans: Your views seem to reflect those of Professor Martin van Creveld and more recently Martin Libicki of the NDU. If we take the view that the US armed forces at the moment are in the grip of the platform modernists, how do you see information radicals like yourself breaking the grip of the 'platformists'?

Mr Szafranski: I think the goal is not so much to 'break the grip', but to give us other things to think about. Platforms, because they're the reification of a Service's program for capability and modernisation, are difficult to escape as a focus. I think the point that we're all summoned to (and the new Air Power Manual does a good job of this) is that we need to get a step above things to see where all of this is leading. What kind of capabilities do we seek in the future? *Then* we can argue about the *means* to provide those capabilities. I think that Professor van Creveld was correct in anticipating the

transformation of war - there is no more front; there is no more rear; I cannot get the bad guys to wear uniforms, to dress properly and march. These have changed warfare and warfare will continue to be transformed. That's why in our studies in how power might be applied in the future, we have to appreciate the much more complicated, much more diverse ways in which we can be hurt. As Air Chief Marshal Allison said, 'The weak will do what they can'. By that I mean (and Dr Butfoy talks to this also) adversaries are humans and they are wonderfully inventive in the ways they can hurt us. The ways to hurt democratic governments are much more extensive than the ways to hurt other forms of government.

So I think Martin Libicki and Martin van Creveld have achieved good glimpses into the future. I don't want to whine or complain about whether we have platform fixations. I want to say, let's do like the Air Power Manual does and this conference has done. Let's go a step above that and try to look at what it is we are really trying to do.

Air Commodore D. Bowden: My issue is about organisations to match the rather big change you've talked of, and I'd like you to make a few comments about that. We're blessed in Australia with lots of headquarters and organisations, and when our soldiers aren't marching they're in those headquarters. This is obvious to the casual observer by the dominant colour of such places. If we have this sensor-to-shooter process developing - and that's certainly technically becoming feasible - what role then will there be for these headquarters? What will they be doing? What should they be doing? Should we be having air force people in them or, in fact, should we be getting rid of them altogether? This is a major problem because headquarters absorb resources and they do in fact interfere with the rate at which decisions are made - that is, those *real* decisions that affect the sensor-to-shot or the reaction of your forces.

Mr Szafranski: Those here from a headquarters, including from the Pentagon, will know that the tempo of operations in a headquarters involves about 12 to 14 hours work a day; every day, peace or war. The question that I always ask is: what if there is a war? There is no strategic reserve of time or energy to fill demands. What actually happens in these cases is we begin shedding those tasks that we know to be unimportant. What we *should* do, I think, is take that list of tasks that we shed in a crisis and get rid of them in peacetime also.

John Warden talked previously about a very flat networked organisation where information - the key component, the carbon molecule - is shared laterally and where people are re-empowered to decide within limits that don't require six signatures or transmittal through 17 desks. One of the functions of the Second Wave is that you really can't be an important person unless you have a lot of people as your subordinates. In Napoleon's Army you couldn't be a major general - and Napoleon said this - until you had lost 25 000 troops. That blunderous stupidity somehow qualified you to be a major general. We have the same thing today: for someone to take pride in being a brigadier or an air commodore, they have to have some subordinates working for them. I think what we're going to see in the future is that there'll be some relationship between your responsibilities and the knowledge you possess or have access to. I don't think it's a foregone conclusion that air forces in the future will have *enlisted* people and *officers*. These differentiations which we have taken from the army may not be appropriate for us.

So what should headquarters do? Headquarters should get out of the way, get the information required to make decisions down to the lowest possible level, and empower people at that level to make those decisions. Then they could do all those other kinds of protocol and administration things, but there wouldn't need to be many people for that task. There are far too many people in the headquarters today, in my opinion.

Flying Officer M. O'Byrne: You said at the end that we should push the limits. I'd like to go beyond the limits. I'd like to put some ideas to you and see what you think but, since they're controversial, before I begin I'd like to just point out to my posting officer (who is here today) that if there is a nasty phone call after this, a posting to Antarctica or Herd Island would be just fine. We've been talking a lot over the last couple of days about technology and the Revolution in Military Affairs. But I don't see the Revolution in Military Affairs. I agree with everything you said about Second Wave forms and Third Wave forms and indeed I've read the Toffler's book *War and Anti-War*. But what I see is technology serving as some sort of electronic Potemkin village. We talk about technology as *being* a Revolution in Military Affairs. But what the Revolution in Military Affairs is really all about is restructuring the military to be able to take advantage of the leaps and bounds we're making in technology. What we're really doing is using Second Wave forms of organisation and decision making and planning, to utilise Third Wave form tools. I was just wondering if you would comment on that?

Mr Szafranski: I think you're a brilliant young man and send me a postcard from Antarctica.

Group Captain S. Peach: One of the problems I see with moving from where we are now (with a Frederick the Great structure) to where we may need to be (as a number of speakers have observed) involves the throwing away of a lot of 'baggage' which, in fact, is identified by some of our senior people as essential to the core values which keep people in, and which also identifies the very ethos that has thus is far defined air forces. Alan Stephens (my colleague) has already touched on that a couple of times. So there's a real dilemma here and that is: how do you actually move from that vertical hierarchy that we're all part of, to a network with people who are effectively working on a sort of a sub-contract basis, whilst also protecting the values and histories and traditions of air power?

Mr Szafranski: Mike [Flying Officer M. O'Byrne, from previous question], help me think through an answer to this. Since you represent the values of a younger generation, how do we preserve those things in which we today take great pride as we enter this Third Wave where forces and capabilities are transformed?

Flying Officer M. O'Byrne: I think we have to ask ourselves why are we preserving these things. Is it for sentimental reasons? And if it is for sentimental reasons, then maybe we should out-source.

Mr Szafranski: To add to that, and it's a very good answer: what we're seeing is tremendous value differences in the cohort that's coming up. A book I recommend to you is by Don Tapscott called *Growing Up Digital: The Rise of the Net Generation*. It's an extensive study of people who were born with the Internet. Today, television

penetration is near 100 percent. We live amongst the first generation of people raised with the television and their behaviours are in many ways different from ours. People raised in the net generation are going to be even more different.

I think the answer to this is that we must accept our responsibilities as mentors, and lovingly release those kinds of things that held our deepest affection, and transfer that affection to these *new* things that represent what we must become. We should be proud of what we were because it got us to the position where we could become what we could become; but then we should let it go. I think it's going to be the most difficult challenge, but we're already seeing the responses to the challenge manifested in our younger generation. They're more inquisitive, they're more critical, and they're more quick to sully those unexamined assumptions upon which we built much of our lives and careers. To me these are good things. We just have to be mature and adult about the situation and realise that as long as the retirement cheque keeps coming in, and the younger group are able to incorporate advice, guidance, counsel and the bitterness of experience into their vision of how things should operate, then we'll all do quite well.

CONTROLLING AUSTRALIA'S INFORMATION ENVIRONMENT

OR

DECISION SUPERIORITY AND WAR-FIGHTING

AIR VICE-MARSHAL P.G. NICHOLSON

INTRODUCTION

Our new strategic guidance requires the most important capability development priority to be the 'knowledge edge'; that is, the effective exploitation of information technologies to allow us to use our relatively small force to maximum effectiveness. The knowledge edge is described functionally in the 1997 Strategic Review as intelligence; command arrangements and command support systems; and surveillance of our maritime approaches.[1] This is a very conventional categorisation in the light of emerging technology and operational concepts. So, the knowledge edge can be characterised in ways in which it might be applied across all levels of war and in terms of its components or elements.

The subject of 'Controlling Australia's Information Environment' will be treated in the context of the use of armed force at all levels of war, but especially at the operational level, in fighting campaigns that will be referred to as war-fighting. Specifically, this paper will examine the application of our new theatre war-fighting concepts (in essence, joint operational doctrine) to controlling our information environment.

THE GETTING OF WISDOM

A hierarchy of data, information, knowledge and wisdom is created by successive analysis and assessment of the lower elements to add value to levels of understanding. At the lowest level, *data* is collected from sensors or other sources (for example, a radar detection of an aircraft). The next level, *information*, is produced by processing data to associate different or successive observations to enable conclusions to be made about behaviour, and perhaps predictions to be made about future behaviour (for example, successive radar detections are combined to form a track). Further analysis of information including association with other data and information provides a deeper understanding of this behaviour called *knowledge*. In the military context, knowledge enables the understanding of what is happening, where, and probably how the activity is taking place. Knowledge is the level of understanding needed to comprehend what has happened and make reasonably confident predictions about future behaviour. Following the previous examples, knowledge would be exemplified by analysis of track history, track origin, aircraft identification, flight path parameters and so forth, to deduce that an air attack was in progress and to identify the likely targets. The final level of

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[1] Department of Defence, *Australia's Strategic Policy*, Canberra, December 1997, pp. 56-60.

understanding postulated is termed *wisdom* which relates to why events are taking place and enables a complete mental picture to be formed of adversary behaviour.[2]

On this hierarchical scale, the more conventional notion of *intelligence* fits somewhere between information and knowledge. The common complaint of commanders that they wish to know what is about to happen from their intelligence specialists rather than what has happened in the past underlines the reluctance of the intelligence function to predict future events. This substantiates the view that intelligence is more than information but not quite knowledge. Indeed, our conventional notion of intelligence may now be outmoded and perhaps should be discarded in favour of a term which describes the function - gaining a complete understanding of the enemy's behaviour. This is not the only conventional notion which does not fit the paradigm of warfare in the next millennium.

The tasks at the lower levels of understanding, gathering and analysing data, can be largely performed by machines. However, there is some point in the continuum between what we are calling information and knowledge where the complexity of the assessment task cannot be replicated by machines. Despite the advances in artificial intelligence, expert systems and the use of techniques such as neural networks and fuzzy logic, technology has not yet been able to replicate human reasoning. This is particularly true for the association of apparently unconnected items of information, the ability of the mind to make cognitive leaps and intuitive deductions. The consequence of this is that physical or electronic action on data or information can be used to influence the lower levels of understanding but the higher end will require influencing the assessment and evaluation process of the adversary's mind; that is, successful knowledge warfare will require attacking his decision making process.

THE UTILITY OF KNOWLEDGE

Knowledge, or even wisdom, is not an end in itself. Rather, it is how that knowledge is exploited to achieve the military objective which is important. Knowledge of the adversary and of oneself has always been important in warfare. Knowledge of the enemy is an understanding of the threat posed by him - understanding his capability, his intention and his motive. Understanding his capability is to have knowledge of his force preparedness and force structure, and in some definitions, the modernisation state of his force.[3] Knowledge of his intent introduces the predictive element, extrapolating from past behaviour to estimate what his actions are likely to be in the new situation. Understanding his motive may provide clues to why he is pursuing that course of action and enable a more indirect and subtle means to counter him. This may be the future kernel of knowledge warfare - changing the adversary's will, influencing his motive through controlling his perception of what is happening and why.

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[2] Sometimes, the idea of a hierarchy includes the conventional notion of *intelligence* as the result of analysis of information. Thus, intelligence is seen as an intermediary step between information and knowledge. See for example, Murphy, Lt Col Edward F. *et al.*, 'Information Operations: Wisdom Warfare for 2025', in *Air Force 2025 White Papers*, Vol. I, Air University, Maxwell AFB, Alabama, 1996, p. 3.

[3] The most encompassing description of operational capability is that propounded by former US Secretary of Defense Frank Carlucci who defines it as the combination of *readiness, sustainability* (which together define preparedness), *force structure* and *force modernisation*. The notion of force modernisation captures the idea of upgrading capability through incremental improvement of sub-systems throughout the life of type of the weapon system.

Knowledge or the lack of it exerts influence at all levels of war and across the spectrum of conflict pervading every engagement, operation, campaign and war. At the strategic level, all sources of knowledge available to the government will be used to determine which instruments of national power will be brought to bear to deal with an adversarial state or any non-state group which poses a threat to national security. Data and information will be gleaned from many sources within and external to the government covering a wide range of indicators, including economic, financial and commercial fields, as well as social, cultural and religious aspects. But ultimately, the grand strategic decision - whether or not to engage the adversary and what combination of means available should be used, including the military instrument - will be a political decision. Political decisions are based on judgements formed from perceptions; that is, they could be loosely described as knowledge based. It may be important, even crucial, to influence or change the adversary's political decision making process, to cause a change to his grand strategy through successful knowledge warfare at the strategic level. But that is not the purpose of this dissertation which will concentrate on the operational level of war and how we could endeavour to control Australia's information environment for the purposes of successful war-fighting.

To do this, we will look at our new theatre war-fighting concepts which provide the theoretical framework for campaigns to defend Australia and its interests. The key precept of this joint operational doctrine is called *decisive manoeuvre*. Decisive manoeuvre is 'the conduct of synchronised operations ... to defeat the adversary by positioning in time and space the most appropriate force to threaten or attack critical vulnerabilities, thereby unhinging the centre of gravity and obtaining maximum leverage'.[4] This can only be accomplished successfully if we adhere to several core concepts. In turn, these are enabled by four supporting concepts, the most important of which is termed *decision superiority*.

In addition to examining some of the operational concepts made possible by technological advances, such as decision superiority, it is also necessary to consider the organisational adaptation and response if we are truly to reap the rewards of a full blown Revolution in Military Affairs. The Air Force of tomorrow might look nothing like the one we know today.

DECISION SUPERIORITY

Decision superiority is achieved when we can make and implement more informed and more accurate decisions at a rate faster than the adversary. For decisive manoeuvre to succeed, not only must our decision cycle be faster than the adversary's, the quality of those decisions must be superior and they must be implemented in the required time-frame. Like all other aspects of warfare, achieving decision superiority necessarily involves a close interaction with the enemy. We are concerned not only with our own, but also *his* decision making process. The objective can be accomplished if we can force him to make *bad* decisions as well as allow him to make good decisions but too slowly. This is a considerably more subtle approach than the usual adage to 'get inside the enemy's decision cycle'.

There are several discrete and to a large extent independent steps in achieving decision superiority which provide a convenient means of analysis. The process begins

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[4] Australian Defence Force Warfare Centre, *Decisive Manoeuvre: Australian War-Fighting Concepts to Guide Campaign Planning*, Interim Edition, January 1998, pp. 1-3.

at the start of the knowledge cycle with the collection of data and its transformation through analysis into information which will ultimately provide battlespace awareness. Battlespace awareness requires a variety of complementary sensors which will detect, or have a high probability of detecting, events and activity through both passive and active means. Whenever the enemy emits radiation (transmits) in his efforts to gain battlespace awareness, we should be able to detect that he has transmitted, localise the source of the transmission, classify the transmitter and identify it. In addition, in parallel and perhaps concurrently, we must seek to detect through active means platforms that do not transmit.

The detection capability needs to at least span the communications, data transfer and active illumination (radar) portion of the electromagnetic spectrum; that is, from the low HF (high frequency) to the K band (3 megahertz to 30 gigahertz). The physics of transmission and the curvature of the earth preclude remote, long-range detection of emissions or active illumination of targets except by high frequency ionospheric refraction. This leads us to the inevitable conclusion that the sensor must be either space-based or carried to the area of interest by another platform. While direction finding can be accomplished in most cases with only a single detection, spatially fixing the location of the emitter is a trigonometric problem which requires at least two and probably several detections, from either a moving sensor or a second sensor. Platform movement relative to the target and successive detections at intervals sufficient to provide a triangular fix, is the common technique using a single platform which has been highly refined electronically in the synthetic aperture radar. However, much greater potential is available, especially for Australia's situation, in the second method of *multi-static detection*. This exploits burgeoning information technologies associated with onboard or distributed processing and high speed, high capacity data transfer.

A fruitful area for multi-static detection techniques which has been long exploited is of course the use of acoustic sensors for underwater target detection and fixing. The usual method is to lay a sonar buoy field across the path of a submarine and by triangulation plot its track through the field. While passive detection ranges are relatively short - a few kilometres at best - active methods have the potential for detection of submarines over scores or even hundreds of kilometres. Fixed, passive arrays are useful for barrier or focal point detection tasks, but open water detection and tracking requires a mobile platform. Detection and tracking of aircraft at acoustic frequencies is also proving feasible using fixed arrays on target approaches or where intruders can be channelled by placement of surface-to-air missile systems. What we need in the future is the application of multi-static illumination and detection techniques at radio frequencies.

Australia's geographic circumstances predicate a surveillance system with enormous coverage. This immediately suggests a move to space-based sensors but economic realities deny us an independent, full coverage, sovereign capability although we must take full advantage of information obtained from our major ally, the United States. An alternative for wide area coverage is over-the-horizon radar but this does not provide the resolution for accurate tracking and is strongly dependent on ionospheric conditions which can be problematic because of diurnal, seasonal and solar effects. An operational concept which immediately seems feasible is to use the combination of a limited space-based capability and over-the-horizon radar to provide cueing for other sensor packages. Because of time and space considerations, these sensors should be mounted in aircraft in order to provide rapid response and broad area coverage. Some

weapon systems to meet this requirement will enter the inventory in the next few years, notably a new generation airborne early warning and control aircraft. But there is a clear requirement for long endurance, high altitude, long range unmanned aerial vehicles to carry sensor packages and to provide data linking with other platforms.

In determining the type and mix of sensors needed for situational awareness, it is important to note the difference between detection of an activity, and repeated observation and tracking of the event or platform. Detection is not likely to require the same degree of resolution required for tracking nor the same intensity of observation or revisit rate. So detection of an event by a less precise, wider area sensor can be used to cue the deployment of a higher accuracy, more focussed sensor for subsequent tracking.

Many features of the surveillance system required to provide battlespace situational awareness are also necessary for targeting and, increasingly, information technology will allow manipulation and control of surveillance sensors for this purpose. Clearly a very sophisticated sensor management and tasking system is a prerequisite for multiple use of the sensor suite for surveillance, reconnaissance and targeting.

INFORMATION MANAGEMENT

The wide variety and types of information sources available requires processes in place to synthesise incoming data to present the best possible information in an easily comprehensible fashion without overloading the commander, staff or the communications information system. However, it is most important that the technology is the means employed and does not become the ends in itself by 'automating a stubby pencil'. The decision making and battle management *process* must be designed to identify the initial information requirements, present this in a coherent manner, allow it to be evaluated to become knowledge, and permit interaction between the automated functions and the human elements. This process is well established and regularly tested in the air component and the joint theatre headquarters but it would be prudent to ensure it is constantly examined and refined.[5] We must assume that the adversary will have an equally effective process in place, so this may be a fruitful avenue for knowledge attack and would certainly represent a capability edge if accomplished.

Data and information is electronically collated, stored, manipulated and presented in a Command Support System. To be effective, this will be a distributed system in a wide area network comprising several local area networks including the theatre and component headquarters with links down to other local area networks at the Wings and Squadrons, laterally to other components, and up to the strategic level. Modern information gathering capabilities will inevitably overload both the commander and the communications system if all information is presented, so it must be managed such that only knowledge that is both timely and appropriate is presented to those who need it. This management is facilitated by a 'pull' system whereby the user seeks the information required from databases distributed over the system rather than the opposite 'push' arrangement from the sources to the user.

From the earlier discussion of the point in the hierarchy of understanding where human interaction becomes the more important component, it is evident that data and information management should be automated to the greatest extent possible up to this point, and limited in quantity from this point on. Otherwise, the crucial decision making

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[5] Australian Defence Force Warfare Centre, *Joint Military Appreciation Process*, Interim Edition, January 1998

process could be swamped in a flood of incomprehensible information. An obvious area for improvement in the future is the development of automated decision support aids to reduce, by aggregation and summary, the amount of information passing to the human operatives. The likelihood is that this will be accomplished by presenting information in visual form so that it can be rapidly comprehended by the humans in the chain and intellectually 'bundled' for comparison and integration with other knowledge packages for decision making. The principle should be that humans should be able to concentrate their attention on those aspects or 'knowledge bundles' that machines are unable to digest and automate everything else to the greatest extent possible. We must not become over-reliant on the information system presenting all pertinent information. Even under extreme pressure from time, superior commanders, system degradation and adversary disruption, the commander must have the wherewithal to make decisions rapidly.

To this point, the discussion of information management addresses our own processes and is part of knowledge of oneself or own forces. But we must also consider the likelihood that the adversary will attempt to degrade our internal processes, especially the automated functions and the flow of information in electronic form, in order to reduce our knowledge of own capabilities.

INFORMATION SECURITY AND WAR IN CYBERSPACE

Our Command Support System is clearly a target for attack by the adversary as are the communications links between the local area networks. While both can be physically attacked, the more dangerous threat comes from undetected intrusion of the computer system and disruption of its operation, or corruption of the data it uses. The lexicon of the techniques used are redolent of the information revolution itself - viruses, logic bombs, Trojan horses, trapdoors - and are as pervasive and dangerous in the civilian arena as the military.[6] The outcome of an information attack might simply be a massive overload of the computer and communications system, and the most worrying aspect yet to be resolved is recognition that an attack is underway. The first level of threat is simply disruption of the information system which, while destroying or rendering useless data and information, will probably be obvious, if not as an attack, at least as a system failure. The second and more subtle threat is a partial distortion of data and information which is not recognised as an attack and which leads to misunderstanding and false knowledge. This is one form of attack on the internal decision making process which if successful can lead to a situation of decision inferiority.

Computer networks designed for other than command and control functions are also vulnerable to attack. These include the computer aided aircraft maintenance management system which will eventually hold all information concerning aircraft serviceability and maintenance history, the equipment supply tracking system, the personnel management system, and so on. Again both the separate databases and the links between them could be attacked, but corruption of the data is unlikely to significantly degrade decision making so attacking the communication system may be a more likely prospect. In any case, entry to the widely distributed network is becoming increasingly easier. The situation is likely to worsen in the future because '...current trends indicate that public telecommunications and the Internet will merge [and] many of today's networks will likely be absorbed or replaced by a successor...infrastructure

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[6] Correll, John T., 'War in Cyberspace', *Air Force Magazine*, Vol. 81, No. 1, January 1998, pp. 32-36.

capable of providing integrated voice, data, video, private line and Internet based services.'[7]

All US services have established an Information Warfare Centre or something similar to oversight what is becoming known as information operations, but responsibilities are dispersed in the traditional staff structure between intelligence, operations and communications (J2, J3 and J6). In contradiction of the tenets of the Revolution in Military Affairs, so ardently espoused, these organisations have failed to respond and adapt to the introduction of new technology and operational concepts. In addition, the US military appears to be concentrating on information security rather than other aspects of knowledge warfare. For example, the USAF has raised the 609th Information Warfare Squadron which concentrates almost exclusively on protection and reaction to computer attack.

Information security is much more than a military problem because there are several national infrastructures in an advanced information society such as Australia which are vulnerable to strategic attack which might not be recognised in time for adequate protection measures to be put in place.[8]

Despite our best efforts to improve information security, knowledge assurance can probably never be guaranteed and best protection is likely to come from the development of systems and architectures which are sufficiently robust to function during and after malicious intrusion.

INFORMATION ATTACK

An advanced, information age adversary is vulnerable to attack on his information systems. Knowledge attack is the obverse of the coin of knowledge assurance. Determining how his systems interact will give clear pointers to his decision making process which should be the objective of future attacks. Understanding our own information system vulnerabilities will provide insight to methods and techniques of attack on the enemy's systems. But more and more the emphasis should be on degrading the interaction between the data available on the adversary's system and the human who analyses and interprets that information.

A major problem in the future will be how to deal with a non-developed adversary or non-state player who is not reliant on information technology and chooses to engage in asymmetric warfare. Decision superiority remains the key to success but the sensors needed for our battlespace situation awareness may need to be different, including for example a greater proportion of human intelligence sources and with less reliance on electronic detection. An adversary who does not use computers which can be 'hacked', or who does not communicate using terrestrial or space-based bearers which can be intercepted, is largely invulnerable to information attack. Equally, however, his decision cycle time will be long and his knowledge of our force capability and disposition are likely to be limited. So in this situation we must ensure we play to his weaknesses not his strengths. In particular, we must ensure we identify exactly what are our intelligence requirements - what do we need to know - and put in place a collection mechanism to obtain the data we need together with the processing and analysis to transform this into information and knowledge.

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[7] *Ibid.*, p. 34.

[8] The Marsh Commission identified eight critical US national infrastructures: information and communications, electrical power systems, transportation, oil and gas delivery and storage, banking and finance, emergency services, water supply systems, and government services (Correll, loc. cit.).

While a less developed adversary might lack the infrastructure and capacity to operate as a modern information age force, he might well have access to other tools to circumvent his lack of capability. For example, by keeping the conflict or impending action at crisis level he will attract media attention, and through their reporting he will most likely be able to gain most of the knowledge he needs about our operational capability and disposition. He will also be in a position to manipulate political perception of events and through his influence on public opinion even control political reaction.[9] An open democratic society is at a decided disadvantage in dealing with an unscrupulous, authoritarian adversary.

A final aspect of information attack is encompassed by what we have traditionally called electronic warfare. Like all dimensions of warfare there is both a defensive and an offensive element to electronic warfare. The defensive element includes threat warning, counter-measures and jamming to electronically protect an aircraft threatened by an adversary weapon system. The offensive part includes detection and jamming of his defensive systems typically to open the way for a strike package to their target. However, in the new paradigm of knowledge warfare, we can look at electronic warfare capabilities as diminishing the enemy's situation awareness by denying, degrading or deceiving his observation of activity in the battlespace. There is a closely coupled and highly geared relationship between our own and the adversary's situation awareness in this situation. First we must know of his activity in the battlespace - the surveillance capability detailed earlier - then we must look to ways of decreasing the probability of him detecting our activity. Some of this will be accomplished through physical means by reducing the signature of our platforms - reduced infra-red emissions, the use of radar absorptive materials, the application of a whole range of stealth technologies, and so on. Some will be achieved using electronic means but because at present these are likely to be predominantly active means, he will become aware of our efforts. And some will be by threatening or attacking his collection platforms. There is a clear need for improved electronic capability to counter adversary collection effort which is undetectable by him or so ambiguous in origin as to not be attributable. The point is that any decrease in his situational awareness will enhance our decision superiority.

PRECISION STRIKE

No matter how good our decision superiority, common sense, war-fighting experience and prudent planning all point to the need to complement this by simultaneously degrading that of the adversary. This can be accomplished both by reducing his situation awareness and by degrading his internal processes. We have already seen the present capability deficiency in electronic and defensive means of diminishing his situation awareness and this points to the requirement to physically attack or threaten his collection capability - his surveillance radar sites, his maritime patrol aircraft and his other airborne collectors - and his command, control and communications infrastructure (sometimes called a nodal strategy). We know that computer attack is a burgeoning field and may eventually allow electronic attack of his decision making processes, but the likelihood is that this too will need to be complemented by physical attack, certainly in

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[9] No where is this more evident than at present in the Gulf where Saddam Hussein has garnered Arab support by appearing to defy US threats while at the same time diminishing political and electoral support for action against him in the US itself.

the medium term (say, twenty years). In any case, having attained a sufficient degree of decision superiority, we will need at some stage to physically attack and destroy the target sets associated with his centre of gravity.[10] The technology of the information revolution has provided us the means to accomplish this with great accuracy using precision guided munitions.

The battlespace awareness needed for decision superiority also provides the first element in accomplishing precision engagement. We already know what the target is and where it is located. The next element is recognition of the target and guidance of the weapon to impact. This will almost always require different sensor characteristics with a much narrower field of view and a much higher resolution than wide area surveillance sensors. Some components of the sensor system will need to be mounted on the weapon itself, while others, for example a target illuminator, may be mounted on the aircraft releasing the weapon. A more recent innovation is the use of off-board sensing to better utilise very expensive sensor systems and minimise the cost of the attack aircraft, and this trend can be expected to continue in the future. An early example of this technique was 'buddy lasing' where one aircraft laser was used to designate the target while the laser guided bomb was released by another. Similarly, ground based laser designation has long been used by forward ground controllers (FAC) in close air support missions. More recently, weapon delivery cues have been passed from a ground based FAC directly to the head-up-display of F-16 aircraft during the Bosnian conflict and this system is also capable of linking video in both directions.[11] Some emerging weapons systems such as the Joint Strike Fighter are planned to utilise a high degree of off-board sensing and they will routinely take target information from airborne systems such as JSTARS aircraft and more than likely from space-based systems.[12]

Off-board sensing is multi-static illumination by another name but oriented toward target recognition and illumination rather than wide area surveillance. However, this trend may not suit Australia's circumstances because of lack of autonomy through not controlling the off-board systems, especially those which are space-based, and alternative arrangements may be necessary. On the other hand, off-board sensing provides a strong measure of force protection by allowing the high value sensor system to stand off from the target and the release aircraft to remain passive to minimise detection and engagement by target defences. This is a powerful incentive for a small air force where aircraft attrition cannot be tolerated. Somehow we must achieve a balance between multi-static and onboard, autonomous sensors.

We have already seen with the surveillance sensors required for situational awareness that complementary systems have a strong multiplying effect and this is also true of the sensors associated with precision engagement. But rather than occurring in the slower time of wide area surveillance, multi-mode sensors must function in the compressed time frame of the final engagement. When this has been accomplished, a significant increase in effectiveness has been evident. For example, US Army and other

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[10] Stephens, Alan, 'Weapon of first choice: Strike Aircraft in the Asia-Pacific Region', *Asia-Pacific Defence Reporter*, Volume XXIII, No. 1, January 1997, pp. 26-27.

[11] Project Sure Strike - an improved data modem in Block 40 F-16C allows a ground based FAC with a laser range finder to transmit target co-ordinates via UHF/VHF radio to an aircraft for presentation on the HUD. Also allows video transmission both directions. See Warwick, Graham, 'USAF Plans Upgrade for F-16s', *Flight International*, Number 4615, Volume 153, 4-10 March 1998, p. 25.

[12] La Franchi, Peter, 'Master of the Battlefield', *Australian Defence Business Review*, 19 December 1997, p. 17.

force experience of operational degradation of electro-optical sensors by weather, dust or battlefield smoke and haze has led to the incorporation of millimetre wave fire control radar into the Longbow AH-64D version of the Apache attack helicopter. The combination of the electro-optical suite and the radar enables the generation of multi-spectral imagery allowing operation in almost any type of condition.[13] In the future, precision guided munitions will routinely incorporate multi-mode sensors. There have already been demonstrations of communications with other airborne platforms such as the E-8 JSTARS and the RC-135 Rivet Joint electronic intelligence system, combining targeting and terminal guidance information. This synchronisation of surveillance information with targeting and terminal guidance information has great potential to enhance the knowledge base by providing rapid, high quality feedback.

There has already been some experimentation with an even wider operational concept to tie together surveillance and targeting capabilities using airborne early warning and control aircraft (AEW&C), joint strike targeting system aircraft (JSTARS), and signals and electronic intelligence gathering aircraft (Rivet Joint), which has been called the electronic triad.[14] Linking the information available on each of these platforms using human operators to interpret and task strike aircraft, provides an unprecedented precision engagement capability while affording maximum concealment of the strike package and unparalleled force protection. The effect of precision engagement based on superior battlespace situational awareness and multi-static targeting is that a small strike force like that of the RAAF becomes extremely viable.

With further acceleration of information technology and miniaturisation the likely medium to long term outcome is the combination of all these surveillance and targeting systems into a single platform. The immediate question then is: can these manned aircraft eventually be replaced by uninhabited aerial vehicles?

IS THERE ANYBODY UP THERE?
Unmanned aerial vehicles (UAVs) are ostensibly a very attractive alternative option to manned aircraft, especially for high-risk missions. Without the need to provide life support systems for a crew, airframe and engine complexity can be greatly reduced, in turn reducing weight and cost which can be translated into a variety of desirable attributes; for example, exchanged for increased range and endurance. In particular, unmanned aircraft can be designed to routinely operate at very high altitudes (above 50 000 feet) where human life support systems become very complex, and can take advantage of this to provide very long endurance (several days). A vehicle configured for high altitude, very long endurance flight begins to assume some of the characteristics of a low orbit, (almost) geostationary satellite with wide area coverage and great persistence. But most important of all, the loss of an unmanned aerial vehicle does not represent the waste of the very considerable investment in highly trained aircrew.

However, despite rapid advances in information related technologies, the unmanned aerial vehicle has not yet come of age as part of a system. Bosnian experience with UAVs indicates the life cycle costs of the total system to be not less than manned aircraft despite the cost of aircrew. For the future, Northrop Grumman is exploring ways to save as much as one third of the life cycle costs and it is looking at ways for one

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[13] La Franchi, op cit., p. 19.

[14] Wall, Robert, 'The Electronic Triad', *Air Force Magazine*, Vol. 81, No. 1, January 1998, pp. 54-59.

person to control up to eight unmanned aircraft.[15] Also, the system is totally reliant on extensive and wide band communications links that may be difficult to provide reliably and securely, and are vulnerable to interception. Finally, the flexibility inherent in a manned system is diminished in comparison with an unmanned system because, among other reasons, the element of human interpretation is at the end of a long, vulnerable, bandwidth-limited communication link. Of course, even a very high altitude UAV is subject to sovereignty laws and cannot penetrate foreign airspace until war has been declared or rules of engagement permit this intrusion.

Nevertheless, there are considerable advantages for the use of unmanned aerial vehicles in the Australian situation, particularly to complement other remote and manned systems. Continuing research and experimentation with Pathfinder aircraft indicates that solar powered UAVs may have long duration persistence at high altitudes. The coverage of such craft and size of footprint may contribute to air power in the areas of communications at a cost lower than satellites.[16] In addition, a high altitude, long endurance vehicle can carry several types of sensors and provide wide area surveillance coverage. It can act as a communications link between other platforms and a ground air operations centre, giving us independence from non-sovereign satellite systems and a smaller footprint for interception of traffic. Finally, an unmanned aerial vehicle can provide targeting information to a manned strike package. In suppression of enemy air defence (SEAD) tests a Hunter UAV was able to transmit targeting data to F-16 aircraft fitted with improved data modems (IDM).[17]

The introduction of Uninhabited Combat Air Vehicles (UCAVs) is distant, probably past 2010. UCAVs would probably rely on off-board sensing '...to keep cost and operational complications to a minimum.'[18] One of the main advantages for a UCAV is that it possesses greater manoeuvrability because of the higher normal accelerations (g forces) it can sustain unfettered by the physical limits of a human being.[19] Lockheed Martin also predict that taking the pilot out of the aircraft could reduce acquisition costs by 20 percent.[20] However because of a lack of an onboard pilot to provide situational awareness, the UCAV would require an automated self-protection system. Another implication resulting from the lack of an onboard pilot is that typical rules-of-engagement require human intervention in the sensor-to-shooter link. The critical issues facing UCAV systems are command and control and particularly the ability to fly multiple vehicles, including operating manned and unmanned aircraft together.[21]

IN THE PUBLIC EYE

Perhaps the single most striking feature of the new revolution in military affairs made possible by the technology of the information revolution is the pervasive influence of the media in all aspects of war-fighting. This has several implications for successful prosecution of warfare in the knowledge domain. The first is dealing with the 'CNN

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[15] 'Pentagon to Test Lethal Air Strikes by Robot Planes', *Defense News*, Vol. 13, No. 10, p. 36.

[16] 'Pathfinder Quest', *Flight International*, 25 February-3 March 1998, p. 43.

[17] 'UAVs Go To SEAD', *Flight International*, 25 February-3 March 1998, p. 22.

[18] 'Navy Eyes Stealthy Unmanned Aircraft', *Aviation Week & Space Technology*, 13 October 1997, p. 27.

[19] The Robotic Air Force, *Air Force Magazine*, September 1997, p. 74.

[20] 'Pentagon To Test Lethal Air Strikes By Robot Planes', *Defense News*, Vol. 13, No. 10, p. 36.

[21] Warwick, Graham, 'Persistent Ambitions', *Flight International*, 15-21 October 1997, pp. 36-37.

effect' and another is management of the adversary's perception.[22] The first Gulf War in 1991 saw near real-time reporting for the first time with vivid television images of the air attacks on Baghdad. For Australia and her highly professional defence force, the CNN effect is generally beneficial because it is likely to enhance the moral authority of the government's decision to resort to armed conflict and we should not fear close examination of our strict compliance with the laws of armed conflict. However, it has the downside that it is an avenue that is open to exploitation by the adversary and has the potential to give him powerful leverage over public opinion and the political reaction to it. In any case, because of the transnational characteristics of modern media capability, it is effectively beyond control even of a closed society and we must come to terms with its existence.[23] The main danger is that while the media cycle time is faster than our decision cycle time, the information available from media sources are snapshots selected by a news editor with particular intent and is more akin to uncorrelated data or information 'noise' than knowledge.

An important corollary of the CNN effect is that governments will be reluctant to commit to armed conflict and there will be a strong tendency to seek 'bloodless battles' to minimise casualties and reduce the duration of war. In company with this imperative for rapid resolution of conflict is an emphasis on negotiated settlement rather than unconditional surrender. Since the superpower confrontation after the Second World War exposed the impossibility of total war, the traditional paradigm of warfare for the democracies has been of three phases. The first phase is reacting to aggression and halting the enemy advance, the second then building up combat power, and finally the third a counter-offensive to reverse the losses sustained. But this legacy view of war-fighting as a three-phase affair has been outmoded by the power of the media and the consequent electoral and political reaction. Now, governments must be seen to react to counter aggression or other unacceptable international behaviour but time will never be available to build up the forces required to roll back the aggressor's gains let alone to actually implement a counter-offensive.[24]

The outcome of this is a preference for particular forms of warfare and air power is likely to be the weapon of first choice. This is because air power provides the means of reacting quickly to a crisis by assembling and deploying forces, using their operational reach to threaten adversary forces early in his offensive, and employing combat power precisely and with great discrimination to halt his attack. No other form of combat power can achieve this without being permanently deployed forward, clearly not an acceptable political or economic proposition for Australia or her allies. Ships take too long to reach the area under threat, and the deployment and development of land combat power (the build up) takes even longer. However, the combination of the

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[22] For discussion on media operations see Cobbold, Richard, 'Information Warfare: An Underview', *The New International Security Review*, Royal United Institute for Defence Studies, London, 1997, pp. 66-76; and Badsey, Stephen, 'Information Warfare and Media Warfare', unpublished paper given to the Annual Air Power Symposium held at the Royal Norwegian Air Force Academy, Trondheim, 10-12 February 1998.

[23] Column 8, *Sydney Morning Herald*, Thursday 19 March 1998, reported that RAAF personnel stationed in Kuwait were communicating with their families and the newspaper via the Internet and receiving their news from home from various media web sites.

[24] The difficulty in building and holding together a coalition to respond to Iraq's development of weapons of mass destruction is evident at the time of this conference. By skilful manipulation of world public opinion, Saddam Hussein has maintained the strategic initiative and looks likely to face down the threat of air strikes against him. Any ground action seems so improbable as to be ludicrous.

operational reach and precision strike capability of modern air power can be employed rapidly and to great effect. The important thing is to stop the aggressor quickly before he has time to make major territorial and political inroads or to consolidate his gains.

DON'T SEND ME A MEMO

These new operational concepts of decision superiority and precision strike made possible by the technology of the information revolution may never be fully exploited unless we are able to adapt our internal processes to cope with the change. The ability of our hierarchical structure to respond to a technology that relies on networking is perhaps a bigger challenge than absorbing the technology.[25]

We have already seen that there are several elements of knowledge warfare. First, we need to define our knowledge requirements so that specialised agencies can collect data and information to satisfy what we need to know. Then this information (it may only become knowledge in our mental hands) must be filtered, organised and manipulated so that only that portion which requires interpretation by the human mind is presented and as much as possible of the remainder is handled electronically. Since this information is vulnerable to corruption in both its physical and electronic form it must be protected from unauthorised interception and change. Similarly, we must attack ('hack') the enemy's systems to alter his databases and degrade his level of knowledge. Because much of our knowledge base and that of the adversary will be derived from information in the public domain, we must be skilful in the presentation and use of public information to give the 'pitch' we want and diminish the effect of his 'spin doctors'. The manipulation of public information will be a vital part of any deception and psychological operations plan. Finally, many of the tools of knowledge warfare are legacies from the field of electronic warfare, resident in the closely guarded world of the old crows.

In the past these have been seen as disparate elements but in the new paradigm of knowledge warfare, there would seem to be little sense in dispersing these functions among several staff branches such as intelligence, operations and communications. Rather they would be better grouped together at the operational level to reflect the central position of knowledge warfare in attaining decision superiority. There is already evidence of this as a successful approach in the formation of the Directorate of Information Warfare within Headquarters Air Command. Considerable synergy is evident by physically collocating specialists from each of the fields of knowledge requirements (intelligence), information management, information security, communications, public information, knowledge attack and electronic warfare. Of greater importance is that knowledge warfare is regarded as a functional entity and integrated into all operational planning starting from the initial mission analysis, through the appreciation and identification of courses of action, the development of the concept of operations, to the formulation of the air plan to support the campaign plan.

At the tactical level within Air Command, the intention is to unite all force elements involved in developing situation awareness under a single command to be called Surveillance and Control Group. This will take the existing Air Defence Ground Environment Wing encompassing all control and reporting units and their associated

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[25] Carl Builder has postulated four distinct models of human organisation. The hierarchy is best suited for power transactions such as in command and control arrangements whereas a network is best suited for information (or knowledge) transactions. Clearly, knowledge warfare will be primarily concerned with knowledge transactions.

command support system and add imminent force structure improvements such as airborne early warning and control aircraft and the Jindalee operational radar network. Eventually, this Group will include electronic warfare assets and their support, computer emergency response teams, and unmanned aerial vehicles. Future remote or unmanned target designation systems would also come under this Group.

CONCLUSIONS

We are in the midst of a new revolution in military affairs driven by the private sector technology of the information revolution. This has opened up a whole new field of warfare in the knowledge domain which must be treated holistically if it is to be mastered. Successful warfare in the knowledge domain will require addressing all constituent elements - knowledge requirements, information management (including communications links), knowledge assurance, knowledge attack and public information. Our organisation must respond to the new environment and adapt to successfully exploit the emerging operational concepts.

The key to success is decision superiority that is attained by having better battlespace situation awareness than the enemy and by using this knowledge edge to make better decisions. To fight in the knowledge domain we must attack and defend both situation awareness and the decision making process. The information revolution has given us new tools for offensive and defensive action in pursuit of situation awareness but this has always been an arena of battle. The revolutionary aspect is knowledge attack aimed at the decision making process. This potentially has much greater leverage than attacks against the lower levels of the hierarchy of understanding of data and information. Success in this arena will require a much better understanding of not just how humans make decisions but the decision making process of particular individuals, especially the opposing commander. This 'cognitive mapping' of the opposition may well provide the ultimate knowledge edge.

Where our future force structure and equipment are concerned, sophisticated sensor management and complementary sensor systems are prerequisite capabilities for both battlespace situation awareness and targeting. UAV and future airborne collection aircraft will provide the balance between autonomous sensors on board our fighter and strike aircraft, and off-board space-based systems.

Management of the public perception of events and limiting the adversary's ability to manipulate reporting of them are integral parts of successful knowledge warfare. More importantly, the other truly revolutionary part of the new revolution in military affairs is that taking and holding ground has been outmoded by the CNN effect.[26] Victory has been made obsolete.

A new arm of the Australian Defence Force will emerge in the next twenty years with the same tenacity that gave rise to the formation of the RAAF in 1921. There are many lessons to note from that historical event and to be applied wisely in this next important evolution. The Air Force can offer a great deal but what we would not want to see is a repeat of the debilitating divisions and arguments which marked the formation

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[26] The emerging operational concept of 'Halt Phase' warfare was elucidated by Lieutenant Colonel Peter Faber at the Royal Netherlands Air Force annual conference on Air Power Theory and Practice held in The Hague, 24-28 November 1997. I am indebted to Dr Alan Stephens for bringing these views to my attention before publication.

of the RAAF and undermined joint endeavour through three of the four major wars in which Australia participated this century. Decision superiority and precision engagement are key operational concepts in future warfare. Air power plays the main, perhaps dominant, role in both.

DISCUSSION

Wing Commander D. Tramoundanis: Decision making capability, as you pointed out, involves more than sensors and processors. Much of the equipment that you talked about was available in the Gulf War, yet from my readings the decision making processes in that conflict were adversely affected by the human element. Specifically there was conflict between operational level commanders often resulting in compromised decision in air targeting and air apportionment. How would you suggest we overcome that problem?

Air Vice-Marshal Nicholson: I think that, as several speakers have brought out, the whole concept of what I'm calling *knowledge warfare* - and others are calling it much the same thing; information warfare or information operations, and you can understand why I'm calling it knowledge rather than information - is something that wasn't really appreciated until after the Gulf War. And it's an important point to note that most of the technology that we're talking about *has* been around for some time. Sure, according to Moore's Law it goes faster and it is cheaper, but there's really nothing new about it.

What is new is the changing of our organisation to exploit some of our operational concepts. In other words, seeing what's going on in our head and understanding it; and I think that answers the question. We have to be very careful that we don't treat the issues organisationally or intellectually in an old mind-set. I'm suggesting that we could smash all these things together. And if it doesn't work we can disaggregate them and smash them together in a different way. Knowledge warfare's contribution to decision superiority is what really matters. The theatre commander's decision superiority - the decision that's made or the outcome - is what is important, not the fact that you have knowledge.

Squadron Leader D.D.C. Williams: I'd just like to challenge your notion, sir, that intelligence is out and knowledge is in. I would suggest that they're actually the same, and I think that what we're doing by changing the name is just a Band-Aid fix like we're doing a lot in society these days. When we've got a problem, rather than fix it, we change the name or move onto something else.

I suggest that the problem with intelligence in the past has been, in part, because the 'Intello' (Intelligence Officer) is seen by most as a secretive hoarder of information. However, that problem is largely due to the customer (and often that's the commander) not telling the Intello what he wants. I've got the information, I can process it and I can give you some educated guesses on what the enemy is going to do, or some sort of prognosis. I would suggest that the Intello is the ultimate in the 'pull' technology that you want to move towards. You tell me what you want and I'll give it to you.

Air Vice-Marshal Nicholson: I'd just like to emphasise that this is not just a question of semantics. The difference between information and knowledge is absolutely crucial because it involves the human brain. The brain is the greatest processing thing ever invented and we don't use it well enough. We've got to make sure that we don't swamp it; that we present to it only that knowledge which is needed for it to make decisions. That's my point.

The problem with the pull/push analogy or model is that commanders often won't know what to pull. Just as in the past, as I've implied, intelligence officers haven't known what to push, or they've pushed and the commanders haven't appreciated it. This is not meant as a derogatory comment on intelligence officers or commanders. What it says is that we need to have some other way of looking at the process. That's why I'm particularly enthusiastic about the views of Dr Brabin-Smith and Mrs Crawford regarding the way we actually present information and knowledge. I think it has to be in a visual way and I use the term 'knowledge bundles'. Somehow we've got to put these knowledge bundles together in ways that allow us better handling. As one of the other speakers has said, we're very good at pattern recognition and picking pattern variations. We've got to work out ways of making it much easier for the mind to take in this stuff.

To reiterate, my point is that we've got to make sure that the brain does things that *only* the brain can do, and that we automate everything else to the greatest extent possible.

Group Captain J. Baker: Following on from that, sir. If we're going to work in an information rich environment, how are we going to train our commanders (at all levels) in the future to know what to pull and what not to push?

Air Vice-Marshal Nicholson: I don't know; I haven't got the answers. What I'm trying to do is expose the dimensions of the problem. Certainly there's a lot to do here when we think about the levels of war. I used the term 'war-fighting' specifically because the problem, I believe, is not at the strategic level or, at the moment, at the tactical level. It might be at the tactical level in the future for manned systems with lots of off-board sensing like the JSF. That could well provide a workload problem. I'll give you another example. The F-18 Hornet is probably the easiest aeroplane *to fly*, that I've ever flown. But the workload in the cockpit is *higher* than in any aircraft I've ever flown. The reason is that they've automated the flying part, but there's so much information available that the operator's brain is going overtime. And because it's going overtime it can neglect other simple flying tasks.

I would imagine the technology will get the tactical level under control. For example, there's lots of work going on in ways to present adversary threats. Rather than as a spike in the head-up display or a spike on a radar warning receiver, information can be presented orally in a three dimensional picture so that you instinctively look to where the sound is being generated in your headset. Things like that will come along at the tactical level.

At the strategic level (and I wasn't jocular when I said that political decisions are loosely based on knowledge; they're based on perception), we and most democracies (and perhaps even most authoritarian governments and dictatorships) are not too bad at decision making generally. You might criticise Saddam Hussein perhaps, but generally countries do that fairly well.

The gulf is in the *operational* level. It's at the operational level of command that we've got to concentrate our education and training. Part of that is just exposure - exercising - but there's also got to be a bit more intellectual work done. For example, in our officer education and training system under the new arrangements, we need to push some material out of what's being called Joint Services Staff College (JSSC), and into the single service Staff Colleges. We need to push some of what's at the top end of JSSC up into the strategic level course - at the Australian College of Defence and Strategic Studies. But there's a bit in the middle there which is not 'joint staff', and that's the war-fighting part.

Now, a lot of this could be greatly assisted by simulation, but we are in the weeds here. When I say *we*, I mean that the information technology is available, but no one has really got a theatre or campaign model for simulation where you can actually train and test your battle staff. There are a lot of systems around, but I don't think any of them are any good. So this is another potentially very fruitful area of research and development. I don't even know what you might call it. It's not war gaming and it's not simulation, and it may or may not involve simulating actual systems as part of it. The technology is available but we haven't turned it into a single coherent tool just yet.

Dr Graeme Cheeseman: I would characterise, perhaps unfairly, the presentation you've given to us as preparing the RAAF to fight a Gulf-like war in the future or, expressed in another way, adapting second wave militaries to some of the implications of the third wave of development in information technologies but without making a *fundamental* change. It assumes essentially that there is an adversary - you mentioned 'adversary' a number of times - and that we will be involved in state-to-state warfare where one can control the activities of that adversary and so on. Yet it seems that this may not be the case in the future. The real source of threat to our information systems is not some external enemy, but 16 year old hackers (who might just as likely live *within* the country) interested simply for some intellectual reason or whatever other reward it generates, to tap into and destroy information systems and so on. Alternatively, the real source of insecurity, or threats to Australia in particular, might simply be the spin-offs of a collapsing economic order - failing states in the region leading to migration, or whatever. The kind of security future for Australia is not the one that underpins the sort of vision - a highly structured vision - that you've offered us.

Air Vice-Marshal Nicholson: It's not an 'instead of', it's an 'as well as'. I agree that the 16 year old hacker is just as much of a problem, and he may well be malicious. The Chief of Staff of the United States Air Force said that there was some concern that what was effectively three people having fun in their own way was, for a while, thought to be a significant attack, and one perhaps associated with what was going on in the Gulf. In a related way, perhaps no commander should really be comfortable unless he has, wandering around in his headquarters or in his wing, someone with a ponytail and a ring in his nose. There's no doubt it's a threat. There is no doubt that the situation you paint of some sort of disastrous collapse or catastrophe in the region is equally threatening. However, I would not accept that the state player, or the player that looks like a state and threatens us physically, has gone away. He will probably not go away for several decades at least.

So for the foreseeable future I see a combination of all these threats. The tools that I'm talking about are essentially useful for all of them. You still need the superiority of sensors. There's no doubt that you have to be able to counter a 16 year old just as you have to be able to physically destroy an enemy's command and control system when you can't do it electronically.

Wing Commander M. Toia: There's been much talk over the last few days about technology and advancements in speeds of microchips etc. One thing that always interests me in this, however, is how few people address the issue of human resource management. I'm just wondering what your comment would be regarding what's happened with the DRP (Defence Reform Program) - with the numbers of navigators and pilots increasing, and the number of electronics engineers, for example, being cut by 50 percent. We talk about the effort required to achieve information dominance in the future, yet it seems to me that one of the biggest problems we have is the lag in our personnel system to be able to respond to technological and sociological change. We seem to be saying that in 10, 20, 30 years time we're going to have a military force that is not as dependent upon the particular physical and mental talents which are required by the man in the cockpit, yet we persist in cultivating them. In the past we recruited people with hand-eye co-ordination, spatial awareness and all those kinds of things, yet what we're looking for in the future is a different kind of beast. Some of the people we might need are the ones we're giving away during the course of DRP, and we're going to have to grow these kinds of people again over the next 20 or 30 years. I personally think we've got our human resource strategy all messed up if this future that we're talking about today is even plausible. Do you have any comments on that?

Air Vice-Marshal Nicholson: First of all, let's make it clear what we need and do not need in blue suits. Essentially we need the people who are going to be exposed to danger to be in blue suites. I don't think the physical part of warfare is going to go away in the near term - not in the lifetimes of anybody here or their children, that's for sure. So we're still going to need people in blue suits - and green and white suits - to do that stuff. Now some of those people will have to be particularly skilled in some of the information technology that has been spoken about, but not too many. You wouldn't be employing too many of these people forward or exposing them to danger. So we could contract that out to a very large degree and solve a lot of the problems we have in the forces with moving people around and so forth. We have to keep enough of these people in blue suits to make sure that we are knowledgeable buyers, and most importantly, that we are knowledgeable about where the leading edge is. Several of the speakers so far have spoken in these terms. We need to know exactly what we need to know.

As for the actual aircrew part of your question: I think I've made it clear that that's not going to go away either. There's going to be a complex interaction between manned aeroplanes, unmanned aeroplanes and people controlling and tasking both of these from the ground and other airborne platforms - perhaps even in the future from space. So you'll still need those kinds of people in the foreseeable future.

How do we produce the sorts of people we need? I don't have too much of a concern about that. First of all, no matter how responsible an education system is, or an education training system is, it's never going to keep up with the kind of pace that we're talking about. The human brain can. We shouldn't try and structure it too much; we should let it roll. When you first bought your kids a PC you probably had in mind the

Encyclopaedia Britannica, and the kids doing their homework. Now I'll bet they're doing things you didn't even think were possible. Society adapts to the tools and things that are around it. I don't have any fear about us having the right kinds of people now or in the future.

THE RAAF AND THE KNOWLEDGE REVOLUTION

AIR COMMODORE B.J. ESPELAND

It is 5.30 p.m. on the last Saturday in September. Close to 100 000 people are streaming out of the Melbourne Cricket Ground, heading for places to celebrate or commiserate the fortunes of their favoured team in the Australian Football League Grand Final. The sky has become very dark and a soft drizzle turns quickly to heavy rain. As if on cue, hundreds in the crowd reach for their mobile phones, looking to make arrangements to ease the passage of their companions and themselves to their destination. All at once their mood turns to frustration and hostility as the mobile phone network overloads locally. The human condition of today holds high expectations of the power of communications and the flow of information. As we move into the next century these expectations will soar as continuing advances in microchip processing speed and the advent of photonics enable a much broader use of information systems such as the Internet and multimedia.

Photonics are radical new optical technologies that replace electrons with light as the medium of communication.[1] Available commercial photonic systems operate 200,000 times faster than the latest generation of telephone modems, while in the laboratory researchers have produced systems that carry two terabits, or two trillion bits per second. That's six times the volume of all phone calls on an average day in the United States. This optical breakthrough comes as demand for bandwidth intensifies to meet an Internet traffic growth of 30 percent per month. It would seem that we are only at 'brakes release' point as the knowledge revolution takes off.

That revolution is fundamentally changing the way we communicate and impacting in a similar fashion on organisational behaviour. Networking is the most effective and favoured form of exchanging ideas and accessing information in the new age. It is characterised by speed, informality, world-wide access, openness, cross-organisation contacts and a fair degree of anarchy. Among other things the process is undermining the controlled narrow, top-down method by which individuals are provided with information and changing the way in which people form associations, recognise patterns of information and make thought connections. As a result individual and organisational attitudes, work practices and values are changing.

AN OLD OR NEW PARADIGM
In terms of an outcome this is not a new paradigm. Twenty years ago Dr H. C. 'Nugget' Coombs saw a malaise in the Australian Public Service.[2] He recognised that command of information and the bases of analysis are the effective sources of power and that the hierarchy that was the Public Service of the day had institutionalised that power with undue top-level concentration to the detriment of the bureaucracy's efficiency and humanity. It wasted and destroyed the capacity and energy of the middle and lower levels of the bureaucracy and prevented it responding adequately to rapid and

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[1] Jonathon Marshall, *New York Times News Service*, 5 August 1997.

[2] *Royal Commission on Australian Government Administration*, Canberra, 1976.

unpredictable changes in the environment. The 1976 report of the Royal Commission on Australian Government Administration, which Dr Coombs chaired, proposed changes to build a cultural shift in the public service around a more appropriate distribution of power. The changes were promptly scuttled, thus making true Dr Coombs' own prophecy that 'It is these changes [to] which I anticipate resistance will most effectively be mounted'. The difference this time is that these changes are occurring in large, complex organisations, regardless of hierarchal opposition. This is the essence of the information revolution as it would impact on the organisation that is the RAAF today.

The RAAF, or perhaps more correctly the Air Force, must address this impact as it affects perhaps two distinct organisation arrangements; firstly the strict hierarchy of Air Force Headquarters (AFHQ) and the 'Commands',[3] and secondly the less-constrained operational units. There are those who would argue that large numbers of people capable of selectively gathering quality information and converting that information into knowledge means RAAF 'leaders' are no longer able to assert their authority by controlling knowledge; that within the Air Force bureaucracy, decision making authority and leadership styles must change; that as an organisational framework the traditional Air Force hierarchy has had its day; that the corporate entity needs to be dismantled and rebuilt to meet the pressures of the knowledge revolution.

ALTERNATIVE STRUCTURES

In looking for possible alternative structures for the RAAF, there might be some utility in examining a recent radical corporate restructuring in the private sector that has met with considerable success. Clearly, business practices cannot be applied wholesale to the military. There is a profound difference between an organisation whose *raison d'etre* is the bottom line of a balance sheet and one which exists to apply organised violence and whose members must offer themselves, if necessary, to the possibility of death. This difference, however, becomes less marked when comparisons are drawn between the military and the most successful companies in the corporate sector. A recent seminal work by James Collins and Jerry Porras has looked closely at what underpins the continuing success of large, complex businesses over the long haul (100 years plus). Their conclusions point to the fact that, contrary to conventional business school doctrine, profit maximisation is not the primary objective of the most successful institutions in the corporate sector. While these institutions do, of course, seek profits, their dominant driving force has been a central ideology of core values and a sense of purpose.[4] In this context such commercial entities are not unlike the military.

A good case in point is the firm Semco, Brazil's largest marine and food processing machinery manufacturer. Since he succeeded his father as head of Semco, Ricardo Semler has spent his time dismantling the corporate hierarchy and turning the traditional idea of a business organisation on its head. He began by throwing out all of the company rules - today Semco has almost no manuals or written procedures - and he insisted that the workers made the decisions previously made by the company executives. Employees set their own working hours and most of the managerial staff set their own salaries and bonuses. They all have access to the company books and vote on

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[3] This would include SCA (AF) and pertinent elements of other programs in the post-DRP environment.

[4] James Collins and Jerry Porras, *Built to Last*, London, 1994, p. 8.

important company decisions.[5] This unorthodox approach has been vastly successful. Semco has grown eleven-fold during a period of savage recession in Brazil and is now one of Latin America's fastest growing companies.

While Semler himself has acknowledged that some of his more extreme initiatives would find no application to the military, a look at the organisational structure he introduced into Semco proves to be most instructive as a benchmark for any organisational change the RAAF might consider necessary to accommodate the knowledge revolution. In conceptual terms as depicted in Figure 1, the Maverick Model comprises three concentric circles and some triangles. The small, innermost circle encloses a team of half a dozen people, the equivalent of the CEO and vice-presidents in conventional companies. They coordinate Semco's general policies and strategies and are called Counsellors. The second circle encloses the seven to ten leaders of Semco's business units and are called Partners. The last circle contains the operating agents with the title Associates. The triangles represent Coordinators who act as a crucial level of management. In Semler's model, the smallest circle would serve as the corporate catalyst, stimulating decisions and actions by those in the second circle, the people who actually run the company. Then would come the Coordinators, integrating the specific activities conducted by the operators.[6]
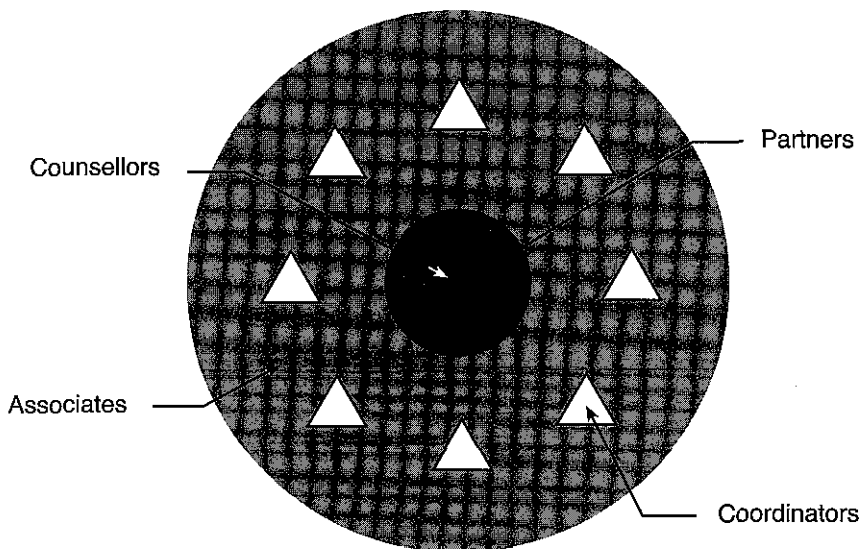
Figure 1.   Maverick Diagram

Semler's revolutionary restructuring stemmed from the failure of more evolutionary efforts to simplify Semco's structure and prune away managerial excess. He had come to the conclusion that real performance improvement was not possible

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[5] Ricardo Semler's book *Maverick!*, (Arrow Books Ltd, London, 1993) about Semco, has provoked intense discussion among senior management in top corporations around the world. He is now a highly sought after speaker at business seminars around the world.
[6] *Ibid.*, p. 153.

until the heart of the problem was addressed: the pyramid model as the basic organising principle of the modern corporation. In his view:

> ... the pyramid ... turns a business into a traffic jam. A company starts out like an eight-lane super highway - the bottom of the pyramid - drops to six lanes, then four, then two, then becomes a country road and eventually a dirt path, before abruptly coming to a stop.[7]

THE RAAF PYRAMID

As depicted in Figure 2, the RAAF conforms to the pyramid shape. In doing so, it accords with the shapes of most modern military organisations and reflects the broad organisational changes to war-fighting entities that have been moulded by many changing factors over the millennia, and in particularly since Napoleonic times. These factors include technological developments in the fields of weapons, intelligence gathering and communications, the raising of standing armies, the primacy of the nation-state in international affairs, the decline of sovereignty (in its original sense), and the custom of law as it would apply to war. As a result the generic military organisation has burgeoned to become a hierarchical construct with a top-level concentration of institutionalised power.

Figure 2.   **The RAAF Pyramid**

    I would argue, though, that there is another way of looking at our RAAF Pyramid. If we look within the pyramid for its conceptual framework it starts to come across as a relatively simple construct. In these days of an ongoing call for downsizing through flatter corporate structures, we tend to overlook the fact that military organisations of today comprise but four levels of management (command) and operate at only three levels for business (the levels of war). In this light, it starts to look

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[7] *Ibid.*, p. 149.

remarkably similar to the Maverick model: starting with a clean sheet of paper, Semler had re-shaped Semco to operate with four levels of management and three levels of business. This understanding, although seemingly uncomplicated, represents an immense change in the conceptualisation of the Air Force as an entity. The refocussed conceptualisation is not unlike the mind-shift of changing our belief system from a geocentric universe to a heliocentric one; our day-to-day observation of events and activities is seen in a different light and our underlying understanding and knowledge offers new opportunities in explaining behaviour and predicting outcomes. In this way, we move from a perceived restructuring imperative to accommodate the knowledge revolution to an emphasis on re-engineering Air Force's governance;[8] or to be more specific, an examination of the Air Force's processes, its leadership, and its culture. Again, comparing the Semler managerial model with the traditional defence pyramid model proves instructive, at least as a starting point.

AIR FORCE GOVERNANCE

While both models can be seen as structurally similar in conceptional terms, a look at their governance arrangements, especially in terms of the relationship between organisational processes and the individual reveals a fundamental disparity. In looking at the organisational 'distance' between the CEO and company 'action', the question arises of whether there is genuine devolution of significant decision making authority in both models. The answer to the Semler case clearly is, yes, there is; the predominant feature of Semler's business principles was the infusion of authority and energy to the middle and lower levels of his company. For the RAAF's case, the answer is much more problematic. The key point here is outcomes. It is far easier for a CEO (or lower level manager) to let go when the bottom line is (say) washing machines and profits are rising, than it is when the bottom line is state-organised violence and public financial accountability. Indeed, devolution of authority for a military organisation like the RAAF will always be bound, in the final analysis, by the expectations of society and government in terms of moral accountability.

If we accept this point, and also acknowledge that, from a structural viewpoint, the RAAF's pyramid model is conceptually sound, then we simply serve to highlight the chain of command as the centre piece of RAAF governance and, most importantly, to accept the essentiality of its integrity despite the threats and opportunities offered by the knowledge revolution. To those of a conservative mind, wedded to the traditional approach of organising military forces along hierarchical lines, this conclusion perhaps sounds self-evident or even trite. However, it is only by first re-affirming the continuing, and arguably the increased relevance of the command chain to the RAAF that we can properly identify and start to deal with the impact of the knowledge revolution.

WHO'S IN CHARGE?

For a start, this understanding begs the immediate question of how well the command chain is standing up to the anarchical and devolutionary pressures inherent in the knowledge revolution; or to put the issue in more colourful terms - Who's in Charge? Already there is evidence that the command chain is not coping to the extent that it is not optimally positioned in areas that I would characterise as information technology

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[8] The term 'governance' is used to bridge both the war-fighting and bureaucratic streams of the RAAF.

(IT) development, decision making processes, and long term organisational health. We will take a look at each of these areas in turn.

COMMAND AND IT

The RAAF does not have an information technology structure which directly supports business processes. A simple ideal model practised invariably in most large businesses is to have an information technology manager who is the right hand for the CEO. It is a specialised, pivotal position where the information manager must understand many business processes as well as the CEO does. This lack of a responsible IT manager means that technological solutions often happen piecemeal without the full costing, repercussions or advantages of technological changes being understood by senior management.

Perhaps, then, it should come as no surprise that the RAAF Network was put in place with only general concepts on its use. By any systematic guidelines, this was back to front, providing an automated solution to an undocumented problem. (Compare this with the introduction of the Air Command Support System which is being introduced to meet the Air Commander's specific requirements.) The ramifications of this lack of direction in rolling out the RAAF Network should not be underestimated.

As Peter Drucker has pointed out, one of the central management challenges in the post-industrial or knowledge-based world is how managers can establish a work environment that ensures both productivity and innovation.[9] Many emerging practices across the RAAF Network deliver neither. In the absence of direction from the chain of command, the unstructured chaos of the Internet has simply been replicated on the Intranet of the RAAF.[10] Users are keen to 'push' information onto the net, information that is more often than not out of date. Moreover, with most RAAF personnel now using a workstation and powerful office tools they are free and encouraged by their relative independence to consume significant amounts of time and system capacity in developing overly-sophisticated packages of information to 'push'.

While the strength of the Internet is its lack of structure, it is the weakness of an Intranet. The unpredicted amounts of information available have little, if any, potential to form the basis of knowledge. To emphasise the point in print rather than in electronic terms; a vast room of unsorted and uncatalogued books is not a library. Organisational information is a critical resource and should be treated as the highly valuable commodity it is. This suggests that a 'pull', rather than the extant 'push', approach is needed. The power of any Intranet can be readily harnessed using a net navigator application to find pertinent databases, together with a web based inquiry tool to query the data. With the additional requirement for some much-needed protocols and other forms of standardisation, the RAAF's Intranet can be re-shaped to deliver productivity in this knowledge-based world.[11]

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[9] Peter Drucker, *Australia's Business Review Weekly,* 15 September 1997.

[10] The Intranet icon itself reinforces this point, being titled 'Internet Explorer'.

[11] A good example would be the still developing Hornet Weapon System Master Planning information distribution which uses an Open System Environment (OSE). This is in line with the Commonwealth Government's global open system policy which looks for a comprehensive set of interfaces, services and supporting formats, plus user aspects, for interoperability or for portability of applications.

The policy framework and implementation oversight to drive this outcome, though, must come from the business process owners - that is, the Command chain. In the Defence Reform Program (DRP) environment, the support of the relevant enabling program (Corporate Information Program) will be required and this may present problems in the short term given the nascent development of that organisation. In the longer term, however, this issue of 'Who's in charge?' should not prove too difficult to handle, but the matter of decision making processes and the knowledge revolution offers a far more formidable challenge.

COMMAND AND DECISION MAKING PROCESSES

As noted previously, the context of governance and the command chain is used in both a war-fighting and bureaucratic sense. In looking at decision making processes this will continue to be the case but, by virtue of the very nature of the RAAF, the argument goes *more to the former sense than the latter.*

Developments in the Revolution in Military Affairs (RMA) have increasingly focussed on command and control systems and a look to alternate futures should see this trend continue. At the heart of these developments is the search for systems that offer knowledge of a rapidly changing environment together with clarity and precision in intent and execution. For armed forces in general, and air forces in particular, this has seen a growing capacity for increased centralisation. The risk here is that the urge most humans have to retain control, and which is accentuated in a hierarchical organisation, will feed off the opportunities offered by the modern information systems in a knowledge-based world and cause commanders to over-control. According to General Charles Horner, the Joint Force Air Component Commander in the Gulf War, he had to often resist the temptation to intrude inappropriately into his command and control system and subvert its integrity.[12]

The irony here is that there is a much greater risk of the knowledge revolution offering opportunities for unauthorised personnel at the lowest levels of the command chain to subvert the system. When American forces conducted Operation Just Cause in Panama in 1989, some soldiers unofficially took cellular phones with them. Two years later, soldiers took commercially purchased GPS receivers into the Gulf War theatre. Within five years from now US soldiers will be equipped - officially this time - with miniature devices enabling then to instantaneously view battlefield scenes beamed to them by surveillance aircraft or satellite.[13] To see where this is leading, I believe Al Stephens' observation that 'a command and control system reflects an institution's *culture* just as much as it does its technical competence'[14] is most pertinent.

The RAAF's culture with respect to the use of knowledge is already changing. Individuals, acting in good faith, are increasingly prepared to work outside the chain of command. A simplistic approach to address this problem would be to demand compliance with the command chain, and the RAAF's hierarchical structure would give considerable effect to this, but that would grossly underestimate the powerful cultural-shift forces that have been unleashed by the communications and knowledge revolution.

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[12] General Charles A. Horner 'New Era Warfare', in Alan Stephens (ed.), *The War in the Air 1914 - 1994*, RAAF Air Power Studies Centre, Canberra, March 1994, p. 327.

[13] *Defense News*, Vol 12 No 44, 3-9 November 1997, p. 1.

[14] Alan Stephens, 'The Changing Face of Command and Control', a paper delivered at the Royal Norwegian Air Force Air Power Symposium, Trondheim, Norway, 10-12 February 1998.

We can gain some insight into the power of those forces by looking at the pattern of democratisation that has followed in the wake of mass communications as they have spread around the world. Gwynne Dyer[15] has argued that this fact illustrates the propensity of the human race to take advantage of new technologies and evolve towards a global culture based on equality and the rights of the individual. Dyer cites the 'people power' revolution in Manila in 1986 and the unsuccessful attempt to emulate it in Beijing in 1989 as examples of this cultural shift. More recently Wei Jingsheng, the exiled dissident, pointed to an extraordinary document that has emerged from China. Nourished by the Internet, a well organised group of middle and high-level government officials have offered a manifesto for political, legal and economic reform, democracy, press freedom, religious tolerance and autonomy for Taiwan and Tibet. Wei noted that the document has been distributed to members of the Party's Central Committee and regards it as a direct challenge to conservative forces in the leadership.[16] I would argue that a similar phenomenon is now occurring in modern military organisations. This is not to suggest that knowledge-based opportunities for individuals in the military will give rise to dissent but it does mean that they will be more prepared to exercise their judgement inclusive of working outside the command chain if they deem it to their service's advantage. The implications for command and control are profound.

The important thing is to tackle the issue in a positive sense. While many successful businesses now function as networks rather than hierarchies to capitalise on the quantum advance in speed and flexibility of decision making offered by the knowledge revolution, military organisations like the RAAF will be afforded no such luxury. Constrained by a hierarchical organisational structure, the RAAF command chain will need to develop control arrangements that allow an appropriate distribution of power and authority, thereby exploiting the positive characteristics of networking. The questions are: how much and by what means? Only in this way will the RAAF become fully confident of accommodating the cultural changes rendered by the knowledge revolution.

The problem is that we know little about the behavioural relationships at work here. In an interesting presentation during the conference to mark the opening of the new Defence Science and Technology Organisation (DSTO) laboratory at Salisbury, Greg Marsh has pointed to the nub of the problem.[17] Command and control systems have been built on the application of the techniques of the 'hard sciences' like physics, chemistry, engineering and computing. These rely on reductionist science in which all parameters of a system are held constant; one is varied and the resulting changes in the others are measured. Warfare in the knowledge-based world, however, will be based on the performance of human and social systems, which by their nature cannot be understood by reductionist science. Boulding's 'hierarchy of systems model' (see Figure 3) puts the issue in better perspective.[18]

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[15] Gywnne Dyer's thesis is taken from a presentation on globalisation and the nation-state, ADSC Conference, Canberra, 12 November, 1997; Gwynne Dyer <a_mars@compuserve.com> on 14 January 1998.
[16] Michael Sheridan, *The Australian*, 3 March 1998.
[17] Greg Marsh, 'What Kind of Science Wins Knowledge Based Warfare', presentation to DSTO, Salisbury New Laboratory Opening Week Conference, 2 September 1997.
[18] Kenneth E. Boulding, 'General Systems Theory', *Management Science*, April 1956.

GENERAL HIERARCHY OF SYSTEMS
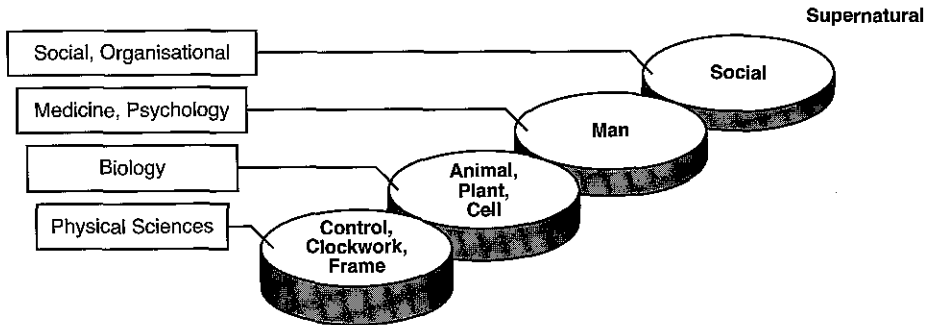
Figure 3.   General Hierarchy of Systems

This model arranges fields of understanding according to a hierarchy of complexity of organisation. To date, efforts to find a reliably predictive basis for command and control systems has concentrated on the first 'stepping stone'. Contrast this with the modernisation of the study of war in an historical context. Michael Howard at London University devised the now famous 'width-depth-context' formula for the use of military history in the armed forces. That is, that officers should study military history comparatively (that is, in 'width'), by wide reading of sources (that is, in 'depth'), and by treating it as a reflection of social forces (that is, in 'context'). John Keegan at Sandhurst exposed the fallacies of the 'tidy-battlefield' by focussing on the sociology and psychology of combat experience. The development of command and control systems that will operate to an acceptable level of predictive reliability in a knowledge-based world requires a similar approach.

Perhaps the answer lies with the application of chaos theory and, more importantly, complexity theory. Even relatively simple systems driven by known causal equations can, under some circumstances, behave unpredictably or chaotically. The most quoted example is weather modelling, where atmospheric physics are well understood, but small inputs can have unpredictable and dramatic outcomes. This is the so-called butterfly effect; where the flap of a butterfly's wings in South America can cause a hurricane in Florida. More recently, though, scientists working on non-linear systems have moved beyond chaos theory to what has become known as complexity theory. While chaos theory can tell us a lot about how certain systems can give rise to complicated dynamics, it has little to offer in explaining the inexorable growth of order and structure in societies, economies and military systems. This is where the field of complexity theory is starting to offer some insights into the properties of these systems. Research to capture and harness the power of these discoveries, that steps across each of the system's hierarchical 'stones' and into the 'soft' sciences, will be fundamental to the RAAF adequately addressing the challenges brought by the knowledge revolution upon its decision making processes in both a war-fighting and bureaucratic sense. We have a long way to go in this area.

COMMAND AND ORGANISATIONAL HEALTH

We also have a long way to go in addressing the *final* 'Who's in charge?' issue facing the RAAF command chain - the long term organisational health of the service. In this case, though, the way ahead is a lot clearer.

Cultures that are not adaptive take many forms. In large corporations, they are often characterised by some arrogance, insularity, and bureaucratic centralisation; all supported by a value system that cares more about self-interest than about customers, stockholders, employees or good leadership. In such cultures, managers tend to ignore relevant contextual changes and cling to outmoded strategies and ossified procedures. They make it difficult for anyone else, especially those below them in the hierarchy, to implement new and better strategies and practices. And they tend to turn people off - particularly those individuals whose personal values include an emphasis on integrity, trust and caring for other human beings.[19] This observation is arguably even more applicable to military organisations.

In the face of the cultural-shift forces stemming from the knowledge revolution, it will be of fundamental importance to guard against imbedding within the RAAF any long term institutionalised power that promotes the type of culture described above. The key here is the need to ensure that RAAF leadership is intuitive, progressive and vibrant at all times. In a world of controlling and managing knowledge and those who would use it to best effect, it will be necessary then to recognise merit rather than seniority in placing individuals in the workforce. This will mean fast-tracking the best people into the most important jobs as soon as possible. In this regard, many would cite that Bill Clinton was President of the United States of America at the age of forty-six, while others would point to the fact that the armed forces of nations such as Singapore and Israel are regularly headed by officers even younger. A policy of less emphasis on seniority and more upward mobility will also address Henry Kissinger's dictum that it is an illusion to believe that leaders gain in profundity while they gain experience in any job. The convictions which senior officers have formed before reaching the pinnacles of their careers tend to be the intellectual capital they will consume for as long as they continue in office. It will be to the prejudice of the long term organisational health of the RAAF if fast-tracking is not introduced forthwith.

In advocating such a policy I am in no way suggesting that some of the more traditional attributes of military commanders and managers will not be needed for the future. For a start, there is the verity that the digital literacy sought for the future is firmly rooted in print literacy.[20] Command of the latter medium will remain a pre-requisite for recruitment to, and promotion through, the RAAF. In a similar vein, there will continue to be a need to acknowledge the intellectual imperative for certain elements of a liberal education. This will particularly apply to the field of military history to guard against a materialist approach to war. In a knowledge-based and electronically networked world, there is a real risk of fostering an Air Force culture based on functional expertise in which war is seldom viewed as the holistic and social phenomenon that it is. Indeed, this leads to the crucial matter of education in the operational art of warfare.

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[19] John P. Kotter and James L. Heskett, *Corporate Culture and Performance*, New York, 1992, pp. 141-42.
[20] In an otherwise excellent analysis of the cultural relativism that the Internet brings, Paul Glister skates over the means by which we acquire the highly sophisticated digital literacy he describes; *Digital Literacy*, New York, 1996.

This is the commander's domain, but a realm rarely held by Australian military leaders in practice. The military history of this nation has been one of subordinate status to immensely powerful allies who have provided only the most limited of opportunities for Australian commanders to exercise the art of operational level warfare. Not surprisingly, education in operational art has reflected a similar paucity. The danger here is that, in the RAAF's search for technical competency of warfare in a knowledge-based world, we will continue to sideline the pursuit of the mastery of war as an art. The military mind must be developed by systematic training in, and exploitation of, the latest technology; it must also being tempered by a progressive education and increasing experience that goes to the operational art of warfare. The RAAF is no exception in this regard.

CONCLUSION

It has been evident that I have tended to take a middle line with regard to the issue of hierarchal versus network-type structures in shaping a military organisation for the knowledge revolution. In doing so, I would argue that I have been most sensitive to the inherent flaws in any hierarchal order and the special dangers that they will pose in the *post-industrial* or *knowledge-based world*. I have also acknowledged the fulsome benefits a network-type structure can bestow to large, complex organisations as exemplified by the Maverick model. At the end of the day, though, the nature of military business itself precludes any move away from the hierarchal norm that is the pyramid. The bottom line here - and I regard it as immutable - is the accountability of the military in financial, legal and above all, moral terms to society and government. The challenge for the RAAF thus becomes one of accommodating the devolutionary threats and opportunities of the knowledge revolution in what might be described as 'the networking pyramid'. To counter claims that this is an oxymoron, I have pointed out that at least in conceptual terms, the RAAF pyramid has strong parallels with radical new network-driven structures and that, as a result, the RAAF pyramid should not be seen as inimical to some form of flexible, devolved organisational system.

What is *not* clear is what form this system should take; what *is* clear is that the command chain, as the centre-piece of RAAF governance, must control both the development process and the end result. I have particularly identified the areas of IT systems, decision making processes and long term organisational health as prime targets to address. In the case of IT systems, I believe that the RAAF command chain can do much more to take control of their use and in doing so, reign in the ineffective and wasteful practices already in place. For organisational health, I contend that vertical mobility or fast-tracking in the workforce requires immediate implementation. I have also pointed to the need to balance, in a knowledge-driven world, technical competence with the understanding of war as an art. It is the final area of the RAAF's decision making processes, inclusive of command and control systems, that warrants the most careful attention.

I would emphasise that this is the area of RAAF governance most exposed to the knowledge revolution; that networking and knowledge-gaining forces at all levels will not be denied the devolutionary cultural shift they portend; and that the power of these forces needs to be harnessed and controlled in a positive sense by the command chain. Much more understanding of control systems that will provide an acceptable level of

predictive reliability in a knowledge-based world is required and it seems it will be necessary to move beyond the reductionist sciences into the fields of human and organisational performance to gain that understanding. Only then will we be able to provide an unequivocal - and the correct - response to the question of 'Who's in Charge?'

DISCUSSION

Group Captain S. Peach: In the UK we have set off down the joint road. We've formed the Joint Services Staff College and Permanent Joint Headquarters; we're looking at joint warfare centres, joint doctrine centres, and so on. And, of course (to be slightly controversial towards that testing of the limits) in the joint environment if you're not careful the colour khaki quickly emerges. So my question in organisational and structural terms is actually quite a simple one: how do we not just apply the changes that you've hinted at and advocated in a *single service air force* sense, but also ensure that we take those changes forward to what is increasingly likely to be a joint military environment?

Air Commodore Espeland: General Connolly was here yesterday. He is our senior operational level commander - COMAST (Commander Australian Theatre). If he were here now I would ask him to answer that question. I know the answer he would have given, and it wouldn't have been, I think, a great deal different than the thrust of the paper that I've just presented.

I think there *is* some organisational baggage across all three services. I think it's arguable that the long traditions of armies and navies mean that this baggage is heavier than that carried by airmen. But it is also true that across all the three services, particularly as we move more and more towards a joint environment, people are becoming more progressive; that officers are aware of these issues. I have a degree of confidence that it won't just be the Air Force that'll be interested in these issues but all the services, indeed the ADF.

We're not actually fully integrating our staff colleges, but we are co-locating them and we will have a partial integration of their courses in about the next three or four years. I think all these things are helpful in progressing the sort of issues that are inferred by your question. But I'm confident that Army and Navy - the whole ADF or, in your context, all of the Defence Force - will come along with airmen, but they might travel a bit more slowly.

John Warden: I'd like to challenge a couple of the things you put out in the first part of your presentation which I think become central to whether your conclusion is correct. You described the hierarchical form of the RAAF as not being significantly different from the 'maverick model', but I suspect that there may have been some oversimplification in there. That oversimplification, which is reasonable at one level, may be confusing at another. It is at this other level where we can see there are headquarters, commands and units etc. There, in fact, we do have the multiple levels of command that are inherent in our rank structure: four-star generals, three-star generals, colonels, lieutenant colonels and so on. We all know from experience that each one of

those grades expects to have certain prerogatives that are largely defined by passing information up and down. So I suspect that if we look at that next level of analysis, we will find that what looked like a fairly clean four layer system, is in fact much more complex.

The second point is that almost any system will work when it's not badly stressed. The 17-layer command structure we have in the United States Air Force works satisfactorily when it's not badly stressed. During the Gulf War - in the build-up and actual execution - it was obviously very heavily stressed. Almost instantly the system allowed (and in fact encouraged) the development of a completely alternate structure which was really very much a cellular system or neural network that moved information and made decisions at a rate demonstrably faster than the decision making capability of the still existing hierarchical structure (which was simply bypassed). So we had an example where, under stressed circumstances, the institution simply had to go to a different organisational structure in order to survive, and indeed, to fulfil its public obligations. Interestingly, as soon as the stress was relieved, it went back to where it had previously been, because it no longer had the stress and it could go back to the zone of comfort in which it liked to operate. So I throw those two things out for your comment.

Air Commodore Espeland: In respect of the first part of your observation I would agree. However, what I was looking to point towards is that the very simple concept of the four levels of command and the three levels of business needs to be preserved as you move down to the lower levels. In the staff process, we're seeing this happen already. It used to be that within Air Force Headquarters the two-star (the Deputy Chief) would have the information come up through the major, the lieutenant colonel, the colonel and the one-star. But the practice now is that the Deputy Chief goes straight to the desk officer. He is looking to pick up on the concept that I talked about, so that at his level of business or level of command, they're seen as one entity and not introducing unnecessary complicated layers in between. But you're quite right; the rank structure itself breeds that sort of approach so we've got to be on guard against it. I wasn't saying that those multi-level layers don't exist. I was saying that we've got a clean concept, let's move towards it and cut out, not necessarily the layers, but the processes.

You mentioned system performance under stress and then reverting back to the peacetime mode. It brings to mind a dictum that is very much on our minds at the moment within the Australian defence organisation, and that is that the Defence Reform Program is driving us towards structuring for war and adapting for peace. We are increasingly looking at ensuring that all of our processes, our structures, and our lines of business are orientated towards war-fighting. In other words - albeit in a time of peace and despite the pressures of our rank structure, the baggage we might carry, etc. - we *are* moving towards refining the system so it will be ready for war. Rather than move to something that is unknown at the time (to cobble something together), even if our practices are not *exactly* aligned in peace to war, we know we've *practised* those organisational arrangements and that the basic processes are in place.

Air Commodore D. Bowden: I'd like to agree with John Warden's comment, that there is a tension between the way you organise the structure and responsibilities and accountability, and the way you handle information. I run a theatre level simulation mechanism which is directly aimed at operational level headquarters, and as recently as six months ago we put a stress in a CPX (command post exercise) on a headquarters.

We put in the simulated war game load of information currently in the doctrine in the books. We did not try to put in intranet information and stuff like that; we simply put in the standard messages that everyone expects to occur from a high level simulated war game for which we had real missions flying. We stopped the command support system in less than a day. It ground to a halt; it could not handle the load. It was declared off line and we started printing paper and handing paper.

I would challenge this audience to bear in mind that what we're saying is actually not what we can do today. We can, by simply following today's procedures, grind that system down until you have to use an alternate system. I think that what John Warden has said is that unless you do actually stress it regularly and prove it, you'll end up using alternate means. In our case the alternate means was paper - we printed and passed paper. This is probably not a question so much as a comment to put things back in perspective. What you do about it is probably the question. Where do you go? Quite frankly the only way you're going to find the answer is to play this game again and again until you either find a way to ensure your systems can handle the load, or you adjust your procedures to the way it's really going to be. We need to take one option or the other. A present we're saying one thing, but we really can't do it.

Air Commodore Espeland: I wouldn't add to that observation in terms of your experience. However, I would add something that has been picked up before: that while we're having difficulties in the workplace getting on top of developing these systems then - from my role as a training commander - it's even more difficult to train and educate people. Until the workplace arrangements are in place, then training and education presents its own extra difficulties. It just reinforces the need for all this to happen at a very fast pace. We've got a lot of catching up to do; we've got a long way to go.

Richard Szafranski: I have observed (and this may be incorrect) that in business, technical competence is evaluated separately from moral competence; that they can be isolated and one can be fast-tracked based on technical competence. It seems in the armed forces that they're so closely wed that technical competence alongside moral *incompetence* is a disqualifying deficiency for senior command and that we grow at different rates. Is there a danger, since this moral competence is only developed over time, in fast-tracking when we haven't sufficiently tested a person and tempted a person to see their true moral competence?

Air Commodore Espeland: It is a danger, but I think it can be addressed. It is a matter of training and education, but is more importantly shaped by experience and exercise. It requires personnel management processes that identify the right people and test them progressively and, in doing so, forge that moral competency you've spoken about. There are other armed forces in the world that already do this. You're quite right; the risk there is extreme, but I believe it can be handled and that the initial selection for fast-tracking is no guarantee that you're going to pop out the other end. There need to be appropriate hurdles put for you to get over at appropriate times, and they need to be very carefully selected.

Wing Commander B. Sutherland: You were talking about the shift towards the network organisation. I would suggest that, in fact, when an organisation is under stress it *does*

network. If we look at K95 (Exercise KANGAROO 1995), the air organisation that was set up was inadequate, I believe, and people resorted to cross functional communication (or in simple terms, the *buddy* network). If we're talking about going to networking we need to remember we're a fairly conservative organisation - based on power structures - and when people are kept within that culture they tend to work within the rigid structures and remain inflexible. How would you propose that the air force addresses the cultural question in going to the network organisation in the future?

Air Commodore Espeland: I don't think it's a matter of opposing it: it's going to happen. My mind-set is very different from the mind-set that was evident in the question posed to Dick Szafranski earlier. The networking Internet based lifestyle is here, and these are the people coming into the service today. As I said, that cultural shift cannot be denied; it's a matter of harnessing it. You are quite right; in times of stress the propensity to network will increase, so it's a matter of coming to grips with it.

Now, I've only posed the question. There needs to be some devolution of authority - that's quite clear - but to what extent that can occur without undermining the integrity of the command chain and, in so doing, pulling the rug from under that moral accountability issue that I put down as a line in the sand, is less clear. All these things remain to be seen, but they are something that perhaps we can start to address sooner rather than later.

I was talking with John Warden over lunch, and when John was Commandant at Command and Staff College at Maxwell, Alabama, he dispensed with the individual approach to work outcomes. In other words, people were not required to put in various theses and examination papers individually, but they were required to do it in groups or in a networking process. John's experience was that the quality surpassed anything that had been delivered over the past 40 years. So there are ways even now, I think, of starting to take very small steps. However, the big issues like what's actually occurring in terms of the behavioural relationships in the context of a networking pyramid, are most difficult.

OBSERVATIONS ON THE CONFERENCE

AIR VICE-MARSHAL E.J. MCCORMACK

My task this afternoon is to provide observations on the conference. I'll do this for presentations individually, and then collectively.

We opened this conference with Air Marshal Fisher outlining the background of the previous conferences that we've held, touching on the topics covered since the first RAAF air power conference was convened by Air Marshal Funnell. Air Marshal Fisher also stated the aim was to challenge conventional wisdom. I believe that has been done in the last two days.

Our Minister for Defence, the Hon Ian McLachlan AO MP, then provided the keynote address. He said the conference was to be 'both practical and provocative'. Further, the Minister stated that the Australian Government's aim was to remain pre-eminent in the region, and that knowledge was the key to enable the ADF to be precise in its intent and action. He then covered some of the political aspects of military acquisitions.

I believe this was a timely reminder that, in a democracy, the rate of change is what the public will allow, or what the politicians perceive the public will allow. Since the ADF is responsive to our politicians in Government and they in turn work for the benefit of all Australians, we must keep in mind that, ultimately, the ADF serves all Australians.

Importantly, the Minister announced that there will be a discussion paper on replacement strategies for the F/A-18. This is an important development for the ADF and, in the ensuing months, the task of commencing forward planning for our next generation of fighter aircraft will begin.

Following the keynote address, Air Marshal Fisher launched the third edition of the Air Power Manual and outlined its content. Even though the manual is a fairly small book, I can assure you it had a very difficult birth. Once again, some conservatism was evident in its evolution and quite a few people objected to the significant change. At this point I would like to mention that Dr Alan Stephens and Air Commodore Westmore (retired) were the authors of a lot of the original thought behind this booklet, and I'd like to pay tribute to the work they did. Please read this latest edition so that you may better understand the RAAF's future doctrinal initiatives.

General Ryan gave us a view of new world vistas, an excellent follow-on, by projecting doctrinal issues into the next millennium . It was the perspective of 'one of the types of Air Forces', in this case the only one. Most interesting were the use of the terms 'reach-back' and 'halt-phase warfare'. I must give it to our American allies, they come up with a lot of new names. 'Reach-back' I interpret to mean having secure lines of resupply so that expeditionary forces can deploy with minimal logistics support and rely on the principles of 'just-in-time' supply. Additionally, General Ryan discussed at length the concept of 'halt-phase', giving historical examples of the concept's utility as far back as the Battle of the Bismarck Sea. I believe that it's very important for us to understand what is meant by 'halt-phase' because it requires the rapidity and flexibility

of air power to produce a successful outcome. We airmen assembled here need to keep abreast of developments in the 'halt-phase' concept.

This led to a discussion on coalition warfare. It seems to me that, while it's a lot easier to conduct operations within your own service and your own country, it is imperative now for political purposes that we work together on developing coalition doctrine. I was glad that Group Captain Roxley McLennan asked the 'Dorothy Dix' question about the civilians in the Areas of Operations (AO). It's something that has been troubling us for quite some time, because there are a lot of people in Canberra who believe we can use the civilians in the AO all the time no matter what the circumstances.

Another point I took from General Ryan's presentation was that he mentioned people. I've found throughout my time in the RAAF that we tend to be technologists, and are all too worried about shiny machines even though we frequently mention that people are our key assets. I'm not sure we make our personnel our top priority and suspect we sometimes we pay lip service to their importance.

The bottom line from this presentation for the other types of air forces, like ourselves, is that while we should draw lessons from the vast experience that the USAF offers, we must adapt them for our local conditions. There is no way we can have the layered approach that the Americans have been able to create.

Mrs Natalie Crawford followed General Ryan, discussing the impact of technology in the next quarter century. I found this to be a fascinating presentation and I'd like to hear the full version, because I'm sure that it was just a 'once over lightly' on a vast array of information. There were two particular comments that I think were very good. First, the comment that 'we're not alone', and second the statement, 'I like nukes' I'm not sure they're both for publication.

On a more serious note, a particularly interesting issue for me were the comments about UAVs. Mrs Crawford graphically mentioned that she wouldn't fly across the Pacific in a UAV, just yet. I believe this comment is important because there is a lot of pressure for us to go into the next phase of aircraft: totally UAVs. I agree that it has to be very carefully done and we shouldn't commit to their usage without a serious understanding of their strengths and weaknesses. I think I'd also take Mrs Crawford's advice that we should proceed 'not just yet'.

Another point that attracted my attention was that of the unintended consequences of change. We have already seen some of these unintended consequences in our latest changes under the Defence Reform Program. Defence forces can save initially by reducing capability and personnel, but what will be the full cost in the long run?

Mrs Crawford also mentioned that future military personnel must have business skills. We also need to be careful that we do not develop too many generalists, which may deprive us of the specialists we require to do our primary business properly. But, I add, we do need specialists in business areas like we need in combat areas.

We were also treated to a fascinating exposé of technologies currently being developed and also those still in the conceptual phase. This included phased array lasers, hypersonic propulsion, 'no moving parts' engines, 'speed of light' computer processing, micro electromechanical systems, biological and chemical detection, sensor fusion and multiple UAV use. I'll be watching these with interest in the future and I think they will be very interesting developments. In all, a most interesting presentation.

Dr Brabin-Smith followed Mrs Crawford's US technical update with his presentation on the impact of technology from an Australian perspective. His talk was based on our latest Strategic Review of 1997 and the force structure priorities contained within. The bottom line list of changes include :

- Increased coalition warfare
- Increased interdependence
- Increased reliance on knowledge technologies
- An increase in the rate of technological advance
- Revolution in war-fighting
- Revolution in force development and acquisition processes

I don't think there would be too many arguments about that list. The real issue here is how we handle these changes; how we handle the increase in coalition warfare, for example. There is also the contentious issue of how we will plan such warfare. This contentiousness was demonstrated later when some of our speakers disagreed with this concept of war-fighting.

Next, Dr Graeme Cheeseman entreated us with his views on alternative futures. Like all good arguments, Dr Cheeseman gave a strong historical basis for the many alternate models presented. The question that was most interesting was that of where the traditional defence force model fits into these alternative futures. I must admit that I was a little disappointed that while the challenges presented by the models were highlighted, there were not many solutions forthcoming. There was criticism of the hierarchical structure, but only hints of better models. Maybe, Dr Cheeseman's point is that the challenge for us is to actually to come up with better solutions to our present system.

Planning to win was Colonel John Warden's contribution to this gathering: 'War winners, not war fighters', was his theme. I was fascinated by the changing energy states approach to planning and I think this is a good model for us to follow. I was also interested in the statement that we should focus on the strategic plan and that tactical mistakes are less important than strategic blunders. We've often been taught that it's the other way around and I believe that's something we should keep in mind.

Colonel Warden's comment that 'It's not your father's Air Force' particularly caught my attention because even now the Royal Australian Air Force is not the same Air Force that it was ten years ago, and in five years time it will surely be a different Air Force again. I see that my Air Force, the Royal Australian Air Force, for all sorts of good reasons, changed in the name of efficiency from what we had at the end of the Second World War. We got rid of a lot of the deployable fighting units; we had our squadron as the smallest element that went off to fight; we put bricks around our infrastructure (that is, we fixed them in specific locations); we confused our levels of maintenance so that they were all in 'brick' accommodation - and it wasn't until we started to reform our flying Wings that, in fact, we started to think more and more about fighting wars. I believe whole-heartedly that in the next five years we'll end up with a much more focussed Air Force that will be better organised for war.

Moving away from our region, Sir John Allison offered air power lessons gained from a European perspective. This is a perspective from one of the larger 'other types of Air Forces', but still one with capability and the capacity far beyond the Royal Australian Air Force. Sir John covered the changes in their operations since the Cold War. A cynic could say they were looking for self-justification, and I've heard that on a

few occasions about the US and their involvement in Somalia. I'll leave that for you, however, to judge.

Sir John did raise some other very salient points: who is the enemy? and where are they going to be? He raised important questions on the levels of readiness required and its dependence on who it is that we are going to be up against. I think they're very good questions. There was also the question raised about compatibility between coalition forces. Will British defence forces be able to work with the Americans in future conflict? We must also ask that question of ourselves (and there were some answers offered in some of the other presentations at this conference which talked about interfacing and, in particular, that the issues are not just about hardware and software).

One particular point that Sir John made was very pertinent: if we cannot get forward basing for these operations, should we really be there? That, of course, is a political question. It also raises the question about unintended consequences - for example, the Iraqis not buying wheat from Australia because of our involvement in the Gulf. Sir John struck a chord with me also in my role as Deputy Chief of Air Force when he talked about operational health and safety, and the very expensive constraints it puts on armed forces. Equal Opportunity, the multiple avenues of complaint resolution, the effect on command in battle, and civilians in the AO - all pertinent questions that we're grappling with right now. Sir John's emphasis on people as their most important asset is a vital and enduring truth in all modern defence forces.

Dr Andrew Butfoy further expanded on Dr Cheeseman's thesis of alternative strategies. His was a reminder that, as technologists, a lot of us cannot be too careful of technology overshadowing the political dimension. We are, after all, respondent to our political masters. I thought Dr Butfoy a bit controversial in his approach to US supremacy, in particular his comments about the US as the world's 'sheriff' and whether we should be joining the 'posse'. I believe this to be a question that should always warrant discussion. I also believe that we need to be good citizens of the world; to help when necessary, and to not just cloister ourselves in issues that only focus on Australian Defence. If such an approach were taken by everyone, I believe the world would become a very sorry place. Also, I do not support the mooted premise that weapons incite belligerence. Dr Butfoy obviously doesn't believe in the saying, 'Ye verily, though I walk through the valley of the shadow of death I shall fear no evil [because I've got the biggest stick in the valley]'.

The conference then moved from alternative strategies to alternative air force roles with Mr Richard Szafranski providing a thought provoking proposal for an 'info-sphere' Defence Force. I found his presentation to be an exciting vision of the future. Knowledge will be a powerful weapon of the future. Intrinsically, I must support anything where you can get out of the messy business of fighting wars - and leave that to the Army and Navy. However, I'm not sure that we will be able to achieve that in the immediate future. I also believe that the practical aspects of knowledge superiority will not be available for many years to come. Though some in the audience may think that Mr Szafranski's statements were a bit too radical, if we don't think about the future we'll be all too quickly stuck in the past.

Air Vice-Marshal Nicholson continued the theme of knowledge wars when he talked about controlling the information environment. This has been a problem for commanders since the beginning of time, I believe - how to get the appropriate information in the right form to the decision maker at the right time. Mrs Crawford touched on this aspect when she alluded to the issues involved with data fusion. Fusion,

in its fullest sense, is the biggest issue to be faced in getting the information in time for commanders to make appropriate decisions. Instead we face the issue of information overload, and too little of the right amount of knowledge to make the appropriate decisions at the appropriate time. Air Vice-Marshal Nicholson suggested we need a new paradigm for our organisation and he has started preparing for this change in his Command. I wish him well.

To finish the formal part of our Conference, Air Commodore Espeland proposed a way ahead for the RAAF and the knowledge revolution. I must say he put things in perspective with his first statement and it's something that we should keep in mind: what would happen if that which we are unconsciously dependent on (our telecommunications networks) failed? It was also interesting that he challenged the statement that the management pyramid is no longer an effective organisational structure. I'm sure that a lot of discussion will ensue on that statement alone. He did also suggest that the command chain must control both the development process and the end result. I think this is both interesting and challenging as an organisational conundrum.

Ladies and gentlemen, we have been privileged to have a broad range of speakers at the conference; from practitioners in the 'two types of Air Forces' to excellent theorists such as Richard Szafranski. We need both the theorists and the practitioners: the theorists to test the limits and the practitioners to attempt to convert theory into practical outcomes. Without both we cannot actually 'test the limits'. This I believe is the measure of the success of the conference. We have tested the limits, in fact some people got quite excited.

An important theme throughout, I think, has the increasing need for interoperability. There are many concerns, and a couple of speakers commented specifically on concerns of future interoperability with the US. I noted that one of the speakers (Mrs Crawford) mentioned that there is a similar problem within the US; between the US Army, the US Navy and the Marines, but also between new and old aircraft. I hope that Mrs Crawford was correct in the suggestion that we will be able to join in operations as long as we have some of the interfaces that are necessary.

The other issue that generated great interest was the discussions on UAVs. That the 'practice is not yet up to theory' appears to be the message conveyed. We need to exercise caution in leaping forth without due consideration of all the issues. I'm reminded of the time the US decided that they didn't need guns on aeroplanes. Within a few years, the decision was reversed.

Personnel, of course, is a vitally important issue. We must be careful of paying lip service to our key resource, our people. One issue that came throughout the conference to me was that the rate of change is such that there is a crying need to review our requirement specifications and acquisition processes. If we cannot do this, we will be forced to live in the past, always 'behind the eight ball'. I would like to suggest that perhaps it could be the topic for our next conference.

I'd like to congratulate all the presenters. It's been a privilege for me to be here and listen to these diverging views and thank you very much, everybody, for your attendance.

CLOSURE

AIR MARSHAL L.B. FISHER

Ladies and gentlemen, just a few remarks. I'm sure you're all keen to move on. I must say that it's been, from my point of view, a most enjoyable, entertaining and enlightening conference. I have no doubt that the objective of challenging our conventional wisdom and institutional comfort has been achieved - and I would say, achieved far beyond what I would have expected.

These conferences in my view have improved one after the other. And one of the main reasons this has occurred is because the status and calibre of presenters has gradually increased every second year - every conference. We've been able to attract, in my view, the highest calibre of presenters for this particular conference. The end result of that is not just a very successful conference, but the attraction of the large number of people that we've had here for this particular conference. I'm sure it's the greatest number so far, in the order of 900 plus. So, it has been an excellent conference - an outcome with which I am extremely happy.

I took the opportunity of launching the third edition of the Air Power Manual. And for the RAAF people, when you read through that document, I will be somewhat disappointed if you cannot see the next few steps that need to take place over the next four or five years. It's an evolving document and one that must move on. We have a crying need, for example, in the RAAF and in most other services in the world, for the doctrine on information operations to be developed - and I say, properly. It's inadequate at the moment and there's still much discussion internationally and nationally. It seems that even to come to grips with the terminology we would wish to use seems to be a difficulty - a major challenge for us for the future.

Air Vice-Marshal McCormack mentioned interoperability. It was a major discussion point throughout with the main focus on operations with the United States. But for us in Australia there are some other interoperability issues. We're a member of the Five Power Defence Arrangements, for example, and there's an issue there about interoperability - fairly obviously with the United Kingdom - and we achieve that through striving for interoperability with the United States, but also Malaysia and Singapore. And indeed our near major neighbour, Indonesia. What level of interoperability should we be seeking with Indonesia? It's a question and it's got to be answered, because we must look to the future. Ten, twenty years down stream it may be very important that we're highly interoperable with the Indonesians.

The success of this conference overall has been largely dependent on the presenters. My view is that a lot of very good ideas have been put before the audience: some have been controversial; some haven't agreed with each other and that's good. It's for you to decide what you want to take away from the conference. You don't buy the whole package. You take what your experience and knowledge tell you to take. Think about them, there were some great ideas - certainly many of much interest to me and, I hope, of interest to all of you.

Thanks are due to the organisers for the conference. The Air Power Studies Centre puts this together biennially - Wing Commander Keith Brent, Doctor Alan

Stephens, Mrs Sandra Di Guglielmo. Thanks to the security staff that were here today, Flying Officer Jenny Walk and the security police team. Quite a number of my staff have also been involved. Staff of the National Convention Centre, of course, also played an important role in the final outcome - a magnificent job.

Of course we couldn't do any of it without sponsors. As I mentioned in my first speech, British Aerospace Australia, Qantas, Rolls Royce, DefCredit, Army Health Benefits Scheme and Smart Cover have importantly contributed as sponsors and we thank you. We need your support, without it we cannot run these conferences and we are most appreciative of you coming to the party for these events.

Thanks to the audience. As I said before, we must be able to attract the audiences. It was very easy to attract a large number of people, not only from Australia - from the other services and from the Public Service - but from overseas as well. We had some great questions this year. I thought the quality of the questions was excellent. So I congratulate you all. A pat on the back really for the audience here today. Ladies and gentlemen the proceedings will be published in late August and attendees will be given a copy of these proceedings.

Finally, the next conference will be two years from now, in the year 2000 and around this time. I would ask you, the presenters and the audience here today to continue to give us support. I believe it is a very worthwhile activity - one that does bring out new ideas. An activity that takes us away from the doldrums of the day to day activity and allows us to zero-base our minds to a certain extent and look outward to draw in new ideas and concepts - all very, very important.

So ladies and gentlemen, in concluding the conference I'd like to thank you all, but most of all I'd like the audience to put their hands together for the presenters and the organisers. Thank you very much.

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The post-Cold War political environment combined with information and military technology 'revolutions' has set new political demands, organisational challenges and technological possibilities for air power planners.

'Testing the Limits' - as a conference and as a book - has been concerned with the stimulation and collection of new thought on air power. Presenters in this work include strategists, military chiefs, technologists, futurologists and sociopolitical scientists. The emergent lexicon includes micro electromechanical devices (MEMS), 'reach-back' logistics, information management by pattern recognition, expeditionary aerospace forces, hypersonics, 'halt phase' warfare, combat UAVs, cloned organic sensors, phased array lasers, sensor-to-shot systems, knowledge dominance and information attack. Inseparable from these developments in the greater defence picture are the ongoing issues of political system evolution, the changing role of physical force in national security, and the migration of military culture and ethos. 'Testing the Limits' is about all these issues and more.

Readers of this work are encouraged, as were conference speakers and delegates, to challenge conventional wisdom and institutional comfort and to push the boundaries in thinking about national security, defence and air power.

The contributors are Sir John Allison, Richard Brabin-Smith, Andrew Butfoy, Graeme Cheeseman, Natalie Crawford, B.J. Espeland, L.B. Fisher, E.J. McCormack, The Hon. Ian McLachlan, P.G. Nicholson, M.E. Ryan, Richard Szafranski, and John Warden.

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